Plums

— Production guideline —

agriculture,
forestry & fisheries

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— Production guideline —

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CONTENT

GENERAL

Scientific name: *Prunus salicina*

Common names: Plum (English), Pruim (Afrfikaans), Porêime (Northern Sotho), Poreima (Southern Sotho), Upululamu (isi-Zulu), Iplamsi isiXhoza), Poraema (Sepedi), Poremi (Setswana)

Origin and distribution

According to Anon (2007a) and Anon (2007b), the origin of plums can be traced along two lines, *viz* the common European plum and the Japanese plum. The common European plum (*Prunus domestica*) most probably originated more than 2 000 years ago in the regions around the Black and the Caspian Sea. The Japanese plum originated in the People's Republic of China. According to legend, Lao Tse, an Ancient Chinese philosopher who lived in the 4 Century BC, was thought to have been born under a plum tree (Anon, 2007c). Plums were also mentioned in the writings and songs of Confucius (551–479 BC), a famous Ancient Chinese teacher and social philosopher (Filippone, 2007). Pompey the Great, a distinguished military commander and political leader of the late Roman Republic, introduced plums to the orchards of Rome during 65 BC, while Alexander the Great, King of Macedonia (336 to 323 BC), introduced plums to the

Mediterranean regions (Filippone, 2007). The Japanese plum was only introduced to Japan some 300 years ago, from where it was introduced to the United States of America (Anon, 2007b) and the rest of the world.

Plums were introduced to South Africa by Jan van Riebeeck, the first Governor of what was then known as a Dutch settlement. The first reference on plums was on 11 October 1656 when he recorded in his diary, '… currants and strawberries are also thriving well and cherries, pears, plums oaks and ash trees too…' (Karsten, 1955). Methley, the only plum cultivar which is undoubtedly of South African origin, was discovered in Natal in 1907 near the homestead of Mr. W.L. Methley of Balgowan (Hurter, van Zyl, De Wet, Heyns, Ginsburg and van Tonder, 1971 and references within). Several other cultivars were introduced to South Africa during 1922 by Harry Pickstone, who could be considered as the father of the South African fruit industry. Plums are mainly planted within the Western Cape Province. Tree surveys of 2006 indicated that 4 358 ha are currently under plum production.

Production levels and areas

South Africa

According to the national Department of Agriculture (2006), the total production and gross value of plums produced in the Republic of South Africa from the 1999/2000 season up to the 2004/05 season were as follows:

Year	Gross value (ton)	Value (R 1 000)
1999/00	32 911	215 830
2000/01	38 235	258 279
2001/02	38 728	188 529
2002/03	58 336	250 759
2003/04	62 843	295 359
2004/05	55 279	250 229

The People's Republic of China, Serbia and Montenegro as well as Germany are the major international producers. According to estimated data from the Food and Agricultural Organization (FAO) (2006), the major international plum producers for 2005 were as follows:

Internationally

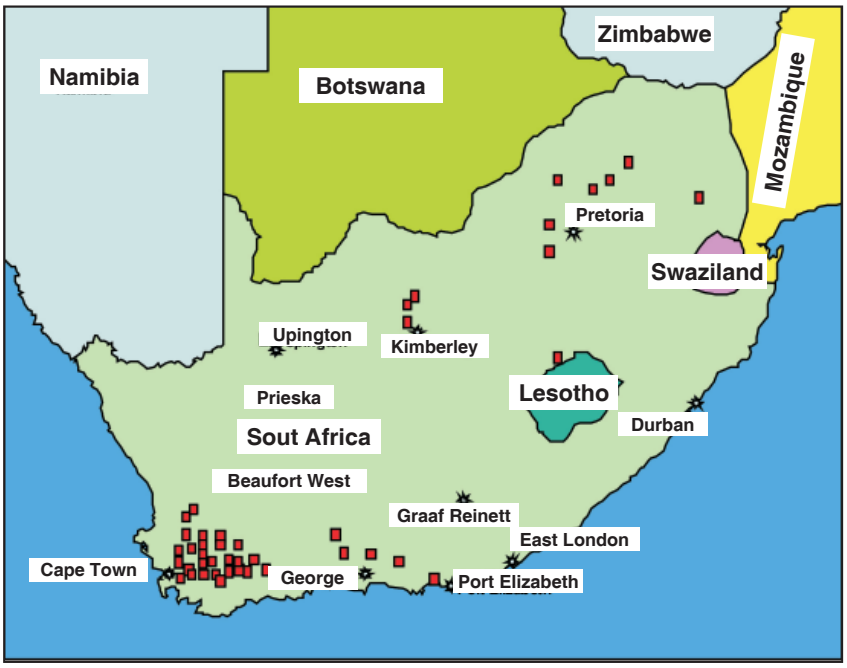
The People's Republic of China, Serbia and Montenegro as well as Germany are the major international producers. According to estimated data from FAO (2006), the major international plum producers for 2005 were as follows:

Major international plum producers

Rank	Country	Production (metric ton)	Income (international $ 1 000)
1	People's Republic of China	4 635 600	1 112 740
2	Serbia and Montenegro	580 000	140 302
3	Germany	568 000	137 399
4	Romania	409 286	99 006
5	United States of America	300 000	72 570
6	France	283 000	68 458
7	Chile	255 000	61 684
8	Spain	217 500	52 613
9	Turkey	215 000	52 008
10	Italy	191 543	46 334
11	Russian Federation	185 000	44 752
12	Ukraine	170 000	41 123
13	Islamic Republic of Iran	147 000	35 559
14	Argentina	127 413	30 821
15	Poland	100 000	24 190
16	Japan	90 000	21 771
17	Uzbekistan	90 000	21 771
18	India	80 000	19 352
19	Republic of South Africa	75 835	18 344
20	Republic of Korea	75 000	18 142

Plums are primarily produced in the Western Cape Province and some of the northern provinces but mainly and concentrated in the areas surrounding Paarl, Montagu, Stellenbosch and Wolseley/Tulbagh. According to the Optimal Agricultural Business Systems (OABS, 2006), results from a survey which was conducted during the 2005/06 season to determine the different regions where plums are cultivated and the total area under production, indicated the following:

Major production areas in South Africa	
Province	**Area under production (ha)**
Western Cape	3 903
Limpopo	35
Gauteng	23
North West	18
Eastern Cape	11
Free State	3
Mpumalanga	1
Total	**4 070**



Description of the plant

Roots

Plum trees cannot be propagated by seed as the offspring will not be true-to-type. Certified, disease-free and true-to-type vegetative material of the cultivars is therefore budded onto rootstocks. The clonal rootstocks which are currently primarily used are Maridon and Marianna. Marianna root-stocks have a more vigorous growth compared to Maridon. The root-depth of Marianna rootstock can vary from between 300 to 600 mm, depending on the soil type. They also produce very few suckers when the roots are damaged. Suckers are shoots that grows from the root or stem of a plant and are often able to produce their own roots and grow into a new plant. Maridon and Marianna rootstocks are resistant to wet soil conditions yet sensitive to drought. Both are also fairly resistant to nematode infection and well adapted to more saline soils.

Stem

Plum tree cultivars differ in growth habit. Some cultivars have moderate vegetal growth with an upright growth habit, while others have a spread-

ing, vigorous growth habit. It is important to note that all plum trees can be trained onto a trellis. However, the branches of the cultivars with an upright growth habit should not be bent more than 45 degrees horizontally when trained onto the trellis system. It is important to keep in mind that training onto a trellis is unnatural to the tree and the tree will experience stress if the branches are bent down more than 45 degrees. When under stress, the trees will also become more susceptible to fungal infections and bacterial diseases, which will in turn be detrimental to plant health and fruit production.

Upright growing cultivars also tend to produce strong growth on the upper side of the branches, which will affect the tree's fertility. These strong shoots will also prevent sunlight to enter the inner parts of the tree, resulting in the death of bearing units.

Leaves

The leaves are broad and rounded at the base and tapered towards the tip with sharp or wide tips, short petioles, with finely scalloped or notched wavy edges.

Flower

Plum blossoms are similar in form and structure to that of peach flowers. However, they are white, smaller and have longer pedicels (flowers stalks) than those of peach trees. The blossoms are predominantly borne in umbrella-shaped clusters, which consist of two to three individual flowers. These clusters are, in turn borne on short spurs. The flowers of almost all plum cultivars are self-sterile. Cross-pollinations would therefore be necessary to ensure good fruitset. Honeybees are the major pollinating agents. Individual trees blossom for a period from between 2 to 4 weeks, depending on the weather conditions. The stigma of a flower is only receptive for 6 days. Pollination should therefore take place during this period in order to ensure fruit set. The flowers secrete nectar which attracts the bees. It is advisable to place not less than six beehives per hectare in an orchard. Care should therefore be taken when applying pesticides as it could kill the honeybees. The beehives should either be covered or moved out of the orchard during spraying (Allsopp, 2007).

Fruit

A plum fruit is a drupe, in other words, the fruit has a thin outer skin, a soft pulpy inside with a hard stony central part which encloses the seed.

The fruit surface is usually covered in a greyish, whitish or bluish, waxy or powdery substance that rubs off easily. The round, smooth-skinned fruit can be red, yellow, purple or yellow-green. The fruit is borne on spurs and shoots. A spur is a short, fruit-bearing shoot that arises from either a stem or a branch of the tree. Plum fruit develops over a period from 3 to 6 months, depending on the specific cultivar and the time of harvest. Fruit thinning should commence before stone hardening occurs. This is necessary to obtain optimum fruit size at harvest. Different cultivars have varying crop potentials. Fruit thinning guidelines for each specific cultivar should therefore be followed very closely.

Seed/nut/pods

There are certain aspects that should be taken into consideration when selecting a specific cultivar. Cultivars which are sensitive to frost should not be planted in low lying areas or areas with unusually low temperatures (cold pockets). Areas prone to frost during late spring should be avoided at all costs. However, cultivars that blossom after the latest date during which spring frost occurs, can be selected. Special attention should be given to slopes, soil characteristics, the cultivar's chilling requirements and time of blossoming, climatic variations throughout the year, susceptibility to diseases and cross-pollinator requirements. The basic rule would be to plant only early maturing cultivars in early, warmer areas and *vice versa* for late maturing, high chilling plum cultivars. It is also important to identify a future market before selecting a specific cultivar. There are currently 30 cultivars which are planted commercially in the Republic of South Africa. The following four cultivars were selected on the basis of their

growth habit, i.e. upright or spreading. Further information can be obtained from ARC Infruitec-Nietvoorbij.

Cultivars

Cultivar characteristics	**Sun Kiss** (also registered under the African Pride®)	**Ruby Red**	**Pioneer**	**Southern Belle**
Chilling requirements	Medium to low	Medium to low	Low	High
Vigour	Moderate	Moderate	Strong	Moderate
Growth habit	Upright	Upright	Spreading	Semi-upright
Full bloom date	Week 37	Week 36	Week 33	Week 39
Production (kg per tree)	Reasonable (11–20)	High (>20)	Reasonable (11–20)	High (>20kg)
Harvest date	Week 52	Week 52	Week 47	Week 8
Fruit mass (g)	80	100	60 g	105
Shape	Round	Round	Round	Round
Skin colour	Yellow	Red	Red	Black
Flesh colour	Yellow	Orange-red	Light yellow	Yellow
Taste	Excellent	Excellent	Good	Moderate
Texture	Melting	Melting	Melting	Melting
Stone	Cling	Semifree	Cling	Cling
Fruit set	Good	Good	Moderate	Good

Cultivar—general aaspects	**Sun Kiss (also registered under the African Pride®)**	**Ruby Red**	**Pioneer**	**Southern Belle**
Processing abilities	Not suitable	Not suitable	Not suitable	
Storagage abilities	Excellent, sensitive to rub marks	Turns red, handles and ships well		Requires shrivel sheets during export

Cultivar—general aaspects	Sun Kiss (also registered under the African Pride®)	Ruby Red	Pioneer	Southern Belle
Storagage temperature	-10,5 °C for 35 days followed by 7 days at 10 °C	-0,5 °C for 35 days followed by 7 days at 10 °C	-10,5 °C for 35 days followed by 7 days at 10 °C	-10,5 °C for 35 days followed by 7 days at 10 °C
Pollinators	Harry Pickstone Laetitia Sapphire Sundew	Harry Pickstone Laetitia Sapphire Songold	Self fruitful	Laetitia Songold
Rootstocks	Maridon and Marianna	Incompatible with Marianna	Maridon and Marianna	Maridon and Marianna (open pollinataor)
Plant Breeders' Rights	ARC Infruitec-Nietvoorbij	ARC Infruitec-Nietvoorbij	ARC Infruitec-Nietvoorbij	Zeiger Genetics

Climatic requirements

Temperature

Plum trees require sufficient low temperatures during the winter (winter chilling) to enter into their rest period (or winter dormancy). Dormancy is a developmental phase of the tree which occurs annually and is necessary as it allows the trees to survive unfavourable winter temperatures. The trees enter into the dormant state as soon as cooler temperatures are experienced during autumn. The minimum air temperatures during this dormancy period should be between 2,5 and 12,5 °C for a period of approximately 850 to 1000 hours during the months of April to August. The trees will remain in this state of dormancy until they have been exposed to a specific period of winter chilling and will only bloom when they experience warmer temperatures during spring. Flowering and vegetative growth will therefore start as soon as the trees experience more favourable environmental conditions. It is important to keep in mind that a cold spell or late frost during spring will damage the flowers as well as the fruit, which will result if poor production.

Trees will not receive sufficient chilling during mild winters and dormancy will therefore only be achieved partially. The trees will consequently flower and sprout irregularly during the spring. This phenomenon is called 'delayed foliation'. The more winter chilling a fruit tree requires to overcome its

resting period, the more susceptible it becomes to delayed foliation. Plum cultivars differ in their chilling requirements. It is therefore important to take the chilling requirements into consideration when selecting cultivars for a specific region. It is advisable to seek expert advice on this aspect.

Rainfall

Annual rainfall should be taken into consideration in planning a plum orchard as it could affect the fruit quality negatively. The quantity of rainfall would also determine the quantity of irrigation that should be applied to supplement the water requirement of the trees. The occurrence of rainy, windy conditions during flowering will lead to poor fruit-set as the pollinating agents (bees) would not be able to operate.

Soil requirements

Plum trees can grow in a variety of soil types but prefer deep, well-drained soils, ranging from sandy loam to sandy clay loam, with an effective depth of at least 600 mm. However, plums are more tolerant to heavy or waterlogged soils than most other stone fruit types. The soils should have a pH (KCl) of between 5,5 and 6,5. Areas where nematodes are problematic should be avoided, although plum rootstocks are reasonably resistant to root-knot nematodes. Soil profile pits should be made to inspect the soil in order to determine the best method to be used in preparing the soil. Any limiting soil layers, such as compacted or very clayey soil layers, should be identified as these layers will prevent water drainage and limit root development. At least six soil samples should be taken to determine the nematode status within the soil in order to control of the nematode infestation.

CULTIVATION PRACTICES

Propagation

Plum trees cannot be propagated from seed. Buds of the required cultivar are either budded or short shoots are grafted onto compatible rootstocks. The rootstocks should be selected according to the criteria mentioned earlier in this publication. It would not be advisable for a producer to propagate his own trees. All plum trees in South Africa have Plant Breeders' Rights and are therefore protected by legislation against illegal propagation.

However, it would be advisable to purchase trees from a reputable nursery as it would ensure true-to-type as well as pest and disease-free trees.

Soil preparation

It would be sensible not to economise on soil preparation. In the long-run thorough soil preparation will be rewarded with higher yields. The land should be cleared of any weeds or plant residues from crops which previously grew on the land. Soil samples should be taken and sent to a reputable laboratory to be analysed in order to determine the nutrient content and the water-holding capacity of the soil as well as to test for the incidence of diseases or pests such as nematodes. The soils could be fumigated when the soil analysis indicated a nematode problem. However, expert advice should be obtained. Herbicides must be applied with care as traces of herbicide residue in the soil could have a negative effect on young trees.

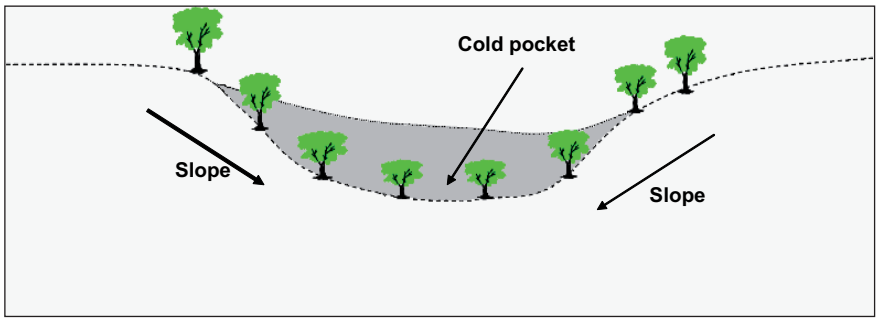
It is also beneficial to seek expert advice with regard to site selection and soil preparation. Soil samples should be taken prior to soil preparation.

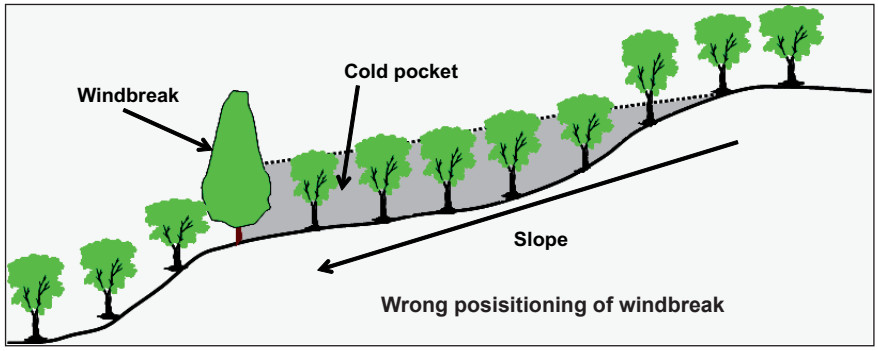
At least five to six soil sample pits should be made in a plot of one hectare (100 m x 100 m). A spade should be used to make a pit of 1 m wide, 1 m in length and 1 m deep. A vertical sod from the surface down to a depth of 30 cm must be taken from the profile wall and transferred into a marked plastic bag. The second sample should be taken from the wall in the bottom part of the profile (30 cm to 60 cm deep). The blade length of a new spade is approximately 30 cm.

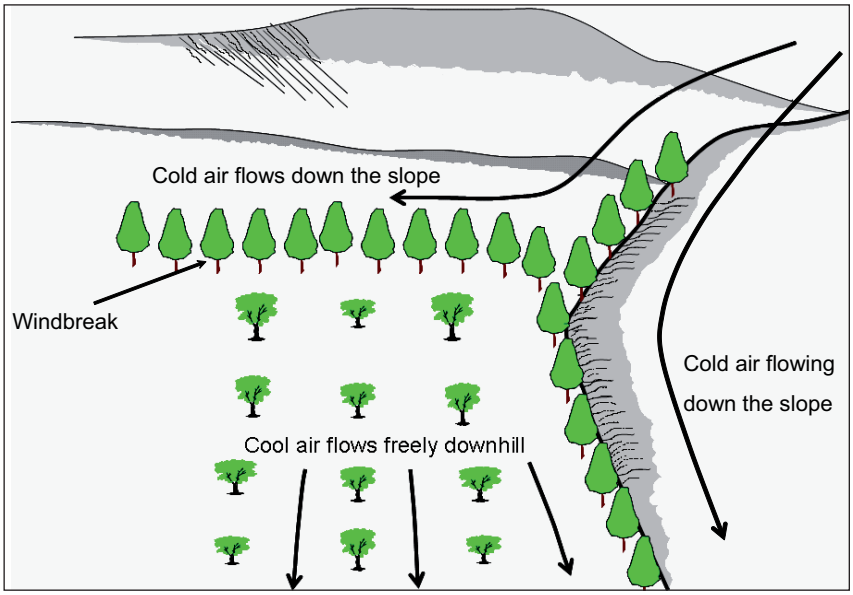
Any layer in the soil, such as a stone or clay layer as well as the depth at which it occurs should be recorded. All stones larger than 10 cm in diameter may be removed from the sample. However, the number and sizes of stones not included in the sample should be recorded. The samples can be sent to a reputable institution for a soil analysis. The sampling pit should be filled again. The bottom layer soil, in other words, the layer which was removed last, should be replaced firstly into the pit. This step is important as the bottom layer usually consists of more clay. If the bottom layer of soil is replaced into the top part of the pit, it can lead to soil compaction. The samples taken at the different positions should not be mixed or added together. This is important as the soils within one plot can differ in texture. The position within the plot where the samples were taken should be marked.

The results of the soil analysis will indicate whether the soil is suitable for plum cultivation and, if so, which kind of fertilisers as well as the quantity of fertiliser to be applied.

A good practice to follow would be to establish a green cover crop such as oats at least 1 year before planting on the chosen site. This would improve the soil texture and organic matter content of the soil.


Cold pocket
Slope
Slope


Windbreak
Cold pocket
Slope
Wrong posisitioning of windbreak


Cold air flows down the slope
Windbreak
Cold air flowing
down the slope
Cool air flows freely downhill

A general rule would be to prepare the soils to a depth of 50 to 80 cm. The soils should at least be moist and not saturated when ploughing. All limiting soil layers should be loosened in order to ensure good drainage and healthy root growth. Deeper, clayey soil layers should not me mixed with the topsoil. Soils with high water-tables should be drained. Shallow soils can be ridged to a height of approximately 50 cm. All the limiting factors should be removed during soil preparation. The correct amounts of phosphate and potassium should be applied to soils. Dolomitic lime should be applied if the soil pH(KCl) level is below 5,5. Any basic phosphate could be applied to acidic soils. However, superphosphate should be applied to alkaline, so-called ''sweet'' soils or soils with a high lime content. Fertiliser applications should be done according to the results of the soils analysis.

Planting

There are certain aspects which should be taken into account before the trees are established, *viz*. slope, plant spacing/planting density, design of the orchard, planting date and planting depth. Proper orchard planning should be done in order to achieve optimum use of land and to ensure cost-effective orchard management. It is important to have the correct irrigation system installed before the trees are planted.

Slope

Cold pockets will occur in low-lying areas such as the bottom of a valley as illustrated in the pictures below. It is important to remember that cold air is heavier than warm air. The cold air will accumulate in the lower-lying areas of an orchard which could lead to frost damage. This should be kept in mind when establishing plums in areas that are prone to frost.

Windbreaks should not be planted across the line of airflow in an orchard as it will hamper the flow of cold air from the orchard (see picture below). Excessively cold air within the orchard will result in frost damage in the rows adjacent to the windbreak. The direction of the planting rows should allow movement of air in order to avoid frost damage to fruit as illustrated in the picture below.

Design

Windbreaks are important in areas in which strong winds are a prevailing factor. This will ensure protection against wind damage. Windbreaks should be erected before planting, preferably with an own irrigation system.

The windbreaks should also be orientated in such a way to allow air movement in areas affected by frost as illustrated previously. Tree rows should be orientated in a north-south direction in order to obtain maximum light penetration needed for good tree and fruit growth. However, the rows should run downhill when the trees are planted on a sloping plot. This will ensure sufficient movement of air within the orchard, allowing cold air to drain away from the trees to the lower-lying areas beneath the orchard.

Planting date

The best time to plant is when the trees are still dormant, i.e. late July to mid-August.

Planting depth

Nurseries usually sell rooted trees in bundles of 20 to 25 trees. The roots should be covered with moist wood chippings when the trees are transported from the nursery to the farm. This step is necessary to prevent the roots from drying out. Under no circumstances should the roots be allowed to dry out. The planting holes should be made to the same depth as they have been in the nursery, provided the soil was prepared properly in advance. However, if the soils have not been prepared in advance, i.e. house gardens, it would be necessary to make larger square planting holes, *viz.*, 1 m wide x 1m in length x 80 cm in depth. The edges of the planting holes should be roughened in order for the plant roots to penetrate the soil adjoining the planting hole. Specific amounts of lime, phosphorus, potassium and microelements, based on the soil analysis, should be applied to the soil and mixed thoroughly.

The roots should not get into contact with any fertiliser or manure which was applied into the planting hole as the roots might get scorched. The trees should be planted with the bud-union of the tree approximately 5 to 10 cm above the soil surface. The soil should then be packed firmly around the roots and irrigated directly after planting. Care should be taken not to compact the soil in the planting hole as it would have a negative effect on the soil aeration which, in turn, will result in poor root development.

The last step would be to trim the central, leading branch of the tree to approximately 20 to 30 cm above the bud-union where the first branches will be produced (±70 cm above the soil surface), directly after planting. Depending on the training system, the tree should be allowed to develop 3 to 4 well-positioned branches which will eventually form the main scaffolds.

Fertilisation

There are certain factors which would influence the fertilisation programme of plums, such as, soil type, soil and plant reserves, the age, size, vigour and yield of the trees and the fertilisation programme used in the past.

Soil type

Nutrients such as nitrogen and potassium tend to leach easily from sandy soils. The correct quantities and application rates of fertilisers should therefore be applied annually according to soil and leaf analyses.

Soil and plant reserves

The analyses of the soil as well as the leaves of the tree will give an indication of the nutrient status of both the soil and the plant. These results should be taken into account in planning the fertilisation programme. Soil and leaf analyses should be done not later that January of each year.

Age of the trees

Vegetal growth of young trees should be stimulated for the first 3 years and, depending on the growth rate, these should not be allowed to bear any fruit during this period. Vegetal growth of trees planted in good soils can be regulated by allowing a light crop during the second and third tear after planting. This is sometimes necessary to prevent overshadowing of the inner parts of the trees or what is called goof sunlight management. The fertiliser requirements of young trees differ considerably from those of mature, full-bearing trees. The fertilisation of mature, full-bearing trees should therefore be adapted to ensure good optimum yields and quality fruit.

Size of the trees

Larger trees require more fertiliser than smaller trees. Fertiliser programmes should therefore be managed according to expected production.

Vigour of the trees

Nitrogen applications should be decreased if the trees grow too vigorously. More fertiliser should be applied to the trees which are not performing well.

Yield of the trees

The quantity of nutrients that is lost as result of the harvested fruit, will determine the quantity of fertiliser which would be required. More fertiliser would be required for a larger yield in comparison to a smaller yield.

Fertilisation programmes used in the past

Records of the quantities and application rates of fertilisers as well as the results of the soil and leaf analyses should be kept for future reference.

Fertilisation of young trees

The future production potential of a tree will be determined by the attention it has received during the first 3 years. Only nitrogen should be applied during the first 3 years. However, potassium should be applied with the nitrogen to sandy soils (<10 % clay content). It is important to allow the young tree to fill the space allocated to it as soon as possible. However, overshadowing of braches should be avoided.

First year after planting

The first application should be applied 1 month after the tree has been planted. Each tree should get 8,5 g limestone ammonium nitrate (LAN), or its equivalent, every month until leaf senescence during autumn. Potassium should only be applied to sandy soils when it was not applied during soil preparation. Potassium chloride (KCl) should then be applied at a rate of 15 g per tree every alternate month. The fertiliser should be applied over an area of approximately 50 cm around each tree or not wider than the drip zone of the tree.

Second year after planting

Each tree should receive 17 g LAN or its equivalent every month from bud reak until leaf senescence during autumn, applying the fertiliser over an area of 750 mm around the tree. Potassium (30 g/tree) should be applied every alternate month only if it is necessary.

Third year after planting

Nitrogen and potassium should be applied if the trees have not grown yet enough to fill the space allocated to them. Nitrogen should be applied at a rate of 25 g per tree/month and potassium at 45 g per tree every alternate month. The fertiliser should be applied over an area of 1 m around each tree.

Fertilisation of bearing trees

There are certain factors to be taken into consideration in determining a effective fertilisation programme such as the removal of nutrients by the crop, effective application of fertilisers and fertilising according to the expected production.

The size of the crop, the vigour of the trees and the concentration of the nutrients in the fruit and the rest of the tree will determine the quantity of the nutrients that is removed during harvest and autumn.

Some of the fertilisers which are applied do not always reach the roots of the tree and would be inaccessible to the tree. Some fertilisers such as nitrogen also leach readily from soils and could therefore not be absorbed by the roots of the trees. Larger quantities of fertilisers are usually applied in order to compensate for these factors.

It is also important to take soil and leaf samples (not later that January of each year) in order to determine the nutrient status of the soil as well as of the trees. Guidelines for the fertilisation of full-bearing plum trees are indicated in the following Tables, *viz*.

Production (t/ha)	Vigour: Poor			Vigour: Normal		Vigour: Strong	
	Full bloom	Summer	Autumn	Full bloom or summer	Autumn	Full bloom	Autumn
10	25	25	25	12,5	25	0	25
15	35	35	35	17,5	35	0	35
20	45	45	45	22,5	45	0	45
25	54	54	54	27,0	54	0	54
35+	62	62	62	31,0	62	0	62

Production (t/ha)	Full bloom			Autumn		
	K saturation (%)					
	< 3	3–4	> 4	< 3	3–4	> 4
10	60	60	0	30	0	0
15	90	90	0	45	0	0
20	120	120	0	60	0	0
25+	150	150	0	75	0	0

Production (t/ha)	Full bloom	
	P in leaves (%)	
	< 0,14	> 0,14
10	15	0
15	20	0
20+	25	0

Nitrogen nutritional need (kg N/ha) during different growth stages of the season for medium and high-density plum plantings varies according to vigour and expected production (Kotzé, 2001).

The fertilisation applied during the spring/summer is used to manipulate the vigour of the trees. Application rates can be increased or decreased according to the tree's need.

Potassium nutritional need (kg K/ha) during different growth stages for medium and high-density plum plantings varies in order to increase Potassium to the 4 % level of the Cation Exchange Capacity and expected production (Kotzé, 2001)

Phosphorous fertilisation need (kg P/ha) during the different growth stage of the season for high-density plum plantings variesaccording to P-status of the leaves and expected production if extractable P within the soil is lower than 15 mg/kg (Bray II)

Irrigation

Certain important factors should be taken into consideration in deciding on the volume and frequency of irrigation of plum trees. Such factors include soil type, water quality, climate, season, type of fruit, the age and size of trees, growth phase of the tree, the type of irrigation system used as well as mulching with organic material such as straw.

Soil type

Sandy soils consist of coarse particles, resulting in low water holding capacities. It is therefore essential to apply small volumes of water at relatively short intervals. Clayey soils consist of finer particles resulting in higher water-holding capacities. Larger volumes of water should therefore be applied with longer intervals between irrigations.

Soil containing large quantities of organic material can hold the water more effectively and require longer intervals between irrigations. Plum trees can be cultivated in a variety of soil types on condition that the soil is well drained. It is therefore important to examine the soil for any limiting layers before planting.

Excessive irrigation can result in the leaching of nutrients from the soil while waterlogging and root disease can occur. Signs of over-irrigation on plums will be viable as patches of gum (gummosis) oozing from the lower parts of the tree trunks. Insufficient water would inevitably inhibit tree and fruit growth as well as fruit quality.

It is therefore important to have the soil analysed for water-holding capacity as well as particle size distribution. By doing this, the correct volume of water can be applied and excessive or insufficient irrigation can be prevented.

Climatological factors

The climate also determines how often and how intensively one should irrigate. It is evident that plum trees in warmer climate areas require more water compared to trees in cooler areas. The rainfall should also be taken into account in deciding whether to irrigate or not. Wind also influences the water consumption of trees. It is essential to replenish the water in the soil after a long, windy period.

Seasons

Irrigation is also affected by seasons. Less irrigation will be necessary during spring and autumn when the temperatures are lower than during the warmer and drier summer months.

Type of fruit

The most suitable crop must be selected according to the volume and quality of the water available. Different crops have different water requirements. Most fruit trees are very sensitive to high saline concentrations in the water and soil. Of all the stone fruit types, plums are the most tolerant to high saline soil conditions.

Size of the tree

Young trees should be irrigated more frequently than older trees, as their root systems are still relatively shallow and not well-adapted at this point in time. However, smaller volumes of water should be applied during irrigation. Care should be taken to avoid shallow irrigation, as this will not stimulate root development in the deeper soil levels. The root systems of larger and older trees are generally much deeper. Larger volumes of water, less frequently applied, are essential in order to wet the total root zone.

Growth phase of the tree

The growth phase of the crop should also be taken into account in determining the irrigation cycle. Four growth phases can be distinguished for plums, namely:

Phase 1 (cell division and cell growth, i.e. from bud-break until 40 days after full bloom)

Phase 2 (fruit growth, a period of approximately 11 weeks)

Phase 3 (fruit ripening, a period of approximately 9 weeks)

Phase 4 (post harvest, a period of approximately 12 weeks)

The trees usually do not require much water during spring, which is the first growth phase. The normal spring rainfall is usually sufficient. Little irrigation is therefore required during this phase. Excessive irrigation during this stage can inhibit root development.

More water is necessary during the second growth phase. Sandy soil should be irrigated at least once per week and twice per week under warm and dry conditions. Irrigation should be applied correctly during the ripening phase. Excessive irrigation during this phase will result in flavourless fruit with a low sugar content and the fruit will bruise easily.

The same guidelines used in the first phase should be followed during the post-harvest phase. The irrigation intervals could vary from between 7 to 14 days during the first and the last growth phases, as it is dependent on the type of soil and the climate of the area.

Estimated water requirement

The estimated water consumption for plum trees is indicated in the following table. These estimations are based on a Class A-evaporation as well as the utilisation of a microirrigation system and are only applicable to fully-grown trees. It is important to note that these figures should only be used as a guideline. The volume of supplementary irrigation would then be the water requirement minus the rainfall.

Month	Water requirement (cubic meter/ha per month)
January	1 938
February	1 627
March	1 185
April	322
May	217
June	165
July	170
August	232
September	415
October	840
November	1 260
December	1 821
Total	10 192

It is advisable to measure the soil water content. However, most of the instruments used to monitor soil water content used by commercial farmers are rather expensive. A basic and most cost-effective method is to dig a hole, within the drip zone of the tree, 1 day after irrigation. An indication of the depth of the water infiltration can then be observed. The moisture content can also be determined by feeling the soil between one's fingers. Although this method is not very accurate it could give an indication of the water content in the soil.

Weed control

Weeds within the work row must be kept short, however, a strip of not more that 1,0 meter on both sides of the tree should be kept clear of weeds. Two types of herbicides can be used, i.e. Roundup or Gramoxone. Roundup should not be sprayed in orchards where the trees are younger than 3 years. This herbicide is a hormonal herbicide and should not come into contact with any green parts of the trees. Gramoxone, on the other hand, is a contact herbicide which has a scorching effect on the trees. However, the application instructions should be followed very carefully.

Weeds that interfere with the water distribution pattern of the emitters should be removed. Tall weeds can obstruct the operation of especially rotating emitters of the irrigation system as these prevent the rotation of the swivel, causing the water to spray only one spot only.

Pest control

There are a number of pests that can occur on plums, *viz.* fruitflies, fruit-piercing moth, vinegar fly, codling moth, false codling moth, American bollworm, fruit nibbler, Antestia bug, leafroller, snoutbeetles, CMR beetles, garden locusts, fruit beetles, thrips, aphids, Bryobia mite, grey scale, mealybug, nematodes, pernicious scale, red scale, red spider mite, European red mite, slug caterpillar and weevils. However, of all the pests listed above, the ones encountered most often are the banded fruit weevil, scale (red and pernicious), thrips, American bollworm, fruitflies and the codling moth. All the other above-mentioned pests occur sporadically but do cause damage on plums.

Banded fruit weevil

Banded fruit weevils are also called snoutbeetles or V-backed snout beetles. They have elongated heads with protruding, often curved snouts, which bear the mouthparts and antennae. Adult weevils are hard-bodied,

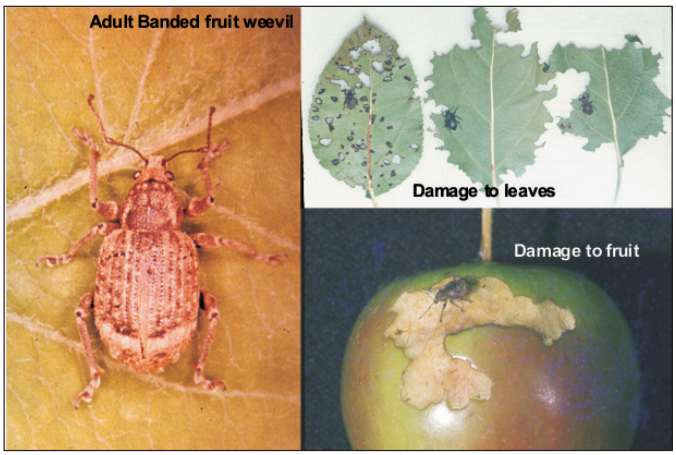


Photo: ARC 2007, Murial Knip

grey-brown, approximately 7 mm in length and are incapable of flight as they do not have wings. They have hard, bulging, sphere-shaped abdomens with a characteristic V-shaped line across the rear of the abdomen. The soft-bodied larvae on the other hand, grow to a length of 6 mm, are arc-shaped and legless, have a creamy white colour with brown heads and live in the soil. The adult weevils feed on foliage, flowers, buds and fruit. They feed at night, are inactive during the day and they often escape from potential predators by pretending to be dead. The females lay eggs in loose organic matter on the soil. These eggs hatch in 10 to 14 days. The larvae immediately burrow into the soil, where they feed on plant roots. The larvae develop throughout the winter and pupate during the spring. Adult weevils emerge from the soil from mid to late October. The highest numbers of weevils are usually found during November and December and sometimes also from January till as late as March. These pests can be controlled either biologically, physically or chemically, or by cultural means.

Biological control—Birds predate on these pests, but chickens and guinea fowl can be employed to reduce the weevil numbers.

Cultural control—Weevil numbers can be reduced by removing the weeds from the planting rows as the larvae feed on the roots of the weeds and the adult weevils use the weeds as ‘ladders’ to climb onto the trunk of the trees.

Physical control—Sticky bands can be placed around the trunks of the trees. This will prevent the adult weevils from reaching the canopy.

Chemical control—Pesticides registered specifically for the banded fruit weevil and which contain active ingredients such as acephate, beta-cypermethrin and cypermethrin can be sprayed onto the leaves as soon as damage is noticed.

Scale (red and pernicious)

The word 'scale' refers to the thick or scaly cover which protects them from predators. Scale insects are 2 to 3 mm in length. There are two kinds of scale insects which occur on plum trees, *viz*. the pernicious and red scale.

Pernicious scale is an armoured scale, in other words they have a hard, protective covering. These scales are relatively circular and slightly conical. The colour varies from greyish-black to grey and have a distinct yellowish centre. The body of the insect underneath this scale is stationary and bright, yellow in colour, has four distinct lobes which are situated near or towards the back of its body. These insects feed on the branches, shoots, leaves and even fruit by sucking the sap from the plant tissue. The branches of the trees could start dying back if the tree is infested heavily.

Reds scale is similar in size to the pernicious scale. The protective covering (scale) appears brownish red but is actually transparent. The colour can be ascribed to the colour of the insect's body underneath the scale.

Ants are usually associated closely to the scale insects. The reason being that scale insects produce large quantities of honeydew, which provides a food source for ants.

These pests can be controlled biologically, chemically, or by cultural means.

Biological control—Ladybirds, lacewings, praying mantis and even birds will assist in controlling the scale insects if the ants are controlled. .

Cultural control—Branches that are heavily infested should be pruned away and destroyed.

Chemical control—Pesticides registered specifically for these insects and which contain active ingredients such as chlorpyrifos, methidathion, polysulphide sulphur and prothiofos can be applied. Light mineral oils can also be applied during the dormant phase of the tree. At least 2 to 3 applications should be applied before the trees start to blossom.

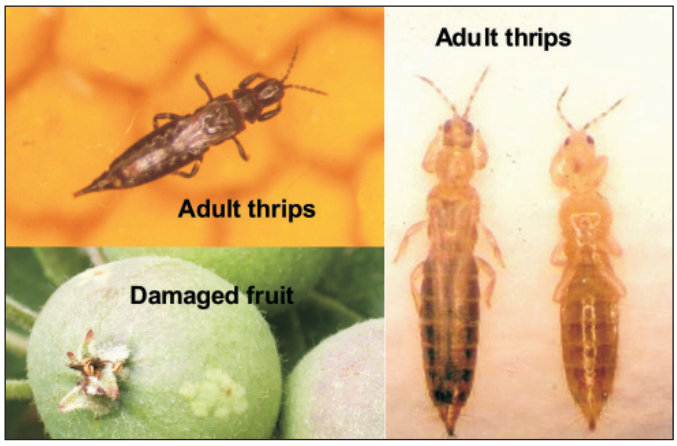


Photo: ARC 2007, Murial Knip

Thrips

Thrips are tiny insects, 1 to 2 mm in length, slender, varying in colour from from yellow to black and are barely visible to the naked eye. The adults have long, slender, membranous wings, fringed with fine hairs. Thrips have piercing mouthparts. They pierce the cells of the plants and feed on the plant juices. The plant cells will consequently collapse, resulting in deformed flowers, leaves, stems, shoots and fruit. The adults also lay eggs one by one beneath the skin of young fruit. The hatched young thrips leave the fruit, however, the wounds made to the fruit by the larvae, remain. These wounds develop into round holes as the fruit swells.

Biological control—Lacewings, ladybirds, praying mantis, chameleons and even birds will assist in controlling these insects.

Control by cultural means—Weeds provide a habitat for these insects as they feed and reproduce in weeds, especially in the absence of crops. It is therefore necessary to keep the planting row free of weeds.

Chemical control—Pesticides registered specifically for these insects and which contain active ingredients such as chlorphenapyr can be applied. Pesticide should be applied when the first signs of damage are noticed.

Americam bollworm

These insects are prominent on all deciduous fruit crops. The young larvae has a dark-beige colour, are hairy but tend to become lighter in colour as

they grow older. The colour of mature larvae can vary from green to brown or reddish-pink with a distinct pale abdominal side. They are approximately 30 mm long and have a characteristic yellow stripe on both sides of their bodies. The colour of both the adult male and female bollworm moths can vary from a dull yellow to light or dark-brown. However, the males have a touch of olive-green. The rear wings of both the male and female moths are paler in colour with a typical large dark brown to black spot. Adult moths are 15 to 20 mm long. The larvae feed on flowers, young shoots and newly set fruit. The damaged fruit will form corky tissue to protect the wound. These 'scars', in turn, will affect fruit development, resulting in malformed fruit.

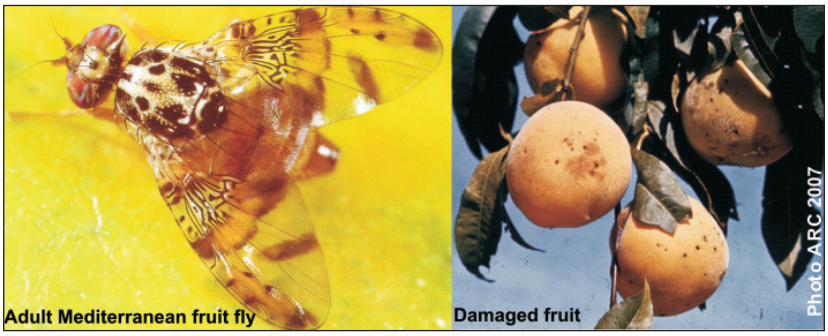
Biological control—Owls, bats and other nocturnal feeders can control the moths. Other garden birds, which feed on the larvae, should be encouraged to nest in the trees. Spiders and lacewings also predate on the larvae.

Control by cultural means—Monitor the leaves for the occurrence of moth eggs and larvae as well as for damage to leaves and fruit caused by the larvae. Remove the eggs and larvae and destroy these.

Chemical control—Pesticides registered specifically for the these insects and which contain active ingredients such as acephate (Western Cape Province only), beta-cypermethrin, cypermethrin, deltamethrin, endosulfan, lambda-cyhalothrin and tralomethrin, can be applied. It is of the utmost importance to follow the application instructions as supplied by the manufacturer of the pesticide.

Mediterranean fruitfly

The adult female Mediterranean fruitfly lays her eggs underneath the skin of ripening fruit. These eggs are small (1 mm long), white and banana



shaped. These eggs hatch within 2 to 4 days. The tiny larvae immediately starts feeding on the ripening fruit when they emerge. The larvae are translucent when they hatch, turning to a creamy-white as they grow in size to approximately 8 to 10 mm in length when fully grown. The larvae have a typical maggot shape, with distinct reddish-brown to black mouthparts at the front tip. The pupae, which hibernate in the shallow soil layers, are brown, fairly hard, barrel shaped and approximately 3 to 4 mm in length. The adult Mediterranean fruitfly is approximately 8 mm long and has shiny, blue eyes. The body usually has a yellow or light-brown colour. Its wings are spotted with brown bands extending to the tips of the wings. The thorax of the adult has black patches which are bordered by a silver colour. Crop damage is caused by the larvae, which tunnel into the pulp of the fruit, feed on the fruit which causes the fruit to decompose, resulting in unmarketable fruit.

Control by cultural means—All the rotten fruit which have fallen from the tree should be picked up. A hole should be made in the soil to a depth of at least 600 mm, in an area away from the orchard. All the rotted, infected fruit should be discarded into these holes and covered with a 50 cm thick layer of soil.

Fruitflies should also be monitored by using fruitfly traps. Commercial traps using pheromones are available at the cooperatives. Pheromones are chemical compounds, produced and secreted by an animal, which influence the behaviour and development of other members of the same species.

Chemical control—Pesticides registered specifically for the these insects and which contain active ingredients such cypermethrin, dimethoate and fenthion can be applied. It is of the utmost importance to follow the application instructions as supplied by the manufacturer of the pesticide.

Codling moth

This insect is one of the most damaging pests on deciduous fruit. The adult codling moth has an inconspicuous, dull brown to grey colour, is 10 to 15 mm long (at rest), with distinct cross-bands on the forewings and a metallic-bronze spot near the tips of each wing. The eggs are small (the size of a pinhead), round, flattened, straw-coloured and difficult to detect. The eggs are laid during the earlier part of the season on young twigs. Later in the season the eggs are laid on the leaves or on the fruit. The eggs usually hatch in approximately 5 to 6 days. The larvae are whitish with dark heads and grow to approximately 20 mm in length. The larvae chew their way into the fruit without swallowing or absorbing the plant tissue. The plant tissue is pushed to the outside of the fruit where it will accumulate and will be visible as frass. Frass is insect excrement or debris left behind by an insect or insect larva. Larvae will feed and grow for 4 to 6 weeks. After 6 weeks the larvae will leave the fruit and will crawl to the adjacent branches and stems to find a suitable spot to pupate. The larvae usually pupate on old pruning wounds or cracks in the wood of the tree. The pupae are dark orange-brown and approximately 10 mm long. The life-cycle of this insect would continue with the emergence of the adult moth from the cocoon.

Biological control—Codling moths can be controlled biologically by a tiny yellow wasp called the digger bee or parasitic wasp (Tric*hogrammatoidea lutea*). This wasp is a parasitoid. A parasitoid is an insect that lays its eggs inside the living body of another animal or insect. The hatched newborns feed off the body, eventually killing the host. These wasps should therefore be encouraged in an orchard or garden.

Control by cultural means—The fruit should be monitored for codling moth damage. All the damaged fruit should be removed from the orchard and

buried. Bats, birds and other predators should be encouraged to forage in the orchard.

Mating disruption—Pheromone traps are placed randomly in different areas within the orchard. Mating disruption involves saturating an area with the female pheromone so that males get confused and cannot find females to mate with. The male moth only has a certain period of time in which to locate a female. If the male is not able to find a female, the cycle is disrupted as no mating would be possible.

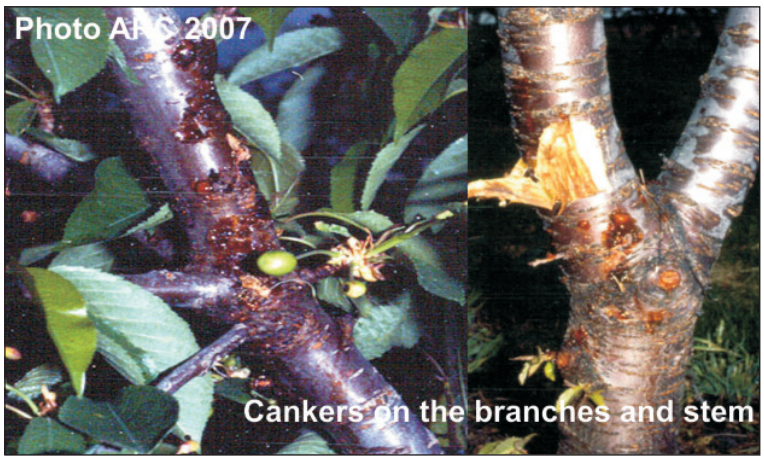
Chemical control—Pesticides registered specifically for these insects and which contain active ingredients such acephate, azinphos methyl, beta-cypermethrin, cypermethrin and methidathion can be applied. It is of the utmost importance to follow the application instructions as supplied by the manufacturer of the pesticide. Codling moth control should be done in close cooperation with monitoring.

Disease control

The most common diseases which affect plum trees are bacterial canker, bacterial spot, blossom blight, brown rot and crown gall. A disease which affects the fruit after harvest is powdery mildew.

Bacterial canker

This disease is caused by bacteria called *Pseudomonas syringae* pv. *syringae* (van Hall). The symptoms are typically by cankers, secreted gum and dieback. The bark and branches of the trees are usually attacked



during the winter, resulting in cankers. The infected parts of the tree or cankers will have a brown colour and gum will be secreted from these parts during the late spring and summer. Leaves and fruit occur sporadically but could pose a problem during long-lasting cold and wet weather conditions during of shortly after bloom. Small, brown spots with yellow edges will be visible on the leaves.

Disease cycle

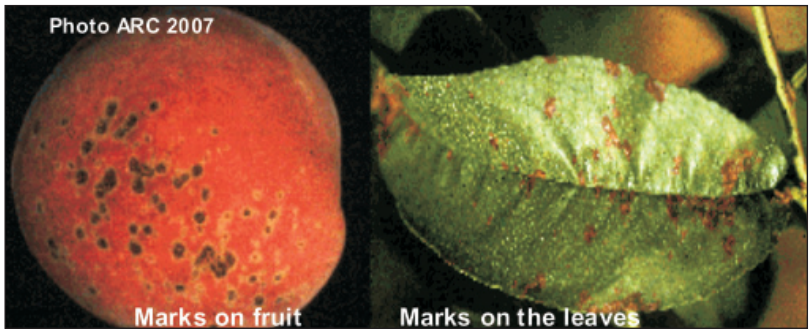
Bacterial canker infections usually occur during the autumn and winter. The bacteria can survive during the winter in the tissue of the bark at canker margins, in seemingly healthy buds and by spreading through the vascular system of the tree. The bacteria will grow and multiply within these areas of the trees during the winter and will be spread by rain to the blossoms and young leaves during the spring. The bacteria can also survive during the summer by growing as an epiphyte on the surfaces of leaves without showing the symptoms and on other plants or weeds in the orchard. An epiphyte is a plant that grows on top of or is supported by another plant but does not depend on it for nutrition.

Control

The most important control measure is to minimise stress on young or recently planted trees. Sufficient irrigation should be applied to prevent drought stress. Optimum nutrient levels should be maintained. Other pests and diseases, which could weaken the tree, must be controlled. Weeds should be removed as these not only compete for water and nutrients, but also increase the humidity and may harbour populations of the bacteria that cause canker. Severely affected trees should be removed and dead or dying branches should be pruned and removed from the orchard. It is unlikely that the disease would spread if pruning is done during dry weather conditions in midsummer. However, it would be advisable to disinfect the pruning tools after pruning as this will prevent the disease from being spread from one tree to another. Pruning should not be done during the early spring and autumn as the bacteria are the most active during these periods. The cankers can also be healed partially as the tree has the ability to contain it with callus tissue.

Bacterial spot (*Xanthomonas campestris*)

This disease in caused by bacteria called *Xanthomonas campestris* pv.*pruni* (Smith) Dye. This disease will be visible on the leaves, fruit as well as the shoots. The first signs of infection can usually be observed as small,



water-soaked, greyish areas on the undersides of leaves. These spots turn to angular, purple, black, or brown lesions as the disease develops. Spots remain angular and are most prominent towards the tip and along the mid-ribs of leaves. The infected areas may fall out, giving the infected leaves a pronounced tattered, keyhole appearance. Infected leaves will eventually turn yellow and drop.

Disease cycle

The bacteria survive the winter by inhabiting small branches, buds and plant tissue without showing the symptoms. The bacteria are spread to leaves, shoots and fruit by the first spring rains. Spring infections can occur anytime after the leaves have started to unfold. Severe outbreaks of this disease will be favoured by a moderate season with light, frequent rains and accompanying heavy winds. Oozing summer cankers can also be a source for secondary infection and spreading of the bacteria. The systemic movement of the bacteria from leaves and shoots could contribute to the formation of cankers.

Control

Major outbreaks of bacterial canker in young orchards can often be attributed to poor cultural practices. This disease cannot be controlled chemically. The best option to control the disease would be by obtaining disease-free plant material from the nursery.

Brown rot

This disease is caused by a fungus called *Monilinia fructicola* (G. Wint.). Brown rot attacks the blossoms, spurs, shoots as well as the fruit. The

infected blossoms will wilt and turn brown. The symptoms will initially be visible as small, round, light-brown spots on the fruit. The affected tissue will remain firm but will be covered by a leathery skin. The rotted fruit can either fall from the tree to the ground or it could remain on the tree as dry and shrivelled fruit called mummies.

Disease cycle

This fungus survives in the orchards from one growing season to the next as mycelium on mummies, fruit stems, blighted blossoms and twigs and cankers. Mycelia form a loose network of the delicate thread-like strands called hyphae—the body of a fungus. However, the conidia (spores of the fungus) residing on the mummies and cankers on stone fruit trees are believed to be the primary sources of infection. Conidia are distributed by wind and rain and germinate rapidly under favourable conditions. The number of spores distributed, the subsequent incubation period and the severity of the infection will also depend on the temperature and the duration of the humid period. During periods when high humidity and optimum temperature conditions are experienced, fruit infections can occur rapidly within a short space of time, as soon as 3 hours, if the inoculum levels are high. The incubation period will be shorter if the periods during which high humidity prevails are longer. The symptoms will also develop more rapidly.

Monitoring

Trees should be monitored during and after pruning for the presence of fruit mummies and cankers. It is of the utmost importance to remove and burn the mummies in order to prevent further spreading of the disease. A total of one to ten mummies and/or cankers per tree will represent moderate levels of risk for blossom infection under the appropriate environmental conditions, while more than ten mummies and/or cankers will represent high levels of risk. Fruit susceptibility to brown rot increases rapidly as soon as the fruit starts to change colour. Ten fruit per sample tree should be monitored for the occurrence of the disease. Trees should be monitored approximately every 3 to 5 days during the preharvest period. Insect, bird and hail damage to ripening fruit can result in wounds, which can rapidly be colonised by the fungus.

Control

High levels of orchard sanitation should be maintained in order to prevent the accumulation of spores on the fruit. The fruit should be harvested at the appropriate time. Bruising of fruit should be minimised and the fruit should

be cooled as quickly as possible. Effective sanitation during harvesting and storage should be maintained. A diluted sodium hypochlorite solution can be used for sanitation. Suitable fungicides can also be applied.

Blossom blight

This disease is caused by a fungus called *Monilinia laxa* (Aderhold et Ruhland) Honey. The fungus causes the blossoms to wilt and dry out but the blossoms do not fall from the tree. The infected blossoms closely resemble blossoms that have not been pollinated. These blossoms will appear stiff and stuck to the stalk when it is tipped with a finger, while the unpollinated blossoms would be pliable and fall off easily. Small, grey raised areas usually occur on the stalks of the flowers.

Disease cycle

Similar to those of brown rot disease.

Control

Similar to those of brown rot.

Crown gall

A bacterium called *Agrobacterium tumafaciens* (E.F. Smith and Townsend) Conn. is responsible for this disease. This disease in characterised by wart-like tumours or galls on the roots and crowns. Young galls are light in colour and have a cheesy texture. Older galls are dark and hard and can range from 10 to 100 mm in size. The numerous galls on the roots may disrupt the uptake of water and nutrients. The trees will therefore show reduced growth and possible nutrient deficiencies.

Disease cycle

The bacteria are distributed in many soils and can survive for several years in the soils. The tree must have a wound for these bacteria to enter the plant. Wounds originating in the nursery serve as entry sites for the bacteria. The bacterium carries a large piece of DNA known as tumour-inducing plasmid. A portion of this plasmid is then inserted into the chromosome of a plant cell. The tree will consequently produce excessive amounts of growth hormones, which in turn will cause the formation of galls. The bacteria do not play any further part in the development and growth of the gall, once the gall has been initiated.

Control

Soil fumigation can control this disease successfully, especially in nurseries. The best method of prevention would be to obtain disease-free material from a reputable nursery.

Powdery mildew

This disease is caused by a fungus called *Podosphaera oxyacanthae* (de Bary). White, powdery areas form on new leaves which could eventually cover the entire leaf surface. Fungal growth is primarily on the underside of the leaf with yellow spots visible on the upper surface.

Disease cycle

The mycelium of this fungus survives the winter on the tissue of the buds or diseased leaves. As soon as spring commences, the fungus will grow on the surface of the leaf and will send fine threads also called haustoria into the cells of the leaf. These haustoria extract nutrients from the cells without killing the cells. New spores are formed after only a few days. These new spores are then transported by the wind to other leaves.

Control

The best method of control is to destroy the fallen leaves and fruit. A registered fungicide can be applied as soon as fungal growth is observed.

Other cultivation practices

Pruning and training

Pruning is the process whereby different parts of woody plants, such as branches, branch tips, shoot buds or roots are removed. Training, on the other hand, is to shape and form the tree into a desired shape. It is very important to prune and train the tree correctly from the start. The following reasons for pruning are important and should be taken into account when fruit trees are pruned:

Young trees

- To shape young trees to a particular form and to ensure a strong framework.
- To remove interfering branches in order to allow sunlight and air to penetrate and reach all parts of the tree.
- To remove dead, weak, damaged and diseased branches from the tree.

- To restore the balance between the above-ground growth and the roots.

BEARING TREES AND MATURE TREES

- To remove interfering branches in order to allow sunlight and air to penetrate and reach all parts of the tree.
- To shape trees and ensure a strong framework.
- To remove dead, weak, damaged and diseased branches from the tree.
- To rejuvenate mature trees.
- To do early thinning of flower buds.
- To increase the quality and the number of fruit.
- To make thorough spraying of the trees possible.
- To simplify the harvesting of fruit.

Pruning is usually done during July. Plum trees are shaped within the first and second years after planting. This is done in order to obtain an improved spreading of scaffold branches, to eliminate weak crotches (parts of a tree where it forks into two branches) and to prevent the branches from rubbing against each other. Dead branches should be pruned throughout the year and removed from the orchard. This step is very important as it is done to remove the branches which are affected by bacterial canker. Future infections will therefore be limited. Corrective pruning should be done during the third year after establishment and onwards. Summer pruning entails the removal of all water-shoots to allow sunlight into the canopy of the tree.

Mulch

Organic or inorganic mulches could be applied on the soil surface as it will assist in controlling control weeds and conserving soil moisture, especially for trees that were planted on ridges or trees planted in a coarse, sandy soil.

Trellising

Trellising systems are sometimes utilised for plums, for example, the Tatura and Palmette systems. These trellising systems will not be effective when used for trees that have vigorous rootstocks and is also very expensive.

Harvesting

It is important to harvest fruit at the correct (optimum) harvesting maturity as fruit which is picked either too immature or too ripe will not have a long

storage and shelf-life. Plums which are picked too early will be more susceptible to a physiological disorder called internal breakdown. Fruit which is intended for cold storage must be harvested at optimum harvesting maturity. Fruit which is intended for home consumption can be harvested at a riper stage.

There are different methods of determining when the fruit is ready to be harvested such as the colour of the skin, shape, size as well as the taste of the fruit. These methods is usually used by the home gardener. However, the maturity of fruit which are intended to be cold-stored or exported, should be determined more accurately.

Aspects such as the firmness of the fruit, sugar content, skin colour and acid content should be taken into consideration. There are instruments which are used such as colour charts, a refractometer, (to determine the sugar content) and a penetrometer (to determine the firmness).

The fruit should be picked and handled with care in order to prevent damage to the fruit. There are certain aspects that should be taken into consideration such as:

- The containers used for harvesting should be cleaned thoroughly with a water and detergent solution and finally rinsed with water and disinfectant. This step is important to ensure that all fungal spores which might be present in the container, are killed.
- The fruit should be picked carefully by grasping the fruit firmly between the middle part of the fingers and pulling gently with a slight twisting action. The nails of the harvesters should be kept short in order to prevent damage to the fruit.
- It is important not to harvest too many fruit in one container as it might get squashed or bruised.
- Damaged or rotted fruit should be harvested separately or removed from the container as soon as possible as it will infect the healthy fruit.
- It is better to harvest fruit early in the morning when it is cool. The fruit should be kept out of the sun. Once it has been harvested, the fruit needs to be placed in the shade or transported to the packhouse as soon as possible.
- The fruit should be covered with damp blankets to prevent exposing it to fungal spores in the air, especially in dusty conditions, but mainly to prevent the upper layer of fruit from bruising during transport.
- Care should be taken when transporting the fruit. Poor, bumpy roads can cause bruising of the fruit. The driver of the vehicle should therefore drive

carefully. He must also see to it that the tyre pressures of the vehicle are not excessively high.

POST-HARVEST HANDLING

The first step would be to estimate the size of the crop well in advance. This will enable the packhouse personnel to plan the sorting, grading and packaging.

Sorting and grading

Once the fruit is delivered to the packing-shed, it is firstly sorted and graded according to size by a sorter. The sorters select only the first-grade fruit. The fruit which is not selected is removed as second and third-grade. A second grading process is then done where the second-grade fruit are selected for local marketing and the third-grade fruit is removed.

Packaging

Once the fruit is graded, it is packed. There are different kinds of containers that can be used. These containers can differ in size and can be made from plastic, wood, cardboards or natural fibres. It is important to choose containers which are strong enough to prevent injury to or bruising of the fruit. Wet or pulpy containers will collapse easily and may result in damage to the fruit. Affordable containers should also be purchased. Plastic containers might be more expensive than cardboard ones, but will last much longer and are less prone to infection by fungal spores.

The fruit should always we packed with care in order to prevent damage or bruising. The fruit should be packed in a single layer in clean containers. The fruit should preferably not touch one another. Cardboard containers should only be used once. Fungal spores might accumulate within these containers and will cause fruit decay if they are reused.

Cooling

There are several reasons why the fruit should be cooled after harvest, such as:

- The temperature of the fruit in the orchard can be very high. The fruit should therefore be cooled as soon as possible to prevent the fruit from losing quality.

- To slow down fruit ripening and the production of ethylene gas. Ethylene is the hormone which is produced by the fruit and which is responsible for fruit ripening.
- To slow-down the respiration rate of the fruit.
- To reduce moisture loss from the fruit.
- To inhibit fungal and bacterial growth.
- To help streamline logistics and increase marketing options.

Wilted, bruised or rotted fruit should not be stored in the cold-room.

Transporting

The most important part of transporting the fruit is to maintain the temperature of the fruit within an optimum range. This process of maintaining the temperature from harvesting to the point of consumption is called the cold chain. Transportation can take from as soon as a few days to several weeks. There are several links in the cold chain such as cold stores, refrigerated trucks, distribution centres, refrigerated containers, vending cabinets to domestic refrigerators.

There are certain aspects that should be taken into consideration when transporting the fruit, such as to use a clean, well-equipped transportation vehicle with a effective refrigeration system. The containers should be stacked in such a way to ensure adequate air flow inside the truck and ripe and unripe fruit should not be loaded in the same compartment within the vehicle.

Marketing

One must be certain that the produce you want to sell will actually be bought by the end consumer i.e. that there is really a need or a demand for that produce. Attempt to find a gap in the market. For example, if the consumer is looking for plums, but nobody is currently supplying it, there will be a gap in the market which can be filled.

However, it is important to ensure that the sustainable need for the product is large enough. It would be unwise to sell produce in order to fulfil the needs of only a few consumers. It is therefore important to do market research, as it will assist ensuring that your produce or service is fulfilling a need.

PRODUCTION SCHEDULE

Activities	January	February	March	April	May	June	July	August	September	October	November	December
Soil sampling	■											
Soil preparation					■							
Planting							■	■				
Fertilisation	■	■	■	■					■	■	■	■
Irrigation	■	■	■	■					■	■	■	■
Pest control	■	■	■	■	■				■	■	■	■
Disease control	■	■	■	■				■	■	■	■	■
Weed control	■	■	■	■	■	■	■	■	■	■	■	■
Pruning							■	■				
Leaf sampling	■											
Harvesting	■	■									■	■
Marketing	■	■	■	■	■	■	■	■	■	■	■	■

UTILISATION

Plums can be processed in addition to consuming it fresh. Plums can be frozen, processed into jam and used for plum conserve.

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