

# SUNFLOWER PRODUCTION IN INDIA

**K. GIRIRAJ**

Sunflower Project, University of Agricultural Sciences, Bangalore-560065, India

During the early period of this century, sunflower was raised as an ornamental plant. In villages, the farmers used to lubricate the bullock carts with sunflower kernels and the oil was also used for lighting purpose. However, the commercial cultivation of sunflower as a source of edible oil began about a decade back when the promising material from USSR and Canada were received. The performance of new introductions were satisfactory in the beginning but subsequently there was gradual reduction in yield and oil content. Besides, problems like seed filling, diseases and pests, bird damage and marketability came in the way of acceptance of the crop by the farmers. In order to solve these problems and establish the crop in the country, the Indian Council of Agricultural Research initiated five research centres in the year 1973. The research work carried out under All Indian Co-ordinated Research Project in the country is monitored by the Project Co-ordinator located at Bangalore. A brief review of varietal improvement, crop management aspects and also the present status of the crop in the country are discussed in the following paragraphs.

### I. PERFORMANCE OF OPEN-POLLINATED VARIETIES

VNIIMK 8931 (BC. 68413), Peredovik (BC. 68414), Armavirski 3497 (BC. 68415) and Armavirets (BC. 69874) all from USSR and Sunrise from Canada, were evaluated for their performance in different parts of the country. The results showed that BC. 68415 in Karnataka State, BC. 68414 in Andhra Pradesh, Tamil Nadu, Maharashtra and Uttar Pradesh were high yielding and these two cultivars are now under cultivation. BC. 68414 and BC. 68415 varieties are tall growing (180 to 200 cm) and late in maturity (100 to 110 days in Southern parts of the country and about 130 days in Northern parts of the country). The average achene yield under rainfed conditions is about

8—10 q/ha. These cultivars are susceptible to *Alternaria* leaf spot, rust and root rot diseases.

In the course of screening germplasm, it was found that one entry viz. BC. 101495 (Cernianka-66) was dwarf (90 to 110 cm) and early in maturity (75 to 85 days). Its yielding potential is almost equal to BC. 68414 and BC. 68415. This variety is now widely grown in the country and is very popular with farming community since it can be grown as a mixed crop with sorghum, peanut, millets and pulse crops, and also as a catch crop under multiple cropping system under irrigated conditions.

### II. POPULATION IMPROVEMENT

#### a) DEVELOPMENT OF NEW POPULATIONS

At Akola centre (Maharashtra) a new improved population (Surya) from local Latur selection has been developed and released for commercial cultivation in Western region of the country. This variety has wide adaptability.

At Coimbatore centre (South India), a new early (70 days duration) and dwarf population from Morden has been involved. Under increased plant density, this new cultivar equals in yield the late variety (BC. 68414).

At Bangalore (South India), an improved population from Canadian gene pool material, has been found to be promising in yield and oil content over the presently cultivated open-pollinated varieties. This entry is being evaluated under multilocation trials.

#### b) VARIETAL RENOVATION AND SEED PRODUCTION

Cultivation of introduced varieties began to go down in their yield ability and oil content in the absence of any programme on varietal renovation and seed production. This factor had a great negative impact on sunflower cultivation and the area under sunflower started

coming down remarkably. It was at this stage the government of India realised the importance of varietal renovation and opened up five seed production centres in the country.

The varietal renovation and seed production of BC. 68414, BC. 68415 and Morden have been taken up at these centres. The procedure is based on Pustovoit scheme ("method of reserves") which is a three-tier system, viz. super-elite → elite → stage-I. The cyclic selections for the past 7 years for achene yield and oil content has imparted production stability and increased oil content in the presently grown cultivars which was lacking earlier. The experience has shown that when the farmers used renovated quality seeds, the seed filling problem was not serious and there was high oil recovery. Although uniformity in plant height and maturity has been achieved in Morden sunflower variety, it is still to be realised in tall and late duration varieties (BC. 68414 and BC. 68415). The five seed production centres in the country produce over 60 tons a year of elite seeds (foundation) which is sufficient to cover all the sunflower area with stage-I and stage-II seeds (certified seeds).

It may also be pointed out at this stage that after the establishment of sunflower seed production centres in the country during the year 1976—77, the area under sunflower began to increase from 500 ha in 1972—73 to 300,000 ha in 1978—79. Presently, about 700,000 ha are cropped to sunflower.

### III. DEVELOPMENT OF HYBRIDS

The discovery of cms and fertility restorer lines in sunflower during early seventies has made it possible to have hybrid varieties in the crop. The programme on heterosis breeding was initiated at Bangalore centre during 1974

by initially crossing several cms lines with restorers. The resultant hybrids were evaluated for their performance at several locations in the country. The results revealed the superiority of one hybrid, viz. BSH-1 (CMS 234 × RHA 274) (Fig. 1) over other hybrids and open pollinated varieties. The performance of this hybrid over BC. 68415 (Armavirski) at Bangalore is given in Table I.

Table 1

Performance of „BSH-1“ sunflower hybrid at Bangalore

Variety	Seed yield in kg/ha								
	Kharif Rainfed						Irrigated		
	1975	1976	1977	1978	1979	mean	1975	1977	mean
BSH-1	1 107	1 564	1 924	1 367	1 299	1 452	2 563	2 892	2 727
Arma- virski- 3497 (Check)	645	1 301	1 542	480	639	920	2 104	1 873	1 958

(Source : A. Seetharan, January 1981 issue of „Indian Farming“).

In addition to high yield potential of BSH-1 sunflower hybrid, the other features are :

1. More self-fertility leading to superior seed set.
2. Uniformity in flowering facilitating harvest at one time.
3. Tolerance to diseases.
4. Early maturity and drought tolerance.
5. Suitable for imput incentive agriculture.

Consequent to the release of BSH-1, several new hybrids are being developed at various re-



Fig. 1 — Commercial crop of sunflower hybrid BSH-1

search institutes in the country. Besides, the private seed industries have also taken up research studies on the development of new hybrids. The new experimental hybrids are being evaluated since 1981—82 in a number of field trials across the country using BSH-1 as a check. A few hybrids appear to be promising. At Bangalore, high combining inbred lines have been converted into cms lines and new restorer lines have been developed. Every year about 8—10 promising hybrids based on preliminary yield evaluation are included in the national testing programme.

#### IV. POPULATION VS HYBRID VARIETIES

Presently the sunflower crop is mainly concentrated in the southern part of the country. The results of preliminary trials conducted in other parts of the country are encouraging. Of the three predominant open-pollinated varieties, viz. BC. 68414, BC. 68415 and Morden, as mentioned earlier, Morden is the most preferred variety by the farmers for its short stature and early maturity. Varietal renovation and seed production of the se open — pollinated varieties organised at five centres was mainly responsible for the spread of the crop in the country. Although varietal renovation based on Pustovoit model involves various stages of selection and testing, the high seed multiplication ratio (1 : 100) makes it possible to cover large area under renovated quality seeds in a short period of time. It is also possible to increase oil content and achene yield in each cycle of selection. However, with this method, it is difficult to incorporate disease/insect resistance in the population and once ceiling is reached for oil content, limits the scope for the exploitation of variability. On the contrary, with heterosis breeding, the incorporation of resistance in the hybrid cultivar is easy once we identify resistance source in one of the parental lines. It is possible to develop high oil content hybrid cultivars by selecting cms/restorer line high in oil content. In USA, Canada and some European countries including Italy, more than 90% of sunflower cropped area is covered under hybrid varieties. In India, hybrid sunflowers were released recently and only a few thousand hectares were cropped with hybrid varieties. The hybrid sunflower cultivation finds place in assured rainfall and irrigated tracts. The present infrastructure of seed industry is inadequate to saturate the entire area of sunflower in the country with hybrid varieties. Both government and private seed industries have intensified their efforts for large scale production of hybrid seeds and in coming years the area under hybrid sunflower will increase. However, it may be said that the populations will continue to stay for years to come.

#### V. AGROTECHNIQUES

Varietal improvement alone will not result in realising higher yield. Crop management assumes equal importance in increasing the productivity. With this factor in view, the package of practices to be adopted for sunflower were studied in all the research centres and the results obtained are summarised in the following paragraphs.

Though sunflower can be planted all round the year, three distinct seasons of cultivation prevail — *kharif* season (June-July planting), *Rabi* or winter season (October-November planting) and summer season under irrigation (January-February planting). Seed rate of 8 to 10 kg/ha and spacing of 60 × 30 cm are recommended for BC. 68414, BC. 68415 and BSH-1 cultivars while for Morden (early and dwarf variety) spacing of 45 × 30 cm has been found to be optimum.

**Nutrition :** Sunflower responds to applied major nutrients like nitrogen, phosphorous and potash. Application of 60 kg N — 60 kg P<sub>2</sub>O<sub>5</sub> — 40 kg K<sub>2</sub>O kg/ha has been found to be optimum dose for irrigated crop while for dry-land cultivation 40 N — 60 P<sub>2</sub>O<sub>5</sub> — 40 K<sub>2</sub>O kg/ha is the recommended dose. All the quantity of phosphorous and potash and 2/3 dose of nitrogen is given as basal dose at the time of planting. The remaining 1/3 dose of nitrogen is applied at the time of bud formation (30 to 35 days after planting). Depending upon the native soil status, the dose is modified.

The studies carried out to identify agronomical variants that will maximise seed production without impairing the quality standards, revealed that fertilizer dose of 80 N — 90 P<sub>2</sub>O<sub>5</sub> — 40 K<sub>2</sub>O kg/ha with a spacing of 60 × 45 cm has been found to be optimum for BC. 68415 sunflower variety.

**Irrigation :** Sunflower is mainly grown as a rainfed crop. Irrigating the crop once in 8—10 days in light sandy soils and once in a fortnight in black soils (vertisol) helps in realising higher yields. Soil moisture stress during floral primordial initiation, bud formation, flowering and seed development stages of crop growth affects the achene yield to larger extent.

**Weed control :** Keeping the plots weed-free for a period of 45 days from planting is very essential. Spraying of weedicides like Alachlor (1.5 kg a.i./ha) as preemergence spray has been found to control the weeds effectively.

**Mixed cropping :** Sunflower can be successfully grown as an intercrop with peanut/finnger millet in 2 : 6 proportion.

#### VI. PLANT PROTECTION

**Diseases :** In India although sunflower is susceptible to several diseases, rust (*Puccinia helianthi*) and *Alternaria* (*Alternaria helianthi*)

are the major diseases in Karnataka while in Maharashtra, *Alternaria*, *Phoma*, *Curvularia* and bacterial leaf spots are the important ones. Several of these diseases can be controlled by spraying 0.2 to 0.3 per cent Dithane M-45, 2 to 3 times at about 10 days interval. Other diseases of less importance at present are :

1. Leaf spots caused by *Cercospora* sp. and *Cladosporium cladoides*.
2. Root rots (*Sclerotium rolfsii* ; *Rhizoctonia bataticola* and *Rhizoctonia solani*).
3. Stem rot (*Sclerotinia sclerotiorum*).
4. Head rot (*Rhizopus species*).

Regarding breeding for disease resistance, work has already been initiated to incorporate rust resistant genes in the hybrids/populations. However, the screening of available germ-plasm has shown that there are no gene source for other major diseases.

**Pests :** Though many insects have been recorded on sunflower in India, only a few are of pest status. They are :

- a) The sap-sucking jassid bug — *Amrasca biguttula*,
  - b) Defoliating caterpillars — *Plusia signata* and *Diacrisia obliqua* and
  - c) Capitulum borer — *Heliothis armigera*.
- Preliminary studies on the estimation of crop loss due to insect pests indicated that the loss ranged from 18 to 30 per cent. Over a decade, it is found that jassids are the major pests in Maharashtra and Tamil Nadu states, whereas in Karnataka defoliator and capitulum borer were the major pests.

The jassids could be controlled by spraying systemic insecticides like demeton-s-methyl or dimethoate or phosphamidon 0.5 kg a.i./ha. The defoliators and capitulum borer can be controlled by spraying Endosulfan or phosolone or Quinalphos 0.5 kg a.i./ha at fortnightly intervals. The egg masses or larvae of the defoliators on the leaves should also be destroyed. The capitulum borer should be sprayed against, at the budding and flower opening stages to avoid killing the pollinators.

Studies on honey bees, the major pollinators (*Apis cerana* — hive bee and *Apis dorsata* — rock bee) have revealed that 5% spray of either sugar or jaggery solutions at the time of flower opening, significantly increased the bee attraction and achene yield. Studies have also been initiated on the bee toxicity of insecticides which are effective in the control of major pests and endosulfan is one of the least toxic insecticides.

## VII. PRESENT STATUS OF SUNFLOWER

In recent years, sunflower has caught the attention of farming community as a potential oilseed crop of high returns with minimum

inputs. Although groundnut (peanut) is a major oilseed crop of the country, sunflower has now firmly established as a dryland crop. This crop has come to the rescue of farmers as an alternate cash crop in preference to cotton, sorghum and groundnut. In the present edible oil shortage in the country, it is not desirable to encourage one oilseed crop replacing another oilseed. However, the dominance of groundnut will not be altered for years to come in view of its forage value.

About five years back, sunflower had some problems like seed filling, bird damage, marketability etc. Although interaction of some physiological, genetic, nutrition and environmental factors decide seed filling, the results have shown that the final seed set is decided by the pollinators. In the absence of natural pollinating insects, in particular honey bees, hand pollination has been recommended to promote seed filling. Damage to the crop by birds is less of a problem now as the crop is grown on large areas and the growing season of the crop coincides with other crops. As regards marketability, the government has offered minimum support price for sunflower and is now easily procured in all the sunflower growing areas in the country. In villages, the produce is crushed in local "ghanis" for oil extraction. A few extraction plants use sunflower for large scale crushing and oil is marketed after refining.

## VIII. SUNFLOWER IN EIGHTIES

There is potentiality of presently cultivated open-pollinated varieties and hybrids in realising seed yield to the extent of 15 to 25 quintals/ha. However, the national average is as low as 6 to 8 q/ha mainly because of rainfed cultivation over large area. Hence, the main emphasis during eighties would be to stabilise productivity of the crop at a reasonable level of 10 q/ha. This could be achieved through hybrid sunflower cultivation especially where irrigation facilities are available. Besides, emphasis should be placed on management aspects of the crop considering various agro-climatic regions of the country for realising higher yields. Diseases being one of the important constraints in sunflower cultivation, breeding for disease resistant cultivars utilising wild species are to be attempted as a long range objective.

There is possibility of intercropping finger millet with sunflower over an estimated area of 2 million hectares in Tamil Nadu and Karnataka States. Similarly, there exists potentiality of intercropping cotton/peanut with sunflower in Gujarat, Rajasthan, Madhya Pradesh, Orissa, Uttar Pradesh, Punjab, Haryana and West Bengal. It is envisaged that sunflower will be planted over an area of one million hectares by the end of 1984—1985. In conclu-

sion, sunflower will continue to be an important oilseed crop in the future. Research work on development of high yielding varieties/hybrids with high oil content and resistant to pests and diseases should be accelerated to increase production per unit area and thereby *per se* production. This will narrow down the present wide gap in the oilseed production.

#### LA CULTURE DU TOURNESOL EN INDE

##### Résumé

On présente les principaux aspects de la culture du tournesol en Inde qui se rapportent aussi bien à l'obtention et à l'introduction en culture de certains cultivars de valeur, qu'à la technologie de culture. Parmi les cultivars essayés, les meilleurs résultats sont ceux enregistrés chez les cultivars soviétiques Peredovik (EC 68414) et Armavirski 3497 (EC 68415) le rendement desquels a atteint 8 à 10 q/ha. Des résultats similaires ont été enregistrés avec le cultivar Cernianka-66, cultivé surtout en association avec d'autres plantes. La baisse des rendements enregistrée d'une année à l'autre a rendu nécessaire le développement des recherches en vue de l'obtention de nouveaux cultivars et l'amélioration du procès de production des semences. Vu les résultats encourageants obtenus dans les centres de recherches d'Akola, de Coimbatore et de Bangalore, ainsi que les quantités de semences obtenues, les superficies occupées par les cultures de tournesol ont augmenté de 500 hectares en 1972 à environ 700 000 hectares à présent. A partir de 1974 on a aussi développé les recherches pour l'obtention de nouveaux hybrides de tournesol en utilisant la stérilité mâle cytoplasmique. Les meilleurs résultats ont été obtenus avec l'hybride BSH-1 qui a dépassé de 30 à 50% le témoin Armavirski 3497.

Dans l'obtention des rendements élevés et constants un rôle important, à côté de l'utilisation des génotypes très productifs, joue aussi bien la technologie de culture dont les éléments les plus importants sont l'époque des semis, la fertilisation, la lutte contre les mauvaises herbes et contre les maladies et les rava-

geurs, l'irrigation des cultures, etc. Le tournesol est à présent l'une des principales plantes oléagineuses à côté du coton et des arachides. Les superficies occupées par le tournesol atteindront en 1985 environ 1 million d'hectares et le rendement moyen à l'hectare sera d'environ 10 quintaux.

#### EL CULTIVO DE GIRASOL EN INDIA

##### Resumen

Están presentados los principales aspectos del cultivo de girasol en India concernientes tanto al modo de crear e introducir la producción de unos cultivares valiosos, como también a la tecnología de cultivo. De las variedades testadas los mejores resultados se han obtenido con las variedades soviéticas Peredovik (EC. 68414) y Armavirski 3497 (EC. 68415) cuya producción ha alcanzado 8—10 q/ha. Resultados parecidos se obtuvieron también con la variedad Cernianka 66, cultivada sobre todo en combinación con otras plantas. Las bajas de cosecha registradas de un año a otro impusieron el desarrollo de las investigaciones con respecto a la creación de nuevas variedades y el mejoramiento del proceso de producción de semilla. Como consecuencia a los resultados satisfactorios obtenidos en los centros de investigación Akola, Coimbatore y Bangalore, así como a las cantidades de semillas obtenidas, la superficie cultivada con girasol aumentó de unas 500 ha en 1972 a unas 700.000ha en presente. Desde 1974 se han desarrollado también las investigaciones para crear híbridos de girasol a base de androsterilidad citoplasmática. Los mayores resultados se obtuvieron con el híbrido BSH-1, que superó la variedad testigo 3497 con 30—50 por ciento.

Además del cultivo de genotipos con una gran capacidad de producción, un papel importante para obtener producciones grandes y constantes, cuyos eslabones más importantes son las siguientes: la época de la sembra, la aplicación de los abonos, el combate de las malas hierbas, de las enfermedades y las plagas, la irrigación de la cultura, etc. En presente, el girasol ha llegado a ser una de las principales plantas oleaginosas, al lado del algodón y los cacahuets. La superficie cultivada con girasol llegará en 1985 a cerca de 1 millón ha, y la producción media por hectárea a cerca de 10 q.