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**PROVINCE OF KWAZULU-NATAL**

# **Sunflower Production -** *A Concise Guide*

## ***Introduction***

Sunflower is a crop which, compared to other crops, performs well under drought conditions; this is probably the main reason for the crop's popularity in the marginal areas of South Africa. Unfortunately, the crop is particularly sensitive to high soil temperatures during emergence and it is especially in the sandy soil of the Western Free State and the North West Province where this problem often leads to poor or erratic plant density.

In large parts of the sunflower producing areas, the soil has acidified dramatically during the last decade. Consequently, molybdenum shortages often occur and are possibly one of the greatest yield-limiting factors. The crop is very susceptible to bird damage and for this reason, it cannot be cultivated at all in some areas. On the positive side, however, the drought tolerance and low input cost of the crop are major advantages. The short growth season of the crop, which has the consequence that it can be planted over a period of at least three months, renders it extremely suitable for producers who make use of adaptable crop rotation and/or fallow systems. In any case, sunflower is a crop which only belongs in a crop rotation system.

## ***Soil requirements***

Sunflower adapts relatively well to a wide variety of soil types. Traditionally, sunflower cultivation has been limited to soils where the clay percentage varies between 15 and 55 %, In other words sandy loam to clay soil types. At present, the major planting areas are in soils with a clay percentage of less than 20 %.

In South Africa, a shortage of water is the main factor limiting crop production. It is important that the available water is used to the best advantage. Especially in the more arid western areas, it is essential that as much water as possible be stored in the soil profile before planting, to limit the chance of failure.

The sunflower plant has a deep and finely branched tap-root system which can utilize water from deep soil layers, even deeper than 2 m. Consequently, the crop often performs well even during a dry season, especially in deeper soils or in soils with a water-table. Because of its unique water-use pattern and root system the shallow soils which are found mainly in the eastern areas, such as shallow Westleigh, Estcourt, Kroonstad and other duplex soils, are suitable for the cultivation of sunflower as well. Sunflower is capable of utilizing water from the clay horizons of these soils. The potential for high yields on these soils is, however, limited.

The following characteristics of soils will limit successful sunflower production and should be avoided:

- Sunflower is very sensitive to wind damage in the seedling stage and for this reason, cultivation on light-textured soils susceptible to wind erosion, should be avoided unless wind erosion is being combated successfully.

- Sunflower is very sensitive to water-logging.

- Sunflower is very sensitive to high aluminium levels and should not be planted in soils with a pH lower than 4,6 (KCI).

### *Yield potential*

From a management point of view, it is essential to make a reliable assessment of the yield potential, with effective planning in mind. Plant density, cultivar and especially the fertilisation programme cannot be planned unless yield potential has been accurately determined.

Table 1 provides a guideline for the determination of yield potential.

**TABLE 1. Yield potential in relation to soil depth and rainfall for loam soils (kg/ha)**

| Soil Depth | Rainfall (mm) | | |
|---|---|---|---|
| | **500** | **550** | **650+** |
| 40-60 | 1 000 | 1 200 | 1 500 |
| 60-80 | 1 300 | 1 500 | 1 900 |
| 80+ | 1 300 | 1 600 | 2 200 |

### *Guidelines for the choice of sunflower cultivars*

Choice of cultivar is an important facet in the production process and its effect is often underrated. Choosing the right cultivars is one way of ensuring higher profits at no extra cost. Sunflower is not very subject to diseases and from a production point of view, disease resistance and quality do not play a major role yet. For this reason, yield and yield reliability are by far the most important criteria when cultivars are evaluated. The yield reliability of a cultivar at a certain yield potential is the minimum yield which will be achieved by that cultivar in nine out of ten cases. Yield reliability therefore takes the yield disposition, average yield and the riskiness of a cultivar into account, It is a very reliable criterion which can be used for cultivar recommendations. Further detail on specific cultivars is covered by a separate leaflet, which is updated annually and is available from the ARC-Grain Crops Institute on request.

### *Soil cultivation*

Production stability can be enhanced by the application of cultivation practices which limit moisture stress as far as possible. The point of departure in soil preparation should be to

utilise rainfall and soil moisture to a maximum, Soil preparation should be focused on decreasing runoff losses, especially in the case of soils with a low infiltration rate. These losses can be limited to a great extent by applying the correct soil cultivation practices.

Primary cultivations, such as ploughing with a mouldboard plough or chisel plough, are suitable. The aim of the cultivation is to break up limiting layers, destroy weeds, provide a suitable seedbed and to break the soil surface at the same time to ensure maximum rainfall infiltration as well as to prevent wind and water erosion.

Sunflower is usually cultivated in rotation with maize or sorghum and benefits from the dense mulches of these crops. Mulches protect the soil against the impact of raindrops, which seals the surface and reduces the infiltration rate but may enhance some other pests. Soil compaction can be a serious problem, especially in sandy soils. If the compaction is not broken, the crop cannot utilise the full water capacity of the soil profile, because roots cannot penetrate the compacted layer. The root development of the previous crop should be examined through profile pits. In dry years, the root development of the sunflower plant will be seriously hampered where compaction exits.

### *Planting date*

Normally sunflower can be planted from the beginning of November until the end of December in the eastern areas and until mid-January in the western areas, When choosing the best planting date, a number of factors should be taken into consideration. These include the onset and lost dates of frost, the soil temperature, moisture requirements of the crop, rainfall pattern, other crops being cultivated and the risk of bird damage.

High soil temperatures during planting time lead to poor emergence. In the warmer western areas with sandy soils, this is a major factor, which often leads to a poor stand. At Viljoenskoorn in the northwestern Free State, soil temperatures as high as 45 $^{o}$C have been measured in a sandy soil at plant depth during December. In these parts planting should rather be done before mid-November when soil temperatures are not as high yet or when a period of two to three days' cooler weather is expected.

### *Row width*

The influence of row width on sunflower yield is quite small. Row widths of 90 to 100 cm are mostly used, but wider rows can also be used. Where other crops such as maize are planted in rows of 1,5 m or even 2,1 m, sunflower can also be planted successfully in these row widths, in order to fit farm implements. Wide row spacing is only suitable for yield potentials lower than 1500 kg/ha.

### *Plant density*

A correct and uniform plant density with sunflower is the basis of a good yield. Although the plant is able to compensate by head size and number of seeds per head, a very low plant density (eg less than 20 000 plants/ha) often limits yield. At a low plant density, heads are forming which are too large, dry out unevenly and eventually impair the harvesting process. Large heads also have serious seed setting problems, For instance, a sunflower head of 30 cm produced only 19 g of seed (20 % seed setting), compared to the 54 g of seed of a 16 cm head (80 % seed setting). High densities of 55 000 plants/ha and more cause a higher occurrence of lodging, which should be avoided. Plant densities higher than 30 000 plants/ha should be avoided at yield potentials below 1200 kg/ha as the high rate of water use often causes water stress, leading to poor yield or even crop failure.

It is essential that sunflower be spaced evenly. The accuracy of the planter determines whether an even plant density will be achieved. Guidelines for plant density are given in Table 2 and for seed requirements in Table 3.

**TABLE 2. Guidelines for plant density at different yield potential levels**

| Potential (kg/ha) | Plant density (plants/ha) |
|---|---|
| 1 000 - 1 200 | 25 000 - 30 000 |
| 1 200 - 2 000 | 30 000 - 35 000 |

**TABLE 3. Sunflower seed requirements (kg/ha) according to plant density and seed size**

| Plants/ha | | | |
|---|---|---|---|
| **Seed size** | **25 000** | **30 000** | **35 000** |
| 4 | 1,42 | 1,71 | 1,99 |
| 3 | 1,81 | 2,17 | 2,54 |
| 2 | 2,32 | 2,78 | 3,24 |

### *Planting depth and planting techniques*

Sunflower seeds are planted at relatively shallow depths. In soil with a high clay content, seeds are planted at a depth of 25 mm. In sandy soils, seeds can be planted at a depth of up to 50 mm. For the planting process, the importance of a good planter cannot be over-emphasised. To plant sunflower, a planter should be able to space seeds evenly, it should have a good depth control mechanism and should be equipped with press wheels. Good contact between the seed and the soil is essential, For this purpose, the use of press wheels is necessary. During germination, however, sunflower plants are particularly sensitive to compacted soil, which means that press wheels should only exercise light pressure on the soil to avoid compaction.

### *Tips*

- Avoid extremely high temperatures during planting time, as well as the possibility of frost damage.
- The quantity of water which has been preserved in the soil before planting time has a major influence on the establishment, growth and survival of the plants during droughts.
- Use more than one planting date to spread the risk of drought.

- In clay soils, sunflowers should be planted in narrow rows (90 to 100 cm) to improve soil water utilisation.

- Planters with press wheels, which compact the soil alongside the seed, are more suitable than those with press wheels excercising direct pressure from above.

***Fertilisation***

Compared to grain crops, sunflower utilises soil nutrients exceptionally well. The main reason for this is the finely branched and extensive root system. The roots come into contact with nutrients which cannot be utilised by other crops.

**Macro nutrients**

Sunflower normally reacts well to nitrogen and phosphorus fertilisation where there is a shortage of these elements in the soil. It is therefore essential that any fertilisation programme for sunflower should be based on soil analyses. Soil analyses will not only lead to more appropriate fertilisation levels, but can also significantly limit unnecessary fertilisation costs.

**Nitrogen**

When there is a shortage, growth rate decreases dramatically, leaves turn to pale green and the lower leaves die off,

**TABLE 4. Guidelines for nitrogen fertillsotion (kg N/ha)**

| Target yield (kg/ha) | N guideline (kg/ha) | |
|---|---|---|
| | Clay soils | All other soils |
| 1 000 | 0 | 0 - 15 |
| 1 500 | 0 - 15 | 25 - 35 |
| 2 000 | 40 - 50 | 60 - 70 |

**Phosphorus**

A shortage of phosphorus is characterised by retarded growth. In serious cases, necrosis can be detected on the tips of the lower leaves. Fertilisation guidelines for phosphorus are given in Table 5. Factors which should be taken into account when planning a phosphorus fertilisation programme, are the following:

- Attempts should be made to build up the phosphorus content of the soil over time.

- The optimum soil phosphorus level for sunflower is about10 mg/kg (Ambic 1). This means that phosphorus fertilisation is essential when the level of phosphorus In the soil is below 10 mg/kg. However at a higher level the crop will probably not respond to phosphorus fertilisation.

**TABLE 5. Guidelines for phosphorus fertilisation (kg P/ha)**

| Soil P (mg/ha) | | Target yields (kg/ha) | | |
|---|---|---|---|---|
| **Ambic 1** | **Bray 2** | **1 000** | **1 500** | **2 000** |
| 2 | 7 | 11 | 16 | 21 |
| 4 | 10 | 9 | 14 | 18 |
| 6 | 12 | 8 | 12 | 16 |
| 8 | 15 | 7 | 11 | 15 |
| 10 | 18 | 6 | 9 | 12 |
| 12 | 21 | 3 | 5 | 10 |
| 14 | 24 | 0 | 4 | 8 |

**Potassium**

Although sunflower draws large quantities of potassium from the soil, potassium fertilisation is usually unnecessary as South African soils generally have adequate quantities of this nutrient.

**Molybdenum and boron**

Shortages of boron and molybdenum often limit the growth and yield of sunflower in the eastern parts of the country. To avoid problems concerning these two elements care should be taken to apply fertiliser containing boron and to ensure that seeds are treated with molybdenum. Local seed companies usually treat their seed with molybdenum.

If no soil analysis is available 50 to 100 kg/ha of a 3:2:1 (25) fertiliser mixture applied at planting is adequate for a yield potential of 1000 to 1500 kg/ha.

***Weed control***

Efficient weed control is a prerequisite for high sunflower yields. It is achieved by a combination of mechanical and chemical practices.

Young plants are very sensitive to strong weed competition and cannot develop fast enough to form a full shade covering which can suppress weed seedlings. Therefore, the first six weeks after planting are a critical period for the crop. Yield can be increased significantly by keeping fields free of weeds during this time.

## Mechanical weed control

Mechanical weed control can be very effective provided it is done in time and with care not to damage the crop. Chemical weed control can be applied successfully together with mechanical methods and cultivation practices to bring about better weed control. The following tips are given for mechanical control:

- Cultivate before the sunflower is too high for equipment, otherwise the plants will be damaged easily.
- To prevent damaging the sunflower roots, cultivation should be shallow (less than 75 mm).
- Throw loose soil onto the row-this will help to suffocate weeds which sprout in the row.
- Smaller weeds die off easily when dry soil is hoed.
- Hoe during the hottest part of day when the sunflower is wilted - this reduces stem breakage.

## Chemical weed control

The use of herbicides has many advantages, of which the most important is that effective weed control can be applied during wet periods when mechanical weed control is impossible. If sunflower is cultivated in crop rotation with maize, weeds can be controlled more effectively in both crops as grass and broadleaf herbicides can be used to succeed each other continuously.

### *Insects and diseases*

Although a number of insects and diseases may attack sunflower, it is often not serious enough to have a negative effect on yield. Soil insects such as cutworms, dusty surface beetle and ground weevils may cause damage to emerging seedlings.

### *Crop rotation*

Sunflower should be grown in rotation with other crops as:

- The risk of diseases and weeds increase with monocropping.
- A yield and quality advantage is often measured in a follow-up maize or sorghum crop.
- Weed and pest problems lessen with crop rotation.

However, take note that some herbicides do have a long residual period and may damage the follow-up crop in a rotation system. It is therefore important to strictly follow instructions on herbicide labels.

***Harvesting***

Harvesting should commence as soon as 80 % of the sunflower heads are brown in order to minimize losses caused by birds, lodging and shattering.

***Development Stages***

The development stages and associated crop management inputs of sunflower are shown in Fig 1.

**FIG 1. A schematic representation of sunflower's stages of development**