SUNFLOWER PRODUCTION GUIDE

CLIMATIC REQUIREMENT

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.
- 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 utilizes moisture reserves far more effectively than maize for example.
- 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.

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) 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 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.

D) 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.

SOIL REQUIREMENT

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 sandy loam or clay soils.
b. 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%. Acid, sandy soils are unsuitable, as sunflower is very sensitive to aluminium toxicity.

a. 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.

b. 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.

**SEED SELECTION**

Excellent sunflower hybrids are 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. Disease resistance.

f. 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.
LAND PREPERATION

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.

PLANTING AND PLANTING SPACING

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 – 40 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.

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.

Plant sunflower one week from the onset of effective planting rains. Sunflower should be planted on rows which are spaced at 75cm and planting station spaced at 30cm to achieve a plant population of 44,000 plants per hectare. Plant two seed per station then thin to one seed per
station 14 days after planting. Thinning reduces competition and results into a bigger sunflower head and a strong stalk which will be able to support the head. Plant your sunflower seed at a depth of 3-4 cm. Per hectare, sunflower seed rate is 5kg.

WEEDING

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.

- The following herbicide can be used if they are registered in the country:

<table>
<thead>
<tr>
<th>Incorporate/Pre Emerge</th>
<th>Common Name</th>
<th>Trade Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pendimetalin</td>
<td>Stomp</td>
<td></td>
</tr>
<tr>
<td>Trifluralin</td>
<td>Trifluralin</td>
<td></td>
</tr>
<tr>
<td>Metalachlor</td>
<td>Dual</td>
<td></td>
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<tr>
<td>Dimethenamid</td>
<td>Frontier</td>
<td></td>
</tr>
<tr>
<td>Alachlor/Bifenoks</td>
<td>Mowdown-Plus</td>
<td></td>
</tr>
<tr>
<td>Alachlor</td>
<td>Lasso</td>
<td></td>
</tr>
<tr>
<td>Metazachlor</td>
<td>Pree</td>
<td></td>
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<tr>
<td>Sikloksidim</td>
<td>Focus Ultra</td>
<td></td>
</tr>
<tr>
<td>Diquat/Paraquat</td>
<td>Preeglone</td>
<td></td>
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</tbody>
</table>

Where sunflower is grown in rotation with maize, weed killers with a short residual action must be used on maize.

FERTILIZER APPLICATION

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 utilized 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.

**Table 1. Sunflower nutrient removal**

<table>
<thead>
<tr>
<th>Plant Component</th>
<th>Production kg/ha</th>
<th>Nitrogen (N) kg</th>
<th>Phosphorous (P) kg</th>
<th>Pottasium (K) kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed</td>
<td>1000</td>
<td>25.8</td>
<td>1.9</td>
<td>8.5</td>
</tr>
<tr>
<td>Leaves &amp; stems</td>
<td>6000</td>
<td>41.2</td>
<td>5.2</td>
<td>87.6</td>
</tr>
<tr>
<td>Whole Plant</td>
<td>7000</td>
<td>67.0</td>
<td>7.1</td>
<td>96.1</td>
</tr>
</tbody>
</table>

Sunflower removes relatively large quantities of nitrogen, phosphorus and potassium.

**Nitrogen**

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.
Table 2. Nitrogen required based on type of soil

<table>
<thead>
<tr>
<th>Soil type (Clay %)</th>
<th>Planned Yield (ton/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Sand (0-10%)</td>
<td>16</td>
</tr>
<tr>
<td>Loamy sand (10-15%)</td>
<td>12</td>
</tr>
<tr>
<td>Sandy loam (15-20%)</td>
<td>10</td>
</tr>
<tr>
<td>Sandy clay loam (20-35%)</td>
<td>8</td>
</tr>
</tbody>
</table>

The higher rate of N should be applied as a split application. Do not apply more than 30kg N/ha in band next to the seed.

Phosphorous

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. Phosphorous required based on soil analysis

<table>
<thead>
<tr>
<th>Soil P (Bray) mg/kg</th>
<th>Planned Yield (ton/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>0-7</td>
<td>11-14</td>
</tr>
<tr>
<td>8-14</td>
<td>9-11</td>
</tr>
<tr>
<td>15-20</td>
<td>7-9</td>
</tr>
<tr>
<td>21-27*</td>
<td>5-7</td>
</tr>
<tr>
<td>28-34*</td>
<td>5</td>
</tr>
</tbody>
</table>

*Where the pH (KCL) is between 5.2 & 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. Potassium required based on soil analysis
<table>
<thead>
<tr>
<th>Soil P (Bray) mg/kg</th>
<th>Planned Yield (ton/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>20</td>
<td>16</td>
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<tr>
<td>40</td>
<td>10</td>
</tr>
<tr>
<td>60</td>
<td>7</td>
</tr>
<tr>
<td>80</td>
<td>0</td>
</tr>
<tr>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>120</td>
<td>0</td>
</tr>
</tbody>
</table>

These are tentative potassium recommendations as a reaction to potassium fertilization is inconsistent.

**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.

**Boron**

Deficiencies are normally associated with leached-out soil and mid 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.**

- 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.
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.
- The bracket recommendation is 100 kg of urea and 150 kg of 23:21:0 + 4S per hectare. It is recommended to apply fertilizer which has boron where boron is deficient in the soils. Apply the 23:21:0 + 4S fertilizer at planting or soon after planting for better root development and plant vigor. Apply Urea 14 days after planting and after thinning. A standard cup number 5 can be used to apply fertilizer.
- Super D is recommended where it is available instead of 23:21:0 + 4S because it has potassium and boron.

SUNFLOWER PEST

1) Wireworms

Wireworm larvae are hard, smooth, slender, wirelike worms varying from 38 to 50 mm in length when mature. They are a yellowish white to a coppery color with three pairs of small, thin legs behind the head. The last body segment is forked or notched. Adult wireworms are bullet-shaped, hardshelled beetles that are brown to black and about 13 mm long. The common name “click beetle” is derived from the clicking sound that the insect makes when attempting to right itself after landing on its back.

2) Cutworms

Dirty gray to gray brown. Grub like larva, 0.25 to 1.5 inches in length.

3) Palestriped Flea Beetle

The adult is about 3.2 mm long and shiny black, with two white stripes on the back. The hind legs are enlarged and modified for jumping.
4) **Sunflower Beetle**

The sunflower beetle is associated exclusively with sunflower. The head of the adult is reddish brown and the thorax (area between head and abdomen) is pale cream-colored with a reddish-brown patch at the base. Each front wing cover is cream-colored and has three dark stripes that extend its length. A shorter lateral stripe ends at the middle of the wing in a small dot that resembles

5) **Sunflower Bud Moth**

Sunflower bud moths have a wingspread of about 16 to 18 mm. Each gray-brown forewing has two dark transverse bands. One band extends across the middle of the wing and the second band is near the wing tip. The larva has a dark head capsule with a smooth, cream-colored body and is 8 to 11 mm at maturity.

6) **Longhorned Beetle**

The adult is pale gray and 6 to 11 mm in length, with long gray and black banded antennae. Eggs are about 1.9 mm long and elongate, and turn dark yellow prior to hatch. Mature larvae are yellowish and 7 to 13 mm in length. Larvae bear fleshy protuberances on the first seven abdominal segments.

7) **Sunflower Stem weevil**

Adult sunflower stem weevils are about 4 to 5 mm long and grayish brown, with varying-shaped white spots on the wing covers and thorax. The snout, eyes and antennae are black. The snout is narrow and protrudes down and backward from the head. Eggs are deposited inside the epidermis of sunflower stems and are very small 0.51 mm long by 0.33 mm wide, oval and yellow, making them difficult to see. The larvae are 5 to 6 mm long at maturity, legless and creamy white with a small, brown head capsule. They are normally in a curled or C-shaped position within the sunflower stalk. Pupae are similar to the adult in size and creamy white.

8) **Thistle Caterpillar (Painted red Butterfly)**
The body of the adult is about 25 mm long with a wingspread of about 50 mm. The upper wing surfaces are brown with red and orange mottling and white and black spots. The undersides of the wings are marble gray, buff and white. Each hind wing possesses a row of four distinct and obscure eyespots. Eggs are small, spherical and white. The larvae are brown to black and spiny, with a pale yellow stripe on each side. When mature, the larvae are 32 to 38 mm long. The chrysalis, or pupa, is molten gold and about 25 mm long.

9) **Sunflower Midge**

The tan body of the adult sunflower midge is about 1.69 mm long, with a wingspan of about 4 mm. The wings are transparent with no markings except the veins. The larvae attain a length of nearly 2.42 mm at maturity and they are cream to yellowish orange when fully grown. They are tapered at the front and rear, with no legs or apparent head capsule.

10) **Sunflower Seed weevils**

Red sunflower seed weevil adults are 2.5 to 3.06 mm long and reddish brown. The larvae are small 2.54 mm long, cream-colored, legless and C-shaped.

11) **Sunflower Moth**

The adult is a shiny gray to grayish tan moth about 9 mm long, with a wingspan of about 19 mm. The hind wings are devoid of markings; however, the forewings have a small, dark, dot near the center of each wing and two or three small, dark dots near the leading margin of each wing. When at rest, the wings are held tightly to the body, giving the moth a somewhat cigar-shaped appearance. The larva has alternate dark and light-colored longitudinal stripes on a light brown body. The larva is about 19 mm long at maturity.

12) **Banded Sunflower Moth**

The adult has a dark band across the buff or yellowish-tan forewings. The wingspan is 13 mm. Early instar larvae are off-white; late instar larvae are pinkish to red with a brown head capsule. Larvae will be about 11 mm at maturity.
13) **Lygus Bug**

The most common species occurring in sunflower fields is the tarnished plant bug. Adults are small, cryptically colored insects with a distinctive yellow triangle or “V” on the wings and 4 to 5 mm in length. They vary in color from pale green to dark brown. The immature stages, or nymphs are similar in appearance to the adults, but lack wings and are usually green in color. They often are confused with aphids, but lygus move much more rapidly.

14) **Sunflower Head clipping weevil**

The sunflower head clipping weevil adult is shiny black. The weevil is about 8 mm long from the tip of the snout to the rear of the abdomen. The area behind the head and thorax is large and “squared” in relation to the narrow and prolonged head and snout. Headclipping weevil larvae are cream-colored, somewhat C-shaped and grublike and 4 to 6 mm long.

**IMPORTANT SUNFLOWER DISEASES**

**Foliar Diseases**

**Early Season.**

a) **Downy Mildew**

Typical systemic symptoms in seedlings include dwarfing and yellowing (chlorosis) of the leaves and the appearance of white, cottony masses (fungal mycelium and spores) on the lower and sometimes upper leaf surface during periods of high humidity or dew. Most infected seedlings are killed, but those that survive will produce stunted plants with erect, horizontal heads with little, if any, seed. When seedlings are infected several weeks after emergence, or a fungicide seed treatment inhibits rather than prevents infection, the plants usually start showing symptoms at the four-, six- or eight leaf stage. This situation is referred to as “delayed systemic infection.” These plants are characterized by some degree of stunting, with typical downy mildew leaf symptoms starting at some level in the plant (with lower leaves appearing normal).
b) **Apical Chlorosis**

Apical chlorosis is the one of two bacterial diseases of sunflower. Apical chlorosis is striking and seldom goes unnoticed. The major symptom of the disease is the extreme bleaching or chlorosis of the upper leaves. Apical chlorosis may be distinguished from iron chlorosis or nitrogen deficiency by the complete lack of green pigment and the uniformity of the chlorosis. With mineral deficiencies, the veins characteristically remain green. In addition, the white leaves affected by apical chlorosis never will “regreen,” while those due to mineral deficiencies will.

c) **Rust**

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. They also occur on petioles, bracts and the back of the head under severe infestations. 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. The initial appearance of rust is determined by adequate rainfall and warm temperatures.

d) **Alternaria Leaf and Stem Spot**

Alternaria leaf spot is a ubiquitous disease on senescing leaves and generally of little concern, but under warm, humid conditions it can be a serious defoliating disease and they produce dark brown spots on leaves. These spots are irregular in size and shape with a very dark border and a gray center. The spots on young plants may have a yellow halo. Leaf lesions may coalesce, causing leaves to wither. Stem lesions begin as dark flecks that enlarge to form long, narrow lesions. These stem lesions often coalesce to form large blackened areas, resulting in stem breakage. Stem lesions are distributed randomly on the stem and are not associated with the point of attachment of the leaf petiole. Brown, sunken lesions also may form on the back of the head, especially following any mechanical damage such as that caused by hail or birds.
e) **Septoria Leaf Spot**

Septoria leaf spot develops first on the lower leaves and spreads to the upper leaves. The spots begin as water-soaked areas (greasy green in appearance). The spots become angular, with tan centers and brown margins. A narrow yellow halo often surrounds young spots. 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.

f) **Powdery Mildew**

Powdery mildew, caused by the fungus *Erysiphe cichoracearum*, can be found in most fields after full bloom. The symptoms are distinctive and easy to recognize: a dull white to gray coating of the leaves, starting as individual circular spots and eventually merging to cover the entire leaf. This coating is the scant mycelial growth of the fungus on the leaf surface. Severely infected areas senesce prematurely and dry up. Normally the lower leaves are more heavily infected than the upper leaves.

**Viral Diseases**

g) **Sunflower Mosaic Virus (SMV)**

Symptoms of SMV are a mottled pattern of light green and normal green areas on the leaf, referred to as mosaic. Affected plants may die in the seedling stage or live to maturity, with all leaves affected. SMV is spread primarily by aphids but is also seed-borne to a small extent. Seedlings less than a month old are the most susceptible, and mosaic symptoms appear within a week after aphid transmission. Affected leaves will retain the mosaic pattern for the life of the plant, but no stunting due to the virus is discernible.

**Stalk and Root Infecting Diseases**

e) **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**

Sclerotinia wilt usually is observed first as plants start to flower. Typical symptoms are the sudden wilting and death of the plant and a characteristic stalk lesion at the soil line. The length of time from the first sign of wilt to plant death may be as little as four to seven days. The stalk lesions that form at the soil line are tan to light-brown and eventually may girdle the stem. Under very wet soil conditions stalks and roots may be covered with white mycelia and hard black structures called sclerotia. Sclerotia are irregular shaped structures which range in size and shape from spherical to cylindrical or Y-shaped. Sometimes a series of dark “growth” rings produced by the daily extension of the fungus can be observed.

(ii) **Sclerotinia Head Rot**

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. The first symptoms of head rot usually are the appearance of water-soaked spots or bleached areas on the back of the heads. The fungus can decay the entire head, with the seed layer falling away completely, leaving only a bleached, shredded skeleton interspersed with large sclerotia. These bleached, skeletonized heads, which resemble straw brooms, are very obvious in the field, even from a distance. During harvest, infected heads often shatter and any remaining seeds are lost. The large sclerotia in the heads may be 12 m or greater in diameter and many are harvested along with the seed. 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 only effective control measure is crop rotation with members of the grass family such as maize, sorghum and pastures.

(f) **Middle stalk rot**

Middle stalk rot is the disease least often caused by Sclerotinia, and is first observed in the middle to upper portion of the stalk at or before flowering. Midstalk rot begins with infection of the leaf, and the fungus progresses internally through the petiole until it
reaches the stem (Figure 88). Symptoms of Sclerotinia leaf infection are not unique enough to identify the fungus, but once the stem lesion forms, the symptoms are identical with the lesion formed by root infection. The characteristic pith decay and formation of sclerotia both within the stem and sometimes on the exterior are highly diagnostic. The stalk usually lodges at the lesion site and the leaves above the canker die. With time, the fungus completely disintegrates the stalk, and the affected area will have a shredded appearance, as only the vascular elements of the stem remain.

(g) Charcol Rot
Charcoal rot is caused a fungus that attacks about 400 plant species, including sunflower, dry bean, soybean, maize and sorghum. 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. Charcoal rot generally appears after flowering but seedling blights have been reported. Symptoms on stalks appear as silver-gray lesions near the soil line, which eventually decay the stem and tap root, leaving a shredded appearance. Stems are hollow and rotted, and lodge easily. Plants show poor seed fill and undersized heads. Seed yield, test weight and oil concentration are reduced. Numerous tiny black fungus bodies form on the outside of the stalk and in the pith.

(h) Root Rot
Root rot is a soil-borne fungal disease, usually occurs in patches in sunflower lands. On sunflower, as with most crops, the initial symptom is wilting followed quickly by death of affected plants. No diagnostic symptoms appear on leaves or stems, but white mycelial strands on roots are characteristic of this fungus. 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. Following rain, the fungus may produce white mycelial mats on the soil surface.

(i) Stem Rot
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.

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.
Effective control measures for most sunflower diseases are:

- Planting resistant hybrids
- A minimum rotation of four years between successive sunflower crops
- Seed treatment for control of downy mildew and damping-off
- Tillage to bury crop residue that may harbor pathogens
- Foliar fungicides for rust and other foliar diseases

**HARVESTING**

Sunflowers are mature when the backs of the heads are yellow and the outer tracts brown. The fleshy heads and the stems will still be high in moisture. If bird damage is not serious, seed curing may take place on the standing stalk. If harvest is required before the seed is completely dry, the heads must be cut and placed in thin layers on an open drying floor with occasional turning. This drying operation will take 5-8 days. The dried heads may then be threshed by beating with sticks or rubbing them on a rough or slotted threshing board or by a threshing machine. The seed should then be winnowed to remove all chaff and foreign matter. This helps avoid molding and contamination by insects. The seed should be dried below 12% moisture for temporary storage and below 9% moisture for long time storage (2-3 months).

**POST HARVEST HANDLING**

Empty storage containers or sacks should be clean and treated with insecticide to avoid damage. Ensure sunflower is well dried, weighed and packaged before it is taken to the market. Rotten and moist sunflower is not acceptable for sale at the market.

**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 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.

**Yield**

Under Irrigation – 3 – 3.5 t/ha

Dryland : High Potential Conditions – 2 – 3 t/ha

Dryland : Marginal Conditions – 0.5 – 1.5 t/ha