IMPROVEMENT OF SUNFLOWER DEHULLING ABILITY AN INTERDISCIPLINARY APPROACH

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ABSTRACT

A small laboratory dehulling system has been set up and performed for fastly mesuring dehulling ability of seed samples with a breeding aim (fast comparison of cultivars) and a technological aim (forecast of dehulling ability for commercial samples). The feasibility of breeding program for dehulling ability by keeping high oil content has been clearly shown and environmental conditions have to be taken into consideration even though genetic effects are always predominant. Drying technology improves dehulling ability and a quite significant progress can be expected from overheated steam drying. Technology drying needed new adjustments of dehulling and sorting parameters and led to define some recommendations for the design of a new industrial dehulling system.

KEY-WORDS

Dehulling, meal, drying technology, breeding, environment.

INTRODUCTION

Using of sunflower meal in animal feeding has been limited for a long time because of very high fiber content of the seed hulls. Industrial dehulling is already performed to a small extent in some countries (Argentina, France, Spain, U.S.A.), but the meal quality (mainly metabolizable energy value for poultry and digestible energy value for pigs, but also protein content) is irregular essentially because of large variations in dehulling ability (fig.1).

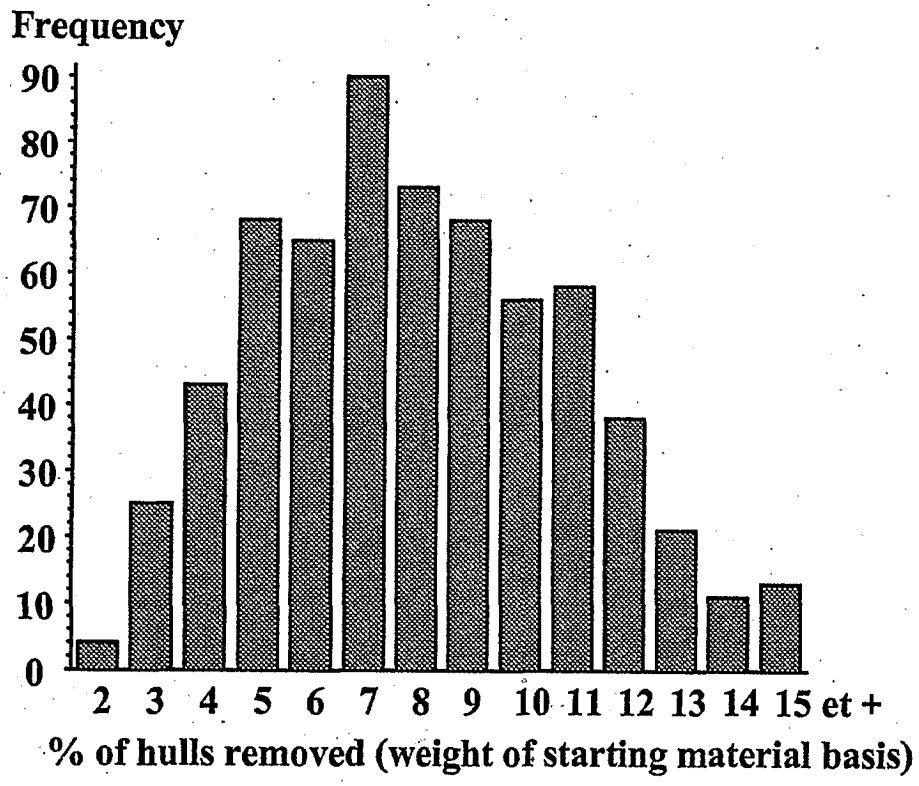

Figure 1. Dehulling ability distribution of 633 sunflower seed samples harvested in France (1991)

The aim of this research program, supported by European Union (ECLAIR, AGRE.0029), was to get a better knowledge in different scientific, technical and economical areas (mainly plant physiology, agronomy, breeding and **technology**) for improving sunflower dehulling ability.
It was led, from may 1990 to april 1994, by CETIOM, the technical center of the french oilseed producers. The other main partners were italian (Istituto di Agronomia, Facoltà di Agraria, Università di Pisa), spanish (CIDA (Junta Andalucia) - CSIC, Cordoba) and french (INRA, Station d'Amélioration des Plantes, Clermont-Ferrand) public breeders, a french hulling system manufacturer (TECMACHINE) and the BUNGE group, which is crushing sunflower in France and Spain.

METHODS

The works were focused on the main following aspects :

- Setting and evaluation of a laboratory dehulling system for measuring hulling ability of small seed samples.
- Breeding aspects.
- Importance of environmental conditions.
- Setting and evaluation of new technologies for improvement of dehulling ability.
- Nutritional studies with dehulled sunflower meals.
- Economics.

RESULTS

Setting and evaluation of a laboratory dehulling system

A small laboratory dehulling system has been set up by CETIOM and TECMACHINE company, and performed by CETIOM for measuring dehulling ability of seeds with a breeding aim (fast comparison of cultivars) and a technological aim (forecast of dehulling ability for commercial samples). It has been also verified that the tests are correlated with an industrial plant ones.

Breeding aspects

The breeding studies have clearly shown that dehulling ability is under genetic control : The large variability of dehulling ability observed on more than 40 lines, cropped in 3 different environmental conditions, in 1992 and 1993, enables a breeding program for this character. Some genotypes are producing seeds with a good dehulling ability and a high oil content. The comparison of parent lines and hybrids have also shown high values for heritability ratio (0.77 to 0.85). The large variability between plants of a same fixed genotype makes better a familial breeding.

Importance of environmental conditions

Environmental effects have been studied in collaboration with breeders : it is pointed out that there is a negative correlation between moisture of cropped seeds and dehulling ability (the higher is the moisture, the lower is the dehulling ability). A dessication taking place in good conditions is

determining a high dehulling ability. Nevertheless, the genetic effects are always predominant on environmental conditions.

Optimization of seed treatment between harvesting and crushing : effect of drying.

Different drying technologies have been developed in the pilot plant of CETIOM (GERDOC) for improving dehulling ability of seeds : efficacity of traditional warm air drying, feasibility and evaluation of superheated steam drying. This last process significantly improves dehulling ability : for each removed water point, removed hull percent is close to 1.48 for superheated steam drying against 1.28 for hot air drying (fig. 2). No damage for oil quality is observed (only the protein solubility is lowered).

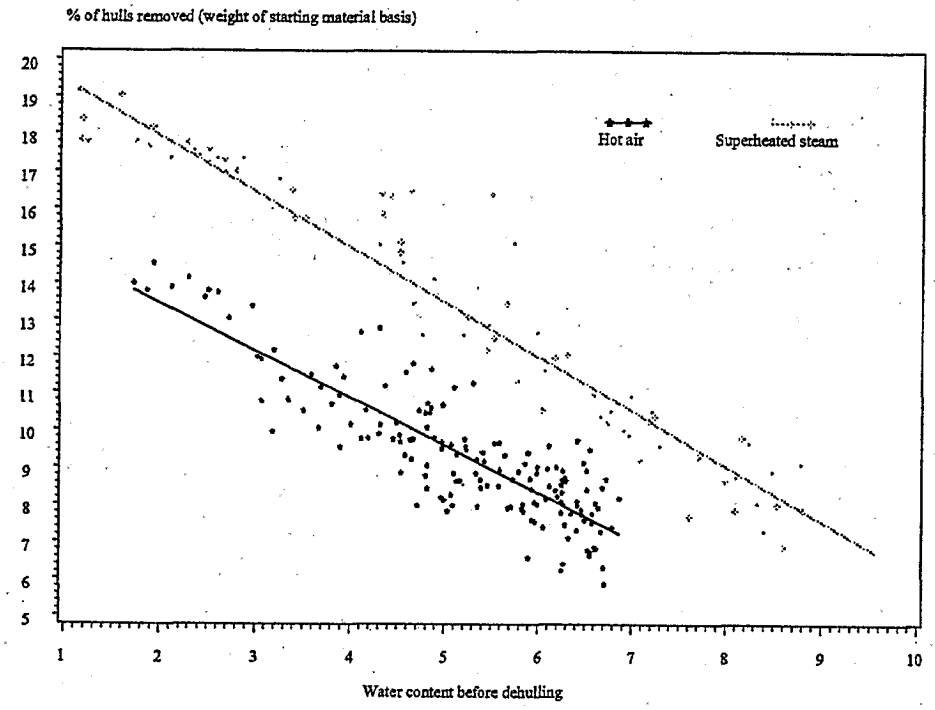

Figure 2. Compared efficiencies of hot air drying and superheated steam drying

Nevertheless, this process generates much more kernel fines, picked up in the hull fraction, than a dehulling without heat pretreatment and a new flowsheet for dehulling and sorting has been set up at laboratory and pilot stages. On the laboratory scale, it was shown that a process combining superheated steam drying and optimized dehulling-sorting removes 90 % of total hulls from a lot of seeds difficult to dehull, with a residual oil content in hull close to 6 %. These new adjustment parameters have led to define some recommendations for the design of a new industrial dehulling system.
The superheated steam drying could take place in a well dehulled meal manufacturing line, where extra needs for steam would easily be supplied by hull burning.

Dehulling profitability

Meals at different levels of dehulling have been processed in the pilot plant of CETIOM and nutritional value clearly proved (fig. 3).
The profitability of dehulling for crushing and interest of dehulled sunflower meal for animal feeding are not compatible in all economical circumstances : The meal and oil markets available to the processor, economical uses of the removed hulls (actually burnt for steam production of the plant) and good technical control of the process (particularly control of oil losses in hulls) are important in deciding whether to dehull.

	NON DEHULLED SUNFLOWER	PARTIAL DEHULLED SUNFLOWER	DEHULLED SUNFLOWER "40"	SOYA "48"
Crude fiber	28.3	23.9	17.6	5.6
Lignin	11.0	7.3	5.8	0.7
Crude protein	33.2	37.8	43.6	45.8
ME,Kcal/Kg(1)	1650	1850	2040	2440
DE,Kcal/Kg(2)	2400	2850	3500	3500

(1) Metabolizable energy (poultry)
(2) Digestible energy (pigs)

Figure 3. Quality improvement of sunmeal by dehulling (Dry matter basis)

CONCLUSIONS

- A small laboratory dehulling-sorting system has been set up and a standardized method has been developed for fastly measuring dehulling ability of small seed samples. This system has been commercialized to several breeders by TECMACHINE.
- It has been clearly proved that it is possible to introduce dehulling ability character in a breeding scheme. Genetic material can be put at the disposal of breeders.
- Environmental conditions have to be taken in consideration for dehulling ability but the genetic effects are always predominant on environmental conditions.
- Drying technology is improving dehulling ability and a significant progress can be waited from overheated steam drying.
- On this basis, a new dehulling-sorting flowsheet has been designed and must be scaled-up at a plant level.

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