MAIN RESULTS IN SUNFLOWER RESEARCH IN THE U.S.S.R.

N. I. DVOREADKIN
(U.S.S.R.)

In the Soviet Union sunflower forms the main oil bearing plant. It is cropped on 4.6 to 4.8 million hectares and of its seeds around 75% of the country's vegetal oil is produced.

In the Unional Research Institute for Oil Crops (VNIIMK) the main care is afforded to sunflower crops. The investigations pertaining to breeding are directed towards seed production, soil management, plant protection and the mechanization of cultural practices.

The Soviet breeders have achieved great success in the development of highly productive suflower varieties. Altogether 21 sunflower varieties were released from the selection of the Institute.

In the Soviet Union, 94% of the sunflower planted area is held by the varieties coming from the Institute selection. Two of these (Peredovik and Armavirski 3497) are cropped on 2.4 million hectares, i.e. on a larger area than is held by other sunflower varites in the country.

Owing to the introduction of varieties high yielding in oil, sunflower productivity has considerable increased in the last years. During this period seed yield has increased by 2.5 times, kernel yield by 3 times and oil yield by 3.5 times (table 1).

Table 1

Increase in sunflower productivity in the Soviet Union

Indices	Years				
	1951/1955	1956/1960	1961/1965	1966/1970	1973
Seed production q/ha	6.3	9.2	11.2	13.2	15.4
Kernel production q/ha	4.0	6.2	8.1	10.0	12.0
Oil content in seeds %	33.8	36.8	42.7	45.1	45.24
Oil production q/ha	2.1	3.4	4.7	6.0	6.97
Protein production q/ha	0.9	1.3	1.6	1.9	2.3

It should be stressed that variety-population potentialities are not by far completely used. Thus, for example, in 1973 mean production was in the Krasnodar region of 20.7 q/ha, while in the frontranking farms it ranged from 24.1 to 27.0 q/ha. Many farms obtained even 30.0 to 31.0 q/ha and different farming-brigades obtained 34.0 to 35.0 q/ha. Thus, the „XXII Siezd KPSS" kolkhoz averaged in 1973 31.5 q/ha on a 562 ha area, the „Ventzî Zarea" sovhoz 30.7 q/ha (on 410 hectares), and section No. 1 of this sovhoz 35.5 q/ha on a 216 hectare area.

The present sunflower variety-populations yield 40 q/ha under irrigated conditions.

In the past, in sunflower breeding, greatest attention was afforded to the increase of oil content in the seeds. This activity, begun and successfully developed by V. S. Pustovoit brought a valuable contribution to the agricultural science. This activity was, is at the present time and will still be in the future of great economic importance.

Breeders reach at present that maximum of oil content whose excess is not rational on account of different reasons. This maximum amount probably ranges between 55 and 56%.

Our 1971—1975 plan provides for the development of sunflower variety — populations with a 53 to 54% oil content. Such varieties are in fact already developed. Thus, for example, in the 1973 competition of comparative trials, a series of varieties was characterized by a 53% or even higher content of oil, in a production of 29 to 30 q/ha. A new sunflower variety — „Voshod" was recently released with a 53% oil content in the seeds. The Aurora and Vostok varieties, with a 54.5% oil content, are being prepared to be sent to the state network for variety tests.

When breeding sunflower it is important to develop high yielding early varieties. These varieties are of great importance for the northern and eastern regions where sunflower is cultivated and production is highly interested in them. This is exhibited in the fact that the Saliut new variety was planted on a 150.000 ha area only two years after its release. In certain years the production of this variety reaches — under conditions prevailing in the Kuban — 29—30 q/ha and an oil content of 52 to 53%. The institute has earlier sunflower varieties (by 3 to 5 days); these are not inferior to the Saliut variety regarding productivity.

The development of early sunflower varieties, that do not show a lower productivity than the half early ones, constitutes a great achievement of the Soviet breeders.

In these last years sunflower crops damaged by pathogens have become increasingly frequent. This led to a considerable extention of the investigations towards immunity.

The breeding for variety, interspecific hybrid and inbred line resistance to the new broom-rape race (*Orobanche* sp.) is achieved by different methods.

Estimation of resistance degree is carried out on infected fields and under hothouse conditions.

It should be emphasized that among the many variety-populations, especially among those of the Krasnodarskaia and Armavirskaia stations' selection, biotypes completely resistant to the new strain of broom-rape were identified. This made us discard the biotypes attacked in the first stages of initial seed production, in order to improve the released varieties against this new strain of broom-rape. The greatest part of this activity is carried out under hothouse conditions, during autumn and winter. A great volume of work in sunflower breeding for immunity is carried out by the method of interspecific hybridization. Immunity sources against broom-rape, *Plasmopara helianthi* f. *helianthi* Novot., *Sclerotium bataticola* Taub., *Puccinia helianthi* Shon., *Sclerotinia libertiana* Fuck. and other pathogens were noticed in the specific hybrids obtained at the Institute. Under the effect of breeding, a range of hybrids of the higher generations were not inferior to the released varieties concerning productivity. These hybrids have group immunity and are simultaneously resistant to 5—6 sunflower pathogens. Activities in sunflower breeding for heterosis get increasingly extended.

It is well known that the achievements obtained by the breeders can be rapidly and efficiently introduced in kolkhozes and sovhozes only if seed production is well organized. With respect to pollinating plants, this was for the first time proved in the classical works of V. S. Pustovoit, by his seed production system that served as a basis to sunflower variety renewal; this system was adopted by a resolution of the Council of Ministers of the Soviet Union already in 1956. As a consequence, the same varieties supply to the country an additional amount of up to 800 tons of sunflower oil for the sum of 1.200.000.000 roubles a year.

Our Institute carries out a range of complex investigations, subordinated first and foremost to breeding problems.

In order to obtain varieties and hybrids of oil bearing plants, the breeders co-operate with citologists, physiologists, biochemists, phytopathologists, entomologists, agricultural experts and machine specialists.

By investigations in physiology, the laws governing fat accumulation were discovered, the physiologic background on wich the limit of oil content in sunflower seeds lies was established and the means by which protein content per area unit could be increased were discovered. A range of important stages in the nature of sunflower resistance to the broom-rape new strains was studied and a rapid initial estimation method of the breeding material and of seed production resistant to broom-rape was elaborated.

So as to comply with the task to improve vegetal oil quality our biochemists analyse oil composition, determine the iodine index, the acidity index, vitamines, sterines, and other substances.

Our Institute also carries out a high volume of work in the field of agriculture and chemization.

In the main zones that grow oil bearing plants in stationary and short trials, a rational soil working and fertilizing system with crop rotation was eleborated. It was established that a substantial number of deep tillage operations could be discarded without any damage for production in rotation crops, as well as deep tillage substitution with a 12—14 cm deep furrow. The beneficial effect of soil tillage with machinery with scuffle knives, provided herbicides are applied, was also proved.

The series of experiments were ended in view of reducing the number of mechanized operations before sowing. The results of trials carried out by the Institute in different zones of the Soviet Union showed that a single tillage — instead of 3—4 -could be carried out on structured chernozem before sowing (table 2).

Table 2

Effect of tillage methods before sowing on sunflower seed production

Method of soil working before sowing	Seed production, q/ha					
	Number of tractor passages before sowing	VNIIMK 1966	Belgorodskaia ex. st. 1961—1969	Armavirskaia ex. st. 1969—1971	Donskaia ex. st. 1969—1971	Kirovogradskaia ex. st. 1969—1971
1. Autumn tillage harrowing, deep soil loosening, clod crushing, cultivating before sowing	4	27.9	17.7	20.2	18.1	21.2
2. Harrowing, early cultivating, cultivating before sowing	3	28.4	18.2	20.2	17.6	21.8
3. Harrowing, cultivating before sowing	2	28.6	18.1	20.2	17.8	22.3
4. A single cultivator operation before sowing	1	28.7	18.3	20.5	17.9	22.1

The Institute worked out a prospective technology for sunflower cropping on a previously fertilized soil treated with treflan herbicide; this is a highly efficient herbicide that controls weeds 93 to 99%. In this case, only 2—3 soil operations are necessary for providing high yields (one before sowing and one or two passages with the cultivator), instead of the usual 8—10 operations. This technology, applied in the Kuban in the „Zaveti Lenina" (Ust-Labinski district), the „Drujba" and „Pameat Lenina" (Tbilisi district) kolkhozes provided a sunflower seed yield of 29 to 30 q/ha, as compared to 25—26 q/ha with usual cultural practices (intensive cultural practices) (table 3).

Table 3

Efficiency of the new sunflower cropping technology („Zeveti Lenina" Kolkhoz, Ust-Labinski district, average for 1970—1972)

Treatments of the trial	Total mechan. operations	Of which cultivation between rows	No. of weeds before harvest. pl./ha	Seed production q/ha	Man/hour expenses per ha
1. Usual cultural practices without manual weeding	8	2	50.3	24.6	3.88
2. Usual cultural practices with 2 manual weedings	8	2	5.0	28.7	73.88
3. Minimum tillage on a soil previously treated with treflan 2 kg/ha	2	1	2.9	29.5	2.62

An outstanding effect was obtained in the experiments related to the application of mineral fertilizers (N 40—60, P 60—90). Under such conditions mean sunflower seed yield gains due to fertilizers were as follows :

— in the North Caucasus, 3.3 q/ha (24 trials) ;
— in the Ukraine, 2.6. q/ha (11 trials) ;
— in the Moldavian S.S.R., 2.8 q/ha (55 trials) ;
— in the Central Region with chernozem, 2.4 q/ha (22 trials).

Cropped on chernozems in different zones of the country, sunflower responded most favorably to nitrogen and phosphorus fertilizer applications (table 4).

Table 4

Sunflower response to mineral fertilizers

Zone	Chernozem types	No. of trials	Seed yield in unfertilized control q/ha	Seed yield gain when applying		
				P	NP	NPK
North Caucasus	leached	5	22.7	2.1	3.9	2.1
	carbonated	15	14.1	2.0	3.1	2.5
Central zone with chernozem	leached	8	11.3	2.3	3.1	3.1
	usual	6	13.8	1.0	2.3	2.6
Ukraine	usual	3	18.8	—	2.3	1.2
	southern	5	14.1	1.6	2.8	2.1

A high volume of work is carried out at the Institute in order to elaborate means for sunflower mechanized cropping. Together with the Special Office for Harvesting Machine Building, the Institute achie-

ved a new equipment for the SK-5 „Niva" PSP — 1.5 combine, which in a single passage carries out all the harvesting operations. This equipment was tried out two years ago in the State Network and recommended for production.

In collaboration with this Office of the „Voronejselmash" plant, the Institute elaborated an appliance that may be attached to the ZAV-10 and ZAV-20 seed cleaning aggregates for the cleaning of sunflower seeds. This appliance has also been tried out by the State Network and recommended for production.

This appliance provides seed cleaning and grading and allows the Institute to execute its plan of sunflower seed production of high quality from released varieties.

The cropping methods and the mechanized means elaborated by the Institute as well as the sunflower varieties developed by the same Institute, are rapidly entering agricultutal production.

By growing sunflower varieties from the selection of the Unional Research Institute for Oil Crops and by applying the cropping methods recommended by the Institute, the kolkhozes and sovhozes obtain high yields. Thus, the „Ventzî Zarea" sovhoz of the Krasnodar region averaged in 1973 30.7 quintals per hectar on a 410 hectare area, and the No. 1 section of this farm (210 ha) — obtained 35.5 q/ha. The „XXII Siezd KPSS" kolhoz averaged on a 562 ha area 31.5 q/ha, a.s.o.

When calculating the incomes of field crops, sunflower hold a share of 25 to 30%. In the main sunflower growing regions the profitableness of this crop exceeds 250%.

A further technico-scientific progress will increase sunflower production and raise sunflower income and profitability in the Soviet Union.