Integrated Production Standards

"Swat Valley Peach"

Pakistan

1. CHOICE OF ENVIRONMENT AND GROWING SUITABILITY

It is very important to assess the soil and climate characteristics of the cultivation area, taking into account the requirements of the peach trees. Particular care should be taken in choosing in the event of new crop plantations and/or varieties in the cultivation environment.

1.1 Soil

Before planting, it is necessary to know the chemical and physical characteristics of the soil where the fruit trees will be planted, therefore the necessary analysis must be carried out. The most suitable soils for the peach tree are permeable, deep, with a good water supply and free-draining subsoil, with an active limestone content below 4% and a pH value between 6.5 and 7.2.

Table 1 below shows certain criteria used to identify the aptitude level of the soil for peach tree cultivation:

Measurement	**Why it is important**	**Benchmark reference values**
pH	It indicates the chemical reaction of the soil.	6.5-7.5
Texture	It traces the relationship between the different particle size components (sand, silt and clay) to produce a particle size classification of the soil.	Medium texture
Total limestone	It indicates the total limestone content.	2-10%
Active limestone	It indicates the quantities of soluble calcium, calcium bicarbonate and calcium carbonate in the soil.	< 10%
Organic matter	It indicates the content of organic matter, which is one of the most important components in the soil because it affects the chemical, physical and biological fertility.	From 1% for sandy soil to 3% for clay soil
Total nitrogen	It indicates the total nitrogen quantity; in general, over 98% of nitrogen is in organic form, which must undergo a mineralisation process so it can be made available for the crops.	
Available phosphorous	It indicates the quantity of phosphorous available for the crops.	10-20 ppm (Olsen) 20-40 ppm (Bay-Kurtz)

Cation exchange capacity (C.E.C)	It determines a soil's capacity to hold positively charged particles (cations) in free form for the nutrition of the plants (exchangeable).	From 10 to 20
Exchangeable potassium	It indicates the fraction available for root absorption.	70-120 ppm with C.E.C.<10 100-200 ppm with C.E.C. from 10 to 20 150-300 ppm with C.E.C.>20
Exchangeable sodium	It indicates the fraction available for root absorption.	100 ppm
Exchangeable calcium	It indicates the fraction available for root absorption.	800-1800 ppm with C.E.C.<10 1500-3500 ppm with C.E.C. from 10 to 20 3000-6000 ppm with C.E.C.>20
Exchangeable magnesium	It indicates the fraction available for root absorption.	70-120 ppm with C.E.C.<10 100-180 ppm with C.E.C. from 10 to 20 150-300 ppm with C.E.C.>20

1.2 Climatic requirements

Climate conditions determine the suitability of the cultivation environment. In general, peach trees are particularly susceptible to high levels of humidity during the flowering and ripening phases of the fruits, which can encourage pathogens such as powdery mildew, monilinia and bacterial diseases. Consequently, it is best to choose areas for new planting that are less susceptible to frosts and humid wet areas; frost damage can occur on flowers with pink buds at -3 and -4 °C, on open flowers at -2 and -3 °C and on small fruits at -1 and -1.5 °C. Heavy rainfall is equally damaging around the ripening phase. Long-lasting rainfall can be damaging during the growth period; in autumn and winter this can cause waterlogging and as a result root rot during spring it can prevent pollination, which will then damage fruits in the periods around harvest time. Hail can damage the crop during all phenological phases; it is even more damaging during fruit growth or pre-harvest.
Bear in mind that from November to mid-February many peach tree cultivars have a cold requirement of between 600 and 800 hours at a temperature below 7.2°C. Nowadays, the cold requirement of nearly all common cultivars is fully satisfied by the regional climate conditions.

2. VARIETAL CHOICE AND PROPAGATION MATERIAL

2.1 Choice of variety

The varietal choice must be performed by evaluating the specific soil and climatic conditions for cultivation. In general, once the fitness of the environment is verified, the choice will be made by preferring the cultivar most widely accepted by the market for the qualitative features of the fruit. The following cultivar are "*Swat Valley Peach"* name: *Early Grande*, *Spring Crest, Elberta, Carmin (No 4), NJC-84 (No 5), Maria Delicia (No 7), Swanee* and *Indian Blood (no 8).* In any case, great care should be taken in making the decision, taking into account the climate, phenology, vigour, growth habit, productivity and susceptibility and/or resistance to the main pests.

The cultivation of varieties of or issuing from Genetically Modified Organisms (GMOs) is not permitted.

2.2 Selection of rootstock

When planting the orchard the choice of rootstock is very important for the crop to adapt the different soil and climate conditions, as well as to the environmental and agricultural conditions, in order to give the plants the best chance to grow.

The choice of rootstock must take into account the following factors:

a) Soil: the different vigour of the rootstock can effectively compensate for the different fertility, in fact in very fertile soils rootstock with controlled vigour are preferable, while in less fertile soils vigorous rootstocks are better. The active limestone content (maximum 7-8%) is very important and a pH above certain thresholds can cause iron chlorosis;

b) Cultivation techniques: it is important to take into account the shape structure and planting density, in particular relation to vigour. Generally, the planting density must be inversely proportional to vigour;

c) Variety: as a general rule, it is best to use a graft with a different vigour to the other parts: a vigorous variety requires a weak rootstock and vice versa. Early varieties benefit (more so than intermediate or late varieties) from the choice of not too vigorous rootstocks, which helps to reduce growth vigour and pruning work, improves the quality of the fruits (size and colour) and moves the date of ripening forward;

d) Pests: resistant or tolerant rootstocks must be chosen in the presence of root-knot nematodes, root tumours, silver leaf and root rot.

Below is a list of the recommended rootstocks depending on the soil and climate conditions: **local peaches** (most used); **Okinawa** with a vigorous and long-lasting rootstock resistant to the main root-knot nematodes (*Meloidogyne Incognita* and *Meloidogyne javanica*) but susceptible to *Meloidogyne floridensis* and **Nemaguard**, resistant to the main root-knot nematodes (*Meloidogyne Incognita* and *Meloidogyne javanica*) but susceptible to *M. floridensis* and *M. Xenoplax*, resistant to *Agrobacterium tumefaciens* (Crown Gall). As a result, it is resistant to calcareous soils (which cause iron chlorosis), waterlogging and root rot. It moves budding and flowering forward and therefore it is not suited to frigid climates and early spring frosts. The rootstock is vigorous and long-lasting.

2.2 Choice of nursery stock

The propagation material must come from authorised nurseries, be healthy and of a good agricultural quality, and meet the required genetic characteristics.

It is advisable to use striplings with a well-developed root system, a stem that is at least 1 m from the collar and well-lignified, a graft up to 30 cm from the collar and a diameter of at least 1.2 cm above the grafting point, which is free from pathogens damage or attacks to the roots, collar and stem.

3. SYSTEMISING AND PREPARING SOIL FOR PLANTING

3.1 Works for the planting

In the case of new planting, the first operations to be performed, only if necessary, are clearing rocks and levelling. If levelling is performed, movement of the earth is limited to avoid compromising the fertility of the layer explored by the roots or the slope stability. If the levelling involves large amounts of the active soil layer, it is advisable to set aside the topsoil and then redistribute it onto the surface after the levelling.

The soil management must ensure the correct flow of surface waters and seepage through a suitable ditch system in order to prevent waterlogging and erosion.

On hillsides, peach tree cultivation must be carried out on slopes at a gradient less than 30%.

The work on said system begins with digging the holes in correspondence to the points for setting the plants of the size of 0.8 x 0.8 m with a depth of 80 cm. Then it is recommended to make a base fertilisation with seasoned manure. The hole is then covered by filling to the bottom with surface soil. The best time for performing the work is the summer or early fall, depending on the weather conditions.

Planting is done in late autumn or at the beginning of winter so that the winter rains compact the soil around the roots of the set plants. Avoid any damage to the root system when setting the plants and make sure, once the soil has been filled in and set, that the plant remains at the same depth it was in the nursery.
The soil management should avoid waterlogging in flat areas, as well as soil erosion in hillside areas.

2.3 Systems and planting distances

The planting distances vary according to the shape structure and vigour of the plants. Planting distances and shape structures aim to produce better quality fruits and orchards with high production capacities. Generally speaking, it is best to use shape structures that allow the most sunlight into the whole crown of the plant and facilitate all the cultivation operations (pruning, thinning and harvest).
The recommended distances are in the table below:

Shape structure	Distances (M)			
	between the rows		on the row	
	min.	max	min.	max.
Vase	5.5	6.0	5.5	6.0

A break of at least three years should be given before replanting peach trees on the same soil.

4. MANAGEMENT OF THE TREE AND FRUITING

The choice and execution of crop management practices aim to bring production forward, optimise production from a quantitative and qualitative point of view and reduce production costs.

4.1 Pruning

In the first two years after planting, it is best to limit pruning to allow the plants to reach the chosen shape structure as quickly as possible and to enter into production early.
Shape pruning essentially aims to develop the final structure of the plant based on the chosen shape structure.
During regular pruning, it is important to take into account the vigour and productivity of the plant, its health condition, the fructification characteristics of the cultivar and the plant's relationship with the climate.
Winter pruning can be carried out from November to January until the flowering phase; however, it is best to avoid this procedure in late autumn because cuts made during this period encourage the spread of fusicoccum cankers. Initial summer pruning can be done as early as the fruit thinning phase; a second round

can be done in July to remove any excess growth, let the most sunlight through, avoid fruit shading and encourage lignification of the branches for the following year's produce.

4.2 Thinning

Thinning is vital to obtain consistent produce and enhance the quality of the fruits. This procedure is carried out depending on the fruit yield of the cultivar, the branch vigour, the number of leaves, the length of the internodes and the position of the branch in the crown. In practical terms, thinning should be done after the complete fruit setting phase and before the hardening of the stone.

5. SOIL MANAGEMENT

Soil management and the related processing techniques are aimed at improving the conditions for crop adaptation to maximise the production results, help control weeds, improve nutrient efficiency by reducing losses through leaching, runoff and evaporation, keep the land in good structural condition, prevent erosion and landslides and preserve the organic matter content and help rainwater and irrigation penetration. On slopes at a gradient between 10 and 15% it is essential to leguminous crops in between the rows (or spontaneous growth cut with a mower). If there is little rainfall during spring and summer (under 500 mm/year), this obligation does not apply to soils with a clay, clay loam, sandy clay, silty clay loam, silty clay and sandy clay loam texture (USDA classification); during spring and summer, as an alternative to grass planting, scarifying or soil loosening is permitted to a maximum depth of 10 cm.

On plains, planting grass in between the rows is compulsory during winter; in areas with low rainfall (under 500 mm/year) the tilling work can be brought forward. Localised manuring is permitted in soils where leguminous crops must be planted in between the rows.

6. FERTILIZATION

Fertilising must be done to ensure economically sustainable quantities of high quality products, all while respecting the requirements of environmental protection, maintaining soil fertility and preventing problems to the crop. Therefore, it must take into account the soil characteristics and crop requirements.

6.1 Manuring or basal dressing

This procedure, carried out before the peach trees are planted, can cover the whole area or it can be localised near to the planned holes where the seedlings from the nursery will be set. Taking into account the reduced needs of the crop in the first years after planting and the insolubilisation and leaching processes which the fertilizers act against, the use of mineral fertilizers based on nitrogen, phosphorous and potassium may only

meet the short-term requirements and possibly reach the minimum fertility threshold required by the species. Nitrogen fertilizers must not be used before the plants are set in the soil.

During this phase it is better to enrich the soil with organic matter and return the year of planting with legume green manure including 500 g of nitrogen per plant, or to seal about 40 tonnes of rotted manure per hectare into the soil over the whole area.

To determine the basal dressing correctly, physical and chemical soil analysis must be carried out. For each single plot, the following parameters must be determined: skeleton, texture (sand, silt and clay), pH, total limestone, active limestone, total nitrogen, available phosphorous, exchangeable potassium, organic matter, exchangeable calcium, exchangeable magnesium, cation exchange capacity, and exchangeable sodium.

6.2 Application of chemical fertilization during growth.

In this phase, nitrogen fertilisers are mainly used to encourage the rapid development of the young saplings so they enter production earlier. In the first 2-3 years, fertilisers should not be spread beyond the crown projection area so that they only affect the soil explored by the roots. From the beginning of spring, nitrogen fertilisers should be spread periodically in two split doses in relation to the water supply and fruit development.

Overall the amount of nitrogen used each year must not exceed 40 kg per hectare.

6.3 Chemical fertilization during production.

Manuring during production must maintain a nutritional supply in the soil that meets the plant's requirements during the different phenological phases in order to obtain a balance between growth and production. It should be done based on soil removal, water supply and soil analysis, with an annual maximum dose of 300 g/plant for Unit Nitrogen, 200g/plant for Unit Phosphorous and 250 g/plant for Unit Potassium.

For production the peach tree requires the most water during the 20 days before the fruit ripen, however, it is best to keep a good supply for when the shoots grow quickly.

6. IRRIGATION

6.1 Methodology for assessing the irrigation requirements

The methodology to assess the irrigation requirements is based on the calculation of the product by the reference evapotranspiration **ETo**, which depends on climatic conditions, and the crop co-efficient **kc,** a measurement of the crop's growth development during the different phenological phases, deducting the rainfall **P**:

ETo * kc – P

Monthly crop co-efficients (kc) for the peach tree depending on the soil farming methods (bare soil or grass):

	Apr	May	June	July	Aug	Sep
Grass soil	0.95	1.05	1.15	1.15	1.10	0.90
Tilled soil	0.70	0.85	0.90	0.90	0.90	0.80

To find out the ETo, you need to put the maximum temperature (**Tmax**) and the minimum temperature (**Tmin**) into the following formula:

ETo = (9.862 + 15.120 x Tmax – 9.028 x Tmin) / 1000

This sum should then be multiplied by:

(0.76 n + 55.20) **from 1 January to 15 June**

(-0.70 n + 299.97) **from 15 June to 31 December**

Where **n** is the day in the Julian calendar (1 January = 1; 1 February = 32….; 31 December = 365).

Irrigation should be carried out when the sum of the daily data of (**ETo * kc – P)** reaches the predetermined value of **Irr**, or the maximum irrigation volume (expressed in m^3/ha), which will be defined by the daily sum, as is expressed below:

Irr = daily sum (ETo * kc – P)

Maximum irrigation volumes (Irr) for different soil types:

Type of soil	Cubic metres per hectare (m^3/ha)	Equivalent in millimetres
Sandy soil	350	35
Silt soil	450	45
Clay soil	550	55

The maximum irrigation volumes are only compulsory for plants watered by sprinkler irrigation or by high flow rate hoses; conversely, there are no limitations for the micro-irrigation of plants (drip, spray, driplines and low flow rate hoses).

The farm must comply with the estimated Maximum volume for each irrigation procedure depending on the type of soil described in the table below:

Permitted Maximum Volumes for each irrigation procedure

Type of soil	m	m^3/h
Loose soil	3	35
Medium texture soil	4	45
Clay soil	5	55

The overall irrigation requirements of the peach tree have been assessed at around 3,500-4,500 m^3 of water per hectare each year. In modern orchards three irrigation methods can be used: water distribution sprinklers, drip micro-irrigation and spray irrigation. The choice of method does not affect the quantitative and qualitative results of the fruit trees. In fact, maximum production can be achieved with each of the methods, as long as they are used correctly (which means identifying for each method the best time for use, the appropriate amount and the correct shifts).

7. HARVEST

The only harvest system used now is picking by hand, the use of mechanical shakers for the harvest of industrially grown peaches has fallen into disuse.

The quality of the fruits is heavily influenced by the timing of the harvest, which is one of the most important and delicate phases of the entire peach production chain. The harvest period not only influences the appearance and flavour of the fruit but also its correct storage life.

In order to determine the right moment to begin harvesting it is extremely useful to assess the stage of ripeness by using the following parameters:

- *Ground colour of the skin:* must be whitish for cultivars with white flesh, and rather dark yellow for cultivars with yellow flesh;
- *Firmness of the flesh:* must be between 4 and 6 kg according to a penetrometer with an 8 mm rod; the higher values are used for markets that require rather long transportation times or for refrigerated keeping; the lower values are for close or local markets;
- *Dry refractive index:* must not be below 9-9.5% for very early or early, and 11% for intermediate and late.

The staggered ripening and number of harvests vary greatly depending on the cultivar; to limit the damage to the fruit during the harvest phase, it is best to:

- avoid harvesting during the hottest hours of the day;
- avoid putting excessive pressure on the fruits with your hands during the picking phase, it is better to use a twisting motion;
- place the fruit in the harvest baskets with the cheek and not the stalk;

- use soft gloves to avoid damaging the skin;
- avoid overfilling the harvest baskets with fruit;
- nail should be cut to avoid injury to the fruit during picking;
- fruit should be picked by twisting clock wise movement;
- transfer the fruit into larger boxes (crates, bins, etc.) to prevent the fruit from falling onto the ground or onto other fruits;
- avoid overfilling the rims of the containers;
- avoid exposing freshly harvested fruits to sunlight;
- transport the fruit quickly to the processing warehouse (max up to 6 hours); if it takes longer to transfer the fruit they should be kept refrigerated.

To avoid damaging the fruit during transportation from the orchard to the company centre or to the processing warehouse, it is advisable to maintain good road access around the company, use machinery that is not too rigid and work at a steady pace.

The harvested fruits should be kept in the shade and refrigerated as soon as possible, up to 8-10 hours after harvest.

It must be possible to identify each batch during all the phases, from harvest to marketing, in order to allow traceability.

7. PROTECTION

7.1 Fungal and bacterial diseases

Problem	**Intervention guidelines**	**Recommended active substances**
Brown rot: (*Monilinia fructicola, Monilinia laxa*)	**Agricultural intervention:** remove the dry twigs and the mummified fruits; avoid excessive growth by rationing nitrogen supplies and irrigation. Avoid waterlogging. Carry out green pruning to increase ventilation around the crown of the plant. **Chemical intervention:** Flowering period: take preventative action only on very susceptible cultivars and if the climate conditions encourage the development of the disease. Pre-harvest**:** on susceptible varieties treat the plants 7-10 days before harvest. In climate conditions that encourage diseases and for intermediate to late varieties developed for medium-long storage, two rounds can be done with different active substances.	Sodium bicarbonate + Mustard oil Fludioxonil + cyprodinil Fenbuconazole Tebuconazole Difenoconazole Fenhexamid Pyraclostrobin + Boscalid
Leaf curl: (*Taphrina deformans*)	**Agricultural intervention**: gather and destroy the diseased leaves and shoots. **Chemical intervention:** carry out a first round when the leaves fall. Then take preventative measures at the end of winter during the first rainfall you notice the disease after the shoot buds have burst. Then carry out treatment in the event of particularly cold, humid or rainy springs.	Sodium bicarbonate + Mustard oil Copper products Lime sulphur **Chemical control** Thiram Ziram Difenoconazole Dithianon

Root rot and collar rot: (*Armillaria mellea, Rosellinia necatrix, Phytophthora spp.)*	**Agricultural intervention:** avoid waterlogging and encourage drainage; avoid damage to the root system. Remove the diseased soil around the stem and disinfect with copper products. **Chemical intervention**: work in a localised manner with applications around the stem.	Copper products **Chemical control** Metalaxyl-M (Ridomil gold)
Powdery mildew: (*Sphaerotheca pannosa)*	**Agricultural intervention:** In high risk areas use varieties that are not susceptible; carry out balanced manuring; remove and destroy the parts of diseased plants. **Chemical intervention:** - In low risk areas (mainly on plains): take action only after the appearance of the first symptoms of the disease. - In high risk areas (mainly on hillsides and areas that have shown signs of the disease in previous years): take preventative measures at the end of the flowering phase, repeating the measures every 8-12 days. Successive measures should be taken when the symptoms appear. Avoid the repeated use of fungicide treatments when the disease is not present.	Sulphur Sodium bicarbonate + Mustard oil **Chemical control** Bitertanol Fenbuconazole Myclobutanil Propiconazole Brupinate Quinoxyfen
Shot hole: (*Coryneum beijerinckii*)	**Agricultural intervention:** In affected peach tree orchards, limit the use of nitrogen fertilisers; remove and destroy affected branches. **Chemical intervention:** The same measures should be taken for the blister. On the affected peach trees, take action also during the first spring growth phases.	Copper products Sodium bicarbonate + Mustard oil+ surf **Chemical control** Ziram Dodine

Gumosis	**Agricultural intervention:** Thin away the infected branches **Chemical intervention:** Applications in winter before the flowering	Success Score Copper sulphate

7.2 Plant eaters

Problem	**Intervention guidelines**	**Recommended active substances**
Green Aphid and Black Aphid: (*Myzus persicae* e *Myzus varians)*	**Intervention threshold:** For nectarines: 3% of shoots infected during pre-flowering and post-flowering. For peaches and cocoa: 3% of shoots infected during pre-flowering and 10% after flowering. **Agricultural control:** Avoid excessive lush growth. **Chemical control:** Take action during pre-flowering and post-flowering if the intervention threshold is exceeded.	**Biological control:** Natural enemies: coccinellidae, (*Adalia bipuncatata, coccinella septempunctata,* etc.) chrysopidae, diptera syrphidae (*Syrphus spp., Scaeva spp., Episyrphus*), Hymenoptera Aphidiidae (*Aphidius* spp), diptera cecidomyiidae (*Aphidoletes spp.).* Sodium bicarbonate + Mustard oil **Chemical control:** Methamidophos Pirimicarb Pymetrozine Fluvalinate Imidacloprid
San Jose scale and white peach scale: (*Comstockaspis perniciosa, Pseudaulacaspis pentagona)*	**Intervention threshold:** presence of the scale. **Agricultural control:** remove and destroy the affected branches. **Chemical control:** take action on hibernating forms and on first generation summer	**Chemical control:** Mineral oil Lime sulphur Buprofezin Chlorpyrifos-methyl

	nymphs.	
Fruit fly: (*Ceratitis capitata*)	**Intervention threshold:** presence of the fly.	**Biological control**: Garlic Chilli *Beauveria bassiana* Neem oil **Chemical control:** Trichlorfon Fenitrothion Etofenprox Malathion
European red mite: *(Panonychus ulmi)*	**Intervention threshold**: 60% of leaves infected.	**Chemical control:** Hexythiazox Fenpyroximate Fenazaquin Tebufenpyrad Etoxazole