Russell Center focuses on sunflower oilseed research

Perched atop the tallest of a cluster of gently rolling hills on the outskirts of Athens, Georgia, the USDA's Richard B. Russell Research Center forms part of the University of Georgia Research Park.

With the Southern Regional Research Center in New Orleans, the Russell Center shares responsibility for utilization research on agricultural production in the South—an area that extends roughly from the Atlantic coast westward to Texas and from the Ohio River south to the Gulf Coast. While the geographic jurisdiction is shared, the responsibility for oilseed research is not. New Orleans researchers concentrate on cottonseed and peanuts, two major oilseed crops of the South. Athens researchers focus on sunflower and have an additional project on problems unique to on-farm storage of soybeans in the Southeast. (Most USDA post-harvest utilization research on soybeans is conducted at the Northern Regional Research Center in Peoria, Illinois).

Dr. James Robertson, oilseed research leader at the Russell Center, explains that when the center was opened in 1969, sunflower was viewed as a potential diversification crop. The late Dalton Gandy, then with National Cottonseed Products Association, was spearheading the attempt to introduce sunflower to the South. Thus, one of the Russell Center's original tasks was sunflower research and Robertson was a chartered staff member. For two years, he was the sole oilseed researcher. Dr. W.H. Morrison III joined the staff in 1971, and the two men continue as the Center's principal sunflower investigators.

Robertson began by trying to determine the characteristics of sunflower oil grown in the United States. An extensive network of cooperators was established to keep data on planting dates, locations and weather conditions, which Robertson would correlate with sunflower yield and sunflower oil composition. The results showed that growers can "pretty well tailor grow an oil," Robertson says, as southern grown sun oil's fatty acid profile (35-50% linoleic acid) showed it suitable as a frying oil for the snack and food industry whereas northern grown oil (65-70% linoleic acid) is suitable for salad oil and similar uses. Temperature and planting location are significantly correlated with sun oil's fatty acid composition. In general, for each centigrade-degree increase in average minimum daily temperature from flowering of the sunflower until maturity, linoleic acid content of the seed decreases by about 2%. The results have been published in a USDA bulletin, *Effect of Planting Location and Temperature on the Oil Content and Fatty Acid Composition of Sunflower Seeds* (USDA, SEA, Agricultural Research Results ARR-S-3/ October 1979).

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Some of the Russell Center's early work involved examining the suitability of sun oil for frying potato chips or preparing frozen french fries. The reason is that potatoes and sunflowers are grown in the same general region of the U.S. and provide cooperatives and others the possibility of using readily available raw materials. The work on french fries showed sun oil, despite a low

initial active oxygen method (AOM) value, has about the same AOM value after equilibrium status was reached as soy-based and palm-based drying oils. Robertson has copies of publications and a presentation of a 1978 international sunflower conference on these topics.

Rapidly increasing sunflower production and processing in the U.S. will lead to increasing on-farm storage of seed. "We do not have adequate information on optimum conditions for (on-farm) storage of sunflower," Robertson notes. Grain buyers are asking how much damage can be expected under various storage conditions, at what free fatty acid level they should reject sunflower seed and similar questions. An initial analysis from 54 storage bins on 27 farms showed that there were significant storage problems with seed that was placed in storage at high moisture contents (above 10%) and improperly aerated.

Storage conditions have been the subject of the soybean research at the center, specifically, what physiological effects on soybeans are caused by storage at the high-temperature, high-humidity conditions common in the Southeast. The Russell work showed that the normal practice of storage of 13-13.5% moisture may not be best in the Southeast; moisture probably should be 12% or below. "On-farm storage facilities have increased 300% since 1977, and with the accumulation of U.S. soybean stocks, it is essential that adequate information be developed on both short- and long-term storage," Robertson says. The soybean work also involved developing a new analytical phospholipid conversion factor by determining individual phospholipid molecular weight based on fatty acid composition. The work also applied to sunflower,

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the first time such a factor had been developed for crude sunflower oils.

In fact, the Russell team has had to develop several analytical methods for sunflower. There are now three tentative methods, adopted in 1975, for sunflower (moisture and volatile matter, oil, and nitrogen-ammonia-protein) in *AOCS Official and Tentative Methods.* But as Robertson says, "there are no industry-wide accepted methods and different methods are being used."

The team is looking for faster, better methods for oil analysis. Wideline nuclear magnetic resonance (NMR), for example, can provide more rapid analysis than the extraction techniques the AOCS tentative method uses, with equivalent results. More recent work has explored use of near infrared (NIR) analysis, but with less favorable initial results. In working with NMR, Robertson says his work shows drying samples at 130 C for three hours is unnecessary, that 30 minutes may be enough; samples exposed to a microwave for four minutes or longer also was tried, but results were spotty.

Robertson serves as chairman of the AOCS sunflower seed analysis committee. With increasing commercial trading of sunflower, development of industry-wide accepted analytical methods becomes important.

One analytical project seeks to identify and characterize sunflower seed waxes and their effects on oil quality. The goal is to investigate the composition and location of waxes and other minor constituents and what can be done about them. In small amounts, the waxes are an aesthetic problem in that they cause oil to become hazy. The first step is to determine the amount of wax in sunflower hulls, kernels and seed coats. Morrison presented a paper on initial work of this three-year project during the ISF/AOCS World Congress this past spring.

Morrison presented another paper on a second active project: correlating gas liquid chromatography (GLC) volatile measurements with evaluations by taste panels (trained and untrained panel tastings are conducted under supervision of a Russell Center home economist). The project involves testing of fresh oil as well as oils stored for varying amounts of time under different conditions. The work has shown that storage in dark or amber bottles provides adequate flavor protection without the addition of antioxidants. But since the firms presently marketing sun oil consumer products prefer to emphasize the "lightness" of sun oil, they probably will continue to use clear containers, Robertson says. Evaluations of sun oils stored for 16 weeks in clear containers did not show significant flavor protection by antioxidants for sun oil, Robertson notes.

What about sunflower meal? Although somewhat deficient in lysine, sunflower meal contains about twice as much methionine as soybean meal and is

potentially an excellent source of protein for livestock. Research conducted at the Russell Center by Drs. Henry Amos and Donald Burdick showed that a higher percentage of sunflower protein was retained by sheep when the meal was heated with formaldehyde (1%) to "protect" the protein from degradation in the rumen. Also, data obtained indicated that sunflower meal heated to 100 C during processing resulted in faster weight gain in rats than untreated meal or meal heated to 127 C. Two factors which presently preclude greater use of sunflower protein in human foods are the presence of polyphenolic acids and the high fiber content of sunflower meal. Polyphenolic acids, particularly chlorogenic acid, impart a greenish color to foods which is esthetically undesirable. Research funded by the Russell Center at Texas A&M University has been partially successful in solving both problems.

The Russell Center is still relatively new, which has benefits and drawbacks. The facility includes modern design, but it also lacks the capital improvements that build up over time (such as pilot plant facilities). Recent cutbacks in federal ag utilization research funds have forced changes at all the regional research centers, usually involving curtailment of staff and research projects. Reduced travel funds may mean less opportunity to meet with other researchers to discuss, for example, the effect of fertilization on sunflower seed yield and composition.

As sunflower becomes economically more important, Robertson says it could be the only oilseed crop the Russell Center will have time and funds to study. The dilemma, as at every research organization, is that there are many challenging tasks and not enough resources to undertake them all, especially in an era of rising costs and limited funding.□

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