PROTEIN CONTENT OF SUNFLOWER HYBRIDS AND VARIETIES TESTED IN INTERNATIONAL TRIALS (1977)

E. KURNIK
Research Institute for Forage Crops
7095 Iregszemcse, Hungary

In countries where sunflower is widely grown, its press-cake and extracted grits play a considerable part in the livestock feeding and so, in addition to being an important oil seed crop, sunflower is a significant plant protein source as well. Therefore, presumable changes in its protein content as depending on the growing conditions are of economic importance too.

MATERIALS AND METHODS

Due to the fact that the F.A.O. trials with sunflower varieties and hybrids have supplied detailed information on the significant influence of the environment on seed yield and oil content and quality, it has appeared interesting and useful to investigate also the protein content of sunflower entries.

At our request, seed samples from the F.A.O. trials performed in 1977 were sent by 12 institutions from 9 European countries. A number of 3 varieties, 19 single hybrids and 2 three-way hybrids were analysed for protein content at Iregszemcse, Hungary. These sunflower genotypes were experimented in two trials : Trial No. 1 with half-late hybrids and Trial No. 2 with early hybrids and cultivars, and the results concerning seed and oil yield and morpho-physiological characteristics were published in "Helia" Nr. 1, 1978.

Data on protein content, presented in Tables 1 and 2, are discussed from the standpoint of variety, location and latitude.

RESULTS AND DISCUSSION

Sunflower genotypes show considerable differences in protein content when compared among them. Between Flambeau, the hybrid of the highest protein content (17.5%) and Romsun 53, that of the lowest protein content (14.4%), there is an absolute difference of 3.1% and a relative difference of 21%.

Three early genotypes have shown the highest protein content : the single hybrids Flambeau (17.5%) and H 5-C 3 (17.1% and the variety Issanka (17.3%). The lowest protein content belongs to the half-late hybrids Airelle (14.5%), Sorem HT 58 (14.4%) and Romsun 53 (14.4%). The rest of sunflower genotypes, with 14.8 to 16.8% protein content, ranges between the two groups of values.

The ecostability of sunflower genotypes has been investigated on the ground of the location values. Taking into account the differences between the standard deviations and the extreme values, Helios 322, Sorem HT 58, Romsun 53, Sorem 80, Helios 14-219 and Romsun 59 (in this order) can be regarded as ecostable genotypes (standard deviation : 0.70 to 10.06, extreme value differences : 1.8% to 4.1%).

Ecolabile genotypes are, in order : H-23, Wielkopolski, Remil, H 5-C 3, Peredovik, Flambeau, Romsun 18 and Romsun 301 (standard deviation : 1.70 to 2.37, extreme value differences : 5.2% to 8.6%).

It is worth mentioning that most of the ecostable genotypes belong to the half-late group of maturity, while the ecolabile ones to the early group.

The remainder of the genotypes ranges between the two groups of values in respect of ecolability (standard deviation: 1.22 to 1.46, differences between extreme values : 2.5% to 5.5%).

The particular ecological conditions of each locations are considerably acting on the protein content of sunflower cultivars and hybrids. The highest average protein content has been determined at Poznan, Poland (17.2%), and the lowest at Elvas, Portugal (13.3%). Between these extreme values, there is an absolute difference of 3.9% and a relative difference of 3.6%. It is evident, at least with regard to the

differences and fluctuation when considering both the genotypic and environmental influences.

It should be mentioned here that, according to our own experiments, the influence of the year is still greater than that of the location with regard to both oil and protein content.

In Tables 1 and 2, the locations where the F.A.O. trials were conducted are grouped according to their geographic situation, in order to examine the latitude effect on protein content. This sequence of locations however, evidently du to the small number of observations, does not indicates any changing tendency. Presumably, at least in the instances examined, the latitude affects the protein content of sunflower to a smaller extent than the particular ecological conditions of the experimental sites. The same applies to oil content.

The composition value of a genotype can be also characterized by the total amount of oil and protein : the OP value (oil+protein).

The OP value is determined by the oil content, since nearly three times as much oil as protein is formed in the total cropyield. Between Helios 322, the hybrid of the highest OP value (65.4%) and Relax of the lowest (59.4%), there is 5.9% absolute and 9.9% relative difference. The relatively high OP value of the hybrid Romsun 301 (63.7%) should also be pointed out, because it is the joint result of a relatively high protein content (17.0%) and a good medium oil content.

As regards the analysed sunflower entries, 13% of them showed a relatively high OP value (64 to 67%), and 35% a relatively low OP value (59 to 60%).

With respect to the ecostability of the OP values, the order of sequence is different from that obtained for protein content, i.e. :

— ecostable genotypes : Helios 14-219, Sorem 82, Sorem HT 58, Wielkopolski, Helios 322, YU NS 65 and Flambeau (standard deviation : 1.65 to 1.90, extreme value differences : 5.1% to 7.3%) ;

— ecolabile genotypes : Remil, YU NS 26, Relax, Issanka, Airelle and Romsun 53 (standard deviation : 2.57 to 2.96, extreme value differences : 8.4% to 10.2%).

The rest of entries ranges between the two groups of values in respect of the OP value ecostability (standard deviation : 2.03 to 2.4, extreme value differences : 6.2% to 7.9%).

When studying the location effect, the highest OP value has been recorded at Aude, in France (65.0%) and the lowest at Iregszemcse, in Hungary (59.2%). The difference between the extreme values amounts to 5.8% and the relative difference to 9.9%, just as much as it has been recorded between the individual genotypes.

For the above mentioned reasons, the latitude effect, as expected, has not proved determinant on the OP value, either.

CONCLUSIONS

On the ground of our findings exposed in detail in this paper, although on the basis of only one year data and a relatively small number of locations, it could be concluded that sunflower genotypes differ significantly between them as protein content is concerned, but nevertheless the environmental influences are greater than the genotypic ones, so that ecostable and ecolabile cultivars and hybrids can be distinguished. Therefore, the attention of breeders and growers should be called to the important role played by the ecological background, which cannot be neglected neither in the breeding programmes nor in the decisions taken by growers for establishing a sunflower crop.

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Résumé

On a analysé la teneur en protéines de 24 hybrides et variétés de tournesol essayés en 1977 dans le réseau F.A.O. de recherches sur le tournesol.

Les résultats ont montré d'importantes différences entre les hybrides et les variétés sous le rapport de la teneur en protéines, mais ce caractère est aussi fortement influencé par les conditions de climat de la localité où l'on a efectué les essais. De ce point de vue on peut distinguer des génotypes écostables et écolabiles. Quant à la teneur en protéines, les fluctuations d'une localité à l'autre sont généralement plus grandes que les différences génotypiques.

La valeur HP (huile + protéines) dépend surtout des effets génotypiques et de milieu exercés sur la teneur en huile qui est à-peu-près trois fois plus grande que la teneur en protéines.

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Resúmen

Unos 24 híbridos y variedades de girasol experimentadas durante el año 1977 en la Red F.A.O. de investigación para el girasol fueron analizados con respecto al contenido de proteína.

Se encontraron diferencias importantes entre híbridos y variedades en cuanto al contenido de proteína, característica que viene, sin embargo, fuertemente influída también por las condiciones climáticas de las localidades donde se efectuó el experimento. Las fluctuaciones de una localidad a otra en lo que concierne el contenido de proteína se refiere, son generalmente mayores que las diferencias genotípicas.

El valor OP (aceite + proteínas) depende especialmente de los efectos genotípicos y ambientales excercitados sobre el contenido en aceite, el cual es casi tres veces mayores que el contenido en proteína.

Table 1

Protein content of sunflower half-late hybrids (1977)

Variety, hybrid	Genetic type *	Country of origin	Crude protein (in % of dry matter)										Average values	
			Iran Karaj	Portugal Elvas	Turkey Yeşilköy	France Aude	Italy Pisa	Romania Fundulea	USA Fargo	France Clermont Ferrand	Hungary Szeged	Hungary Iregszemcse	Prot. %	OP % (oil + protein)
			35 °	39 °	41 °	43 °	44 °	44 °	45 °	46 °	46°	47 °		
Airelle	SH	F	16.5	12.6	15.3	14.9	14.3	15.0	14.7	12.7	—	14.8	14.5	60.4
Relax	SH	F	17.9	15.7	16.2	15.4	17.5	16.0	19.3	16.4	—	16.7	16.8	59.5
Remil	SH	F	20.0	14.6	17.9	16.1	17.6	17.1	16.1	14.9	—	15.0	16.6	60.5
Peredovik	OPV	BG	18.5	12.7	15.3	16.7	15.5	14.9	16.1	15.2	19.1	16.0	16.0	64.4
Sorem HT 58	TH	R	14.9	13.1	14.4	15.4	15.1	13.5	14.7	14.2	14.9	14.5	14.5	60.8
Sorem HT 64	TH	R	17.0	13.4	14.4	15.6	14.2	15.3	16.9	15.1	13.6	13.1	14.9	62.3
Sorem HS 80	SH	R	17.6	15.6	14.2	14.6	15.4	13.6	14.4	13.5	13.7	15.3	14.8	63.6
Sorem HS 82	SH	R	16.0	13.3	15.6	15.2	14.3	15.5	13.4	15.0	14.2	14.7	14.7	63.3
Romsun 52	SH	R	16.3	14.3	17.3	15.2	16.8	15.3	15.8	13.4	13.9	15.5	15.4	62.8
Romsun 53	SH	R	15.1	13.3	15.7	13.8	14.1	14.0	14.6	14.9	13.9	14.1	14.4	62.7
Romsun 59	SH	R	17.3	14.5	16.6	16.0	16.2	15.5	16.3	15.1	14.3	14.3	15.6	62.3
Helios 322	SH	BG	16.6	14.7	15.0	15.6	15.1	14.6	15.9	14.6	14.3	15.0	15.1	65.4
Helios 14/219	SH	BG	16.5	13.8	14.8	15.3	15.9	14.2	16.3	14.5	15.5	14.0	15.1	65.2
YU NS 65	SH	YU	16.8	14.3	15.9	16.4	15.4	15.9	13.7	15.0	12.8	14.7	15.1	61.3
YU NS 26	SH	YU	15.9	13.0	14.4	14.5	15.2	16.1	13.5	16.0	17.9	15.7	15.2	61.3

* SH = single hybrid ; TH = three-way hybrid ; OPV = open pollinated variety.

Table 2

Protein content of sunflower early hybrids and varieties (1977)

Variety, hybrid	Genetic type *	Country of origin	Crude protein (in % of dry matter)											Average values	
			Iran Karaj	Portugal Elvas	Turkey Yeşilköy	France Aude	Italy Pisa	Romania Fundulea	USA Fargo	France Clermont Ferrand	Hungary Iregszemcse	Austria Fuchsembigl	Poland Poznań	Prot. %	OP % (oil + protein)
			35 °	39 °	41 °	43 °	44 °	44 °	45 °	46 °	47 °	48 °	52 °		
H5-C3	SH	F	18.7	13.1	18.4	17.5	16.9	17.4	19.6	16.4	16.2	16.8	—	17.1	59.8
Issanka	OPV	F	18.5	14.5	19.4	18.1	17.1	17.2	16.9	15.7	16.8	17.1	16.6	17.3	62.3
Flambeau	SH	F	18.6	12.7	18.3	19.9	18.7	18.4	19.1	14.8	15.8	17.2	18.6	17.5	62.6
Wielkopolski	OPV	PL	15.5	12.6	16.1	18.4	14.0	14.5	15.0	14.2	13.3	15.9	17.4	15.2	60.3
H-23	SH	E	17.5	12.3	15.2	15.8	15.2	15.6	16.5	13.1	12.7	15.4	13.1	14.8	60.7
YU NS 1	SH	YU	16.7	11.6	16.3	16.4	15.5	15.0	15.5	15.3	14.0	16.1	16.0	15.3	64.1
Romsun 18	SH	R	15.7	9.9	16.3	17.6	14.7	15.7	17.5	15.1	13.4	14.7	18.5	15.4	60.9
Romsun 20	SH	R	16.9	11.4	16.2	15.8	15.4	14.7	16.1	15.1	15.7	15.9	16.3	15.4	62.5
Romsun 301	SH	R	20.2	12.5	18.6	17.1	17.8	18.4	16.3	16.4	13.0	17.5	18.8	17.0	63.7

* SH = single hybrid ; OPV = open pollinated variety.

investigated genotypes and locations that the fluctuation in protein content due to the environmental influences is higher than that caused by the genotypic differences.

Referring to the oil content, one can state that the protein content is an essentially more labile feature than the oil content, because the former is showing relatively much greater

differences and fluctuation when considering both the genotypic and environmental influences.

It should be mentioned here that, according to our own experiments, the influence of the year is still greater than that of the location with regard to both oil and protein content.

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