VARIABILITY IN DEHULLING ABILITY OF SUNFLOWER HYBRIDS (*HELIANTHUS ANNUUS*) IN ARGENTINA

María J. Di Leo, Isabel C. Riccobene, and **Susana M. Nolasco,** Grupo de Investigación TECSE, Departamento de Ingeniería Química, Facultad de Ingeniería, UNCPBA, Av. del Valle 5737, B7400JWI-Olavarría, Buenos Aires, Argentina
E-mail: iriccobe@fio.unicen.edu.ar
E-mail: snolasco@fio.unicen.edu.ar.

Abstract

Dehulling ability index was defined as the ratio (in %) between the proportion of hull mechanically extracted and the actual proportion of seed hull. This characteristic of the seeds affects the industrial performance of oil extraction. Before this process the sunflower seeds are partially dehulled. The objective of this work was to detect and examine the variability of dehulling ability in sunflower seeds of hybrids grown in Argentina. Ten traditional hybrid samples grown in two locations were analysed. The dehulling ability varied from 9.9 to 83.6% (mean 36.1±17.5%). The existence of variability in dehulling ability of hybrids grown in Argentina was demonstrated. Significant differences among hybrids were detected in the dehulling ability. This characteristic was sensitive to the environment. The hybrid and environment selection is important to obtained sunflower seeds of the appropriate quality for the dehulling process.

Introduction

Argentina is one of the most important producers of oil seeds, oils and protein flours in the world. In the oil industry, partial dehulling of the sunflower seeds, before processing or extraction of the oil constitutes a relevant stage of the process. The dehulling aptitude of the grain greatly affects its industrial yield, modifying the quantity of product that participates in the extraction process as well as the quality of the raw oil and of its protein subproducts.

The grains' dehulling facility depends to great extent on variations in the hull structure, such as the lignification degree and discontinuities inside the sclerenchyma layer (Beauguillaume and Cadeac, 1992a; Leprince-Bernad, 1991), air cavity between hull and grain (Morrison et al., 1981), hull thickness (Denis et al., 1994; Beauguillaume and Cadeac, 1992b), lignin and cellulose content (Morrison et al., 1981; Denis et al., 1994) and shell content (Denis et al., 1994; Dedio and Dorrell, 1989).

Different characteristics of the grain such as the hull structural characteristics, the size and density of the grain (Tranchino et al., 1984; Merrien et al., 1992), oil content, moisture percentage (Merrien et al., 1992; Fernández et al., 2001) would affect to some extent their aptitude to dehulling.

Although studies have been made that allow confirmation of genetic variability of the dehulling ability (Beauguillaume and Cadaec, 1992a; Denis et al., 1994; Beauguillaume and Cadaec, 1992b; Fernández et al., 2001), studies made regarding the environmental effects on this character are scarce.

The objective of this work was to explore the variability of the dehulling aptitude of ten sunflower hybrids cultivated in this country.

Materials and Methods

The sunflower seeds used in the present study were obtained from a crop grown during 1998/99 in the Balcarce (58º 45´ OR and 37º 45´S) and Tandil (59º 15' OR 37º 14' S) Argentina. The seeds were manually cleaned to remove all foreign matter, broken or immature seeds.

Ten hybrids belonging to official yield trials from Buenos Aires and La Pampa provinces were used: ACA 884, Cariló, Contiflor 11, Dekalb 3900, Jaguel, Morgan 742, Paraíso 20, Pyramid-1, Rancul and Zenit.

Grain yield was determined in the central row of each plot and expressed in kg/ha. Oil content was determined by Nuclear Magnetic Resonance (Robert and Morrison, 1979) with an Analyser Magnet Type 10 (Newport Oxford Instruments, Buckinghamshire, England), according to the AOCS Ai 2-75 method (1998) in selfed plants. Oil concentration was expressed on a dry weight basis. Moisture content was determined according to the Association of Official Analytical Chemists method (AOAC, 1980).

The dehulling ability was determined in pilot equipment based on a centrifugal process with a rotation speed of 3300 rpm. The dehulling ability was calculated as a percentage relationship between the hull percentage extracted mechanically and the total content of hull expressed as percentage in weight (determined by manual dehulling).

Means and standard deviations for grain yield, oil content and dehulling ability were calculated. A combined variance analysis among locations for total and individual dehulling ability was performed. The coefficients of determination between the oil content and the dehulling ability were determined using Sigma Plot software for Windows Version 4.01 (1997 SPSS, Inc.). Coefficient of variation (CV, %) among hybrids and locations were calculated with the objective to analyse dehulling ability variations. The data presented are average of triplicates and they are expressed on a dry weight basis.

Results and Discussion

Grain yield mean was 2,647.7 kg/ha (VC=34.4%). This grain yield mean is frequent in Argentina. It ranged between 1,831.3±308.0 kg/ha in Tandil and 3,464.1±461.1 kg/ha in Balcarce. Grain yield variation among hybrids was 2,292.3±808.6 kg/ha for Jaguel, and 2,938.0 ± 1,164.6 kg/ha for Paraíso 20.

Oil content mean was 48% (CV=6.4%). This value is superior to the commercialisation base in Argentina (42%). It ranged between 45.9±3.0% in Tandil and 49.4±3.1% in Balcarce. Oil content variation among hybrids was 44.3±2.0% for Morgan 742 and 50.5±3.2% for Dekasol 3900 (Figure 1).

The dehulling ability of sunflower seeds varied from 9.9 and 83.6% (mean=36.1±17.5%, CV=48.6%). The dehulling ability mean was higher in Tandil (46.9±14.7%) that in Balcarce (25.2±12.8%). A greater dehulling ability mean was obtained in the seeds Morgan 742 (64.1± 16.1), while Cariló presented the smallest values (25.1±12.2).

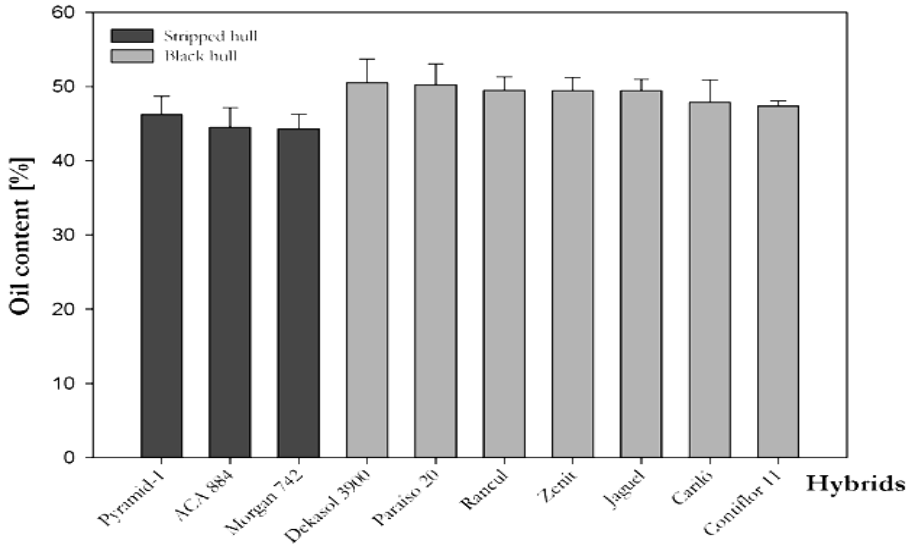

Figure 1. Oil content of different sunflower hybrids.

Significant differences among hybrids (P≤ 0.005) and among locations (P≤ 0.005) were detected. Genotype x Location interaction was nonsignificant (P>0.1). For all the hybrids the dehulling ability was superior in Tandil compared to that observed in Balcarce (Table 1). Variation coefficient (%) values among locations for each hybrid ranged between 26.7 and 66.3%, and CV values among hybrids for each location were 29.9 and 46.7% for Tandil and Balcarce, respectively. Results indicated that it would be possible to modify dehulling ability with little variation in the quality of locations.

Table 1. Dehulling ability (average ± standard deviation) corresponding to the ten hybrids.

Hybrids	Dehulling ability (%)	
	Location	
	Tandil	Balcarce
Morgan 742	76.3 ± 6.4	52.0 ± 12.9
ACA 884	66.7 ± 1.5	39.5 ± 9.7
Contiflor 11	48,1 ± 1.8	22.9 ± 5.5
Paraiso 20	46.9 ± 8.9	23.8 ± 3.7
Rancul	44.9 ± 8.0	22.6 ± 10.6
Dekasol 3900	41.6 ± 14.6	15.0 ± 6.7
Jaguel	40.7 ± 5.0	24.1 ± 4.2
Zenit	36.0 ± 2.2	20.8 ± 2.0
Cariló	35.5 ± 4.9	14.8 ± 5.0
Pyramide-1	32.7 ± 2.2	16.5 ± 2.0

The results show significant difference in the dehulling ability of the hybrids Morgan 742 and ACA 884, both with striped hulls and smaller oil yield (Table 1), compared to the

remaining hybrids. Pyramide-1, although a hybrid of striped hull and lower oil content than the hybrids with black hulls, presented a very low dehulling ability.

Dehulling ability decreased linearly when the oil content increased. That relationship can be represented as y = C1 + C2 x, with C1:241.306±24.329 and C2:-4.280±0.506, where y: dehulling ability (%) and x: oil content (%), P<0.0001, n=60. This function accounted for 55% of the variability in dehulling ability, regardless of the location (Figure 2a) or the hybrid studied (Figure 2b).

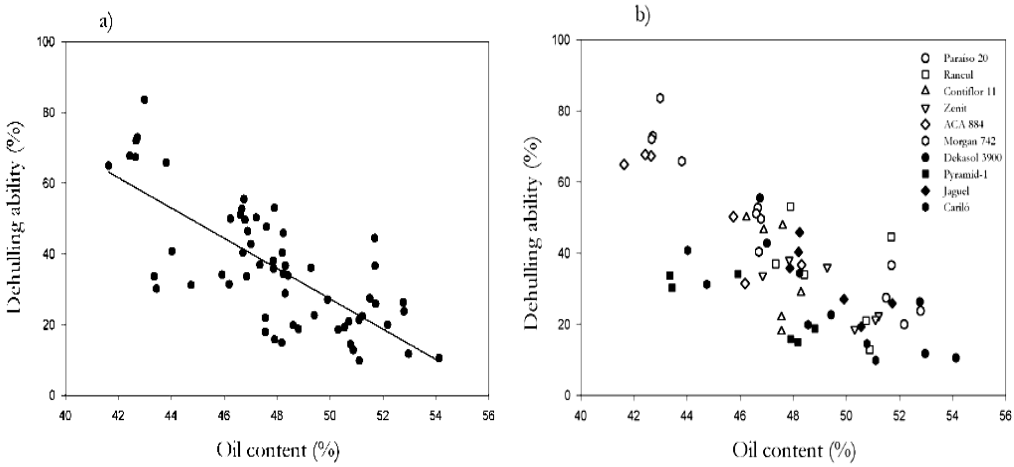

Figure 2. Relationship of dehulling ability and oil content.

The relationship between the dehulling ability and oil content for each hybrid showed the same trends observed in the total experiment; but the proportion of variation explored was higher (66-89%, P≤0.048, n=6).

Conclusions

The existence of variability in dehulling ability of hybrids grown in Argentina was demonstrated. Significant differences among hybrids were detected in the dehulling ability. This characteristic was sensitive to the environment. The results obtained on a pilot plant scale are encouraging. The selection of both hybrid and environment is important to obtain sunflower seeds of the appropriate quality for the dehulling process.

Acknowledgments

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