ECONOMICAL SIGNIFICANCE OF SUNFLOWERS IN THE U.S.S.R.

By

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Sunflower, as an ornamental plant, was taken to Spain from America in the 16th century. Then, from Spain it was brought to Belgium, Germany, and in the middle of the 18th century to Russia wherein it found its second native land. In Russia, thanks to the creative labour of simple peasants first, and afterwards to that of scientists-breeders - the plant of wild flora was turned into a cultivated oil crop.

At the end of the 18th century, first attempts were made to grow sunflower in Russia. That time, however, no attention was given to sunflower production as nobody knew any method of obtaining oil from seeds. Only in the thirties, 19th (1830's) century, the method was found. More extended acreages were sown to sunflowers in Russia since then.

Thus, sunflower history, as that of a field crop, dates over 100 years back.

Increased plantings and frequent sunflower recurrence to the same field in the rotation caused a serious rust, broomrape and sunflower moth problem. Sharp decrease in sunflower acreages resulted. It was urgent to breed disease-and-pest resistant varieties.

Russian scientists - breeders E. M. Plachek in Saratov, L. A. Zhdanov in Rostov, V. S. Pustovoit in Krasnodar, and others from 1912 to 1926 conducted a significant work on breeding sunflower varieties immune to broomrape and sunflower moth. As a result, resistant varieties were bred, and the problem seemed to be solved.

However, sunflower varieties which were immune to broomrape in Kuban and other regions proved to be susceptible to the disease in some other regions. New physiological broomrape race - "race B" accounted for this. And again, plant-breeders were confronted with a hard breeding task to be solved. Academician L. A. Zhdanov, a Soviet plant-breeder, was the first in the Soviet Union to breed broomrape "B" resistant varieties - 8281, 6432, and others. More than 1 million hectares were sown to these sunflower varieties from 1935 through 1945.

Following the success, V. S. Pustovoit developed superior broomrape resistant varieties, with higher oil percentage, and higher oil yield per hectare.

Thus, broomrape problem has been successfully solved through breeding method.

In spite of diseases and pests diffusion, wide expansion of sunflower acreages occurred, all due to the resistant varieties. In 1913 in Russia, sunflowers were grown on the area of 980,000 hectares, in 1967 on that of over 4.8 million hectares; i.e. five-fold increase. Average yields increased as well: in 1913 it was estimated at 7 centners of seeds per hectare, in 1967 - at 12.9 centners per hectare. Considering the increase in sunflower acreages and increase in production per hectare, the total production in the Soviet Union has increased tenfold since 1913.

Sunflower acreage expansion was followed by an appreciable change in its geographical distribution in the whole country. The gain of seeded acreages and main sunflower producing areas in the USSR are shown in Table 1.

Table 1

SEEDED ACREAGES OF SUNFLOWERS IN USSR

Name of republic or zone	Seeded area in 1000 hectares	
	Year	
	1913	1967
Ukraine	73	1700
Kazakhstan	18	100
Northern Caucasus	346	1160
Central black soil region	289	469
Urals and Western Siberia	20	226

Sunflower, as a valuable plant, is essentially the product of man's labour though environmental and historical factors have influenced its development as well.

Sunflower is of great importance in the national economy of the country.

In 1967, of total oil crops acreage, 72.5 percent was sown to sunflowers; sunflower oil production as compared to other vegetable oils was estimated at 91.2 percent.

After World War II, seeded area, cropping power, and gross yield of sunflowerseeds increased. (Table 2).

The Soviet Union holds first place in the world in sunflower production: namely, in sunflower acreages, seed crop, and gross yield of oil. Of total 8 mln hectares sown to sunflower in the world, 4.8 million hectares are located in the USSR.

Table 2

SUNFLOWERSEED PRODUCTION,
CROP AND GROSS YIELD AFTER WORLD WAR II

	Years				
	1940	1955-1959	1960-1964	1965-1966	1967
Seeded area, mln hectares	3.3	4.0	4.4	4.9	4.8
compared to 1940,%	100	121.2	133.3	148.5	145.4
Cropping power, centners/ha	6.2	9.0	10.8	11.7	12.9
compared to 1940,%	100	145.2	174.1	188.7	208.0
Gross yield, mln tons	2.0	3.6	4.8	5.8	6.2
compared to 1940,%	100	180	240	290	310

Sunflower oil production in the USSR is currently more than 2 mln tons per year; i.e., 91.2 percent of total oil production from all the other oil seeds, and 74 percent of total vegetable oil production, cotton oil including.

In the main sunflower producing areas, one hectare of sunflowers produces significantly more oil as compared to all other oil crops.

In 1967, for instance, sunflower yielded oil 527 kgs/ha, oil flax 283 kgs/ha, and mustard 86 kgs/ha on the average in the whole country.

It became possible only as a result of tremendous work done by Soviet plant-breeders who created high oil varieties with as high oil content as 51 to 52 percent (on dry seed basis).

Over 95 percent of the total sunflower seeded area in the USSR is sown to varieties bred by our plant breeders - Academician V. S. Pustovoit,

Academician L. A. Zhdanov, V. I. Shcherbina, K. I. Prokhorov, and others, VNIIMK, USSR.

The sunflower renovation scheme developed by Academician V. S. Pustovoit makes it possible to annually increase oil output at our oil extraction plants.

The scheme implies the following: improved elite seeds of licensed varieties are annually delivered from research institutions to collective- and state-farms; from the material grown on their seed plots the first reproduction of sowing seeds is obtained and sown on the whole sunflower acreage; the second reproduction is produced on commercial seeded areas, and sold to oil extraction plants.

Breeding new varieties and yearly variety renovation are of great economical value as it is shown in Table 3.

Table 3

GAIN OF OIL PERCENTAGE IN SUNFLOWER SEEDS (USSR)

	Years					
	1940	1950	1955	1960	1965	1967
Oil percentage of commercial seed	28.5	30.4	34.7	39.8	44.0	45.0
Oil yield at oil extraction plants, %	25.4	28.4	32.9	37.9	42.5	43.6

From Table 3 it appears that within 27 years oil content in sunflower seeds in the whole country has increased by 16.5 percent, and oil yield - by 18.2 percent.

Thus, successful research of sunflower breeding and seed production have resulted in higher sunflower productivity and in the increased value of sunflower in economics. Here is a convincing illustration to it.

If at present we grew sunflower varieties with 28.5 percent oil (1940 level), then to produce as much oil as we do now, we should have seeded extra 3 million hectars (i.e.; all in all about 8 mln hectars), should have required extra thousands of tractors, harvesters, and other equipment, should have built twenty more large oil extraction plants.

Cultivation of sunflowers has undergone considerable changes as well. Formerly they were seeded, cultivated, and harvested by hand; at present all the major processes are almost fully mechanized. The costs of sun-

flower cultivation are nearly equal to those of cereal production (wheat, rye, etc.).

Extensive mechanization and effective agricultural practices in sunflower production have made it possible to considerably increase labour productivity and reduce sunflower production expenses.

To grow 1 hectare of sunflowers 5.8 men-days are required, and to obtain 1 centner of sunflower seeds - 0.43 man-day; i.e., 5-fold reduction as against 1940.

Sunflower oil is one of the most palatable vegetable oils in the world. No wonder the oil enjoys great popularity throughout the country. Sunflower oil has a wide variety of uses in our country. It is used in the human food trade, in margarine, in shortening, and as a cooking oil. Of total volume of vegetable oils, two-thirds are used for food and one-third for industrial purposes.

Sunflower oil in its calorific value and assimilation by man's organism competes well with other vegetable oils, and it is slightly inferior in nutritional quality to butter. Calorific value of 1 g of sunflower oil, for instance, is equivalent to 8,817 calories whereas man organism assimilates about 98 percent.

Recent research indicates that highly nonsaturated fatty acids, linoleic, linolenic, arachidic, are of greatest physiological value. Linoleic acid, however, is of particular importance. It cannot be synthesized in man's organism and has to be incorporated into it together with food. In this respect, sunflower oil is the most valuable product as it contains more than 55 percent of linoleic acid.

Sunflower oil is also used for production of hydrogenated fat: the superior grade oil is utilized for margarine, the inferior grade for soap production, the oil of worse quality is used for drying oil production.

At present, in many foreign countries, preference is given rather to vegetable oils than to animal fats. In France, Yugoslavia, and many other countries margarine is preferred to lard and other animal fats.

Sunflower oil contains phosphatides, very important food components from physiological standpoint, commonly used in confectionery, margarine, and baking, and also in lecithin production for medical purposes.

Sunflower oil has a higher Vitamin E content than animal fats. It contains other vitamins, too, A, D, and K as well as flavour substances.

Sunflower is the source for obtaining not only vegetable oil but also valuable feeding stuffs.

Oil extraction plants in the USSR produce 350 to 360 kgs of cake and meal from 1 ton of sunflower seeds. These highly concentrated protein products are generally fed to the cattle in the whole country. One kilogram of sunflower cake and meal contains 396 and 363 grams of digesting protein respectively, whereas soybean cake contains 368 g, oil flax - 285 g, hemp - 244 g, and cotton - 331 grams.

The country produces yearly a total average of 2 million tons of cake and meal, more than 81 percent of sunflower cake and meal including; i.e., almost 1 mln ton of crude protein.

Chemical composition and protein amount of sunflower cake and meal are almost similar to those of soybean - the richest protein source.

Thus, sunflower should be considered as a source of not only vegetative oil but also of protein, valuable feed for livestock. It is possible to use its protein for human food too.

Threshed sunflower heads are also of good nutritional quality, and being no less inferior to hay crops (medium grade) can be fed to sheep and cattle.

Threshed sunflower heads are either fed green or dried to cattle, or are preserved as ensilage.

Meal preparation from dry sunflower heads and stalks is rather promising. The meal is well assimilated by livestock and distinguished by high nutritional quality.

2.5 kilograms of the meal added to the ration have increased daily weight gain of calves by 406 grams, much greater effect than from conventional ration.

Hull remaining after oil extraction used formerly as fuel is at present employed as a raw material to a number of valuable products, where hydrolysis plants are available.

82.0 litres of ethyl alcohol can be produced from 1 ton of hull. The latter may serve as fodder yeast as well. From 1 ton of hull you can obtain 150 kgs of fodder yeast (valuable protein feed for livestock and poultry) containing 14.0 to 23.0% protein, 6.0 to 8.0% glycogen, 1.0 to 8.0% cellulose, 0.9 to 2.0% crude fat, 1.8 to 2.3% ash, and 68.0 to 75.0% water.

Sunflower hull saves considerable amount of grain and grain wastes used formerly for alcohol production. Thus 1 ton of the hull substitutes 250 kgs of grain in ethyl alcohol production.

Industrial enterprises produce furfural - a product commonly used for chemical purposes. One ton of sunflower hull when processed yields as much as 50 kgs of furfural, 72 kgs of fodder yeast, and 280 kgs of lignin. Furfural and its resins are supplements for production of artificial fibre, plastics, unbreakable glass, and other chemical manufacture.

Sunflower hull is used for the production of lining plywood not inferior in quality to wood-waste-shavings slabs. The plywood holds paints in place firmly, is easily polished, and fits well for gypsum and cement solution to coat it, all that extends the range of the plywood utilization.

Sunflower is a remarkable honey plant too. From 20 to 40 kilograms of honey can be obtained from 1 hectare of blooming sunflowers, not including large amounts of pollen to which young bees are fed. Coronas of ray florets when dried can be used for medical purposes.

Threshed heads are employed for production of pectin, the latter being used as a gelatinized means in place of agar-agar in confectionery industry.

Pectin output is estimated at 10 percent of the total weight of sunflower heads; it implies that 1 ton of dry heads yields up to 100 kilograms of pectin. From 1 centner of sunflower heads as much pectin is obtained as from 1 centner of apple pulp.

From above it appears that sunflower is of high importance in our economics.

Sunflower oil - valuable product from nutritional standpoint, cake and meal are obtained from sunflower seeds. Stalks and heads are valuable feeding stuffs, and hull is a raw material for hydrolysis industry.

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DISCUSSION

Baldwin: What are the industrial uses of the sunflower outside of the food industry?

Suslov: To furnish substances for the paint industry and for the soap industry. At certain times, the sunflower oil is not very high quality with a high acid number. This kind of oil then goes into drying oils for the paint industry and other industrial purposes.

DISCUSSION
(Continued)

Hayenga: What is the projected yield of sunflowers in 1968 compared to 1967?

Suslov: The Soviet Union is very large and this is a difficult question to answer in that the 1968 harvest is not yet complete. We do have favorable conditions this year in the main production areas of the Ukraine so the prospects are good.

Schoonover: Is the average oil weight content, as expressed in your remarks, on the dry weight basis or the gross weight basis?

Suslov: The Soviet Union uses two methods of expressing oil content. The scientist expresses oil content on the absolute dry basis. The commercial processor purchases on the basis of 12 percent moisture and 1 percent of dockage; so, when we say commercial seed is 45 percent oil, it means that on the absolute dry basis the sunflower seed is about 50 percent oil. An interesting sidelight here is that last year our nation celebrated its fiftieth anniversary and last year the average of the entire sunflower crop processed in the Soviet Union averaged 50 percent oil on the dry basis.

Baldwin: What percentage of your processing is the extractor method and what percentage is the expeller method?

Suslov: In the main, our modern plants use the extraction method and these plants leave only about one percent oil in the cake and hull. The pressing or expeller method leaves about 3.5 percent oil in the cake.

Johnson: What methods of harvest are used and what percent of efficiency is achieved?

Suslov: All the Acreage in the Soviet Union (about 5,000,000 hectares) are harvested with the conventional combine. We tend to run our combine cylinders at a slower speed than in the U.S.A. and in Canada. On the cutter bar, we have an adjustable mechanism so that we take just the heads into the combine. The losses of seed depends entirely on the accuracy of harvesting. About one centner per hectare of seed is lost. The time of harvesting and the skill of the operator are very key elements. We are not satisfied with the kind of combine operation we have now. The stalks are left on the field which means we have to go over the field an additional time or two before we can get the fields ready for wheat. We are now in the process of designing and constructing special combines for sunflowers only. This machine will thresh the heads and cut

DISCUSSION
(Continued)

the stalks up into very small pieces and distribute them out on the field.

Question: What is the relationship between a centner and the pound?

Suslov: Centners per hectares are the same as pounds per acre. Not precisely, but close enough for comparison.

Question: What is done with sunflower hulls?

Suslov: In some portions of the Soviet Union, we have a hydrolyzation industry. The hulls are used to make furfural, for yeast production, and to make alcohol. In the areas where these chemical plants do not exist, the hulls are ground up and used for cattle feed in combination with sunflower meal.

Watson: What other sources does the Soviet Union have for vegetable oil?

Suslov: Sunflowers are the major source by far of vegetable oil in the Soviet Union - amounting to 90 percent of all vegetable oil. The balance comes primarily from soybeans and from flax; both are low yielders in the Soviet Union. Soybeans are raised in the Far East region (about 2,000,000 acres and Castor Bean nuts are raised on 540,000 acres. Castor Bean oil is used in chemical production of plastics. Cottonseed is considered a fiber crop and not included in oil crop statistics for the Soviet Union. There is some rape seed oil--about 25,000 acres are grown. Rape is very susceptible to frost so there are years when there is no crop at all. Last year, the yield of oil per acre for sunflowers in the Soviet Union was 525 kilograms per hectare. Today, the other oil crop plants yield considerably less and therefore play a very minor role for vegetable oil production.

Question: Do you have an effective control for bird damage of sunflowers?

Suslov: The extensive acreage of sunflowers in the Soviet Union brings about no such problem with birds. Most collective farms have 2500 acres or more. There aren't very many trees in the area; consequently, the bird population is low. We do have trouble on our experimental plots in certain areas so we have to take action to prevent losses from birds in this case.

DISCUSSION
(Continued)

Hayenga: You do not consider cottonseed as an official oil crop. You do some crushing evidently. How do you use the oil from this process?

Suslov: The system of statistics for crops provides information for oil crops and for fiber crops. Inasmuch as cotton is among fiber crops, we are unable to give you that information. We do crush the cottonseed however. The Central states use cottonseed oil to a large extent.

Knowles: What acreage of safflower do you have and in what area is it grown?

Suslov: We very much appreciate your work in safflower, Dr. Knowles, and we appreciate the work you have done on the composition of safflower oil. Safflower is a very old plant in Central Asia. Presently, it is not of commercial importance. It is raised in the private plots in Central Asia. The Soviet Union tends to have a narrow range of oil crops at this time in history. There is increasing interest in safflower and other oil crops and we can expect some changes in the use of other plants for oils. Soviet statistics report yields in bunker weight. Sunflower seeds are purchased by states and by the processing plants. The price of sunflowers, as they are delivered, is established on a standard of 12 percent moisture and one percentage dockage. There is a decrease in price if sunflower seeds are delivered above these figures. There is an increase if the sunflower seeds are delivered below these figures. The statistics are reported at the 12 percent moisture and one percent dockage level.

Watson: Is the per capita consumption of available oils increasing as much as your increase in oil production?

Suslov: Currently, the consumption is about 8 to 9 kilograms per capita. The Institute of Medical Science estimated that about 8 kilograms of vegetable oil were needed per capita. The plans are going ahead however to increase production because sunflower oil has good prospects for international trade and for domestic industrial purposes in the Soviet Union. Possibly the Soviet Union could go as high as 12 to 13 kilograms per capita. We have noted the increase per capita of vegetable consumption in the Western countries and we think this may take place over a period of time in the Soviet Union.

Question: Are your present production of cake and meal sufficient for your needs?

Suslov: No, we have a deficiency of protein for livestock feed.

DISCUSSION
(Continued)

Question: What size plants are used for extracting pectin from sunflower heads?

Suslov: The crushing plant in Krasnodar processes 600 tons per day. The production of pectin is a question we cannot answer in that those figures are in another agency. While I know of pectin plants, I have not seen them and I am not acquainted with the figures.

Johnson: Do you consider honey crop an important adjunct to sunflowers in your country?

Suslov: We have in our country special research for beekeeping, The leading varieties of sunflowers raised currently in Russia are productive in honey. The sunflower is a very important honey crop. All the collective farms have bees and move the hives to where the sunflowers are with good results.

Johnson: How much increase in yield do you get by using the bees on sunflowers?

Suslov: We do not have figures on this as we have so many bees in most areas. In areas where we do not have bees, we notice a considerable difference in the number of empty seeds and lower production.

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