Sunflower Production and Important Production Strategies in South Africa

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Sunflower is grown in South Africa since the beginning of the previous century (Department of Agriculture, 1957b). By 1947 the production reached 41 000 t and by 1951 it was 63 000 t. The production steadily increased to 254 081 t in 1982 and 591 469 t in 1991 (Oilseeds Board, 1992). The production figures for the five years to 2001 are presented in Table 1 (Crop Estimates Committee, 1997-2001). It is apparent from Table 1 that the production has stabilised between 500 000 and 650 000 t. The all-time record production of 1 109 000 t in 1998 was the result of favourable prices and an excellent sunflower season.

To put the production of sunflower seed in perspective one should consider some natural resource figures for the Republic of South Africa (RSA), as well as production figures for some other crops in the RSA. The total land area of the RSA is 122 million hectares of which 10.7% or 13 million hectares are cultivated land used for annual and perineal crops. About 65% of the RSA land area has an annual rainfall of less than 500 mm and only 10% has a rainfall of more than 750 mm (Department of Agriculture, 1957a). In areas where summer crops are grown little or no rain is recorded in winter. Of the current arable land area only 40% consists of high potential soil while 26% has low potential soil or is not suitable for crop production (Lombard, 1998).

Maize is the dominant field crop in the RSA and is the staple food of the majority of South Africans. From Table 1 it is clear that maize and wheat are by far the most important field crops in the RSA. Although sunflower production is the third highest, it is only about 8% of the production of maize and about 20% of the production of wheat. Also in terms of area planted (Table 2) sunflower is dominated by maize and wheat. From Tables 1 & 2 it can be calculated that the average yield for maize is 2.48 t ha^{-1}, for wheat 2.06 t ha^{-1} and for sunflower seed 1.21 t ha^{-1}.

The area planted, yield and production of sunflower seed in a number of Southern African countries are presented in Table 3. From Table 3 can be calculated that the sunflower seed production of the Southern African countries is only 2.2% of the world production indicating that Southern Africa is a minute player in world terms. In terms of yield per unit area Botswana, Namibia and the RSA are close to the world average of 1 234 kg ha^{-1} while yields in other Southern African countries are roughly 50% of the world average.

In the RSA high-oil sunflower seed is by far the most important type produced. Sunflower seed is the most important source of plant oil for human consumption in the RSA. About 50% of the demand for plant oil is satisfied by locally produced sunflower seed. The balance is made up of imports and other local plant oils such as canola, cotton seed and soya. Sunflower cake is an important by-product of the oil extraction process. It is a source of protein used by animal feed manufacturers. Although there is a big demand for protein, the inclusion of sunflower cake in pig and poultry feeds is restricted by the high fibre content of the cake. Due to this constraint the demand for cake plays an important part to determine the demand for seed.

Although there is a small market for locally produced birdseed and confectionary type seed, no figures are available to quantify the production for these markets. As far as oil quality is concerned there is presently little interest in high-oleic and mid-oleic cultivars. One reason may be because the seed needs to be stored separate which complicates the management of storage facilities. Another reason may be the diverse range of oil qualities available from other plant oils.

Production strategies

Almost 90% of the national sunflower crop is produced in the Free State and North-West provinces. These two provinces largely represent the western drier crop production areas. In many of these areas successful dry land crop production is only possible if sufficient soil water can be stored in the soil profile before planting to contribute substantially to the yield. The variation in soil and rainfall characteristics from area to area resulted in the adoption of a variety of production systems to suit the requirements of each specific area.

Deep yellow soils

Large areas of the western Free State have deep sandy soils with a clay layer in the subsoil which limits the vertical movement of water. The result is that water can be stored in the soil profile above field capacity for extended periods and stored water can be carried over from one season to the next. It is possible to store up to 200 mm of plant available water in some soils. In general the soils are very sandy (often with less than 10% clay in the topsoil) and susceptible to wind erosion. With a large percentage of the sand fraction being fine sand, the soils are also very prone to compaction, usually within 400 mm of the surface. Regular deep ripping is needed to break up compaction. All tillage operations are done to keep as much stubble as possible on the soil surface to limit wind and water erosion.

The use of long fallow periods to accumulate water is common practice in areas where the annual rainfall is less than 500 mm. A 12-month fallow period is used where wheat is included in the rotation system. Wheat is harvested in November and the fields are left fallow until the next November when a summer crop (sunflower or maize) is planted for two years. After harvesting the second summer crop the fields are again left fallow for 12 months followed by wheat. A 18-month fallow period is used where only summer crops are planted. A field is planted to maize followed by sunflower and then left fallow for 18 months before planting maize again. With proper management and sufficient inputs, sunflower yields between 2 000 and 3 000 kg ha^{-1} are common on these soils.

Deep red soils

In contrast to the yellow soils, red soils are very well drained and cannot store water in excess of field capacity. The extent to which water can be carried over from one season to the next is very limited. The soil texture is in general comparable to the yellow soils although the topsoil may have slightly more clay. These soils are slightly less susceptible to wind erosion and compaction.

Regular deep ripping is essential to break up compaction. Mouldboard ploughing is quite common which means that no stubble is left on the soil surface. Wind erosion is limited through frequent tillage operations before and after planting. These soils are common in the western Free State and North-West provinces. Production systems are not well defined and sunflower is often grown on the same fields for a number of years, increasing the risk of devastating diseases such as Sclerotinia head and stem rot (*Sclerotinia sclerotiorum*), Alternaria leaf spot (*Alternaria sp*.) and Septoria leaf spot (*Septoria helianthi)*. Some farmers follow a structured rotation system with maize and sunflower or wheat and sunflower. It is often advisable to delay planting until sufficient water is stored in the soil to decrease the risk of failure to an acceptable level. Yields between 1 000 and 2 000 kg ha^{-1} are common on the deep red soils, but seasonal variation is large.

A common problem on all sandy soils, is poor emergence due to high soil temperatures during planting. Temperatures higher than 43 ^{o}C at planting depth may decrease seedling vigour to such an extent that emergence is poor and re-planting is often necessary. This often happens when the maximum air temperature rises above 30 ^{o}C for a number of cloudless days. Techniques to keep soil temperatures from rising too high include keeping the soil above the seeds loose to minimize heat conduction, planter mechanisms to avoid compaction directly above the seeds and planting when overcast conditions are expected.

Clay soils

In parts of the Free State, North-West and Northern provinces soils with more than 40% clay in the topsoil are common. These marginal soils are suitable for sunflower production provided sufficient water is stored before planting. For this reason planting is usually delayed until January or February. Deep tillage operations are not required because the soil is self mulching and tillage is limited to weed control. Farmers usually do not apply any fertiliser or herbicide. Yields vary between 500 and 1 200 kg ha^{-1}. During wet seasons yields above 2 000 kg ha^{-1} are common, but such seasons are the exception.

Boron nutrition

Boron is one of the essential elements needed by plants. Until about 1974 little was known about boron nutrition of sunflower. Blamey (1975) found in a field experiment in KwaZulu-Natal that the application of 10 kg borax ha^{-1} decreased the percentage of deformed heads from 27% where no borax was applied to less than 5%. In the same experiment 10 kg borax ha^{-1} increased the seed yield between 18 and 38%. This was one of the first confirmed cases of boron deficiency under field conditions that was reported in literature. Visible symptoms included hardened, malformed and necrotic upper leaves and a corky appearance of the peduncle. Malformations of flowers and subsequent malformed capitula were also observed (Blamey, 1975). Birch (1981) reported that boron deficiency occurred in all production areas of South Africa. The occurrence of boron deficiency symptoms is associated with dry periods during the growing season. As most plant available boron is usually present in the topsoil, drought during flowering may markedly reduce the boron availability to crops (Birch, 1981).

A number of strategies are followed to compensate for the negative effects of boron deficiency. Some farmers use boronated fertilisers as a standard preventive measure. The uses of highly water soluble chemicals containing boron in combination with herbicides is also popular. The chemical is added to the herbicide mix and is applied to the soil surface from where it is leached into the soil. Some farmers delay the application of boron until shortly before flowering when a water soluble boron compound is sprayed onto the leaves. The preferred strategy is to analyse sunflower leaves taken just before flowering. A leaf boron concentration of less than 40 mg kg^{-1} indicates a deficiency (Birch, Blamey & Chapman, 1977). Although it may be too late to rectify a deficiency, future applications of boron as a standard procedure is indicated. Recommended application rates are 1, 2 and 3 kg B ha^{-1} for sandy, loam and clay soils respectively (Birch, Blamey & Chapman, 1977). Application rates for foliar application should not exceed the recommendation of the manufacturer as the leaves may be scorched.

Research

Research is conducted by various organisations such as seed companies, fertiliser companies, agribusinesses, Provincial Departments of Agriculture, the ARC, the CSIR and universities. This is not an attempt to give a comprehensive report on past and current research, but only to give a few examples of substantial contributions made by various researchers.

- The late Mr. Willem Vermeulen started a well coordinated breeding programme in 1970 (Pakendorf, 1993). From this programme numerous lines were released to breeders locally and abroad, some of which are still used today. Currently two co-hybrids are among the top performers in the national cultivar trials. One was the top performer in 1999/2000 and second in 2000/2001.
- In 1975 Dr. Pax Blamey reported boron deficiency in sunflower in KwaZulu-Natal. This was the first confirmed case of boron deficiency in sunflower under field conditions.
- The yield reliability concept (van der Merwe, 1982) for the evaluation of cultivars was adopted in 1983 and is still used in the national cultivar trials.
- Research done on sunflower nutrition (Loubser, 1991) made a substantial contribution towards the development of fertiliser guidelines for sunflower (du Toit, Loubser & Nel, 1999).
- Some private seed companies have active breeding programmes in South Africa. The performance of some of their cultivars is outstanding and comparable to the best in the world.
- Since 1974/75 the national sunflower cultivar trials are coordinated by the ARC Grain Crops Institute and conducted in collaboration with seed companies, agribusinesses, and Provincial Departments of Agriculture.
- Comprehensive research was done on the effect of various factors during the production process on the processing quality of sunflower seed (Nel, 2001).

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Table 1. The production of selected crops in the RSA during 1997 to 2001 (Crops Estimates Committee, 1997-2001).

Crop	1996/97	1997/98	1998/99	1999/00	2000/01
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Maize	8 488	7 082	6 716	10 563	7 483
Wheat	2 700	2 284	1 788	1 561	2 122
Sunflower	450	562	1 109	531	638
Groundnuts	95	65	98	114	184
Soybeans	120	201	175	149	210
Dry beans	52	42	76	72	92
Sorghum	359	265	156	352	176

Table 2. The area planted to selected crops in the RSA during 1997 to 2001 (Crops Estimates Committee, 1997-2001).

Crop	1996/97	1997/98	1998/99	1999/00	2000/01

	---------------------------------- x 1 000 ha ------------------------------------				
Maize	3 361	2 956	2 905	3 814	3 223
Wheat	1 294	1 382	748	718	934
Sunflower	464	511	828	396	522
Groundnuts	95	59	95	83	165
Soybeans	87	125	131	94	134
Dry beans	47	39	65	72	78
Sorghum	161	131	99	142	88

Table 3. The area planted, yield and production of sunflower seed in selected Southern African countries for the year 2000 (FAO, 2001).

Country	Yield (kg ha^{-1})	Area (ha)	Production (t)
Angola	625	14 000	9 000
Botswana	1 083	6 000	6 500
Developed countries	1 198	13 211 026	15 826 809
Malawi	539	13 000	7 007
Mozambique	500	22 000	11 000
Namibia	1 111	90	100
South Africa	1 339	396 350	530 713
Zambia	536	14 000	7 504
Zimbabwe	598	26 500	15 850
World	1 234	21 714 959	26 800 303