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RESULTS OF AN INTERNATIONAL TRIAL WITH SUNFLOWER HYBRIDS
II. Seed yield and its components

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SUMMARY

The experiment object were 154 sunflower hybrids developed by research institutes and international breeding companies and intended for growing in the agroecological conditions of Europe, the Americas, Australia, Asia, and Africa. The hybrids were tested for the following characters: seed yield, oil and protein concentration, 1000-seed mass, volume weight, husk percentage, and autogamous pollination. Statistical calculations included the cluster analysis with the Euclidean distance treated as a metric distance. The hybrids were uniformly distributed in all five clusters regarding seed yield, protein concentration, husk percentage, and autogamous pollination. Regarding oil concentration and volume weight, more than 98% of the tested hybrids were clustered in three distinct groups.

Key words: Sunflower hybrids, seed yield, statistical analysis

INTRODUCTION

Seed yield is a complex character. Phenotypic values for individual components of seed yield vary in dependence of agroecological conditions in experiment site. This explains a high portion of ecological variance in the phenotypic variance, even in hybrids which are phenotypically stable. On the other hand, environmental conditions in experiment site may limit maximum seed yield or individual yield components. A good example of it are relatively low oil concentrations in entire sets of experimental hybrids.

The grouping of cultivars, according to mutual similarities, into a selected number of clusters is enabled not only by the variability of the characteristic tested but even more so by the distribution of phenotypic values within the appointed limits. A rare occurrence of values close to the minimum or maximum further enhances the accuracy of grouping. Increase in the number of clusters or elimination of extreme values may solve the problem.

The present paper complements the one already published on the morpho-physiological characteristics.

MATERIAL AND METHODS

The experiment object were 154 sunflower hybrids developed by research institutes and international breeding companies and intended for growing in the agroecological conditions of Europe, the Americas, Australia, Asia, and Africa.

The hybrids were a part of the demonstration plot of the 12th International Sunflower Conference (Yugoslavia, 1988). They were also sown at the experiment field of the Institute of Field and Vegetable Crops, in a system of random blocks in three replications, within a series of small-plot trials with 23 hybrids and NS-H-26 and NS-H-45 as the controls in each small plot. Cultural practices were adapted to the local conditions (Mihaljčević, 1991). This paper presents the results of the analyses of the following characteristics: seed yield (t/ha) at 11% seed moisture; oil concentration (%), 5% seed moisture - NMR method; protein concentration (%) Trebor protein analyzer, 5% seed moisture; 1000-seed mass (g) at 11% seed moisture; volume weight (kg/100 l) at 11% seed moisture; husk (%); autogamous pollination the ratio of seed set under autogamous pollination vs. seed set under open pollination.

Statistical calculations were done by the System for Statistics Systat Ver. 5.0, software modules STATS and CLUSTER. For clarity, we used the five-group K-means analysis with the Euclidean distance treated as a metric distance.

RESULTS AND DISCUSSION

The hybrids tested differed significantly in the examined characteristics. The lowest and the highest seed yield per hectare were registered with Sunwheat-102 and NS-H-45, 1.41 t and 4.15 t, respectively, the lowest and the highest oil concentration in oil-type hybrids with PAC-3054 and RO-1213, 37.30% and 48.00%, respectively, the lowest and the highest protein concentration with Sunwheat-102 and S-530, 15.90% and 19.70%, respectively, the lowest and the highest 1000-seed mass with Citosol-3 and RO-1390, 38.00 g and 81.50 g, respectively, the lowest and the highest volume weight with Sunwheat-102 and Pardisol, 39.50 kg and 67.20 kg, respectively, the lowest and the highest husk percentage with DO-728 and Citosol-4, 20.0% and 32.0%, respectively, and the lowest and highest autogamous pollination with RO-1418 and SPS-3094, 0.01 and 0.84, respectively.

The trial included also the confectionary cultivar Guadalsur which had the lowest values of oil concentration and volume weight, 24.80% and 34.70 kg, respectively, and the highest values of 1000-seed mass and husk percentage, 105.0 g and 47.00%, respectively.

The highest coefficient of variation was registered for autogamous pollination, 51.3%. The coefficients for seed yield, 1000-seed mass and husk percentage (18.6, 16.2, and 13.3, respectively) were significantly higher than those for volume weight, oil and protein concentrations (7.2, 6.8, and 3.6, respectively).

The positive values of skewness indicate the assymetry towards the values higher than the average ones for husk percentage, 1000-seed mass, volume weight, and autogamous pollination, while the negative values indicated the assymetry towards the values lower than the average ones for seed yield, oil and protein concentrations.

Summary statistics for the seven characteristics in the hybrid collection are presented in Table 1.

The partitioning of the set of 154 hybrids into five clusters was done in order to make them comparable with the distributions of the morpho-physiological characteristics of

the same five groups of hybrids (Mihaljčević, 1991). The values between and within the sums of squares and the values of the F-ratio are presented in Table 2.

Tab. 1. Summary statistics for seven characters in the hybrid collection

Characteristic	Number of hybrids	Mean	Se	Min	Max	S	Skewness	Cv
Seed yield (t/ha)	154	2.97	0.04	1.41	4.15	0.55	-0.31	18.6
Oil conc. (%)	154	42.53	0.23	24.80	47.9	2.84	-1.97	6.8
Protein conc. (%)	154	18.03	0.05	15.9	19.7	0.64	-0.43	3.6
Mass 1000 seed,(g)	154	58.65	0.73	38.0	105.0	9.17	1.43	16.2
Volume weight (kg/100l)	154	47.88	0.27	34.7	67.2	3.43	0.52	7.2
Husk (%)	154	26.40s	0.28	20.0	47.0	3.51	1.61	13.3
Autogamous pollination	154	0.34	0.02	0.01	0.84	0.17	0.20	51.3

Tab. 2. Summary statistics for the five clusters

Characteristic	Between SS	DF	Within SS	DF	F-ratio
Seed yield (t/ha)	43.50	4	2.95	149	548.90
Oil conc. (%)	1102.36	4	139.34	149	294.68
Protein conc. (%)	58.53	4	5.56	149	391.98
Mass 1000 seed (g)	11417.57	4	1456.10	149	292.08
Volume weight (kg/100l)	1573.91	4	232.48	149	252.17
Husk (%)	1744.94	4	145.32	149	447.27
Autogamous pollination	4.45	4	0.28	149	582.12

The cluster analysis for seed yield showed that about 40% of the examined hybrids had the seed yield over 3.20 t, and 13% over 3.60 t. On the other side, the yield below 2.10 t was registered in the dwarf hybrids (Sunwheat-102 and T-557 DW) and the eight hybrids developed for the agroecological conditions of Australia and Argentina which are considerably different from the conditions of the experiment site. It is noteworthy to mention that the cultivars were uniformly distributed (26% in each group) in clusters 1, 2, and 3, which had the mean seed yields of 3.20 t, 2.73 t, and 2.20 t, respectively.

To produce partitioned clusters, one must decide in advance how many clusters he wants. The decision is brought on the basis of the range and distribution of phenotypic values between the maximum and minimum values, and hybrid type (oil or confectionery). Therefore, a decision to keep the same number of clusters for all characteristics under study may result in a non-uniform grouping of cultivars. A good example of it are the data obtained in this trial for the cluster analyses of oil and protein concentrations.

The range between the lowest and the highest value for oil concentration was large (23.10%). The hybrids with extremely low values of oil concentration, i.e., Guadalsur and Sunwheat-102 (24.80% and 30.60%,respectively), although belonging to different hybrid types, had the values of oil concentration lower by 12.20% and 6.50%, respectively, than the lower limit of the nearest group. Nevertheless, about 50% of the hybrids were in cluster 3 which had the mean oil concentration of 42.57% (range 41.20% - 43.90%). Only

about 28% of the hybrids were in cluster 1 with the maximum oil concentration of 47.90%. The oil concentrations significantly lower than the normal value obtained in the agroecological conditions of the experiment site may be explained by premature ripening that resulted from a long dry spell. This explanation is supported by the fact that more than 20% of the oil type cultivars tested had less than 41.00% of oil. It appears that more useful information about the hybrids could have been obtained by partitioning them in more than five clusters or by eliminating the hybrids with the extremely low values from the calculations.

The range between the lowest and the highest value of protein concentration was small. The analysis showed that 82% of the hybrids tested differed by less than 2.0%, and even 99% of them by 3.0%. The partitioning in five clusters allowed the extreme cases to be allocated in a separate cluster (Sunwheat-102 and Contiflor 9) ensuring at the same time that the difference between the minimum and maximum values per cluster did not exceed 0.60%.

The analysis of 1000-seed mass showed that more than 75% of the hybrids did not exceed the limit of 61.0 g. Because of somewhat larger seeds, about 20% of the hybrids were allocated in a separate cluster (no. 3), with the mean value for 1000-seed mass of 66.0 g. With the exception of the hybrid Guadalsur in cluster 4, only five hybrids had a higher seed mass than 75.0 g.

The cluster analysis for volume weight showed a symmetry of distribution in relation to the mean value for the entire collection. More than 50% of the hybrids were in the cluster with the limits of 46.0 kg and 49.2 kg. The hybrids Guadalsur and Pardisol, which had the lowest and the highest value of volume weight, were in separate clusters.

Low husk percentage (22% - 26%) is a major target of sunflower breeding. Despite the unfavorable conditions, less than 60% of the hybrids had the husk percentage below the upper limit. About 30% of the hybrids were grouped in cluster 3, with the husk percentage between 27.0% and 30.0% High husk percentages (31% -36%) in 16 hybrids were due more to their lack of adaptation to drought at the stage of grain filling than to hybrid type, as evidenced by the fact that, with the exception of Sunwheat-102, only two or three hybrids were expected to have a poor filling (confectionery type).

Heritability determinants, environmental influences, and type of bags were important for the expression of autogamous pollination. Although the pollination was poor due to high temperatures at the stage of flowering and use of paper bags, over 60% of the hybrids had a satisfactory degree of autogamous pollination (0.30% - 0.60%). The hybrids in two clusters deserve special attention. Twenty-one hybrids in cluster 5 had an exceptionally low autogamous pollination (less than 0.12). Conversely, 8 hybrids had a high seed yield under bag, about 70% of seed yield recorded under open pollination (cluster no.4).

Mean values, limits and number of hybrids belonging to the five clusters are given in Table 3.

Table 4 contains the names of the hybrids, the breeding institution and the distribution per cluster.

Tab. 3. Mean values, limits and number of hybrids belonging to the five clusters

Characteristic	Cluster	Mean	Min	Max	S	No.of hybrids
Seed yield (t/ha)	4	1.41	1.41	2.11	0.23	10
	3	2.47	2.20	2.71	0.14	42
	2	2.95	2.73	3.17	0.12	41
	1	3.41	3.20	3.58	0.12	40
	5	3.76	3.59	4.15	0.13	21
Oil conc. (%)	5	24.80	24.80	24.80	0.00	1
	2	30.60	30.60	30.60	0.00	1
	4	39.60	37.00	41.00	1.09	33
	3	42.57	41.20	43.90	0.80	76
	1	45.43	44.00	47.90	1.10	42
Protein conc. (%)	5	16.00	15.90	16.10	0.10	2
	3	17.07	16.70	17.30	0.19	23
	2	17.73	17.43	18.00	0.20	46
	1	18.34	18.10	18.60	0.16	58
	4	18.91	18.70	19.70	0.24	25
Mass of 1000 seeds (g)	1	48.00	38.00	52.00	3.45	49
	2	56.22	52.20	61.00	2.41	68
	3	66.00	61.50	72.70	3.60	31
	5	79.84	75.50	86.70	3.95	5
	4	105.00	105.00	105.00	0.00	1
Volume wieght (kg/100 l)	5	34.70	34.70	34.70	0.00	1
	4	43.39	39.50	45.50	1.74	29
	3	47.72	46.00	49.20	0.90	80
	1	51.08	49.50	55.70	1.36	43
	2	67.20	67.20	67.20	0.00	1
Husk (%)	5	22.39	20.00	23.00	0.77	28
	1	25.03	24.00	26.00	0.87	63
	3	28.39	27.00	30.00	1.05	46
	4	32.38	31.00	36.00	1.36	16
	2	47.00	47.00	47.00	0.00	1
Autogamous pollination	5	0.07	0.01	0.12	0.04	21
	1	0.21	0.15	0.27	0.03	33
	2	0.34	0.28	0.41	0.04	45
	3	0.50	0.42	0.60	0.05	47
	4	0.72	0.63	0.84	0.08	8

Tab. 4. Hybrids, originator and cluster number for the examined characteristics

Hybrid	Comp.	Seed yield (t/ha)	Oil conc.	Prot. conc.	Mass 1000 seeds	Vol. weight	Husk cont.	Auto. poll.
NS-H-26	IFVC	2	4	2	1	1	1	3
NS-H-33	IFVC	3	4	2	1	3	3	1
NS-H-15	IFVC	1	3	3	2	3	3	1
NS-H-17	IFVC	5	3	3	3	4	1	2
NS-H-43	IFVC	1	1	2	3	1	1	4
NS-H-45	IFVC	5	4	3	3	1	1	5
NS-H-52	IFVC	2	3	2	1	3	1	3
NS-H-64	IFVC	1	1	1	2	1	1	1
NS-H-68	IFVC	5	3	1	2	1	1	2
NS-H-70	IFVC	5	1	2	2	3	1	2
NS-H-90	IFVC	1	3	2	2	1	1	4
NS-H-91	IFVC	5	3	2	2	1	1	1
NS-H-92	IFVC	2	1	1	1	1	1	5
DO-704-XL	DAHLGREEN	1	3	3	2	3	3	1
DO-855	DAHLGREEN	1	3	3	2	3	3	5
DO-728	DAHLGREEN	1	1	2	2	3	5	2
DO-705	DAHLGREEN	2	3	1	3	3	1	5
DO-66-EYP	DAHLGREEN	2	3	2	2	3	3	5
SIGCO-442	SIGCO	3	3	2	2	3	3	5
SIGCO-468	SIGCO	2	1	1	1	1	5	2
SIGCO-465A	SIGCO	3	4	3	1	4	4	2
SIGCO-475	SIGCO	2	1	4	2	1	3	1
SIGCO-4710	SIGCO	3	1	4	1	3	4	5
HYSUN-24	PAC.SEEDS	1	1	1	2	4	1	2
HYSUN-34	PAC.SEEDS	2	3	2	2	4	1	3
HYSUN-44	PAC.SEEDS	4	3	1	1	3	1	3
HYSUN-54	PAC.SEEDS	2	3	1	2	3	1	3
PAC-3054	PAC.SEEDS	4	4	2	1	4	3	1
SUNKING-256	NK-FRA	3	3	1	3	3	3	3
PH ARAON	NK-FRA	3	3	4	2	3	1	3
SUNBRED-277	NK-FRA	1	1	1	2	3	1	4
SUNBRED-281	NK-FRA	2	1	4	1	3	3	3
SUNBRED-285	NK-FRA	2	3	1	3	4	3	1
MARYFLOR	RUSTICA	1	1	2	1	3	3	5
EUROFLOR	RUSTICA	5	3	1	1	3	3	3
TOPF LOR	RUSTICA	4	3	1	1	4	1	3
MIKAFLOR	RUSTICA	2	3	1	1	3	3	1
VERAFLOR	RUSTICA	3	4	2	1	3	3	3
AGSUN-110	AG-SEED	3	3	2	1	3	3	4
AGSUN-230	AG-SEED	5	1	1	1	3	5	3
AGSUN-210DW	AG-SEED	3	3	4	1	3	5	5
SUNCROSS-40R	AG-SEED	1	3	1	1	3	1	3
SUNCROSS-60	AG-SEED	1	3	1	2	3	1	3
CITOSOL-3	C.R.I.-HUN	3	4	3	1	4	4	3
CITOSOL-4	C.R.I.-HUN	3	4	1	1	4	4	3
VIKI	C.R.I.-HUN	3	3	2	1	3	1	3
BLUMIX	C.R.I.-HUN	1	3	2	1	1	1	3
VIGOR	C.R.I.-HUN	2	3	2	1	1	4	1

Hybrid	Comp.	Seed yield (t/ha)	Oil conc.	Prot. conc.	Mass 1000 seeds	Vol. weight	Husk cont.	Auto. poll.
MAXIFLOR	RUSTICA	2	3	2	1	1	4	1
RUSTIFLOR	RUSTICA	2	4	2	2	3	1	2
CERFLOR	RUSTICA	2	1	1	2	3	1	2
ARIFLOR	RUSTICA	3	3	1	1	4	1	3
FLORICA	RUSTICA	1	3	2	2	3	1	1
DKS-39	DEKALB	3	4	1	2	4	3	1
G-100	DEKALB	2	3	4	2	3	4	2
DK-4020	DEKALB	2	3	1	2	4	1	2
DKS-37	DEKALB	3	3	3	1	3	1	1
FLORAKISZ	DEKALB	1	3	1	2	3	3	3
IS-3107	CRIADEROSPS	3	3	1	2	3	3	1
SPS-3130	CRIADERO SPS	1	1	2	3	3	1	1
SPS-3160	CRIADERO SPS	1	3	4	5	3	1	3
SPS-3094	CRIADERO SPS	4	4	2	1	4	3	4
SPS-7115	CRIADERO SPS	3	4	2	2	4	3	1
CON TIFLOR-3	CONTINENTAL	1	4	1	3	3	4	2
CONTIFLOR-7	CONTINENTAL	1	4	3	3	3	4	1
CONTIFLOR-8	CONTINENTAL	2	3	3	2	4	1	1
CONTIFLOR-9	CONTINENTAL	2	4	5	1	4	3	2
P-86	CONTINENTAL	4	4	4	2	4	3	3
OD-105	VSGI	1	3	2	1	4	4	3
OD-106	VSGI	3	4	2	2	4	3	5
OD-122	VSGI	4	4	2	1	4	3	1
OD-123	VSGI	5	1	2	2	3	5	2
OD-126	VSGI	5	1	2	1	1	5	2
SUNWHEAT-102	SEEDTEC	4	2	5	2	4	4	1
ST-314	SEEDTEC	5	3	1	1	3	1	2
ST-335	SEEDTEC	3	3	1	2	3	1	2
ST-349	SEEDTEC	1	3	1	3	3	3	2
ST-330	SEEDTEC	2	3	3	1	3	3	1
T-548	TRIUMPH	3	3	4	2	3	1	3
T-557DW	TRIUMPH	4	3	1	1	4	1	5
T-560A	TRIUMPH	5	1	4	2	1	1	1
T-565	TRIUMPH	5	1	1	2	1	1	2
T-575	TRIUMPH	3	3	2	3	3	1	1
VYP	KOIPESOL	3	3	1	1	3	1	3
TESORO-92	KOIPESOL	3	3	2	1	3	3	5
FLORIDA-2000	KOIPESOL	2	3	1	2	3	1	2
EMANO	ESP. de CULT	4	3	1	2	3	3	5
MONRO-45	ESP. de CULT	1	1	1	2	1	1	2
TOLEDO-55	ESP. de CULT	3	4	1	1	4	1	2
TOLEDO-2	ESP. de CULT	2	3	1	2	3	3	3
IS-33142	VAN DER HAVE	1	1	1	1	3	5	3
IS-33231	VAN DER HAVE	1	1	4	2	4	5	3
IS-61074	VAN DER HAVE	1	1	2	2	3	3	3
DOBRITCH	IWS-BGR	1	3	3	3	4	3	1
SUPER	IWS-BGR	5	3	2	3	4	3	1
START	IWS-BGR	5	3	1	3	1	3	3
ALBENA	ICCPT	1	1	3	3	3	5	5
RO-1418	ICCPT	1	1	1	5	3	5	5
RO-1390	ICCPT	1	1	3	3	3	5	2
RO-1155	ICCPT	1	1	2	3	1	5	5
RO-924	ICCPT	5	1	1	2	1	5	5

Hybrid	Comp.	Seed yield (t/ha)	Oil conc.	Prot. conc.	Mass 1000 seeds	Vol. weigh t	Husk cont.	Auto. poll.
FLOROM-328	ICCPT	1	1	4	2	3	5	1
SUN-M-20	AGR.CAN.RES.	5	4	3	5	4	4	3
SF-100	CARGILL-USA	2	4	2	2	1	3	4
SF-102	CARGILL-USA	1	1	2	2	1	1	1
ADVANCE	CARGILL-AUS	3	3	2	2	3	3	2
CANNON	CARGILL-AUS	3	3	3	1	1	1	2
DYNAMITE	CARGILL-AUS	2	3	1	2	1	1	2
S-407	CARGILL-ARG	1	1	2	3	1	1	3
S-405	CARGILL-ARG	3	4	4	3	3	4	2
S-430	CARGILL-ARG	3	4	4	3	3	4	2
S-530	CARGILL-ARG	3	4	4	2	3	5	2
GIRAFLOR	SEMILLAS PAC	3	1	2	2	3	1	3
GIRAPAC	SEMILLAS PAC	3	3	4	1	1	1	2
ALHAMA-EXTRA	SEMILLAS PAC	3	1	1	2	3	5	2
SH-31	SEMILLAS PAC	3	1	1	1	3	5	3
SH-3322	SEMILLAS PAC	2	1	2	3	1	5	3
SH -3822	SEMILLAS PAC	3	3	1	3	3	1	3
SH-3622	SEMILLAS PAC	1	1	4	3	1	1	1
FRANKASOL	CARGILL-FRA	2	4	3	3	1	3	3
ALPHASOL	CARGILL-FRA	2	1	2	2	1	1	2
MIRASOL	CARGILL-FRA	3	4	2	1	3	3	2
CARGISOL	CARGILL-FRA	3	1	1	2	1	5	2
PARDISOL	CARGILL-FRA	1	3	3	2	2	3	2
FLORA SOL	CARGILL-ESP	2	3	1	2	1	5	3
RIOSOL	CARGILL-ESP	2	3	1	2	3	3	1
OROSOL	CARGILL-ESP	3	1	1	2	3	5	1
IS-7111	IS-USA	2	3	2	2	3	5	5
IS-33025	IS-USA	2	3	4	1	3	1	3
ISOMAX	IS-USA	2	3	1	3	3	3	2
IS-32025	IS-USA	2	3	4	3	3	5	5
HYSUN-354	CONTISEED	3	3	4	2	3	4	4
SUN BIRD	CONTISEED	5	4	4	5	1	4	4
HYSUN-340	CONTISEED	2	3	2	2	4	1	5
POCIN	VNIIMK	2	4	3	2	1	1	5
OML-58	VNIIM K	1	1	3	2	3	5	1
OML-17	VNIIMK	4	4	3	2	4	1	1
M-701	MORGAN-ARG	1	3	2	3	1	1	3
M-702	MORGAN-ARG	3	3	1	1	1	5	2
M-731	MORGAN-ARG	2	1	4	2	3	1	3
M-732	MORGAN-ARG	1	3	1	2	1	1	3
M-733	MORGAN-ARG	5	1	1	3	1	1	3
HYSUN-32	NICKERSON	2	3	1	1	1	5	2
HYSUN-33	NICKERSON	5	3	1	3	1	1	3
OS-325	OS-YUG	2	4	2	2	1	4	5
OS-393	OS-YUG	2	3	3	3	3	1	1
ELIA	C.S.T.	3	3	2	2	3	1	2
VEGA	C.S.T.	2	3	4	2	1	5	3
GUADALSUR	C.S.T.	3	5	1	4	5	2	2
PINTO	C.S.T.	2	4	1	1	3	3	2
RODEO	C. S.T.	2	4	4	1	3	3	2
HNK-81	IREG.INST.	5	3	4	5	1	3	1
IBH-166	IREG.INST.	5	3	1	3	4	3	2
BARBARA	IREG.INST.	3	4	2	1	3	3	3

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RÉSULTATS D'UN ESSAI INTERNATIONAL D'HYBRIDES DE TOURNESOL II. LE RENDEMENT ET SES COMPOSANTS

RESUME

L'objet de l'expérience est un ensemble de 154 hybrides de tournesol developpés par des institus de recherches et des firmes semencières internationales et destinés aux conditions agroécologiques d'Europe, d'Amérique, d'Australie, d'Asie et d'Afrique. Les hybrides ont été testés pour les caractères suivants: rendement en grain, teneur en huile et en protéine, poids de 1000 grains, poids volumique, pourcentage de coque et autogamie. Les méthodes statistiques incluent l'analyse de regroupement avec la distance euclidienne traitée comme une distance métrique. Les hybrides sont uniformément distribués dans les cinq groupes lorsque l'on considère le rendement en grain, la teneur en protéine, le pourcentage de coque et l'autogamie. Lorsque l'on considère la teneur en huile et le poids volumique, plus de 98% des hybrides testés se regroupent en trois ensembles districts.

RESULTADOS DE ENSAYOS INTERNACIONALES CON HIBRIDOS DE GIRASOL II. RENDIMIENTO Y SUS COMPONENTES

RESUMEN

El experimento estuvo constituido por 154 híbridos de girasol desarrollados por institutos de investigación y empresas internacionales de Mejora, y se llevó a cabo en las condiciones agroecológicas de Europa, América, Asia y Africa. Los híbridos fueron testados para los siguientes caracteres: rendemiento en grano, concentración de aceite y proteina, peso de 100 semillas, peso específico, porcentaje de cáscara y polinización autógama. Los cálculos estadísticos incluyeron análisis "cluster" con distancia euclidea tratada como distancia métrica. Los híbridos fueron distribuidos uniformemente en los cinco "clusters" en relación a rendimiento en semilla, concentración de proteina, porcentaje de cáscara y polinización autógama. En relación a concentración de aceite y peso específico mas del 98% de los híbridos ensayados se agruparon en tres grupos distintos.