# SUNFLOWER
## PRODUCTION GUIDE

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PANNAR®

# Sunflowers

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# THE PRODUCTION OF SUNFLOWERS

## A) INTRODUCTION

Sunflower is the most important oil seed crop in Southern Africa at present, and is being grown in virtually all the summer rainfall areas.

In the past, the total area under sunflower production varied from year to year as a result of climatic factors and market prices. It is expected that the total area under sunflower will stabilise at 500 – 600 000 ha and even increase in future as a result of the following factors:

a) Marginal soils will be utilised more for the production of other crops which are less risky and require lower production inputs. Sunflower conforms to these requirements.

b) It is expected that the demand for vegetable oils and proteins will increase in future. Sunflower is the ideal crop as far as oil production is concerned.

c) Sunflower is an excellent rotation crop which may be cultivated under widely varying climatic and soil conditions.

d) Since the advent of hybrid sunflower the traditional problems such as uneven height and maturity have been largely eliminated, with the result that it is now easier to handle and has become an excellent alternative crop to maize and sorghum.

e) Sunflower normally competes favourably and is a good alternative to the other summer grain crops.

## B) ADAPTABILITY

### 1. CLIMATIC REQUIREMENTS

a) Sunflower is widely adaptable and more drought tolerant than most other grain crops. The main reasons for this are as follows:

- Sunflower can tolerate high temperatures and drought conditions more effectively than maize for example. It wilts readily, thus the temperature on the leaf is lowered, which in turn leads to considerably lower moisture loss. On the other hand the leaves recover rapidly again once moisture conditions improve.

- Sunflower is a very efficient user of soil moisture as a result of its deep and branched tap root system. Even in the sub-soil and on heavy clay soils it utilises moisture reserves far more effectively than maize for example.

- The shorter growing season and better cold tolerance of sunflower makes it suitable for later planting. This can be an advantage when moisture is conserved early in the season.

- Sunflower is normally planted in midsummer, which means that it grows during the "cooler" summer months when excessive moisture loss is limited.

- Under stress conditions the sunflower plant develops fewer and smaller leaves. It has the ability therefore to adapt to conditions and use less moisture during conditions of stress.

- Stress conditions during flowering are less critical in the case of sunflower than with maize. Pollination takes place even under extreme stress conditions, because sunflower has the ability to produce stamens and pollen simultaneously. Also, larger kernels are produced in the event of a lower seed-set.

- Although sunflower requires more water per unit dry matter than maize, viz. 577 : 1 as compared to 350 : 1, they produce much less dry matter per ha, with the result that sunflower uses less water per unit area than maize.

b) A warm, somewhat dry climate is considered optimal for sunflower production. Cool, moist weather conditions, especially during the ripening period, are unsuitable, because they encourage rust and head rot, while very hot dry conditions cause charcoal rot.

c) Sunflower can tolerate cold nights and light frost much better than maize, except during the pollination and early seed development stages.

d) Slow sunflower cultivars require an annual rainfall of 650 – 850 mm. For the shorter, quicker types 500 – 650 mm is sufficient. However, good yields can also be achieved with 300 – 400 mm rain during the growing season, and because the feared ***Sclerotinia*** disease (head rot) develops under high rainfall conditions, the drier, warmer areas with an annual rainfall of ± 650 mm and a low humidity are preferred.

e) The most critical period in the life of the sunflower plant is during bud formation and especially during the flowering and early grain filling stages, and, if possible, an effort should be made to let this stage coincide with the period during which good rains normally occur. Severe stress, as well as wet, very hot conditions during pollination may lead to poor seed set and hollow husks.

**2. SOIL REQUIREMENTS**

a) Deep, well-drained loam soils with good physical characteristics are naturally ideal, but sunflower can, provided the soil is well-drained, be successfully grown on sand, loam, or turf soils, as well as poor and slightly brackish soils. Sunflower grows much better on turf soils than maize.

b) Acid, sandy soils are unsuitable, as sunflower is very sensitive to aluminium toxicity.

c) Eelworm-infected soils must be avoided as sunflower is very sensitive to this pest.

d) Young seedlings are not very strong. Soils that are inclined to crust easily must be loosened after planting in order to ensure a good stand.

e) Sunflower is a valuable rotation crop on soils infected with witchweed. The witchweed seed do germinate in the presence of sunflower, but die soon after germination because they cannot develop on sunflower.

## C) MANAGEMENT PRACTICES

## 1. SOIL PREPARATION

Sunflower reacts positively to good soil preparation. Effective moisture conservation and a fine, well-prepared seed bed ensure:-

a) good germination and an even stand,
b) effective weed control,
c) even maturity and drying – simplifies harvesting,
d) good yields, even during drought.

Sunflower is very sensitive to unfavourable conditions during and shortly after germination, as well as to weed competition. A fine seed bed and effective weed control are thus extremely important for ensuring a good stand.

## 2. PLANTING TIME

Sunflower is not very sensitive to date of planting, and may be grown over a long period in most areas. Normal planting times for the various areas are as follows:

| | |
|---|---|
| Cooler, eastern areas | : November – Mid December |
| Warmer, western areas | : Mid-November – Beginning January |
| Frost-free areas with long growing season | : Until February – March |

## 3. PLANT POPULATION

It has been proved in practice that populations of 30 – 45 000 plants per ha are best. The lower plant population is recommended for areas with a low rainfall and at wide row spacing's, while the higher plant population is preferred under high potential conditions and at narrow row spacing's.

Uneven spacing's and low plant populations are undesirable as they result in excessively large heads which cause the plants to lodge before harvesting, while indications are that populations of more than 45 000 per ha, even under irrigation, do not have any yield advantage. Excessively high plant populations may even result in small heads with a poor kernel development.

An exception to the above recommendations are the very quick-growing cultivars, which may be planted successfully at 10 – 20% higher plant population.

## 4. CULTIVARS

Excellent sunflower hybrids are presently available in the trade. The following factors must be considered when choosing the right cultivars:

a) High yield potential, especially in terms of oil mass.

b) High oil content.

c) Good standability (well-developed roots and strong stalks).

d) Even plant height
- Simplifies harvesting
- Reduces yield losses as a result of immature heads, bird damage & seeds that fall out because of excessive drying out.

e) Degree of self compatibility, i.e. independence of insects for pollination. Unlike the old open-pollinated varieties which are not very self compatible, most of the new high oil-content hybrids have the ability to maintain a high degree of self compatibility. Hybrid differences occur and in this respect good hybrids are capable of self pollinating up to 70 – 80% in the absence of insect pollinators.

Nevertheless, bees (play an important role) are still necessary for hybrids available at present to ensure good pollination and a good seed set.

f) Disease resistance.

g) Length of growing season.

Oil content is very important because the producer's price is determined accordingly.

High oil content goes hand in hand with low fibre content in the seed. The high oil types have a fibre content of ± 16% while those with low oil content contain ± 26% fibre.

All sunflower hybrids presently marketed by PANNAR are high-oil types.

As new improved cultivars are released from time to time, it is recommended that the latest PANNAR brochure or the local PANNAR Representative or Agronomist be consulted for information regarding the latest cultivars and recommendations per production area.

## 5. SEED REQUIREMENTS

Sunflower seed is graded according to size in order to simplify the planting process. The seed requirements will depend on the seed size and the envisaged plant population. The approximate number of ha which may be planted with 25 kg seed at the various plant populations per ha are as follows:

| **Class** | **$Kernels per kg** | | **PLANT POPULATION PER ha** | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | *Less 20% | 20 000 | 25 000 | 30 000 | 35 000 | 40 000 | 45 000 | 50 000 |
| 4 | 22 000 | 17 600 | 22.0 | 17.6 | 14.7 | 12.6 | 11.0 | 9.8 | 8.8 |
| 3 | 17 250 | 13 800 | 17.3 | 13.8 | 11.5 | 9.9 | 8.6 | 7.7 | 6.9 |
| 2 | 13 500 | 10 800 | 13.5 | 10.8 | 9.0 | 7.7 | 6.8 | 6.0 | 5.4 |

NB *20% Subtracted as a result of losses at or shortly after planting due to poor germination, insect damage, cultivation, etc.
$The number of kernels per kg may vary, depending on the cultivar.

Cultivars also vary with regard to the amounts of seed they produce of the various kernel sizes. Genetically there is no difference between small and large kernels, but the larger

kernels are preferred on soils with a high clay content which compact easily, because a larger kernel produces a larger seedling, which is important under the above circumstances if the desired plant population is to be obtained. Small kernels have the advantage that they "plant further", thereby reducing seed costs.

Sunflower is very sensitive to a molybdenum deficiency in the soil, and where seed has not been treated with sodium molybdate by the supplier this must be done by the producer himself. This is particularly important in areas where it is known that soils have low molybdenum content.

## 6. PLANTING DEPTH AND CONDITIONS AT PLANTING

The heavier the soil, the shallower the recommended planting depth, and the drier the soil, the deeper the recommended planting depth. On heavy soils the seed should not be planted deeper than 25 – 37 mm, while on lighter soils with a clay content of 15% and less, it may be planted up to 50 – 60 mm deep.

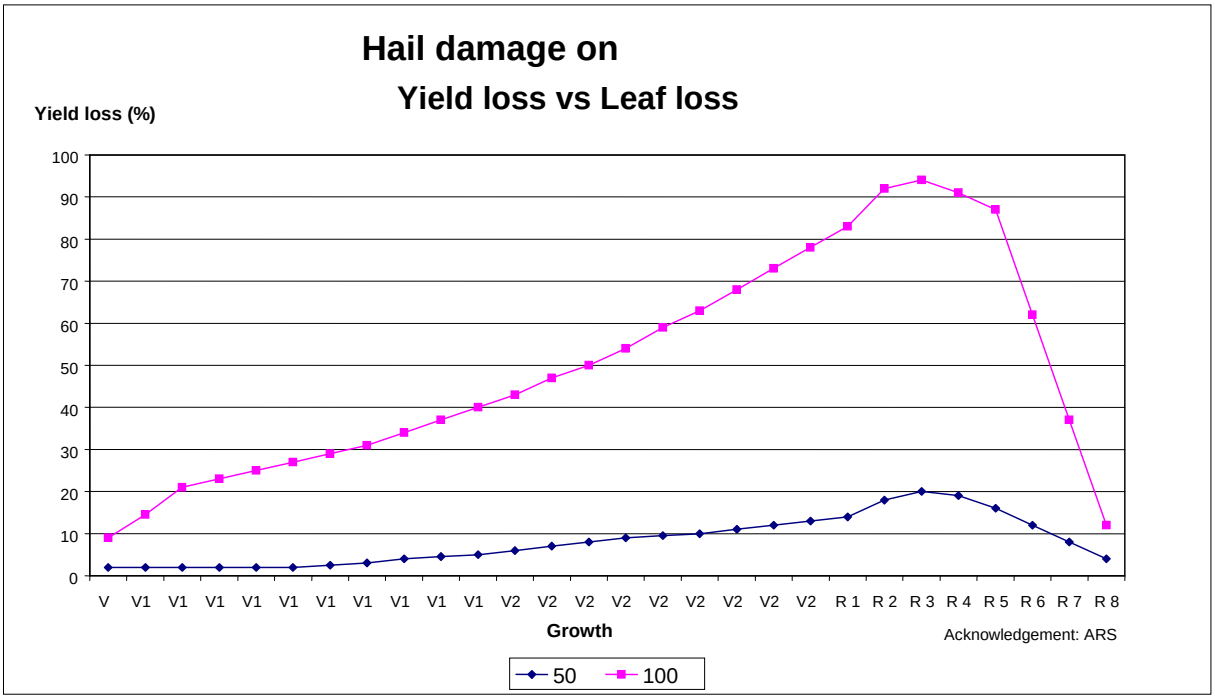
If the soil compacts after planting and forms a hard crust, it must be loosened as soon as possible otherwise the neck of the emerging seedling may break, resulting in the death of the seedling and a subsequent reduction in plant population.

Regarding soil temperature, $12^{o}C$ – $20^{o}C$ is considered optimal for germination. Very high soil temperatures are not advantageous for good germination.

## 7. THE RELATIONSHIP BETWEEN LEAF LOSS AND EXPECTED YIELD

**The estimated percentage yield loss from leaf loss at the diffenent growth stages:**

| Growth stage | Percentage Leaf Loss | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **10** | **20** | **30** | **40** | **50** | **60** | **70** | **80** | **90** | **100** |
| V9 | 0 | 1 | 1 | 2 | 2 | 3 | 3 | 5 | 7 | 9 |
| V10 | 0 | 1 | 1 | 2 | 2 | 3 | 3 | 5 | 7 | 9 |
| V11 | 0 | 1 | 1 | 2 | 2 | 3 | 3 | 6 | 12 | 21 |
| V12 | 0 | 1 | 1 | 2 | 2 | 3 | 3 | 6 | 12 | 21 |
| V13 | 1 | 1 | 2 | 2 | 2 | 3 | 4 | 7 | 14 | 25 |
| V14 | 1 | 1 | 2 | 2 | 2 | 3 | 4 | 7 | 14 | 25 |
| V15 | 1 | 1 | 2 | 2 | 3 | 4 | 4 | 8 | 17 | 29 |
| V16 | 1 | 1 | 2 | 2 | 3 | 4 | 4 | 8 | 17 | 29 |
| V17 | 1 | 2 | 2 | 3 | 4 | 4 | 5 | 10 | 20 | 34 |
| V18 | 1 | 2 | 2 | 3 | 4 | 4 | 5 | 10 | 20 | 34 |
| V19 | 1 | 2 | 3 | 4 | 5 | 6 | 9 | 14 | 25 | 40 |
| V20 | 1 | 2 | 3 | 4 | 5 | 6 | 9 | 14 | 25 | 40 |
| V21 | 1 | 2 | 4 | 5 | 7 | 9 | 13 | 19 | 30 | 47 |
| V22 | 1 | 2 | 4 | 5 | 7 | 9 | 13 | 19 | 30 | 47 |
| V23 | 2 | 3 | 5 | 7 | 9 | 12 | 17 | 24 | 35 | 54 |
| V24 | 2 | 3 | 5 | 7 | 9 | 12 | 17 | 24 | 35 | 54 |
| V25 | 2 | 4 | 6 | 8 | 10 | 14 | 19 | 27 | 40 | 63 |
| V26 | 2 | 4 | 6 | 8 | 10 | 14 | 19 | 27 | 40 | 63 |
| V27 | 2 | 4 | 7 | 9 | 12 | 16 | 22 | 31 | 46 | 73 |
| V28 | 2 | 4 | 7 | 9 | 12 | 16 | 22 | 31 | 46 | 73 |
| R1 | 2 | 5 | 8 | 11 | 14 | 18 | 25 | 35 | 52 | 83 |
| R2 | 2 | 6 | 9 | 13 | 18 | 24 | 31 | 42 | 62 | 92 |
| R3 | 3 | 6 | 10 | 15 | 20 | 26 | 33 | 45 | 65 | 94 |
| R4 | 2 | 5 | 9 | 14 | 19 | 25 | 32 | 43 | 63 | 91 |
| R5 | 2 | 4 | 7 | 11 | 16 | 23 | 30 | 40 | 55 | 87 |
| R6 | 1 | 2 | 5 | 8 | 12 | 17 | 23 | 31 | 43 | 62 |
| R7 | 0 | 1 | 3 | 5 | 8 | 12 | 16 | 22 | 30 | 37 |
| R8 | 0 | 0 | 1 | 2 | 4 | 6 | 7 | 9 | 11 | 12 |




## 8. FERTILISATION

Like all other crops sunflower requires a number of plant nutrients for maintaining good yield levels, and responds much more to fertilisation than is generally realised. However, there are certain factors in connection with the fertilisation of sunflower that must be borne in mind.

- Sunflower has a very fine, well branched root system which utilises plant nutrients very efficiently. This is the reason why sunflower is considered a good "catch crop" i.e. it has the ability to utilise nutrients which were applied to, but not utilised by, the previous crop in the rotation system.
  Sunflower can, therefore, be successfully grown after other crops that were fertilised well, but which did not produce a crop as a result of climatic factors such as drought or hail.

- Notwithstanding the above, it is wrong to assume that sunflower does not need to be fertilised, particularly on high potential soils where it is grown as an alternative cash crop to maize.

The following fertilisation programme may act as a guide for sunflower production:

### a) Liming

Sunflower is more susceptible to acid soils and aluminium toxicity than maize for example. Correcting soil pH by liming is therefore essential for successful sunflower production.

The optimum pH (KCl) for sunflower is 5.2 – 6.1 or at an acid saturation level of less than 10%.

**b)** **N-P-K**

Sunflower removes relatively large quantities of nitrogen, phosphorus and potassium, as may be seen in Table 1:

**Table 1 : Nutrient removal by Sunflower**

| Plant Component | Production kg/ha | Nitrogen (N) kg | Phosphorus (P) kg | Potassium (K) kg |
|---|---|---|---|---|
| Seed | 1 000 | 25.8 | 1.9 | 8.5 |
| Stems & Leaves | 6 000 | 41.2 | 5.2 | 87.6 |
| Whole Plant | 7 000 | 67.0 | 7.1 | 96.1 |

It is clear that sunflower is a fairly heavy user of nitrogen and that most of the plant nutrients are contained in the leaves and stems. Few plant nutrients are therefore removed in the seed crop. Nitrogen makes the biggest contribution to the crop. If the phosphorus levels are low it might hamper the yield potential because of a nutrient imbalance in the soil.
Specific recommendations of the 3 elements are based on the general fertility of the soil, however.

Dying off of the bottom leaves are normally an indication of a nitrogen deficiency. These symptoms may also occur during a period of drought as the biggest concentrations of nutrients are present in the top soil.

***Nitrogen***

Nitrogen plays an important role and a lack there of leads to a reduction in growth tempo. An indication of a nitrogen deficiency is pale green leaves.

**Table 2: Nitrogen requirements (kg N/ha):**

| Soil type (Clay %) | Planned yield (ton/ha) | | | | |
|---|---|---|---|---|---|
| | **1** | **1.5** | **2** | **2.5** | **3** |
| Sand (0-10%) | 16 | 35 | 60 | 80 | 108 |
| Loamy sand (10-15%) | 12 | 30 | 50 | 70 | 90 |
| Sandy loam (15-20%) | 10 | 20 | 45 | 60 | 80 |
| Sandy clay loam (20-35%) | 8 | 15 | 37 | 45 | 65 |

***Hint:*** The high rates should be applied as a split application. Do not apply more than 30 kg N/ha in the band next to the seed.

***Phosphorus***

In situations of low phosphorus levels sunflower should benefit from phosphorus applications. At optimum soil P levels a maintenance fertilisation programme is recommended.

**Table 3: Guidelines for P-Fertilisation of Sunflower**

| Soil P (Bray ) mg/kg | Planned Yield (ton/ha) | | | | |
|---|---|---|---|---|---|
| | **1** | **1.5** | **2** | **2.5** | **3** |
| 0-7 | 11-14 | 16-23 | 22-32 | 28-41 | 40-50 |
| 8-14 | 9-11 | 12-16 | 16-22 | 21-28 | 25-35 |
| 15-20 | 7-9 | 10-12 | 13-16 | 16-21 | 18-26 |
| 21-27* | 5-7 | 8-10 | 10-13 | 13-16 | 11-20 |
| 28-34* | 5 | 8 | 10 | 13 | 16 |

*Where the pH(KCl) is between 5.2 en 6.1 less P may be applied.

***Potassium***

Although sunflower is an efficient user of soil potassium only 13% is utilised for seed production. This means that the bulk of the potassium stays on the field in the form of stalks and leaves. A potassium shortage results in chlorosis of the leaves and crown leaves turning brown.

**Table 4: Guidelines for potassium fertilisation of sunflower**

| Soil K mg/kg | Planned Yield (ton/ha) | | | | |
|---|---|---|---|---|---|
| | **1** | **1.5** | **2** | **2.5** | **3** |
| 20 | 16 | 21 | 27 | 33 | 39 |
| 40 | 10 | 15 | 20 | 25 | 30 |
| 60 | 7 | 10 | 14 | 18 | 22 |
| 80 | 0 | 8 | 11 | 14 | 17 |
| 100 | 0 | 0 | 9 | 11 | 14 |
| 120 | 0 | 0 | 0 | 0 | 0 |

These are tentative potassium recommendations as reaction to potassium fertilisation is inconsistent.

## c) Trace elements

Sunflower is very sensitive to boron and molybdenum deficiencies and if these trace elements are not supplemented, deficiencies can have a significant effect on yields.

***Molybdenum***

Molybdenum plays an important role in nitrate reduction in the plant during protein synthesis. It also acts as a catalyst in many other processes in the plant.

Deficiency symptoms appear in the seedling stage. The leaves turn yellow between the veins, while the veins themselves remain dark green. The yellowish-green discolouration of the young plants varies in intensity over the total land area, with the severest symptoms appearing on the sandier portions. Germination also is often poor. Molybdenum deficiencies normally occur in soils with a pH(KCl) of 4.7 and less. In acid

soils molybdenum combines with other soil components, thereby rendering it unavailable for the plant.

Where fertilisers containing sulphates and nitrates are band placed, serious molybdenum deficiencies may be induced.

Seed treatment with sodium or ammonium molybdate at a rate of 1 g/kg seed should satisfy the molybdenum requirements of sunflower under normal conditions. However, it is important to bear in mind that smaller seeds are usually more subject to a deficiency because, as a result of their smaller surface area, less sodium molybdate will stick to the seed, and also that seed treatment is merely a preventative measure which will not cure any future deficiencies.

In soils where severe molybdenum deficiencies occur, seed treatment alone may not be enough, and an additional spray with approximately 50 g sodium molybdate per ha in 100 litre of water may be necessary when symptoms appear soon after emergence.

Pannar Seed (Pty) Ltd. applies molybdenum on all its sunflower seed production lands, which is the most effective method to apply this trace element to seed.

The fact that symptoms usually disappear completely 48 – 72 hours after spraying is typical of a molybdenum spray application.

***Boron***

Boron deficiencies generally occur in KZN and Mpumalanga. Deficiencies are normally associated with leached-out soil and mid-summer droughts.

Boron is present in all parts of the plant and fulfils important functions, e.g.

- involved in cell development and cell division
- plays a role in the translocation of carbohydrates and protein production
- plays a role in pollination
- essential for flower and seed development
- plays a role in the uptake of elements such as Ca, Mg, K and various other elements.

Deficiency symptoms usually appear after flowering and may be identified as follows:

- Flower heads are deformed. Notching towards one side of the head occurs with no seed set at the notch or indentation.

- Seed production is seriously affected by a boron deficiency. The stigma does not develop normally, pollination is ineffective, with the result that seed development and seed set is impaired. Patches occur on the head where seed hulls contain no grain.

- In severe cases the top leaves harden and are deformed. A reddish-brown or bronze discoloration appears between the leaf veins, the leaves are brittle and wrinkled.

- In extremely severe cases heads break off completely.

**Apply Boron according to leaf analysis**

Boron fertilisation by soil sampling is unreliable and leaf analysis is recommended. Where a possible boron shortage in young sunflower plants should be rectified, a sample of young plants should be tested for these trace elements. The young plants of about 1 month old could be cut off above the ground level for sampling purposes. If the boron content is less than 60 mg/kg (p.p.m.) a foliar application before the critical flowering period should be applied.

The best method of determining boron requirements however is to use uppermost large leaves during early flowering for analysis. Do not use the small leaves near the head. The leaf stalk should be removed and at least 30 leaves taken from a large representative sample of the land should be collected to get the most reliable analysis. In this case the critical boron level should be at least 40 mg/kg (p.p.m.). Boron application is recommended for all readings below this level. Obviously this method of determining the boron requirement is too late for a specific season, but is a good guideline for the following season.

**Table 5: Soil application - Boron recommendations on various soil types**

| Soil Type | Quantity Boron kg/ha | Product kg/ha | |
|---|---|---|---|
| | | Solubor (20.5%) | Borax (11.3%) |
| Sand | 1 | 5 | 9 |
| Sandy loam | 2 | 10 | 18 |
| Heavy clay | 3 | 15 | 27 |

A special fertiliser mixture which contains 1% Boron is at present commercially available. This application method is very effective and is strongly recommended.
Boron applications should be regarded as standard practice, as deficiencies are widespread in Southern Africa. Deficiencies can be expected particularly on rich calcareous soils with a high pH as well as soils with a very low pH and very sandy soils.

**d) General**

- Fertiliser applications, especially mixtures, must not be placed too close to the seed, as germination may be effected.

- All the fertiliser may be applied at planting. On light soils which leach easily, half the nitrogen may be applied at planting and the other half 4 –5 weeks later.

- Mixtures with Zn are preferred on soils where zinc deficiencies have previously been observed in maize.

## 9. WEED CONTROL

Sunflower is very sensitive to weed competition, particularly in the young stage. If weeds are not effectively controlled during the first 6 -– 8 weeks after emergence, up to 50% of the potential yield may be lost.

The best control is achieved by implementing a system making use of both mechanical and chemical means.

- Prepare your lands thoroughly before and at planting. A well-prepared seed bed ensures not only good germination, but creates optimum conditions for chemical herbicide killer.

- When the seedlings have established themselves and reach approximately 15 cm in height, a "millipede" may be used to control young germinating weeds – preferably during the warmest parts of the day.

- Later cultivations between the rows may be carried out with a tined implement. As damaged plants recover with difficulty or not at all, cultivations must be shallow in order to avoid any unnecessary damage to the roots.

- If necessary all khaki weed plants must be removed before harvesting.
  Seed harvested together with khaki weed assumes the smell of the latter and is degraded.

- The following herbicide in South Africa registered for use on sunflower:

| | **Common Name** | **Trade Name** |
|---|---|---|
| Incorporate | Pendimetalin<br>Trifluralin | Stomp<br>Trifluralin |
| Pre Emerge | Metalachlor<br>Dimethenamid<br>Alachlor/Bifenoks<br>Alachlor<br>Metazachlor | Dual<br>Frontier<br>Mowdown-Plus<br>Lasso<br>Pree |
| Post Emerge | Sikloksidim | Focus Ultra |
| Between Rows | Diquat/Paraquat | Preeglone |

It is important to remember that sunflower is particularly sensitive to the residual effect of Atrazine. On certain soils such as black turf, the residual effect of Atrazine can still damage sunflower 2 seasons later. Where sunflower is grown in rotation with maize, weed killers with a short residual action must be used on maize.

## 10. INSECT CONTROL

- To ensure a good stand, cutworms must be controlled by means of a bait or spray, preferably as a preventative measure, and not only when cutworms are observed, at which stage it is usually too late already.

- Sometimes bollworms severely damage sunflower. The plants are at their most sensitive in the early stages of head formation. An infestation at this stage may result in deformed heads and poor seed set. Sometimes no head is formed at all. After the flowering stage plants are less sensitive and damage is limited to eaten kernels in the head. Although bollworms may also attack the top leaves, damage is seldom serious, except when the infestation is particularly severe.

  Bollworms can be effectively controlled with insecticides such as Endosulfan, provided spraying takes place before they have penetrated the head.

  It is very difficult to establish at what severity of infestation the chemical control of bollworms is economically justified, because varying sizes and numbers of worms may be found on the various parts of the plant at the different growth stages of the plant.

  The presence of an average of 2 – 3 medium to large larvae or more smaller larvae per large flower head is usually an indication that control measures are justified.

## 11. DISEASE CONTROL

The spread of sunflower diseases varies from year to year depending on climatic conditions. Certain diseases are more prevalent in dry years, while the development of others again is aggravated by cold wet conditions.

While many diseases can affect sunflower, the only one of real economic importance is ***Sclerotinia*** Head Rot.

The most effective and economical way of controlling diseases is to plant resistant cultivars and to follow sound agricultural practices.

### *a)* Crop Rotation

Sunflower should not be planted more than once in 3 years on the same land in order to prevent the build-up of diseases.

Maize and grain sorghum are excellent rotation crops for sunflower. Crops such as potatoes, soybeans, groundnuts and common beans must be avoided, as they are also susceptible to ***Sclerotinia*** Wilt and Head Rot.

***b)*** **Seed**

Many Sunflower diseases are seed-borne. It is important therefore to plant only treated seed from a reliable source.

***c)*** **Sanitation**

Volunteer plants and diseased plants must be removed from the land if possible to prevent the build-up of diseases.

***d)*** **Cultivars**

As far as possible, only those cultivars should be planted which are resistant to the diseases prevalent in the particular area.

Unfortunately no cultivar exists yet which is resistant to **Sclerotinia** Wilt and Head Rot.

## IMPORTANT SUNFLOWER DISEASES

**a)** **Sclerotinia sclerotiorum (Wilt and Head Rot)**

Sclerotinia is a very serious disease and no resistant cultivars or effective chemical exist to control this disease.

This disease manifests itself in 2 ways:

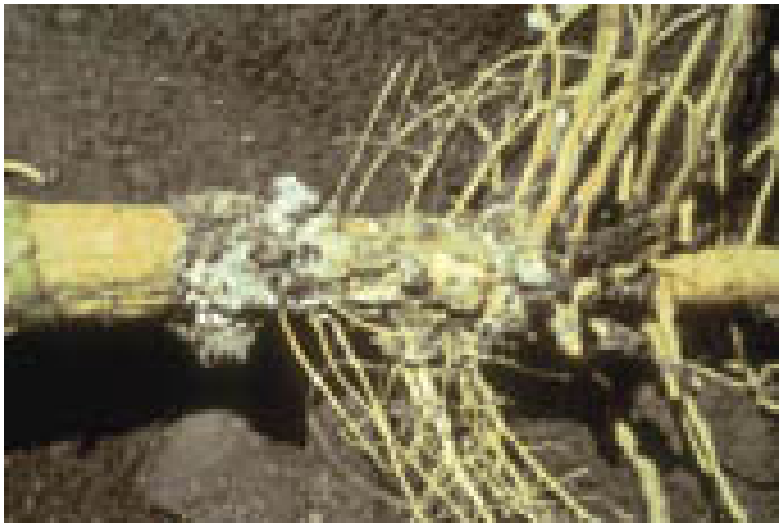
***(i)*** ***Sclerotinia Wilt***

This is the so-called asexual form of the disease and typical symptoms are the sudden wilting and death of the plant. White mycelial threads (not unlike cotton wool) develop on the stem near the soil surface, followed by soft grey or brownish spots of rotted tissue. These increase in size until the entire stem is ringed. Dense white mycelia appear which forms white lumps that soon harden into grey-black sclerotia. The soft, white pith inside the stem is destroyed.

The sclerotia formed in this manner can lie dormant in the soil and produce new mycelia under favourable conditions. The mycelia penetrate the stem of the plant, which wilts and dies, and new sclerotia are formed. In this manner the disease can survive in the soil for a long period, but normally only a very small percentage of plants are affected by this form of the disease.

### *(ii) Sclerotinia Head Rot*

***Sclerotinia Wilt***



This is the so-called sexual form and is far more damaging than the asexual form. The sclerotia, instead of forming mycelia in the soil which parasitise on the host plant, develop tiny sexual fruiting bodies, shaped like champagne glasses, known as apothecia. In turn, the apothecia produce millions of invisible sexual spores, also known as ascospores, which are spread by air currents and which land on the sunflower heads during pollination. It is suspected that the spores feed on the pollen grain before penetrating the head further, forming new sclerotia and thereby starting a new life-cycle.

Typical of infected heads is their frayed, ragged appearance at maturity and the presence of dark-grey to black sclerotia in the plant tissue. Severe infections can destroy the entire sunflower crop.

Although ***Sclerotinia*** may be transmitted in the seed, it must be borne

in mind that the sclerotia can survive in the soil for long periods, as well as on a number of so-called host plants. These plants include beans, potatoes, certain fruit trees, weeds such as Blackjack and many others. The disease organisms therefore occur fairly widely, and when an outbreak occurs on sunflower, it does not necessarily mean that it was transmitted through the seed, even when no sunflower has been grown on the specific land for a number of years.

***Sclerotinia Head Rot***

***Sclerotinia*** occurs mainly during prolonged cool, wet conditions and damage is most severe if these conditions are experienced late in the season and when the sexual form of multiplication occurs.

The only effective control measure is crop rotation with members of the grass family such as maize, sorghum and pastures. On infected soils resistant crops must be grown for at least 5 years. Volunteer plants must be removed as soon as possible.

Healthy, uninfected seed from a reliable source must be planted under all circumstances.

**b) <u>Rust</u> *(Puccinia helianthi)***

Rust usually occurs under cloudy, wet conditions in the middle of the season. Typical symptoms are the small reddish-brown, powdery rust pustules, mainly on the lower-surface of the leaves and stems, which later turn black. Severely affected plants degenerate rapidly.

As severe rust infections can reduce the oil content of the seed, effective control measures are essential. The use of resistant cultivars, removal of infected volunteer plants and the adoption of a rotation system are the most effective control measures.

Breeding of rust resistant cultivars is complicated by the continual development of new rust strains.

**c) <u>Root Rot</u> (*Sclerotium rolfsii*)**

Root Rot is caused by a soil fungus and usually occurs in patches in sunflower lands. Mechanically damaged roots are attacked, leaves wilt and die. Young plants often remain dwarfed and no flower-bud development takes place.

As the fungus multiplies on dead plant residues the deep incorporation of all plant residues is recommended.

**d) <u>Leaf Spot</u> (*Septoria* and *Alternaria spp*)**

Large, light to dark-brown round to angular sunken spots form on the leaves. Damage is normally insignificant, except when continuous rains occur, which create ideal conditions for the disease to spread to the younger leaves.

The use of resistant cultivars and crop rotation are effective control measures.

**e)** **<u>Charcoal Rot</u> (*Rhizoctonia spp*)**

Serious infections can occur under warm, dry conditions. The plants mature early, the stems break easily and plants lodge. The disease is recognised by the small, brown-black pin-head bodies in the stems.

The fungus is very sensitive to cold, and, if the infection was serious, plant residues may be left on the soil surface during winter.

**f)** **<u>White Blister</u> (*Albugo tragopogonis*)**

Damage is seldom serious and usually appears worse than it is. White blisters form on the underside of the leaves and give them a blistered appearance.

**g)** **<u>Head Rot</u> (*Rhizopus spp* and *Botrytis spp*)**

The fungi penetrate the sunflower plant where plant tissue is weak or damaged, e.g. by hail, insects of even birds. The disease occurs at the end of the growing season and is aggravated by cool, moist weather conditions. It can damage part or the whole head. It is important to distinguish this disease from the more serious and feared ***Sclerotinia*** Head Rot. No fruiting bodies, the typical black, irregular shaped survival structures, occur in the damaged heads.

**h)** **<u>Stem Rot</u> (*Phoma oleracen var helianthi-tuberosi*)**

The disease penetrates the stem at the base of the leaf petiole. Typical symptoms are the black lesions on the stem. The disease causes week stems which may break under strong, windy conditions. Grain development may also be affected by the disease. It is seldom serious and therefore of little economic consequence.

## D) HARVESTING

### 1. FOR SEED

a) The best harvesting stage is when the backs of the heads are still slightly damp. Losses during the harvesting stage are thereby reduced.

b) Heads may be threshed by means of a combine, threshing machine or even with a slow-speed hammermill fitted with large screens. Combines must be fitted with the correct gathering pans and other accessories specially designed for sunflower combining.

c) If the seed is to be stored for any length of time, it must not contain more than 10 percent moisture. If storage is temporary, 12% is acceptable.

d) Losses due to birds and insects, seeds falling out and poor standability may be reduced by harvesting at 20% moisture followed by artificial drying. The recommended drying temperature is 71$^{o}$C – 80$^{o}$C.

The harvesting process may also be advanced. Sunflower is physiologically mature when the back of the heads change from green to yellow and the small leaves around the head circumference turn brown and brittle. At this stage a defoliant may be sprayed on the plants, and harvesting may follow 1 – 2 weeks later.

### 2. FOR SILAGE

For the best ratio between yield and quality the plants must be harvested when 50 percent of the heads are flowering. The plant material must be allowed to wilt before it is ensiled. Ensiling may take place in conjunction with maize or sorghum (1:2) or alone by adding 20 kg of molasses per tonne.

### 3. FOR DRY FEED

Threshed or unthreshed heads may be milled and fed alone or in mixtures with other feeds.

## E) GRADING AND MARKETING

Technically, the sunflower seed is an achene, consisting of a true seed and a hull. The colour of the hull varies from practically white, striped to pitch black, depending on the type of sunflower.

The pericarp makes up approximately 20 – 25% of the total mass of the seed. The greater this mass, the lower the oil content.

The average composition of a high oil type sunflower is approximately as follows:

| | | |
|---|---|---|
| Oil | – | 42 – 45 % |
| Protein | – | 15 – 20 % |
| Hull | | |
| Water | – | 40 – 45 % |
| Minerals | | |

The grading of sunflower seed, as well as the producer's price structure, is in the first instance based on the oil content of the seed and then also on the physical purity and cleanliness of the sample. Seed with a musty, khaki weed or other unpleasant odour, or containing poisonous seeds, is discriminated against.

## F) YIELDS

| | | |
|---|---|---|
| Under Irrigation | – | 3 – 3.5 t/ha |
| Dryland : High Potential Conditions | – | 2 – 3 t/ha |
| Dryland : Marginal Conditions | – | 0.5 – 1.5 t/ha |