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SUNFLOWER GROWING IN ROMANIA

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Sunflower became a quite traditional crop in Romania as a main source of edible vegetable oil and a valuable supplier of protein for animal feeding. Although recorded as a crop as early as 1865, the first official data related to the cultivated area refer to 1910, when 672 ha were grown with sunflowers. Around the first world conflagration, the area reached some 6,000 ha and in the period 1934—1938 an average of 55,800 ha were cultivated with a seed yield of 8.7 q/ha.

Special attention was given to sunflower culture after World War II when the oil imports stopped completely, Romania becoming gradually an exporting country. The total sunflower production increased seventeen times in 1972 as compared to the period between 1934—1938 (table 1) due to both the extension of the cultivated area and to ever increasing yields per unit area.

Table 1

Sunflower area, yields and varieties grown in Romania

Years	Area (thousands ha)	Seed yield		% oil output (average of crushing plants)	Varieties grown
		total (to)	average (q/ha)		
1934—1938	55.8	48.4	8.7		Local populations
1951—1955	354.2	265.7	7.4		Jdanov 8281
1956—1960	385.1	362.9	9.1	30.2	Jdanov 8281
1961—1965	452.1	503.8	11,1	39.4	VNIIMK 8931
1966—1970	521.0	727.5	14.0	44.4	Record
1971	548.4	790.6	14.4	44.7	Record
1972	553.8	840.4	15.4	44.2	Record, Romsun

The cultivated area increased almost 10 times, reaching its top level in 1970 with 604,100 ha, but setting down in the last years at 530—550,000 ha.

The country's average production increased continuously reaching the highest value in 1972 with 15.4 q/ha. The Agricultural Cooperatives achieved an average yield of 14.7 q/ha while the State Farms obtained in the same year (1972) an average of 17.8 q/ha. Much higher productions were achieved in the most favourable regions of the country. Thus, the Ialomița district achieved in 1967 an average yield of 20.2 q/ha on a cultivated area of 59,600 ha while the Constanța district obtained in 1971 an average of 19.3 q/ha from its 57,000 ha. In the year 1973, a number of 800 State and Cooperative Farms obtained productions higher than the country average level (table 2), most of them being situated in the districts Constanța, Ialomița and Brăila [1].

Table 2

Sunflower average yields obtained in 1973

Average yield (q/ha)	Number of farms	
	I.A.S. (State farms)	C.A.P. (Agricultural cooperatives)
15—20	60	474
20—25	58	164
25—30	8	26
over 30	1	1

Romania holds a prominent place on a world scale with respect to sunflower production, ranking the 3rd place in the world after U.S.S.R. and Argentina, according to the cultivated area, and the second — since 1970 — according to its total oil production, due to the ever increasing seead and oil yields per unit area (table 3).

Table 3

The oil production of the main sunflower growing countries (data supplied by „Foreign Agriculture Circular" USDA, FFO 16—72, Washington, 1972)

Country	Year						
	1966	1967	1968	1969	1970	1971	1972
U.S.S.R.	2338	2570	2553	2384	2314	2147	2293
Romania	269	294	301	309	319	328	373
Argentina	360	303	282	367	257	264	322
Bulgaria	169	195	188	224	168	206	207

[1] *N. Ceaușescu*, Speech at the National Conference of the Management Personnel from the State — and Cooperative Farms, February 28. 1974.

Sunflower plays today an important rôle in the world trade of oleaginous seed and edible oils, too. In 1971, Romania had a share of 25% from the total volume of the sunflower oil world exports.

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The considerable increase of the total sunflower production as well as the doubling of the yield per unit area during a period of only two decades was mainly due to the following three factors :

1. The location of sunflower in very favourable and favourable cultivation regions ;
2. The improvement of the sunflower cultivation methods ;
3. The cultivation of highly productive varieties and hybrids.

Sunflower concentration in the most favourable — from the agro ecological point of view — regions of the country was one of the main objectives within the framework of the measures aiming at improving the plant and animal production zoning. Sunflower was completely withdrawn from Transilvania and Subcarpathian hilly zones characterized by chillier climate in summer time. The principal sunflower areas are placed in the Southern part of the country, in North-East and the center of Moldavia and in the Western plain (table 4).

Table 4

Sunflower concentration by zones and the average yields obtained in 1967—1971

Cultivation area	% of the country's total sunflower cultivated area	% of the arable land in the zone	Average yield (q/ha)
I. Bărăgan, Dobrogea and Covurlui Plain	42.4	9.8	16.9
II. Burnas, Bucharest Plain, Burdea-Neajlov and Vlasia Plains	17.6	6.0	13.2
III. Oltenia Plain	12.3	6.1	12.4
IV. North-Eastern and Central Moldavia	16,1	6.9	10.7
V. Timiș, Crișana and Someș Plains	11.0	3.8	11.2

More than 40% of the total sunflower area is cultivated within the first region which is the most favourable, including the Bărăgan Plain, Dobrogea and the Covurlui Plain. In this zone, the Ialomița district, which presents the highest concentration of this crop (12.4% of the total area sown with sunflower and 13.2% of the district's arable land) is remarkable also for its highest average yields (18,3 q/ha) obtained in 1967—1971.

In the same period, the lowest yields were obtained in the North-Eastern and Central Moldavia, a region with a relatively high concen-

tration of this crop, especially the Botoşani district which cultivates 7% of the total sunflower area on 12% of the district's arable land, but with an average yield of only 10.0 q/ha.

An essential cause of such low yields is the intensification of the downy mildew attack (*Plasmopara helianthi* Novot.) in this region due to favourable conditions for the pathogenic development and the difficulties encountered to secure a 6-year rotation to sunflower crop. This conclusion is based on the experimental results concerning sunflower crop rotation performed at the Research Institute for Cereals and Industrial Crops from Fundulea and at a number of agricultural research stations proving that downy mildew attack is at present the main factor contributing to the marked decrease of sunflower production. The frequency of the attack increases from 5% to 38% with the decrease of the rotation period from 6 to 1 year.

The concentration of the crop in the South of the country further constitutes a significant reserve for sunflower production increasing. On the fertile chernozem soils from the South, sunflower turns to good account the deep water reserves and benefits by the remanent effect of the fertilizers applied in larger quantities to the cereal crops. The extension of the area to be irrigated in the South also constitutes a favourable premise by increasing the sunflower proportion among the irrigated crops. Yet, the decisive factor in the concentration of this crop in the most favourable regions is the possibility of short-term rotation application (3-year rotations, for example) by introducing hybrids immune to downy mildew, recently created at the Research Institute for Cereals and Industrial Crops-Fundulea.

The improvement of the cultivation practices directly contributed to the increase of suflower production. The Academy of Agricultural and Forestry Sciences has elaborated a system of agricultural practices specifically adapted to the different agro-ecological areas and completely mechanized on the basis of the research work carried out in the respective Institutes and Research stations.

The main items of this system refer to :

— The proper placing of the crop within rational rotations ;

— The ensuring of the optimum plant density by sowing in rows, spacing sunflower seeds equally with the help of the pneumatic machine SPC-6 ;

— The weed control by the joint application of the chemical weed control and mechanical cultivation ;

— The cutting to a minimum of the losses due to the direct combine harvesting.

Sunflower is usually cultivated in cereal crop rotations, specific to the country's flatlands, where wheat and corn hold the main share. These cereals make very good previous crops for sunflower. Sunflower monoculture is counter-indicated, as well as crop rotations having sugarbeet, sorghum or alfalfa as previous crops. At present, the greatest part of the State farms and Cooperative farms use a minimum rota-

tion of 4 years and, in many cases, even 5—6 years, mainly due to downy mildew attack intensification. During the years favourable to the pathogen, this dangerous disease spreads even on the fields where sunflower has not been cultivated for 5—6 years, as a result of secondary infections caused by volunteer plants from the adjoining fields. Therefore, the early destruction of sunflower volunteer plants from the corn, soybean, bean and other crops stands as a decisive step in the fight for sunflower diseases control, especially in the areas with a high concentration of this particular crop.

A problem still presenting certain contradictory aspects is that of fertilizer application in sunflower. Though an important consumer of nutrient elements, sunflower renders the fertilizers less profitable than wheat or other plants due mainly to the high capacity of its radicular system to extract the necessary nutrient elements even those hardly soluble, from a considerable depth of soil. Fertilizers yielded small production gains in sunflower, on the chernozem soils of Romania i.e. between 1.6 and 2.3 q/ha. However, on the poor soils from the humid zones, non-fertilized and improperly tilled in the past, the fertilizer effect is more considerable.

On most of the soil-types of Romania, sunflower reacted mainly to the P-fertilizer application and then to N-fertilizers and very seldom to K-fertilizers.

In order to reduce the growth of the vegetative organs in favour of the fruiting, fertilizers have to be correctly applied in accordance with the nutrient elements existing in the soil and the respective rainfall regime.

A more economic and more efficient fertilization method consists in the side-application of fertilizers, concomitantly with the seeding. The experiments carried out at the Research Institute for Cereals and Industrial Crops from Fundulea, with the help of the stable isotope ^{15}N and the radioactive isotope ^{32}P, indicated that the joint application of superphosphate and ammonium nitrate in small doses induced a better utilization of the phosphorus from the superphosphate as compared to the all-surface application of the fertilizers.

A rational utilization of fertilizers in sunflower growing should consider their influence upon the oil-content of the seed.

The results obtained from many experiments, in different years indicated a marked decrease in the oil percentage caused by fertilizer application, especially with high nitrogen doses.

Therefore, the highest oil yields are obtained with reduced doses of N-fertilizers.

Sunflower yield is less influenced by the fluctuation of the nutrition space as the most favourable number of plants per ha ranges between 30,000 and 50,000, within rather different ecological parameters. The average population density of 40,000 plants/ha presents a larger zone of application and ensures a certain reliability in production as a higher density increases the number of fallen plants. The

utilization of the pneumatic sowing-machine SPC-6, a creation of the Romanian technicians represents an advanced stage in the complete mechanization of sunflower cultivation as such a machine completely eliminates the thinning. The precision seeding, seed by seed, at equal, precise, intervals within the row, favours the vigorous growth of plants just after the emergence, contributes to their uniform development throughout their growth period, meanwhile reducing to a minimum the sowing seed norm. Nevertheless, it has to be stressed that this will increase the exigence towards the seed quality and land preparation for sowing. Sunflower seed should therefore be properly conditioned, eliminating the shrivelled or light grains, accepting only seed with a high germinating power. The SPC-6 machine can be thus equipped to spray herbicides and incorporate granulated fertilizers while sowing.

Sunflower is very sensitive to weed infestation, especially at the beginning of the growth stage. Later on, sunflower plants grow vigorous overshadowing the soil and smother the weeds. This is why, the chemical and mechanical weed control during the first growth stages is an essential aspect in the techonology of this crop.

The herbicide Gesagarde 50 is used on the fields invaded by weeds from the Cruciferae family. This product is recommended usually in the humid regions with frequent rainfalls after the sowing. In this case, Gesagarde 50 will be applied during the sowing on the sunflower rows in a dose of 1.5 kg/ha (commercial product with 50% prometrin) on the light soils, and 2—2.5 kg/ha on the humus soils. Gesagarde 50 is also applied in the dry regions, but only on the fields adapted for sprinkling irrigation. In order to increase the herbicide efficiency, after its application one should apply small quantities of water.

In the case of the fields invaded by weeds from the Gramineae family, the herbicide Treflan is being successfully used in doses of 4 l/ha, incorporated in the soil before sowing.

When Gesagarde 50 is applied on the rows, the sunflower crop needs inter-rows hoeing 2 or 3 times. With Treflan we only have to use the mechanical hoeing once or twice — if the number of weeds left requires it.

The establishing of a more efficient chemical weed control system is a present concern for the agricultural research.

The utilization of grain combines renders possible the thorough mechanization of sunflower harvesting with minimal production losses.

The main problems set forth by the mechanized harvesting of sunflower are connected with the selection of the optimum harvesting time, the proper setting of the combine and its rational operation.

The most favourable moisture content of seeds where the combine harvesting losses drop to a minimum of 2.7% — ranges between 10—12%. Below this level, losses during the harvesting will increase significantly as seeds detach from the head during the harvesting and shatter. The combine-harvesting during the over-ripening period, when all the heads are dry and the seed humidity decreases to 6—8%, will be accompanied by seed losses between 8—12%.

The harvesting is made with the help of the Romanian self-propelled combine „Gloria C-12", equipped with a sunflower harvesting device (R.F.S.).

The utilization of highly productive varieties and hybrids, having a high content of oil in seed is the most dynamic factor for the increase of sunflower oil and seed yields.

The contribution of high oil varieties is clearly mirrored in the average oil and seed yield gains (table 1). Thus, in the period 1961—1965, when the Russian variety VNIIMK 8931 was almost exclusively cultivated in our country, it was obtained an average production of seed reaching 11.1 q/ha, i.e. some 2 q/ha more than in the previous period when the Jdanov 8281 variety was cultivated. In the period 1966—1972, when the Romanian variety Record was cultivated in proportion of 85—95%, the average yields increased some 3 q/ha, ranging between 14,0—15.4 q/ha. In this period the oil production increased 40% while the seed production increased 28%. The considerably superior increase of the oil yield best reflects the results of sunflower breeding regarding the oil content of the seed. Thus the oil output of the crushing plants increased from 30.2% at the Jdanov 8281 variety, to 39.4% at VNIIMK 8931 and 44.2—44.7% at the Romanian variety Record.

In the year 1972, the domestic hybrids Romsun 52 and Romsun 53 produced on marked genetic male sterility basis were introduced, yielding oil and seed yields higher than the best varieties. In 1973, these hybrids occupied about 15% of the sunflower cultivated area and in 1974 — 25%. In the following years, these hybrids will be cultivated on the majority of the sunflower area in Romania, thus contributing to the marked increase of the average yields per unit area.

The development of selection methods and schemes of the lines with cytoplasmic male sterility as well as of the restorer lines rendered possible the creation of a new type of sunflower hybrids easily produced on large crossing fields at a very low cost price, meanwhile securing a maximum percentage of hybrid plants.

The first experimental hybrids of this kind surpassed the Romsun 53 hybrid concerning both the seed and oil yield. In the first group of experiments (1972—1973), 3 hybrids (HS 80 C, HS 201—72 C and HS 2—15—72 C) yielded significant oil-production gains of up to 10—11%. In the second group (1973) one hybrid HS 198—73 C, yielded 42.5 q/ha exceeding the seed yield obtained with Romsun 53 by 22%. Significant increases of 15—18% also yielded the hybrids HS 50 C and HS 185—73 C.

The new hybrids are remarkable for their high oil content with a top value for the hybrid HS 197—73 C in the year 1973 (53.1%).

A recent development of a high economic value is represented by downy mildew-resistant hybrids (table 5).

Among the forms created on the basis of cytoplasmic male sterility with pollen fertility restoration presenting downy mildew resistance genes, the hybrids HT 50 CRM and HT 60 CRM remarked

Table 5

Seed and oil yields at sunflower mildew-resistant hybrids, created on the basis of cytoplasmic male sterility (Fundulea, 1973)

Hybrids	Resistance genes	Seed yield (at 11% moisture content		Oil yield	
		q/ha	%	q/ha	%
HT 50 CRM	Pl_1, Pl_2	44.2	116***	20.7	117***
HT 60 CRM	Pl_1, Pl_2	43.1	113***	20.0	113***
HS 80 CRM	Pl_1	42.7	112***	19.6	111***
HS 82 CRM	Pl_1	41.9	110***	19.1	108***
Romsun 53	—	38.1	100	17.7	100
L.S.D. 5%		2.6	7	1.3	7
L.S.D. 1%		3.0	8	1.8	10
L.S.D. 0,1%		3.9	10	2.3	13

themselves by a very large seed yield under irrigation conditions (44.20 and 43.10 q/ha in 1973). The HT 50 CRM hybrid yielded 17% more oil than the check hybrid Romsun 53.

In the coming years, allowance will be made for the promotion of downy mildew resitant sunflower hybrids obtained on the basis of cytoplasmic male sterility. Efforts are made for the creation of new hybrids more productive, still, with a higher oil-content. The research work will be continued on the line of continuous improvement of suflower cultivation practices; the oil-extraction technology will be also improved.

The sunflower crop has a particular significance within the long-term plan of national economy. A surface of about 530,000 ha is stipulated for the sunflower crop at a yield of more than 22 q/ha. Thus could be fully met the ever-increasing oil-consumption requirements of the population. The availability for exportation will also increase. Meanwhile, the sunflower oil cake will supplement the fodder protein reserves for the livestock in our country.