Proteas

PRODUCTION GUIDELINE

agriculture,
forestry & fisheries

Department:
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REPUBLIC OF SOUTH AFRICA

Proteas

PRODUCTION GUIDELINE

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Contents

PART I: GENERAL ASPECTS

1. Classification

Kingdom: Plantae
Family: *Proteaceace*
Genus: *Protea*
Common names: King Protea, Grootsuikerkan, sugarbushes

2. Origin and distribution

The protea family comprises about 80 genera with about 1600 species. Most of the protea family members are originated from South Africa and Australia; however, this family is widely distributed throughout the Southern Hemisphere with few species found in Tropical Africa, South America, Tropical America, New Zealand, Pacific Islands and in Malaya.

There are 14 genera of the protea family in South Africa, which are all exclusive only to Africa, none of them grows wild anywhere else in the world. In South Africa, there is a total of 300 native protea species. A large number of proteas grow principally in the mountains which curve around the coastline of South Africa, spreading in a rough crescent from the Clanwilliam district to the area around Port Elizabeth, with highest concentration in the Tulbagh area, the Peninsula, Caledon and Knysna.

Relatively few proteas also grow in the eastern mountain ranges, extending northwards into KwaZulu-Natal and Mpumalanga. Certain species are cultivated in Australia while others occur naturally in central Africa, however, none of them can be compared in terms of beauty and variety with those from south-western Cape.

3. Production levels

3.1 South Africa

In 2004 there was a total of 1 058,0 hectares (ha) of land under commercial production and 2 795 ha of land with broadcast sown in South Africa. The total area under protea production in South Africa is four times the total land under production in the northern hemisphere.

3.2 Internationally

South Africa and Australia are the world leading producers of proteas. Protea production areas can be grouped into two categories, namely: the southern hemisphere which includes South Africa, Australia, Zimbabwe, Chile and New Zealand and the northern hemisphere, which includes California, Canary Is-

land, Portugal, Madeira, Israel, France and Hawaii. A great number of proteas are produced in the southern hemisphere which have an estimated 5 665.0 ha of land under production. In the northern hemisphere, California with a total of 405,0 ha leads the category, while the smallest producer is Hawaii with a total of 81 ha of land under production. Total land under protea production in the northern hemisphere is 896,75 ha.

4. Major production areas in South Africa

The majority of proteas grow wild in the Cape, especially the most attractive ones. Proteas also grow wild in other provinces, particularly in the mountainous parts of KZN (in the Midlands and Drankensberg) and Mpumalanga. In all the above-mentioned places, there are also commercial plantations, which extend to the far northern part of the country in Polokwane.

5. Cultivars

Proteas grown from seeds do not ensure uniformity; hence all registered cultivars are propagated from cuttings. There are many cultivars available. Choice of a specific cultivar will depend on many factors. These factors include: adaptability to the environment, disease and pests resistance, yield, vase life and market demand of a particular cultivar.

All protea cultivars bred are registered with the International Protea Cultivar Register (IPCR) in South Africa before the commercialisation of the cultivar to ensure that the name is unique.

Hereunder are some commonly grown *protea* cultivars.

Table 1: Protea cultivars

Cultivar	Species	Size of flower	Colour	Flowering time	Yield
Brenda	*P.compacta*	small	deep pink	Apr-May	good
Red rex	*P. cynaroides*	medium	red	Sept-Oct	average
Sugar Daddy	*P. repens*	large	red	Feb-Mar	good
Luteum	*Leucospermum*	medium	yellow	Sept-Oct	high
Madiba	*P.cynaroides*	medium	red	Sept-Oct	high

6. Description

6.1 Mature plant

6.1.1 Leaves

Leaf form varies from species to species; however, most species have sessile broad leaves with a rounded or pointed end. They are arranged around the stem in an alternate fashion while for some species, leaves lean at an acute angle away from the stem. The colour varies from dark green, bluish green, yellow green, grey green and sometimes whitish because of pubescence.

6.1.2 Stem

Proteas have short and strong stem. The average diameter of its stems is 80 to 100 mm when the plant is five years old. The colour of the stem varies within species. However, most species seedlings have yellowish green stems while the mature bushes have a dark brown stem.

6.1.3 Root system

Most proteas have a deep and spreading taproot which ramifies into four or five strong lateral roots. Naturally, these roots are strong enough to grow between rocks and stones. Mature proteas have an average root width of 3 m.

6.1.4 Flower

The flower head is broad, cup-like, goblet or bowl-like in shape. It is made up of multitudes of florets which are crowded together. The length, shape, colour and number of whorls of florets vary from species to species.

6.1.5 *Seeds*

Seeds develop from flower heads which swell and harden as seeds. Protea seeds (also called nut fruit) are small with a very hard pericarp.

6.2 Essential part

The two essential parts of the protea plants are the flower and branches.

7. Climatic requirements

Proteas which are native to South Africa grow exceptionally well in local climates. Mild climates with low humidity are generally preferred by many protea species. Humidity should never be greater than 80% for more than a week.

They can tolerate frost; however, on susceptible species such as *P.neriifolia* and *P. cynaroides* frost can cause a mark and damage foliage. Young plants of all protea species are generally susceptible to frost. Whenever frost is expected, it is recommended that plants must be watered or covered overnight to allow sufficient ventilation.

Summer winds are very beneficial for proteas; however, cold winds with frosty conditions hamper growth. The majority of proteas will not grow in damp areas. *P.cynaroides* seems to be the widest adapted species of the genus Protea with regard to soil types.

7.1 Temperature

The different species of proteas show considerable variation in temperature requirements. *P. magnifica* thrives best in localities with hot summers and rather cold winters with extremes in temperature of about 41 ^{0}C to -5 ^{0}C, while *P. grandiceps* prefers localities with cool summers and cold winters. *P. neriifolia* has a wider tolerance than most proteas and can be grown in a climate with wet winters and dry summers, as well as in a climate with cold winters and wet summers. Below are generalised temperature requirements for proteas:

- The generally recommended temperature is a minimum of 7,2 ^{0}C to a mean maximum of 27, 6 ^{0}C.
- The average daily temperature should vary from about 7 ^{0}C to 24 ^{0}C.
- Average daily temperature for the coldest months should be 12 ^{0}C.
- Average daily temperature for the hottest months should be 31 ^{0}C.
- The absolute minimum should be -6 ^{0}C and a maximum of 44.6 ^{0}C.

7.2 Rainfall

Most protea species require abundant quantities of water throughout the year. The rainfall requirements vary from 180 to 2 500 mm per annum. The minimum water requirement for proteas is equivalent to 700 mm of rain a year. Some proteas can still survive in areas which receive as little as 300 mm of rainfall annually; however, the drainage of the place needs to be good. Additional water application through irrigation is highly recommended to produce high cut-flower yields. Good quality irrigation water will also help in keeping the pH low and washing away salts which accumulate in the upper soil profile.

The quality of water used for watering can have an influence on the overall response of a plant on irrigation. Ideal water should have high electrical resistance with low pH (except for alkaline-loving species such as *P. neriifolia*) with an electric conductivity (EC). Proteas are sensitive to high salt levels in water. It is ideal to use water with a chloride content of not more than 220 parts per million (ppm). Apart from rain water, other sources include rivers, bores and on-farm dams. Water from dams should be frequently monitored against *Phytophthora cinnamomi* fungus which is fatal to proteas.

8. Soil requirements

The majority of species and cultivars require deep, well-drained sand, acidic soils with a pH of 5, 5 to 7, 0 for optimum growth and production. Some proteas grow naturally on soil pH of higher than 7, 0. It is known that such pH influences the nutrient of plants only indirectly, it is not considered critical and protea plants will grow well in soil with a wide pH-range. Problems could be expected with high pH soils because some micro nutrients become less available due to insolubility, which could lead to deficiencies.

Most acid-loving species will also grow well at a pH less than three, while this pH will be deadly for species which grow in limestone rock along the south coast of the Cape. Soil with high clay percentage is not ideal, but sandy loam soil with 6 % clay is suitable. Humus containing soils have proved to be very beneficial; however, excessive humus impedes drainage and will suppress root growth.

Protea do well under a low phosphorus site. It is recommended that soil tests should be conducted before planting in new area to determine the residual phosphorus. Soil samples should be taken at a depth of 0 - 300 mm and 300 - 600 mm, from five to eight sites per hectare. Take a 1 kg sample from each site and mix all the 0 - 300 mm samples together and analyse a 1 kg portion. Do the same for soil from 300 - 600 mm deep. It will be very wise to correct any nutrient shortage or excess before planting begins. Below are the recommended levels for different nutrients.

Table 2: Soil nutrient levels guidelines for growing proteas

Nutrient element	Levels (ppm)
P	22-33
K	400
Ca	1250
Mg	<150

PART II: CULTIVATION PRACTICES

1. Propagation

Proteas can be propagated either by means of seed or vegetatively through cuttings. No cuttings may be harvested from plants that display any symptoms of disease.

Propagation by cuttings would ensure that proteas become an important commercial crop and that the flowers would be uniform in type.

1.1 Growing proteas from cuttings:

Cuttings are usually harvested from December to end of April. It is important to harvest them at the right age. A simple test to determine whether the cutting is ready, is to take a cutting of 20 cm from current season growth and bend it. If the ends can touch each other, the cutting is too soft and if the wood cracks, it is too hard. Only leaves from the upper end of the cuttings should remain, the rest should be removed. The following dates serve as guidelines for the harvesting of cuttings:

- Protea: December to April
- Conebrush: February to April
- Pincushions: March to May

The ends of shoots are preferably used for the production of cuttings. Cuttings must be harvested in the morning and the plants should at no stage of the harvesting be subjected to heat or drought stress. The cuttings must be kept cool.

The cuttings are placed in growing bags (preferably transparent) that have holes and are filled with a mixture of sand and peat (2:1), to develop roots. The cuttings must receive a mist water spray every hour throughout the day and a spray programme against disease must be applied. After six weeks,

the cuttings begin to form roots. This usually takes place six to 16 weeks after harvesting. Cuttings that have not formed roots after five months can be destroyed.

Cuttings are ready to be planted when the new roots are well developed and discoloured brown roots are visible on both sides of the bag.

1.2 Growing proteas from seed

Protea seedbuds should be harvested and conebush that have flat, winged seeds nine to 12 months after the plants have flowered, that is more or less when the plants flower again. Conebush with round, nutlike seeds, and pincushion seed must be harvested three to six months after the plants have flowered, as soon as cones begin to open, or as soon as the cones begin to open. After a protea seed has been harvested and sorted, it must be stored in a cool, dry place until it is sown in autumn. The sowing time for proteas is from March to May.

Seeds are best sown in a seedbed than in plastic bags and containers. They should not be spread on the seedbed, but sow seeds sparsely (at least 4 cm apart). Sowing depth will depend on a particular species being sown. For species like *leucodendron*, it requires deep sowing up to 2 cm while other species should be sown shallowly to avoid the tendency where seedlings die back before the development of first true leaves.

2. Soil preparation

For Proteas, soil must preferably be disturbed as little as possible when planting a new orchard. Only small holes for the seedlings must be made while grass on the rest of the surface must be cut regularly to avoid competition of soil nutrients with the seedlings. No soil cultivation should be carried out near the plants. This recommendation of minimum tillage is made for a specific reason. When ploughing natural veld, the equilibrium between macro flora (ordinary plant) and the micro flora (micro-organism in the soil) is disturbed.

Normally these groups compete for the available nitrogen in the soil. When the macro flora is disturbed the micro flora tends to dominate. Under these conditions, the organic material is decomposed and organic nitrogen transformed to nitrate-nitrogen, which might become toxic to certain species.

In cases where limited irrigation water is available, the placing of a plastic sheet under the plants which is then covered with soil is sometimes recommended to reduce evaporation. To do this the soil must be disturbed, but the advantage of moisture concentration might justify this practice. The plastic sheet, on the other hand, might also prevent the infiltration of moisture and the movement of fertiliser. Usually holes are made in the plastic to lessen this

problem. Seedbeds can be prepared in an open, sunny position. A bed should not be broader than 1 m. The depth should be 30 cm and it must have good drainage.

3. Field layout and design

Proteas can be planted in single or double rows; however, best management practices can be done in single rows. In single row spacing, proteas can be planted in 4 to 5 m inter-row spacing with an intra-row spacing of 1 to 3 m. Seedlings should be planted at the same depth of nursery pot. Planting too deep will expose foliage to soil, and therefore promote infestation of soil-borne diseases.

4. Planting of proteas seedlings

Proteas seedlings can be established with care at any time of the year; however, planting in early autumn gives best results. In summer rainfall areas, some irrigation is eliminated by transplanting following the first spring rains. The seedlings should be transplanted when they are about 100 to 200 mm high. When transplanting them, great care should be taken to avoid root disturbance.

Proteas seedlings should be planted in a position with full sunlight. Normally, proteas require high light levels to photosynthesize effectively and to produce flowers. Proteas and *Leucospermums* (pincushions) planted in shade or semi-shade will struggle to flower and *Leucodendrons* (cone bushes) will not produce their brilliantly coloured foliage.

5. Fertilisation

Nitrogen should only be applied in a form of ammonium. 50 kg of ammonium sulphate per hectare should be applied in three different application times. The first application should be applied before the start of the active growth period and the other two applications should be applied every second month (eight weeks interval). Ammonium sulphate will also help to acidify soil. These applications should be made during the rainy season under dryland conditions to ensure that the fertiliser dissolves and infiltrates into the soil.

Proteas require very little phosphorus for normal growth and it could even cause toxic effects if applied in large quantities. It seemed that protea plants have a very effective uptake mechanism for phosphorus and can obtain sufficient phosphorus even in soil with a low phosphorus level. For this reason, no phosphate fertilisation is recommended for proteas.

As in case of phosphorus, it has been found that proteas require little potassium for normal growth. Most soils in South Africa contain sufficient potassium for proteas. If, however, soil analysis shows a very low potassium level (less than 20 mg/kg), an application of 50 kg potassium chloride/ha per year may be applied. The application must be carried out after consultation with an expert. Potassium must be applied prior to the active growth period just like in case of nitrogen, or during the rainy season under dryland conditions.

6. Irrigation

Irrigation requirement will largely depend on soil type, plant size and the climatic conditions. It is recommended to replace about 40 % of total water lost from the soil through evaporation. On a very hot day, this could be about 10 to 12 l (litres) per plant per day. Less watering is required during the cooler months. As a general guide, one irrigation session per week is sufficient during cooler months. Devises for monitoring soil moisture should be used. The most commonly used devises on protea farms are the evaporation pan and the tensiometers.

The best irrigation system for proteas will be the one which brings the water directly to the soil surface, since the majority of protea species are susceptible to foliage diseases which are accelerated by frequent moistening foliages through overhead irrigation. Sprinkler and drip irrigation systems are recommended.

7. Weed control

The best time to control weeds is when doing soil preparation; during this time most of the proteas troubling weeds such as Kikuyu can be effectively controlled. Post-emergence herbicides can be used for weeds that emerge after the crop has been planted (when using herbicide great care should be taken to avoid contamination).

In a commercial proteas plantation, mulching with weed matting material serves as an economic and efficient weed control method. Other methods which can be used include hand hoeing and mowing, preferably with brush cutter.

8. Pest control

Table 3: Pests and their control

Pest	Description	Damage	Chemical control	Comments
Mite-Witches Broom	Very tiny mites with two pairs of legs.	Feed on the stem bud leading the bud to develop abnormally	No registered chemical. Malformed growth should be removed and destroyed	Highly transmitted by pruning shears. All shears should be efficiently sterilised
Flower head borer/Scarlet protea butterfly	Butterflies with dark brown or black lines on their fore-wings	Makes holes in both flowers and florets. Also bore on the flower bud, causing flower malformation	No registered chemical. Closing buds with a nylon stocking or hand removing eggs on flower buds could help	Remove and destroy infested blooms
Black moth	These moths are black in colour with 20 mm wingspan	Tunnels into the inflorescence and also damage developing seeds	Dimethoate (EC) 120 ml /100 l	*P.cynaroides* cultivars are the most susceptible to black moth attack
Blotch leaf miner	Tiny moths of about 5 mm long	Feed on leaves, making dead patches and later small holes	Dichlorvos (EC) 100 ml /100 l	Apply a full cover spray whenever the pest is observed

Pest	Description	Damage	Chemical control	Comments
Soft scales	Flattened motionless insect with elliptical shaped body	Found on the underside of leaves.Suck the sap from leaves and stems, causing stunted growth	Chlorpyrifos (EC) 100 ml /100 l Water or Mineral Oil (EC) 2 l /100 l	Controlling ants can greatly lead on disappearance of soft scales
Snout beetles	Differ with species, can be either brown or black	They chew foliage, stems and bracts of flower heads	Gamma-BHC (EC) 300 ml /100 l water	Apply full cover spray whenever this pest is noticed

9. Disease control

Proteas are attacked by a variety of diseases. The most important ones are the following:

9.1 Damping-off

This is a fungal disease which attack seedlings. This disease is caused by transplanted dense seedlings, poor ventilation and too much water.

To avoid dumping off, seedling beds should receive direct sunlight, enough spacing between seedlings for air penetration and overhead irrigation should be avoided. There are also some registered fungicides; however, sanitary measures to prevent this disease are very important.

9.2 Phytophthora root rot

This is a soil borne disease which is caused by *Phytophthora cinnamomi* fungus. The fungus infests the feeder root system and leads to stunted growth, wilting and ultimately leads to the collapse of the plant.

To avoid infestation by *Phytophthora cinnamomi* it is important that soil preparation be done efficiently to facilitate good drainage and also overhead irrigation should be avoided. Infested plants should be removed and destroyed as soon as they are noticed.

9.3 Stem and shoot canker, die back and shoot blight

Lesion on stem, shoot and leaves which are caused by *colletotrichum* and *Drechslera* fungus. This fungus is difficult to control since it has a wide range of hosts.

Control should best be based on preventive measures such as: sterilising seeds, growing resistant cultivars and lastly keeping plants in a healthy condition. Infected plants should be removed and burned. Although in most cases chemical control of these diseases are not very effective the following registered fungicides can be sprayed on infected plants:

- *Mancozeb*> apply 200 g/100 litres of water
- *Chlorothalonil*> apply 275ml/100 litres of water

9.4 Scab

Scab defines lesions on leaves, shoots and flowering branches which are caused by *Elsinoe* fungus. Overhead irrigation and wet climatic conditions when the plant is actively growing favours scab infestation.

Fungicide application should be applied before the symptoms are noticed. For young trees, the best time for such application is when they are on growth flush, while mature trees should be sprayed when new flush is expected. Fungicides for controlling canker and blight can also work for scab.

10. Other cultivation practices

10.1 Pruning

Pruning is done with aim of increasing yield, productive lifespan and controlling pest and diseases. To be economic, pruning should be done simultaneously with harvesting. All diseased branches and short flower stems are removed. Branches which look weak and old should also be removed. This will help to maintain proper shape and size of the plant.

For pruning, it is important that labourers should have adequate training before they begin with this practice. Furthermore, only shears designed for pruning should be used and pruning shears should be sterilised before pruning is started on a plant.

11. Harvesting

Proteas are best harvested early in the morning or late afternoon when temperature starts to drop. Harvesting should not be done when flowers are wet, as this increases incidence of leaf blackening.

11.1 Harvest maturity

Most protea species are ready for harvesting three years after planting, however, for quick to flower species such as *Leucadendrons*, it will only take two years to start flowering. Flowers should be picked when the flower begins to open, when the terminal leaves which surround the central involucral receptacle mass starts to loosen. Flowers picked when excessively opened, they will have a shorter vase life, while picking too early (immature) leads to poor quality flowers. Usually, experience is the main key for identifying this stage, but consultation to your exporter could also help.

11.2 Harvesting method

Shears (secateurs) is used as a tool to harvest protea flowers.

PART III: POST-HARVEST HANDLING

1. Sorting

Flowers are sorted according to their quality. Poor quality flowers are sorted for local market or sometimes discarded. These are usually flowers high in blemishes, bruising, insect damage and bent stems.

Good quality flowers are mostly sorted out and graded well for overseas market. Lower leaves on stems and lateral shoots subtending the flower heads should be removed. However, this will be determined by the buyer's preferences.

2. Grading and bunching

Proteas are graded manually. Graders should go through intensive training before grading starts. This is to ensure that flowers are graded efficiently with no bias to either the producer or customers. The grading is done on the basis of stem length and thickness, maturity of flower, and removes blemishes on both the flower and stem. For the export market, longer stems of 50 cm and above are preferred.

A bunch of flowers should be made up of flowers with same grade. Normally, five to ten stems make a bunch. It is not advisable to make a bunch with few stems since this will leave more space in the carton which may result in stem injuries during transportation.

3. Handling and packing

Flowers are very tender and are easily damaged by rough handling. Therefore, they should be handled with care. A good packing material should be the one which is easy to pack and handle, gives efficient protection to flowers and prevents drying and warming. Flowers are mostly packed in cartons; however, buckets and plastic sleeves are also used, depending on the destination.

4. Storage

Immediately after harvesting, flowers should be placed into water to remove field heat. A good storage for flower will ensure that flowers have a longer vase life. Flowers should be stored in a cold room. Temperature at store rooms should be between 2 ^{0}C and 5 ^{0}C for three to five hours.

To facilitate cooling at store rooms, cartons should have reasonably big holes on their sides. Cartons should be packed in such a manner that they allow easy flow of air through these holes. Pesticides, fumigants and other post harvest chemicals should be used to avoid contamination in the store room.

5. Transport

5.1 On field

After harvest, flowers are transported by tractors and motor vehicles with/ without trailers, hand pulled farm carts and carried by hands when the grading shed is near.

5.2 To the market

For the local market, flowers are normally transported by trucks. It is important that trucks with refrigeration should be used if the market is too far from the farm from which the flowers are being transported.

For overseas markets, flights and ships are used. The difference between the two is that flights are faster and reach the market quickly, however, they are expensive and do not have efficient cooling system as compared to ships. Temperatures in flights are usually above 10 ^{0}C.

6. Marketing

Protea flowers are sold in fresh or dried form. Both fresh and dried flowers are sold for local and export market. For fresh flowers, 70 % of the total produce is exported while the remaining 30 % is sold on the local market. For dried flowers, 80 % is exported. Locally, proteas are sold to individual buyers, traders who distribute the flowers to demand centres and institutional buyers such as

hotels, restaurants, funeral parlours, supermarkets, flower shops, boutiques and street vendors.

Most of the South African fresh protea flowers are exported to the European market, America and the Far East.

PART IV: PRODUCTION SCHEDULES

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												

PART V: UTILISATION

Proteas are chiefly grown for their beautiful cut-flowers which are sold either fresh or dried. Protea flowers are mostly used at hotels, restaurants, weddings, etc for decoration.

PART VI: ACKNOWLEDGEMENTS

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