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ZAMBIA - EXPANSION OF SUNFLOWER CROP (HELIANTHUS ANNUUS L.) BY THE NATIONAL OILSEEDS DEVELOPMENT PROGRAMME

Introduction

Before the beginning of the NODP in 1972 the acreage of sunflower in Zambia was very small and generally limited to investigation. Varieties cultivated in the past were mainly of the poultry seed and stockfeed types.

Increasing interest in the crop as a source of edible oil is recent and its inclusion in the oil development programme stems mainly from the belief that industrial processing of its seed is easy. Little was known about the behaviour of temperate high oil yielding cultivars under Zambian climatic conditions, which made it difficult to expand this crop in the country's territory.

On the other hand, other oil crops such as groundnut (which has been established in every Province as a subsistence crop for some time) could have represented a preferable alternative, particularly for small growers. Past exploratory research in sunflower, conducted at various regional research stations, have indicated that the seed yield is not stable but greatly varies from year to year and in most cases was disappointing. Serious concern was raised over the pollination of the flowers due to the prevailing opinion that local bees (Apia mellifera adansoni) were not particularly attracted to this plant and might not be sufficiently prolific to pursue the intended increase in acreage.

There has been no attempt in the past to establish a breeding programme either to select or adapt sunflower to Zambian conditions.

Zambias's Physical Conditions

The country lies between 9° and 17° South Latitude. Its total area is 752,000 sq km but most of the soils are non-fertile, over-mature on much of the plateau (average of 1200 m s. l.) and eroded in the escarpment areas.

The duration of the rainy season is about five months (from November to middle of April) when the temperature ranges between 15°C to 30°C whereas in the dry season the temperature gradually lowers to a minimum of 2-5°C early in the morning, in June and July.

The principal limiting factor in growing sunflower is the lack of moisture during the latter season. The relatively low temperature, which is relevant for some legumes and other crops, does not have much effect on sunflower growth.

Agronomic Research

Information available on sunflower cultivation practices was rather uncertain in the past because the crop was barely cultivated. The NODP provided for various agronomic experiments to determine the most suitable time of planting sunflower in different localities, together with other main factors affecting the yield.

The right time of planting is important for achieving the maximum yield and for the optimum use of agronomic inputs required in connection with other crops that may be grown in the farming system.

The different pattern of reinfall in each area can greatly affect the optimum time of planting. In particular, the minimum amount of moisture available during the budding and flowering stage can indicate a substantial change of this time.

In general, the period of planting in Zambia is delayed in the Northern Provinces compared to the Southern owing to a longer rainfall period in the former.

Optimum plant population per hectare is dependent upon the different varieties, soils, moisture available, etc. Local tall and late maturing varieties require a plant density of 75 x 35 cm (38.095 per ha) to reduce the percentage of ladging and stem rot.

Extensive studies have been carried out upon the phosphate and nitrogen requirements of the new commercial varieties in relation to the various soils. Phosphate (P_2O_5) appears to be the main fertilizer required by the new hybrids. Nitrogen also shows a response, but mainly on the local large leaf area varieties.

Not all the soils of Zambia can be considered appropriate for sunflower. As mentioned above, some of them are poor in organic matter, acid and strongly acid with a pH lower than 5.0 (CaCl) which is not suitable for the requirements of the majority of the present varieties. Nevertheless where leaching has not occurred to a great extent, as is the case with some red clays and sandvelt soils in Southern, Central or Eastern Provinces, the yield of sunflower is rewarding.

Breeding Research

However, the main hindrance to the expansion of sunflower in this country is the requirement for superior cvs adapted to these conditions. It has been reported on several occasions that high oil yielding temperate varieties fail to give satisfactory yield (see Table 1). Almost all of them are affected by pests and diseases which reduce the production of seed. Crosses made between temperate and local varieties possessing high hull percentage and anthocyanin pigment show more adaptability. In some instances, seed yield has improved considerably due to the heterotic effect, but oil percentage and kernel ratio of the seed remain low. In our breeding programme we have detected good general combining ability for seed

Table 1

Sunflower Variety Trials 1974/75. Square Lattice design: two replications, two localities. Varieties tested No. 25. The varieties with poor yield have not been included in the table

Variety	Speed yield (10 % moist), kg/ha	Oil % (10 % moist)	Total oil, kg/ha	Height, cm
CH 214	1840	32.8	604	229
OCA (73)	1500	30.0	450	234
CH 230	1230	36.0	443	187
CBG	1620	25.0	405	256
K 126	1160	30.1	349	218
VNIIMK 8931	900	38.2	344	194
Saffola 113	990	334	331	182
INRA 470	880	37.0	326	193
CMS (U. S. A.)	920	34.5	317	165
Saffola H 321	870	35.7	311	191
L. S. D. 0.5	3. 29			
C. V.	8. 91			

and oil content between some progenies of different origin. It appears that especially among Kenya populations of sunflower there are frequent instances of lines with GCA when crossed with VNIIMK cvs. A recurrent selection method adopted since the beginning of our programme has yielded composites and pure hybrids (100%) which are now available to the farmers of the country.

The new varieties have a better adaptability and productivity than those previously available. However, progress can still be expected with further cycles of selection.

Two composites A and B have been formed. Composite A(73) comprises most of the top progenies selected from populations established long ago in tropical or subtropical regions. Only a small fraction of this composite variety traces its origin from high oil yielding temperate varieties (VNIIMK 8931, VNIIMK 6540 etc.) or derived lines.

Composite B(73) on the contrary is constituted chiefly of temperate origin lines but with a small amount of tropical origin germ-plasm (Kenya).

Both of them possess wide genetic variability including some lines with nuclear male sterility. Phenotipic uniformity is reached after a few cycles of random mating to provide reasonable contemporary maturity for all the plants. The presence of incorporated nuclear male sterility, even after a few generations of random mating, guarantees a partial effect of heterosis on the seed yield. The wide genetic variability ensures some environmental stability with reasonable horizontal disease resistance. In addition, they are not costly to be bulked as commercial seed, requiring only one generation.

Composite A(73) being a tall variety cannot easily be harvested by combine. It is therefore recommended for small growers whereas Composite B(73) is more suited to mechanical harvesting.

Hybrids of sunflower, in Zambia, are produced by crossing female cytoplasmic male sterile lines and normal fertile male parent lines where a restorer fertility gene has been incorporated.

Although only two generations are required for the commercial seed the cost per bag (25 kg) appears to be high for African growers. They seem to be more attractive to the large-scale farmers.

Diseases and Pests

Up to now no comprehensive survey has been carried out of sunflower diseases in Zambia. The intensity and volume of the infection is also related to the degree of susceptibility of the varieties in this environment. We have observed catastrophic effects from leaf spot diseases (Alternaria spp. and Septoria spp.), mainly on high oil varieties imported from temperate regions.

The variety VNIIMK 8931 has been destroyed in commercial fields, and also in our experiments, by the above diseases. More marked resistance is noted in several varieties and particularly in Kenya selected progenies.

On the other hand, local varieties are easily affected by stem rot, a not well identified disease apparently caused by Bacterium sp.

Fortunately, downy mildew (Plasmopara helianthi Nov.) has not yet reached this country. Resistance to this disease has been incorporated in our breeding populations.

The combined phenotipic and genetic breeding used in our recurrent method of breeding will release at the end of each cycle (4 generations, two years) composites and hybrids with increased resistance.

Insects are not particularly harmful at present, but some attack of loopers (Plusia spp.) on the leaves and bud worm (Helianthus armigera H.) on the flower heads has been noticed.

During the dry season, irrigated sunflower crops are frequently affected by the breaking of the heads. The causal agent has not yet been determined. However, it appears that this damage is closely associated with a rapid fall in temperature during night time, and deficiency of micronutrients in the soils.

Sunflower grown in rotation with tobacco crops suffers in some cases nematode attacks (Melsidogyne spp.). Plants affected by these parasites are stunted and poor.

Conclusions

Over the last four years the cultivated area of this crop has grown from a negligible acreage to more than 55,000 acres (22,000 ha) during the last season.

This year yield totalled about 24,000 tons of dry sunflower seed. Several reasons can be attributed to this expansion. Apart from the Government action through encouraging prices (not only for this crop) and extension activities, great impact is due to the release of superior and better adapted varieties.

Improved varieties and especially composites are very popular among the farmers of all rural areas. Composites have shown a wider range of adaptability together with higher total oil production per ha compared with the best of the temperate varieties.

According to recent estimates provided from the districts and individual farmers, sunflower acreage will be further expanded in the next season. Most of the seed produced in Zambia is now from the NODP. Sunflower hybrids will be more popular with large-scale farmers, but their increase will depend on the improvement of the local seed production.

The present successful development of sunflower in this country underlines the remarkable potential of this crop in tropical and subtropical regions. Its popularity, especially among small African growers, shows that sunflower fits well in agriculture.

We are sure that our experience and results can also be utilized in other similar climatic conditions.

Sunflower can meet the skyrocketing needs for edible oil and cake for animal feed in many developing countries.

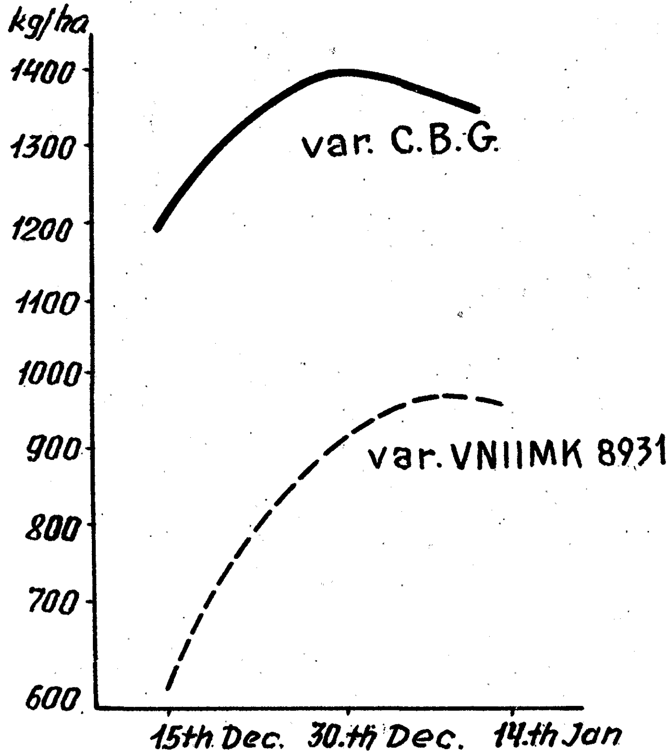

Fig. 1. Effect of different time of planting upon the variety VNIIMK 8931 and the variety CBG. Average of three rainy seasons 1972/73, 1973/74, 1974/75

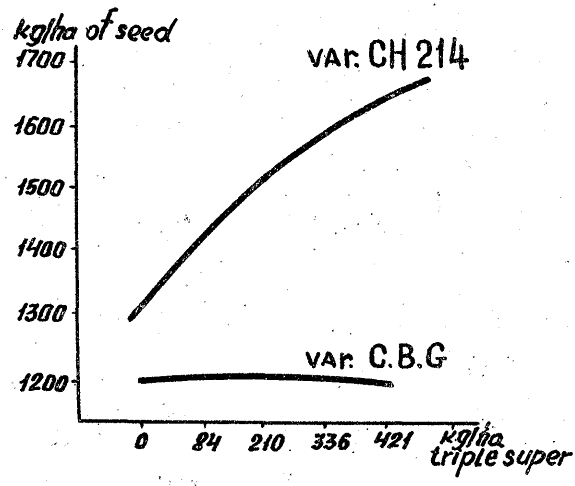

Fig. 2. Phosphate (P) effect upon seed yield of the variety CBG and CH 214

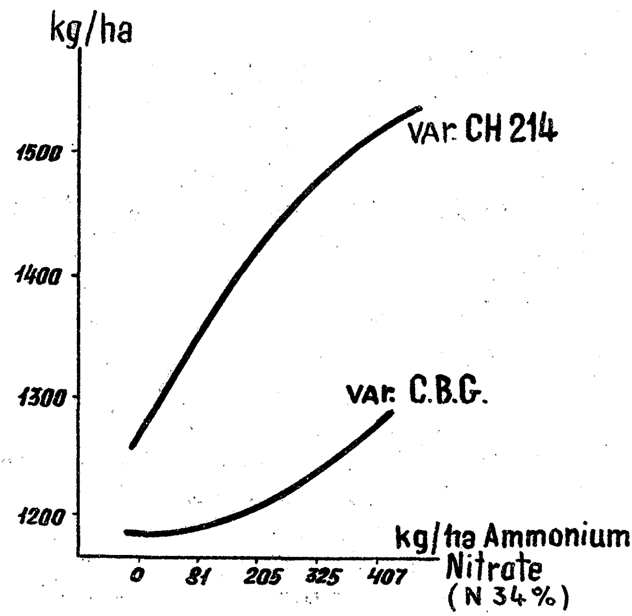

Fig. 3. Nitrogen (N) effect upon seed yield of the variety CBG and CH 214