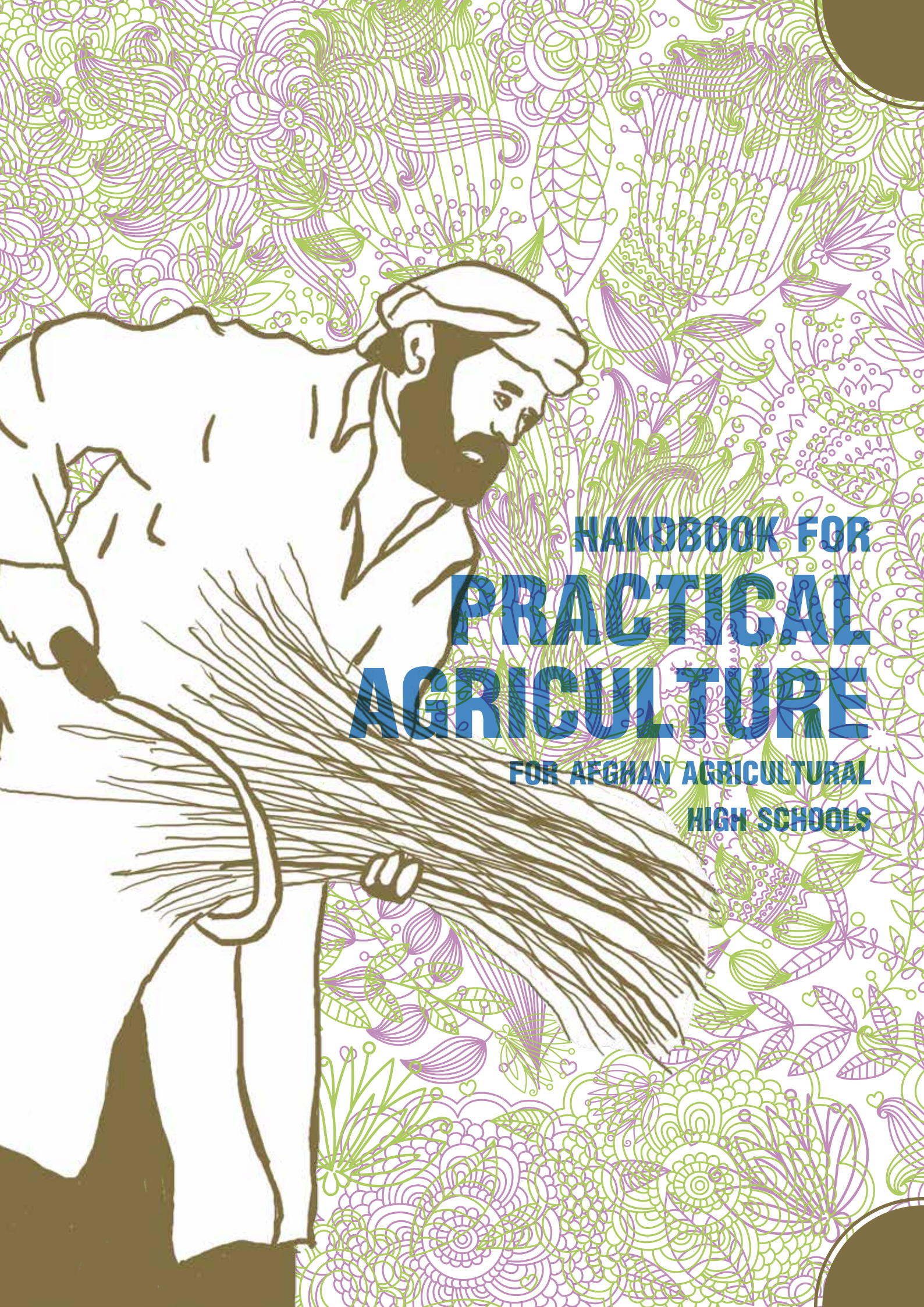

HANDBOOK FOR PRACTICAL AGRICULTURE

FOR AFGHAN AGRICULTURAL HIGH SCHOOLS

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CZECH REPUBLIC
DEVELOPMENT COOPERATION

ABOUT PEOPLE IN NEED IN AFGHANISTAN

PIN's permanent mission in Afghanistan was founded at the end of 2001. Since then, PIN has supported humantarian programmes responding to natural and conflict-induced disasters, reconstruction and rehabilitation of war-damaged infrastructure, and development programmes focusing on raising the standard of living. Currently, PIN focuses on the sectors education, sustianable livelihoods, local infrastrucre development, water & sanitation, and meeting humanitarian needs where they arise. By providing both assets and long-term technical support to communities, PIN aims to achieve sustainable solutions to the challenges faced. Importantly, PIN has also worked to strengthen the ability of local residents to jointly identify and implement permanent solutions to their communal problems by using locally-accessible resources.

At present PIN maintains central coordination offices in Kabul and Mazar-e Sharif. In addition, PIN has 11 field offices in the provinces of Balkh, Samangan, Nangarhar and Paktya. PIN continues to work in close cooperation with local residents and with public institutions at all levels, from the national to the regional, and from the district to the village level.

PIN Agriculture Education Programme

Since 2007, PIN has built a nationwide programme supporting the expansion of Agricultural High Schools (AHS) in 33 provinces. Under this programme, PIN has played a central role in promoting practical agricultural training and improving quality of formal agricultural education.

PIN's aim is to bring the education from classrooms to the field in order to deliver an education reflecting needs of the labour market and ground realities of Afghan agriculture.

CONTENT

SPECIFIC CHAPTERS

INTRODUCTION

Agriculture is the main source of Afghan economical income. Based on the report by the Ministry of Agriculture Irrigation and Livestock (MAIL) and UN (FAO), over 77 % of Afghan population is involved in agriculture. In reality, just 12% of the farming land, mostly located in scattered valleys, is cultivated.

To improve this situation, Afghan agriculture needs professional agricultural experts to be involved in the field. Hands-on teaching practiced in schools strengthens the expert competences and skills of the Agriculture High Schools and Institutes (AHS, AVI, AI) students and their teachers. It is not just a part of the curriculum, but if professionally applied, it is a great example of the income generating activities - in terms of products (e.g. healthy agriculture products for the school canteen) and/or in terms of free funds (used for the development of the school farm and supporting other school activities).

Students involved in this type of education gain the complementary knowledge to the theories and gain practical experiences with different agricultural topics - e.g. environmental protection, crop cultivation, postharvest methodologies, sales of the agriculture product, marketing, financial management etc. Students participating in the hands-on education are ready for their future jobs and careers.

The main objective of this Handbook is to guide school management, students and teachers in the introduction or improvement of the hands-on education (practical teaching) system at their school farms.

It is obvious that such practices can't be successful without the support of the school management and active participation of teachers and students. At the beginning, school management should provide some farming plot (setting the school farm) and actively support the teachers and students in such activities. Later, the local farmers, agricultural institutions and other stakeholders should be involved in these school farms.

This Handbook focuses on the field of plant production and provides two types of concrete and specific information for the successful hands-on teaching implementation.

First part – General chapters – focuses on providing the requirements for the basic property and equipment (Filed plots, Trenches, Greenhouses, Nurseries, Compost), while the second part – Specific chapters - provides the step-by-step guiding for the most significant plant cultivation (for a better orientation divided in the categories e.g. Cereal crops, Vegetables, Oil plants, Fruit and Forest trees).

The information is provided in a simple and unified structure if applicable.

General chapters always describe the basic requirements (what do we need) and continue with the specific information (e.g. selection of the proper location, detailed construction steps/settings, maintenance/use of the concrete facility, etc.). The Specific chapters are always divided in three subchapters - Before We Start (ecological, soil, seed, fertilizer and watering requirements, crop rotation matrix, cultivation tools), Specific Requirements of the Cultivation (cultivation calendar and step-by-step cultivation) and Post-harvest Steps.

Following the instruction provided in this Handbook will help you to successfully introduce or improve the hands-on teaching, set up the functional school farm, educate real agricultural experts and to increase the prestige of your schools.

GENERAL CHAPTERS

FIELD PLOTS

LIST OF PLANTS

Examples of crops and plants suitable for the field-cultivation:

English	*Dari*	*Pashto*
Cereal crops	غله جات	
Wheat	گندم	غنم
Maize	جواری	جوار
Rice	برنج	وریجی
Barley	جو	اوربشی
Legumes	نباتات دو پله ای	
Glycine max/ soy bean	سایبین	سایبین
Vetch/ mung bean	ماش	می
Lentils	عدس	عدس
Cicer (Chick peas)	نخود	نخود
Vegetables	سبزیجات	
Tomatoes	بادنجان رومی	رومیان
Cucumber	بادرنگ	بادرنگ
Onion	پیاز	پیاز
Carrot	زردک	گازری
Pepper	مرچ	مرچک
Eggplant	بادنجان سیاه	تور بادنجان
Ladyfinger	بامیه	لیلو
Spinach	پالک	پالک
Radish	ملی	ملی
Cauliflower	گلپی	گلپی
Garlic	سیر	اوژه
Cabbage	کرم	کرم
Root crop	نباتاتی که ریشه آن قابل خوردناست	
Potatoes	کچالو	آلو/کچالو
Fruits	میوه جات	
Strawberries	توت زمینی	زمکنی توتان
Watermelon	تربوز	هندوانه
Oil crops	نباتات تیلی	
Flax	زغر	زغر
Sesame	کنجد	کنزل
Textile crop	نباتات بافتنی یا نساجی	
Cotton	پنبه	پنبه
Flax	زغر	زغر
Herbs and spices	نباتات گیاهی طعم افزا وخوش مزه	
Saffron	زعفران	زعفران
Anise	رازیانه	
Badian	بادیان	بادیان
Fennel	بادیان	کاژه
Coriander	گشنیز	دنیه
Forage	نباتات علوفه ای	
Alfa alfa	رشقه	رشقه
Clovers (Egyptian, Persian, Red)	شبدر	شوتله

PROVISION OF THE LAND AND SELECTION OF THE LOCATION

LAND FOR THE SCHOOL FARM:

The best option is to use the land owned by the school. If there is not that possibility, the school should rent the land at an appropriate place (see below). The school can also get the land from the local community, cooperatives or associations. Such procedure should be discussed with DM TVET in advance, as the way of paying the rent should be confirmed beforehand. If you have to rent the land, be sure that it is done with a long-term perspective!

THE BASIC REQUIREMENTS FOR THE FIELD PLOTS WHICH YOU, AS AHS MANAGEMENT AND RESPONSIBLE TEACHERS, HAVE TO ENSURE:

1. **Accessibility:** location has to be accessible for students and teachers, close to the school building or within walking distance; in case of longer distance, the transportation should be available; also the transportation of the school farm products to the local markets should be possible;
2. **Security:** the security of students, teachers and other workers must be guaranteed; place should be protected against property damages; the boarders should be marked and fenced if possible
3. **Cleanness:** the place has to be cleaned – no waste or garbage should be there; avoid the contaminated plots!
4. **Facilities:** if possible some sheds or storages for the basic equipment should be at the place; don't forget about hygiene and sanitation (latrines); a place for a compost should be secured; trenches and greenhouses should be set here; the nurseries should also be included.
5. **Watering:** a watering source sufficient for the whole plot should be there (well, stream, river, tanks, candas, whole-year accessible watering channel, etc.)
6. **The Shape:** if relevant, the place should be accessible by the basic mechanization (tractors, combines etc.) + avoid the full-shade places, extremely sloped plots etc.
7. **Soil:** it should have the adequate quality for the cultivation of different corps/plants (e.g. rocks and big stones should be removed, field leveled, terraces prepared, soil fertility should be checked, etc.); humidity of the plot should be checked in advance – be careful with long-term mud soils– check the drainage; avoid the weeded plots or be ready to eliminate the weeds before the cultivation.

FIELD PLOTS: PROTECTION OF SCHOOL FIELD – FENCING

You should fence your school fields to protect it against damages and unwelcomed losses.

You can use different types of fencing in accordance with the local customs, locally available materials and your budget. Always keep in mind the purpose of fencing and the possible advantages and disadvantages of different types designs.

Picture No. 1: Barbed wire with the wooden slopes

Picture No. 2: Metal mesh fencing

Picture No. 3: Stone fence combined with the wooden slopes and barbed wire

Picture No 4: Mud walls

MAIN PROCEDURES

This chapter describes the main procedures that you have to do in your school farms for the proper cultivation.

PREPARATION OF THE FIELD PLOT:

Choose an adequate plot in accordance with the crop/plant you plan to cultivate, keep the crop rotation rules and prepare the field according to the crop/plant requirements. Don't forget to secure the adequate irrigation system and proper seedbeds!

Check and prepare the irrigation system:

Be sure that the irrigation system is functional e.g. in case of needing the irrigation channels, be sure that the channels are fixed and ready for use.

Prepare the land:

1. Manually (using hand tools - spades, hoes, rakes, etc.) (See picture No.1)
2. With use of simple mechanization driven by animals - ploughs, harrows, etc. (See picture No.2)
3. With use of mechanization – tractors, combines etc. (See picture No.3)

Picture No. 1

Picture No. 2

Picture No. 3

Preparation of the land includes:

1. **Tillage or plowing:**

   Tillage or plowing is the first step in the field preparation process and is done after the pre-crop harvest or before the sowing/seeding. It helps to process the pre-crop residua, improves the soil structure and eliminates the weeds. Select the proper method and use the plow shares or discs.

   Methods:

   a) Tillage: 5 -12 cm depth; done immediately after the pre-crop harvest (e.g cereals)
   b) Shallow plowing: 10 – 18 cm depth; used for good, structured light soils;
   c) Middle plowing: 18 – 24 cm depth; used before winter for all types of soils;
   d) Deep plowing: 24 - 30 cm depth; used before winter and before seeding of biannual or perennial crops;
   e) Very deep plowing: 30 – 35 cm depth; used in the spring before the root crops seeding;
   f) Whole profile plowing: 60cm; used by preparation of the nurseries and/or orchards;

2. **Harrowing:**

   Harrowing before the cultivation: Use harrowing after the plowing and before sowing/seeding because it keeps the good structure of the soil (destroys the clods or crusts).

   Harrowing during the cultivation: helps to keep the adequate soil humidity, eliminates weeds;

   Use one of the proper type of harrows: standard, chain or disc, etc., based on the purpose of use.

3. **Dragging:**

   If need to drag the land before seeding, do so after harrowing as it helps to level the field before seeding;

4. **Rolling:**

   Rolling before sowing/seeding: If needed is used just for field levelling (if the dragging is not efficient); use this just on light soils, never for the clayey one; keep in mind that sowing has to be done immediately after the rolling

   Rolling after sowing/seeding: helps to decrease the water vaporization and keeps the seed in the seedbed;

   You can use different types of rollers– flat, ribbed, light or heavy

IDENTIFICATION OF THE CULTIVATION PLOTS:

To keep the information, create the information table for each plot and record:

- Plot Number
- Area of the plot
- Name and variety of the cultivated crop/plant
- Date of seeding/sowing

To record the exact information about the field, create a Cultivation book for a given plot. Include the identification information (same as mentioned above for the information table) plus record all additional activities (date and type of irrigation, date and type of fertilization, date and type of weeding and herbicides/fungicides/insecticides if application, date of the agronomic activities such as thinning, hoeing etc., date of harvest and yield).

SEEDING/SOWING:

Always use good quality seeds/seedlings. To avoid the purchase of bad quality seeds, try to get the following information:

- Year of yield/ Date of expiration – not to use old seeds
- Place of origin - to be sure that the seed is usable in your conditions
- Name of the producer - to be sure that this producer delivers a quality seed
- Existence of certificate – the certificated seeds has a better quality than the not-certificated one

Always check the sample of the seed/seedlings to see its quality. You have to at least do the eye check to avoid a purchase of non-quality seeds. If there is time, you can take a sample of the seed and do the germination test.

Before seeding/sowing:

- Check the crop rotation recommendations: Are you going to seed the proper plant?
- Check the field: Is it well levelled? Are the pre-crop residua well processed?
- Check the soil structure: Is it well-structured without large clods and large crusts?
- Check the soil moisture: Is it too dry or too moist for germination?
- Check the date: Is it too early or too late for seeding?

Types of sowing:

Manual or mechanical- with use of simple sowing machines driven by man or fully mechanized sowing machines driven by tractor

a) Broadcast seeding: manual - the seed is thrown by a farmer around him while walking to and from the field;
b) Sowing in plant holes: manual - a few seeds are placed by a farmer in the holes prepared by the hoe; the seed is covered by soil afterwards;
c) Sowing in rows: manual - the seed is placed by a farmer in the regular furrows prepared in advance by a marker; the seed should be covered by soil afterwards; or mechanical – with use of the sowing or seeding machine

CULTIVATION AND HARVEST:

Each crop/plant requires specific agro-techniques and cultivation processes which are described in the Specific part of this Handbook. Same applies for the harvest and postharvest steps.

IRRIGATION

You have to ensure your school farm's irrigation. You can use two main sources of water for the field irrigation – deep wells and rivers. Also candas can be used. To get the water from the water source to the distribution system, you can use hand or electric water pumps and/or buckets. The systems that you will use depend on the specific needs and possibilities of the area – irrigation channels, ditches, pipes, water sprayers, etc. are mostly used in the school farms. In accordance with the type of cultivated crop, you should select the proper irrigation system – surface or localized.

Picture No. 1: Deep well with the water reservoir; used for school and for the school field irrigation

Picture No. 2: River water source for the irrigation of school nursery in Helmand province

SURFACE IRRIGATION:

Types: ditches, furrow and border strips, flooded plots

Source of water: surface water (rivers, ponds), ground water (wells, springs, karizes)

System and the special devices: pumps, pipes distributing water from the source to the water reservoir or to the field directly, buckets or cans carried by men or by animals; gravity leads the water from the water reservoir to the irrigation system;

Crop: Rice, wheat, barley, maize, melon, water melon, cotton etc.

Advantages: Simple tools, not complicated system

Disadvantages: Uncontrolled water distribution leading to the water wasting; could cause waterlogging.

Picture No. 3: Surface irrigation - ditches

Picture No. 4: Surface irrigation – flooded Rice field

LOCALIZED IRRIGATION:

Source of water: ponds, water reservoirs with rain or snow water, springs

System and the special devices: water is led from the water reservoir under low pressure via the system of pipes to the final destination of the single plants

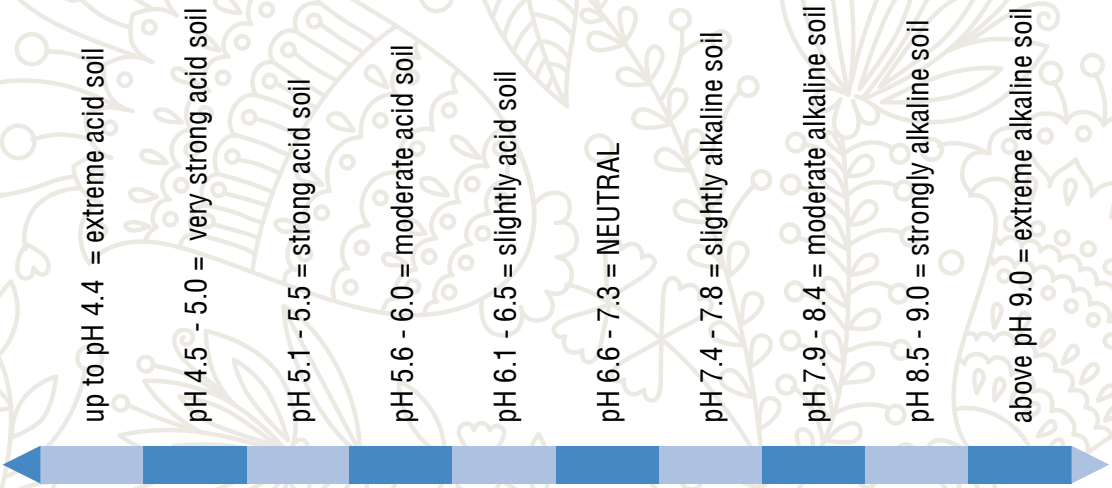
Use: greenhouses, nurseries, orchards, vineyards

Advantages: controlled irrigation, not wasting water; the quantity of water available is adequate;

Disadvantages: very high investment and operation cost; limited use (nurseries, orchards, greenhouses etc.)

FERTILIZATION

Fertilization is the process of providing the essential elements to the soil. Adequate fertilization will help to keep high quality soil and leads to the optimum yields. The proper fertilizing scheme you will use should be based on the results of the soil analyses (sample testing) and on the observations of the crop/plant growth.



For the cultivation of the majority of the crops/plants a pH level from 6.0 to 7.3 is optimal (potatoes, maize, conifers, maples, oaks, etc. prefer the acidic soils - pH from 5.5 to 6.0). A simple soil test will indicate the amount of lime needed to increase the pH of acidic soils or the amount of sulfur needed to lower pH of alkaline soils. In general the high alkalinity of the soil is the main problem in Afghanistan. 50% of the agricultural land shows the range from 8 to 8.5, 35 % of the land ranges from 8.5 to 9 and 15% of the land is classified as extreme alkaline with the value above 9. You can increase the soil acidity by the use of ammonium sulfate – but be careful and aware of the combination with the other fertilizers!

ESSENTIAL ELEMENTS:

There is 6 essential elements (macronutrients) required in relatively large amounts during the crop/plant cultivation:

- Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), Magnesium (Mg), and Sulfur (S);

Other 3 macronutrients (Carbon - C, Hydrogen - H, Oxygen - O) are required by all crop/plants. These elements are contained in water and in air.

There is 7 essential elements (micronutrients) required in small amounts during the crop/plant cultivation:

- Irion (Fe), Manganese (Mn), Zinc (Zn), Boron (B), Molybdenum (Mo), Copper (Cu) and Chlorine (Cl).

In case of any essential element insufficiency, the growth of crops/plants is affected and the losses are high. The more or less specific symptoms occurred and the proper action should be taken.

FERTILIZERS:

1. **Organic fertilizers:**
   - Compost – see the respective chapter;
   - composted manure;
   - green fertilizers as grass-leguminous mixtures plowed into the soil before harvest;
   - processed urine;

- chicken litters mixed with sawdust;
- Guano;
- dried algae;
- processed sewage sludge

Advantages of the organic fertilizers: long-term improvement of the soil fertility, increase of the microorganism in the soil;

Disadvantages of the organic fertilizers: variable content of the nutrition; pathogenic risks caused by mispro-cessing; contain "slow-release" nitrogen – Nitrogen in NH_2 form has to be converted by microorganisms to NH_4 or NO_3 which is acceptable for the crops/plants;

2. **Inorganic fertilizers:**
   - Mineral inorganic fertilizers: saltpeter, limestone, etc.
   - Artificial inorganic fertilizers: chemically synthetized fertilizers

Usually you can get a 50kg package of the solid form artificial fertilizers in Afghanistan.

THE LIST OF COMMON ARTIFICIAL FERTILIZERS WITH THE CONTENT OF THE ELEMENTS:

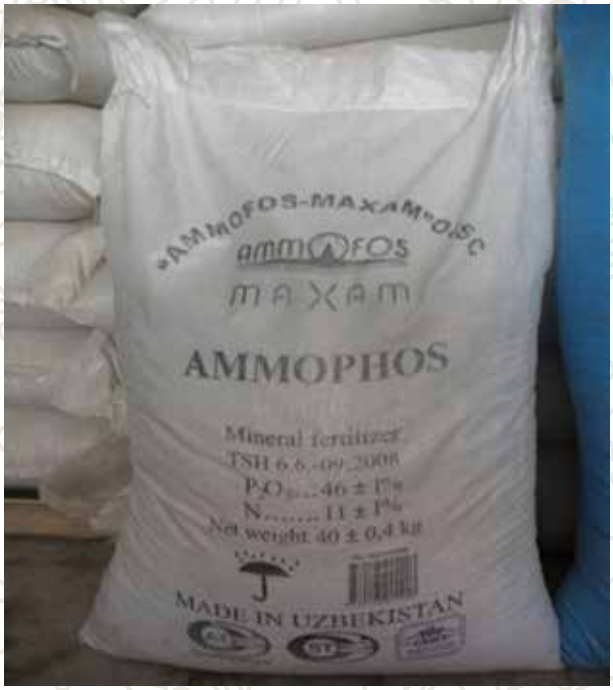
Nitrogen fertilizers	Analysis	Nitrogen (N), %	Phosphate (P_2O_5), %	Potash (K_2O), %	Sulfur (S),%
Urea – white fertilizer	46-0-0	46	0	0	0
Ammonium Nitrate	34-0-0	34	0	0	0
Ammonium Sulfate	21-0-0-24	21	0	0	24
Nitrophos	23-23-0-0	23	23	0	0

Phosphate fertilizers	Analysis	Nitrogen (N), %	Phosphate (P_2O_5), %	Potash (K_2O), %	Sulfur (S),%
Diammonium Phosphate (DAP) – black fertilizer	18-46-0	18	46	0	0
(Amophos) Ammonium Phosphate (MAP)	11-46-0	11	46	0	0
Simple Super phosphate	0-20-0	0	19-23	0	0
Triple super phosphate	0-45-0	0	42-49		

Potash fertilizers	Analysis	Nitrogen (N), %	Phosphate (P_2O_5), %	Potash (K_2O), %	Sulfur (S),%
Potassium chloride	0-0-50	0	0	40-60	0
Potassium sulphate	0-0-50	0	0	50	40-45
NPK (Diammophoska)	10-26-26	10	260	26	0

Note: the numbers (e.g., UREA 46-0-0) refer to the percent Nitrogen (N), Phosphorus Pentoxide (P_2O_5) and Potassium Oxide (K_2O) in a fertilizer.

Picture No. 1: UREA fertilizer available at Mazar-e- Sharif market



Picture No. 2: AMMOPHOS fertilizer available at Mazar-e-Sharif market

Advantages of the artificial fertilizers: stable content of the nutrition; easy storage and manipulation; favorable price; Nitrogen ready-to use by crops

Disadvantages of the artificial fertilizers: not a long-term solution - repeated application is needed (not supporting the ecosystem stability); doesn't replace the trace mineral elements; rapid solubility and availability; dependency on the market supply (e.g. limited sources of K_2O fertilizers in Afghanistan!)

APPLICATION OF THE INORGANIC FERTILIZERS:

Be aware that the analysis or grade of a fertilizer refers to the minimum amounts of nitrogen (N), phosphorus (as P_2O_5), and potassium (as K_2O) in the fertilizer, and is always printed on the bag, can, or bottle. Please note that a 10-10-10 fertilizer would represent 10 percent nitrogen, 10 percent P_2O_5, and 10 percent K_2O. Therefore, in 50 kg of 10-10-10, there are 5 kg of N, 5 kg of P_2O_5 (not of P!) and 5 kg of K_2O (not of K!).

Before the application – be sure about the soil quality of your field and always follow the instructions given on each package of fertilizer!

FORM OF FERTILIZERS:

1. **Solid:** granular, powder, rough (e.g. compost); applied by tillage/plowing or later by seeding and vegetation – broadcasted or in rows;
2. **Water-soluble or liquid:** applied either to the soil or on the foliage. Many water-soluble formulations are applicable for almost any specific need: from plant starter, high nitrogen fertilizers, to minor element formulations
3. **Slow-release:** either inorganic or organic; they are characterized by a slow rate of release, longer residual, low burn potential, low water solubility, and higher cost. Their application reduces the problem of „burning" the plants due to excess nitrogen.

WEED, DISEASE AND PEST CONTROL

You should ensure proper weed, disease and pest control in your school farm.

WEED CONTROL:

To protect the cultivated crops/plants against weeds (e.g. common groundsel, atriplex, couch grass) can be done in several ways:

1. **PROPER AGROTECHNIQUE:**
   a) preparation of the field: proper pre-crop residua processing (tillage/plowing), soil processing before seeding
   b) proper crop rotation system
   c) use of cover crops
   d) use of seed free of weed seed
2. **MECHANICAL CONTROL during the vegetation:**
   a) done manually: use of hoes, sickle, weed eater, ridging hoe and hand
   b) or mechanically: use of cultivators, discs and trowel, black plastic mulch
3. **CHEMICAL CONTROL – use of Herbicides;**
   a) systemic herbicides
   b) specific herbicides

   ** before the use of herbicides, you have to be aware of the weeds identification = you have to know which type of weed you want to eliminate!*

PEST AND DISEASE CONTROL:

You have to do regular pest and disease control to reach the high yield in your school farm. Be aware that the proper prevention helps you to save money because you will reach high yields.

Examples of pests and diseases:

- Barley yellow dwarf virus - BYDV (viruses), Ring rot bacterium: Clavibacter michiganensis ssp. sepedonicus (bacteria), Potato blight (Oomycota/fungi), Root-knot nematode, Strawberry foliar nematode (nematodes), Greenflies/Aphids, Colorado potato beetle (insect);

Protecting the cultivated crops/plants against pests and diseases can be done in several ways:

1. **PROPER AGROTECHNIQUE:**
   a) preparation of the field: proper pre-crop residua with potential diseases processing (tillage/plowing), soil processing before seeding
   b) proper crop rotation system
2. **MECHANICAL CONTROL during the vegetation:**
   a) manual: elimination and burning of the affected plants

3. BIOLOGICAL CONTROL

a) natural agents, primarily parasitoids and predators; e.g. ladybugs are used in greenhouses and gardens to prevent aphids

4. CHEMICAL CONTROL – use of Fungicides, Pesticides, Insecticides (applied by the sprayer);

a) systemic tools which affect the plants generally. A systemic pesticide moves inside a plant after absorption by the plant. With insecticides and most fungicides, this movement is usually upward (through the xylem) and outward.

b) specific tools which affect the concrete parts of the plants or just the concrete diseases or pests

** before the use of herbicides, you have to be aware of proper identification = you have to know which type of disease or pests you want to eliminate!*

POST-HARVEST OPERATIONS AND FOOD PROCESSING

To maintain the quality of the agriculture products you have to follow the appropriate post-harvest technology. Post-harvest technology includes all operations that are required for the processing of food, feed and byproducts between harvesting and further industrial processing or consumption.

Purpose of post-harvest steps: to process, conserve and store the production

1. **Types of post-harvest operations that are required for the processing of food, feed and byproducts:**
   - Separation
   - Grating
   - Fermentation
   - Washing (vegetable) / Cleaning (grain, legumes)
   - Pulping
   - **Preservation**
   - Peeling (fruit and vegetable) and de-husking
   - Expelling
   - Storage
   - Cutting
   - Threshing
   - Grading/Classification
   - Grinding, crushing

   Preservation Methods:
   - Drying
   - Fermentation
   - Sugaring
   - Cooling
   - Salting/Curing
   - Sulphuring
   - Smoking
   - Ensilage
   - Roasting
   - Boiling
   - Pickling

2. **Food Processing:** e.g. grain milling for bread making, oil pressing, starch production, rice milling, sugar production, fruit juice production, vegetable processing

   Basic Operations in Food Processing:
   - Heating
   - Refining
   - Refrigeration
   - Milling
   - Freezing
   - Baking
   - Drying (low temperature x high temperature)
   - Fermentation
   - Pasteurization
   - Canning
   - Sterilization
   - Packaging

Handling and Transportation of the products to the storage or to the market.

GENERAL CHAPTERS

TRENCHES AND GREENHOUSES

LIST OF PLANTS

Examples of plants suitable for cultivation in trenches/greenhouses:

English	*Dari*	*Pashto*
Legumes		
Chick peas		
Bean		
Vegetables		
Tomatoes		
Cucumber		
Onion		
Pepper		
Spinach		
Radish		
Cauliflower		
Garlic		
Cabbage		
Carrot		
Eggplant		
Lady finger		
Fruits		
Strawberries		
Herbs and spices		
Coriander		
Ornamental flower		
Rose		
Geranium		
Jasmine		

SELECTION OF THE AREA

WHAT IS A TRENCH?

Trench is a simple plastic/polyethylene construction which helps to cultivate the plants in the adverse weather conditions. It's especially suitable for the cultivation of vegetable and flowers. You can use it to also protect the small tree seedlings and young plants during the winter.

The advantages of trench cultivation:

1. cheap initial investments (+ the possibility to reuse the construction material next season)
2. simple maintenance
3. there is not much cultivation depending on the weather conditions
4. early harvest
5. helps to keep the income from the agriculture production before/after the main season

Picture No. 1: Simple trenches for the flower (roses) cultivation

Picture No. 2: Simple trench for vegetable, herbs and flower cultivation in Parwan

WHAT IS A GREENHOUSE?

A greenhouse is more sophisticated construction than a trench and helps to cultivate the plants in the adverse weather conditions. It's especially suitable for the cultivation of vegetable, flowers, small trees, etc.

The main benefits of a greenhouse are:

1. not just one season solution
2. there is not much cultivation depending on the weather conditions
3. early harvest
4. helps to keep the income from the agriculture production before/after the main season

Picture No. 3: Greenhouse for vegetable, flowers, herbs and olive cultivation, Jalalabad

Picture No. 4: Interior of the greenhouse for the herbs and vegetable cultivation, Balkh

SELECTION OF LOCATION:

The proper place for establishing a trench or greenhouse should:

- be ideally at the school farm
- be accessible by students and teachers (daily visits during the teaching should be possible)
- be close to the local market (the products shouldn't be transported far)
- be accessible for the transportation (to simplify the transportation of the construction material and transportation of the products to the market)
- not be rocky or stony
- have good soil conditions (compost should be accessible)
- the irrigation system should be available during the cultivation season (water source should be close – max 150 m)
- secure enough sun radiation (more than five and half hours)
- not be exposed to strong winds (cold winds decrease the inner temperature); the doors/entrance should be always located on the least windy side

The influence of the location to the design of the greenhouse:

1. **Terrain:** Slope area south-oriented: you can use the terrace wall as the back wall and roof support of the greenhouse;
2. **Altitude:** In higher altitudes (colder places) you should provide sufficient ground insulation and adapt the design of the greenhouse (e.g. width of greenhouse); Always consider the lowest winter temperatures at the location.
3. **Snowfall:** In areas with regular snowfall you should focus on proper roof design – you have to avoid leaving snow on the plastic, so you should increase the roof slope.

TRENCHES: CONSTRUCTION

*Trench 2*6m in Parwan AVI*

*Trench 2*6m in Balkh AVI*

You should follow these instructions to construct a small trench (2x3m) in your school farm:

1. Select the proper place for your trench
2. Prepare the design of the trench; the longer side of the trench has to be oriented from east to the west, while the shorter side from north to the south
3. Prepare the basic materials and equipment – see table in the chapter 3e - WHAT WE NEED Preparing the equipments and materials
4. Mark the future walls on the ground and excavate the trench 2x3m, 50 cm in depth
5. Level the future ground of the trench
6. Construct the 80 cm high north wall (above the ground surface)
7. Construct the 10-15 cm high south wall
8. Construct the west and east walls to be connected with the given slope
9. Prepare the cultivation area = bring sufficient amount of the composted soil to the trench
10. Put the poles of the east-west walls in the corners (put them directly on the walls)
11. Place the iron bar on the poles properly
12. Place the plastic sheet on the trench

How to place the plastic sheet on the trench:

1. The plastic should be 30 cm longer than each side of the trench.
2. Roll the top end of the sheet around some beam or pipe and lay this just south of the trench properly.
3. Spread the polythene sheet from the top to the bottom on the fixation skeleton and use some weights (e.g. mud or mud bricks on the jute bags) to secure the sheet edgings – at the top and on the sides.
4. Use the special fixation to the bottom end of the sheet. You can use the same method as mentioned above (mud, mud bricks) and add an extra mud layer to place the sheet on the south wall. To avoid any crumpling, wrinkling, warping or flapping in the wind, the Polythene sheet should be firmly secured to the wooden/steel skeleton in the correct way.

The proper installation should be done by at least 3 people in 3 hours during the warmest days (polythene expands with the increasing heat).

GREENHOUSES: CONSTRUCTION

BASIC DESIGNS

You should choose the proper greenhouse design in accordance with the given climate conditions.

Design 1 – COLD CLIMATE:

Lowest average temperature during winter: not colder than -10˚C (e.g. Kabul, Balkh and Nangarhar Provinces)

Roof material: plastic sheet

Ventilators: for small size, don't have ventilators on the roof and sides. The need for ventilation depends on having the proper temperature- open both side doors if ventilation is not needed and the west doors will stay closed.

Door: two doors on the east and west

Slope of the roof: It is a tunnel design, the slope depends on the width of the greenhouse

Design 2 – VERY COLD CLIMATE:

Lowest average temperature during winter: -10˚C to -15˚C (e.g. Parwan, Kabul Provinces)

Roof material: All plastic sheet roofs from the north wall to the south wall.

Ventilators: one ventilator on the west wall

Door: one door on the east wall

Slope of the roof: low slope around 25˚

Design 3 – EXTREMELY COLD CLIMATE:

Lowest average temperature during winter: below -15˚C (e.g. Badakshan, Bamyan, Ghazni Provinces)

Roof material: the northern side is a mud roof and the southern side is double layer plastic sheet

Ventilators: one ventilator on the north side mud roof, one ventilator on the west wall

Door: one door on the east wall

Slope of the roof: 30˚ to 35˚ (less than design 4)

Design 4 – REGULAR SNOWFALL AREAS:

Lowest average temperature during winter: below -15˚C and large amount of snow (e.g. Bamyan, Ghazni, Badakhshan Provinces)

Roof material: mud roof on the northern side and double layer plastic sheet roof on the southern side

Ventilators: one on the mud roof and one on the west wall

Door: one door

Slope of the roof: the slope has to be at least 40˚ to sustain the weight of the snow

CONSTRUCTION PROCESS

1. Before Construction:

- Select the proper place and adequate design - consult with the experts!
- Study the selected design and get familiar with the list of required materials
- Ensure the adequate amount of workers – don't forget to involve students - purchase the construction material and store it at the construction site

2. Construction steps:

a) Building the foundation
b) Construction of the walls
c) Construction of the partition walls for design No. 3, 4
d) Installation of the door
e) Installation of the wall ventilator
f) Construction of the roof
g) Installation of the roof ventilator(s)
h) Installation of the polythene sheet
i) Installation of the night insulation

2a) Building the foundation:

- Clean the construction plot – it has to be leveled before the start of the construction. The greenhouse has to be south oriented with its main wall laying on the east-west axis. Max. 10˚ change in the orientation to east/west is acceptable. If you are not sure about the plot orientation, use the compass or 'plumb-line' method;
- When you detect the proper orientation, draw the outline of the future cca 60 cm wide walls on the ground. Use the chalk and sticks with string to mark the future walls;
- Then dig the trenches and fill them with the foundation;
- Then focus on the ground – it should be 15 cm lower than the surrounding soil.

2b) Construction of the walls:

The walls consist of 3 layers and are 60cm wide. Just the south wall is 50cm wide.

- Start to construct the walls on the prepared foundation, but not at the same width - keep 2.5cm from both sides (external and internal) free
- Be sure to construct the walls at the right angle (90˚)! If you need to you can use the 3,4,5 method (Draw the triangle where the high line is 3cm, the base line is 4cm and the hypotenuse is 5 cm -the angle must be 90˚)
- Construct the walls in 3 vertical layers:
  - » external bearing wall: 30cm width, consists of mud bricks and rammed soil, or stone
  - » layer of insulation: 10cm width, consists of chopped grasses and/or straw
  - » internal warm-protecting wall: 15cm width, consists of mud bricks
- The internal walls should be finalized by covering them with mud. A more durable, but more expensive alternative is to put the strips of waste planks (8cm width) on the insulating layer and to cover it by mud afterwards. A bank of soil can be put around the outside walls (just a low layer) to reduce heat loss through the foundation

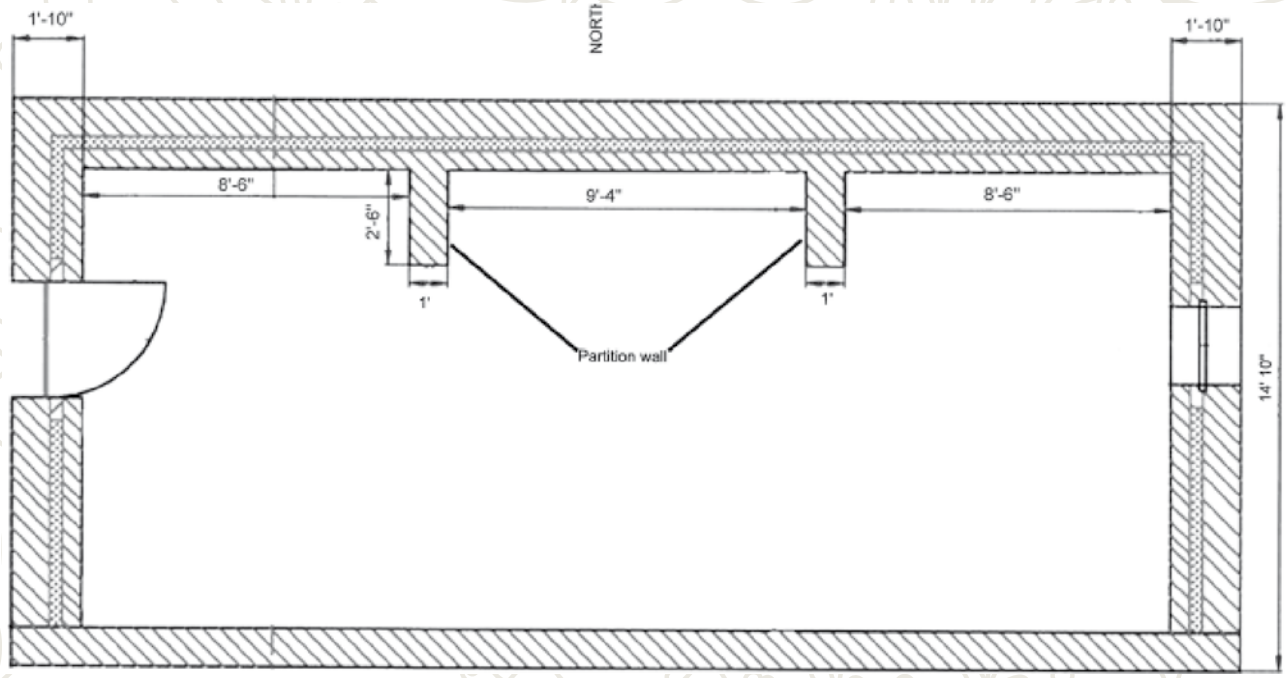
Picture No. 5: construction of the greenhouse wall – design No. 4

- The walls should be plastered completely from both sides – from the inside as well as from the outside; traditional mud plaster is suitable for outside part; cement wash plaster is preferable for inside walls. If you need to use the mud plaster from inside, never add straw to it! The plaster should be very fine – to allow paintings.
- Walls should be painted once the roof is finished: the inner west side wall is painted white to reflect the morning radiation to the vegetables; the inner east side wall should be painted black to absorb and store the afternoon solar radiation; the inner north side should be painted white up to 60cm and black in the upper parts;

White paint: usually whitewash – never use the synthetic poisoning paints!
Black paint: usually mixture of oil and ashes or powder paint - never use the synthetic poisoning paints!

2c) Construction of the partition walls for design No. 3, 4

To support the roof and to divide the space, 2 shorter internal partition walls should be constructed at the north wall of the greenhouse. Sometimes these walls can be replaced by the wooden pillars. The preparation of the foundation is needed and should be done together with other greenhouse walls foundations. The partition walls should be constructed together with the north wall.



Picture No. 6: Partition walls situation in designs No. 3 and 4.

2d) Installation of the door

Doors should be installed at the east or west side of the greenhouse. You have to always respect the local weather conditions and install the door always on the less windy side. Except the entrancing, the doors are used for the regulation of the ventilation.

Don't forget to contact the carpentry in advance to discuss the design of the doorpost and of doors. Fix the doorpost at first and add the door afterwards. Be careful with the choice of material – keep in mind that the higher temperatures and humidity in the greenhouse can affect the quality of wood.

2e) Installation of the wall ventilator

The wall ventilator helps to keep the adequate climate inside the greenhouse. It should be installed in the opposite wall to the one with door (east or west). You should follow the same procedure as with the door purchase – try to purchase the door and wall ventilator at the same time.

Picture No. 7: Installed wall ventilator

2f) Construction of the roof

Roof is supported by the north wall and 2 side walls. Once the north wall is 1.2 m high (above the foundation) add the single line of bricks (15 cm width) on the top.

Be sure to purchase the wooden beams (15cm diameter, same length as the length of the greenhouse (over-reaching the side walls by several centimeters on each side). If there is no sufficient length of beams at the market, you can extend the shorter beams by joining them in one (max 3 not more!). Put this main beam(s) in the proper top position as shown in the pictures. Don't forget to install the vertical beam supports and if you had to join more beams into one, put the supports in the place of joint(s).

Picture No. 8: Vertical support of the main horizontal beam

Picture No. 9: Vertical support to the jointed horizontal beams

Then identically construct the second inner horizontal line. In design No. 3 and 4 you can use the north partition walls as a support instead of the supporting beams.

Once those 2 horizontal structures and the supports are finished, use the shorter beams to create the half-roof skeleton. Put those beams one by one close to each other perpendicularly to the horizontal beams on the north part at the roof (see the pictures).

Picture No. 10: The inner construction of the greenhouse – main horizontal beam supported by wooden slope and the second horizontal beam supported by the partition north walls

2g) Installation of the roof ventilators – the number of roof ventilators depends on the specific design

Don't forget to contact the carpentry in advance to discuss the design of the shutters and ventilation windows. Install the shutter(s) first and add the ventilator(s) afterwards. Be careful with the choice of material – keep in mind that the higher temperatures and humidity in the greenhouse can affect the quality of wood. Two layers of the polythene sheet should be fixed at the wooden frame.

The ventilation windows should open manually.

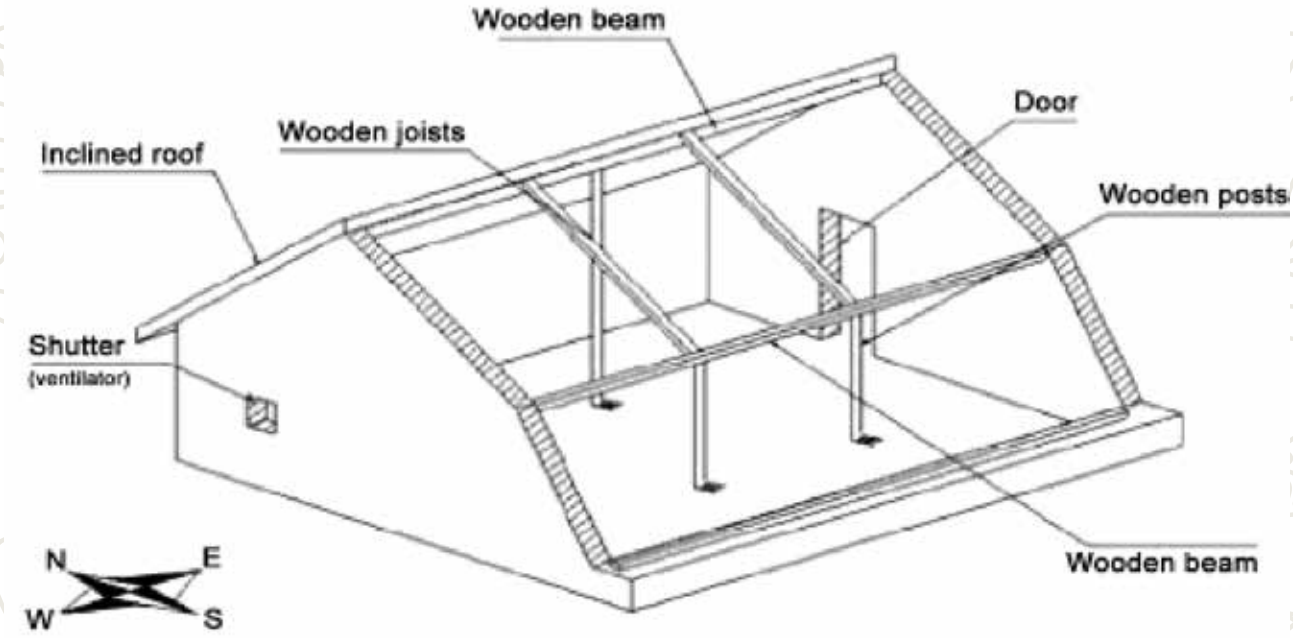
Picture No. 11: Installed and opened roof ventilator – inside view

Picture No. 12: Installed and opened roof ventilators – outside view

2h) Installation of the polythene sheet

The polythene sheet should be firmly fixed at the wooden/steel skeleton in the proper way (to avoid any crumpling, wrinkling, warping or flapping in the wind). If you manage to secure the polythene correctly, you can use it for 7 years. Vice versa – if the quality of securing is poor, you have to change the sheet every year. The proper installation should be done by 3 people in 5 hours during the warmest days (polythene expands with the increasing heat).

A) Construction of the recommended skeleton for fixation of the polythene sheet:



Picture No. 13: Schema of the wooden structure for the polythene sheet fixation

1. For smaller greenhouses two wooden posts/reused steel pipes should be constructed 45 cm from the edge of the south wall; the west post should be constructed 27 cm from the west wall while the east's post 27 cm from the east wall. Because of the stability the posts should be 30 cm rammed in the ground and reach the site wall's edge line at the top. In case of a bigger greenhouse, the use of more posts is needed.

NOTE: In case of using 2-layer's polythene sheet and the wooden construction (design No. 3 and 4), the first (inner) 0.2 mm sheet should be put over the posts before the next step.

2. The wooden beams/reused steel pipes should be put on the posts (in the site wall's edge line) and fixed to the side walls (cut to the proper length, fixed in the site walls and nailed to the posts; in case of steel pipe it should welded on the posts)
3. The wooden joints/reused steel pipes should be fixed between the posts and the central (top) beam
4. The supporting joints should be installed to join the central (top) beam with the side wall's edge beam/pipe; those additional joints help to secure the polythene sheet in the proper way in different clime conditions; you can use 8cm x 5cm wooden beams, 5 cm wooden sticks, 12 cm bamboo sticks, 3 cm steel pipes and/or the wire for the additional joint's construction; try to use the wire-painted white to avoid polythene damages; more joints ensure a better stability in tough weather conditions (but reduce the solar transmission and hamper the plants' growth):
   - In less windy areas with minimal snowfalls: 1.65 m joint distance is recommended
   - In moderate windy areas with the moderate snowfalls: 1.20 m joint distance and the use of 2mm wire transversals per each 90cm is recommended
   - In windy areas with high snowfalls: 1.00 m joint distance and the use of 2mm wire transversals per each 60cm is recommended

NOTE: be always sure about the smooth surface of the used materials and whole supporting construction (no edges, splinters etc.)! You can put some cloth under the polythene sheet to protect it against the possible damages caused by the sharp joints etc.

Picture No. 14: Adjusted skeleton for fixation of the polythene sheet

B) Fixation of the polythene sheet:

Designs No. 1 and No. 2 – single sheet fixation:

1. quality 0.4mm polythene sheet (adequate size to the greenhouse – the plastic should exceed the size of the greenhouse by 30 cm at each side) should be secured during the warm sunny day
2. roll the top end of the sheet around some beam or pipe and lay this just behind the central/top beam of the construction
3. spread the polythene sheet from the top to the bottom on the fixation skeleton and use some weights (e.g. mud or mud bricks on the jute bags) to secure the sheet edgings – at the top and on the sides;

Picture No. 15: Top and side fixation of the polythene sheet by the mud layer and mud bricks

4. use the special fixation to the bottom end of the sheet - use the galvanized iron mesh (the one used for the construction of the gabions) or straps or bands to anchor the sheet into the walls. You can use the same way of the fixation as mentioned above (mud, mud bricks) and add the extra mud layer to fix the sheet to the south wall

NOTE: never cover the north part of the roof by the polythene!

Designs No. 3 and No. 4 – double sheet fixation:

1. during the construction of the supporting skeleton, don't forget to secure the inner polythene layer (0.2mm)! It should be done after the construction of the posts (see above): take the sheet and put it over the posts without the fixation; some textile should be put between the posts and the sheet to protect it;
2. the rest of the construction procedure is the same as mentioned above
3. prepare the special wooden frame to the south wall (some sticks fixed on the wall)
4. fix (nail) the bottom part of the inner sheet to the prepared frame
5. weight the inner sheet on the side walls by 5 cm leveled layer of mud
6. fix the upper layer of the polythene sheet 5 cm above the inner layer (use the wooden frame) using the same procedure described above

NOTE: Two layers of the polythene sheet shouldn't touch each other!

NOTE: In windy areas, put some rope net above the upper sheet and install another rope net inside the greenhouse – just below the inner polythene layer between the central (top) beam and the edge wall line beam

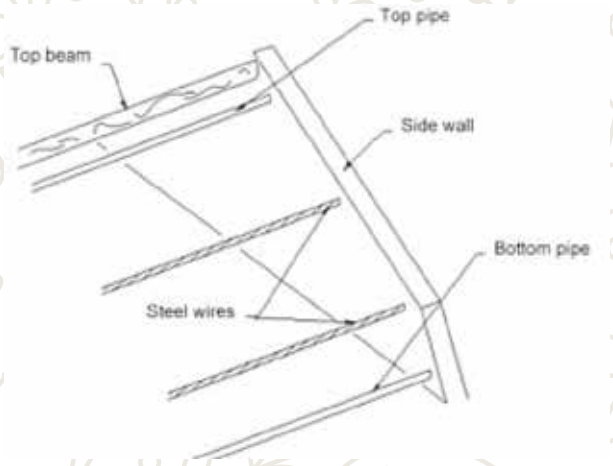
2i) Installation of the night insulation

If needed, you should fix the textile (e.g. the parachute textile) curtain inside to the greenhouse, to limit the night heat loss during the night.

The curtain should be closed after the sunset and opened immediately after the sunrise;

The curtain, supported in the middle by two steel wires, should be attached at the top and bottom by rings sliding on a thin pipe or iron wire.

Picture No. 16: Installed night insulation in the greenhouse



Picture No. 17: Schema of the night insulation structure

3. Recommendations for the hot summer areas (Kabul, Mazar-e-Sharif etc.)

If there is no chance to transplant the plants outside (e.g. citruses), you should manage the effective ventilation of the greenhouses in the hot-summer areas. During the day, the lower part of the greenhouse sould be opened. For that purpose the bottom part of the polythene sheet should be lifted; be aware of needing to shut those openings in case of strong wind!

Picture No. 18: The summer ventilation of the greenhouse by lifting the bottom part of the polythene sheet.

WHAT WE NEED

Material and Equipment for 2m × 3m = 6m^2 trench:

	Item	Unit	Number of units	Estimated Price per Unit [AFA]	Total price [AFA]
1	Plastic sheet	Meter	6	25	150
2	Rope/ String	Bundle	1	50	50
3	Bricks	Pcs	1000	3	3000
4	Cement	Kg	100	500	1000
5	Iron bar	Pcs	5	50	250
6	Wooden sticks (just for construction)	Pcs	3	30	90
7	Barrow	Pc	1	2000	2000
8	Sickle	Pcs	2	50	100
9	Pickaxe	Pcs	2	150	300
10	Shovel	Pcs	2	150	300
11	Hoe	Pcs	2	150	300
12	Labor cost	Person	3	700	2100
13	Weeder	Pcs	2	30	60
14	Seeds (MIX)	Kg	0.6	500	300
15	Garden tools	Set	1	700	700
16	Sprinkler	Pc	1	400	400
				TOTAL	11 100

Material and Equipment for 3m × 8m = 24m^2 greenhouses:

	Item	Unit	Number of units	Estimated Price per Unit [AFA]	Total price [AFA]
1	Plastic sheet/polyethylene	Meter	9	120	1080
2	Rope/ String	Bundle	1	100	100
3	Wooden beam big (8mx8cmx6cm)	Pcs	2	1000	2000
4	Wooden beam small (8mx6cmx4cm)	Pcs	4	800	3200
5	Bricks	Pcs	1.5	6000	9000
6	Cement	Kg	500	10	5000
7	Sand	Mł	9	700	6300
8	Mud	Mł	9	200	1800
9	Door	Pcs	1	2000	2000
10	Window	Pcs	1	1000	1000
11	Wooden plate for roof	Pcs	4	1000	4000
12	Shovel	Pcs	4	150	600
13	Hoe	Pcs	2	150	300
14	Sickle	Pcs	2	50	100
15	Pickaxe	Pcs	2	150	300
16	Barrow	Pcs	1	2000	2000
17	Straw	Kg	100	10	1000
18	Labor cost	No	6	700	4200
19	Sprayer	Pc	1	200	500
20	Water sprinkler	No	2	150	300
21	Weeder	Pcs	2	40	80
22	Tarpaulin	Pcs	1	2000	2000
23	Garden tools	Set	1	700	700
24	Seeds (MIX)	Kg	1	500	500
25	Flower pot	Pcs	50	30	1500
				TOTAL	49 560

Note: The amount of materials needed will be different based on the type of the greenhouse design selected. The differences are clearly described in Chapter 3d Greenhouse construction.

PLANTING CALENDAR FOR GREENHOUSE

Planting calendar helps you to keep the proper deadlines in the cultivation of each plant. You can see which activity has to be done in which term with the given crop. The list of the activities are on the left and the list of months on the top. If the given activity should be done in the exact months, the field in the table is highlighted. If the activity is not done, the field is empty. The characters A, B, C, D stands for the different plants – you can see the list of plants below the table. The cultivation calendar respects the differences between the cultivation in cold and in warm areas – therefore there are 2 separate tables.

Planting calendar – Cold areas – EXAMPLE

See the cultivation calendar for different crops cultivation in the greenhouse in cold areas. Listed activities should be done in given period (the new year starts by Nauruz). According to the planting calendar below the activity of transplantation of seedlings/flowers should be done only in April; activity of watering should be done during the whole cultivation;

	Activity in Greenhouse	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar/Nauruz
1	Soil preparation and Fertilization before seeding												
2	Seeding								A B	A B D	A D	A C	C
3	Watering								A B	A B D	A B D	A B C D	A C D
4	Control of germination								A B	A B	A	A C	C
5	Fertilization during cultivation									A	B D	A	C
6	Weed control	C D							A B	A B D	A B D	A B C	A C D
7	Pest control	C D							A B	A B D	A B D	A B C D	A C D
8	Disease control	C D							A B	A B D	A B D	A B C D	A C D
9	Transplantation of seedling/ cuttings from greenhouse	C D											A
10	Harvesting in greenhouse									A	A	A B	A
11	Greenhouse maintenance												

A) Leaf vegetable (spinach, lettuce), coriander and cabbage:

- First seeding: November/December; second seeding December/January (after the first harvest); third seeding: January/February (after second harvest)
- Harvest: approximately 40 days after seeding

B) Cucumbers:

- Seeding: November /December
- Harvest: until end of February

C) Eggplant, Pepper, Tomatoes (cultivation of seedlings):

- Seeding: since last week of Feb to mid-March
- Transplanting to the garden/field: April
- Harvest: June- August

D) Flowers (roses, geranium):

- Planting of cuttings: December/January
- Transplanting to the final destination: April

Planting calendar – Warm areas – EXAMPLE

See the cultivation calendar for different crops cultivation in the greenhouse in warm areas.

	Activity in Greenhouse	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar/Nauruz
1	Soil preparation and Fertilization before seeding												
2	Seeding										A C	A B	A
3	Watering										A C	A B C	A B C
4	Control of germination										A	A B	A
5	Fertilization during cultivation										A	A	B
6	Weed control	B										A B C	A B C
7	Pest control	B										A B C	A B C
8	Disease control	B										A B C	A B C
9	Transplantation of seedling/ cuttings from greenhouse	B											C
10	Harvesting in greenhouse											A	A
11	Greenhouse maintenance												

A) Leaf vegetable (spinach, lettuce), coriander and cabbage:

- First seeding: January/February ; second seeding: February/March (after second harvest)
- Harvest: approximately after 30 days from seeding, last in March

B) Cucumbers, Eggplant, Pepper, Tomatoes (cultivation of seedlings):

- Seeding: February
- Transplanting to the garden/field: April
- Harvest: May- August

C) Flowers (roses, geranium):

- Planting of cuttings: January
- Transplanting to the final destination: March

Temperature and moisture in greenhouse

- The temperature: min. 10 ˚C, max. 25 ˚C
- The moisture: max. 75%

Temperature and moisture can be controlled by:

- Proper watering system;
- Proper ventilation (windows, door);
- Addition/remove of extra tarpaulin or plastic;
- Proper use of coloring;
- Etc.


GENERAL CHAPTERS
NURSERY

LIST OF PLANTS

Examples of trees and plants suitable for the cultivation in nurseries (not the vegetable nurseries):

English	*Dari*	*Pashto*
Fruit and nut trees		
Apples		
Pears		
Peaches		
Apricots		
Cherries		
Pomegranate		
Mulberry		
Plums		
Almonds		
Pistachios		
Walnut		
Olive		
Forest and ornamental trees		
Cedar		
Pine		
Junipers		
Willows		
Poplar		
Ash		
Acacia		
Tree of heaven		
Elm		
Herbs		
Saffron		
Anise		
Fennel		
Coriander		

SELECTION OF LOCATION

Picture No. 1: Nursery at flat area

Picture No. 2: Nursery at sloped area

BASIC RULES FOR SITE SELECTION

The site you select should:

- be irrigable throughout the year, which means that water is available during the cultivation period at least
- be accessible (close to the road) which helps to reduce transportation costs and sapling damages during transportation to the market
- be large enough – from 50m^2 used just for demonstrations to 2000 m^2 to fulfill its purpose
- be flat or slightly inclined to allow sufficient drainage
- have good soil condition – dry, sandy loam or loam soil, topsoil of about 30 cm, high quantity of organic matter
- have the place for the compost
- allow sunlight for at least 6-8 hours
- be protected from strong winds with temporary windbreakers using local materials. Green belt (trees which protect against strong winds) around the nursery is an ideal permanent windbreaker
- be close to the planting area, which helps to reduce the transportation costs and damages
- be accessible from the market to purchase and/or to sell the seedling and saplings

SITE PREPARATION

- After a suitable nursery site is selected: remove stones, rocks, stumps and roots, and all undesirable vegetation.
- If it is sloping, construct bench terraces respecting the contour - use soil covered with grasses or dry stones (riprap); occasionally you can use the hollow blocks

SOIL

A good soil for use in tree nurseries can be made by mixing:

- 3 basins of soil collected from under vegetation cover, such as in forests or under large trees
- 2 basins of clay soil
- 1 basin of sand.

To ensure adequate fertility of the soil, add one basin of sieved mature manure or compost to every three or four basins of the standard mixture

To test the mixture, roll a damp sample in your hand. A good mixture should roll and hold its shape but break if the roll is bent (If it does not break, then it has too much clay; if it crumbles before you can roll it, then it has too much sand).

WHAT WE NEED

Materials and Equipment for 25 m x 20m = 500 m2 nursery:

	Item	Dari	Unit	Number of units	Estimated Price per Unit [AFA]	Total price [AFA]
1	Spade	بیل	Pcs	4	150	600
2	Trowel	ماله	Pcs	2	500	1000
3	Hand trowel	ماله دستی	Pcs	1	200	200
4	Hoe	پنجه	Pcs	2	150	300
5	Fork	کشک	Pcs	2	200	400
6	Sickle	داس	Pcs	4	50	200
7	Pickaxe	کلند	Pcs	2	150	300
8	Sieve (metal)	غربال	Pcs	1	1000	1000
9	Plastic sheet	پلاستیک	Meter	20m	20	400
10	Rope	تار رجه	Meter	100	5	500
11	Stick	چوب میخ خورد	Pcs	10	10	100
12	Barbed wire	سیم خاردار	Kg	100Kg	40	4000
13	Wooden poles for fencing	چوب دستک	Pcs	50	80	4000
14	Barrow	کراچی	Pcs	1	2000	2000
15	Pruning scissors	قیچیشاخهبری		2	500	1000
16	Budding knife	چاقو	Pcs	4	100	400
17	Saw	اره	Pcs	2	200	400
18	Sprayer	دوا پاش	Pcs	1	1800	1800
19	Water sprinkler	آب پاش	Pcs	2	200	400
20	Pail	سطل	Pcs	2	200	400
21	Plowing tools	سامان قلبه	Pcs	2 set	500	1000
22	Weeder	رمبه	Pcs	4	30	120
23	DAP Fertilizer	کود کمیاوی	Kg	10	20	200
24	Animal manure	کود حیوانی	Kg	500	1.5	750
25	Fungicide	فنگس کش	Kg	0.5Kg	400	200
26	Pesticide	حشره کش	Liter	0.5lit	1000	500
27	Seed mix (fruit and ornamental trees)	تخمهای مختلف	kg	5	200	1000
					TOTAL	23 170

Prices of saplings and seedlings:

English	Dari name	Estimated Price /100 PCs [AFA]
Apples	سیب	10000
Pears	ناک	13000
Peaches	شفتالو	10000
Apricots	زردالو	10000
Cherries	گیلاس	8000
Pomegranates	انار	7000
Mulberry	توت	5000
Plums	آلوچه	5000
Almonds	بادام	7000
Pistachios	پسته	5000
Walnut	چارمغز	15000
Citrus	خاندان نارنج	14000
Vine		
Vine grapes	تاک انگور	8000
Forest Trees	درختان جنگلی	
Cedar	ارچه/لمنز	20000
Pine	کاج/ناجو	20000
Junipers	سرپ	15000
Willows	بید	3000
Thuja orientalis	موپان	20000
Elm	پشه خانه	3000
Haeven tree	بید روسی	3000
Acacia	اکاسی	3000
Ash	شنگ	2500
Ornamental flower		
Rose	مرسل/گلاب	12000
Jasmine	یاسمین	10000
Geranium	جیربند	4000
Rosa muscata	نسترن	5000

SETTING THE NURSERY

Usually, 40% of the total nursery area is allotted for infrastructure and facilities, including pathways, road networks, buildings, and sheds. The remaining 60% is for the nursery beds.

While setting the nursery, you have to follow these rules:

- Nursery should be set in an east to west direction to protect seedlings from the hot sun. The shade will also protect seedlings from strong winds and heavy rain. Use locally available materials as temporary shades, during the time shortly after germination and after transplanting.
- Do not overcrowd seedlings in the nursery bed to minimize competition for resources like nutrients and water
- Potting shed is an open-sided structure for mixing, storing of potting materials, and filling of plastic bags and other containers.
- Water storage and pumps are necessary to ensure year-round supply of water. Water twice a day during hot dry days (in the morning before 8:00 a.m. and in the evening after 4:00 p.m.) to protect seedlings from wilting.
- Fences and windbreaks are built to keep animals away and protect seedlings from strong winds.
- Road network is wide enough for vehicles to transport planting materials.
- In commercial nurseries (not at schools), the nursery bunkhouses are necessary to house nursery workers, and to store tools and other materials

SEEDBED PREPARATION:

- Seedbeds/germination beds are 1 meter wide (not more to make the working here easier), any length depending on the nursery possibilities with about 0.6 meter pathway between them.
- Pot beds are 1 meter wide and from 5 to 10 meters long, with 1 meter-wide pathway to make weeding, manual watering, and transporting seedlings easier.
- Weed regularly to prevent weeds competing with seedlings for water and soil nutrients.
- Ideally, establish the seedbed on a gentle slope (but don't let water flush the upper layer of soil!)
- Dig a trench about 10 cm deep all around the seedbed
- Set large pieces of timber, bamboo or flat stones into the trench to a height of at least 15 cm above the ground
- Put a 5-cm layer of coarse gravel or small stones at the bottom of the bed to improve drainage
- Add a 5-cm layer of standard nursery soil on top of the coarse gravel
- Elevated beds are recommended in areas that flooded easily – especially in foothill areas – Maidan Wardak, Parwan, etc.

Control insects and diseases that could destroy seedlings. The risk of insect pests and diseases can be greatly reduced through the following nursery hygiene:

- sterilize all potting materials; wash it regularly and put it on sunny place to dry; if the infection appears, use fumigation etc.
- disinfect all nursery equipment and the general working area regularly (by washing with detergents, heating and other disinfection tools)
- bring/take into the nursery only plant materials that are free from diseases and insect pests
- monitor the occurrence of any insect pest or disease constantly (thinning the seedlings to allow movement of air among them is a good prevention).
- spray the seedlings with appropriate pesticide in case of pest problems – always follow the instruction mentioned at the label

MAIN OPERATIONS

You have to follow these steps for the main operations in the nursery:

1. **Seed provision:**

   You should test the seed you want to purchase or that you produce:

   - *Viability test:* This is done by germinating randomly sampled seeds using appropriate pre-germination treatment to determine how many will germinate; it should be done on the moisture paper or cotton and soil
   - *Seed health test:* This is done through visual or laboratory (use microscope) examination of the seeds to identify disease-causing organisms, such as fungi, bacteria, viruses, as well as animal pest, such as worms and insects

2. **Harden-off seedlings** by gradually reducing the shade and frequency of watering. This prepares them for the prevailing environmental conditions in the planting area. Most seedlings will be ready to plant between two and six months, depending on the type of trees.

   After hardening-off, seedlings can be planted in well-prepared sites or sold. Take care to protect them from grazing animals such as goats.

3. **Pricking-out seedlings (transfer of seedlings from the seedbed to pots):**

   Pricking-out is done when the seedlings develop 3 - 4 true leaves. Forest tree should be transferred after 1 year to another nursery.

   - Choose a cloudy day or late afternoon to avoid seedlings wilting in the sun
   - Water the seedlings well before pricking-out
   - Remove the seedlings by inserting a small flat stick beneath them and gently lifting them
   - from the seedbed; take care not to break the small roots
   - Put the seedlings in a tray of water immediately to prevent them from wilting
   - Pot the pricked-out seedlings in containers made from locally available materials, such as
   - leaves or bamboo stems, or specially made black polythene bags
   - Fill pots with the soil mixture and make a hole with a stick about the size of a pencil in
   - the middle of the pot, just a little deeper than the roots of the seedlings.
   - Carefully lower the seedlings into the hole and refill so that there is no empty space
   - around the roots; gently press down the soil
   - Put the potted seedlings into a nursery bed under shade.

4. **Root pruning:** Root pruning is the cutting of roots that grow out of the pots or containers in order to have quality and uniform seedling sizes. This will also facilitate transport to the planting field. Lift the pot regularly and cut root outgrowth using pruning scissors/shears.

NOTE – use cuttings for production of seedlings for trees in which it is difficult to get seeds

- Take cuttings from woody branches in the lower crown near the main stem; do not cut the main stem.
- The cuttings should be about 15-25 cm long and 10-20 mm thick.
- Cuttings should have at least two budscars but preferably three or four
- Remove leaves from cuttings.
- Insert the cuttings in a slanting position, into the nursery bed or a pot.
- Put slant side to the soil bed, the upper part of the cutting not be in the direct sunlight, it will be easy to plant and absorb enough moisture and nutrients.
- Maintain and care after the cuttings watering, and protect them against animals.


GENERAL CHAPTERS
COMPOST

SELECTION OF THE AREA

WHILE SELECTING THE PROPER COMPOST PLACE, YOU SHOULD RESPECT THESE RULES:

- Select the place which corresponds with the type of compost -pile or bin. If you need more composted soil and will use bins, place more bins at different places at your school plot. This will help you to distribute the compost easily to the different parts of your school farms.
- select a accessible place, as you will put the waste here regularly, will be watering the compost from time to time and will need to manipulate the composted soil
- select a place that allows you to manipulate the compost – to rearrange/aerate the compost from time to time
- respect the hygiene requirements that helpsyou to avoid the contamination of the composted material; Never set the compost close to the latrines or close to the wasted water etc.
- select a place that is protected against the wind
- select a place that is not exposed to the extreme sunshine – keep in mind that partial shade is ideal
- always try to allow direct contact of composted soil with the soil; if it's not possible, put some paper layers, branches and twigs on the bottom of the bin before starting the composting

Picture No. 1: Compost Pile

Picture No. 2: Simple Wooden Compost Bin

Picture No. 3: Simple Wire Compost Bin

WHAT WE NEED

Material and Equipment for 1.5 m × 1.5 m × 1.5 m = 3.4 m^3 wooden compost bin:

	Item	Unit	Number of units	Estimated Price per Unit [AFA]	Total price [AFA]
1	Wooden Bin	pc	1	2500	2500
2	Metal mesh	meter	3	60	180
3	Plastic sheet	meter	4	20	80
4	Small plastic dust remover	pc	2	25	50
5	Spade	pc	2	160	380
6	Fork	pc	2	130	260
7	Axe	pc	1	80	80
8	Sickle	pc	4	60	240
9	Rack	pc	2	120	240
10	Hatchet	pc	1	120	120
11	Barrow	pc	1	1600	1600
12	Pail	pc	1	100	100
13	Water sprayer	pc	1	400	400
14	Bag	pc	4	20	80
15	Brush	pc	2	50	100
16	Glasses	pc	2	50	100
17	Gloves	pair	3	50	150
18	Mask	pc	10	5	50
19	Cloth	pair	2	400	800
				TOTAL	7 510

COMPOSTING RULES

Composting is the easiest way to get cheap and effective fertilizer for your school farm. It also helps to keep your school-yard clean as the majority of the organic waste can be used in this positive way. Always keep in mind that the use of your own compost will save money and increase the fertility of your field in long-term and sustainable ways. Because you always know where your compost comes from and what is composted inside, you can be sure that there are no health-risk components in the farming soil.

The knowledge of items suitable and not suitable for composting can help you ensure that you have good quality compost.

Always compost:

- Fruit/vegetable waste – peelings, salad scraps, etc
- Grass, grass cuttings
- Old plants and flowers
- Used tea bags
- Soft prunings
- Wood prunings - they will break down quicker if they are in small pieces
- Weeds (unless they are persistent)
- Bedding from herbivores e.g. rabbits, sheep
- Horse manure
- Crushed egg shells
- Cardboard and paper
- Wood, paper and charcoal ash

Never compost:

- Non-organic products e.g. glass, and plastic
- Meat or fish products, fatty foods
- Large wood materials
- Persistent weeds
- Diseased plants
- Coal ash
- Plants treated with chemicals
- Bones

Rather not compost:

- Autumn leaves (shredded)
- Nettle tops
- Larger prunings (useful at the bottom to assist drainage and aeration)
- Hay and straw if the heap is too soggy
- Feather
- Sawdust

KEEP THE CARBON/NITROGEN RATIO RULE!

Maintain a working balance between these two elements.

Healthy compost should have much more carbon than nitrogen. A simple rule of thumb is to use one-third green and two-thirds brown materials. This allows oxygen to penetrate and nourish the organisms that reside there. Too much nitrogen makes for a heavy, smelly, slowly decomposing mass. Good composting hygiene means covering fresh nitrogen-rich material, which can release odors if exposed to open air, with carbon-rich material, which often exudes a fresh, wonderful smell.

- Carbon-rich matter (like branches, stems, dried leaves, peels, bits of wood, bark dust or sawdust pellets, shredded brown paper bags, conifer needles, egg shells, hay, peat moss, wood ash) gives compost its light, fluffy body.
- Nitrogen or protein-rich matter (animal manures, food scraps, leafy materials like grass clippings and green leaves) provides raw materials for making enzymes.

HOW TO PUT THE ITEMS IN YOUR COMPOST:

- Lay twigs or straw first, a few centimeters deep.
- Add compost materials in layers, alternating moist and dry. Moist ingredients are food scraps, tea bags, etc. Dry materials are straw, leaves, sawdust pellets and wood ashes. If you have wood ashes, sprinkle in thin layers, or they will clump together and break down slowly.
- Add manure, green fertilizers (clover, buckwheat, wheat grass). This activates the compost and speeds the process along.
- Keep compost moist. Water occasionally, or let rain do the job. Cover with anything you have - wood, plastic sheeting, carpet scraps to avoid the over-moisture.
- Turn. Every few weeks give the compost a quick turn with a pitchfork or shovel.

USE OF COMPOST

Compost is the universal organic fertilizer that can be used in all types of soil improvement – in fields, gardens, orchards, nurseries, etc. Furthermore, the compost helps to protect soil against erosion.

1. **Use in fields**
    - Use the compost before the start of cultivation during the field preparation– in cold areas: ideally before winter, while plowing. You should cultivate the majority of the field crops - (cereals, root crops, etc) in fields fertilized by compost. Find the specific requirements for each crop mentioned in the Specific Chapters section of this Handbook
2. **Use in gardens (horticulture)**
    - Use the compost during the patch preparation, before the cultivation
    - Be aware that different gardening soil mixtures can be prepared with the compost -mixed with sand, clay, sawdust, etc. always in accordance with the plant requirements; note that in this case compost share should not exceed 30% of the total mix
    - The quality of the compost used in horticulture should be even better than the one used for field fertilization
3. **Use in trenches and greenhouses**
    - Be aware that soil used for the cultivation in trenches and greenhouses should be enriched by quality humus – so the use of compost is ideal. You can use different soil mixtures - mixed with sand, sawdust, drain e.g. small pieces of pottery, perlite, etc. which can be prepared for specific plant's cultivation and for the pot-planting (potting soil mixtures)
4. **Other uses**
    - Use the compost to improve the soil in orchards and nurseries – before setting the orchard and/or nursery and for regular fertilization

GENERAL CHAPTERS

EXAMPLES OF BEST PRACTICE AND KEY CONCLUSIONS

BEST PRACTICE: SAMANGAN AHS

Samangan AHS was established in 2010 and after 2 years there are 13 teachers, 290 students and 5 members on the technical staff.

Practical teaching (hands on education) was introduced immediately after the school opening and is used for the teaching of horticulture and plant protection subjects. At the beginning there was just 1 jerib of land and the basic equipment was pickaxes and spades. Now they manage to use 18 jeribs of land for the practical teaching and they have one tractor, sprayer, water tank and pipes for the irrigation. The school farm uses the drip irrigation technique and the school serves as an advisory center (on drip irrigation, pest and disease control) for local farmers.

Apples, Almonds and Grape vines are cultivated at the school farm.

They considered 2010 to be the best year for their hands-on teaching as there weren't any problems with the watering and students and teachers were actively involved in the practical education.

Samangan AHS: drop irrigation on grape vine, and vegetables plots

BEST PRACTICE: NANGARHAR AVI

Nangarhar AHS established in 1975, promoted to AVI in 2009 and after 3 years there are 27 teachers, 832 students and 12 members on the technical staff.

Practical teaching (hands on education) was introduced in 2009 and is used for the teaching of horticulture, forestry, agronomy, soil science and animal husbandry. At the beginning there were just (500m^2) 0,25 jeribs of land and the basic equipment was shovels, pickaxes, sickles, hoes, a weeder and sprayer. Now they managed to use 0,9 jeribs of land for the practical teaching and they have two small tractors, sprayer, shovels, pickaxes and other simple tools. The school cooperates with the community and organizes weekly meetings with fathers of the students - mostly farmers. The students are also available for the local farmers to share their new agricultural knowledge during their school excursions.

Apricots, citruses, coniferous and vegetables are cultivated at the school farm.

The year 2009 is considered to be the poorest year regarding the hands-on teaching as there was a lack of agriculture equipment and interested teachers. On the other hand 2011 is considered to be the best year for the practical education as they have started the apricot, citrus and forestry nurseries and students were actively involved in the hands-on teaching.

Nangarhar AVI in Jalalabad: citrus and apricot nurseries

BEST PRACTICE: HELMAND AVI

Helmand AHS was established in 1975, promoted to AVI in 2009 and after 3 years there are 18 teachers, 250 students and 16 members of the technical staff.

Practical teaching (hands on education) was introduce in 2007 and is used for the teaching of horticulture, forestry, agronomy, soil science and other vocational subjects. At the beginning there were just 5 jeribs of land and the basic equipment was shovels, hoes, sickles etc. Now they still use 5 jeribs of land for the practical teaching, but they have one small tractor, sprayer, shovels, hoes, pickaxes, sickles, a weeder and pruning tools. The school cooperates with the community and they help the local farmers solve agricultural problems in two ways – students spread their knowledge and information and farmers visit the school for the consultations.

Plums, peaches, pomegranates, coniferous and vine grapes are cultivated at the school farm.

The period since 1980 to 2001 is considered to be a poor era regarding the hands-on teaching as there was a lack of security and students weren't interested in this type of education. On the other hand 2010 is considered to be the best year for the practical education as students were actively involved in the hands on teaching.

Helmand AVI: Setting up an apricot nursery and apple trees in the nursery

CONCLUSION:

All of the schools involved in the PIN practical education program agreed that the practical teaching is one of their priorities. Without the practical training, students are not able to have enough experiences and sufficient practice. Also without the practical training schools are not able to transfer their knowledge to their communities (who are interested in such cooperation). **Therefore the schools don't introduce the practical education just because of the TVET instructions (the official statement says that 40% of the agriculture education should be delivered through practical teaching)**.

The three most important benefits are considered to be 1) students gaining more knowledge and professional experiences by practice (it's the most effective teaching method); 2) students being prepared to work with the local farmers; 3) practical education generating income for the school development;

According to the survey, students are interested in such learning because it's not as "boring and theoretical" as the classical education and they are highly motivated to gain the practical skills. They see the effectiveness of such learning and appreciate that they can contribute to a bigger income for the school farms while practicing their knowledge.

On the other hand students are inspired by their teachers and the school management and they should be encouraged to actively participate in the practical lessons.

All interviewed schools are successful in the practical work teaching – they managed to improve the teaching conditions (e.g. get better equipment, get more land, increase the yield from the school farms, identify motivated teachers etc.). They listed some other bonuses like the introduction to the successful grafting done by students, provision of the drip irrigation etc.

The main obstacles in the introduction of the practical education are 1] the lack of modern teaching materials (in the local languages) or experienced teachers; 2] lack of equipment; 3] lack of land or water in some school farms. Also the coordination and support of the practical education by TVET could be improved and teachers themselves should be trained in some practical teaching methods during their studies.

The practical education is usually guaranteed by the school management and most of the time 1 - 2 teachers are responsible for the quality of practical teaching. All vocational subject teachers are involved in the delivery of the practical education. Some schools serve – thanks to the practical teaching – as the advisory centers for the local farmers (farmers visit them for advice or participate in the demonstration trainings delivered by teachers with the active assistance of the students; sometimes students go visit the farmers and share their agricultural knowledge and experiences gained through practical education). This helps schools to gain a good reputation and to actively participate in the community life.

If the practical teaching is successful, it leads to good yields. Part of the yield is delivered to the school canteen, part is distributed and sold among the teachers and students (in accordance with the transparent rules!) and part of the production is sold at the local market. There are some questions regarding the income generation of the school farms and different schools have different experiences with this practice – some of them have to provide part (50 %) of the income to the government budget and keep 50 % for the school. Some schools have to hand over the whole income to the government. Some schools use the whole income for the further investment in the practical education development (e.g. purchase of the equipment) or for the investment in the school (e.g. purchase of the laboratory equipment). So please, always negotiate with the authorities about the purpose of the school farm incomes! The best way is to reinvest such money for the practical education development which helps schools to be more independent on the state subsidies!

For the practical teaching to be introduced it is not important whether the school has a long history or is newly established. Also the number of teachers or the number of students and of the technical staff doesn't influence the quality of the practical education. Even the land and initial equipment don't play a significant role. The preconditions for good results of practical teaching are support from the school management and a lot of interest from the teachers.

All of the interviewed schools considered the introduction of practical teaching to be a great success and if they had the option again, they would do it even earlier. They advise the other school managers to ensure the initial conditions (some land) and to encourage their teachers and students to actively participate in this type of education (see the benefits mentioned above). Schools should start with the introduction of the practical teaching of the plant production and once they establish the school farm they should continue with the animal production. Once you manage those two fields, you should introduce the practical teaching in specialized subjects as secondary production (post-harvest technologies, animal products processing selling and marketing, financial and farm management etc.). Students can gain practical comprehensive knowledge and experiences in one place – at the school farm – as they are actively involved at the plant production, animal production, and secondary production and in the school farm management - product selling, marketing, financial and farm management, etc.

This type of education can help to solve many of Afghan agriculture's large problems as it educates real experts and hands-on experienced agriculture professionals.

SPECIFIC CHAPTERS

CEREAL CROPS

WHEAT

LATIN: Triticum aestivum, Ttriticum durum, (Poaceae) + cultivars
DARI: Gandum
PASHTO: Ghanům
ENGLISH: Wheat

BEFORE WE START

Ecological requirements:

- The best yield is gained in a moderate climate. Wheat is resistant to draught and cold (adequate agronomy resistance to -20˚C under the snow cover was proven)

Soil:

- Well prepared plots, i.e. good texture, moisture, but not affected by ground water. Neutral or alkaline soil, not acidic.

Crop rotation:

- AFTER: Wheat should be seeded after clover, beans, potato, vegetable, cicer, maize, sugar beet, sugar cane.
- BEFORE: After maize cultivate sunflower, mustard, maize, barley, millet, flax, alfalfa, peas

Seeds:

- High quality seeds: 98-99% cleanness, at least 85% germination.
- Amount required: 30 - 45 kg/jerib (hand sowing), 30 kg/jerib (machine sowing). In rain fed areas: 18-20 kg/jerib (hand sowing).
- Depth of seeding: 3 – 5 cm

Cultivation tools:

- Tractor/ox and plough, disk plough, drag (land leveler), harrows, rollers, sower/seeding machine, sickles/ combine

Fertilizers:

- **Before cultivation of WINTER WHEAT:** 4 t/jerib completely composted animal manure before winter while plowing; or alternatively max. 8 kg/jerib of Nitrogen (avoid of Carbamide form – especially in arid areas!), max. 6 kg/jerib of Phosphate (in Superphosphate form) and max. 12 kg/ jerib of K (Potassium; in salt form)
- **Before cultivation of SPRING WHEAT:** 8 t / jerib completely composted animal manure before winter; alternatively: 10 – 13 kg/ jerib of Nitrogen, max. 6 kg/jerib of Phosphate (in Superphosphate form before winter) and max. 12 kg/ jerib of K (Potassium; in salt form before winter)
- **During cultivation of WINTER WHEAT:** immediately in spring 7 kg/jerib of Nitrogen (i.e. regeneration fertilization); after 3 weeks since regeneration fertilization max. 6,5 kg/jerib of Nitrogen (best in DAM 390 form = 30% of Nitrogen in $N\text{-}NH_2$ & $N\text{-}NH_4$ form) and final fertilization just before anthesis (once the uppermost leaf / the flag leaf occurred) stage max. 7,5 kg/jerib of Nitrogen
- **During cultivation of SPRING WHEAT:** 8 – 10kg/jerib of Nitrogen after stolone forming (avoid of Carbamide form – especially in arid areas!)

Watering:

- since sowing to anthesis stage (start of ripening)

CULTIVATION CALENDAR:

- **cold areas:** winter and spring wheat cultivation
- **warm areas**: winter wheat cultivation

WINTER WHEAT

	Activity	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Field preparation and Fertilization before sowing							■	■				
2	Sowing								■	■			
3	Watering	■	■						■	■	■	■	■
4	Control of germination		■										
5	Field processing and fertilization during cultivation	■	■	■									■
6	Weed control	■	■	■						■	■	■	■
7	Pest control	■	■	■	■					■	■	■	■
8	Disease control	■	■	■	■					■	■	■	■
9	Harvesting			■	■	■							

■ cold areas ■ warm areas ■ cold and warm areas

CULTIVATION STEP BY STEP – WINTER WHEAT:

1. **Preparation of the field and fertilization before seeding:**
    - After the pre-crop: stubble-tillage (stubble breaking) and plowing after 3 weeks. If not possible at least 1x plowing or 2x tillage is needed.
    - In arid areas: just one tillage before sowing. In slope terrain: first plowing (tillage) lengthways, second has to be crosswise!!!
    - Before sowing: dragging (field leveling), harrowing (for adequate texture of soil)
    - Winter Wheat Fertilization: 4t/jerib completely composted animal manure before winter, while plowing or tillage or alternatively max. 8 kg/jerib of Nitrogen (avoid of Carbamide form – especially in arid areas!), max. 6 kg/jerib of Phosphate (in Superphosphate form) and max. 12 kg/ jerib of K (Potassium in salt form) while plowing or tillage.
2. **Sowing:**
    - 30 – 48 kg/jerib; 5- 10˚C temperature, good soil moisture; in rows: 12,5 cm (spacing between rows), 3 – 5 cm deep
    - Date: since October 10 to October 31 in cold areas, since October 30 to November 20 in warm areas; rolling after sowing if needed.
3. **Watering:**
    - Continuously during the cultivation till anthesis stage (start of ripening).
4. **Control of germination:**
    - 7 – 15 days after sowing
5. **Field processing and fertilization during cultivation:**
    - Immediately after winter rolling (if needed) and fertilizing: 7 kg/jerib of Nitrogen (= regeneration fertilization)
    - Harrowing with spring-tine/spring-tooths harrows; after 3 weeks since regeneration fertilization max. 6,5 kg/jerib of Nitrogen (best in DAM 390 form = 30% of Nitrogen in N-NH2 & N-NH4 form) and final fertilization just before anthesis (once the uppermost leaf / the flag leaf occur) stage max. 7,5 kg/jerib of Nitrogen
6. **Weed control:**
    - The problems can be eliminated through proper agro techniques! e.g. proper preparation of the field before sowing and harrowing in spring. If necessary use herbicides and always follow the instructions given on each package of herbicides.
7. **Pest control:**
    - The potential problems can be eliminated through proper agro techniques! If necessary use insecticides and always follow the instructions given on each package of insecticides. Never use the chemicals after the anthesis stage.
8. **Disease control:**
    - The potential problems can be eliminated through proper agro techniques such as crop rotation! If necessary use fungicides and always follow the instructions given on each package of fungicides. Never use the chemicals after the anthesis stage.
    - *Puccinas' (Sourkhie)* are the most dangerous diseases. Regular control has to be assured during the vegetation period!
9. **Harvest:**
    - Between the dough development and ripe stage - in cold areas between June 20 and July 20, in warm areas between May 10 and May 31.
    - Done manually by sickles or scythes and/or mechanically by tresher/combine.
    - Expected yield between 0,6t – 0,7t / jerib (local varieties), 0,7t – 1,2t in case of improved varieties.

SPRING WHEAT

	Activity	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Field preparation and Fertilization before sowing												
2	Sowing												
3	Watering												
4	Control of germination												
5	Field processing and fertilization during cultivation												
6	Weed control												
7	Pest control												
8	Disease control												
9	Harvesting												

cold areas warm areas cold and warm areas

CULTIVATION STEP BY STEP – SPRING WHEAT:

1. **Preparation of the field and fertilization before seeding:**
   - In autumn, after the pre-crop: stubble-tillage (stubble breaking) and plowing after 3 weeks. If not possible at least 1x plowing or 2x tillage is needed. In arid areas: just one tillage before sowing. In slope terrain: first plowing (tillage) lengthways, second has to be crosswise!!!
   - Before sowing: dragging (field leveling), harrowing (for adequate texture of soil)
   - SPRING WHEAT fertilization: 8 t / jerib completely composted animal manure before winter. Alternatively: 10 – 13 kg/ jerib of Nitrogen before sowing, max. 6 kg/jerib of Phosphate (in Superphosphate form before winter) and max. 12 kg/ jerib of K (Potassium; in salt form before winter)
2. **Sowing:**
   - 40 – 48 kg/jerib; 5- 10˚C temperature, good soil moisture; in rows: 12,5 cm (spacing between rows), 3 – 5 cm deep;
   - Date: since April 1 to April 30 in cold areas; rolling after sowing if needed;
3. **Watering:**
   - Continuously during the cultivation till anthesis stage (start of ripening)
4. **Control of germination:**
   - 7 – 15 days after sowing
5. **Field processing and fertilization during cultivation:**
   - Anti-weed harrowing by spring-tooths harrow and then 8 – 10kg/jerib of Nitrogen after stolone forming (avoid of Carbamide form – especially in arid areas!)
6. **Weed control:**
   - Problems can be eliminated through proper agro techniques, e.g. proper preparation of the field before sowing and harrowing in spring. If necessary use herbicides. Always follow the instructions given on each package of herbicides.

7. **Pest control:**
    - Potential problems can be eliminated through proper agro techniques! If necessary use insecticides. Always follow the instructions given on each package of insecticides. Never use the chemicals after the anthesis stage.
8. **Disease control:**
    - Potential problems can be eliminated through proper agro techniques (e.g. crop rotation). If necessary use fungicides. Always follow the instructions given on each package of fungicides. Never use the chemicals after the anthesis stage.
    - *Puccinas' (Sourkhie)* are the most dangerous diseases. Regular control has to be assured during the vegetation period!
9. **Harvest:**
    - Between the dough development and ripe stage (in cold areas between June 20 and July 20) usually 2 weeks later than the Winter Wheat.
    - Done manually by sickles or scythes and/or mechanically by thresher/combine.
    - Expected yield between 0,5t – 0,7 t/jerib (local varieties), 0,6t – 1,1 t/jerib (improved varieties)

POST HARVEST STEPS:

- First step is to separate grain from straw. This can be done automatically through combines directly by harvesting, or mechanically by treshers.
- Once the grain is separated, it has to be cleaned. Cleaning has to be done before storage! Again it is done automatically by combines or mechanically with the use of treshers. The system of different sieves is used. The manual cleaning – with the use of air is insufficient.
- Moisture of grain before storage should be lower than 14%! If it is higher, the grain should be dried before the storage. Grain for next season seeding should be storage separately from the grain for consumption! Always store the seeds in silos well protected again rodents, moisture and light!
- The grain for seeding should be marketed in the seeding season, when the price is higher. It means that the adequate storage has to be assured!
- Grain for consumption should be stored in silos or at least in duffels or sacks in dry, dark place. Grain is processed by mills and different types of flours can be gained (meal, middle, soft, etc). Flour prepared without bleaching (dark flour) is healthier and preferable for export. Flour should be stored in dark dry place in sacks, or in small amounts in paper packets. The good quality flour can provide more cash than the grain itself.
- Grinded grain (grouts) is used for the animal consumption. It is very valuable source of nutrition for cattle and small ruminants in the winter season.
- Wheat straw should be used in the animal production. Cut straw is used for bedding (different size of cuts for poultry, small ruminants and cattle), but has to be stored in proper conditions! Elimination of moisture and mildew should be assured. The best way is to store the straw in stacks in fields. Straw can be used as well as building material and for some commercial purposes (decorations).
- Stubble should be plough/tillaged max. in 2 weeks after harvest as it provides nutrition to the soil and protects the dissemination of the weeds and diseases.

BARLEY

LATIN: Hordeum vulgare (Poaceae) + cultivars
DARI: Jaw
PASHTO: Worbashi
ENGLISH: Barley

BEFORE WE START

Ecological requirements:

- Spring Barley – not weather or moisture demanding, but very sensitive to the soil quality
- Winter Barley – not as soil sensitive as spring barley, but also not as cold resistant as winter wheat (resistant just to mild freeze); short vegetation: 90 (spring form) – 130 days (winter form)

Soil:

- Spring Barley: sensitive: quality texture soil clay and sand soils (preferably muck soil or brown earth), with sufficient ready-to-use nutrition; pH neutral;
- Winter Barley is more soil quality resistant than Spring Barley, but is sensitive to soil acidity too;

Crop rotation:

- AFTER: Spring barley is seeded after spring root crops, especially sugar beet and potatoes, winter rape. Winter barley is cultivated after root crops, wheat, maize, sorghum, poppy, legumes only if necessary.
- BEFORE (Following crops are planted after barley): maize for silage production, fodders; after Spring Barley: peas, after Winter Barley: rape

Seeds:

- Clean and not defected seeds.
- Spring Barley: 40 kg/jerib for hand sowing, 32 - 44 kg/jerib for machine sowing
- Winter Barley: 35 kg/jerib for hand sowing, 28 - 40 kg/jerib for machine sowing. When machine sowing, have 12.5 – 15 cm between rows.
- In rain fed areas: 15 - 20 kg/jerib for hand sowing
- Depth: 2 – 3 cm

Cultivation tools:

- Tractor/ ox and plough for stubble tillage (stubble breaking), disk plough, drag (land leveler), harrows, sower/seeding machine, sickles/combine

Fertilizers:

- **Before cultivation:** Barley is sensitive to the inadequate use of artificial fertilizers. It's recommended to use the organic fertilizers (e.g. completely composted animal manure before winter) or green fertilizers (e.g. sugar beet leaves if used as pre-crop), if necessary.
    - Winter Barley: Use 6 kg/jerib of Nitrogen (in Ammonia form) during the autumn ploughing and 6 – 10 kg/jerib of Nitrogen (in Niter form) during spring cultivation. Maximum of 1.5 kg/jerib of Phosphate just for light-acid and neutral soils, not for alkaline soils! Otherwise max. 2 kg/jerib of P_2O_5 during sowing; Potassium is used just if necessary in an adequate amount with the organic fertilizers during the autumn ploughing (in 40% salt form);
    - Spring Barley: Apply 6 – 10 kg/jerib of Nitrogen while seeding. If the amount of needed Nitrogen is higher than 12 kg/jerib, it has to always be divided! I.e. 8 kg/jerib while seeding in solid form and 4 kg/jerib of Nitrogen in the stage of tillering in liquid form. Use maximum 2 kg/jerib of P_2O_5 during seeding.

      When fertilizing during sowing - never use "flat-fertilizing" for Nitrogen and Phosphate fertilizers (always add the fertilizers to the seed directly)
- **During cultivation:** It is not necessary.

Watering:

- Barley is not as water demanding as wheat, but good moisture is needed from germination to the boot stage

CULTIVATION CALENDAR:

	Activity	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Field preparation and fertilization before sowing	SB						WB	WB	WB			
2	Sowing												
3	Field processing and fertilization during cultivation												
4	Watering												
5	Control of germination												
6	Weed control												
7	Pest control												
8	Disease control												
9	Harvesting			SB + WB	SB + WB	SB + WB							

■ cold areas ■ warm areas ■ cold and warm areas

Note: WB – winter barley, SB – spring barley

CULTIVATION STEP BY STEP:

1. **Field preparation and fertilization before seeding:**
    - **Winter Barley:** After pre-crop before winter: Stubble tillage (stubble breaking) - use green fertilizers (e.g. sugar beet leaves if used as pre-crop) or the organic fertilizers (e.g. completely composted animal manure). If organic fertilizers are not available and in the case of very poor soil or not recommended pre-crop, use the artificial fertilizers: 6 kg/jerib of Nitrogen (in Ammonia form) during the autumn ploughing, maximum 1.5 kg/jerib of Phosphate. Use potassium (in 40% salt form) only if necessary in adequate amount with the organic fertilizers and only on light-acid and neutral soils. Not on alkaline soils!
    - **Spring Barley:** Stubble tillage (stubble breaking) before winter. Before sowing make sure the field has been leveled. While seeding, it is necessary to use Nitrogen: 6 – 10 kg/jerib. If the amount of needed Nitrogen is higher than 12 kg/jerib, it has to always be divided! i.e. 8 kg/jerib while seeding in solid form and later 4 kg/jerib of Nitrogen (in the stage of tillering in liquid form); Phosphate - max. 2 kg/jerib of P_2O_5 during sowing. Never use "flat-fertilizing" for Nitrogen and Phosphate fertilizers (always add the fertilizers to the seed directly); sowing in cold areas: from April 1st to April 30th; 40 kg/jerib (hand sowing), 32 - 44 kg/jerib (machine sowing).
2. **Sowing:**
    - Use good quality seeds in the following quantities: 35 kg/jerib for hand sowing and 28 - 40 kg/jerib for machine sowing. When machine sowing have 12.5 – 15 cm between the rows. In rain fed areas you will need 15 - 20 kg/jerib for hand sowing in the depth 2 – 3 cm. Harrowing after seeding and rolling. Use the rib rollers!
3. **After-sowing field processing and fertilization during cultivation:**
    - **Winter Barley** – after the winter: rolling with heavy rollers + 6 – 10 kg/jerib of Nitrogen;
    - **Spring Barley** – in the stage of 3rd - 4th leaf (3 – 4 weeks after sowing) harrowing by spring-tine harrows
4. **Watering:**
    - Barley is not as water demanding (250-300 mm water per vegetation) as wheat and has a short vegetation period: (spring form) – 130 days (winter form). Spring Barley is more draught sensitive than Winter Barley. Adequate water is required especially till early to milk kernel stage.
5. **Control of germination:**
    - Germination at minimum 3 – 4˚C. Germination control is needed in 6 – 10 days.
6. **Weed control:**
    - DO weed control until the stem elongation stage.
    - Use of herbicides is possible for Winter Barley during the spring field-cultivation. Always follow the instructions given on each package of herbicides.
7. **Pest control:**
    - After the germination, regular control is required, i.e. infected plants have to be eliminated.
    - In case of the use of chemical insecticides, always follow the instructions given on each package of insecticides and never use chemicals for fodder-barley.
8. **Disease control:**
    - In case of heavy attack the use of chemical fungicide is needed – always follow the instructions given on each package of fungicides and never use chemicals for fodder-barley. Usually 2 fungicides applications are required: first in the stage of full tilering, second in the stage of earing.

9. **Harvest:**
    - Always harvest Barley in the stage of full ripeness (kernel cannot be dented by thumbnail). It is done manually by sickles or scythes and/or mechanically by thresher/combine. In cold areas Winter Barley and Spring Barley from June 20th to July 10th, in warm areas Winter Barley from June 1st to June 30th!
    - **Expected yield:** Winter Barley local varieties between 0.3 – 0.5t/ jerib, improved varieties between 0.9 t/jerib to 1.3 t/jerib; Spring Barley local varieties between 0.25 to 0.35 t/jerib, improved varieties between 0.6 to 1.1 t/jerib.

POST HARVEST STEPS:

- First post-harvest step is to separate grain from straw. This can be done automatically by combines directly during harvesting, or mechanically by treshers. Once the grain is separated, it has to be cleaned.
- Cleaning has to be done before storage! Again it is done automatically by combines or mechanically with the use of treshers. The system of different sieves is used. Manual cleaning with the use of air is insufficient. Always store the seeds in silos, well protected again rodents, moisture and sunlight!
- The grain for seeding should be marketed in the seeding season as the price is higher at that time. Adequate storage has to be assured, such as seed banks, silos or storages!
- Grain for consumption should be stored in silos or at least in duffels or sacks in dry, dark place. Grain is processed by mills and different types of products can be gained (peeled barley = Pearl Barley, Barley Flakes, Barley Flour). Barley products should be stored in a dark, dry place in sacks, or in small amounts in paper packets. Good quality products can provide more cash than the grain itself!
- Grinded grain (grouts) is used for animal consumption. It is a very valuable source of nutrition for cattle and small ruminants in the winter season.
- Barley straw in the animal production is used for feeding (just as an additive, not as a main source of nutrition!). It has to be stored in proper conditions! Elimination of moisture and mildew should be assured.
- Stubble should be plough/tillaged max. 2 weeks after harvest as it provides nutrition to the soil and protects the dissemination of the weeds and diseases.

MAIZE

LATIN: Zea mays, Poaceae
DARI: Jawari
PASHTO: Jowari
ENGLISH: Maize, Corn

BEFORE WE START

Ecological requirements:

- Moderate and warm climate (optimum for vegetation: 20 – 40˚C, minimum for germination: 10˚C, critical temperature 5 - 6˚C causes termination of vegetation);
- Soil moisture sensitive (not resistant to draught: Maize is most sensitive to drought, when the flowers are ready for pollination), sun light sensitive (short days = limits for growth)

Soil:

- Well prepared plots - good texture and deeper profile with sufficient nutrition
- Neutral Ph (5,6 – 7,0), good moisture, but not affected by ground water
- Water permeability (not heavy soil such as clay)
- Maize is highly salt soil sensitive!

Crop rotation:

- AFTER: Maize is seeded after legumes (peas, beans), root crops fertilized by organic fertilizers (e.g. potatoes), forage tillaged after first mowing, alfa alfa, soya beans.
- BEFORE: Following plants are seeded after maize, wheat and other cereal crops, maize can be seeded max 4 times on the same spot.

Seeds:

- Good quality seed
- Seed quantity: for seed/corn: 4 - 6 kg/jerib (machine sowing), 12 -15 kg/jerib (hand sowing); for silage: 10 - 14 kg/jerib (machine sowing), 20 kg/jerib (hand sowing)
- Way of seeding: 70 cm between rows, 18 cm between seeds, 6 – 8 cm in depth

Cultivation tools:

- Tractor/ox and plough, disk plough, drag (land leveler), harrows, rollers, sower/seeding machine, harvesting combine

Fertilizers:

- **Before cultivation for seed/corn:** After the pre-crop (in cold areas before winter): while ploughing 6 – 10t/jerib completely composted animal manure or compost, 13 – 17 kg/jerib of Nitrogen (in DAM, Urea or Ammonium sulphate form), 24 – 32 kg/jerib of K (Potassium in Potassium salts form) and 10 – 16 kg/jerib of Phosphate (in Superphosphate form)
- **Before cultivation for silage:** After the pre-crop (in cold areas before winter): while ploughing 6 – 10t/jerib completely composted animal manure or compost, 13 – 17 kg/jerib of Nitrogen (in DAM, Urea or Ammonium sulphate form), 12 – 20 kg/jerib of K (Potassium in Potassium salts form) and 6 – 8 kg/jerib of Phosphate (in Superphosphate form)
- **During cultivation:** Same for seed/corn and for silage: in the phase of 5th – 6th leaves: 6 – 8,5 kg/jerib of Nitrogen

Watering:

- Water since seeding to the start of ripening.

CULTIVATION CALENDAR:

	Activity	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Preparation of the field and fertilization before seeding												
2	Seeding												
3	Watering												
4	Weed control												
5	Control of germination												
6	Fertilization during the cultivation												
7	Pest control												
8	Disease control												
9	Harvesting												

■ cold areas ■ warm areas ■ cold and warm areas

CULTIVATION STEP BY STEP – WINTER WHEAT:

1. Preparation of the field and fertilization before seeding:

- Perfect preparation of the field is a must! After pre-crop (in cold areas before winter): stubble-tillage and plowing after 2 weeks; deep plowing (40 – 50cm) is required at least once per 4 years;
- Fertilization for seed/corn production: while ploughing 6 – 10t/jerib completely composted animal manure or compost, 13 – 17 kg/jerib of Nitrogen (in DAM, Urea or Ammonium sulphate form), 24 – 32 kg/jerib of K (Potassium in Potassium salts form) and 10 – 16 kg/jerib of Phosphate (in Superphosphate form)

- Fertilization for silage production: while ploughing 6 – 10t/jerib completely composted animal manure or compost, 13 – 17 kg/jerib of Nitrogen (in DAM, Urea or Ammonium sulphate form), 12 – 20 kg/jerib of K (Potassium in Potassium salts form) and 6 – 8 kg/jerib of Phosphate (in Superphosphate form)
- Before seeding: dragging (field leveling) and harrowing

2. **Seeding:**
   - For seed/corn production: 4 – 6 kg/jerib while seeding for silage production: 10 – 14 kg/jerib; 8 – 10˚C temperature.

     Seeding for seed/corn production in rows 50 cm (spacing between rows) while seeding for silage production 70 – 80cm (spacing between rows), 5 – 8 cm in depth.

     If danger of damages caused by birds exists, then seeding 6 – 9 cm in depth. Deepness depends on the quality of soil: 5 - 6 cm in heavy soils. Density of the seeds depends on the climate – more dense in warm areas than in cold areas (average: 18 cm between seeds).
   - Hand seeding is not effective, as the seed needs to be seeded deeply. If inevitable, sowing in 6 – 9 cm holes, 18 cm between seeds, 70 cm between rows is recommended.
   - Date: cold areas: since 20 May to 20 June; warm areas: since 20 June to 20 August
3. **Watering:**
   - Water continuously during the cultivation till start of ripening.
4. **Weed control:**
   - Mechanical control: harrowing after seeding, before germination; if heavy soil with good rooting - harrowing after germination is possible, but with blunt harrows and never in the morning!; first 50 days after seeding, field has to be clean of weeds! In row hoe weeding is recommended during the later cultivation;
   - Chemical control: Herbicide application is not recommended for silage production! In case of use of herbicides for seed/corn production – always follow the instructions given on each package of herbicides
5. **Control of germination:**
   - After 7 – 10 days from seeding, 4 -5 days in ideal condition
6. **Fertilization during the cultivation:**
   - Same for seed/corn and for silage: in the phase of the 5th or 6th leaves: 6 – 8,5 kg/jerib of Nitrogen
7. **Pest control:**
   - The potential problems can be eliminated through proper agro techniques! If necessary – use insecticides - always follow the instructions given on each package of insecticides. Never use the chemicals after start of ripening and for silage production!
8. **Disease control:**
   - The potential problems can be eliminated through proper agro techniques such as crop rotation!
   - If necessary – use fungicides - always follow the instructions given on each package of fungicides. Never use the chemicals after start of ripening and for silage production! Regular control has to be assured during the vegetation period and the affected plants have to be removed immediately!
9. **Harvest:**
   - **Silage production:** In “milk stage”, i.e. 28 – 30% dry matter; done manually by scythes or mechanically by cutters - whole plant has to be cut to 2 – 5 cm pieces (if dry matter is 28%, the cuts of 2 cm are required, if it is higher 7 cm cuts are possible). The grain has to be cut too!
   - **Seed/corn production:** In “wax stage”, i.e. 50% dry matter; done manually by scythes or by hand or mechanically by combine; Expected yield between 0,5 – 1t/jerib, max 1,4 t/jerib; for silage production yield 3 – 4 t/jerib, max 6t/jerib.
   - **Date**: seed/corn production in cold areas: since October 12 to October 30, in warm areas: since October to the end of November

POST HARVEST STEPS:

- **Silage production:** For details see relevant literature. Always keep the hygiene rules! I.e. not infected silage, clean procedures, control etc. Never use infected silage for feeding!
- **Seed/corn production:** Immediately after the harvest has to be stored at an appropriate place, i.e. dry, with sufficient air circulation. Only clean and not damaged corncobs can be stored. The biomass used for animal feeding has to be cut in pieces and kept in clean space.
- **Seed production:** Grain has to be separated from corncobs and stored at appropriate place, i.e. in duffels or sacks. If possible storage in grain silos is recommended. The grain for seeding should be marketed in the seeding season (as the price is higher in that period). That means that the adequate storage has to be assured.
- **Corn production:**
    - For direct consumption – freezing: storage in plastic bags in freezer is recommended.
    - For flour production: after the harvest, corn has to be dried to approx. 12 -15% moisture using sun-wind drying, than it can be milled; flour should be stored in clean duffels or sacks in dry dark place.
- If not milled directly, grain for consumption should be stored in silos or at least in duffels or sacks in dry, dark place.

RICE

LATIN: Oryza sativa (Poaceae)
DARI: Brenge
PASHTO: Worige
ENGLISH: Rice



BEFORE WE START

Ecological requirements:

- Producing Zones and Cropping Seasons: Rice is an important crop in Nangarhar, Laghman, Herat, Kunduz, Baghlan, Balkh, Wardak and Kapisa in particular, but it is also grown in other provinces. Rice is grown mainly during the period from April/May to October/November.
- *Lowland irrigated Rice*: the most common in Afghanistan.
- *Lowland meadow Rice*: drought prone, favors medium dept, waterlogged, submergence, and flood prone.
- *Upland Rice*: drought tolerant, extremely diverse ecosystems - level, gently rolling or steep fields.

Soil:

- Rice is not alkaline tolerant and requires pH neutral or slightly acid soil - clay loam or clay type.

Crop rotation:

- AFTER: Rice is seeded after corn, legumes, vegetable and wheat if necessary.
- BEFORE: After rice sugarcane, legumes, onion are seeded. Corn, cotton, grain sorghum or wheat is NOT recommended.

Seeds:

- High quality seeds, i.e. clean, not infected should be either transplanted in the amount of 16 kg/jerib or directly seeded in the amount of 20 – 30 kg/jerib.

  Most of the seeds used in Afghanistan are of local origin. Following improved rice varieties are available in the country: Afghan-98, Baghlan-98, Basmati 385, JP 5 and Swat 2.
- In the East rice is grown immediately after wheat as a transplanted crop. In Herat, it is either transplanted or broadcasted at very high seed rates. Transplanted rice is also an important crop in Baghlan and in the Jalalabad area during the second season.

Cultivation tools:

- Tractor or ox and plough, shovels, drag (land leveler), sower/seeding machine, planting guides for transplanting (wire, twine, and wood)/ mechanical or machine transplanter, sickles, knives/thresher, combine.

Fertilizers:

- **Before cultivation:** if seeded after organically fertilized crop (e.g. potatoes, maize etc.) there is no need of additional fertilizing before sowing. In case of repeated rice cultivation, use completely composted animal manure or compost 4-6 t/jerib during the winter/early spring tillage. You can also use PHOSPORUS in P_2O_5 form: 6 – 8kg / jerib for direct sowing method or 6 – 10 kg/jerib for bed method (= nursery)
- **During cultivation:**
  - *Direct seeding* – use NITROGEN in early stage during first 14 days: approx. 4 kg/jerib, in the phase of active tilling additional 4 - 4,6 kg/jerib Nitrogen in Urea form and again during panicle initiation 4 – 4,6kg/jerib Nitrogen in Urea form. POTASSIUM in K_2O form: 3 – 6 kg/jerib 45 days from sowing and 3 - 6 kg/jerib in the panicle initiation.
  - *Transplanting method – bed preparation*: use NITROGEN in early stage 3 – 5 kg/jerib, in the phase of active tillering additional 6 – 10 kg/jerib and 3 – 5 kg/jerib in the phase of panicle initiation. Use POTASSIUM in K_2O form in the early stage 6 – 12 kg/jerib 4 weeks after sowing and 6 – 12 kg/jerib before flowering. In zinc deficient soils, give two sprays of zinc sulphate (5 kg zinc sulphate and 2,5 kg calcium hydroxide mixed in 1000 liters of water for 5 jeribs), one 10 days after sowing and another 20 days after sowing. In case of iron deficiency 0,5% Ferrous sulphate solution can be sprayed.

Watering:

- Rice is water demanding since seeding till ripening. Artificial irrigation is a must in case of lowland cultivation.

CULTIVATION CALENDAR:

- **cold areas:** Sowing from April 1st to April 30th, harvest from September to October.
- **warm areas**: Sowing from April 30th to June 20th, harvest from September to November.

	Activity	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Plot and beds preparation and fertilization before sowing												
2	Sowing												
3	Control of germination												
4	Fertilization during cultivation												
5	Thinning (if direct sowing method)												
6	Transplanting (if transplanting method)												
7	Watering												
8	Weed control												
9	Pest control												
10	Disease control												
11	Harvest												

■ cold areas ■ warm areas ■ cold and warm areas

CULTIVATION STEP BY STEP:

1. **Plot preparation and fertilization before sowing**
    - ***For direct sowing and paddy for transplanted seedlings:*** immediately after the pre-crop harvest deep ploughing 25-30 cm is required. Organic fertilizers should be used (straw from the pre-crop, leaves, etc.) or completely composted animal manure. Then the plot has to be leveled by dragging – slight slope 10 – 20 cm is required due to effective irrigation. The supply/drain canals have to be prepared with plough and shovels. Expected flooding during the cultivation is 25 – 40 cm. Once the plot is perfectly leveled, the water should be released. If the plot is prepared before winter, leveling should be repeated before sowing.
    - ***Seed beds preparation:*** 2 main methods are used – wet beds and dry beds. Some alternative methods such as Dapog's can be used too.
        - *Wet beds:* The soil is flooded by two or three runs of puddle or three or four ploughings with local plough. After 1 - 2 days of puddling, divide the nursery area into narrow beds of 1.25 m in width and of any convenient length depending upon the slope. This facilitates sowing, weeding, the spray of chemicals and irrigation operations. Construct the drainage channels 30 cm wide in between the seed beds.
        - *Dry beds*: If the irrigation is insufficient, plough the field 3 - 4 times till the soil is thoroughly broken up. Prepare beds of the same size as in wet nurseries but 15 cm high with channels (30 cm wide) between them.
2. **Sowing:**
    - Sow 1.5 – 2.5cm in depth.
    - ***Direct sowing on dry or flooded plots:*** Sowing to the dry soil or to the flooded plot (3 – 18cm of water) by hand or by sowing machine.
        - *At the dry plot*: 16 – 20 kg/jerib by broadcasting (up to 50kg/jerib, depending on the variety) or drilling to the made into furrows (-20-25-30 cm between furrows).
        - *At the flooded plot*: broadcast the pre-germinated seeds that were soaked for twenty four hours and incubate for forty-eight hours. Sow them by hand at 16 – 20kg/jerib. Seeds for the machine seeder should be incubated for only twenty-four hours.
    - ***Sowing in the seed beds:***
        - *Wet beds:* Uniformly broadcast about 2 - 3 handfuls of seed on a square meter of seed bed. Keep the seed beds saturated with water for the first 5 days and then increase the level of water gradually up to 5 cm as the seedlings grow. Drain the excess water in periods of heavy rain during the first week of sowing. Adopt suitable disease and pest control measures. Seedlings will be ready for transplanting at an age of 20-25 days.
        - *Dry beds:* Sow the seeds in rows of 10 cm apart from one another, in dry or moist soil conditions. Use the same seed rate and fertilizer as in wet nurseries. The sown seeds should be irrigated in these beds. Allow the water to run in channels first and then raise the level of water slowly to saturate the soil of beds. Keep the seed bed saturated by water. Maintain a thin film of water if possible for 5 days after sowing. Follow all the directions as described for wet nurseries.
3. **Control of germination:**
    - Germination at minimum 10 - 12˚C
    - Check germination 7 - 10 days after sowing.
4. **Fertilization during cultivation:**
    - ***Direct sowing method:*** Use NITROGEN: in early stage (i.e. first 14 days) approx. 4 kg/jerib, in the phase of active tillering additional 4 – 4.6 kg/jerib Nitrogen in Urea form and again during panicle initiation 4 – 4,6kg/jerib Nitrogen in the form of Urea.. Apply POTASSIUM in K_2O form: 3 – 6 kg/jerib 45 days from sowing and 3 - 6 kg/jerib in the panicle initiation.

- ***Wet and Dry beds***: Use NITROGEN: in early stage 3 – 5 kg/jerib, in the phase of active tillering additional 6 – 10 kg/jerib and then again 3 – 5 kg/jerib in the phase of panicle initiation. Apply POTASSIUM in the form of K_2O during the early stage: 6 – 12 kg/jerib 4 weeks after sowing, and 6 – 12 kg/jerib before flowering. In zinc deficient soils, apply two sprays of zinc sulphate (5 kg zinc sulphate and 2.5 kg calcium hydroxide mixed in 1000 litres of water for 5 jeribs) once 10 days after sowing and again 20 days after sowing. In case of iron deficiency 0, 5% Ferrous sulphate solution should be sprayed.

5. Thinning:

- Only for *direct sowing method*: In the stage of 20 cm, plants have to be thinned. Thinning is done manually or by plowing the young crop crosswise 25–35 days after seeding (DAS) with a light, narrow wooden plow and harrows. -20-25-30cm (depending on the variety) spacing between rows is required.

6. Transplanting:

- Transplant 20 day old seedlings (in some cases already 10 days old) to the well prepared plots. The plot should be leveled, fertilized, clean with functional canals. Transplanting is done in one of two methods: randomly, i.e. without a definite distance or space between plants; or straight-row.
- Tall, leafy, heavy-tillering varieties are spaced as follows: During the dry season 25 by 25 cm in relatively poor soil, 30 by 30 cm in fertile soil. During the wet season 30 by 30 cm in relatively poor soil and 35 by 35 cm in fertile soil. Short, lodging resistant, and photoperiod-insensitive varieties at 20 by 20 cm regardless of season. However, desirable spacing in less fertile soils must be at 20 by 15 cm.
- When the whole area is planted, place the extra seedlings in small bundles along the levee. Use them later for replanting missed hills within 10 days after transplanting. Keep the water level at about one centimeter until the plants recover in 3 or 4 days.

7. Watering:

- When using wet cultivation method, plants should be flooded up to 1/3 - 1/2. Last 30 days during the phase of ripening 80–90% saturated soil is sufficient. Drain the fields 10-15 days before the expected harvest date to hasten maturity and grain ripening, it prevents excessive nitrogen uptake, and makes the land better accessible for harvest operations.

8. Weed control:

- Weeds should be controlled during the first 30–40 days after sowing or transplanting. The problems can be eliminated using appropriate agricultural techniques such as the preparation of the field before sowing. You can also prevent it manually. To avoid a weed epidemic, don't leave the soil dried.
- If necessary, use herbicides and always follow the instructions given on each package of herbicides.

9. Pest control:

- Potential problems can be eliminated by use of agricultural techniques and through regular control.
- If necessary, use insecticides and always follow the instructions given on each package of insecticides!

10. Diseases control:

- Potential problems can be eliminated by agricultural techniques such as crop rotation and by regular control.
- Use of fungicides is not recommended.

11. Harvest:

- For harvesting the grain moisture content ideally is between 20-25% (wet basis). Grains should be firm but not brittle when squeezed between the teeth, e.i. 4 – 5 days after the yellow ripeness.
- Harvest is done manually by knives or sickles or mechanically by threshers or by combines.
- Straw can be left on the field for fertilizing of the field or harvested for further use.
- The expected yield of local varieties is 700 - 800kg/jerib, but can reach 1,4 t/jerib with improved varieties.
- Harvest from September to October in cold areas and from September to November in warm areas.

POST HARVEST STEPS:

- Grain has to be thrashed either manually or mechanically, dried, cleaned and storage in proper conditions.
- Four methods of drying are used: Field Drying, Sun Drying, Heated Air Drying (in the temperatures of approx. 40˚C) and In Store Drying. Grain has to be stored at 14 – 15% moisture content.
- The seeds for next year's seeding must be stored in an appropriate place – in a dry place in sacks, duffels etc. or in seed banks.
- Seeds for consumption should be stored in bulks, bags and silos. Storage in bulks and bags has to be assured at dry, rodent-protected places.
- A rice milling system can be a simple one or two step process, or a multi stage process. In a one-step milling process, husk and bran removal are done in one pass and milled or white rice is produced directly out of paddy. In a two step process, removing the husk and removing the bran are done separately, and brown rice is produced as an intermediate product. In multistage milling, rice will undergo a number of different processing steps.
- Rice husks, as milling byproducts are used as bedding materials and once ground, are also used as ingredient in animal feeds. Rice straw can be left on the field as an organic fertilizer for the next cultivation, or can be used for bedding for animals. Different size of cuts for poultry, small ruminants and cattle, it has to be stored in proper conditions! Elimination of moisture and mildew must be assured.

SPECIFIC CHAPTERS

LEGUMES

SOYBEAN

LATIN: Glycine max, (Fabaceae)
DARI: Soyabin
PASHTO: Soyabin
ENGLISH: Soybean

BEFORE WE START

Ecological requirements:

- Temperature and photoperiod sensitive, optimum temperature for growth is 30˚C. Ideal if night temperature reaches 21˚C followed by days of at least 27˚C.
- Most cultivars bloom only when the day length is less than 14 hours (11 – 13 hours ideal).
- Minimum temperature for sowing is 8˚C.

Soil:

- Soybeans need a good seedbed, pH level of 6.0 -7.5 in a range of soils types.
- Ideally medium-textured loam with medium to high levels of P and K, but low to medium levels of nitrogen.

Crop rotation:

- AFTER: Soybean is cultivated after corn, wheat, vegetables, potato, barley, sorgo.
- BEFORE: The following crops are cultivated after soybean: corn, wheat and other cereals
- Most common crop rotation: Soybeen – corn – alfa-alfa or clover – wheat.

Seeds:

- Good quality not infected and clean seeds are required.
- Seed quantity: depending on seed size 20 – 24 kg/jerib. For fodder: 8 – 10 kg/jerib in areas with high rainfall, for combined green fodder seeding: 8-10 kg/jerib (example: corn + soybean, three rows of maize and one row of soybean).
- Required depth: 3 – 6 cm, deeper in sandy soils.
- Seed preparation: treat seed on sowing day with film formers (1% solution NaKMTs, or 3% solution of PVA). In the film-forming solution, stirring consistently, is a solution of trace elements (molybdenum, boron, etc.) and the suspension rizotorfina. Working fluid is10-15 liters per 1 ton of seeds. Processing is carried out under cover to avoid the sun's rays in the processing, transporting of seeds and placing them in the drill.

Cultivation tools:

- Tractor/ox and plough, disk plough, drag (land leveler), harrows, seeding machine, sickles/combine

Fertilizers:

- *For 0.5 t/jerib yield (if the yield is lower, you have to decrease the fertilizers adequately):*
- **Before cultivation:** After the pre-crop (in cold areas before winter) while ploughing max 40 kg/jerib of K (Potassium in 40% Potassium salts form) and max 60 kg/jerib of Phosphate (in Superphosphate form). P and K should be used long time before seeding. No additional Nitrogen needed!
- **During cultivation:** Use Nitrogen before flowering. Optically check the root nodules situation, if they are well developed, no additional Nitrogen is needed. If the development is poor, add 20 – 30 kg/jerib of Nitrogen.

Watering:

- Irrigation is most important in the period of germination and from flowering to the formation of seeds.

CULTIVATION CALENDAR:

- **cold areas:** Seeding from June 20 to July 10, harvest from Sept ember 10 to September 30.
- **warm areas**: Seeding from May 20 to Jun 20, harvest from Sept ember 20 to October 30.

	Activity	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Preparation of the field and fertilization before seeding												
2	Seeding												
3	Watering												
4	Control of germination												
5	Weed control												
6	Pest control												
7	Disease control												
8	Harvesting												

■ cold areas ■ warm areas ■ cold and warm areas

CULTIVATION STEP BY STEP:

1. Preparation of the field and fertilization before seeding

- For soya: Good after pre-crop field processing using the disk ploughs is needed. Once it is done properly, no further field preparation is needed. If ploughed with the classical plough, then additional preparation before seeding is needed. Use of harrows is recommended.

2. **Seeding:**
    - Use good quality, not infected seeds.
    - Seed quantity: 20 – 24 kg/jerib
    - Temperature above 19°C
    - Seeding in rows: minimum 24 - 30 cm spacing between rows while maximum is 45 – 60cm, 3 - 6 cm in depth.
3. **Watering:**
    - Especially important during the germination and then since flowering to the seeds ripening
4. **Control of germination:**
    - 7 – 12 days after seeding
5. **Weed control:**
    - Mechanical control: Hoe weeding in row is recommended during the later cultivation.
    - Herbicide application is not recommended for silage production! In case of the use of herbicides for seed/corn production, always follow the instructions on each package of herbicides.
6. **Pest control:**
    - Potential problems can be eliminated by proper agro techniques! If necessary, use insecticides. Always follow the instructions on each package of insecticides.
7. **Disease control:**
    - Potential problems can be eliminated by proper agro techniques (e.g. crop rotation)! If necessary, use fungicides. Always follow the instructions given on each package of fungicides.
    - Never use the chemicals after the start of ripening and never for silage production!
    - Regular control has to be assured during the vegetation period and the affected plants have to be removed immediately!
8. **Harvest:**
    - Soya sheds its leaves before ripening. The harvest starts after the green leaves disappear.
    - Moisture of 13 – 15% has to be assured. If it is below 12% moisture there is a high risk of cracking seed coats.
    - It is harvested by sickles or by appropriate combines.
    - Expected yield is 150 - 250 kg/jerib, 500 kg/jerib in ideal conditions.
    - Harvest for fodder starts after the start of seed formation. Whole plant has to be green!
    - **Date:** cold areas: Sept 10 to Sept 30; in warm areas: Sept 20 to Oct 30

POST HARVEST STEPS:

- By traditional harvesting, the crop is gathered at a dry place and thrashed manually. Seeds have to been cleaned and stored in dry clean places. By using the threshers or combines, the seeds have to be cleaned and stored in a dry clean place. Always keep the 12% moisture limit in mind! It is especially important to transport the beans from the field to storage centers as soon as possible to avoid deterioration.
- **Natural drying:** Threshed soybeans are spread in thin layers on a drying floor where they are exposed to the air and sunlight for about 1 to 2 weeks. The beans must be stirred frequently to encourage uniform drying. As a rule of thumb, the relative humidity of the ambient air must not exceed 70% for drying to be effective. When relying on natural drying methods, soybeans must not be exposed at night. The cold and moist night air fosters re-humidification of the beans which may be detrimental to bean quality.
- **Cleaning:** Cleaner-separator machines are used when large quantities of beans are cleaned. They are motor-driven and consist mainly of a reception hopper, a fan and set of vibrating sieves. Cleaning is done by repeated suction of the lightest impurities, followed by siftings of the beans.

- **Packaging and storage:** Pack and store in bags that are stacked on wooden platforms called pallets in order to prevent direct contact of the bags with the floor. The free space between the top layer of the stacks and the top of the storehouse should be at least 1 meter.

  The seeds for next season seeding have to always be kept in proper conditions. i.e. avoid the moulds, rodents etc.
- **Processing:** Soybeans are cracked to remove the hull and then rolled into full-fat flakes. The rolling process disrupts the oil cells, facilitating solvent extraction of the oil. After the oil has been extracted, the solvent is removed, and the flakes are dried, creating defatted soy flakes. While most of the defatted soy flakes are further processed into soybean meal for animal feeding, the flakes can be ground to produce soy flour, sized to produce soy grits or texturized to produce textured vegetable protein (TVP) for food uses.
- **Oil:** Soybean seed contains about 19% oil. To extract soybean oil from seed, the soybeans are cracked, adjusted for moisture content, rolled into flakes and solvent-extracted with commercial hexane. The oil is then refined, blended for different applications, and sometimes hydrogenated.
- **Dairy product substitutes** (e.g., soy milk, margarine, soy ice cream, soy yogurt, soy cheese, and soy cream cheese) **and meat substitutes:** Soy milk does not naturally contain significant amounts of digestible calcium, therefore it has to be enriched artificially.

MUNG BEAN

LATIN: Vigna radiate or Phaseolus aureus (Fabaceae)
DARI: Mash
PASHTO: Mash
ENGLISH: Mung bean

BEFORE WE START

Ecological requirements:

- Requires warm climate
- High temperature resistant and draught resistant

Soil:

- Requires well prepared plots, i.e. good texture and good permeability
- Neutral (pH 7), not resistant to the soil acidity.

Crop rotation:

- AFTER: Mung beans are seeded after wheat, cotton
- BEFORE: The following plants are seeded after mung beans: wheat, maize, watermelon.

Seeds:

- Broadcast sowing: 4-4.5 kg/jerib
- Sowing in 70 cm wide rows: 3.5-4.0 kg/jerib
- Sowing in 45 cm narrow rows: 4-4.5 kg/jerib
- Depth: 2.5-4 cm, deeper in sandy soils

Cultivation tools:

- Plough or disk plough, leveling device, dragging and harrowing devices

Fertilizers:

- **Before cultivation:** 5t/jerib of compost or 1.2 – 1.6 t/jerib of completely composted animal manure during the preparation of the soil (harrowing). Add 10kg/jerib of Urea (Nitrogen fertilizer) and 20 - 30kg/jerib of Single Superphosphate (phosphate fertilizer) or 60 kg/jerib of DAP
- **During cultivation:** not necessary

Watering:

- If there is no rainfall: 2 protective irrigations at the time of flowering and at the time of pod filling
- In dry areas: first 3 weeks after sowing also and then every 2 weeks during the vegetation.

CULTIVATION CALENDAR – AUTUMN MUNG BEANS:

- **cold areas:** Autumn and spring mung beans cultivation
- **warm areas**: Autumn and spring mung beans cultivation

	Activity	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Field preparation and fertilization before sowing												
2	Sowing												
3	Watering												
4	Control of germination												
5	Field processing during cultivation												
6	Weed control												
7	Pest control & disease control												
8	Harvesting												

cold areas warm areas cold and warm areas

CULTIVATION STEP BY STEP – AUTUMN MUNG BEAN:

1. **Field preparation and fertilization before sowing:**
   - Field preparation after the pre-crop: Stubble-tillage repeated after 2-3 weeks to avoid weeds.
   - Field preparation before sowing: Dragging (field leveling), harrowing for adequate soil texture and compost/manure processing.
   - Fertilization before cultivation: 5t/jerib of compost or 1.2 – 1.6 t/jerib of completely composted animal manure during the preparation of the soil (harrowing). Add 10kg/jerib of Urea (Nitrogen fertilizer) and 20 - 30kg/jerib of Single Superphosphate (phosphate fertilizer) or 60 kg / jerib of DAP.
2. **Sowing:**
   - Broadcast sowing: 4 – 4.5 kg/jerib
   - Sowing in 70 cm wide rows: 3.5 – 4.0 kg/jerib
   - Sowing in 45 cm narrow rows: 4 – 4.5 kg/jerib
   - 15-20 cm between the plants
   - Depth: 2.5 – 4 cm, deeper in sandy soils
   - Date: cold areas: June 15th -30th, warm areas: July 15th -31st
3. **Watering:**
   - If there is no rainfall: 2 protective irrigations during flowering and during pod filling
   - In dry areas: first 3 weeks after sowing also and then every 2 weeks during the vegetation.

4. **Control of germination:**
   - 8-12 days after seeding
5. **Field processing during the cultivation:**
   - One light hoeing and one weeding 3-4 weeks after sowing
6. **Weed control:**
   - One weeding 3-4 weeks after sowing together with the hoeing.
   - Weed control has to be done regularly!
7. **Pest control and disease control:**
   - No chemical pesticides, fungicides or insecticides are recommended. If needed try to use the organic materials, such as pyrethrins.
   - In case of the serious risk of the powdery mildew (in humid climate areas), use 1 spray of 1250 gm sulfur and 550ml monocrotophos mixed in 500 liters of water.
   - Some commercial herbicides are available: Dual (metolachlor) is approved for pre-emerge or pre-plant incorporate use and Treflan (trifluralin) is available for pre-plant incorporate use. Both herbicides give grass control, and fair to good suppression of annual broadleaves. Follow label directions to select the appropriate rate based on your soil type and organic matter content!
8. **Harvesting:**
   - Generally, start harvesting when one half to two-thirds of the pods are mature. Seeds might be between 13%–15% moisture at this time.
   - Harvest in morning hours (not during the hottest day period).
   - Hand harvest or swath the plants to allow further maturity of the pods and then hand harvest or use a special thresher if available.
   - **Expected yield:** 210 -300 kg/jerib
   - **Date:** cold areas: October 15th -30th, warm areas: November 15th -30th

CULTIVATION CALENDAR – SPRING MUNG BEANS:

- **cold areas:** Autumn and spring mung beans cultivation
- **warm areas**: Autumn and spring mung beans cultivation

	Activity	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Field preparation and fertilization before sowing											warm	cold
2	Sowing	warm	cold										
3	Watering	warm	cold and warm	cold									
4	Control of germination	warm	cold										
5	Field processing during cultivation	cold and warm	cold										warm
6	Weed control	warm	cold and warm	cold									
7	Pest control & disease control	cold and warm	cold and warm	cold								warm	cold and warm
8	Harvesting				warm	cold							

cold areas warm areas cold and warm areas

CULTIVATION STEP BY STEP – SPRING MUNG BEAN:

1. **Field preparation and fertilization before sowing:**
    - Field preparation after the pre-crop: Stubble-tillage repeated after 1-2 weeks to avoid weeds.
    - Field preparation before sowing: Dragging (field leveling), harrowing for adequate soil texture and compost/manure processing.
    - Fertilization before cultivation: 5t/ jerib of compost or 1.2 – 1.6 t/ jerib of completely composted animal manure during the preparation of the soil (harrowing). Add 10kg/jerib of Urea (Nitrogen fertilizer) and 20 - 30kg/jerib of Single Superphosphate (phosphate fertilizer) or 60 kg / jerib of DAP.
2. **Sowing:**
    - Broadcast sowing: 4 – 4.5 kg/ jerib
    - Sowing in 70 cm wide rows: 3.5 – 4.0 kg/jerib 4 – 4.5 kg/jerib
    - Sowing in 45 cm narrow rows: 4 – 4.5 kg/jerib
    - 15-20 cm between the plants
    - Depth: 2.5 – 4 cm, deeper in sandy soils
    - Date: cold areas: April 15th -30th, warm areas: March 20th – April 20th
3. **Watering:**
    - If there is no rainfall: 2 protective irrigations during flowering and during pod filling
    - In dry areas: first 3 weeks after sowing also and then every 2 weeks during the vegetation.
4. **Control of germination:**
    - 8-12 days after seeding
5. **Field processing during the cultivation:**
    - One light hoeing and one weeding 3-4 weeks after sowing
6. **Weed control:**
    - One weeding 3-4 weeks after sowing, together with the hoeing.
    - Weed control has to be done regularly!
7. **Pest control and disease control:**
    - No chemical pesticides, fungicides or insecticides are recommended. If needed try to use the organic materials, such as pyrethrins.
    - In case of the serious risk of the powdery mildew (in humid climate areas), use 1 spray of 1250 gm Sulphur and 550ml monocrotophos mixed in 500 liters of water.
    - Some commercial herbicides are available: Dual (metolachlor) is approved for pre-emerge or pre-plant incorporate use and Treflan (trifluralin) is available for pre-plant incorporate use. Both herbicides give grass control, and fair to good suppression of annual broadleaves. Follow label directions to select the appropriate rate based on your soil type and organic matter content!
8. **Harvesting:**
    - Generally, start harvesting when one half to two-thirds of the pods are mature. Seeds might be between 13%–15% moisture at this time.
    - Harvest in morning hours (not during the hottest day period).
    - Hand harvest or swath the plants to allow further maturity of the pods and then hand harvest or use a special thresher if available.
    - **Expected yield:** 210 -300 kg/jerib
    - **Date:** cold areas: July 1st-30th, warm areas: June 15th-30th

POST HARVEST STEPS:

- **Storage:** Prior to storing, remove all leaf material, stems, immature pods, dirt, insect parts and other debris. Mung beans at about 12% moisture can then be stored in regular grain bins previously fumigated to control bean weevils. If beans are higher in moisture than 12%, they can be dried slightly by moving unheated air though thin layers until they are near the 12% value. Because they will be sprouted and eaten directly, care should be taken to keep all possible contaminants away from the storage area.
- To transfer the mung beans to the market use clean sacks and duffels.

CHICK PEA

LATIN: Cicer Arietinum (Fabaceae)
DARI: Nachod
PASHTO: Chani
ENGLISH: Chick pea

BEFORE WE START

Ecological requirements:

- Chick pea requires moderate or warm climate, 18-30˚C day temperatures and 10-25˚C night temperatures.
- It is low temperature resistant and draught resistant.
- Frost, hailstones, and excessive rains damage the crop.

Soil:

- Chick pea needs well prepared plots: good texture, good permeability. It refers black or red soils of various pH between 5.8 - 8.6.

Crop rotation:

- AFTER: Chick pea can be plated after wheat, barley, rice, maize and water melon. Never plant chick pea after potatoes!
- BEFORE: Plant chick pea before cereals or fodder.

Seeds:

- Use 25 - 36 kg/jerib for broadcast sowing or 16 -24 kg/jerib for sowing in the rows, keep 25, 45 or 60 cm space between rows, 10 -15 cm between seeds.
- Depth: 5 – 12 cm, deeper in sandy soils.

Cultivation tools:

- Plough/disk plough, leveling device, dragging and harrowing devices, sowing machine or equipment for making holes for seeds.

Fertilizers:

- **Before cultivation:** Use 5t/ jerib of compost or 1,2 – 1,6 t/ jerib of completely composted animal manure during the preparation of the soil (harrowing)
- **During cultivation:** Required only if the lack of Nitrogen is visible, i.e. yellow spots on the leaves. Then use 4 – 5 kg/jerib of Urea once the plant is 10 cm high.

Watering:

- Irrigate 45 days after planting and then again 75 days after planting.

CULTIVATION CALENDAR:

- **cold areas:** Sowing March 20th – April 30th, harvest August 20th – September 30th.
- **warm areas**: sowing November 20th – December 31st, harvest April 15th – May 15th.

	Activity	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Field preparation and fertilization before sowing												
2	Seeding												
3	Control of germination												
4	Watering	2nd		1st	1-2	2nd						1st	1-2
5	Hoeing												
6	Thinning												
7	Weed control												
8	Pest control												
9	Disease control												
10	Harvesting												

cold areas warm areas cold and warm areas

CULTIVATION STEP BY STEP:

1. **Field preparation and fertilization before sowing:**
   - After the pre-crop: stubble-tillage 12 cm deep in arid areas and 20 cm in other areas. Repeat the stubble-tillage after 2 -3 weeks to avoid weeds
   - Before sowing: dragging (field leveling), harrowing (for adequate texture of soil and compost/manure processing). In arid areas just one tillage is sufficient.
   - Fertilization: before cultivation: 5t/ jerib of compost or 1,2 – 1,6 t/ jerib of completely composted animal manure during the preparation of the soil (harrowing);
2. **Sowing:**
   - Use 25 - 36 kg/jerib for broadcast sowing or 16 -24 kg/jerib for sowing in the rows, keep 25, 45 or 60 cm space between rows, 10-15 cm between seeds.
   - Depth: 5 – 12 cm, deeper in sandy soils
   - In cold areas sow from March 20th – April 30th, in warm areas from November 20th – December 31st
3. **Control of germination:**
   - 7 – 12 days after sowing. The minimum temperature of soil should be 7˚C during 24 hours.

4. **Watering:**
    - Irrigate 45 days after planting and then again 75 days after planting.
5. **Hoeing:**
    - Once about 3-4 weeks after sowing. Thereafter the crop develops enough shade to smother weeds.
6. **Thinning:**
    - You will need to thin the chick peas only in cases of wrong sowing (doubling/tripling of seeds). Do the thinning at stage of 4 -5 multifoliate leaves.
7. **Weeds control:**
    - Weeding is done mechanically during hoeing/thinning. Only lightly weed, since the crop is not well rooted! Thereafter, the crop develops enough shade to smother weeds. If needed another light weeding is recommended after reaching the stage of 4 -5 multifoliate leaves.
8. **Pest control:**
    - Good crop rotation and adequate soil processing is good prevention. The crop should be checked regularly and the affected plants should be removed.
9. **Diseases control:**
    - Good crop rotation, adequate soil processing and use of the quality, immune seeds is an important prevention. The crop should be checked regularly and the affected plants should be removed.
    - In case of high need, e.g. Powdery mildew (safidak droghin), use the proper chemicals but always follow the given instructions!
    - Never use the chemicals before harvesting and never use the chemicals in case of fodder use!
10. **Harvest:**
    - Harvest in cold areas from 20th to September 30th, in warm areas from April 15th to May 15th. The leaves turn brown/yellow during maturity.
    - For dry seeds, the plants are harvested at maturity or slightly earlier by cutting them close to the ground or uprooting. The plants are stacked in the field for a few days to dry and later the crop is threshed by trampling or beating with wooden flails. The chaff is separated from the grain by winnowing. Tall cultivars are suitable for mechanized harvesting in which case combines can be used. The leftovers could be used for feeding the animals.
    - Expected yield is 80 - 160 kg/jerib.

POST HARVEST STEPS:

- Chick peas are usually stored in sacks, but are more subject to insect damage than when stored in bulk. Proper cleaning, drying and aeration are necessary to control seed beetles. A thin coating with vegetable oil can reduce storage damage. Sometimes baskets, made from twisted rice straw, are used as storage containers. 10-12% humidity is adequate for storing.

SPECIFIC CHAPTERS

VEGETABLE

SPINACH

LATIN: Cicer Arietinum (Fabaceae)
DARI: Nachod
PASHTO: Chani
ENGLISH: Chick pea

BEFORE WE START

Ecological requirements:

- Spinach needs a moderate or cold climate, it is resistant up to -7˚C. It also needs humidity.

Soil:

- Well-prepared flat plots with good texture, moisture, humus and appropriate depth
- Neutral or alkaline (not too acidic) soils are required
- Stones should be removed from the field before planting!

Crop rotation:

- AFTER: beans, peas and potatoes

Seeds:

- Required quantity for hand sowing is 2 – 3 kg/ jerib and for machine sowing 2 kg/jerib

Cultivation tools:

- Plough, fork, shovels, leveling device, string/rope for marking rows, hoes, knifes

Fertilizers:

- **Before cultivation:** Apply 7 t/jerib of completely composted animal manure before winter, i.e. approx. 3 months before seeding or 5t/jerib of compost before or with seeding. Alternatively use chemical fertilizers: maximum 24 kg/jerib of Nitrogen, maximum 8 kg/jerib of P_2O_5 and maximum 20 kg/jerib of K_2O one month before seeding.
- **During cultivation:** Not necessary

Watering:

- Water several times during growing season

- **Pre-planting in trench/greenhouse:** YES, but not necessary
- **Cultivation in trench/greenhouse:** Possible

CULTIVATION CALENDAR:

- **cold areas:** cultivation in spring, summer (autumn)
- **warm areas**: cultivation in spring, autumn and winter

	Activity	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Fertilization before seeding	■	■				■	■	■	■	■		
2	Seeding		■	■				■			■		
3	Watering		■	■				■	■		■	■	
4	Control of germination		■					■			■		
5	Thinning		■					■				■	
6	Hoeing			■				■			■		
7	Weed control			■				■			■		
8	Pest control		■	■				■	■		■	■	
9	Disease control		■	■				■	■		■	■	
10	Harvesting			■						■			■

■ cold areas ■ warm areas ■ cold and warm areas

CULTIVATION STEP BY STEP:

1. **Fertilizer before cultivation:**
   - Always before the spring cultivation! 7 t/jerib of completely composted animal manure before winter, i.e. approx. 3 months before seeding or 5 t/jerib of compost before or with seeding.
   - Alternatively, use a maximum of 12 kg/jerib of Nitrogen, 8 kg/jerib of P_2O_5 and 20 kg/jerib of K_2O at least 2 weeks before seeding. Followed by a second application of max 12 kg/jerib of Nitrogen in Niter fertilizer once 3 leaves appear.
2. **Seeding:**
   - Required amount of seeds: 2 – 3 kg/ jerib for hand sowing and 2 kg/jerib for machine sowing.
   - Cultivation in rows: keep the space between rows 15 - 25 cm and depth 3 - 4 cm
   - Spring variety is cultivated in late April; Autumn variety in late summer and Winter variety in late autumn.
3. **Watering:**
   - Water continuously during the cultivation. Spinach is drought sensitive!
4. **Control of germination:**
   - Germination time depends on the weather conditions. Spinach should germinate after a maximum of 23 days if the temperature of the soil is 5°C and minimum 6 days when the temperature of soil is above 15°C.

5. **Thinning:**
    - Thin when the majority of plants have 3 or more leaves. Thin to 25x15cm.
6. **Hoeing:**
    - Hoe the spinach to avoid weeds once it is needed. At least once during the cultivation approx. 4-6 weeks after germination.
7. **Weed control:**
    - See point 6, weed control is done at least once by hoeing and repeated continuously as required.
8. **Pest control:**
    - Do regular control especially during the young seedling stage with the elimination of infected plants. When the majority of the plant is infected, the insecticides can be used. Avoid chemicals 3 weeks before the harvest!
9. **Disease control:**
    - All affected plants should be removed immediately to avoid the spreading of disease to the rest of the plots.
10. **Harvest:**
    - Leaves should always be harvested before flowering! When there are 5 to 6 leaves only the oldest leaves can be harvested by a sharp knife for direct consumption. This can be done continuously during the vegetation period, before flowering!
    - In the case of whole plants harvesting, the morning harvest is highly recommended! Plots have to be watered and then after evaporation, the whole plant, with its roots, have to be pulled out from the soil and transferred to the market or stored in cold place.
    - Leaves should always be dry before harvesting! Harvest after the rainfall is not recommended.
    - Estimated yield: Harvest of 2 – 4 t/jerib of spinach can be expected.

POST HARVEST STEPS:

- **Storage:** Spinach can be kept for 10 to 14 days at a temperature of 0şC and a relative humidity of 95% to 100%. Spinach is very sensitive to ethylene and should not be stored or transported with apples, melons or tomatoes because accelerated yellowing will result.
- **Transfer to the market:** Keep it dry--don't sprinkle it! Keep in cold temperatures.
- **Freezing:** If the freezer is available, cut the leaves and put them in the freezer in plastic bags. Then just put the frozen leaves into hot water and cook it as usual. You can store Spinach in the freezer for several weeks.

ONION

LATIN: Allium cepa (Liliaceae)
DARI: Piaz
PASHTO: Piaz
ENGLISH: Onion

BEFORE WE START

Ecological requirements:

- Prefers subtropical or moderate climate, is moderate freeze resistant (some varieties are grown during the winter under the snow cover).
- Prefers long-day environments.
- Onion can be grown either by seeding directly in the field or by setting transplants.

Soil:

- Fertile, well-drained, loamy soil with fairly high organic matter content.
- Optimum pH: 6.0 - 6.5

Crop rotation:

- AFTER: Onion is seeded after potatoes, cucumbers, legumes, cereals
- BEFORE: The following plants are seeded after onion: potatoes, cereals

Seeds:

- **For direct cultivation:**
  - 2 – 2.5 kg/ jerib for broadcast sowing or 0.7 – 1.5 kg/jerib for sowing with 30 - 35 cm between rows. 2 – 3 cm between seeds, later will be thinned to 4- 5cm.
  - Depth: 1.5 - 3 cm, deeper in sandy soils
- **For transplants:**
  - 4 kg/ jerib for sowing with 30 - 35 cm between rows;
  - Depth: 1.5 – 3 cm, deeper in sandy soils
- **Seedlings/transplants:**
  - 25 - 35 cm between rows; 10 – 15 cm between seedlings/transplants.
  - Depth: 2 - 3 cm, deeper in sandy soils

Cultivation tools:

- Plough or disk plough, levelling device, dragging and harrowing devices (if cultivated on field)
- Fork, shovels, string/rope for marking rows
- Sowing machine

Fertilizers:

- Onion is NOT tolerant of direct organic fertilizing and to the fertilizers with the content of chlorine (Cl)!
- **Before cultivation:** 5t/ jerib of compost or 1.2 – 1.6 t/ jerib of completely composted animal manure during the preparation of the soil (ploughing)--at least 2 months before sowing/planting. Another option is to apply N 20 kg / jerib and P_2O_5 20 kg /jerib and K_2O 40 kg/jerib or 100 kg DAFK (10:26:26)

Watering:

- Not water demanding, but has to be watered in arid areas and in the case of long-term droughts!
- The most important period for irrigation is from the stage of bulb creation until 2 weeks before harvest.
- Do not water 1 week before harvest! Onion is not over-watering resistant!

- **Pre-planting in trench/greenhouse:** Pre-planting is possible in greenhouse, but not necessary
- **Cultivation in greenhouse: usually just the seedlings/transplants**

CULTIVATION CALENDAR:

	Activity	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Field preparation and fertilization before sowing	s. v.						w. v.					
2	Sowing seeds for seedlings	s. v.	s. v.						w. v.	w. v.			
3	Sowing seeds for direct cultivation						s. v.	s. v.					
4	Planting of last year seedlings												
5	Transplanting of seedlings												
6	Watering	(if necessary)											
7	Control of germination of the seeds	s. v.	s. v.						w. v.				
8	Thinning												
9	Hoeing												
10	Weed control												
11	Pest control												
12	Disease control												
13	Harvesting		s. v.	s. v.									

cold areas warm areas cold and warm areas

Note: w.v. = winter varieties; s.v. = spring varieties

CULTIVATION STEP BY STEP:

1. Field preparation and fertilization before sowing:

- After the pre-crop: Stubble-tillage and organic or inorganic fertilizers
- Before sowing: Dragging (field leveling) and harrowing for adequate soil texture
- Fertilization: 5t/ jerib of compost or 1.2 – 1.6 t/ jerib of completely composted animal manure during the preparation of the soil (ploughing). Apply at least 2 months before sowing/planting. Another option is to apply N 20 kg / jerib and P_2O_5 20 kg /jerib and K_2O 40 kg/jerib or 100 kg DAFK (10:26:26).
- ! Never use organic fertilizers directly! It has to be well processed at least 2 months before sowing/ planting the onion! Also never use fertilizers with the content of chlorine (Cl)!

2a. Sowing seeds for seedlings:

- ***At field:***
  - 4 kg/ jerib with 30 - 35 cm space between rows.
  - Depth: 1.5 – 3 cm, deeper in sandy soils
- ***In trench/greenhouse:***
  - One month before the direct field sowing. 4 kg/ jerib with 30 - 35 cm space between rows
  - Depth: 1.5 – 3 cm, deeper in sandy soils.

2b. Sowing seeds for direct cultivation Sowing seeds for direct cultivation:

- 2 – 2.5 kg/ jerib when broadcast sowing or 0.7 – 1.5 kg/jerib when 30 - 35 cm space between rows; 2 - 3cm space between seeds, later will be thinned to 4- 5cm
- Depth: 1.5 - 3 cm, deeper in sandy soils

2c. Sowing seeds for direct cultivation Sowing seeds for direct cultivation:

- 25 - 35 cm between rows, 10 – 15 cm between seedlings/transplants
- Depth: 2 - 3 cm, deeper in sandy soils

3. Transplanting of seedlings:

- Seedlings/transplants pre-planted in trenches/greenhouses should be transplanted 20 – 40 days after the seeding when they are 4 mm diameter and 15 – 20 cm high. The leaves and roots should be cut to 2/3 of the original size.
- Before the transplanting, the seedlings should be adapted to the outside conditions, the trench/green-house should be ventilated or uncovered for one week. The planting should be done during the cold days, never during the highest temperatures!
- The plot should be irrigated after the transplanting.
- Spacing: 25 - 35 cm space between rows and 10 – 15 cm between seedlings/transplants. Depth: 2 - 3 cm, deeper in sandy soils.

4. **Watering:**
    - Onion has to be watered in arid areas and in the case of long-term droughts! The most important period for irrigation is from the stage of bulb creation until 2 weeks before harvest.
    - Do not water 1 week before harvest! Onion is not over-watering resistant!
5. **Control of germination of the seeds:**
    - 5 – 7 days after sowing
    - In hot areas the plants should be protected against the direct sunlight, ideally covered by some dry, plant material such as grass. Be careful with weeds. Plants should be covered for 10 days after the germination. After this period the covering should be removed gradually! Start with uncovering during the morning and evening and continue to prolong the period to the whole day.
6. **Thinning:**
    - Thinning should be done when the onion is seeded for direct cultivation. This is not for the seedlings at the permanent spot or for the next year's seedlings. It should be thinned in accordance with the required size of the onion during the harvest, usually 15 – 25 cm per each plant.
7. **Hoeing:**
    - Shallow hoeing is necessary to break crusts and for weed control.
8. **Weed control:**
    - Good soil processing and a proper crop rotation system is one of the best weed prevention methods.
    - Weeding is done mechanically, especially during the hoeing
    - Chemicals: Always use before ploughing when the onions have 1-2 leaf. Available chemicals: Stomp 330 (0.8-1 liter / jerib), Tsenturoion-A (0.2 l / jerib) or Bagheera (Panther) (0.2 l / jerib) or Targa super (0.4-0.6 l / jerib), Goal (0.1-0.2 l / jerib) or Fyuzilad super (0.4-0.6 l / jerib)
9. **Pest control:**
    - The best pest prevention is good crop rotation and adequate soil processing. The crop should be checked regularly and the affected plants should be removed.
    - In serious cases, use the proper chemicals, but always follow the instructions! Never use the chemicals before harvesting!
    - Common onion insects: Tobacco trips (Thrips tabaci), fly (Delia antiqua) and cutworms.
    - Available insecticides: Dimilin, Bi-58, Mospilan, Konfidor, Kallipso, Storm, Acefid, Decis, Nurel-D
10. **Disease control:**
    - The best disease prevention is good crop rotation, adequate soil processing and the use of quality, immune seeds. The crop should be checked regularly and the affected plants should be removed.
    - In serious cases, use the proper chemicals but always follow the given instructions! Never use the chemicals before harvesting!
    - Common onion diseases: Downy mildew, powdery mildew, and tip burn
    - Available fungicides: Lime Sulfur mixture, Blue copper+ Lime mixture, RidomII Gold MC, Topaz. Topsin-M, Baileton, Folicur, Sulfur wet table powder

11. Harvesting:

- Harvest when 75% or more of the tops fall over. The bulbs should be pulled or dug by machines and allowed to dry for 1 -2 days in a row at the plot. Tops should be removed by cutting 2.5 to 3.5 cm above the top of the bulb. Use knifes or hand sheep shears. Machines can also remove tops in the digging operation. The roots are trimmed off, the bulbs placed (not thrown) in field crates and transported out of the field.
- The expected yield is 10-20 t / jerib.

POST HARVEST STEPS:

- Storage onions in clean, dry places with the temperature around 1˚C in sacks, duffels or wooden boxes. To make a bigger profit try to store the onion till next year and sell it during winter or spring of the following year.

GARLIC

LATIN: Allium sativum (Alliaceae)
DARI: Syr
PASHTO: Hozha
ENGLISH: Garlic

BEFORE WE START

Ecological requirements:

- Garlic prefers moderate, warmer climates. Freeze tolerant under the snow cover.

Soil:

- Tolerant to wide range of soils, prefers a free-draining loam high in organic matter. Not flood tolerant.

Crop rotation:

- AFTER: Garlic is cultivated after b, peas, carrots, cabbage. Never after onion or potatoes!
- BEFORE: The following plants are cultivated after garlic: tomatoes, other vegetable. Never onion!

Seeds = cloves:

- 200 - 300 kg/ jerib
- seeding in narrow rows: 20 - 40 cm space between rows and 10 – 15 cm between cloves; depth: 6 cm
- seeding in wide beds of six plants across with 10 – 20 cm of space between plants
- In general, clove size is more important than bulb size as a determinant of future bulb size.

Cultivation tools:

- tractor/ ox and plough, disk plough, drag (land leveler), harrows, rollers
- hoes, flat, narrow bladed shovel or fork

Fertilizers:

- **Before cultivation:** the best option is organic fertilizers as compost or completely composted manure used for either the pre-crop or used a year before garlic cultivation. You can also use green fertilizers before the cultivation. If use of the artificial fertilizers is needed, the actual soil composition has to be checked. Generally, NPK is used in the autumn during the field preparation as follows P: 3 – 7 kg/jerib, K: 1 – 20 kg/jerib and N: 12 kg/ jerib
- **During cultivation:** In spring just NPK is used (17:17:17), 50 kg/jerib

Watering:

- Garlic requires fairly even soil moisture during the growing season with no additional moisture during the last few weeks.

- **Pre-planting in trench/greenhouse:** NO
- **Cultivation in greenhouse:** NO

CULTIVATION CALENDAR:

	Activity	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Field preparation and fertilization before seeding							■	■				
2	Seeding	■							■	■			■
3	Watering	■	■	■						■	■	■	■
4	Control of germination								■	■			■
5	Fertilization during cultivation	■											
6	Field processing during cultivation (Hoeing)	■	■	■							■	■	■
7	Weed control	■	■							■	■	■	■
8	Pest control & disease control	■	■							■	■	■	■
9	Harvesting			■	■								

■ cold areas ■ warm areas ■ cold and warm areas

CULTIVATION STEP BY STEP:

1. Field preparation and fertilization before sowing:

- After the pre-crop: stubble-tillage or ploughing
- 2 weeks before sowing: dragging (field levelling) and harrowing (for adequate soil texture)
- Fertilization: NPK is used before seeding: P: 3 -7 kg/jerib; K: 10 – 20 kg/jerib; N: 12 kg/ jerib or DAP and potash
- ! Never use organic fertilizers directly! It has to be well processed and used just with the pre-crop or a year before the garlic planting!

2. Seeding:

- Autumn cultivation: daily temperatures shouldn't be higher than 9˚C
- Spring cultivation: daily temperatures should be higher than 10˚C
- Seeding in narrow rows: 20 - 40 cm between rows, 10 – 15 cm between cloves, depth: 6 cm (can be 8 cm before winter)
- Seeding in wide beds of six plants across with 10 – 20 cm between plants, always 6 cm in depth.
- Try to keep north to south direction or rows.
- Separate the garlic cloves as close to planting time as possible, preferably within 24 hours, as the root nodules won't dry out and the garlic will be able to set roots quickly.

3. **Watering:**
    - Garlic requires fairly even soil moisture during the growing season with no additional moisture during the last few weeks.
4. **Control of germination:**
    - 10-15 days after seeding
5. **Fertilization during cultivation:**
    - ***Before cultivation:*** The best option is organic fertilizers as compost or completely composted manure used for either the pre-crop or used a year before garlic cultivation. You can also use green fertilizers before the cultivation. If use of the artificial fertilizers is needed, the actual soil composition has to be checked. Generally, NPK is used in the autumn during the field preparation as follows P: 3 -7 kg/jerib, K: 10 – 20 kg/jerib and N: 12 kg/ jerib
    - ***During cultivation:*** In spring just NPK is used (17:17:17), 50 kg/jerib
6. **Field processing during cultivation:**
    - Hoeing between rows and around plants is important for weed control and as a soil aeration tool (especially after rain/surface watering to disturb the soil crusts).
7. **Weed control**
    - Good soil processing and a proper crop rotation system is one of the best prevention methods: Do weeding mechanically, especially by hoeing. Herbicides can be used, but just in extreme cases. Always follow label directions!
8. **Pest control & disease control:**
    - Good crop rotation and adequate soil processing is the best prevention. The crop should be checked regularly and the affected plants should be removed. In serious cases, use the proper chemicals but always follow the given instructions! Never use the chemicals before harvesting! Always remove (dig up) he damaged, yellowed and affected plants and burn them.
9. **Harvest:**
    - ***Flowering varieties:*** Harvest garlic when 5 fleshy leaves are leaving (green or even yellow);
    - ***Non-flowering varieties:*** Harvest garlic when the haulm of half of the plants is lying at the ground. To determine whether the garlic is ready to harvest inspect a few bulbs in the ground by carefully scraping away the dirt. You can feel the bumps of the cloves through the wrappers of a mature bulb. Lift the garlic from the ground when the bulb has reached a good size and before the wrappers begin to deteriorate or the bulbs begin to split open. If a bulb is not well-wrapped, and the skins on the cloves are not intact, the garlic will not keep well. Use a flat, narrow bladed shovel or fork to loosen the ground beside the garlic and lift the plants by hand. Garlic can get sunburned and some varieties of garlic change flavour when left in the sun and so take each load of baskets of garlic into the shadows as soon as it is harvested.
    - Expected yield: 0.7 – 1.2 t/jerib

POST HARVEST STEPS:

- **Storage:** Immediately after the harvest place garlic in a shadowed, well-ventilated place (ex) shed). Store garlic with leaves and bind into sheaves. The sheaves are put on the grates or hung on the prepared ropes, strings etc. After approximately 1 month, the leaves are cut (to 3 cm) together with the roots (to 0.5 cm). The defected garlic is selected and the rest is put in the storage bags in some dry and ventilated place. Under good storage conditions a solid, well-cured, well-wrapped garlic bulb will keep 6 to 8 months or longer. Store garlic at a cool, stable room temperature. A temperature of 15 - 18˚C with moderate humidity and some air circulation works well.
- NOTE: If garlic has been kept cold it soon begins to sprout when brought to room temperature.

TOMATOES

LATIN: Solanum lycopersicum (Solanaceae)
DARI: Badenjan romi
PASHTO: Sri Badenjan
ENGLISH: Tomato

BEFORE WE START

Ecological requirements:

- Tomatoes like a warm climate, i.e. 20˚C – 25˚C during the day and 15 -17˚C at night. They are cold sensitive. A tomato stops flowering below 15˚C, growing stops below 10 ˚C; not resistant to draught

Soil:

- Tomato can grow in many different soil types. Ideal is a deep, loamy, well-drained soil with high organic matter content and a pH of 5,0 -7,5.

Crop rotation:

- AFTER: Tomatoes should NOT be grown after potatoes, aubergine or other members of Solanaceae family. It should be planted after crops, clover and legumes.
- BEFORE: Tomatoes should be grown before maize, beans and rice.

Seeds:

- Pre-cultivation in greenhouses/trenches is done on seedbeds, in seed trays and in seed pots, 3 g of seeds /m^2.
- Transplants are seeded 0,9 – 1,4 m between rows and 0,4 – 0,5 m between transplants.

Cultivation tools:

- Plough, levelling device, string/rope for marking rows, fork, shovels, hoes

Fertilizers:

- **Before cultivation:** 4 - 8t/ jerib of compost or 6 – 10 t/jerib of completely composted animal manure during the preparation of the soil (harrowing). Or use artificial fertilizers having the following composition - N: 16 kg/jerib, P_2O_5: 7 kg/jerib, K_2O: 26 kg/jerib
- **During cultivation:** Use 10 -12 kg/jerib of Nitrogen when the first fruits reach the walnut size.
- !NOTE: Never spread chemical fertilizers on young or wet plants because this will cause burns!

Watering:

- Regularly once a week, or 3 times a week at sandy soils. Watering is important especially during flowering and fruit formation.
- It's better to give a small amount regularly than a lot of water at one time. Watering in the morning is recommended.

- **Pre-planting in trench/greenhouse:** YES, recommended
- **Cultivation in greenhouse:** YES

CULTIVATION CALENDAR:

	Activity	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Cultivation in trench/ greenhouse	■											■
2	Control of germination	■											■
3	Field preparation and fertilization before seeding	■	■					■	■				
4	Supporting stems	■											
5	Transplanting	■	■										
6	Watering	■	■	■	■	■	■	■					
7	Pruning		■	■	■	■	■	■					
8	Fertilization during cultivation			■	■								
9	Weed control		■	■	■	■	■	■					
10	Pest control & disease control		■	■	■	■	■	■					
11	Harvest				■	■	■	■					

■ cold areas ■ warm areas ■ cold and warm areas

CULTIVATION STEP BY STEP:

1. Cultivation in trench/greenhouse:

- Pre-cultivation is taking place in 3 steps: 1] on seedbeds; 2] in seed trays; 3] in seed pots.
- ***Seedbeds:*** A seedbed can be any size, but usually they are 1.2 m wide and 8 m long. A path of 15cm to 18 cm is left open for walking in between the beds. 3 g/m2, i.e. about 30 g of seed per seedbed. Tomatoes are sown in rows, leaving 5 cm between the rows. Place the seeds 5 cm apart in the rows, pressing them about 1.5-2 cm in the soil. The soil should be pressed slightly and moistened after sowing. The seedbeds should be protected from bright sunshine, heavy rains and excessive drying by covering them (e.g. with leaves). If the top centimeter of soil feels dry, it is necessary to moisten the seedbed. It is best to water the beds once or twice a day, preferably in the morning.
- The leaves and the top layer of soil should be dry before night. Do not use too much water at one time because this can cause moulding, especially in shaded areas.

- Tomato seedlings must be hardened off for 7 to 10 days before being transplanted. Gradually the seedlings should be given less water and be exposed to sunlight.
- ***Seed trays:*** An easier way is planting tomatoes in seed-trays, they are easy to transport and to water. Besides this, it is also possible to use a better soil mixture for the seed-trays than for the seedbeds. A few holes are made in the bottom of the trays to allow excess water to drain away. A layer of large pebbles is spread on the bottom of the tray, on top of which a layer of grass is placed to hold water. On top of this, a layer of soil mixture is spread. To get soil with a good structure, mix equal parts of compost, sand and garden soil. Rice husks or bagasse (sugar-cane pulp) can also be added to the mixture.
- !NOTE: Don't use garden soil from a field where any of the following crops were planted in previous seasons: tomato, pepper, potato, aborigine or any other plant of the Solanaceae family. If processed animal manure is available, you can add that to the soil mixture before sowing. However, do not use fresh manure for this purpose. A well-mixed soil should be free of eelworms and other pathogens. Sowing tomato in trays is done in the same way as sowing in seedbeds.
- ***Seed pot:*** Seed pots can be made from cardboard, banana leaves or plastic. If plastic pots are used, you need to take the seedlings out of the pot when transplanting them. This is not necessary if pots of organic (degradable) material are used. The advantage of using organic pots is that roots are damaged less during transplantation. Fill a 7.5cm pot with composted soil, lightly firm and water. Scatter seeds thinly (most germinate so only sow a few more than you need) and cover with a thin layer of soil.
- In cold areas, the tomatoes can be grown in the greenhouses during the whole season. In that case, the transplants should be put in the appropriate distance (see below).

2. Control of germination:

- 6 – 10 days after the seeding

3. Field preparation and before seeding:

- In the autumn, after the pre-crop harvest: ploughing or digging it up, so that organic fertilizers (4 - 8t/jerib of compost or 6 – 10 t/jerib of completely composted animal manure) are mixed into the soil, dragging and leveling.
- Before transplanting on loamy or clayey soils, it is better to plant on raised beds to prevent waterlogging. The height of the bed varies from 20 to 50 cm, and depends on rainfall, the type of soil, and the slope of the land. The distance between the beds varies from 30 to 50 cm. A bed can be 1-1.5 m wide. Distance between rows is 0.9 – 1.4 m, between transplants 0.4 – 0.5 m.
- If using inorganic fertilizers: N: 16 kg/jerib, P_2O_5: 7 kg/jerib, K_2O: 26 kg/jerib

4. Supporting stems:

- ***Tying up:*** Tomato (tall type) can be tied to sticks to support the stems while they are growing. Tie them loosely to the sticks and retie them regularly as they grow. In order not to damage the roots of the plants, support sticks should be put in place before transplanting. The sticks should be at least 1.5 m long, as they will be pushed 40-50 cm into the ground. Sticks that are to be used again should be washed with a disinfectant beforehand, to kill any germs that might still cling to them.
- ***Fencing:*** make fencing of sticks and rope to support tomato (tall type) for several reasons: plants get better support, there is better ventilation so less chance of spreading diseases and plagues, especially in humid areas or seasons, it is possible to plant more plants per jerib, weeding and harvesting is easier. Fencing can also be handy for bush type tomatoes, to prevent heavy clusters of fruit from touching the ground. Leaves and fruit that lie on the ground rot easily; increasing the chance that plants will be damaged by diseases and insects. Placing a fence of two parallel strings on either side of the plant. Planting on ridges or mounds, if you plant on level beds, it will be necessary to earth up around the plants. Place straw or mulch under the plants.

5. Transplanting:

- After 3 – 6 weeks after sowing, including the hardening off for 7 – 10 days, the tomato seedlings are transplanted. The seedlings should be about 20 cm tall. It is best to transplant the seedlings in the evening or in humid weather. This prevents the roots from drying out. Moisten the soil a couple of

hours before transplanting them. When removing the seedlings, keep a large clump of soil attached to the roots to prevent them from being damaged. Make the holes for the plants large enough so that the lowest leaves are at ground level. If possible, place mulch on the ground around the plant after transplanting. Mulch is composed of plant remains (e.g. rice-straw or sorghum-straw), which cover the soil to control weed growth and prevent erosion. Moisten each plant immediately after transplanting. But be careful not to wet the lowest leaves, as this can stimulate the growth of mould. The newly transplanted plants should be protected from heat during the first 5 days, e.g. by covering them with large leaves.

- The distance between rows: 0,9 – 1,4 m and between transplants: 0,4 – 0,5 m, it depends on the variety – the bush type (1m x 0,3m), the tall type (1,2m x 0,5m) and the semi-bush type (1,4m x 0,5m).

6. Watering:

- It is important to water the plants regularly, especially during flowering and fruit formation. It is especially important to water regularly (e.g. 3 times a week) on sandy soils. Under good circumstances once a week should be enough. It is better to give small amounts regularly than a lot of water at one time. To prevent diseases, it is advisable to keep the leaves dry by applying surface irrigation. To allow leaves and the top layer of soil to dry during the day, it is better to water in the morning. In this way mould growth can be controlled.

7. Pruning:

- NOTE! The bush type tomatoes are not pruned, also it should be avoided during rain or high humidity!
- Pruning the side-branches (nipping): important to pinch out side-shoots of tomato plants. The small side-shoots are removed and only one main stem remains. The fruit clusters grow along this main stem.
- Pruning the tops of the stem (heading): the tip of the main stem of the tall type of tomato plant is pinched off when 3 to 5 leaves are fully grown. The shoots that grow out of the top 2 to 4 eyes are left to grow. In this way 2 to 4 side-shoots will grow as main stems, supported by sticks. When these stems are 1- 1.25 m long, the tops should also be pinched off. New side-shoots should be removed regularly by nipping them. Usually 3 to 4 fruit clusters grow along each stem.

8. Fertilization during cultivation:

- Apply N: 10 -12 kg/jerib when the first fruits reach the walnut size

9. Weed control:

- Good soil processing and a proper crop rotation system is one of the best prevention methods. Weeding is done mechanically, before they produce seed, by pulling them out by hand or by hoeing just under the surface of the soil. To avoid damaging the roots, do not weed by hoe too often or too deep. Weed growth can be suppressed or slowed down by covering the ground with mulch.
- Herbicides can be used just in extreme cases. Always follow label directions and never use them after the stage of fruit ripening!

10. Pest control & disease control:

- Good crop rotation and adequate soil processing is the best prevention. The crop should be checked regularly and the affected plants should be removed.
- In serious cases, use the proper chemicals but always follow the given instructions! Never use the chemicals before harvesting!
- The damaged, yellowed and affected plants have to be removed (dig up) and burned.

11. Harvest

- The first tomato harvest is possible 3 to 4 months after sowing. If the tomatoes are to be used for the production of, for example, ketchup, chutney, purée or juice, the fruit must be picked when it is red and completely ripe. If the tomatoes are to be sold as vegetables on the market, they can be harvested while still green. For longer storage, place the unripen fruit in a cooler location, but not under 13˚C. Check the tomatoes periodically and remove any soft or decaying fruit.
- Expected yield: 4 – 10 t/jerib.

POST HARVEST STEPS:

- **Fresh tomatoes:** Should be consumed or delivered to the market as soon as possible; Green tomatoes can be ripened after picking, until they are red. One disadvantage of early picking is that the nutritional value of the tomatoes decreases. One advantage is that green tomatoes are less likely to get damaged or to rot. If harvest is during the rainy season, it is advisable to pick tomatoes early. Add a few red, ripe tomatoes to each crate of green tomatoes, as red tomatoes will speed up the ripening process.
- **Tomato processing – canning:** For small-scale production use the Pressure Canner or Boiling Water Bath Canner. For industry canning check the specific technologies.
- **Tomato processing – drying:** Sun drying in hot dry regions. The tomato halves are placed on clean flat surfaces (e.g. roofs) with the cut side facing up or by threading the halves onto strings and hanging in the sun from a branch or beam. In both cases, drying is relatively rapid (depending on the temperature and humidity of the air) but there may be contamination of the product by insects, dirt and dust, which can be reduced by covering the tomatoes with fine muslin cloth or mosquito netting. The end product is dark, red, leathery pieces with a strong tomato flavour. Provided that the humidity is low, the dried product will keep without special packaging for several months. If the humidity rises the product will go mouldy and should be protected either by suitable packaging (e.g. sealed plastic bags - preferably polypropylene or thick polythene, or in sealed pottery jars). When tomatoes are dried to a low moisture content, so that they are hard (e.g. 5% water), they can be pounded or milled to a powder. This is more convenient to use and store in sealed glass or pottery jars or sealed polypropylene film bags thin polypropylene. (The most common type of plastic will not stop moisture entering the product and subsequent mould growth within a few weeks.) Layers of pulp can also be dried to rubbery fruit leather and stored in plastic film. Alternatively the post dried pulp can be formed into balls or cubes and then dried in the sun or over a fire.
- **Tomato processing – juice/squash:** Tomato juice can be separated from the pulp by filtering but more commonly the entire pulp is used as 'juice'. This can be preserved by hot water pasteurising in sealed bottles at 90-100˚C for at least 10 minutes followed by cooling to room temperature or by hot filling into sterile bottles. A certain amount of separation of pulp and liquid during storage is inevitable - with pulp accumulating at the bottom of the bottle. However, clear separation into a pale liquid and a solid pulp layer is evidence of under-pasteurisation.
- **Tomato processing – ketchup, jam, green tomato chutney:** Check the specific information to this processing.

PEPPER

LATIN: Capsicum annum (Solanaceae)
DARI: Morch
PASHTO: Mrech
ENGLISH: Pepper

BEFORE WE START

Ecological requirements:

- Pepper prefers a warm climate (optimum temperatures for bell-type peppers is 20˚C – 26˚C during the day, and 15 -21˚C at night). It is cold sensitive, growing stops below 12˚C. Optimum temperatures for hot varieties: 21˚C - 29˚C. It is not resistant to draught.

Soil:

- Different soil types, but a well-drained soil with high organic matter content and pH of 6 -6,8 is ideal.

Crop rotation:

- AFTER: Peppers shouldn't be grown after potatoes, aubergine or other members of Solanaceae family. It should be grown after cereal crops, clover and legumes.
- BEFORE: Peppers should be grown before maize, beans, rice, onion, cabbage.

Seeds:

- Pre-cultivation in greenhouses/trenches (on seedbeds, in seed trays or in seed pots) 10 g/m^2
- Transplants should be placed 0.75 – 0.9 m between rows and 0.5 – 0.7 m between transplants

Cultivation tools:

- Plough, levelling device, string/rope for marking rows, fork, shovels, hoes

Fertilizers:

- **Before cultivation:** 4 - 8t/ jerib of compost or 6 – 10 t/jerib of completely composted animal manure during the preparation of the soil (ploughing) or use the artificial fertilizers – N: 16 kg/jerib, P_2O_5: 7 kg/jerib, K_2O: 26 kg/jerib.
- **During cultivation:** N: 6 kg/jerib in the stage of the first fruits development
- !NOTE: Never spread chemical fertilizers on young or wet plants because this will cause burns!

Watering:

- Regularly (once a week, or 3 times a week at sandy soils), especially during flowering and fruit formation. It's better to give a small amount regularly than a lot of water at once. Watering in the morning is recommended

- **Pre-planting in trench/greenhouse:** YES, recommended
- **Cultivation in greenhouse:** YES

CULTIVATION CALENDAR:

	Activity	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Cultivation in trench/ greenhouse	■											■
2	Control of germination	■											■
3	Field preparation and fertilization before seeding	■	■					■	■				
4	Supporting stems	■											
5	Transplanting	■	■										
6	Watering	■	■	■	■	■	■	■					
7	Fertilization during cultivation		■										■
8	Weed control		■										■
9	Pest control & disease control			■	■				■				
10	Harvest			■	■	■	■	■	■				

■ cold areas ■ warm areas ■ cold and warm areas

CULTIVATION STEP BY STEP:

1. Cultivation in trench/greenhouse:

- Pre-cultivation: on seedbeds, in seed trays or in seed pots - in cold areas in March, in warm areas in February.
- ***Seedbeds:*** Seedbed are usually 1.2 m wide and 8 m long. A path of 15 to 18 cm is left open for walking in between the beds. 10 g/m2 = about 100 g of seed per seedbed. Peppers are sown in rows, leaving 5 cm between the rows. Place the seeds 1 cm apart in the rows shallowly in the ground (0.5-1.0 cm). The soil should be pressed slightly and moistened after sowing. The seedbeds should be protected from bright sunshine, heavy rains and excessive drying by covering them (e.g. with leaves). If the top centimeter of soil feels dry, it is necessary to moisten the seedbed. It is best to water the beds once or twice a day, preferably in the morning.
- The leaves and the top layer of soil should be dry before night. Do not use too much water at one time because this can cause moulding, especially in shaded areas.
- ***Seed trays:*** An easier way - seed-trays are easy to transport and to water. Besides this, it is also possible to use a better soil mixture for the seed-trays than for the seedbeds. A few holes are made in the bottom of

the trays to allow excess water to drain away. A layer of large pebbles is spread on the bottom of the tray, on top of which a layer of grass is placed to hold water. On top of this a layer of soil, the mixture is spread. To get soil with a good structure, mix equal parts of compost, sand and garden soil. Rice husks or bagasse (sugar-cane pulp) can also be added to the mixture. !NOTE: Don't use garden soil from a field where any of the following crops were planted in previous seasons: tomato, pepper, potato, aborigine or any other plant of the Solanaceae family. If processed animal manure is available, you can add that to the soil mixture before sowing. However, do not use fresh manure for this purpose. A well-mixed soil should be free from eelworms and other pathogens. Sowing pepper in trays is done in the same way as sowing in seedbeds.

- ***Seed pot:*** Seed pots can be made from cardboard, banana leaves or plastic. If plastic pots are used, you need to take the seedlings out of the pot when transplanting them. This is not necessary if pots of organic (degradable) material are used. The advantage of using organic pots is that roots are damaged less during transplantation. Fill a 7.5cm pot with composted soil, lightly firm and water. Scatter seeds thinly (most germinate so only sow a few more than you need) and cover with a thin layer of soil.
- In cold areas, peppers can be grown in the greenhouses during the whole season. In that case, the transplants should be put in the appropriate distance (see below)

2. Control of germination:

- 10 days after seeding

3. Field preparation and fertilization before seeding:

- In the autumn, after the pre-crop harvest: Ploughing or digging it up in depth of 25 – 30cm, so that organic fertilizers (4 - 8t/ jerib of compost or 6 – 10 t/jerib of completely composted animal manure) are mixed into the soil, dragging and leveling.
- Before transplanting: In loamy or clayey soils, it is better to plant on raised beds to prevent waterlogging. The height of the bed varies from 20 to 50 cm, and depends on rainfall, the type of soil, and the slope of the land. The distance between the beds varies from 30 to 50 cm. A bed can be 1-1.5 m wide. Distance between rows is 0.75 – 0.9 m, between transplants 0.5 – 0.7 m. In case of use inorganic fertilizers: N: 16 kg/jerib, P_2O_5: 7 kg/jerib, K_2O: 26 kg/jerib.

4. Supporting stems:

- ***Tying up:*** Pepper (tall type) can be tied to sticks to support the stems while they are growing. Tie them loosely to the sticks and retie them regularly as they grow. In order not to damage the roots of the plants, support sticks should be put in place before transplanting. The sticks should be at least 1.5 m long, as they will be pushed 40-50 cm into the ground. Sticks that are to be used again should be washed with a disinfectant beforehand, to kill any germs that might still cling to them.
- ***Fencing:*** make fencing of sticks and rope to support tomato (tall type) for several reasons: plants get better support, there is better ventilation so less chance of spreading diseases and plagues especially in humid areas or seasons, it is possible to plant more plants per jerib, in addition weeding and harvesting is easier. Fencing can also be handy for bush type tomatoes, to prevent heavy clusters of fruit from touching the ground. Leaves and fruit that lie on the ground rot easily, increasing the chance that plants will be damaged by diseases and insects. Placing a fence of two parallel strings on either side of the plant; planting on ridges or mounds, if you plant on level beds, it will be necessary to earth up around the plants. Place straw or mulch under the plants.

5. Transplanting:

- After 6 – 8 weeks after sowing, the pepper seedlings are transplanted. The seedlings should be about 20 cm tall. It is best to transplant the seedlings in the evening or in humid weather. This prevents the roots from drying out. Moisten the soil a couple of hours before transplanting them. When removing the seedlings, keep a large clump of soil attached to the roots to prevent them from being damaged. Make the holes for the plants large enough so that the lowest leaves are at ground level. If possible, place mulch on the ground around the plant after transplanting. Mulch is composed of plant remains (e.g. rice-straw or sorghum-straw) which cover the soil to control weed growth and prevents erosion. Moisten each plant immediately after transplanting. But be careful not to wet the lowest leaves, as this can stimulate the growth of mould. The newly transplanted plants should be protected from heat during the first 5 days, e.g. by covering them with large leaves.

- The distance between rows is 0,75 – 0,9 m, between transplants 0,5 – 0,7 m.

6. **Watering:**
   - It is important to water the plants regularly, especially during flowering and fruit formation. It is especially important to water regularly (e.g. 3 times a week) on sandy soils. Under good circumstances once a week should be enough. It is better to give small amounts regularly than a lot of water at one time. To prevent diseases, it is advisable to keep the leaves dry by applying surface irrigation. To allow leaves and the top layer of soil to dry during the day, it is better to water in the morning. In this way mould growth can be controlled.
7. **Fertilization during cultivation:**
   - Apply N: 6 kg/jerib in stage of the first fruits development.
8. **Weed control:**
   - Good soil processing and a proper crop rotation system is one of the best prevention methods.
   - Weeding is done mechanically, before they produce seed by pulling them out by hand or by hoeing just under the surface of the soil. To avoid damaging the roots, do not weed by hoe too often or too deep. Weed growth can be suppressed or slowed down by covering the ground with mulch.
   - Use herbicides only in serious cases. Always follow label directions and never use them after the stage of fruit ripening!
9. **Pest control & disease control:**
   - Good crop rotation and adequate soil processing is the best prevention.
   - The crop should be regularly checked and the affected plants should be removed. In case of high need, use the proper chemicals but always follow the given instructions! Never use the chemicals before harvesting! The damaged, yellowed and affected plants have to be removed (dig up) and burned.
10. **Harvest**
    - 70 to 140 days after the crop has sprouted, a weekly round of the fields is needed to pick ripe fruit. Sweet pepper is usually picked early in the maturity stage, when it is still green. If (sweet) pepper is to be processed in industries, both red and green fruit can be picked. Hot cultivars are usually left to ripen completely (until the colour is red). Care should be taken when breaking the peppers from the plants, as the branches are often brittle. Hand clippers or pruners can be used to cut peppers from the plant to avoid excessive stem breakage. The number of peppers per plant varies with the variety. Bell pepper plants may produce 6 to 8 or more fruit per plant.
    - In general, peppers have short storage life of only one to two weeks.
    - Expected yield: 5 – 6 t/jerib, depends on the variety!

POST HARVEST STEPS:

- **Fresh pepper:** should be consumed or delivered to the market as soon as possible (preferably in 1 week from harvest). Cool, moist conditions (7 to 10 ˚C) and 85-90 % relative humidity are the ideal storage conditions for peppers.
- **Pepper processing – drying:** Sun drying need consecutive days for sun drying peppers, and preferably low humidity or at least a steady warm breeze. Use the simple drying sets to dry the pepper.
- **Pepper processing – freezing:** Cleaned, chopped pepper can be frozen and stored in plastic bags. The transportation to the market has to be done in freezing boxes, as the product can't be refrozen!

CABBAGE

LATIN: Brassica oleracea var. capitata (Brassicaceae)
DARI: Karam
PASHTO: Karam
ENGLISH: Cabbage

BEFORE WE START

Ecological requirements:

- Annual for vegetable production, biennial for seed production.
- Cabbage prefers moderate or cold climate, it is fairly resistant to frost and can survive in temperatures as low as - 3 ˚C without damage. It is not draught resistant.

Soil:

- Cabbage requires well-drained, moisture-retentive loamy soils well supplied with organic matter. Not acidic soil tolerant. Ideal soil pH ranges from 6.0 to 7.0;

Crop rotation:

- AFTER: Cultivate cabbage after potatoes, winter wheat, clover, beans, peas. NEVER after the Brasicaceae family!
- BEFORE: Never grow the Braxicaceae family after cabbage!

Seeds:

- Pre-cultivation in trench/greenhouse: 400 g/jerib, depth: max. 1 cm, 10 -15cm between rows, 2 cm between seeds followed by thinning out to 15 - 20 cm between plants. Final transplanting: to 50 – 70 cm between rows, 30 - 45cm between plants
- Direct seeding: about 50 g of seed/ jerib is required, 50 – 70 cm between rows, 20 cm between seeds, to be unified to 30 – 45 cm between plants.

Cultivation tools:

- Plough, fork, shovels, levelling device, disk harrow if available, string/rope for marking rows, knives

Fertilizers:

- **Before cultivation:** 8 – 12 t/jerib of compost or completely composted is the best option; In case of use of the artificial fertilizers, the actual soil composition has to be checked. Generally, NPK is used during the field preparation, 1 week before sowing / seeding - N: 24 - 32kg/ jerib, P_2O_5: 10 - 20 kg/jerib, K_2O: 36 – 40 kg/jerib.
- **During cultivation:** N: 16 – 18kg/jerib is side-dressed two to three weeks after transplanting and again three weeks later or applied once-off at about six weeks.
- !NOTE: Micronutrients needs: Calcium deficiencies may occur on acid soils, on soils with very high potassium or on very dry soils. Magnesium may also be deficient on acid soils, on very light soils or on soils that are very high in potassium. Molybdenum!

Watering:

- Cabbage should be irrigated immediately after sowing or transplanting. Thereafter, irrigation should be applied at intervals of 10 to 12 days in heavy soils or eight days in light soils and the schedule should be followed until the heads are fully developed and firm. Young plants should receive enough water for vegetative growth before forming heads. Excess moisture when the heads have formed may cause them to crack.

- **Pre-planting in trench/greenhouse:** YES
- **Cultivation in greenhouse:** YES

CULTIVATION CALENDAR:

	Activity	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Soil preparation and fertilization before sowing	■				■	■		■	■			
2	Sowing	■					■						
3	Control of germination	■					■						
4	Thinning	■	■				■	■					
5	Transplanting of seedlings		■					■					
6	Watering	■	■	■	■	■	■	■	■	■	■		
7	Fertilization and field processing during cultivation			■	■			■	■				
8	Weed control		■	■	■		■	■	■				
9	Pest control & disease control		■	■	■		■	■	■				
10	Harvest				■	■				■	■		

■ cold areas ■ warm areas ■ cold and warm areas

CULTIVATION STEP BY STEP:

1. **Soil preparation and fertilization before sowing:**
    - After pre-crop, before winter: Field is ploughed 1 - 2 times and compost/manure is incorporated 3 – 7 t/jerib.
    - 8 weeks before planting: Field is ploughed 1 -2 times to a fine tilth and compost/manure is incorporated at the time of field preparation at 5 t/jerib
    - Immediately before planting: Ground must be ploughed deeply, with a disk harrow or another suitable implement to a depth of 45 - 60 cm.
    - If using the artificial fertilizers, the actual soil composition has to be checked. Generally, NPK is used during the field preparation, 1 week before sowing/seeding - N: 24 - 32kg/ jerib, P_2O_5: 10 - 20 kg/jerib, K_2O: 36 – 40 kg/jerib.
2. **Sowing:**
    - Pre-cultivation in trench/greenhouse: 400 g/jerib, depth: max. 1 cm, 10 -15cm space between rows and 2 cm between seeds followed by thinning out to 15 - 20 cm between plants.
    - The seedlings will be ready for transplanting 3–6 weeks after sowing
    - Direct seeding: about 50 g of seed/ jerib is required, 50 – 70 cm space between rows, 20 cm between seeds, to be unified to 30 – 45 cm between plants
3. **Control of germination:**
    - 8 – 10 days after sowing
4. **Thinning:**
    - In trench/greenhouse cultivation: thinning out to 15 - 20 cm between plants in 2 weeks.
    - In direct sowing: to 30 – 45 cm between plants.
5. **Transplanting of seedlings:**
    - After 3 – 6 weeks after sowing and only well-hardened, young, stocky plants should be used in 50 – 70 cm between rows, 30 - 45cm between plants.
    - Transplanting is done on moist soil. The soil around the roots should be firmed and irrigated as soon as possible after the seedlings are set.
6. **Watering:**
    - Cabbage should be irrigated immediately after sowing or transplanting. Thereafter, irrigation should be applied at intervals of 10 to 12 days in heavy soils or eight days in light soils and the schedule should be followed until the heads are fully developed and firm. Young plants should receive enough water for vegetative growth before forming heads. Excess moisture when the heads have formed may cause them to crack.
7. **Fertilization and field processing during cultivation:**
    - Use N: 16 – 18kg/jerib in side-dressed two to three weeks after transplanting and again three weeks later or applied once-off at about six weeks
    - Earthing up is to be carried out one month after transplanting. Very shallow hoeing is helpful in removing weeds without causing injury to the roots.
8. **Weed control:**
    - Good soil processing and a proper crop rotation system is one of the best prevention methods.
    - Weeding is done mechanically, before they produce seed, by pulling them out by hand or by hoeing just under the surface of the soil. To avoid damaging the roots, do not weed by hoe too often or too deep. The first cultivation should be done two to three weeks after transplanting.
    - Use Chemicals/Herbicides only in extreme cases. Always follow label directions and never use them after the stage of fruit ripening!

9. Pest control & disease control:

- Good crop rotation and adequate soil processing is the best prevention. The crop should be checked regularly and the affected plants should be removed.
- In serious cases, use the proper chemicals but always follow the given instructions! Never use the chemicals before harvesting! The damaged, yellowed and affected plants have to be removed (dig up) and burned.

10. Harvest

- Cabbage heads should be harvested when they attain full size. They burst or loosen after that. A fully developed head has a lighter shade of green. Crops for pickling should be harvested when the cover leaves curl back and the white leaves beneath are exposed. The crop for the fresh market is harvested by hand, with a knife or sickle.
- Cabbage for storage and/or processing is harvested at once manually or mechanically. The heads should be cut off in such a way that a few of the large, open wrapper leaves are left for protection around the heads. Harvesting should be such that bruising of the heads is avoided as this makes them unattractive. Most of the stem should be left on the head if the crop is to be stored.
- Harvested produce should always be removed from direct sunlight and transported to the packing shed as soon as possible. When there is a delay of more than an hour or two between harvest and packing, a water drench or spray arrangement can help prevent dehydration and overheating.
- Date: In cold areas from end of June till July 10. In warm areas from the end of November till December.
- Expected yield: 3,5 – 5 t/ jerib.

POST HARVEST STEPS:

- The whole plant can be consumed cooked or raw as a salad.
- **Storage:** Cabbage should be handled carefully from field to storage and only solid heads with no yellowing, decay or mechanical injuries should be stored. Mature and disease-free crop should not have been exposed to prolonged frost or cold.
- The optimum storage temperature for cabbage is 0 ˚C and relative humidity of 90 % to 95 %. Further trimming may be necessary, mainly to remove the discolored butt upon removal from storage.
- **Transport:** Don't overload trucks. The produce should be covered with a sheet to prevent frosting or desiccation, but on warmer days, when sweating and heating might occur, the sheet should be left off.
- **Pickling:** Cabbage can also be pickled by a process of lacto-fermentation. Put the shred cabbage in a basin with salt between layers, ending with a layer of salt, leave for 24 hours, wash thoroughly in cold water and drain well, pack into clean, sterilized jars and pour in cold, spiced vinegar. Cover the jars and label with contents and date. The product is ready after 1 week. If you keep it longer than 10–12 weeks it will lose its crispness.

CAULIFLOWER

LATIN: Brassicaceae oliraceae.var.botrytis (Brassicaceae)
DARI: Gulpi
PASHTO: Gulpi
ENGLISH: Cauliflower

BEFORE WE START

Ecological requirements:

- Cauliflower needs a moderate, cold climate. It is not tolerant to freezing and/or high temperatures.

Soil:

- Soil should be well drained and fertile with good moisture retaining capacity and a high organic matter content
- Optimum pH is 6.5–7.5

Crop rotation:

- AFTER (Cauliflower is sowed after): potatoes, clover, beans and peas. NEVER after the Brasicaceae family!

Seeds:

- Cauliflower can be planted by pre-cultivation in trench/greenhouse, direct-seeding or transplanting of seedlings.
- **Pre-cultivation in trench/greenhouse:** 400 g/jerib; depth: max. 1 cm; 10-15cm between rows, 2 cm between seeds followed by thinning out to 15-20 cm between plants
- **Final transplanting:** 30 – 60 cm between rows, 40 – 50 cm between plants.
- **Direct seeding:** 80 g/jerib of seeds are required; 60 cm between rows, 20 cm between seeds to be unified to 40 – 50cm between plants.

Cultivation tools:

- Plough, fork, shovels, disk harrow if available, levelling device, string/rope for marking rows, knives

Fertilizers:

- **Before cultivation:** 5– 10 t/jerib of compost or completely composted manure is the best option. In case of the use of artificial fertilizers, the actual soil composition has to be checked. Generally, NPK is used during the field preparation, 1 week before sowing/seeding with following composition - N: 15 kg/ jerib, P_2O_5: 10 - 20 kg/jerib, K_2O: 36 – 40 kg/jerib
- **During cultivation:** Apply N: 10 kg/jerib two to three weeks after transplanting and then again three weeks later or applied once-off at about six weeks.

NOTE: Micronutrients needs Molybdenum!

Watering:

- Cauliflower should be sowed or transplanted to the wet soil. Thereafter, irrigation should be applied at intervals of 10 to 12 days in heavy soil or 8 days in light soil. The schedule should be followed until the heads are fully developed and firm. Young plants should receive enough water for vegetative growth before forming heads. Excess moisture after the heads have formed may cause them to crack.

- **Pre-planting in trench/greenhouse:** YES
- **Cultivation in trench/greenhouse:** YES. Not appropriate in summer as the plastic has to be removed!

CULTIVATION CALENDAR:

- **cold areas:** sowing in March, transplantation of seedlings in April – May; harvest in September 20 – October 20
- **warm areas**: sowing in July, transplantation of seedlings in August; harvest in December

	Activity	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Soil preparation and fertilization before seeding	cold			warm	warm			cold	cold			
2	Sowing	cold				warm							
3	Control of germination	cold				warm							
4	Thinning		cold				warm						
5	Transplanting of seedlings		cold	cold			warm						
6	Watering		cold	cold	cold	cold	cold/warm	cold/warm	cold/warm	cold/warm	warm	warm	
7	Fertilization and field processing during cultivation			cold	cold	cold	cold/warm	cold/warm	cold/warm	cold/warm	warm		
8	Weed control			cold	cold	cold	cold/warm	cold/warm	cold/warm	cold/warm	warm		
9	Pest control & disease control		cold	cold	cold	cold	cold/warm	cold/warm	cold/warm	cold/warm	warm	warm	
10	Harvest							cold	cold			warm	

cold areas warm areas cold and warm areas

CULTIVATION STEP BY STEP:

1. **Fertilizer before cultivation:**
   - After pre-crop, before winter: field is ploughed 1 - 2 times and compost/manure is incorporated 0 -5 t/jerib.
   - 8 weeks before planting: field is ploughed 1 -2 times to a fine tilth and compost/manure is incorporated at the time of field preparation at 5 t/jerib.
   - Immediately before planting, ground must be ploughed deeply, with a disk harrow or other suitable implement to a depth of 45 - 60 cm.
   - In case of use of the artificial fertilizers, the actual soil composition has to be checked. Generally, NPK is used during the field preparation, 1 week before sowing/seeding - N: 15 kg/ jerib, P_2O_5: 10 - 20 kg/ jerib, K_2O: 36 – 40 kg/jerib.
2. **Sowing:**
   - Pre-cultivation in trench/greenhouse: 400 g/jerib, depth: max. 1 cm, 10 -15cm space between rows, 2 cm between seeds. The seedlings will be ready for transplanting in 3–6 weeks after sowing (10 cm transplants)
   - Direct seeding: about 80 g/jerib of seeds are required, 60 cm between rows, 20 cm between seed.
3. **Control of germination:**
   - 8 – 10 days after sowing
4. **Thinning:**
   - In trench/greenhouse cultivation: Thinning out to 15 - 20 cm between plants in 2 weeks
   - In direct sowing: Thinning to 40 – 50cm between plants.
5. **Transplanting of seedlings:**
   - 3 – 6 weeks after sowing, transplant the 10 cm transplants and only well-hardened, young, stocky plants in 50 – 70 cm between rows, 30 - 45cm between plants. Transplanting is done on moist soil. The soil around the roots should be firmed and irrigated as soon as possible after the seedlings rare set.
6. **Watering:**
   - Cauliflower should be irrigated immediately after sowing or transplanting. Thereafter, irrigation should be applied at intervals of 10 to 12 days in heavy soil or 8 days in light soil and the schedule should be followed until the heads are fully developed and firm. Young plants should receive enough water for vegetative growth before forming heads. Excess moisture when the heads have formed may cause them to crack.
7. **Fertilization and field processing during cultivation:**
   - 10 kg/jerib of N is side-dressed two to three weeks after transplanting and again three weeks later or applied once-off at about six weeks.
   - Earthing up one month after transplanting. Very shallow hoeing is helpful to remove weeds without causing injury to the roots.
8. **Weed control:**
   - Good soil processing and a proper crop rotation system is one of the best prevention methods. Weed mechanically before the plants produce seed. Recommended weeding is by pulling them out by hand or by hoeing just under the surface of the soil. To avoid damaging the roots, do not weed by hoe too often or too deep. The first cultivation should be done two to three weeks after transplanting.
   - Herbicides can be used just in extreme cases. Always follow label directions and never use them after the stage of fruit ripening!

9. Pest control & disease control:

- Good crop rotation and adequate soil processing is the best prevention. Check the crop regularly and remove the affected plants.
- In case of high need, use the proper chemicals but always follow the given instructions!!!! Never use the chemicals before harvesting!
- The damaged, yellowed and affected plants have to be removed (dig up) and burned.

10. Harvest:

- Harvest the cauliflower when curds remain compact and smooth, attain proper size and retain original colour. The crop for the fresh market is harvested by hand with a knife or sickle.
- Date: In cold areas from September 20 to October 20, in warm areas in December.
- Expected yield: 2 – 3 t/ jerib.

POST HARVEST STEPS:

- Storing cauliflower in proper conditions (i.e. temperature 0 ˚C and relative humidity of 90 % to 95 %) is not recommended for more than 3 weeks. Slightly immature and compact curds keep better than more mature ones.
- Cauliflower is primarily marketed with closely trimmed leaves.
- Transport to the market: no overloaded trucks. The produce should be covered with a sheet to prevent frosting or desiccation, but on warmer days, when sweating and heating might occur, the sheet should be left off.
- The whole plant can be consumed cooked, fried or raw as a salad.

CARROT

LATIN: Daucus carota (Doucaceae)
DARI: Zardak
PASHTO: Gazeri
ENGLISH: Carrot

BEFORE WE START

Ecological requirements:

- Annual for vegetable production, biennial for seed production.
- Carrot prefers a moderate, cold climate, but does well in warm climates. Optimum temperature for growth is between 15 to 20 ˚C. Fairly resistant to cold temperatures, but not to high temperatures and it is draught resistant.

Soil:

- Carrot requires deep, loose, well-drained sandy to loamy soils
- Optimum pH is 6.0 to 6.5
- Crop produced in humus rich soils tends to increase in foliage excessively and forms forked and hairy carrots. The roots also tend to be more rough and coarse on the outside. Very sensitive to saline soils.

Crop rotation:

- AFTER: Carrot is cultivated after legumes and after organically fertilized crops.
- BEFORE: Carrot is cultivated before brasicaceae.

Seeds:

- Direct sowing: 0.5 – 1kg/jerid and 0.2 – 0.6 kg/jerib for late cultivation

Cultivation tools:

- Plough, harrows, forks, shovels, levelling device, hoes, string/rope for marking rows;

Fertilizers:

- **Before cultivation:** Do not use the organic fertilizers before sowing. It's better to cultivate the carrot after the organically fertilized pre-crop! Artificial fertilizers: N:16 kg/jerib, P_2O_5: 30 kg/jerib, K_2O: 40 kg/jerib.
- **During cultivation:** If the whole dose of nitrogen is not applied before sowing, the remainder should be applied at 4 to 8 weeks. Similarly for K_2O - half application before sowing and half at 4 – 8 weeks.

Watering:

- Soil should never be allowed to dry out. Too much moisture causes short carrots with light colour and a larger diameter
- The field should be lightly irrigated immediately after sowing. Irrigation water should be applied once or twice a day using a solid-set sprinkler system. Watering should gradually be reduced to prevent longitudinal splitting of the roots when the crop approaches maturity.

- **Pre-planting in trench/greenhouse:** NO
- **Cultivation in trench/greenhouse:** YES

CULTIVATION CALENDAR:

- **cold areas:** ***1c*** = sowing March 1 – 20, harvest in June; ***2c*** = winter varieties: sowing in November; harvest in June (trench/greenhouse cultivation)
- **warm areas**: ***1w*** = sowing in mid-August; harvest from mid of November; ***2w*** = sowing in December; harvest in the end of May

	Activity	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Soil preparation and fertilization before sowing	1c				1w	1w		2c	1c, 2w	2w		
2	Sowing	1c					1w			2c	2w		
3	Control of germination	1c	1c					1w		2c	2w		
4	Thinning		1c					1w			2c	2w	
5	Watering	1c, 2c, 2w	1c, 2c, 2w	1c, 2c, 2w	1c, 2c		1w	1w	1w	2c, 1w	2c, 2w	2c, 2w	2c, 2w
6	Fertilization and field processing during cultivation			1c					1w			2c	2w
7	Weed control	1c, 2c, 2w	1c, 2c, 2w	1c, 2c, 2w	1c, 2c		1w	1w	1w	2c, 1w	2c, 2w	2c, 2w	2c, 2w
8	Pest control & disease control	1c, 2c, 2w	1c, 2c, 2w	1c, 2c, 2w	1c, 2c		1w	1w	1w	2c, 1w	2c, 2w	2c, 2w	2c, 2w
9	Harvest			2w	1c, 2c					1w			

■ cold areas ■ warm areas ■ cold and warm areas

CULTIVATION STEP BY STEP:

1. Soil preparation and Fertilization before sowing:

- After the pre-crop: 3 weeks before cultivation soil must be deep ploughed to loosen the soil to a depth of at least 30 cm, it must have a good crumbly structure (use harrowing) and be as levelled as possible. Do not use the fresh manure or compost before the cultivation, it's better to cultivate the carrot after the organically fertilized pre-crop!
- If needed, use the artificial fertilizers directly before sowing - N:16 kg/jerib, P_2O_5: 30 kg/jerib, K_2O: 40 kg/jerib

2. **Sowing:**
    - Sow manually in rows or with use of the manual/mechanical sowing machines
    - Rows (2 – 3) can be gathered in ridges or raised beds, keep 20 – 40 cm between single rows, 40 – 60 cm between sets of double/triple rows and 3 – 6 cm between seeds.
    - Required depth is 1 – 2,5 cm. Planting depth should be shallow on heavier soils and in colder months. Slightly deeper planting is recommended in summer when the soil dries out quickly.
    - Always sow in moist soil!
3. **Control of germination:**
    - 14 – 40 days after sowing
4. **Thinning:**
    - 2 weeks after germination to 6 – 8 cm between plants. Thinning should be carried out when the ground is moist, preferably late in the afternoon
5. **Watering:**
    - Soil should never be allowed to dry out, but too much moisture causes short carrots with light colour and a larger diameter.
    - The field should be lightly irrigated immediately after sowing. Irrigation water should be applied once or twice a day using a solid-set sprinkler system. Watering should gradually be reduced to prevent longitudinal splitting of the roots when the crop approaches maturity.
6. **Fertilization and field processing during cultivation:**
    - Soil cultivation between the rows is carried out by hoeing especially at an early stage to merely control weeds. If the whole dose of nitrogen fertilizer wasn't applied before sowing, the remainder should be applied at 4 to 8 weeks. Similarly for K_2O, use half application before sowing, half at 4 – 8 weeks.
7. **Weed control:**
    - Good soil processing and a proper crop rotation system is one of the best prevention methods. Weeds should not at any time be allowed to compete with crop.
    - Weeding is done mechanically, especially by hoeing. Herbicides can be used just in extreme cases. Always follow label directions!
8. **Pest control & Disease control:**
    - Good crop rotation and adequate soil processing is the best prevention. The crop should be regularly checked and the affected plants should be removed. In case of high need, use the proper chemicals but always follow the given instructions!
    - Never use the chemicals 1 month or later before harvesting! The damaged, yellowed and affected plants have to be removed (dig up) and burned.
9. **Harvest:**
    - Carrots are harvested when they have reached a diameter of 2 – 2.5 cm and more, still young and tender. Usually when the carrots have reached the mature stage, their base tips appear on the soil surface.
    - Harvest is done manually by careful lifting of the roots with fork. Mechanization (harvesting machines) can be used if available.
    - Lifted carrot should not be left on the ground surface for too long as they will attract the attention of carrot fly. Cutting the leaves is not necessary! There is no need to harvest all at the same time.
    - Expected yield: 10-15 t/jerib

POST HARVEST STEPS:

- Carrots are consumed fresh as a salad crop or cooked. They are also processed either alone or mixed with other vegetables. The juice is extracted and used as a drink. Tender roots are pickled or made into jams and sweetmeats.
- After harvesting, the carrots are placed in a shade at the field in crates before washing. It should be washed carefully to cause as little damage as possible to the root surface. The carrots should be sorted by hand to remove broken or split roots and packed in cartons or other packaging materials !NOTE: Uniformity of root size is very important when packing carrots because it enhances the presentation during marketing
- **Storage:** If necessary, carrots can be put in cold storage (0˚C and above 90% humidity) for 6 months with good results.
- **Marketing:** Carrots together with their leaves are still mostly sold in bunches of 5 – 10 pieces. !NOTE: when sent to distant markets, carrots are sold without their leaves!
- **Carrots for processing:** The leaves are cut off in the field and the carrots are placed in bags or plastic containers and sent unwashed to the processing place/factory.
- Defected roots and the leftovers (as leaves) are used as fodder for animals (cattle, horses etc.). Leaves can be used as a green fertilizer too.

RADISH

LATIN: Raphanus sativus (Brassicaceae)
DARI: Moli sorkhak
PASHTO: Sra moli
ENGLISH: Radish

BEFORE WE START

Ecological requirements:

- Radish requires a moderate, cold climate. It is fairly resistant to cold temperatures (resistant to -3˚C; germinates at 7˚Csoil temperature). It is not resistant to high temperatures and draught.

Soil:

- Radish needs sandy loam soils with high organic matter content.
- Optimum pH of 5.5 to 6.8.

Crop rotation:

- AFTER: Radish is cultivated after legumes, carrots, onions, tomatoes.
- BEFORE: Radish is cultivated before cereals.

Seeds:

- Cultivation in trench/greenhouse: 4 – 6 kg/jerib
- Direct field sowing: 3 – 4 kg/jerib

Cultivation tools:

- Plough, fork, shovels, harrows, leveling device, hoes, string/rope for marking rows

Fertilizers:

- **Before cultivation:** Don't use the organic fertilizers before sowing. It's better to cultivate the radish after the organically fertilized precrop!. Chemical fertilizers can be used as follows - N:8 kg/jerib, P_2O_5: 9 kg/jerib, K_2O: 19 kg/jerib.
- **During cultivation:** Fertilization is not recommended during cultivation.

Watering:

- The field should be irrigated lightly immediately after sowing. Watering should gradually be reduced to prevent the roots defects, when the crop approaches maturity.

- **Pre-planting in trench/greenhouse:** NO
- **Cultivation in trench/greenhouse:** YES

CULTIVATION CALENDAR:

- Very short cultivation period: only 30 – 40 days. Possible to cultivate several times during a year but not during hot weather and not at the same place!

	Activity	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Soil preparation and fertilization before sowing												
2	Sowing												
3	Control of germination												
4	Thinning												
5	Watering												
6	Weed control												
7	Pest control & disease control												
8	Harvest												

■ cold areas ■ warm areas ■ cold and warm areas

CULTIVATION STEP BY STEP:

1. **Soil preparation and fertilization before sowing:**
   - After the pre-crop: 3 weeks before the cultivation, soil should be tillaged to loosen the soil to a depth of at least 15 cm. It must have a good crumbly structure (use harrowing) and be as levelled as possible. Do not use the fresh manure or compost before the cultivation, it's better to cultivate the radish after the organically fertilized pre-crop!
   - If needed, use the artificial fertilizers directly before sowing - N: 8 kg/jerib, P_2O_5: 9 kg/jerib, K_2O: 19 kg/jerib
2. **Sowing:**
   - Sow manually in rows or with use of the manual/mechanical sowing machines: 15 – 20cm between single rows, 3 – 6cm between seeds, depth 1 – 2.5cm. Planting depth should be shallow on heavier soils and in colder months, slightly deeper planting is recommended in summer when the soil dries out quickly. Always sow in moist soil!
3. **Control of germination:**
   - 3 – 6 days after sowing
4. **Thinning:**
   - 1 week after germination to 5 – 6 cm

5. **Watering:**
    - Irrigate the field lightly, immediately after sowing. Reduce watering gradually to prevent the roots defects, when the crop approaches maturity. When the soil is not moist, watering once per week should be sufficient.
6. **Weed control:**
    - Good soil processing and a proper crop rotation system is the best prevention method. If necessary, weeding is done mechanically by hand during the thinning out. Radish has very short vegetation period, so it's not recommended to make extra weeding
    - DO NOT USE ANY HERBICIDES or other chemicals!!!
7. **Pest control & Disease control:**
    - Good crop rotation and adequate soil processing is the best prevention. Regularly check the crop and remove the affected plants.
    - The damaged, yellowed and affected plants have to be removed (dig up) and burned.
    - DO NOT USE ANY PESTICIDES, FUNGICIDES or other chemicals!!!
8. **Harvest:**
    - Harvest after 30 – 40 days from sowing, still young and tender crops. When the radish has reached the mature stage, their base tips appear on the soil surface.
    - Harvest manually, by hand or by careful lifting of the roots with fork;
    - Mechanization (harvesting machines) can be used if available, but the risk of damaging is high.
    - Cutting the leaves is not necessary! There is no need to harvest all at the same time.
    - Expected yield: 2 - 3 t/jerib

POST HARVEST STEPS:

- After harvesting, place the radish in a shade at the field in crates. Then wash them carefully to cause as little damage as possible to the root surface.
- **Storage:** radish should be consumed directly after harvesting and is not suitable for storing. If needed, radish can be put in cold storage (0 ˚C) for 1 week.
- **Marketing:** Radish together with their leaves is directly sold in local markets. Radish is consumed fresh as a salad crop.

CUCUMBER

LATIN: Cucumis sativus (Cucurbitaceae)
DARI: Badrang
PASHTO: Badrang
ENGLISH: Cucumber

BEFORE WE START

Ecological requirements:

- Cucumber requires a warm climate (18 – 30˚C), it is not cold temperatures resistant.

Soil:

- Well-drained, neutral or slightly alkaline soil with a pH of 7.0
- Heavier soil types that contain clay should be improved by adding organic matter. Light, sandy soils are preferred for northern fields and gardens.

Crop rotation:

- AFTER: Cucumber is cultivated after peas, beans or vegetable. Not after the cucurbitaceae family!
- BEFORE: Cucumber is cultivated before tomatoes or other vegetable. Not before the cucurbitaceae family!

Seeds:

- Direct field sowing: 0,3 – 0,4 kg/jerib
- Sowing for transplants: 0,2 kg/jerib

Cultivation tools:

- Plough, fork, shovels, levelling device, string/rope for marking rows, hoes

Fertilizers:

- **Before cultivation:** Use compost or well composted manure 4,5 – 9 t/jerib during the field preparation. Cucumbers do well after a sod of perennial forage crop since soil structure is usually at its best. In case of use of the artificial fertilizers, the actual soil composition has to be checked. N: 8 kg/jerib (Ammonium sulphate form), P_2O_5: 32 kg/jerib (Single Superphosphate form), K_2O: 60 kg/jerib (Potassium sulphate form). If these forms are not available, other sources can be used to get the proper level of fertilizers.
- **During cultivation:** N: 8 kg/jerib – 1/2 one week after blossoming begins, second application 3 weeks later.

Watering:

- Water slowly with 2,5 cm of water per week, allow it to completely soak the soil 15 – 20 cm deep. Decrease watering later in the season to encourage fruit to mature. Furrow irrigation is the best technique.
- Water in the morning or early afternoon so the foliage dries by evening. This helps prevent the spread of leaf diseases.

- **Pre-planting in trench/greenhouse:** YES
- **Cultivation in trench/greenhouse:** YES

CULTIVATION CALENDAR:

- **cold areas:** Sowing in April 10, transplantation of seedlings from the end of April, harvest from June 10.
- **warm areas**: Sowing in March 10, transplantation of seedlings in March 30, harvest from May 10.

	Activity	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Soil preparation and fertilization before sowing												
2	Sowing												
3	Control of germination												
4	Thinning												
5	Transplanting of seedlings												
6	Watering												
7	Fertilization and field processing during cultivation												
8	Weed control												
9	Pest control & disease control												
10	Harvest												

■ cold areas ■ warm areas ■ cold and warm areas

CULTIVATION STEP BY STEP:

1. Soil preparation and fertilization before sowing:

- After the pre-crop or 3 weeks before, cultivation soil must be deep ploughed at least 30 cm, it must have a good crumbly structure (use harrowing) and be as levelled as possible. Incorporate compost or well composted manure 4,5 – 9 t/jerib during the soil preparation (applies for trench and greenhouses too).
- Be careful with the use of the artificial fertilizers. If needed, use N: 8 kg/jerib (Ammonium sulphate form), P_2O_5: 32 kg/jerib (Single Superphosphate form), K_2O: 60 kg/jerib (Potassium sulphate form). If these forms are not available, other sources can be used to get the proper level of fertilizers, but be careful with N use!
- Prepare the soil for sowing/seeding - see below

2. **Sowing:**
    - ***Direct sowing:*** Form a hill, mound soil to make a low, broad hill about 20 -25 cm high. Plant 4-6 seeds in a circle in 12 cm intervals for each hill. Each hill should be 120 – 180 cm apart, depending on the variety you select. OR: 120 to 180 cm between rows, 20 to 30 cm between seeds (2 – 3 seeds are sown together). Seed the cucumber seeds in 2,5 cm depth.
    - ***Sowing for transplants:*** Plant 2 seeds per peat pot, peat pellet or individualized pot.
    - ***Transplanting of seedlings:*** 120 – 180 cm between rows, 25 – 35 cm between plants.
3. **Control of germination:**
    - 3 – 6 days after sowing
4. **Thinning:**
    - When seedlings have 2 or 3 leaves (5 cm plant). Leave just 2-3 large, healthy, well-spaced plants per hill (more than 3 plants per hill will lead to crowding, greater chance of disease, and lower yields) OR leave just healthy plants in rows, 25 – 35 cm between plants.
    - Don't forget to thin out the transplants in pots too!
5. **Transplanting seedling**
    - 15 – 21 days after germination in pots in greenhouse/trench. Keep 120 – 180 cm between rows, 25 – 35 cm between plants.
    - Set plants out during the late afternoon or early evening, when the wind has died down, to avoid stress from the hot summer sun.
    - First, make the rows or prepared hills, then dig a hole for each plant roughly twice as wide and twice as deep as the soil ball. Next, set each plant slightly deeper than it grew before. Place soil around the roots and finish by filling the hole with soil, leaving a small basin around each plant.
6. **Watering (during vegetation):**
    - Water slowly with 2,5 cm of water per week. Allow it to completely soak the soil 15 – 20 cm deep. Water in the morning or early afternoon so the foliage dries by evening. It helps prevent the spread of leaf diseases. Decrease watering later in the season to encourage fruit to mature.
    - Furrow irrigation is the best technique.
7. **Fertilization and field processing during cultivation:**
    - Use Nitrogen fertilization: N = 8 kg/jerib – 1/2 one week after blossoming begins, second application 3 weeks later.
    - Start with hand-weeding or hoeing 3- 5 days after thinning out or transplanting the plants and continue to remove weeds until the crop cover the ground.
8. **Weed control:**
    - Soil processing and a proper crop rotation system is one of the best prevention methods. Weeding is done mechanically – especially by hand during the thinning out process. Continue to remove weeds until the crop covers the ground.
    - DO NOT USE ANY HERBICIDES or chemicals as those registered for use on cucumbers do not provide total, season long control. Avoid fields where residual herbicides from previous years persist in the soil as crop injury may occur!
9. **Pest control & Disease control:**
    - Good crop rotation, adequate soil processing and use of quality seeds is a good prevention. The crop should be checked regularly and the affected plants should be removed.
    - In case of high need, use the proper chemicals but always follow the given instructions! Never use the chemicals before harvesting!
    - The damaged, yellowed and affected plants and fruit have to be removed (dig up) and burned.

10. Harvest:

- Harvest before the seeds become too well developed, usually while the fruits are still a little rough. Do not allow any fruits to remain and form seed on the vines, because production of new fruit will be reduced.
- Cucumbers should be harvested regularly, to market or processor size requirements. Impacts and pressure during handling can cause serious internal damages to cucumbers. Minimize or eliminate the dropping of cucumbers whenever possible.
- Expected yield: 3 – 4 t/jerib (7 t/ jerib or more can be reached with improved varieties).

POST HARVEST STEPS:

- Cucumbers are consumed fresh as a salad crop or pickled.
- **Transport:** Bruising and breakage of cucumbers is influenced by the height of discharge above the collection source (e.g. basket, bin or truck). Use foam rubber (8 cm minimum) on the floor of transport vehicles that drastically reduces the otherwise severe damage to the first few layers of fruit. If cucumbers are piled deep in transport vehicles, the likelihood of damage increases.
- **Storage:** Immediately after harvest, keep them in ideal conditions (10 - 13˚C, relative humidity of 95%). Cucumbers can be stored for 2 to 3 weeks.
- !NOTE: Chilling injury develops rapidly at temperatures below 10˚C. Ripening and yellowing occurs at temperatures above 13˚C. Loss of colour will also occur more rapidly if held in the same room with apples, tomatoes or other ethylene producing crops.
- **Pickling:** Some cucumbers could be pickled in brine solution and be stored for long periods of time after such processing.

SPECIFIC CHAPTERS

FRUITS

WATERMELON

LATIN: Citrulus vulgaris (Cucurbitaceae)
DARI: Tarbuz
PASHTO: Hindwana
ENGLISH: Watermelon

BEFORE WE START

Ecological requirements:

- Watermelon requires a warm climate, 20 – 30˚C. It is not cold temperature resistant.

Soil:

- Well-drained, neutral or slightly alkaline soil with a pH of 7.0.
- Heavier soil types that contain clay should be improved by adding organic matter. Light, sandy soils are preferred for northern fields and gardens.

Crop rotation:

- AFTER: Melon is cultivated after beans, winter cereals or vegetable. Not after the cucurbitaceae family!
- BEFORE: Melon is cultivated before tomatoes or other vegetable. Not before the cucurbitaceae family!

Seeds:

- Direct field sowing: 0.3 – 0.4 kg/jerib

Cultivation tools:

- Plough, fork, shovels, levelling device, hoes, string/rope for marking rows

Fertilizers:

- **Before cultivation:** Use compost or well composted manure 4.5 – 9 t/jerib during the field preparation. Watermelons do well after a sod of perennial forage crop since soil structure is usually at its best.

  In case of use of the artificial fertilizers, the actual soil composition has to be checked. N: 8 kg/jerib (Ammonium sulphate form), P_2O_5: 12 - 16 kg/jerib (Single Superphosphate form), K_2O: 15 - 20 kg/jerib (Potassium sulphate form). If these forms are not available, other sources can be used to get the proper level of fertilizers (NPK 10:26:26 – 70kg/jerib).
- **During cultivation:** N: 8 kg/jerib – 1/2 one week after blossoming begins, second application 3 weeks later (urea form can be used). K_2O: 15- 20 kg/jerib (in potash form), before blossoming
- !NOTE: Melons are particularly sensitive molybdenum deficiency.

Watering:

- Water slowly with 2,5 cm of water per week. Allow it to completely soak the soil 15 – 20 cm deep. Water in the morning or early afternoon so the foliage dries by evening. It helps prevent the spread of leaf diseases. Decrease watering later in the season to encourage fruit to mature.
- Furrow irrigation is the best technique.

- **Pre-planting in trench/greenhouse:** NO
- **Cultivation in trench/greenhouse:** YES

CULTIVATION CALENDAR:

- **cold areas:** sowing in April 20; harvest since August 20
- **warm areas**: sowing in March 20; harvest since July

	Activity	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Soil preparation and fertilization before sowing												
2	Sowing												
3	Control of germination												
4	Thinning												
5	Watering												
6	Fertilization and field processing during cultivation												
7	Weed control												
8	Pest control & disease control												
9	Harvest												

■ cold areas ■ warm areas ■ cold and warm areas

CULTIVATION STEP BY STEP:

1. Soil preparation and fertilization before sowing:

- After the pre-crop or 3 weeks before the cultivation, soil must be deep ploughed at least 30 cm, must have a good crumbly structure (use harrowing) and as levelled as possible.
- Incorporate compost or well composted manure 4,5 – 9 t/jerib during the soil preparation (applies for trench and greenhouses too). Be careful with use of the artificial fertilizers. If needed, use N: 8 kg/jerib (Ammonium sulphate form), P_2O_5: 12 - 16 kg/jerib (Single Superphosphate form), K_2O: 15 - 20 kg/jerib (Potassium sulphate form). If these forms are not available, other sources can be used to get the proper level of fertilizers (NPK 10:26:26 70 kg/jerib), but be careful with N use!
- Prepare the soil for direct sowing: Form a hill, mound soil to make a low, broad hill about 20 -25 cm high.

2. **Sowing:**
    - Direct sowing: Plant 4-6 seeds in a circle in 12 cm intervals for each hill. Each hill should be 120 – 180 cm apart, depending on the variety you select OR 120 to 180 cm between rows, 30 to 50 cm between seeds (2 – 3 seeds are sown together). Seed the melon seeds in 2,5 cm depth.
    - Pre-germination of seeds by warm water is possible 1 day before sowing.
3. **Control of germination:**
    - 7 – 10 days after sowing
4. **Thinning:**
    - When seedlings have 3 or 4 leaves, leave just 2-3 large, healthy, well-spaced plants per hill. More than 3 plants per hill will lead to crowding, greater chance of disease, and lower yields.
    - OR leave just healthy plants in rows, 25 – 35 cm between plants
5. **Watering:**
    - Water slowly with 2,5 cm of water per week. Allow it to completely soak the soil 15 – 20 cm deep. Decrease watering later in the season to encourage fruit to mature.
    - Water in the morning or early afternoon so the foliage dries by evening. This helps to prevent the spread of leaf diseases.
    - Furrow irrigation is the best technique.
6. **Fertilization and field processing during cultivation:**
    - Nitrogen fertilization: N = 8 kg/jerib 1/2 one week after blossoming begins, second application 3 weeks later (urea form can be used). K_2O: 15- 20 kg/jerib (in potash form) before blossoming (or NPK 17:17:17 70 kg/jerib).
    - Start with hand-weeding or hoeing 3- 5 days after thinning out the plants and continue to remove weeds until the crop cover the ground.
7. **Weed control:**
    - Good soil processing and a proper crop rotation system is one of the best prevention methods. Weeding is done mechanically – especially by hand during the thinning out process. Continue to remove weeds until the crop covers the ground.
    - DO NOT USE ANY HERBICIDES or chemicals as those registered for use on melon do not provide total, season long control. Avoid fields where residual herbicides from previous years persist in the soil as crop injury may occur!
8. **Pest control & Disease control:**
    - Good crop rotation, adequate soil processing, and use of quality seeds are the nest prevention. The crop should be checked regularly and the affected plants should be removed.
    - In case of high need, use the proper chemicals but always follow the given instructions!!!! Never use the chemicals before harvesting!
    - The damaged, yellowed and affected plants and fruit have to be removed (dig up) and burned.
9. **Harvest:**
    - Before the seeds become too well developed, usually while the fruits are still a little rough. Do not allow any fruits to remain and form seed on the fruit, because production of new fruit will be reduced.
    - Harvest watermelon early in the day, after the plants are dry. Be careful not to damage the vines, pick melons every other day at the start of the season and every day at peak season. At maturity, the stem appears cracked at the point of attachment to the fruit. Check for maturity by gently lifting the melon. If it is ripe it should easily separate from the vine. When ripe, the watermelon rind changes from green to tan or yellow between the netting.

- Maturity check: 1) The light green, curly tendrils on the stem near the point of attachment turn brown and dry. Some varieties may do these 5-10 days before the fruit is fully ripe. 2) Surface colour of the fruit loses its slick appearance and turns dull. 3) Skin becomes rough and you can penetrate it with your thumbnail. 4) Predominantly dark green cultivars will turn a buttery yellow on the ground side. Lighter melons will also turn yellow, but not as deep as darker melons. 5) Produces dull sound upon tapping or the fruits surface.
- Minimize or eliminate the dropping of melons whenever possible. Watermelons may crack during periods of high humidity.
- Expected yield: 5 – 6 t/jerib (8 t/ jerib or more can be reached with some varieties)

POST HARVEST STEPS:

- Melons are consumed fresh or can be dried for a future consumption.
- Freshly harvested watermelons should be moved as quickly as possible to cool storage or a packing shed. Any diseased, overripe or damaged fruit should be culled, otherwise the spoiled fruit will contaminate healthy fruit.
- Watermelons are susceptible to fungal rots after harvest. Dipping melons in hot water at 52-55˚C for 2 minutes can effectively control fungal rots in melons. Following hot water dips, melons should be air-dried at ambient temperature.
- Melons can be wrapped individually in polyethylene or packed in bulk in cartons lined with polyethylene to prevent dehydration during storage. During packing, ensure a firm, not tight fit to minimize squashing and denting of fruit)
- After air-drying or packing, melons must be cooled as quickly as possible to maintain post-harvest quality. Using fans to force cold air through vents in cartons or pallets rapidly cools the fruit. Room cooling involves placing fruit in a refrigerated room should be avoided because it takes 24 to 36 hours to cool melons to about 10˚C.
- If such facilities are not available, the melons should be put in the cool place (around 10˚C) without hot watering. Cooled melons should be stored at 4˚C and 95% relative humidity. Storing cantaloupes at temperatures below 2˚C will result in chilling injury.
- Melons can be stored for 2 – 3 weeks in such conditions.
- **Drying:** Cut melon into thin, small pieces, arrange on drying trays and cover it with sheets to keep insects off. Dry melon until hard and tacky. Store in jars or bags.

MUSKMELON

LATIN: Cucumis melo (Cucurbitaceae)
DARI: Khar buza
PASHTO: Khatakai
ENGLISH: Muskmelon, Cantaloupe

BEFORE WE START

Ecological requirements:

- Muskmelon requires warm climate between 20 – 30˚C. It is not resistant to cold temperatures.

Soil:

- Well-drained, neutral or slightly alkaline soil with a pH of 7.0.
- Heavier soil types that contain clay should be improved by adding organic matter. Light, sandy soils are preferred for northern fields and gardens.

Crop rotation:

- AFTER: Melon is cultivated after beans, winter cereals or vegetable. Never after the cucurbitaceae family!
- BEFORE: Melon is cultivated before tomatoes or other vegetable. Never before the cucurbitaceae family!

Seeds:

- Direct field sowing: 0.3 – 0.4 kg/jerib

Cultivation tools:

- Plough, fork, shovels, levelling device, hoes, string/rope for marking rows

Fertilizers:

- **Before cultivation:** Use compost or well composted manure 4.5 – 9 t/jerib during the field preparation. Muskmelons do well after a sod of perennial forage crop since soil structure is usually at its best. In case of use of the artificial fertilizers, the actual soil composition has to be checked. N: 8 kg/jerib (Ammonium sulphate form), P_2O_5: 12 - 16 kg/jerib (Single Superphosphate form), K_2O: 15 - 20 kg/jerib (Potassium sulphate form). If these forms are not available, other sources can be used to get the proper level of fertilizers (NPK DAFK 10:26:26 70 kg/jerib).
- **During cultivation:** Use N: 8 kg/jerib one week after blossoming begins, second application 3 weeks later (urea form can be used). K_2O: 15- 20 kg/jerib (in potash form) before blossoming.
- !NOTE: Melons are particularly sensitive molybdenum deficiency.

Watering:

- Water slowly with 2.5 cm of water per week. Allow it to completely soak the soil 15 – 20 cm deep.
- Decrease watering later in the season to encourage fruit to mature. Furrow irrigation is the best technique.
- Water in the morning or early afternoon so the foliage dries by evening. This helps to prevent the spread of leaf diseases.

- **Pre-planting in trench/greenhouse:** NO
- **Cultivation in trench/greenhouse:** YES

CULTIVATION CALENDAR:

- **cold areas:** Sowing in April 10, harvest from the beginning of June till August 20.
- **warm areas**: Sowing in March 20, harvest from June 20 till July 20.
- For the winter and late autumn use sowing in May 10 till June 10.

	Activity	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Soil preparation and fertilization before sowing												
2	Sowing												
3	Control of germination												
4	Thinning												
5	Watering												
6	Fertilization and field processing during cultivation												
7	Weed control												
8	Pest control & disease control												
9	Harvest												

cold areas warm areas cold and warm areas

CULTIVATION STEP BY STEP:

1. Soil preparation and fertilization before sowing:

- ***Before sowing:*** After the pre-crop or 3 weeks before the cultivation soil must be deep ploughed at least 30 cm, it must have a good crumbly structure (use harrowing) and as levelled as possible. Incorporate compost or well composted manure 4,5 – 9 t/jerib during the soil preparation (applies for trench and greenhouses too). Be careful with use of the artificial fertilizers. If needed, use N: 8 kg/jerib (Ammonium Sulphate form), P_2O_5: 12 - 16 kg/jerib (Single Superphosphate form), K_2O: 15 - 20 kg/jerib (Potassium Sulphate form). If these forms are not available, another sources can be used to get the proper level of fertilizers (NPK DAFK 10:26:26 70 kg/jerib). Be careful with N use!
- Prepare the soil for direct sowing: Form mound soil to make a low broad hill approximately 20 -25 cm high.

2. **Sowing:**
    - Direct sowing: Plant 4-6 seeds in a circle in 12 cm intervals for each hill. Each hill should be 120 – 180 cm apart, depending on the variety you select OR 120 to 180 cm between rows, 30 to 50 cm between seeds (2 – 3 seeds are sown together).
    - Plant the melon seeds 2.5 cm deep.
    - Pre-germination of seeds by warm water is possible 1 day before sowing
3. **Control of germination:**
    - 7 – 9 days after sowing
4. **Thinning:**
    - When seedlings have 3 or 4 leaves, leave just 2-3 large, healthy, well-spaced plants per hill. More than 3 plants per hill will lead to crowding, greater chance of disease, and lower yields.
    - OR leave just healthy plants in rows, 25 – 35 cm between plants.
5. **Watering:**
    - Water slowly with 2.5 cm of water per week. Allow it to completely soak the soil 15 – 20 cm deep. Decrease watering later in the season to encourage fruit to mature.
    - Water in the morning or early afternoon so the foliage dries by evening. This helps to prevent the spread of leaf diseases.
    - Furrow irrigation is the best technique.
6. **Fertilization and field processing during cultivation:**
    - Nitrogen fertilization: N = 8 kg/jerib 1/2 one week after blossoming begins, second application 3 weeks later (urea form can be used). K_2O: 15- 20 kg/jerib (in potash form) before blossoming (or NPK 17:17:17 70 kg/jerib).
    - Start with hand-weeding or hoeing 3-5 days after thinning out the plants and continue to remove weeds until the crop cover the ground.
7. **Weed control:**
    - Good soil processing and a proper crop rotation system is one of the best prevention methods. Weeding is done mechanically – especially by hand during the thinning out process. Continue to remove weeds until the crop covers the ground.
    - DO NOT USE ANY HERBICIDES or chemicals as those registered for use on melon do not provide total, season long control. Avoid fields where residual herbicides from previous years persist in the soil and crop injury may occur!
8. **Pest control & Disease control:**
    - Good crop rotation, adequate soil processing, use of quality seeds are the best prevention. The crop should be checked regularly and the affected plants should be removed.
    - In case of high need, use the proper chemicals but always follow the given instructions!!!! Never use the chemicals before harvesting!
    - The damaged, yellowed and affected plants and fruit have to be removed (dug up) and burned.
9. **Harvest:**
    - Harvest before the seeds become too well developed, usually while the fruits are still a little rough. Do not allow any fruits to remain and form seed on the fruit, as production of new fruits will be reduced.
    - Harvest muskmelon early in the day, after the plants are dry. Be careful not to damage the vines, pick melons every other day at the start of the season and every day at peak season. At maturity, the stem appears cracked at the point of attachment to the fruit. Check for maturity by gently lifting the melon. If it is ripe it should easily separate from the vine. When ripe, the muskmelon rind changes from green to tan or yellow between the netting.
    - Minimize or eliminate the dropping of melons whenever possible. Muskmelons may crack during periods of high humidity.
    - Expected yield: 3 – 5 t/jerib (6 t/ jerib or more can be reached with some varieties)

POST HARVEST STEPS:

- Melons are consumed fresh or can be dried for a future consumption.
- Freshly harvested muskmelons should be moved as quickly as possible to cool storage or a packing shed. Any diseased, overripe or damaged fruit should be culled, otherwise the spoilt fruit will contaminate healthy fruit.
- Muskmelons are susceptible to fungal rots after harvest. Dipping melons in hot water at 52-55˚C for 2 minutes can effectively control fungal rots in melons. Following hot water dips, melons should be air-dried at ambient temperature.
- Melons can be wrapped individually in polyethylene or packed in bulk in cartons lined with polyethylene to prevent dehydration during storage. During packing, ensure a firm, not tight, fit to minimize squashing and denting of fruit)
- After air-drying or packing, melons must be cooled as quickly as possible to maintain post-harvest quality. Using fans to force cold air through vents in cartons or pallets rapidly cools the fruit. Room cooling involves placing fruit in a refrigerated room should be avoided because it takes 24 to 36 hours to cool melons to about 10˚C.
- If such facilities are not available, the melons should be put in the cool place (around 10˚C) without hot watering. Cooled melons should be stored at 4˚C and 95% relative humidity. Storing cantaloupes at temperatures below 2˚C will result in chilling injury.
- Melons can be stored for 2 – 3 weeks in such conditions.
- **Drying:** Cut melon into thin, small pieces, arrange on drying trays and cover it with sheets to keep insects off. Dry melon until hard and tacky. Store in jars or bags.

SPECIFIC CHAPTERS

HERBS AND SPICES

CORIANDER

LATIN: Coriandrum sativum (Apiaceae)
DARI: Gashniz
PASHTO: Gashniz
ENGLISH: Coriander

BEFORE WE START

Ecological requirements:

- Coriander is annual crop, it is cool seasoncrop cultivated in moderate and subtropical climate. It frost-free climates (susceptible to mild frost) and is not resistant to extreme heat.
- Coriander is also a light demanding crop.

Soil:

- All types of soil, but sandy loam and clay soils are best. Not tolerant to alkaline and saline soils.
- Optimum pH 6,5 – 7,5.

Crop rotation:

- AFTER: Coriander is planted after fertilized potatoes, beet, cereals, peas, fodder beans, vegetable. NEVER after the Apiaceae family (keep 4 – 5 years cycles!)
- BEFORE: Corriander should NOT be followed by Apiaceae family.

Seeds:

- ***For broadcasting*** use 8 kg / jerib
- ***For seeding in narrow rows:*** use 4 - 6 kg / jerib, 25 - 30 cm between rows, 5 cm between seeds, depth: 0.5 - 1 cm

Cultivation tools:

- Plough, fork, shovels, levelling device, string/rope for marking rows

Fertilizers:

- **Before cultivation:** After pre-crop during field preparation use 2 – 4 t/jerib of compost or completely composted manure and N: 4 – 6 kg/jerib, P_2O_5: 6 kg/jerib and K_2O (potash form): 4 - 6 kg/jerib at the time of sowing.

- **During cultivation:** In case of leaf production for irrigated crops: N: 4 kg / jerib 30 days after sowing and N: 4 kg/jerib 75 days after sowing.
- In case of seed production fertilization is NOT RECOMMENDED.

Watering:

- ***For seed production:*** Standard irrigation schedule is 4–5 irrigations 30–35, 60–70, 80–90, 100–105 and 110–150 days after sowing.
- ***For leaf production:*** Water should be supplied every month.

- **Pre-planting in trench/greenhouse:** NO
- **Cultivation in trench/greenhouse:** YES

CULTIVATION CALENDAR:

- **cold areas:** Sowing from March 20 till mid-April and again in August. Leaf harvest: 40 – 60 days after sowing. Seed harvest: 75 – 120 days after sowing (in July and again in November).
- **warm areas**: Sowing in March and again in the end of September. Leaf harvest: 40 – 60 days after sowing. Seed harvest: 75 – 120 days after sowing (the end of June and again in December).

	Activity	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Field preparation and fertilization before seeding	1c, 1w						2w	1c	1c			
2	Sowing	1c, 1w	1c				2c	2w					
3	Control of germination	1w	1c				2c	2c	2w				
4	Watering		1c, 1w	1c, 1w	1c, 1w	1c, 1w		2c, 2w	2c, 2w	2c, 2w			
5	Thinning	1w	1c				2c	2c	2w				
6	Fertilization during cultivation (just for leaf production)		1c, 1w	1c				2c	2w				
7	Field processing during cultivation			1c, 1w	1c, 1w			2c	2w				
8	Weed control			1c, 1w	1c, 1w			2c	2w				
9	Pest control & disease control			1c, 1w	1c, 1w			2c	2w				
10	Harvest - leaves		1w	1c, 1w	1c			2c	2c, 2w	2c, 2w			
11	Harvest - seeds				1w	1c				2c	2c		

■ cold areas ■ warm areas ■ cold and warm areas

CULTIVATION STEP BY STEP:

1. **Field preparation and fertilization before seeding:**
   - After the pre-crop: Stubble-tillage or plough 25 – 30 cm deep and use – 4 t/jerib of compost or completely composted manure
   - 2 weeks before sowing: Clean soil from weeds and stones, drag it (field level) and harrow it (for adequate texture of soil).
   - At the time of sowing: Use : 4 – 6 kg/jerib, P_2O_5: 6 kg/jerib and K_2O(potash form): 4 - 6 kg/jerib
2. **Sowing:**
   - When the temperature of soil is 7˚C - 8˚C
   - ***For leaf production:*** for broadcasting: use 8 kg/jerib,
   - for sowing in narrow rows: 4 - 6 kg/jerib. Keep 25 - 30 cm between rows, 3 - 5 cm between seeds, depth: 0.5 - 1 cm.
   - ***For seed production:*** sow in narrow rows: 4 - 6 kg/jerib, keep 25 - 30 cm between rows, 5 cm between seeds, depth: 0.5 - 1 cm. Sometimes seeds can be soaked in water overnight to remove inhibitor and thereby enhance germination.
   - ! NOTE: Soil has to be moist while sowing.
3. **Control of germination:**
   - 14 – 21 days after sowing
4. **Watering:**
   - ***For seed production:*** Standard irrigation schedule is 4–5 irrigations 30–35, 60–70, 80–90, 100–105 and 110–150 days after sowing.
   - ***For leaf production:*** Water should be supplied every month.
5. **Thinning:**
   - ***For leaf production:*** crops should be thinned to 5 cm.
   - ***For seed production:*** seedlings have to be thinned to 15cm between the plants.
6. **Fertilization during cultivation:**
   - ***For leaves production for irrigated crops:*** Use N: 4 kg / jerib 30 days after sowing and again N: 4 kg / jerib 75 days after sowing
   - ***For seed production*** the fertilization is NOT RECOMMENDED
7. **Field processing during cultivation:**
   - Just hoeing or manual intervention for weed control is needed.
8. **Weed control:**
   - Good soil processing and a proper crop rotation system is one of the best prevention methods.
   - Weeding is done manually by hand or mechanically – especially by hoeing. is done 30 days after sowing and second weeding in irrigated coriander may be done between 50 and 60 days of sowing depending upon the weed growth.
   - Don't use any herbicides in case of ***leaf production***! In case of ***seed production***, some herbicides can be used just in extreme cases, always follow label directions!
9. **Pest control & Disease control:**
   - Good crop rotation and adequate soil processing are the best prevention.
   - The crop should be checked regularly and the affected plants should be removed. The damaged, yellowed and affected plants have to be removed (dug up) and burned.
   - In case of high need, use the proper chemicals but always follow the given instructions! Never use the chemicals for leaf production or before seed harvesting!

10. Harvest:

- ***For leaf production:*** Make sure the plant is big enough, minimum 20 cm. For small scale consumption harvest just some leaves so it can continue to grow. Fmarketing uproot the plants and tie into bundles convenient for marketing. !NOTE: Once the plants start developing flower stalks they stop producing more leaves.
- ***For seed production:*** Harvest when 30 – 40% of seeds turn brown-yellow or 50% seeds turn yellow. In case of manual small-scale harvest, cut the stalks, put them upside down in a big paper bag and leave it in a dry spot for a couple of weeks. In case of manual big-scale harvest, cut the stalks and put them on some moist protected place carefully to avoid a seed loses caused by over-manipulation. Coriander seed can be harvested by special combines too.
- Expected yield of leaves production: 1,2 – 1,4 t/jerib, maximum 2 t/jerib can be harvested.
- Expected yield of seed production: 140 – 160 kg/jerib in case of rainfed cultivation or 240 – 500 kg/jerib in case of irrigated cultivation.

POST HARVEST STEPS:

- ***Leaf production:*** The harvested leaves should be consumed as soon as possible, fresh as a salad crop or should be transported to the local market. Tie into bundles convenient and attractive for marketing.
- ***Seed production:*** Fresh coriander seeds should be dried in shade to retain seed colour and quality. Before placing the stalks on a surface, place a cover to avoid losing seeds. Artificial drying is not recommended. After drying to 10 – 12% seeds are cleaned by lightly beating with sticks. Cleaning can be done mechanically with use of small scale thresher.
- Clean gunny or paper bags are used for packing coriander seeds which are stored in damp-free aerated storage rooms. !NOTE: Coriander seed is susceptible to frost damage.
- Seed is used as flavouring in both sweet and savoury dishes and as an ingredient of curry powder. The seeds have been used to scent after shave lotions too.

FENNEL

LATIN: Foeniculum vulgare (Apiaceae)
DARI: Jani
PASHTO: Jani
ENGLISH: Fennel

BEFORE WE START

Ecological requirements:

- Fennel is a perennial crop, usually 4 year production. It also has annual varieties.
- Cool season crop, prefers moderate and cold climate, susceptible to mild frost, draught tolerant.

Soil:

- Fennel can be cultivated in all type of soils, ideally well drained loamy soil and black cotton soils in high altitudes.
- Not tolerant to extremely alkaline and saline soils. Optimum pH is 6.5 – 8.0.

Crop rotation:

- AFTER: Fennel is planted after fertilized root crops and cereals. NEVER after alfa-alfa, sunflower, Apiaceale family
- BEFORE: Cereals should be planted after fennel.

Seeds:

- ***Direct sowing in narrow rows:*** 2 kg/jerib, 45 cm space between rows, 5 cm between seeds, depth: 2 - 3 cm. For nursery seedlings to be transplanted to 1 jerib final area.
- ***Broadcasting:*** 2 kg seeds in total area of 20 m^2 (3m x 1m beds)

Cultivation tools:

- Plough, fork, shovels, levelling device, string/rope (for marking rows)

Fertilizers:

- **Before cultivation:**
  - *NURSERY preparation:* 5 t/jerib of compost or completely composted manure + N: 12 kg/jerib and P_2O_5: 6 kg/jerib at the time of sowing
  - *DIRECT SOWING:* best cultivation after organically fertilized pre-crop, N: 8 – 12 kg/ jerib at the time of sowing
  - *FIELD preparation for SEEDLINGS:* 4 t/ jerib of compost or completely composted manure during the field preparation + N: 8kg/jerib, P_2O_5: 12 kg/jerib (in the DAP form better) at the time of transplanting of seedlings
- **During cultivation:**
  - *NURSERY cultivation:* Supplementary dose of urea can be applied 3 weeks after germination of seeds, if seedlings are very weak. Use fertilizers only in case of high need!
  - *DIRECT cultivation:* N: 5 – 6 kg/jerib in the stage of 2 – 3 cm.
  - *after TRANSPLANTING of SEEDLINGS:* N: 6 kg / jerib 30 days after transplanting + N: 6 kg / jerib 60 days after transplanting (earthing up).
- 2nd year: N: 12 - 16 kg / jerib in stage of earthing up.

Watering:

- In NURSERY and in case of DIRECT CULTIVATION: First light irrigation just after sowing and then 3 to 4 days after sowing, followed by light irrigation as and when required to keep the soil moist up to full germination. Later on irrigate at intervals of 2-3 days.
- After TRANSPLANTING the SEEDLINGS to the field: First irrigate on the day of transplanting and subsequent irrigations should be done at intervals of 15-20 days, as per the need. Generally 10-12 irrigations are given to fennel crop depending on soil and climate. Irrigation interval is longer in black soils as compared to light soils. Irrigation at the time of seed development is critical = fennel has to be irrigated in that period!

- **Pre-planting in trench/greenhouse:** NO
- **Cultivation in trench/greenhouse:** NO

CULTIVATION CALENDAR – 1ST YEAR OF CULTIVATION:

- **cold areas:** Sowing since March 20 till mid-April, harvest from July till beginning of September.
- **warm areas**: Sowing since beginning of March, harvest in July.

	Activity	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Field preparation and fertilization before sowing												
2	Sowing												
3	Control of germination												
4	Watering												
5	Thinning												
6	Transplanting of seedlings												
7	Fertilization during cultivation												
8	Field processing during cultivation												
9	Weed control												
10	Pest control & disease control												
11	Harvest												

■ cold areas ■ warm areas ■ cold and warm areas

CULTIVATION STEP BY STEP:

1. **Field preparation and fertilization before sowing:**
   - ***preparation of NURSERY:*** 2 – 3 x tillage/ploughing (20 – 25cm) with 5 t/jerib of compost or completely composted manure. In the time of sowing soil has to be cleaned from weeds and stones and other fertilizers should be applied: N: 12 kg/jerib and P: 6 kg/jerib
   - ***preparation of the field for DIRECT SOWING:*** cultivation after organically fertilized pre-crop = no need of extra use of organic fertilizers, do tillage/ploughing 2 or 3 times (20 – 25cm) and soil has to be cleaned from weeds and stones and N: 8 – 12 kg/ jerib should be used at the time of sowing.
   - ***preparation of the field for TRANSPLANTING of SEEDLINGS:*** field preparation after the pre-crop and use 4 t/ jerib of compost or completely composted manure. Before transplanting, land should be cleaned from weeds and stones, brought to fine tilth by one ploughing followed by 2 or 3 harrowing and planking and use N: 8 kg/jerib and P_2O_5: 12 kg/jerib fertilizers at the time of transplanting of seedlings
2. **Sowing:**
   - When the temperature of soil is 6˚C - 8˚C, use direct sowing in narrow rows: 2 kg / jerib; 45 cm between rows, 5 cm between seeds. depth: 2 - 3 cm
   - For nursery seedlings to be transplanted to 1 jerib final area, use broadcasting of 2 - 4 kg seeds in total area of 20 m^2 (3m x 1m beds)
3. **Control of germination:**
   - 14 – 30 days after sowing

4. **Watering:**
   - In NURSERY and in field in case of DIRECT CULTIVATION: first lightly irrigate just after sowing and then 3 to 4 days after sowing, followed by light irrigations as and when required to keep the soil moist up to full germination. Later on irrigate at and interval of 2-3 days.
   - After TRANSPLANTING of SEEDLINGS to field: first irrigate on the day of transplanting and subsequent irrigation should be given at intervals of 15-20 days, as needed. Generally 10-12 irrigations are given to fennel crop depending on soil and climate (irrigation interval is longer in black soils as compared to light soils). Irrigation at the time of seed development is critical, fennel has to be irrigated during this period!
5. **Thinning:**
   - In case of ***direct sowing*** – should be thinned to 60 cm between plants;
   - In case of ***transplanting*** – seedlings should be transplanted at a spacing of 90 x 60 cm or 100 x 60 cm
6. **Transplanting of seedlings:**
   - 45 – 60 days after sowing
7. **Fertilization during cultivation:**
   - ***NURSERY cultivation:*** Only in case of high need! Supplementary dose of urea can be applied 3 weeks after germination of seeds, if seedlings are very weak.
   - ***DIRECT cultivation:*** N: 5 – 6 kg/jerib in the stage of 2 – 3 cm.
   - ***after TRANSPLANTING of SEEDLINGS:*** N: 6 kg / jerib 30 days after transplanting + N: 6 kg / jerib 60 days after transplanting (earthing up).
8. **Field processing during cultivation:**
   - ***In case of direct sowing*** – hand weeding should be done once or twice depending on weed growth. During first 45 days first hoeing should be done, 60 – 75 days after sowing together with earthing up.
   - ***In case of nursery cultivation and transplanting of seedlings:*** hand weeding should be done once or twice depending on the weed growth in nursery. First hoeing should be done 20-25 days after transplanting and should be repeated twice based on need at an interval of 20-25 days. Earthing up is done after 60-75 days from transplanting to check the lodging of plants. If necessary, weeding by hand 2 to 3 times. Depending on the weed growth, weeding by hand should be done an extra one or two times.
9. **Weed control:**
   - Soil processing and a proper crop rotation system is one of the best prevention methods. Weeding is done mechanically – especially by hoeing (see above). Herbicides should only be used in extreme cases. Always follow label directions!
10. **Pest control & disease control:**
   - Good crop rotation and adequate soil processing are the best prevention. The crop should be checked regularly and the affected plants should be removed. The damaged and affected plants have to be removed (dug up) and burned.
   - In case of high need, use the right chemicals but always follow the given instructions! Never use the chemicals before harvesting!
11. **Harvest:**
   - Fennel is harvested by cutting the umbels as and when they reach to physiological maturity (when seeds are fully filled up & green in colour). After cutting the umbels they are dried in partial shade. For seed purpose, fully matured umbels are harvested
   - Expected yield: 1st year: 80 – 180 kg/jerib, 2nd year: 120 – 260 kg/jerib, 3rd year: 40 – 180 kg/jerib. Even 400 – 500 kg/jerib can be yield at 2nd year, depends on variety and proper agro technique.

POST HARVEST STEPS:

- After cutting the umbels they are dried in partial shade. While drying, care should be taken for better aeration and umbels should be turned if necessary.
- The seeds are separated by beating the dry umbels with sticks followed by winnowing. The seed should be dried at max. 35˚C to 10% of moist. Grading is done with the help of sieve. Clean gunny or paper bags are used for packing fennel seeds which are stored in damp-free aerated store rooms. Packaging in glass can be attractive for direct marketing.
- Seed is used for flavouring different dishes and also as a medicinal herb (healing infusion) for digestion and as a lotion with antibacterial effect.

ANISE

LATIN: Pimpinella anisum (Apiaceae)
DARI: Badyan
PASHTO: Kaga (Badyan)
ENGLISH: Anise

BEFORE WE START

Ecological requirements:

- Anise is an annual crop that prefers moderate or warm climate. It is susceptible to mild frost.
- Anise requires a sunny, warm, wind-protected location. Not in shadow!

Soil:

- Anise needs deep, well fed (high organic matter), light soils. Do not plant in clay or water retaining soils.
- Optimum pH: 6.3– 7.3

Crop rotation:

- AFTER: Plant anise after potatoes and cereals. NEVER after alfa-alfa or after anise itself. Keep at least 3 year long cycles!

Seeds:

- Direct sowing in narrow rows: 2,4 kg – 3 kg / jerib, 15 - 35 cm space between rows, 1 -5 cm between seeds, depth: 2 - 4 cm

Fertilizers:

- Direct sowing in narrow rows: 2,4 kg – 3 kg / jerib, 15 - 35 cm space between rows, 1 -5 cm between seeds, depth: 2 - 4 cm
- **Before cultivation:** After pre-crop during field preparation: 3 – 4 t/jerib of compost or completely composted manure. Never use the manure directly before sowing! Use N: 30 kg/jerib, P_2O_5: 6 kg/jerib and K: 40 kg/jerib at the time of sowing.If these forms are not available, other sources can be used to get the proper level of fertilizers.
- **During cultivation:** Use fertilizers only in case the initial fertilization before cultivation has been skipped! Use the sulphur rich fertilizers: 40 kg/jerib of ammonium sulphate, 40 kg/jerib of potassium sulphate, 80 kg/jerib of gypsum and 100 kg/jerib of calcium superphosphate.

Watering:

- Anise is not water demanding, but needs water during the intensive stem growth. Lack of water leads to small plants and decrease of yield.
- Rain during flowering causes problems with pollinations and the yield decrease. If the weather is dry, it should be irrigated when it blooms.

- **Pre-planting in trench/greenhouse:** NO
- **Cultivation in trench/greenhouse:** NO

CULTIVATION CALENDAR:

- **cold areas:** Sowing since March 20, harvest in the end of June/beginning of July.
- **warm areas**: Sowing since beginning of March, harvest from June.

	Activity	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Field preparation and fertilization before seeding												
2	Sowing												
3	Control of germination												
4	Watering												
5	Thinning												
6	Fertilization during cultivation (only if needed)												
7	Field processing during cultivation												
8	Weed control												
9	Pest control & disease control												
10	Harvest												

cold areas warm areas cold and warm areas

CULTIVATION STEP BY STEP:

1. **Field preparation and fertilization before seeding:**
   - After the pre-crop: stubble-tillage or ploughing (25 – 30 cm) with 3 – 4 t/jerib of compost or completely composted manure. Never use the manure directly before sowing!
   - At the time of sowing soil has to be cleaned from weeds and stones, dragged (field levelling) and harrowed for adequate texture of soil and fertilized by N: 30 kg/jerib,P_2O_5: 6 kg/jerib and K_2O: 40 kg/jerib.
2. **Sowing:**
   - When the temperature of soil is 8˚C - 10˚C start sowing in narrow rows: 2,4 kg – 3 kg / jerib, 15 - 35 cm between rows, 1 -5 cm between seeds, depth: 2 - 4 cm.
3. **Control of germination:**
   - 2 – 3 weeks after sowing

4. **Watering:**
    - Anise is not water demanding, but needs water during the intensive stem growth. Lack of water leads to small plants and decrease of yield. Rain during flowering causes problems with pollinations and the yield decreases. If the weather is dry, it should be irrigated when it blooms.
5. **Thinning:**
    - When the seedlings come up, thin them out to 15 to 30 cm apart.
6. **Fertilization during cultivation:**
    - Use fertilizers only in case the initial fertilization before cultivation has been skipped! Use the sulphur rich fertilizers: 40 kg/jerib of ammonium sulphate, 40 kg/jerib of potassium sulphate, 80 kg/jerib of gypsum and 100 kg/jerib of calcium superphosphate.
7. **Field processing during cultivation:**
    - Hoeing is done when necessary after the germination; 3 – 5 weeks after sowing ridging can be conducted to cover the base of plant with sand/light soil to produce a greater root development.
    - Pruning is also recommended at 20 cm height to eliminate slight excess branches or foliage which will help the ventilation of the feet. Pruning has to be done by experienced person! Another option is to provide proper thinning.
8. **Weed control:**
    - Good soil processing and a proper crop rotation system is one of the best prevention methods. Weeding is done manually or mechanically, especially by hoeing. Herbicides can be used just in extreme cases. Always follow label directions!
9. **Pest control & Disease control:**
    - Good crop rotation, adequate soil processing and protection from humidity is the best prevention against pest and diseases. The crop should be checked regularly and the affected plants should be removed. The damaged and affected plants must be removed (dug up) and burned.
    - In case of high need, use the proper chemicals but always follow the given instructions! Never use the chemicals before harvesting!
10. **Harvest:**
    - Usually by cutting the whole plant when the seeds reach the grey-green colour and before the fruits open (wax stage). When the plants begin to lose their leaves or the base turns yellow. This should be done in the morning, as the concentration of the essence is higher; the stalks are cut and dried in the sun or indoors where there is a good ventilation.
    - Expected yield: 100 – 200 kg/jerib

POST HARVEST STEPS:

- After cutting, the stalks are dried in partial shade. While drying, care should be taken for better aeration and stalks should be turned if necessary. The seeds are separated by beating them with sticks followed by winnowing with a sieve. The seeds should be dried at max. 35°C to 10 - 12% of moist. Grading is done with the help of sieve. Another possibility is to hang the cut plants upside down, in a dry place, with a paper bag over the heads to collect the seeds. The bag will catch the dry seeds as they fall. Keep the seeds in their paper bags and allow them to dry in a well-ventilated place then clean the seeds;
- Clean gunny or paper bags are used for packing anise seeds which are stored in damp-free aerated store rooms. Packaging in glass can be attractive for direct marketing. !NOTE: seeds quickly lose their flavour, so keep them whole and grind them when required, keep them out of light in an airtight container. Then it can retain its flavour for at least 2 years.
- !NOTE: young leaves can be used in salads or as a garnish for vegetable dishes/soups.
- Seed is used as flavouring in different dishes in breads and savoury foods, or to flavour fish, poultry, soups, root vegetable dishes etc. Anise is also used in medicine – as it has digestion and antibacterial effects;

SAFFRON

LATIN: Crocus sativus (Iridaceae)
DARI: Za'faron
PASHTO: Zafran
ENGLISH: Saffron

BEFORE WE START

Ecological requirements:

- Saffron is perennial herb with production for 7 – 9 years.
- Demands an extreme climate: hot and dry weather in summer and cold in winter. Dry, aired, flat and no shadow location. It is resistant to freeze and hot temperatures; -18˚C (under snow cover) to 40˚C. Altitude up to 1 000 m above sea level.

Soil:

- Saffron requires loamy sand texture and plenty of Calcium (calcareous soil). Optimum pH is neutral.

Crop rotation:

- AFTER: Saffron should be cultivated after fertilized root crops.

Seeds:

- *Seeds = CORM:* seeding corms (min. 6, optimum 8 grams/corm) in time of corm dormancy. Sow in narrow rows: 20 or 40 cm between rows, 10 or 5 cm between corms, depth: 10 - 15cm.

Cultivation tools:

- Plough, fork, shovels, levelling device, string/rope for marking rows

Fertilizers:

- **Before cultivation:** 3 months before planting during the field preparation: 6 – 10 t/ jerib of compost or well fermented farm manure or 5 t/ jerib of cattle manure has to be incorporated into the soil.
- **During cultivation:** 20 kg of Urea (N – fertilizer) after flower picking
- **From 2nd year onwards:** kg of Urea (N – fertilizer) after flower picking

Watering:

- Once sprout, soil should not dry out completely, but be very careful not to over-water! Irrigation must be done carefully as the water can damage the corms.
- Irrigation should be delivered 10–15 days before flower-picking and when there is no rain. After the harvest, irrigation should be provided to support the corms (in case of dry season).

- **Pre-planting in trench/greenhouse:** NO
- **Cultivation in trench/greenhouse:** NO

CULTIVATION CALENDAR – 1ST YEAR OF CULTIVATION:

- **cold and warm areas:** Seeding from August 10 till the end of August (from June till August, during the dormancy is the best period), harvest in October.

	Activity	March (next year, after harvest)	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Field preparation and fertilization before seeding				■	■	■						
2	Seeding						■	■					
3	Control of germination						■	■					
4	Watering (only if necessary!)	■								■			
5	Fertilization during cultivation									■			
6	Field processing during cultivation	■						■		■			
7	Weed control	■						■		■			
8	Pest control & disease control							■					
9	Harvest								■	■			

■ cold areas ■ warm areas ■ cold and warm areas

CULTIVATION STEP BY STEP:

1. Field preparation and fertilization before seeding:

- 1 to 3 months before planting the new saffron plantation has to be ploughed at a depth of 30 - 35 cm, cleaned from weeds and stones. 6 to 10 t/ jerib well-fermented farm manure or 5 t/ jerib of cattle manure needs to be incorporated into the soil. Plot has to be well levelled to avoid water stagnation!
- 1 week before planting another superficial ploughing must be done to prepare soil very loosely for saffron plantation.
- On heavy, slow drained soils, the ground is prepared in ridges to help the water drain off. The height of the ridge might have about 25 - 30 cm. The distance between ridges is about 50 cm if prepared manually and about 70 cm if prepared mechanically.
- For flat loamy soils, drainage channels have to be formed every 10–12 m to guarantee good drainage of the field in case of heavy rainfall.

2. **Seeding:**
    - Healthy, not injured and large size corms have to be selected for planting. Corm should weigh approximately 8g or more with a diameter of more than 2,5 cm. Corms with smaller diameter need to be raised in a nursery for vegetative reproduction.
    - ***Flatbed planting:***
        - In furrows formed with a plough, 20 cm between rows, put upright in the row 10 cm between corms, depth of 15 cm. Then the corms are covered by soil another option is to plant corms 5 cm between each other in rows 40 cm between each other
        - ! NOTE: 50cm between each 5 rows should be designed to allow harvesting and weeding. Light harrowing should follow corm planting.
        - ! NOTE: In case of use mechanisation, a distance of 60cm to 70cm must separate twin rows of saffron.
    - ***Ridge planting:***
        - Planting twin lines on one ridge separated by 20 cm (on the same ridge). Planting depth is 20 cm below the top of the ridge. Ridges have to be hoed at the end of August and the first decade of September in order to prevent saffron emergence damage.
        - !NOTE: Ridge height shall be maintained and hoed throughout the harvest, winter and spring seasons.
        - !NOTE: The corms will stay at same plantation for 7 – 9 years!
3. **Control of germination:**
    - 8 to 12 days
4. **Watering:**
    - If there is no rain, water the plant 10–15 days before flower-picking. In dry season provide irrigation after harvest to support the corms.
    - Since 2nd year, during March, irrigation must be applied for corm production!
5. **Fertilization during cultivation:**
    - Every year 20 kg of Urea (N – fertilizer) after flower picking.
6. **Field processing during cultivation:**
    - In the second year, hoeing is done in June, September, and after the saffron has flowered to help daughter corms production.
    - Hoeing should be done manually or mechanically with care to not till below 2 to 3 cm.
    - The soil has to be levelled after each operation.
7. **Weed control:**
    - Good soil processing and a proper soil management system is one of the best prevention methods. Weeding is done by hand or mechanically (see above), during 5 months.
    - No chemical is used!!!
8. **Pest control & Disease control:**
    - Adequate soil processing and protection from humidity is the best prevention. The plants should be checked regularly and the affected plants should be removed. Damaged and affected plants and corms have to be removed (dug up) and burned.
    - The most common rivals of saffron are fungi and rodents - fungi are developed under high moisture with high temperatures, which destroy saffron corms.
    - If needed, use the proper fungicides (registered abroad) before planting - but always follow the given instructions!
    - Check the fields regularly for rodent attacks!

9. **Harvest:**
    - ***FLOWER HARVEST:*** harvest has to be done as saffron flowers are short living, maximum 2 days. If they are exposed for a long period to sun or winter the quality is affected. Flowers are picked early in the morning by hand and every day from the beginning of the flowering phase to the end. Depending on climatic conditions, the flowering period starts around the end of October to mid November or even later. The flower has to be cut at the base of the petal without harming leaves. If they appear before the flower because harming leaves influence corm production. The cut flowers are collected in baskets as the crocus blooms are being collected, the stigmas are separated from the flowers.
    - ***CORM HARVEST:*** At the end of saffron life cycle after 6 - 8 years or more, corms have to be gathered from the field. This is done manually or with use of machines (for example: potato picking machine). Manual removing is preferable to avoid damaging or harming the corms. .
    - Expected yield: 1kg/jerib. Yield depends on the proper agro technique and the year of harvesting from the same planting spot. The highest yields reported are from Spain; 5,8 kg/jerib, while the maximum reported from Iran is 2 kg/jerib.
    - !NOTE: approximately 150 flowers yield 1 g of dry saffron threads.

POST HARVEST STEPS:

- **Stigma Separation** from the style and the petals is carried out at home during the on the day of flower collection if conditions are unsuitable for flower conservation.
- **Transportation** should be done in clean containers like plastic baskets and the product should be stored in cold places!
- **Saffron Drying** is the most important and critical process with regard to quality and many methods are tested to dry saffron to have a high quality. Humidity in dried saffron must be 12% and about 10% for a good saffron conservation.

  !NOTE: the best quality of saffron depends on the temperature and the length period of drying.

  Some examples of drying methods:
    - without light and microwave decontamination
    - vacuum 70˚C oven
    - ordinary oven
    - Spanish method (screen and heater)
- According to some authors the best drying is in oven for 35 to 45 ˚C for 5 to 6 hours. The saffron quality is then higher
- **Stigma storage** is also a very important procedure for saffron conservation. Storage of saffron must be done in the dark and cool place, since saffron pigments are light-, oxygen- and temperature-sensitive. The best way is to keep it in airtight darkened glass containersat low temperature (5–10˚C). !NOTE: a poor storage can harm the quality of the the saffron!
- Saffron is one of the most expensive spices and is used for flavouring in different dishes (e.g. rice).

SPECIFIC CHAPTERS

FODDER CROPS

ALFALFA

LATIN: Medicago sativa (Fabaceae)
DARI: Rishqa
PASHTO: Rishqa
ENGLISH: Alfalfa

BEFORE WE START

Ecological requirements:

- Alfalfa is cool-season deep-rooted perennial, growing for 8 – 15 years, but only 3 – 4 years for production
- It requires cold, moderate or subtropical climate. Older plants are draught and freeze resistant, it is not flood resistant

Soil:

- Alfalfa requires deep fertile soils with adequate internal drainage. It has low tolerance to flooding, waterlogging or even high water table (1,5m water table under the surface). Roots are sensitive to low soil oxygen levels and will die if the soil is saturated for an extended period. Optimum pH 6,5 – 7,2.

Crop rotation:

- AFTER: Alfalfa should be planted after cereals, cotton and vegetable.
- BEFORE: Alfalfa should be planted before cereals, cotton, vegetable.
- !NOTE: Alfalfa needs at least 5 years crop rotation cycle, it cannot be cultivated at the same spot earlier than after 5 years. It is not recommended to cultivate it in mixtures! Cultivation with cover crops is possible only in 25 cm rows. Then cover crops as oats, beans, peas with spring wheat are sown in 25 cm rows across the alfalfa.

Seeds:

- Use 2 – 3.5 kg/jerib, 12.5 – 15 cm space between rows
- When sowing for seeds use 2 - 3 kg/jerib, keep 20 – 25 cm space between rows
- Depth: 1.2 – 2.5 cm
- Broadcasting is not recommended, broadcasting with the cover crop is not allowed!

Cultivation tools:

- Plough, forks, shovels, levelling device, rollers, harrows, marking tools (rows design), sickles, reapers

Fertilizers:

- NEVER use N-fertilizers!
- **Before cultivation:** P_2O_5: 6 – 8 kg/jerib per each year of the cultivation, apply to the pre-crop, NOT DIRECTLY to alfalfa! K_2O: 16 – 30 kg/jerib per each year of the cultivation, apply to the pre-crop, NOT DIRECTLY to alfalfa! Calcium: every 5 or 10 years to the pre-crop: 0.4 – 0.6 t/jerib in limestone form for sandy soils or 0.1 – 0.4 t/jerib in quicklime form for heavy soils.
- **During cultivation:** Do not fertilize during cultivation!

Watering:

- Alfalfa is relatively draught resistant, but if the soil is dry, it should be moistened before sowing. Do not overwater! Then wait to irrigate until canopy closure, when the ground is completely shaded by alfalfa. That will limit the chance for weed seedlings to grow and survive.
- Irrigation prior to first cutting in a given year (if needed) can increase the hay yield. But the soil should not be watered during the hay processing. In case of extreme draught, water 2 weeks after mowing when the hay is harvested.

CULTIVATION CALENDAR FOR 1ST YEAR:

- **cold areas:** Sowing from March 20 till April, 1st harvest from beginning of June.
- **warm areas**: Sowing in the beginning of March, harvest in the beginning of May.

	Activity	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Field preparation and fertilization before sowing												
2	Sowing												
3	Watering												
4	Control of germination												
5	Weed control												
6	Pest control & disease control												
7	Harvest												

cold areas warm areas cold and warm areas

CULTIVATION STEP BY STEP:

1. Field preparation and fertilization before sowing:

- After the pre-crop: stubble-tillage or ploughing;
- Before sowing: 2 ploughings, dragging (field levelling), rolling (soil firming), harrowing (for adequate texture of soil, in the depth 2 – 3 cm). Firm clean seedbed and a smooth, uniform surface should be ready before sowing.
- Fertilization before sowing: NEVER use N-fertilizers. Not even the organic nitrogen fertilizers! Use P_2O_5: 6 – 8 kg/jerib per each year of the cultivation to the pre-crop, not to the alfalfa directly!; K_2O: 16 – 30 kg/jerib per each year of the cultivation, apply to the pre-crop, not directly to the alfalfa! Calcium: every 5 or 10 years to the pre-crop: 0,4 – 0,6 t/jerib in limestone form for sandy soils or 0,1 - 0,4t/jerib in quicklime form for heavy soils.

2. **Sowing:**
   - Use 2 – 3.5 kg/jerib, keep 12,5 – 15 cm space between rows.
   - Sowing for seeds: 2 - 3 kg/jerib, keep 20 – 25 cm space between rows, depth: 1.2 – 2.5 cm
   - Broadcasting is not recommended. Broadcasting with the cover crop is not allowed!
   - Sowing should be done by sowing machines (manual or mechanical) or by hand in case of small scale cultivation.
   - The seed can be put in the water 12 hours before sowing and mixed with the soil or sand afterwards before sowing.
3. **Watering:**
   - If the soil is dry, it should be moistened before sowing. Do not overwater! Then wait to irrigate until canopy closure, when the ground is completely shaded by alfalfa. That will limit the chance for weed seedlings to grow and survive.
   - Irrigation prior to first cutting in given year (if needed) can increase the hay yield. But the soil should not be watered during the hay processing. In case of extreme draught, water 2 weeks after mowing when the hay is harvested.
4. **Control of germination:**
   - 10 – 15 days after sowing;
5. **Weed control:**
   - Good soil processing and a proper crop rotation system is one of the best prevention methods. Weed management in forages is divided into two phases: control in the establishment or seedling year and control in an established stand.
   - Weeding is usually done by mowing. Herbicides should not be used as the residua are dangerous for the animals and eating their products can threaten man too. Use of non-selective herbicides is not allowed!
   - Dodder control is very important.
6. **Pest control & Disease control:**
   - Good crop rotation and adequate soil processing are good prevention. The crop should be checked regularly and the affected plants should be removed.
   - Do not use any chemicals. The control is done regularly by mowing. In case of serious disease attack, plough the plants down and start the proper crop rotation.
7. **Harvest:**
   - ***Grazing and fodder:*** rotational grazing is required to sustain plant persistence and production. The resting intervals depend on the growing conditions which prevail but are likely to be in the 5 to 7 week range. Alfalfa at a leafy growth stage can be used as a green fodder too. !NOTE: alfalfa contains oestrogens which reduce conception rates in cattle and sheep if grazed or fed alfalfa prior to mating. Also saponin content in the forage is dangerous because it can cause adverse haemolytic effects on the stock.
   - ***Mowing for hay and silage:*** a succession of cut crops firstly at l0 - 25% bloom (i.e. when 3 ground leaves yellowed). After 5 to 7 week intervals the yield will maximise, giving satisfactory nutritive value and will assist the longevity of the plant. Cut should be done 7 cm above ground! Harvest for silage should be moved to the silage place as soon as possible after the cut. Harvest after first mowing should be done once the dry matter is 16 – 18%.

     !NOTE: to improve the quality of the plants, one of the cuts should be done after blooming. The interval between pre-last and last mowing before winter should be at least 6 weeks. Do not cut alfalfa if rain is imminent, as this can damage the crop and will lead to issues with mould.
   - Expected dry matter yield: 1 – 2 t/jerib (even 3t/jerib)
   - ***Seed harvest:*** when 65-75% of the seed pods are dark brown; to avoid loss of seed through shedding follow the proper techniques. A spring hay cut or grazing before crop closure - irrigate as required until it reaches the seed stage, use bee colonies for pollination.
   - Expected yield: 10 kg/jerib (but 70kg/jerib in Europe)

POST HARVEST STEPS:

- **Conservation**: making hay or wilting crops cut for silage. It is important to save the nutritious leaf fraction as much as possible during handling since leaf shatter and loss is major hazard during drying (high-quality silage can be made using the techniques of wilting, short chopping and the application of an effective additive). Artificial dehydration is also used in order to produce high-quality alfalfa cubes or pellets. After the cut, the alfalfa has to be handled carefully, the risk of losing leaves is high! Alfalfa for hay is dried until 16 – 18% of moist at the field. During this period it should be turned over from time to time in order to avoid mould attacks and then transferred to the final place.
- Silage should be set in some clean protected place. After chopping the silage additives should be added to the alfalfa and the proper maintenance has to be ensured!
- **Seed production:** the cut plants are dried and threshed manually or mechanically in a clean shaded place.
- **Green fodder** should be transferred to the animals as soon as possible. Not to be heated up!

SAINFOIN

LATIN: Onobrychis viciaefolia (Fabaceae)
DARI: Qatraboron
PASHTO: Sainfoin
ENGLISH: Sainfoin

BEFORE WE START

Ecological requirements:

- Sainfoin is a deep-rooted annual or perennial (8 – 20 years, but 3 years for production).
- It is adapted to a wide range of climatic conditions - cold, moderate, subtropical climate. Older plants are draught and freeze resistant but intolerant to waterlogging.

Soil:

- Sainfoin requires deep light or medium (preferable calcareous chalky or limestone) soil with adequate internal drainage
- Low tolerance to flooding, waterlogging or even lot of water.
- Optimum pH 6.0 or higher, it is intolerant to acidic soils.

Crop rotation:

- AFTER: Sainfoin should be planted after cereals.
- BEFORE: Cereals can be planted after sanfoin.
- !NOTE: Monocultures are recommended, but sainfoin can be undersown in a cereal crops too.

Seeds:

- For irrigated hay production of monocultures 8 – 12 kg/jerib of dehulled seeds or 16 – 24 kg/jerib of hulled seed. Slower germinating, hulled seeds are sometimes chosen when germination is only wanted after sufficient rainfall to ensure sufficient seedling development. Keep 15 cm space between rows.
- Lower seed rates are used in dry land conditions, i.e. 1.4 - 5 kg/jerib, 60 cm between rows for seed production.
- Depth: 1.5 – 5 cm

Cultivation tools:

- Plough, forks, shovels, levelling device, harrows, rollers, marking tools (rows design), sickles, reapers

Fertilizers:

- NEVER use N-fertilizers!
- **Before cultivation:** Use P_2O_5: 18 kg/jerib and K2O: 55 kg/jerib when preparing the land after the pre-crop! Use also Calcium every 5 or 10 years to the pre-crop: 0,4 – 0,6 t/jerib in limestone form for sandy soils or 0,1 - 0,4 t/jerib in quicklime form for heavy soils.If these forms are not available, other sources can be used to get the proper level of fertilizers.
- **During cultivation:** If there was no fertilization during the land preparation after pre-crop, P_2O_5 and K_2O replenishment is required after the removal of hay crops.

Watering:

- In the absence of irrigation, annual rainfall of at least 330 mm is required.
- Irrigation in dry periods increases yield and plants persistence. Sainfoin is well draught resistant, but if the soil is too dry, it should be lightly irrigated after sowing. Do not overwater! Then wait to irrigate until canopy closure, when the ground is completely shaded by sainfoin. That will limit the chance for weed seedlings to grow and survive.
- In case of extreme draught, provide the watering 2 weeks after mowing, when the hay is harvested.

CULTIVATION CALENDAR FOR 1ST YEAR AND FOR IRRIGATED AREAS::

- **cold areas:** Sowing from March 20 till April, first harvest from beginning of June.
- **warm areas**: Sowing in the beginning of March, harvest in the beginning of May.

	Activity	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Field preparation and fertilization before sowing												
2	Sowing												
3	Watering (only if needed)												
4	Control of germination												
5	Fertilization during cultivation (see above)												
6	Weed control												
7	Pest control & disease control												
8	Harvest												

■ cold areas ■ warm areas ■ cold and warm areas

CULTIVATION STEP BY STEP:

1. Field preparation and fertilization before sowing:

- After the pre-crop: stubble-tillage or ploughing
- Before sowing: 2 ploughings, dragging (field levelling), rolling (soil firming), harrowing (for adequate texture of soil, depth 2 – 3 cm). Firm clean seedbed and a smooth uniform surface should be prepared before sowing.

- Fertilization before sowing: NEVER use N-fertilizers, also not the organic nitrogen fertilizers!
- Use P_2O_5: 18 kg/jerib and K_2O: 55 kg/jerib when preparing the land after the pre-crop! Use also Calcium every 5 or 10 years to the pre-crop: 0.4 – 0.6 t/jerib in limestone form for sandy soils or 0.1 – 0.4 t/jerib in quicklime form for heavy soils.

2. **Sowing:**
   - For irrigated hay production of monocultures 8 – 12 kg/jerib of dehulled seeds or 16 – 24 kg/jerib of hulled seed. Slower germinating, hulled seeds are sometimes chosen for situations where germination is only wanted after there has been sufficient rainfall to ensure sufficient seedling development. Keep 15 cm space between rows.
   - Lower seed rates are used in dry land conditions, i.e. 1.4 - 5 kg/jerib, 60 cm between rows for seed production.
   - Depth: 1.5 – 5 cm
3. **Watering:**
   - In the absence of irrigation, annual rainfall of at least 330 mm is required.
   - Irrigation in dry periods increases yield and plants persistence. Sainfoin is well draught resistant, but if the soil is too dry, it should be lightly irrigated after sowing. Do not overwater! Then wait to irrigate until canopy closure, when the ground is completely shaded by sainfoin. That will limit the chance for weed seedlings to grow and survive.
   - In case of extreme draught; water 2 weeks after mowing, when the hay is harvested.
4. **Control of germination:**
   - 10 – 14 days after sowing of dehulled seeds and 14 – 21 days after sowing of hulled seeds.
5. **Fertilization during cultivation:**
   - If there was not any fertilization during the land preparation after pre-crop, P_2O_5 and K_2O replenishment is required after removal of hay crops
6. **Weed control:**
   - Good soil processing and a proper crop rotation system is one of the best prevention methods. Weed management in forages is divided into two phases: control in the establishment or seedling year and control in an established stand.
   - Weeding is usually done by mowing. Herbicides should not be used as the residua are dangerous for the animals and eating their products can threaten humans too. Use of non-selective herbicides is not allowed!
7. **Pest control & Disease control:**
   - Sainfoin is resistant to the pest and diseases attacking other legumes. Good crop rotation and adequate soil processing serve as good prevention. The crop should be checked regularly and the affected plants should be removed.
   - Do not use any chemicals, the control is done regularly by mowing.
   - In case of serious disease attack, plough the plants down and start the proper crop rotation.
8. **Harvest:**
   - Sainfoin blooms 1 – 2 weeks earlier than alfalfa. !NOTE: advantages of sainfoin for pasture use include excellent quality and palatability that give superior animal performance without the danger of bloat.
   - **Grazing:** Rotational grazing just between its early budding and early blooming stages is required to sustain plant persistence and production. Scannot tolerate overgrazing during the growing season and plant persistence benefits from a 6-week rest period from grazing before winter. Light grazing during the bud stage allows still yield a good crop of hay. Residual yield after hay cutting may be grazed, but once this species reaches full bloom, regrowth is very poor.

     !NOTE: Grazing in the bud or early bloom stage and keeping the grazing height above about 20 cm, will lengthen productive life.

- **Mowing for hay and silage:** Sis highly suitable for silage and hay production because of its upright growth habit and its pattern of regrowth from axillary buds after defoliation; since regrowth is very poor, it is best suited to taking one mowing at about the half- to full-bloom stage. Stems remain succulent as the plant matures so the quality does not decrease rapidly.
- Expected yield of hay (dry matter): 1 – 2 t/jerib, under irrigation: 1.4 – 3 t/jerib.
- **Seed harvest:** Crop can be harvested when the seed moisture is below 40 %, or at the time seed is beginning to shatter. Stems and leaves may still be green at this stage. After 2 - 5 days of good drying weather, the crop can be harvested with little loss.
- Expected seed yields: 90 kg/jerib

POST HARVEST STEPS:

- **Conservation:** Sainfoin is highly suitable because of its upright growth habit and its pattern of regrowth from axillary buds after defoliation. Shattering and loss of nutritious leaf is a hazard if haymaking is prolonged. Because of a lower buffering capacity i.e. resistance against pH reduction during the ensilage process, sainfoin has a better ensilability than alfalfa. Silage should be set in some clean, protected place and the plants should be chopped before ensilaging! Plants for hay production should be dried at the field, turn over during the drying process. When it reaches the stage where it contains 18% moisture it should be transferred to the final storage place.
- **Seed production:** - 5 days of good drying weather after the cut will help harvest with little loss. The seed is than threshed in some clean, wind-protected space and put in clean bags (not plastic!)
- **Green fodder:** It should be transferred to the animals as soon as possible. Not to be heated up!
- Sainfoin influence in animal production:
- **Grazing/pasture – cattle and small ruminants:** Fresh sainfoin is suitable fodder as it is highly palatable and increases body weight, wool production and reproductive performances.
- **Grazing/pasture – rabbits:** A basic forage due mostly to its relatively high content in protein and calcium.
- Hay - cattle and small ruminants: Sanfoin has a high palatability, higher nitrogen digestion efficiency than alfalfa cut at vegetative stage. Dairy goats also like sainfoin hay, and with regular distribution it can give the same results in milk yield, milk fat and protein content as those obtained with grass. Sainfoin hay also decreases nematode infestation.
- **Hay - rabbits:** It is a safe ingredient, but when fed fresh, the main limitation is its high water content (about 75-80%), which limits feed intake. Green sainfoin must be supplemented with dry materials such as hay, cereal grains or compound feeds).
- **Silage - cattle and small ruminants:** Silage has a beneficial effect on dry matter intake, dry matter digestibility and cellulose digestibility in sheep as well as duodenally utilisable crude protein and metabolizable energy. It is also a good source of macro and micro-minerals, except for Cu, Zn and Mg which should be supplemented.

PERSIAN CLOVER

LATIN: Trifolium resupinatum (Fabaceae)
DARI: Shabder
PASHTO: Shabder
ENGLISH: Clover

BEFORE WE START

Ecological requirements:

- Persian clover is an annual plant, grown both as an overwintering annual and as a summer catch-crop.
- It is adapted to a wide range of climatic conditions from cold to moderate. It is resistant to high altitudes (up to 2500 m) and freezing (-12 ˚C under the snow cover), and a day plant.

Soil:

- Persian clover grows in a wide range of fertile soils. It prefers neutral to alkaline soils. Optimum pH 5.5 – 9.

Crop rotation:

- BEFORE & : Persian clover is seeded before and after cereals.
- !NOTE: Persian clover usually sown in pure stand or in mixture with a nurse crop of oats.

Seeds:

- As a fodder: 1 - 2 kg/jerib broadcasted
- In pasture: 0.5 - 1 kg/jerib usually broadcasted in mixtures with other self-reseeding legumes

Cultivation tools:

- Plough, forks, shovels, levelling device, harrows, marking tools (rows design), sickles, reapers

Fertilizers:

- NEVER use N-fertilizers!!!
- **Before cultivation:** P_2O_5: 16 -25 kg/jerib during the soil preparation after the pre-crop
- **During cultivation:** Fertilization not recommended.

Watering:

- Irrigate the field immediately prior to seeding. As a fodder for hay it is grown often in irrigated areas. Also in seasonally irrigated land where year-round water cannot be assured.

CULTIVATION CALENDAR FOR IRRIGATED AREAS:

	Activity	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Field preparation and fertilization before sowing												
2	Sowing												
3	Watering												
4	Control of germination												
5	Weed control												
6	Pest control & disease control												
7	Harvest												

■ cold areas ■ warm areas ■ cold and warm areas

CULTIVATION STEP BY STEP:

1. **Field preparation and fertilization before sowing:**
   - Persian clover requires a fine, firm seed-bed, preferably with no weeds. For irrigated crops fine levelling is desirable.
   - After the pre-crop: stubble-tillage or ploughing
   - Before sowing: 2 ploughings, dragging (field levelling), harrowing (for adequate texture of soil)
   - Fertilization before sowing: NEVER use N-fertilizers and also not the organic nitrogen fertilizers! Apply P_2O_5: 16 -25 kg/jerib during the soil preparation after the pre-crop.
2. **Sowing:**
   - ***As a fodder:*** 1 - 2 kg/jerib broadcasted
   - ***In pasture:*** 0.5 - 1 kg/jerib usually broadcasted in mixtures with other self-reseeding legumes
   - The winter form may be broadcast into standing rice at the time of the last irrigation. The seeds are soaked over-night and sown (often mixed with sand to aid even distribution) broadcast into shallow standing water. In pasture it is usually broadcast in mixtures with other self-reseeding legumes.
3. **Watering:**
   - Irrigate the field immediately prior to seeding. As a fodder for hay it is grown often in irrigated areas. Also in seasonally irrigated land where year-round water cannot be assured.
4. **Control of germination:**
   - 10 – 14 days after sowing
5. **Weed control:**
   - Good soil processing and a proper crop rotation system is one of the best prevention methods. Weeding is usually done by mowing. Herbicides shouldn't be used as the residue is dangerous for the animals and eating products with herbicides can threaten man too. Never use the herbicides for clover weed control in mixtures!!!
6. **Pest control & Disease control:**
   - Clover is not seriously affected by pests and diseases. Functional prevention is good crop rotation and adequate soil processing. Check the crops regularly and remove the affected plants. Don't use chemicals! The control is done regularly by mowing.

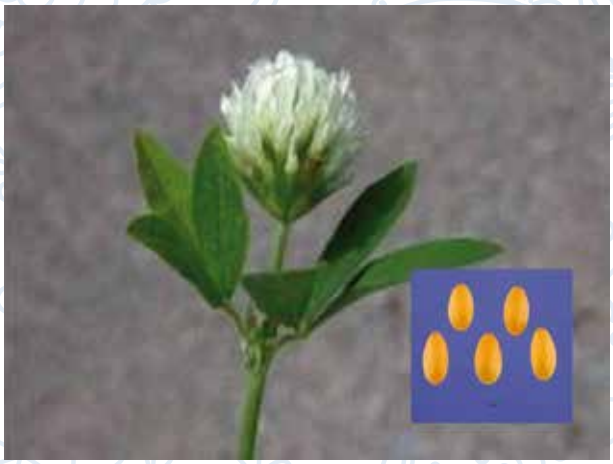
7. **Harvest:**
    - ***Grazing and green fodder:*** It can be grazed just in mixtures. If only Persian clover, it causes bloating! Do the first mowing at high of 3 cm (in winter) and 5 cm (in spring) above the ground, i.e. 50 – 60 days after sowing. The following cut at least in the interval of 30 – 40 days as a green feed it is often chaffed and fed mixed with chopped straw.
    - ***Mowing for hay:*** Use only the leftovers for hay production. Autumn growth is slow and first harvest is usually in spring. Do the first mowing in spring at high of 5 cm or in winter of 3 cm above the ground, i.e. 50 – 60 days after sowing. The following cut will be at least in the interval of 30 – 35 days. NOTE: It is not suitable for ensiling because of its high protein and moisture contents!
    - ***Seed harvest:*** Take a smallholder crop seed from part of the last cut set aside.
    - Expected yield: 150 - 200 kg/jerib

POST HARVEST STEPS:

- **Conservation:** Persian clover makes good hay and is easy to cure, although the usual care must be taken to avoid leaf-loss. Traditional practice is to tie the crop into small trusses as soon as it is wilted, dry those first on the bunds, turning from time to time, and then in loose stacks before final storage. Most of the leaves are, thus, retained within the trusses.
- **Seed production:** After the cut, the crop is dried on a threshing floor and hand-threshed. Mechanical harvest is simple, usually the crop is windrowed before threshing.
- Green fodder should be transferred to the animals as soon as possible, not to be heated up! It should be mixed with other fodders or with chopped straw before feeding!

EGYPTIAN CLOVER

LATIN: Trifolium alexandrinum (Fabaceae)
DARI: Shabder Misry
PASHTO: Shabder Misry
ENGLISH: Clover



BEFORE WE START

Ecological requirements:

- Egyptian clover is an annual plant, grown both as an overwintering annual and as a summer catch-crop.
- It is adapted to a wide range of climatic conditions from moderate to subtropical and tropical. It is cultivated up to 1500m above sea level, i.e. it is light frosts resistant (- 6 ˚C under the snow cover); long-day plant.

Soil:

- Egyptian clover grows in a wide range of soils, preferring heavy loams. It is not tolerant to waterlogging and prefers neutral to alkaline soils, optimum pH 6.5 – 8. It is salinity resistant, but not as much as Persian clover.

Crop rotation:

- BEFORE & : Egyptian clover is seeded before and after cereals.
- !NOTE: Egyptian clover is usually sown in pure stand or integrated into rice-wheat cropping systems as a winter and spring feed. It may be seeded into rice before the harvest of the cereal.

Seeds:

- 4 – 5 kg/jerib broadcasted

Cultivation tools:

- Plough, forks, shovels, levelling device, harrows, marking tools (rows design), sickles, reapers

Fertilizers:

- NEVER use N-fertilizers!!!
- **Before cultivation:** P_2O_5: 16 -25 kg/jerib during the soil preparation after the pre-crop
- **During cultivation:** Fertilization not recommended.

Watering:

- Irrigate the field immediately prior to seeding. Very early sowings must be irrigated weekly at the initial stages, thereafter according to the need. 10 - 15 irrigations are required for fodder and about 18 for seed production.

CULTIVATION CALENDAR FOR IRRIGATED AREAS:

	Activity	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
1	Field preparation and fertilization before sowing												
2	Sowing												
3	Watering												
4	Control of germination												
5	Weed control												
6	Pest control & disease control												
7	Harvest												

■ cold areas ■ warm areas ■ cold and warm areas

CULTIVATION STEP BY STEP:

1. Field preparation and fertilization before sowing:

- Egyptian clover requires a fine, firm seed-bed, preferably with no weeds. For irrigated crops fine levelling is desirable.
- After the pre-crop: stubble-tillage or ploughing
- Before sowing: 2 ploughings, dragging (field levelling), harrowing (for adequate texture of soil)
- Fertilization before sowing: NEVER use N-fertilizers and also not the organic nitrogen fertilizers! Apply P_2O_5: 16 -25 kg/jerib during the soil preparation after the pre-crop.

2. Sowing:

- 4 – 5 kg/jerib broadcasted
- Chicory (Cichorium intybus) is a very common contaminant of clover seed and may be removed by flotation at the time of seed soaking. If a nurse crop is used (e.g. oats) then that should be drilled in before irrigating and sowing the clover. Only light seed rates of oats: 4 - 6 kg/jerib should be used.

3. Watering:

- Irrigate the field immediately prior to seeding. Very early sowings must be irrigated weekly at the initial stages, thereafter according to the need. 10 - 15 irrigations are required for fodder and about 18 for seed production.

4. Control of germination:

- 7 – 10 days after sowing

5. Weed control:

- Good soil processing and a proper crop rotation system is one of the best prevention methods. Weeding is usually done by mowing. Herbicides shouldn't be used as the residue is dangerous for the animals and eating it can threaten man too. Never use the herbicides for clover weed control in mixtures!!!

6. **Pest control & Disease control:**
    - Clover is not seriously affected by pests and diseases. Functional prevention is good crop rotation and adequate soil processing. Check the crops regularly and remove the affected plants. Don't use chemicals! The control is done regularly by mowing.
7. **Harvest:**
    - **Grazing:** Not recommended for grazing! If sown in early autumn it establishes rapidly and will provide feed before and during the colder months and growth speeds up with rising temperatures in spring. As a green feed it is often chaffed and fed mixed with chopped straw.
    - **Mowing for hay:** Succulent stems are not easy to dry, hay is only made from the late spring growth when there is a peak of production. Temperatures are high and the herbage is slightly drier. It is difficult to cure and leaf drop is usually heavy once dried. NOTE: is not a suitable for ensiling!
    - **Seed harvest:** Second or third cut is suitable for seed harvest. Seed is traditionally harvested by hand, care must be taken to avoid shattering. Mechanical harvest is possible only with the proper harvesting machines
    - **Harvest for vegetable:** young shoots are eaten as a vegetable
    - Expected yield: 160 - 240 kg/jerib

POST HARVEST STEPS:

- **Conservation:** Egyptian clover makes good hay and is easy to cure, although the usual care must be taken to avoid leaf-loss. After the cut, the crop should be dried in the field and moved in some clean, wind and rain protected place after several days to complete drying. The dropped out leaves can be swept up afterwards.
- **Seed production:** After the cut, dry the crop on a threshing floor and hand-thresh it. Mechanical harvest is simple, usually the crop is windrowed before threshing; when harvested mechanically a mower with a crimper speeds up drying.
- **Green fodder:** Transferred it to the animals as soon as possible, to avoid heating up! It should be mixed with other fodders or with chopped straw before feeding!

CZECH REPUBLIC
DEVELOPMENT COOPERATION

HANDBOOK FOR PRACTICAL AGRICULTURE FOR AFGHAN AGRICULTURAL HIGH SCHOOLS

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