

THE VARIETY FACTORS WHICH AFFECT THE  
QUANTITY AND QUALITY OF SUNFLOWER PROTEINS

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The research program realized since 1967 was intended to:

- determine the influence of climatic conditions on the production of proteins of the different varieties, pure or hybrid.
- evaluate the action of nitrogenous fertilization (dosing and fractioning) on the nature of the reserves accumulated in the seed.
- situate the importance of cultivation techniques and more particularly of irrigation in relation to protein production.
- to realize the research thoroughly, over 100 tests were carried out.

I - Variety Tests

The study of production potential was realized on over 200 hybrid or pure lines from the selection of the Plant Improvement Centres of the National Institute of Agronomy Research.

The determining of the correlation coefficient between the oil content and the protein content, expressed in relation to the entire seed, enable the positioning of its value of  $r = -0.59$  to  $r = -0.72$ .

The coefficient has a value of  $r = 0.92$  if one considers the oil content of the kernel.

This increase in coefficient is due to the elimination of the factor "percentage of husk" which is variable depending on the variety (from 19 to 35%).

During this research it was possible to determine the effect of climatic on the nature of the reserves accumulated in the seed.

Thus, for the varieties Peredovik, rich in oil (51% to 53% of the dry material) and Ienissei, less rich in oil (43.6% to 46.50% of the dry material) the following averages were obtained:

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|      | <u>Peredovik</u> | <u>Ienissei</u> |
|------|------------------|-----------------|
| 1967 | 17.75            | 21.10           |
| 1968 | 13.20            | 14.65           |
| 1969 | 15.35            | 16.00           |

The influence of the year is very important and is explained by the maximum sensitivity to dryness of the sunflower for the oil content during the period from the end of flowering to 10-15 days before maturity (Robelin 1965). This corresponds to the climatic conditions of 1967 whilst in 1968 the rain was regular during this period, 1969 falls between these two years.

The difference in protein content between the varieties is also accentuated during dry years.

For the different hybrids studied, important variations in protein content were discovered (from 15% to 22%). It will be necessary to situate the influence of the parental lines on this characteristic and also for the kernel percentage on the entire seed.

This kernel percentage is a base for selection to obtain hybrids containing at the same time a good protein content and a high level of oil.

From the point of view variety, the excellent behavior of Russian variety Tcakinsky 269 must be mentioned. It allies an oil content of 49 to 52% with a content of protein, 16 to 20% on the entire seed, thanks to a kernel percentage of 80% on the entire seed.

The qualitative study of proteins undertaken on some varieties of hybrid permitted the noting of slight variation of the composition of amino acids, whereas the differences were practically nil for the Russian varieties studies (Peredovik, Armavir 93 - 45, Ienissei) but it will be essential to study a great number of parental lines and the composition in amino acids to orientate the creation of hybrids.

## II - Study of Fertilization

Mineral nutrition has an appreciable effect on the photosynthesis by intervening in the different phases, either on the catabolism of the hydrates of carbon or on the course of the reduction of nitrates. The intervention of phosphorous, of potassium at various, of the glycolyse, is well know, as is the action of manganese and iron, in the KREBS cycle.

Nicholas has shows that Molybdenum, iron, copper, magnesium and manganese are implicated in the reduction of nitrates. Kursanov has shown the role of potassium in the enzymatic reactions of the amide synthesis, finally Crane and Steward have defined the role of calcium and potassium in the balance between soluble nitrogen fractions and proteinic nitrogen.

From these facts one can easily see that certain mineral deficiencies are rapidly going to affect proteinic synthesis in plants and from there the nature of the reserves accumulated in the seed.

The most important element in mineral nutrition, as far as this research is concerned, is nitrogen and one will remember that the role of nitrogenized nutrition on the photosynthesis will not only depend on the use

of solar energy absorbed by the leaf but also the luminous energy reaching the soil of the area cultivated.

For the sunflower, from the whole of the studies realized on the absorption rhythm of nutritions, it is shown that an average production of approximately 25 cwt. of seed per hectare requires the following quantities of elements:

|                   |        |
|-------------------|--------|
| - Nitrogen        | 175 kg |
| - Phosphoric acid | 65 kg  |
| - Potash          | 225 kg |

The experiments carried out on nitrogenized fertilization did not enable the proving of an action of the nitrogen on the seed returns above 80 units of nitrogen per hectare, but it was important to emphasize the influence of increasing the fractioned doses of nitrogen on the protein content.

On the whole of the tests, a positive effect on the protein content of the seed was remarked, at the same time as a drop in oil content, on condition that the dryness does not play the important role of a limiting factor.

It also became apparent that delayed nitrogenized fertilization does not provoke, as for cereals, an increase in the proteids of the seed. This will be explained in the following two observations.

Firstly, Y. Coic thinks that due to its cationic composition, the sunflower reduces a large proportion of the nitrates in the leaves and secondly that the enrichening of the cereal seed, consecutive to a delayed nitrogenized nutrition, is attributable to the nitrogenized metabolism of the roots at the end of vegetation.

The role of the potash in the protein content of the seed could not be defined during the tests realized up to now; further study is in progress.

The study of the composition in amino acids did not enable the exposing of a difference between the nitrogen doses although the protein content varies considerably.

### III - Cultivation Techniques

Amongst the cultivation techniques, the influence of irrigation on the protein content was most particularly examined, but tests are at the moment under way to situate the action of various rootings on the seed reserves.

The study of the water requirements of the plant and irrigation, confirmed the results of the experiments realized by Robelin at the Centre of the National Institute for Agronomy Research in Clermont-Ferrand, namely, a good water supply during the period of seed formation gives a high oil content to the seed. A hydric deficiency during this period provokes an increase in the protein content but the yield on the seeds being reduced, the yield in proteins per hectare is lower than in the first case.

### IV - Conclusion

The results of these studies enabled the following disclosures:

- The strong negative correlation between the two main components of the seeds, the lipids and the proteids.
- The importance of the Character "proportions" of kernel in the seed, as a selective base for the creation of hybrids or pure lines with a high oil production and protein potential.
- The clear action of increasing doses of nitrogen on the protein content of the seed and the absence of response to a delayed addition nitrogen.
- The clear influence of climatic conditions and irrigation during the period of formation of the seeds, on the nature of the reserves accumulated in the seeds.

It remains to discover the action of potash on the protein content of the seed and to situate the variations in the composition of the amino acids of the parental lines in view to creating hybrids which are rich in essential amino acids.

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