T1992FEED02

QUALITY AND PRODUCTION OF SUNFLOWER FOR HUMAN FOOD.

James R. Lofgren, Dahlgren & Co.,Inc.
1220 Sunflower St., Crookston, MN 56716, USA

SUMMARY

The improvements made in nonoilseed (confectionery) sunflower for quality and productivity have been gradual; however, the methods of measuring the improvements have been refined in recent years. The doubling of hectarage in the United States in the 1980's reflects the increasing demand for nonoilseed sunflower as a human food in several countries of the world. Yields of hybrids have increased, not only as the result of plant breeding for improved productivity, but also through advanced agronomic practices. Achene size has increased to satisfy market demands. Likewise, kernel weight and the percent of kernel recovery have been elevated, largely due to breeding efforts. The term hullability associated with mechanical dehulling has been redefined to be: the larger amount of intact kernels recovered from a given sample of achenes adjusted for unhulled achenes and kernel fragments. Using this method, hullability scores among hybrids show statistically significant differences.

INTRODUCTION

Sunflower (Helianthus annuus L.) has been used as a human food for a long period of time as shown from the discoveries of archaeologists, especially in North America (Young, 1910). European immigrants brought selected large-seeded sunflowers for reintroduction when they came to settle the farming regions of North America (Putt,1978).

Apparently, little improvement was made on the open-pollinated cultivars until the mid 1930's when individual sunflower heads were collected from kitchen gardens at Rosthern, Saskatchewan, Canada (Putt, 1978). Although these early selections were from 'Mennonite', a recognized nonoilseed sunflower, the objective was to secure a potential oilseed crop. In the 1940's, field production of sunflower began in Manitoba, Canada, some of which found a use for human consumption. Later, production hectarage increased and spread to the North Central Region of the United States. The harvested hectarage of nonoilseed sunflower has more than doubled since 1980, increasing from 104,160 to 222,000 hectares in 1990 (NSA, 1992). Improvements have been made simultaneously for higher productivity and improved quality in both oilseed and nonoilseed sunflower, particularly in Canada and the United States, ever since those first head selections were gathered.

The quality characteristics of nonoilseed (confectionery) sunflower differ greatly from those of the oilseed (Lofgren, 1978). Lofgren discussed the quality of "in-shell" and kernels used in numerous ways as human food. Lofgren (1976) observed larger size achenes had a lower hullability score (the ease of mechanical hull removal, by a visual scoring of unhulled achenes) than smaller achenes. He stated that low hullability scores mean greater efficiency in manufacturing but could result in loss of product if dehulling occurred in normal handling of the crop. Dedio & Dorrell (1989) reported differences in hullability among oilseed sunflower cultivars and hybrids. The most important achene traits for improved hullability (percent of recovered kernels from mechanical dehulling) were large achene size, low oil content, and low density.

The objectives of this report are to emphasize the improvements, especially for quality characteristics, that have been made in nonoilseed sunflower in the past several years as the results of breeding efforts.

MATERIALS AND METHODS

A series of yield trials conducted in the year 1991 were seeded with nonoilseed sunflower. The soil was amended with 'Trifluralin' at 0.05 kg/ha for weed control and fertilized to 124 kg of N, 56 kg of P_2O_5 and 40.8 kg K_2O per hectare. One of these trials was seeded in three replications (6.7 X 1.8 m two-row plots) with a lattice design, on May 16, considered the optimum time in the North Central Region of the United States. This trial consisted of 22 entries and three commercial check hybrids that were chosen to be retested among advanced hybrids, i.e., hybrids that exhibited commercial potential in one or two previous years.

Weight of achenes and dockage per plot was recorded directly from the combine, with a subsample of the achenes retained in a sealed 0.25 l. plastic bag for moisture determination, and a second 2.0 l. subsample for dockage and achene quality determinations. Moisture subsamples were weighed wet, then were oven dried at 65°C for three hours, reweighed and the moisture content calculated. Dockage was removed from the 500 g subsample on a bench cleaner, utilizing forced air to remove light weight material and a 4.7 mm sieve to remove small diameter trash, then reweighed. Plot weight was adjusted for dockage and moisture content to obtain yield. Achene sizes, recorded as percent, were determined on a series of round-hole sieves; 8.6, 7.8, 7.0, 6.2 and 5.5 mm, respectively, from large to small. Percent of kernel and kernel weight data were generated from hand hulling twenty-five achenes of each size from each plot, weighing the kernels and the hulls, and calculating the percent recovery of kernels.

To evaluate hullability (the ease of mechanical hull removal), achenes from larger unreplicated plots (9.6 X 240 m) of commercial and pre-commercial hybrids were used as a source material. These plots were grown at two locations, 175 km apart, (locations considered replications in the analysis of variance using a randomized complete-block design, random model with subsamples). Achene samples of 100 g each were uniformly vibrator fed into a locally constructed laboratory huller revolving at 2500 rpm. The weight of kernels, kernel fragments and unhulled achenes was recorded for duplicate samples for each of ten hybrids and three achene sizes, 9.0, 8.2, and 7.4 mm. A hullability score was generated by subtracting the unhulled achenes and kernel fragment weights from percent kernels. The setting of the laboratory huller was made, using 5.5 to 7.8 mm size achenes of a standard hybrid, D-151, to obtain an unhulled portion of 25% and the minimum amount of kernel fragments. The moisture content of these samples was 5.8%. Each characteristic was analyzed statistically using the procedures of Steel & Torrie (1960).

RESULTS AND DISCUSSION

Yield of the 25 hybrids ranged from 23.66 to 36.06 q/ha with a mean of 28.40 q/ha. The analysis of variance indicated non-significant differences with a CV of 14.1% and an $LSD_{.05}$ of 6.58 q/ha. These results were predictable, since the hybrids chosen were among the more productive hybrids available. Furthermore, yields from this study compare favorably with official trial results for nonoilseed sunflower in North Dakota of 19.6, 23.7 and 22.3 q/ha for the years 1989, 1990, and 1991, respectively (Berglund, 1989, 1990, 1991). Consequently, the yields reported in this experiment demonstrate the potential of nonoilseed hybrids under near optimum conditions.

Mean accumulative percentages for achene size were 34.7, 65.7, 84.9, 93.1 and 96.7 % respectively, for >8.6, >7.8, >7.0, >6.2 and >5.5 mm round-hole sieves. The contrast between two hybrids, D-151 and experimental hybrid 283-4, is displayed in Figure 1. For the "in-shell" trade it is desirable to have high proportions of achenes held on a 7.8 mm sieve. Experimental hybrid 283-4,

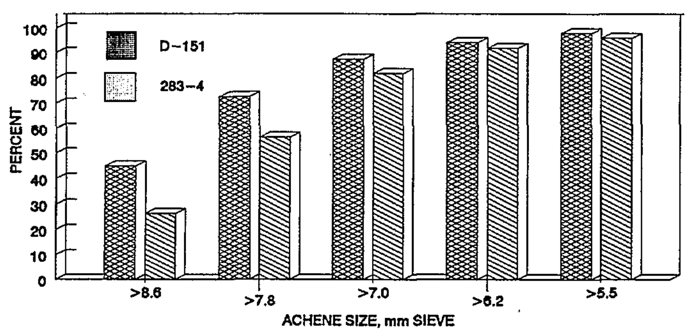

Figure 1. Comparison of D-151 and experimental hybrid 283-4 for cumulative percent of achenes on five sizes of round-hole sieves.

and/or inadequate locations. The percent of kernels from the 9.0 mm size had a significant mean square for hybrids as depicted by Duncan's multiple range test in Table 1. No significant hybrid mean squares were found for the other two achene sizes. Two achene sizes, 9.0 and 7.4 mm, had significant hybrid mean square for hullability score. In the case of the 9.0 mm size, although the mean square was significant, Duncan's multiple range test failed to indicate a difference existed. Eight of the hybrids in the 7.4 mm size were no different from each other according to Duncan's test. Percent kernels in this test were lower than those obtained through hand hulling. In a commercial plant, the actual percent of kernels would be somewhere between the extremes of the two methods. Significant mean squares for experimental errors were found in each of the analysis of variance performed, due to the extremely small sampling error. The raw data agreed well between samples of the same hybrid from a location which accounted for the small sampling errors. Replication mean squares for percent kernels were significant for all three achene sizes indicating the variability of this characteristic at different locations.

ACKNOWLEDGMENTS

Special appreciation is extended to Dr. Jerry Miller and Dr. Rama Urs who graciously reviewed this article. Also, my thanks to the following who performed the field, laboratory and statistical tasks: Vern Demaris, Becky Nelson, Irene Ybarra, Carol Ann Nelson and Brian Strom.

REFERENCES

Berglund, D. 1989, 1990, 1991. North Dakota hybrid sunflower performance testing. Bull. A-652. Agricultural Experiment Station, Fargo, ND 58105, USA.

Dedio, W. and D.G. Dorrell, 1989. Factors affecting the hullability and physical characteristics of sunflower achenes. Can. Inst. Food Sci. Technol. J. 22: 143-146.

Lofgren, J. R. 1976. Seed quality of confectionery sunflowers (Helianthus annuus). Proc. Sunflower Forum. Jan. 8, 1976. Sunflower Assoc of America. pp2-3.

Lofgren, J. R. 1978. Sunflower confectionery food, birdfood and petfood. In: Sunflower Science and Technology, Monograph No. 19, Carter, J.F.(ed.), American Society of Agronomy, Madison, WI 53711, USA.

NSA, 1992. National Sunflower Association official statistics. 4023 N. State Street, Bismarck, ND 58501-0690, USA.

Putt, E.D., 1978. History and present world status. In: Sunflower Science and Technology. Monograph No. 19. Carter, J.F.(ed.). American Society of Agronomy. Madison WI, USA.

Steel, R.G.D. and J.H. Torrie, 1960. Principles and Procedures of Statistics. McGraw-Hill Book Co., Inc. New York NY, USA.

Young, B.H., 1910. The prehistoric men of Kentucky. Filson Club Publications, No 25.