# Projection and Prospects for Sunflower Seed[1]

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## ABSTRACT

Oil-type sunflower production may be expected to increase during this decade and strengthen the crop's position as the second largest world source of vegetable oil. The development would intensify its already profound effect upon world trade in general and the vegetable oil industry in particular. The Soviet Union, producer of more than half of the world's supply of sunflower oil, has greatly influenced the position of this commodity. Apparent increasing production there and in other countries, including the U.S., will influence the market position of all vegetable oils. Sunflower oil with its many desirable characteristics should find ready acceptance in world markets. Sunflower meal should be competitive with most vegetable proteins. Domestic sunflower production has been competitive with other farm crops in many areas. Requirements for successful production include the application of good management and the use of available information and materials. In most instances where production has not been satisfactory, poor management, which is somewhat typical in attempting to grow most new crops, has existed. A need also exists for further development of high yielding varieties, insect and disease control, improved harvesting procedures, control of field losses to birds and improved cultural practices. Good progress is being made in each of these categories.

## INTRODUCTION

The commercial sunflower of today is believed to have originated in America, Peru or Mexico, and was first introduced into Europe by the Spaniards in the sixteenth century. After its introduction to Spain, it spread to Bavaria in 1625, to France in 1787, and then to Hungary, Russia and other parts of Europe in the mid-eighteenth century. Sunflowers were first turned into a cultivated oil crop in Russia during the 1830's, and were reintroduced into the Argentine, as a commercial crop, in 1870 (12).

About 50 years ago, when Pustovoit and others started research work on increases in sunflower oil content, many authoritative scientists treated it skeptically, considering it impossible to combine high oil content with high seed yield. However Pustovoit surpassed even his most ambitious hopes. Beginning with local varieties that contained 28-33% oil (18), his first 12 years of work gave no appreciable results, but in 1927 he released a new sunflower variety with 35% oil content, basis dry weight, against the former 33%. This increase in oil content with no decline in yield evoked great hopes for future success (18). Within 25 years, oil content of commercial sunflower seeds had increased due to breeding from 28.6% to 44.4%, on the average. Breeding work now underway shows candidates for new varieties with 56-59% plus oil content (18).

Sunflower oilseed production began in Canada in 1943 and in Minnesota in 1947, with the introduction of high oil varieties from Russia (22). Present day sunflower production is for three markets—birdfeed, human food and oil.

Commercial production for human food started in the 40's in the Red River Valley of the North, with the seed for roasting and salting obtained from Manchuria and Greystripe varieties grown in California. The introduction of dehulled sunflower seed as a nutrient stimulated production in the Dakota and Minnesota area for the food market.

The attempt at oilseed production in the U.S. in the late 40's lasted only 2 years, since enough soybeans became available to keep the oilseed processing industry operating, and there were no chemicals available to control the head moth, a serious pest in sunflower production (22).

Personnel from government agencies and industry leaders representing five countries, all interested in sunflower production, met on the campus of Texas A&M University in the summer of 1964 and held the First International Sunflower Conference to discuss current and future problems concerning the culture, disease, insect, breeding and economics of the crop (16).

The Second International Sunflower Conference was held in 1966 in Morden, Manitoba, Canada. A Russian delegation attending the Conference contributed much to the exchange of information in the interest of sunflower development. Breeding material of Russian origin was made available to the group, marking the beginning of the development of high oil sunflowers in the U.S. and Canada.

Agricultural experiment station tests showing that high oil Russian varieties could be grown successfully in the Red River Valley of the North led to renewed interest in oilseed production (22). The first commercially grown high oil sunflowers in the U.S. were grown in the Red River Valley of the North in 1967, and the first trial plantings in the South in 1968.

These conferences have provided an excellent opportunity for all segments of the sunflower industry to share research findings and practical experiences and to define research and development needs.

The Third International Sunflower Conference was held in Crookston, Minnesota, in 1968; the Fourth International Sunflower Conference in Memphis, Tennessee, in 1970; and the Fifth International Sunflower Conference was held in France during July 1972.

The story of the growth in the 1960's of sunflower seed production and of sunflower seed and oil trade is the most impressive of any in the fats and oils industry. In 1960, sunflower seed ranked fourth in the world among sources of edible vegetable oils, following soybeans, peanuts and cottonseed. In 1969, sunflower seed held undisputed claim on second place, with an estimated 20% of the world production of edible vegetable oils (20). In this position it plays a significant role in world trade, and unquestionably it will continue to have a profound effect on the vegetable oil industry during the next decade. The production of sunflower oil has more than doubled in 10 years. The interest in the development of sunflowers is at an all time high around the world, and the high oil prices being received are encouraging growers to plant more sunflowers throughout the world (20).

The Soviet Union, producing two-thirds of the world output, is the principal sunflower seed grower. The Soviet Union and Eastern Europe together account for over 80% of the world sunflower output. The sunflower is the leading oilseed in Europe. Romania is the leading sunflower producer in Europe, followed by Bulgaria, Yugoslavia,

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Hungary, Spain and France, with Argentina being the second largest sunflower seed producer in the world. Other countries engaged recently in increased sunflower production are: Africa, Australia, Brazil, Canada, Chile, Czechoslovakia, East Germany, Germany, Greece, Iran, Israel, Mexico, New Zealand, The Netherlands, Pakistan, Poland, Paraguay, Turkey, the United Arab Republic and the U.S.

## AGRONOMIC ADAPTATION

Sunflowers are adaptable to most of the climates and cultivated soils of the U.S. and Canada. Sunflowers are very drought resistant, except for the 3 week interval during blooming and seed formation. Moisture stress at this time halts flower and seed development. Young plants are resistant to freezing and have survived temperatures in the 20's. However temperatures below 30 F may injure the terminal bud and result in branched plants of low yield. After heading, but before pollination is completed, freezing causes sterile seed (empty hulls) (22).

In the 6 years since Cargill introduced the high oil sunflower varieties in the Red River Valley of the North, K. Johnson has reported ". . . more interest each year among the growers as they are acquiring increased production knowledge. Yields have continued to increase on the commercial farms and experimental stations indicating sunflowers are now competing profitably with crops in the area" (14). At Cargill's research station near Glyndon, Minnesota, Johnson, who directs the sunflower-breeding program for Cargill, is developing hybrids and varieties for increased oil content, yields, disease resistance and plant uniformity. "Sunflowers are on the threshold of becoming a major crop in this area," he says (15). The addition of USDA personnel to work on sunflowers in the Red River Valley area has aided materially in solving many of the insect, disease, breeding and production problems encountered with the introduction of the sunflower.

The National Cottonseed Products Association, Inc., is interested in the production of sunflowers and has been conducting an aggressive program to develop sunflowers into a profitable crop in the Cotton Belt. Some oil mills have ample raw materials (cotton, safflower and soybeans) for processing, while others do not enjoy that position. This area has a distinct market advantage because many cotton oil mills have surplus crushing capacity that could be used in processing sunflowers. Many of the farms in the Cotton Belt need an additional cash crop to utilize idle acreage or to replace presently grown marginal profit crops.

Observation from 4 years of farm trial plantings suggests that where a high level of good management has prevailed, sunflowers are already profitable and competitive in certain areas of the Cotton Belt. Harvested yields in excess of 2000 lb/acre of open-pollinated varieties have been obtained with production inputs that have been relatively low compared to other crops grown on demonstration farms. Lack of good management has most frequently been the cause of reduced opportunity for profitable production. This appears to be typical of new crops. The significant trend is the dramatic 56% increase of the open-pollinated varieties over the 4 year period and the 40% increase in yield of the hybrids.

Experience gained each year in growing high oil sunflowers has been used very advantageously by the growers. Available results from our early plantings where suggested good production practices were followed have constantly produced higher yields than the later plantings. This allows for early harvest in July, normally during the dry season, with the spring moisture being received during the critical blooming and seed formation period. Early harvesting does not conflict with the fall harvest of major crops, nor with the processing and storage facilities.

Experiment stations and commercial trial plantings in the Cotton Belt over the past 4 years indicate that the yield of both hybrid and open-pollinated high oil sunflowers increased each year they were tested.

We must recognize that the results of the commercial trial plantings and experiment station plantings involved many variables at various locations over the cotton belt; but the yields justify a major effort of continued research and application to determine the crop's maximum potential and competitive position with presently grown crops.

Chemical companies recognized the need and have worked aggressively toward the development and approval of herbicides, insecticides and bird control chemicals. They are conducting the necessary research on harvest aid chemicals to secure approval, because of the need to hasten drying of the stem and the back of the head after the seed is physiologically mature. This will reduce field loss due to weather and possible damage by birds in certain areas.

Machinery manufacturers have developed an efficient sunflower header attachment for use on a regular combine to minimize harvesting losses.

## HYBRID SUNFLOWERS

Until now the sunflower crop in the U.S. has been planted to open-pollinated varieties in which the individual plants vary in height, time of flowering and time of maturity. New hybrids have been sought to make the sunflower a more uniform, high yielding crop. Adequate quantities of hybrid seed are still several years away. A fertility restorer gene that will make low cost production of hybrid sunflower planting seed commercially feasible has been discovered by Kinman (6). The gene, designated by $Rf_1$, restores fertility to cytoplasmic male-sterile sunflowers. The restorer gene was found in an agronomically desirable, rust resistant line developed at the Texas Agricultural Experiment Station.

Kinman reports that it will now be possible for seed companies to produce $F_1$ hybrid sunflower planting seed for farmers by crossing three different types of sunflower lines. At the West Side Field Station in California in 1970, under irrigated conditions, Knowles reported that under his conditions six hybrids produced over 4000 lb/acre—the highest 4660 lb—while all the open-pollinated varieties ranged from 3200 to 3800 lb/acre (10).

According to Claassen, the Pacific Vegetable Oil Corp. has definitely decided to move into the production of high oil-type sunflowers this coming year. They will be contracting for sunflowers in the Minnesota-North Dakota, southern and western areas

## UTILIZATION

Sunflower oil's greatest potential lies in its use in edible products. Its high ratio of polyunsaturated fatty acids to saturated fatty acids and its excellent stability characteristics make sunflower oil highly attractive for use in several food products.

The fatty acid composition of the oil in sunflower seed has been reported by a number of investigators to vary with planting locations and with the climate conditions during the growing season. Sunflower seed produced in the northern part of the U.S. yields an oil which typically contains 65-70% linoleic acid (7,8,19); whereas, oil from seed produced in the southern U.S. varies from 30-60% linoleic acid (7,8,19). Sunflower oil with a lower linoleic acid content, such as produced in the South, probably will be less susceptible to oxidative rancidity, and thus will have better keeping qualities than oil with higher linoleic acid content (17).

The rapid expansion in fast-food outlets, many of which specialize in fried foods such as chicken, fish and chips, has contributed to the growth in demand for cooking oils. Because in these types of operations the oil is used several times, a highly stable oil is required. The stable properties

of sunflower oil should make it suitable for this purpose.

In addition to its potential use in cooking oils, there is also considerable interest in the use of sunflower oil in salad oil and margarine. The sunflower name, as well as the desirable P/S ratio in the oil could add needed diversity to our domestic edible oil supply, as it appears to be well suited for these uses.

The new Richard B. Russell Agricultural Research Center in Athens, Georgia, began sunflower research soon after its opening in 1969. The Russell Agricultural Center is investigating the use of sunflower oil in various food products and as a cooking oil. It is also interested in defining how the composition of the oil affects its stability and keeping qualities as well as that of the products in which it is contained or cooked (17).

The use of sunflower oil for industrial application has found favor with the American paint industry, due to the low linolenic acid content (2).

Of all the oilseeds, sunflowers are probably the newest and most exciting new protein source. Whole sunflower kernels and high protein sunflower meal can be incorporated into human food formulations, or combined with available inexpensive staples to develop nutritious, enriched products (17).

Chemical and physical analysis of defatted sunflower meal indicates that the major problem is discoloration due to oxidation of chlorogenic acid, according to a study by Burns and Talley of Texas A&M University. Under a grant from the Richard B. Russell Agricultural Research Center on Utilization of Sunflowers in Human Food Products, excellent cream color, relatively bland flavor and excellent stability were demonstrated even under poor storage conditions of the defatted sunflower meal, according to the researchers (26).

Numerous experiments have been conducted on the nutritional value of sunflower meal in rations of poultry, swine and ruminants (24). Sunflower meal is a high quality protein source for inclusion in livestock rations. Care must be taken in formulating nonruminant rations to provide adequate lysine and energy for maximum production, because sunflower meal is normally low in these two nutrients. In practical swine and poultry rations, which are nutritionally balanced for all needed nutrients, sunflower meal should be equal in value to other oilseed protein supplements in supplying a portion of the needed protein. In ruminant rations, sunflower meal should be equal to the other oilseed protein in dietary nitrogen source.

Sunflower meal processing will affect the quality of the protein and energy content. Therefore, as long as there is variation in processing, variation in the nutritive value of the feed products can be expected. No nutritional toxins have been reported in sunflower meal.

Sunflower hulls, like other coarse roughage, contribute primarily to ration value through their functional or physical characteristics. Ground hulls are an economical source of needed bulk in ruminant rations. Hulls are excellent nutrient carriers in mixed feeds. Hulls take up molasses readily, and the mixture increases palatability and feed intake in high concentrate rations.

## PROJECTION

World sunflower seed production in 1970 was estimated at 9.24 million metric tons—210,000 below 1969 and the smallest in 4 years. The decline was influenced by reduced yields despite further increases in acreage, according to USDA's Foreign Agricultural Service.

"Although it is hazardous to attempt to forecast 1971 sunflower seed production at this point, we anticipate aggregate acreage to be up possibly 3.5%," USDA said. "Barring unforeseen factors which could result in below-average yields, the world 1971 sunflower harvest could increase by at least 0.5 million tons or nearly 6%. Such an increase could be expected in increased export availabilities in 1972 (1)."

Euler stated recently in *Foreign Agriculture* that the Soviet Union plans to raise annual sunflower output 927,000 tons by 1975. Reaching the 1975 goal will require a 10% increase from the 1969-70 acreage annual output, or 15% more than reported for 1970. The impression given by the Soviet press is that the increased production is to come from a more or less unchanged area of ca. 11.9 million acres (9). The Soviets will attempt to raise the 1000 and less per acre average yield to ca. 1300 by 1975 and increase oil content as well (9). These efforts are to be based on use of better seed and more fertilizer, machinery and equipment, as well as better use of such inputs. Sunflower varieties producing seed with a 53-54% oil content, compared with an estimate of 48-50% during the past few years, are expected to be made available for growing. The best variety grown so far reportedly has a 52% oil content. For the most distant future, scientists at the oilseed research institute in Krasnador reportedly are continuing to work on varieties that may have oil content of 55-57% and 58-60%.

Improved breeding materials have been made available to many of the developing countries around the world that are improving the availability of fats and oils to raise the per capita vegetable oil consumption.

Jensma recently reported that, in many countries in which his company operates, production is increasing rapidly with further expansions planned for the next decade. As an example, Mexico had over 100,000 acres in 1971 and is planning for 500,000 acres in 1972. It would seem that a substantial increase in sunflower output in the near future is a good possibility from four countries—Australia, Canada, France and Iran, in addition to Mexico—barring any major problems relative to climate, insects, marketing, etc. Jensma said, "Optimism for sunflowers has increased and on the demand side the need is more urgent than ever (13)."

Baldwin has just returned from a trip to Russia, and his comments very well could be the summary for the "Projection and Prospect for Sunflower Seeds (3,4)."

"It is obvious from our experiences of the 1960's that sunflower oil, seed and meal had a strong impact on the vegetable oil economy. We can expect sunflowers to grow in economic importance to strengthen their hold on second place as a source of vegetable oil in the 1970's. It is clear that the Soviet Union alone, which produces more than half of the world's sunflower crop, will greatly influence the future of this crop and the price of all vegetable oils. The Soviet Union's planned economy allows her to increase her exports on short notice. She doesn't need a surplus of oil to bring about increased exports. At this time it appears that the Soviet Union is responding to pressures to feed more vegetable oil to her people, even in the face of high oil prices and strong demand. With the evidence suggesting that the Soviet Union will boost her production of sunflower oil by 1975, and periodic exports are a real possibility in the immediate years ahead, it all adds up to a decade in which the influence on sunflower oil markets will keep the world vegetable oil industry very much on its toes."

The climate for the development of a sunflower seed industry in the U.S. appears very favorable, and I see no reason for this crop not to become of significant economic importance when volume production is achieved.

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