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INTERNATIONAL TRIALS WITH SUNFLOWER HYBRIDS (THE NINTH CYCLE, 1992 – 1993)

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SUMMARY

The experiments of the ninth international cycle were conducted by 11 governmental research institutions or private companies from 9 countries covering the main sunflower cropping area in Europe and North America.

A great variation with respect to the environmental adaptability, genetic yield potential and oil content was registered in the ninth biennial cycle, of international trials with sunflower hybrids.

An important group of hybrids exhibited a satisfactory stability over a multitude of locations in both experimental years, while certain hybrids were better differentiated only within limited areas. A good behaviour was shown by the hybrids HOGGAR, P–6541 PIONN, SANKARA and HU–GKI–43.

INTRODUCTION

The subnetwork on the experimentation of sunflower in international trials (one of the subnetworks of the F. A. O. Research Network on Sunflower) has already completed the ninth biennial cycle, 1992 – 1993.

The results of the previous cycles were published in Helia Bulletin.

The experiments of the ninth international cycle were conducted by 11 governmental research institutions or private companies from 9 countries covering the main sunflower cropping area in Europe and North America. The names of the participants who provided scientific results are listed in Annex 1.

MATERIAL AND METHODS

The twenty-one sunflower hybrid cultivars tested under twelve ecological conditions originated from Bulgaria, France, Hungary, Romania, Yugoslavia, Turkey and U. S. A., representing the recent achievements of sunflower breeders from these countries.

The 1992 experimentation was conducted in 12 locations. Due to a delay in shipping seed samples, the 1993 experimentation was conducted in 9 locations only.

The recommended experimental design was the complete randomized blocks in 5 replications.

The plot size was so established that after discarding two marginal rows and frontal plants in each row, a minimum number of 80 plants per plot be harvested. Cultural practices were adapted to local conditions.

The plant populations ranged from 40 to 60 thousand plants per hectare, with the inferior limit under dry land conditions and higher levels under irrigation. Most trials were conducted in dry land.

The experimental results were interpreted using the variance analysis for seed yield, oil content and oil yield.

In 1992, experiments were conducted in 12 locations, in 1993 only in 9 locations. In both years not all hybrids were experimentated with in all locations. The missing data were replaced by the location average. In this case the error due to the missing data has a lower value, and the influence to the general result is low. The interpretation of data was difficult also because the locations are different in latitude (eg., North Dakota, U. S.A., Egypt, Turkey, France). The interaction with environment was very significant, because the length of vegetation period was different in different locations. Even in the same conditions (eg., Toulouse area), the sowing at different times made possible to escape a disease (*Phomopsis helianthi*).

In such situation variation coefficients gave better information on stability of the analyzed characters and the homogeneity of results in one location.

The general results were also affected by broomrape (*Orobanche cumana* Wallr.) in Turkey and *Phomopsis helianthi* in some areas in France, Yugoslavia and Romania.

RESULTS AND DISCUSSION

The 1992 season was characterized as a dry year, especially in Bulgaria, Yugoslavia, Romania. The results under French conditions were heavily affected by *Phomopsis*.

Regarding the values of C. V. for seed yield (6.3 – 7.7), the results from Fundulea – Romania, Szeged – Hungary, Toshevo – Bulgaria, Novi Sad – Yugoslavia, and Casselton N. D. – U. S. A. were quite homogeneous. The highest value for location average were at Fundulea with 39.4 q/ha, and the lowest in Mexico at Durango under dy conditions with 11.6 q/ha (Table 1). A very low average was registered in France near Toulouse by Rustica trial (17.1 q/ha) due to a very strong *Phomopsis* attack. In the same area (Lectoure), due to a late sowing, the attack was very weak.

In 1992 the highest value for seed yield was registered by HU – GKI – 43 with 29.1 q/ha in multilocation. The L. S. D. values 5% were 1.1 q/ha, so non-significant differences with X – 10326 – SANKARA and VOLTASOL were registered (Table 9).

As mentioned before, different factors affected in homogeneity of data in different locations (Table 7).

The C. V. value in Sakha – Egypt was 21.1, and near Toulouse in Rustica's trial 23.2. The reasons were drought and heat in the first case and the *Phomopsis* attack in the second. Coming back to the stability of yield (Table 1) the lowest values of C. V. for seed yield were registered by SANKARA (29.2) and the highest by NSH – 170 (42.7).

The oil content was less affected by local conditions. The general L. S. D. 5% value (1.4 – Table 2) demonstrates a high homogeneity of results. The lowest value of C. V. presented X – 9210 (5.1%) and the highest P – 6451 (9.9%).

The oil average of different locations was different from 49.1 in Fundulea to 37.5 in Sakha Egypt. The heavy *Phomopsis* attack in Toulouse area affected the oil content.

The multilocation results for seed yield, oil content and oil yield (Tabe 3 and 9) demonstrated that HU – GKI – 43 with 14.2 q/ha was on first place and NSH – 170 on the last. The lowest C. V. (Table 8) for oil yield was registered by ISOSTAR (25.7), but the oil yield was lower than HU – GKI – 43. Taking into consideration the C. V. values, a good behaviour was presented also by SANKARA (26.6) and AZUR (27.1).

The 1993 season was not too different from 1992. A strong *Phomopsis* attack registered in France, Romania, Yugoslavia and Hungary were affected by drought and heat at the end of the vegetation period.

The results presented in Tables 4, 8 and 9, demonstrate that Fundulea, Szeged, Novi Sad and Lectoure were similary on average. The lowest value for seed yield C. V. was registered by ALBENA and the highest by ISEO. The highest value for seed yield was registered by SANKARA (29.6 q/h) an the lowest by AZUR (23.0 q/ha).

Oil content was affected also in 1993 by *Phomopsis* attacks, drought and heath (Table 5). The C. V. values for oil content evidenced that the hybrids ISOSTAR and ISEO had low values (6.2 and 6.1, respectively). Concerning oil yield in 1993 (Table 6, 8 and 9), the best results were obtained by the hybrid HOGGAR with 13.8 q/ha, as well as DOMINO and HU – GKI – 43 with 13.5 and 13.3 q/ha, respectively.

The two-year multilocation results for seed yield, oil content and oil yield (Table 10) placed the hybrid HOGGAR in the first place for oil yield, P – 6541 Pionn. for oil content, and SANKARA for seed yield.

The performance of a hybrid (seed yield and oil yield) is closely related with the length of the period flowering – physiological maturity. In Table 11 and Graph 1, the relation between the two mentioned characters is presented. A positive nonsignificant correlation of r=+0.33 between the length of flowering - phisiological maturity and seed yield has been found. The coefficient was not statistically significant, but was close to the requested value.

The hybrid HOGGAR demonstrated the longest period (41 days), a shorter periods were registered for SANKARA and HU – GKI – 43, with 36.4 and 31.9 days, respectively.

CONCLUSION

A great variation with respect to the environmental adaptability, genetic yield potential and oil content was registered in the ninth biennial cycle of international trials with sunflower hybrids.

An important group of hybrids exhibited a satisfactory stability over a multitude of locations in both experimental years, while certain hybrids were better differentiated only within limited areas. A good behaviour was shown by the hybrids HOGGAR, SANKARA and HU – GKI – 43.

ENSAYOS INTERNACIONALES CON HIBRIDOS DE GIRASOL (NOVENO CICLO 1992-1993)

RESUMEN

La experimentación del noveno ciclo fue llevada a cabo por 11 instituciones gubernamentales de investigación o compañías privadas de nueve paises cubriendo las principales áreas de cultivo de girasol de Europa y Norteamérica.

Una gran variación con respecto a la adaptabilidad ambiental, rendimiento potencial y contenido de aceite fue encontrada en el noveno ciclo bianual de ensayos internacionales con híbridos de girasol.

Un importante grupo de hibridos mostraron una estabilidad satisfactoria sobre una multitud de localidades en ambos años de experimentación, mientras que ciertos híbridos estuvieron mejor diferenciados solo dentro de áreas limitadas.

Los híbridos HOGGAR, PG541, PIONN, SANKARA y HUGKI-43 presentaron un buen comportamiento.

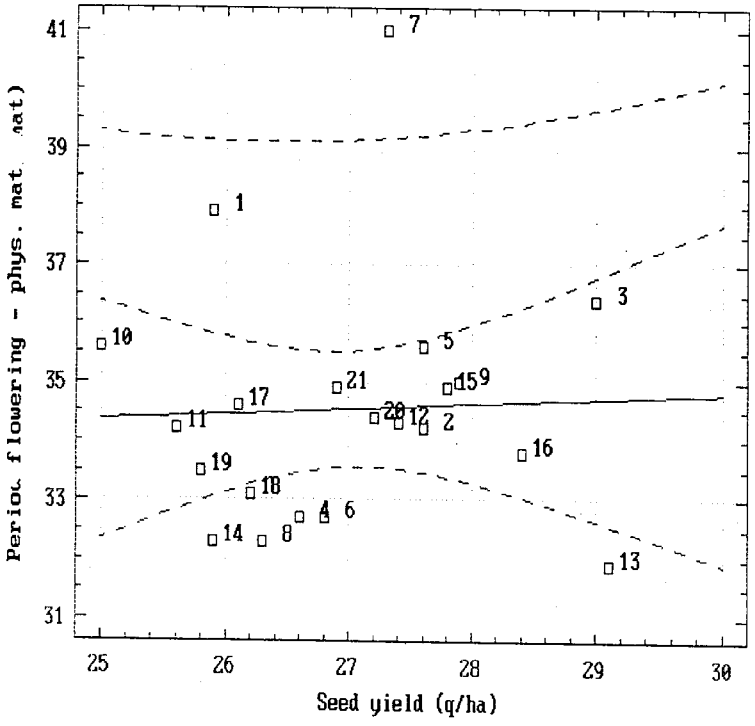
ESSAIS INTERNATIONAUX D'HYBRIDES DE TOURNESOL (9 IEME CYCLE 1992-1993)

RÉSUMÉ

L'expérimentation du 9* cycle d'essais internationaux d'hybrides de tournesol a été conduite par 11 instituts de recherche publics ou compagnies privées appartenant à 9 pays couvrant la zone principale de culture en Europe et en Amérique du Nord.

Un variation importante pour l'adaptation au milieu, le potentiel génétique de rendement, la teneur en huile a été observé au cours du 9ième cycle biennal d'essais internationaux d'hybrides de tournesol.

Un groupe important d'hybrides a révélé une stabilité satisfaisante sur un grand nombre de lieux durant les deux années d'expérimentation. Certains hybrides étaient mieux séparés seulement dans un nombre réduit de zones. Les hybrides HOGGAR, P6541, PIONN, SANKARA et HUGKI-43 ont présenté un bon comportement.



Graph 1 Correlation between seed yield (q/ha) and period flowering – phys. mat. (days)

1. HB-9201
2. X-9210-NK-Hilleshog
3. X-10326-Sankara-NK-Hil.
4. P-6451-Pionn.
5. Euroflor Rustica
6. Malabar Rustica
7. Hoggar Rustica
8. Bambo Verneuil-GKI
9. Albena PR. Genetique
10. Azur PR. Genetique
11. NS-H-170
12. NS-H-240
13. HU-GKI-43
14. HU-GKI-55
15. TR-129
16. Voltasol Cargill
17. Isostar
18. Iseo
19. Domino
20. Decor
21. RO-1934

Table 1. F.A.O. trial seed yield (q/ha) 1992

No.	Hybrid	Fundu-lea Romania	Szeged Hungary	Sakha Egypt	Boul-bone Pepi, Rust. France	Gen. Toshevo Bulgaria	Novi Sad Yugo-slavia	Edirne Turkey	Pom-pignan NK-France	Lec-toure VDH-France	Cassel-ton ND-U. S. A	Durango Prig. Mexico	Durango Rainfed Mexico	Ave-rage hyb.	L.S.D. 5%	C.V. %
1	HB-9201-Bulgaria	40.1	35.8	15.0	16.4	32.7	26.1	17.0	21.1	26.3	34.3	31.6	13.9	25.9	8.7	33.5
2	X-9210-NK-France	42.8	35.8	20.0	17.1	35.7	28.2	26.3	19.9	34.4	35.4	29.6	7.6	27.6	9.5	34.3
3	X-10326-Sankara-NK-Hil. Fr.	39.5	36.7	15.0	25.7	34.2	28.2	23.1	30.0	36.4	34.4	34.0	11.2	29.0	8.5	29.2
4	P-6451-Pionn.-France	40.1	34.2	15.0	17.5	28.7	28.2	19.0	21.1	34.5	34.2	33.6	19.9	26.6	8.7	32.7
5	Euroflor Rustica-France	41.1	36.8	15.4	12.4	31.8	28.6	17.0	19.7	33.8	37.0	45.8	11.7	27.6	11.4	41.2
6	Malabar Rustica-France	39.2	34.4	14.8	13.2	31.5	29.1	14.9	23.7	39.4	34.3	37.5	10.2	26.8	10.5	39.1
7	Hoggar Rustica-France	40.8	37.2	13.2	15.7	32.1	30.7	19.6	22.0	36.5	34.1	34.9	11.4	27.3	9.9	36.2
8	Bambo Verneuil-GKI-Szeged	37.4	36.1	11.3	17.6	30.1	29.4	19.2	19.0	34.4	33.2	35.7	11.7	26.3	9.4	35.8
9	Albena PR. Genetique-Fr.	42.3	36.2	15.0	23.5	33.8	21.2	18.5	28.9	37.8	35.2	30.8	11.3	27.9	9.4	33.8
10	Azur PR. Genetique-France	32.7	29.8	15.0	16.2	29.3	28.4	17.5	21.1	34.6	28.3	35.5	11.3	25.0	8.0	31.9
11	NS-H-170 Novi Sad-Yu	40.3	34.2	9.4	13.9	30.6	28.2	11.2	20.0	34.2	35.7	36.6	12.5	25.6	11.0	42.7
12	NS-H-240 Novi Sad-Yu	40.9	35.9	12.0	17.2	31.9	28.7	18.1	21.3	35.8	35.8	39.2	13.5	27.4	9.9	36.3
13	HU-GKI-43 Szeged-Hungary	44.8	39.2	21.3	19.6	32.7	29.6	16.1	26.3	30.1	36.0	40.4	12.9	29.1	9.7	33.3
14	HU-GKI-55 Szeged-Hungary	36.5	36.2	13.4	17.5	30.8	28.7	14.0	21.1	31.6	33.1	37.1	10.3	25.9	9.5	36.9
15	TR-129 Turkey	40.2	39.2	16.3	21.6	28.3	27.5	18.7	21.9	37.5	29.9	43.5	9.4	27.8	10.2	36.8
16	Voltasol Cargill-France	38.7	38.5	18.4	11.0	35.7	25.0	21.8	22.4	39.0	37.8	40.7	11.5	28.4	10.8	38.0
17	Isostar Coop de Pau-France	33.5	31.4	20.1	17.0	28.6	26.7	18.2	20.7	36.6	32.5	36.5	11.6	26.1	8.0	30.7
18	Iseo Coop de Pau-France	33.3	34.0	17.2	17.1	24.8	30.6	18.2	20.0	35.5	35.7	36.5	11.6	26.2	8.6	33.0
19	Domino-Romania	41.4	33.4	10.3	9.9	32.0	30.5	15.6	18.4	34.3	34.9	35.6	13.5	25.8	10.8	42.1
20	Decor-Romania	40.8	34.4	15.9	15.2	31.5	30.8	17.3	21.1	34.8	31.8	37.7	11.9	27.2	9.7	35.8
21	RO-1934-Romania	40.4	34.6	10.6	23.9	29.8	28.5	20.1	25.0	34.4	30.3	34.1	11.1	26.9	8.9	33.0
Average loc.		39.4	35.4	15.0	17.1	31.2	28.2	18.2	21.1	34.8	34.1	36.5	11.6	27.0		
L.S.D. 5%		3.0	2.2	3.2	4.8	2.1	2.1	3.5	3.2	2.9	2.2	2.8	1.4	1.1		3.51
C.V. %		7.7	6.3	21.2	23.2	7.6	7.6	17.1	14.1	8.2	6.6	10.5	12.2	4.0		

Table 2. F.A.O. trial 1992 oil content %

No.	Hybrid	Fundulea Romania	Szeged Hungary	Sakha Egypt	Gen. Toshevo Bulgaria	Novi Sad Yugoslavia	Pompignan NK-France	Edirne Turkey	Lectoure VDH-France	Casselton ND-U. S. A	Average hyb.	L. S. D. 5%	C. V. %
1	HB-9201-Bulgaria	51.7	49.7	37.5	43.9	43.9	46.0	47.2	43.3	47.1	45.6	3.9	8.5
2	X-9210-NK-Hilleshog-France	47.1	46.2	40.7	42.1	44.6	41.4	43.2	40.7	42.8	43.2	2.2	5.1
3	X-10326-NK-Hil. Fr.	46.9	45.2	37.5	42.4	44.6	43.7	48.0	44.6	41.2	43.8	3.0	6.8
4	P-6451-Pionn.-France (XF-417)	53.0	53.8	37.5	43.6	44.6	48.2	47.2	44.7	47.9	46.9	4.7	9.9
5	Euroflor Rustica-France	48.8	49.4	41.0	45.6	43.4	49.7	46.4	43.2	44.9	45.8	2.5	5.6
6	Malabar Rustica-France	47.4	48.9	38.2	43.3	42.8	48.0	47.8	42.3	42.8	44.6	3.4	7.6
7	Hoggar Rustica-France	52.3	51.4	38.8	42.4	49.1	42.7	49.4	43.6	46.8	46.2	4.4	9.4
8	Bambo Verneuil-GKI-Szeged	47.4	48.8	39.3	41.6	45.5	43.6	47.3	44.0	46.6	44.9	2.9	6.4
9	Albena PR. Genetique-Fr.	49.5	47.9	37.5	41.0	42.5	43.3	47.5	41.5	43.2	43.8	3.6	8.3
10	Azur PR. Genetique-France	48.3	48.1	37.5	42.7	45.2	44.8	47.2	43.8	45.0	44.7	3.1	7.0
11	NS-H-170 Novi Sad-Yugosl.	44.4	43.9	40.7	40.6	37.1	39.4	43.6	41.2	42.4	41.5	2.2	5.4
12	NS-H-240 Novi Sad-Yugosl.	46.1	43.6	40.4	42.9	40.8	39.0	44.7	40.5	39.8	42.0	2.3	5.5
13	HU-GKI-43 Szeged-Hungary	50.0	50.0	38.7	41.5	47.2	40.3	50.3	44.3	47.1	45.5	4.2	9.3
14	HU-GKI-55 Szeged-Hungary	48.1	49.1	38.7	41.4	45.4	42.7	47.3	43.3	44.1	44.5	3.2	7.1
15	TR-129 Turkey	47.9	46.7	40.9	39.6	41.8	41.1	47.1	42.5	42.0	43.3	2.9	6.7
16	Voltasol Cargill-France	48.1	48.1	40.3	40.8	43.7	37.6	45.8	42.9	44.7	43.6	3.4	7.8
17	Isostar Coop de Pau-France	50.7	47.6	40.5	41.5	46.6	43.8	48.7	45.9	45.6	45.6	3.1	6.8
18	Iseo Coop de Pau-France	46.4	48.5	38.2	39.2	45.7	43.8	45.0	44.2	45.5	44.1	3.1	7.1
19	Domino-Romania	51.9	50.0	39.6	42.3	48.2	47.1	48.3	45.0	46.5	46.5	3.6	7.7
20	Decor-Romania	52.4	51.6	40.4	45.3	48.3	39.1	47.3	44.6	47.2	46.7	4.4	9.4
21	RO-1934-Romania	52.1	52.1	41.8	42.1	45.8	45.2	51.8	43.3	47.9	45.0	4.0	8.9
Average loc.		49.1	48.6	37.5	42.2	44.6	43.8	47.2	43.3	44.8	44.7		
L.S.D. 5%		2.4	2.5	1.4	1.6	2.7	3.2	2.0	1.4	2.3	1.4		1.4
C.V. %		4.9	5.2	3.7	3.7	6.0	7.3	4.2	3.3	5.1	3.4		

Table 3. F. A. O. trial oil yield (q/ha) 1992

No.	Hybrid	Fundulea Romania	Szeged Hungary	Sakha Egypt	Gen. Toshevo Bulgaria	Novi Sad Yugoslavia	Edirne Turkey	Pompignan NK-France	Lectoure VDH-France	Casselton ND U. S. A	Average hyb.	L. S. D. 5%	C. V. %
1	HB-9201-Bulgaria	20.7	17.8	5.6	14.3	11.4	7.8	10.0	11.4	16.2	12.8	4.6	35.8
2	X-9210-NK-France	20.2	16.6	8.2	14.2	12.6	10.9	8.6	14.0	15.2	13.4	3.6	27.0
3	X-10326-Sankara-NK-Hil. Fr.	18.5	16.6	5.6	14.5	12.6	10.1	14.4	16.2	14.2	13.7	3.6	26.6
4	P-6451-Pionn.-France	21.3	18.4	5.6	12.5	12.6	9.2	10.0	15.4	16.4	13.5	4.6	34.2
5	Euroflor Rustica-France	20.1	18.2	6.3	14.5	12.4	8.5	9.2	14.6	16.6	13.4	4.4	32.9
6	Malabar Rustica-France	18.6	16.8	5.7	13.6	12.4	7.2	11.3	16.7	14.7	13.0	4.1	31.8
7	Hoggar Rustica-France	21.3	19.1	5.1	13.6	15.1	8.4	10.8	15.9	15.9	13.9	4.8	34.7
8	Bambo Verneuil-GKI-Szeged	17.7	17.6	4.5	12.5	13.4	8.4	9.0	15.2	15.5	12.6	4.3	33.8
9	Albena PR. Genetique-Fr.	20.9	17.3	5.6	13.9	9.0	8.0	13.7	15.7	15.2	13.3	4.6	34.6
10	Azur PR. Genetique-France	15.8	14.4	5.6	12.5	12.8	7.9	10.0	15.2	12.7	11.9	3.2	27.1
11	NS-H-170 Novi Sad-Yugosl.	17.9	15.0	3.8	12.4	10.5	4.4	8.7	14.1	15.2	11.3	4.6	40.7
12	NS-H-240 Novi Sad-Yugosl.	18.9	15.6	4.9	13.7	11.7	7.1	9.5	14.5	13.4	12.1	4.1	33.9
13	HU-GKI-43 Szeged-Hungary	22.4	19.6	8.3	13.6	14.0	6.5	13.2	13.3	16.9	14.2	4.7	33.3
14	HU-GKI-55 Szeged-Hungary	17.6	17.8	5.2	12.8	13.0	6.0	10.0	13.7	14.6	12.3	4.2	34.5
15	TR-129 Turkey	19.3	18.3	6.7	11.2	11.5	7.7	10.3	15.9	12.6	12.6	4.2	33.0
16	Voltasol Cargill-France	18.6	18.5	7.4	14.5	10.9	8.2	10.3	16.8	16.9	13.6	4.2	30.7
17	Isostar Coop de Pau-France	17.0	14.9	8.2	11.9	12.5	8.0	10.1	16.8	14.8	12.7	3.3	25.7
18	Iseo Coop de Pau-France	15.5	16.5	6.6	9.7	14.0	8.0	9.0	15.7	16.3	12.4	3.8	30.4
19	Domino-Romania	21.5	16.7	4.1	13.5	14.7	7.4	8.9	15.4	16.2	13.2	5.1	38.7
20	Decor-Romania	21.4	17.7	6.4	14.3	14.9	6.8	10.0	15.5	16.4	13.7	4.8	34.6
21	RO-1934-Romania	21.1	18.0	4.4	12.5	13.1	9.1	12.9	14.9	14.5	13.4	4.5	33.7
Average loc.		19.3	17.2	5.9	13.2	12.6	7.9	10.5	15.1	15.3	13.0		
L.S.D. 5%		1.9	1.4	1.3	1.2	1.5	1.4	1.7	1.3	1.3	0.7		4.17
C.V. %		9.9	7.9	2.2	9.1	11.5	17.2	15.9	8.4	8.2	5.4		

Table 4. F. A. O. trial seed yield (q/ha) 1993

No.	Hybrid	Fundulea Romania	Szeged Hungary	N.K. Hilleshog France	Lectoure VDH France	Edirne Turkey	Novi Sad Yugoslavia	Levignac Rustica France	Casselton ND U. S. A	Durango Mexico	Average hyb.	L. S. D. 5%	C. V. %
1	HB-9201-Bulgaria	28.3	28.2	24.7	36.4	8.1	31.7	21.8	26.9	26.9	24.9	7.8	31.4
2	X-9210-NK-France	33.0	26.8	22.4	32.9	10.4	31.5	20.0	29.9	29.9	27.6	7.4	26.9
3	X-10326-Sankara-NK-Hil. Fr.	29.2	30.1	28.9	42.5	11.1	31.5	24.2	25.1	25.1	29.6	8.4	28.3
4	P-6451-Pionn.-France	32.1	32.9	24.7	34.9	8.1	31.5	21.8	23.5	23.5	25.3	8.2	32.3
5	Euroflor Rustica-France	33.7	30.1	28.4	24.9	7.2	30.3	24.9	22.4	22.4	24.7	7.3	29.7
6	Malabar Rustica-France	35.3	32.9	28.1	35.6	5.9	27.6	24.2	21.9	21.9	25.6	8.8	34.5
7	Hoggar Rustica-France	36.2	30.3	27.1	34.0	8.3	35.6	24.4	27.5	27.5	29.5	8.7	29.6
8	Bambo Verneuil-GKI-Szeged	32.1	30.5	24.7	28.8	8.1	33.6	21.8	25.1	25.1	24.4	7.9	32.5
9	Albena PR. Genetique-Fr.	34.1	28.0	24.7	33.5	8.1	24.6	21.8	28.0	28.0	25.1	6.9	27.4
10	Azur PR. Genetique-France	25.8	30.7	24.7	27.4	8.1	29.6	21.8	21.7	21.7	23.0	6.6	28.5
11	NS-H-170 Novi Sad-Yugosl.	35.4	31.3	24.7	29.5	8.1	33.0	21.8	26.9	26.9	25.2	8.3	32.8
12	NS-H-240 Novi Sad-Yugosl.	32.1	28.3	24.7	32.5	8.1	34.2	21.8	26.1	26.1	25.1	7.8	31.1
13	HU-GKI-43 Szeged-Hungary	35.5	32.5	25.4	32.1	5.6	31.8	23.6	28.6	28.6	26.0	8.7	33.4
14	HU-GKI-55 Szeged-Hungary	32.2	28.7	23.0	28.3	6.7	32.5	20.6	25.0	25.0	24.0	7.6	31.6
15	Trakya-129 Turkey	29.7	33.3	16.5	30.3	8.7	28.3	24.5	22.9	22.9	23.5	7.5	32.0
16	Voltasol Cargill-France	30.4	32.5	24.9	35.7	7.5	29.6	20.9	25.4	25.4	25.5	7.8	30.5
17	Isostar Coop de Pau-France	30.2	32.0	23.2	30.0	9.7	31.8	14.6	26.6	26.6	23.3	8.5	36.4
18	Iseo Coop de Pau-France	28.5	26.4	24.4	32.7	8.2	34.2	16.9	27.7	27.7	23.3	8.8	37.9
19	Domino-Romania	33.5	32.0	24.7	35.9	8.1	32.8	21.8	26.5	26.5	25.9	8.5	32.7
20	Decor-Romania	34.7	32.8	24.7	31.4	8.1	33.1	21.8	25.1	25.1	25.5	8.2	32.3
21	RO-1934-Romania	31.2	29.5	24.7	33.5	8.1	32.3	21.8	26.3	26.3	25.0	7.7	30.9
Average loc.		32.1	30.5	24.7	32.5	8.1	31.5	21.8	25.7	25.7	25.3		
L.S.D. 5%		2.7	2.1	2.5	3.7	1.2	2.4	2.4	2.2	2.2	1.7		2.7
C.V. %		8.4	6.8	9.9	11.5	14.8	7.8	11.2	8.5	8.5	6.7		

Table 5. F. A. O. trial oil content (1993)

No.	Hybrid	Fundulea Romania	Szeged Hungary	N.K. Hilleshog France	Lectoure VDH France	Edirne Turkey	Novi Sad Yugoslavia	Levignac Rustica France	Casselton ND-U. S. A	Average hyb.	L. S. D. 5%	C. V. %
1	HB-9201-Bulgaria	45.6	49.5	49.2	51.5	41.5	46.0	52.2	45.9	47.7	3.3	7.0
2	X-9210-NK-France	41.1	49.6	45.7	48.5	37.3	45.7	50.4	42.1	45.1	4.3	9.5
3	X-10326-Sankara-NK-Hil. Fr.	39.5	44.2	48.2	48.4	42.8	45.7	51.9	43.4	45.5	3.6	8.0
4	P-6451-Pionn.-France	46.2	54.1	49.2	55.3	41.5	45.7	52.2	47.0	48.9	4.4	9.0
5	Euroflor Rustica-France	46.5	47.3	50.1	51.3	43.5	45.9	51.6	42.1	47.3	3.3	6.9
6	Malabar Rustica-France	45.4	49.7	48.2	49.9	41.8	43.2	51.4	38.7	46.0	4.2	9.1
7	Hoggar Rustica-France	50.2	52.9	51.7	52.9	39.1	50.2	53.2	44.6	49.4	4.7	9.4
8	Bambo Verneuil-GKI-Szeged	46.2	49.4	49.2	53.2	41.5	45.1	52.2	44.1	47.6	3.8	8.0
9	Albena PR. Genetique-Fr.	47.6	49.9	49.2	49.1	41.5	42.9	52.2	43.5	47.0	3.6	7.7
10	Azur PR. Genetique-France	46.7	50.8	49.2	51.1	41.5	45.4	52.2	43.3	47.5	3.7	7.8
11	NS-H-170 Novi Sad-Yugosl.	39.5	43.8	49.2	46.6	41.5	40.5	52.2	37.5	43.9	4.8	10.9
12	NS-H-240 Novi Sad-Yugosl.	46.2	46.0	49.2	48.2	41.5	43.0	52.2	39.0	45.7	4.0	8.9
13	HU-GKI-43 Szeged-Hungary	48.3	50.8	50.9	52.9	42.8	46.9	54.5	44.9	49.0	3.7	7.7
14	HU-GKI-55 Szeged-Hungary	45.9	50.0	50.3	52.1	39.3	46.5	53.5	43.6	47.7	4.4	9.3
15	TR-129 Turkey	45.1	46.5	45.7	49.0	41.4	42.4	52.9	42.2	45.7	3.6	7.9
16	Voltasol Cargill-France	45.4	48.5	48.9	51.1	42.4	43.7	51.8	43.6	46.9	3.4	7.2
17	Isostar Coop de Pau-France	49.7	50.3	51.2	52.1	43.3	46.7	51.7	45.4	48.8	3.0	6.2
18	Iseo Coop de Pau-France	47.4	49.2	50.1	51.5	43.3	47.0	51.5	44.1	48.0	2.9	6.1
19	Domino-Romania	50.0	53.2	49.2	51.7	41.5	50.0	52.2	44.6	49.0	3.8	7.7
20	Decor-Romania	48.7	50.3	49.2	51.8	41.5	49.7	52.2	43.9	48.4	3.5	7.3
21	RO-1934-Romania	48.8	52.7	49.2	53.7	41.5	47.3	52.2	45.7	48.9	3.8	7.8
Average loc.		46.2	49.4	49.2	51.0	41.5	45.7	52.2	43.3	47.3		
L.S.D. 5%		3.0	2.7	1.4	2.1	1.4	2.5	0.8	2.3	1.5		1.2
C.V. %		6.4	5.4	2.9	4.1	3.4	5.4	1.6	5.4	3.1		

Table 6. F. A. O. trial oil yield (q/ha) 1993

No.	Hybrid	Fundulea Romania	Szeged Hungary	N.K. Hilleshog France	Lectoure VDH-France	Edirne Turkey	Novi Sad Yugoslavia	Levignac Rustica France	Casselton ND-U. S. A	Average hyb.	L. S. D. 5%	C. V. %
1	HB-9201-Bulgaria	12.9	14.0	12.2	18.8	3.4	14.6	11.4	12.4	12.5	4.0	32.3
2	X-9210-NK-France	13.6	13.0	10.2	16.0	3.9	14.4	10.1	12.6	11.7	3.5	29.8
3	X-10326-Sankara-NK-Hil. Fr.	11.5	13.3	14.0	20.6	4.8	14.4	12.6	10.9	12.8	4.1	32.0
4	P-6451-Pionn.-France	14.8	17.8	12.2	19.3	3.4	14.4	11.4	11.0	13.0	4.6	35.2
5	Euroflor Rustica-France	15.7	14.6	14.2	12.8	3.1	13.9	12.9	9.4	12.1	3.8	31.5
6	Malabar Rustica-France	16.0	16.3	13.6	17.8	2.5	11.9	13.0	8.5	12.5	4.6	37.2
7	Hoggar Rustica-France	18.2	16.1	14.0	18.0	3.3	17.9	13.0	10.0	13.8	4.8	34.8
8	Bambo Verneuil-GKI-Szeged	14.8	15.0	12.2	15.3	3.4	15.2	11.4	11.1	12.3	3.7	30.5
9	Albena PR. Genetique-Fr.	16.2	14.0	12.2	16.5	3.4	10.6	11.4	12.2	12.1	3.8	31.8
10	Azur PR. Genetique-France	12.1	15.6	12.2	14.0	3.4	13.4	11.4	9.4	11.4	3.5	30.6
11	NS-H-170 Novi Sad-Yugosl.	14.0	13.7	12.2	13.8	3.4	13.4	11.4	10.1	11.5	3.3	28.9
12	NS-H-240 Novi Sad-Yugosl.	14.8	13.0	12.2	15.7	3.4	15.0	11.4	10.2	12.0	3.7	30.8
13	HU-GKI-43 Szeged-Hungary	17.2	16.5	12.9	17.0	2.4	14.9	12.9	12.9	13.3	4.5	33.7
14	HU-GKI-55 Szeged-Hungary	14.8	14.4	11.6	14.7	2.6	15.1	11.0	10.1	11.8	3.9	33.3
15	TR-129 Turkey	13.4	15.5	7.5	15.8	3.6	12.0	13.0	9.7	11.3	3.9	34.6
16	Voltasol Cargill-France	13.8	15.8	12.2	18.2	3.2	12.9	10.8	11.1	12.3	4.1	33.5
17	Isostar Coop de Pau-France	15.0	16.3	11.9	15.6	4.2	14.9	7.6	11.7	12.2	4.0	32.9
18	Iseo Coop de Pau-France	13.5	13.0	12.2	16.9	3.5	16.1	8.7	12.2	12.0	4.0	33.3
19	Domino-Romania	16.8	17.0	12.2	18.6	3.4	16.4	11.4	11.8	13.5	4.6	34.0
20	Decor-Romania	16.9	16.5	12.2	16.3	3.4	16.5	11.4	11.0	13.0	4.3	33.3
21	RO-1934-Romania	15.2	13.0	12.2	18.1	3.4	15.3	11.4	12.0	12.6	4.0	32.1
Average loc.		14.8	15.0	12.2	16.6	3.4	14.4	11.4	11.0	12.4	,	
L.S.D. 5%		1.7	1.5	1.3	2.0	0.5	1.7	1.3	1.2	0.7		1.9
C.V. %		11.2	9.8	10.9	14.8	11.4	11.7	6.3	10.8	5.3	,	

Table 7. Location variation coefficient for seed yield, oil content and oil yield

Location	1992			1993		
	Seed yield	Oil content	Oil yield	Seed yield	Oil content	Oil yield
Fundulea – Romania	7.7	4.9	9.9	8.4	6.4	11.2
Szeged – Hungary	6.3	5.2	7.9	6.8	5.4	9.8
Sakha – Egypt	21.2	3.4	21.6	–	–	–
Boulbone Pepi, Rustica – France	23.2	–	–	11.2	1.6	6.3
General Toshevo – Bulgaria	7.6	3.7	9.1	–	–	–
Novi Sad – Yugoslavia	7.6	6.0	11.5	7.8	5.4	11.7
Edirne – Turkey	17.1	7.3	17.2	14.8	3.4	11.4
Pompignan N. K. Hilleshog – France	14.1	4.2	5.9	9.9	2.9	10.9
Lectoure V. D. H. – France	8.2	3.2	8.4	11.5	4.1	14.8
Casselton ND – U. S. A.	6.6	5.1	8.2	8.5	5.4	10.8
Durango Irig. – Mexico	10.5	–	–	–	–	–
Durango Dry. – Mexico	12.2	–	–	16.6	–	–

Table 8. Hybrids variation coefficient for seed yield, oil content and oil yield

No	Hybrid	1992			1993		
		Seed yield	Oil content	Oil yield	Seed yield	Oil content	Oil yield
1	HB-9201-Bulgaria	33.5	8.5	35.8	31.4	7.0	32.3
2	X-9210-NK-Hil.-France	34.3	5.1	27.0	26.9	9.5	29.8
3	X-10326-Sankara-NK-Hil. Fr.	29.2	6.8	26.6	28.3	8.0	32.0
4	P-6451-Pionn.-France	32.7	9.9	34.2	32.3	9.0	35.2
5	Euroflor Rustica-France	41.2	5.6	32.9	29.7	6.9	31.5
6	Malabar Rustica-France	39.1	7.6	31.8	34.5	9.1	37.2
7	Hoggar Rustica-France	36.2	9.4	34.7	29.6	9.4	34.8
8	Bambo Verneuil-GKI-Szeged	35.8	6.4	33.8	32.5	8.0	30.5
9	Albena PR. Genetique-Fr.	33.8	8.3	34.6	27.4	7.7	31.8
10	Azur PR. Genetique-France	31.9	7.0	27.1	28.5	7.8	30.6
11	NS-H-170 Novi Sad-Yugosl.	42.7	5.4	40.7	32.8	10.9	28.9
12	NS-H-240 Novi Sad-Yugosl.	36.3	5.5	33.9	31.1	8.9	30.8
13	HU-GKI-43 Szeged-Hungary	33.3	9.3	33.3	33.4	7.7	33.7
14	HU-GKI-55 Szeged-Hungary	36.3	7.1	34.5	31.6	9.3	33.3
15	TR-129 Turkey	36.8	6.7	33.0	32.0	7.9	34.6
16	Voltasol Cargill-France	38.0	7.8	30.7	30.5	7.2	33.5
17	Isostar Coop de Pau-France	30.7	6.8	25.7	36.4	6.2	32.9
18	Iseo Coop de Pau-France	33.0	7.1	30.4	37.9	6.1	33.3
19	Domino-Romania	42.1	7.7	38.7	32.7	7.7	34.0
20	Decor-Romania	35.8	9.4	34.6	32.3	7.3	33.3
21	RO-1934-Romania	33.0	8.9	33.7	30.9	7.8	32.1

Table 9. Multilocation results for seed yield, oil content and oil yield of sunflower hybrids F. A. O. trial 1992-1993

No	Hybrid	1992						1993					
		Seed yield q/ha	RK	Oil (%)	RK	Oil yield q/ha	RK	Seed yield q/ha	RK	Oil (%)	RK	Oil yield q/ha	RK
1	HB-9201-Bulgaria	25.9	18	45.6	7	12.8	13	24.9	14	47.7	10	12.5	8
2	X-9210-NK-France	27.6	7	43.2	19	13.4	7	27.6	3	45.1	20	11.7	18
3	X-10326-Sankara-NK-Hil. Fr.	29.0	2	43.8	16	13.7	4	29.6	1	45.5	19	12.8	6
4	P-6451-Pionn.-France	26.6	13	46.9	1	13.5	6	25.3	9	48.9	5	13.0	4
5	Euroflor Rustica-France	27.6	6	45.8	5	13.4	8	24.7	15	47.3	13	12.1	13
6	Malabar Rustica-France	26.8	12	44.6	12	13.0	12	25.6	6	46.0	16	12.5	9
7	Hoggar Rustica-France	27.3	9	46.2	4	13.9	2	29.5	2	49.4	1	13.8	1
8	Bambo Verneuil-GKI-Szeged	26.3	14	44.9	10	12.6	15	24.4	16	47.6	11	12.3	10
9	Albena PR. Genetique-Fr.	27.9	4	43.8	15	13.3	10	25.1	11	47.0	14	12.1	14
10	Azur PR. Genetique-France	25.0	21	44.7	11	11.9	20	23.0	21	47.5	12	11.4	20
11	NS-H-170 Novi Sad-Yugosl.	25.6	20	41.5	21	11.3	21	25.2	10	43.9	21	11.5	19
12	NS-H-240 Novi Sad-Yugosl.	27.4	8	42.0	20	12.1	19	25.1	12	45.7	18	12.0	16
13	HU-GKI-43 Szeged-Hungary	29.1	1	45.5	8	14.2	1	26.0	4	49.0	2	13.3	3
14	HU-GKI-55 Szeged-Hungary	25.9	17	44.5	13	12.3	18	24.0	17	47.7	9	11.8	17
15	TR-129 Turkey	27.8	5	43.3	18	12.6	16	23.5	18	45.7	17	11.3	21
16	Voltasol Cargill-France	28.4	3	43.6	17	13.6	5	25.5	8	46.9	15	12.3	11
17	Isostar Coop de Pau-France	26.1	16	45.6	6	12.7	14	23.3	19	48.8	6	12.2	12
18	Iseo Coop de Pau-France	26.2	15	44.1	14	12.4	17	23.3	20	48.0	8	12.0	15
19	Domino-Romania	25.8	19	46.5	3	13.2	11	25.9	5	49.0	3	13.5	2
20	Decor-Romania	27.2	10	46.7	2	13.7	3	25.5	7	48.4	7	13.0	5
21	RO-1934-Romania	26.9	11	45.0	9	13.4	9	25.0	13	48.9	4	12.6	7
L.S.D. 5%		1.1		1.5		0.7		1.7		1.5		0.7	

Table 10. Two years multilocation results for seed yield, oil content and oil yield of sunflower hybrids F.A.O. trial 1992-1993

No	Hybrid	Seed yield, q/ha	RK	Oil (%)	RK	Oil yield, q/ha	RK
1	HB-9201-Bulgaria	25.4	15	46.7	8	12.7	12
2	X-9210-NK-France	27.6	4	44.2	19	12.6	13
3	X-10326-Sankara-NK-Hil. Fr.	29.3	1	44.7	17	13.3	5
4	P-6451-Pionn.-France	26.0	12	47.9	1	13.3	6
5	Euroflor Rustica-France	26.2	9	46.6	9	12.8	9
6	Malabar Rustica-France	26.2	10	45.3	16	12.8	10
7	Hoggar Rustica-France	28.4	2	47.8	3	13.9	1
8	Bambo Verneuil-GKI-Szeged	25.4	16	46.3	10	12.5	14
9	Albena PR. Genetique-Fr.	26.5	6	45.4	14	12.7	11
10	Azur PR. Genetique-France	24.0	21	46.1	11	11.7	20
11	NS-H-170 Novi Sad-Yugosl.	25.4	17	42.7	21	11.4	21
12	NS-H-240 Novi Sad-Yugosl.	26.3	8	43.9	20	12.1	17
13	HU-GKI-43 Szeged-Hungary	27.6	3	47.3	5	13.8	2
14	HU-GKI-55 Szeged-Hungary	25.0	18	46.1	13	12.1	18
15	TR-129 Turkey	25.7	14	44.5	18	12.0	19
16	Voltasol Cargill-France	27.0	5	45.3	15	13.0	7
17	Isostar Coop de Pau – France	24.7	20	47.2	6	12.5	15
18	Iseo Coop de Pau – France	24.8	19	46.1	12	12.2	16
19	Domino-Romania	25.9	13	47.8	2	13.4	4
20	Decor-Romania	26.4	7	47.6	4	13.4	3
21	RO-1934-Romania	26.0	11	47.0	7	13.0	8
L.S.D. 5%		1.2		1.4		0.6	

Table 11. F.A.O. trial 1992 days to flowering and to phys. maturity

Nr. crt.	Hybrid	Fundulea Romania		Sakha Egypt		Boulbone PEPI - Rustica France	Szeged Hungary		Gen. Toshevo Bulgaria		Novi Sad Yugoslavia	
		Flw.	Mat.	Flw.	Mat.	Flw.	Flw.	Mat.	Flw.	Mat.	Flw.	Mat.
1	HB-9201-Bulgaria	71	110	53	93	87	68	114	73	114	83	134
2	X-9210-NK-France	71	106	55	93	87	68	110	74	115	92	134
3	X-10326-NK-Sankara-Hil. Fr.	70	109	53	93	87	68	113	73	116	92	134
4	P-6451-Pionn.-France (XF-417)	74	110	53	93	91	71	113	77	116	92	134
5	Euroflor Rustica-France	74	116	55	96	92	71	122	78	119	90	132
6	Malabar Rustica-France	77	117	56	96	95	76	119	78	117	96	132
7	Hoggar Rustica-France	74	111	52	91	89	69	112	75	114	85	133
8	Bambo Verneuil-GKI-Szeged	75	110	49	90	91	69	110	76	116	88	132
9	Albena PR. Genetique-Fr.	71	109	53	93	86	68	111	72	116	83	131
10	Azur PR. Genetique-France	72	118	53	93	90	70	113	74	119	88	134
11	NS-H-170 Novi Sad-Yugosl.	74	120	54	95	91	70	112	77	119	99	136
12	NS-H-240 Novi Sad-Yugosl.	74	120	53	96	91	70	112	74	118	96	136
13	HU-GKI-43 Szeged-Hungary	74	117	53	91	91	73	116	74	116	96	133
14	HU-GKI-55 Szeged-Hungary	74	112	53	94	91	71	111	74	114	91	135
15	TR-129 Turkey	72	116	54	97	89	69	113	72	116	88	136
16	Voltasol Cargill-France	71	111	51	92	89	71	115	72	114	96	133
17	Isostar Coop de Pau V. D. Haave – France	71	111	55	93	89	73	115	72	115	90	136
18	Iseo Coop de Pau V. D. Haave – France	74	110	51	90	89	72	114	72	115	96	134
19	Domino-Romania	74	112	51	91	89	71	115	74	117	96	136
20	Decor-Romania	74	115	54	97	93	75	118	75	116	99	136
21	RO-1934-Romania	71	112	51	93	87	68	112	73	114	88	132
Average loc.		73	113	53	93	90	70	114	74	116	92	134

Table 11. F.A.O. trial 1992 days to flowering and to phys. maturity (continued)

Nr. crt.	Hybrid	Edirne Turkey		Pompignan NK-Fr.	Casselton ND U. S. A		Durango Dry. Mex.	Mex. Irrig.	Average days		
		Flw.	Mat.	Flw.	Flw.	Mat.	Flw.	Flw.	Flw.	Mat.	Flw. mat
1	HB-9201-Bulgaria	62	97	84	71	117	82	94	75.4	110.3	37.9
2	X-9210-NK-France	61	94	85	79	117	80	90	75.6	109.8	45.2
3	X-10326-NK-Sankara-Hil. Fr.	62	106	86	68	120	88	96	76.6	113.0	36.4
4	P-6451-Pionn.-France (XF-417)	67	106	84	73	119	99	102	80.3	113.0	32.7
5	Euroflor Rustica-France	69	111	92	74	122	95	104	81.3	116.9	35.6
6	Malabar Rustica-France	73	113	95	76	123	96	106	84.0	116.7	32.7
7	Hoggar Rustica-France	63	97	85	72	119	87	91	76.5	117.5	41.0
8	Bambo Verneuil-GKI-Szeged	68	104	91	73	119	94	97	79.2	111.5	32.3
9	Albena PR. Genetique-Fr.	62	96	84	69	117	94	92	75.8	110.8	35.0
10	Azur PR. Genetique-France	68	104	84	71	122	93	107	79.1	114.7	35.6
11	NS-H-170 Novi Sad-Yugosl.	68	102	90	76	125	96	101	81.4	115.6	34.2
12	NS-H-240 Novi Sad-Yugosl.	68	102	92	73	125	97	106	81.3	115.6	34.3
13	HU-GKI-43 Szeged-Hungary	68	100	92	73	118	95	103	81.1	113.0	31.9
14	HU-GKI-55 Szeged-Hungary	75	104	84	74	120	95	99	80.0	112.9	32.3
15	TR-129 Turkey	68	104	89	71	121	98	108	79.8	114.7	34.9
16	Voltasol Cargill-France	62	96	88	72	121	89	96	77.9	111.7	33.8
17	Isostar Coop de Pau V. D. Haave – France	67	103	88	70	120	92	99	78.7	113.5	34.6
18	Iseo Coop de Pau V. D. Haave – France	67	103	89	72	122	92	99	79.4	112.5	33.1
19	Domino-Romania	68	106	89	74	120	83	93	78.4	113.9	33.5
20	Decor-Romania	72	111	84	76	123	95	106	82.1	116.5	34.4
21	RO-1934-Romania	62	97	86	72	122	88	99	76.8	111.7	34.9
Average loc.		67	103	84	72	121	92	99	79.1	113.6	34.7,

ANNEX 1

List of participants in F. A. O. co-operative trial (1992 – 1993)

Country	Name and address	Exp. year
BULGARIA	Ventislav Venkov – Institute for Wheat and Sunflower Dobrudja. Near General Toshevo	1992
EGYPT	Badr A Elahmar – Agric. Research Center, F. C. R. I Oil Crops Res. Section F. C. R. I. – A. R. C.	1992
FRANCE	Michel Rollier, Rh. Saux, René Auroux – Rustica Semences Domaine de Sandreau 31700 Mondonville. Fax 33.61.06.10.95	1992 1993
FRANCE	Luka Cuk-Hilleshög-12 Chemin de l'Hobit B. P. 27, 31790 Sait-Sauveur. Fax: 33.61.09.57.37.	1992 1993
FRANCE	Ernst Vrancken, Van der Haave – Station de Recherche Domaine de la Revanche 32700 Lectoure Fax 33.62.28.61.65	1992 1993
HUNGARY	Frank Josef-Gabonatermestesi Kutatö Intezet Cereal Research Instute, P. O. Box 6727 H-6701 Szeged Fax 36.62.434.163	1992 1993
MEXICO	Daniel Gomez Sanchez – Instituto Nacional de Investigaciones Forestales y Agropecuarias Durango Km.5 Durango – El Mezquital Apdo Postal 186.34000 Durango	1992 1993
ROMANIA	Alex. V. Vrânceanu – Research Institute for Cereals and Industrial Crops Fundulea 8264 – Călărași Fax 40.1 311.07.22	1992 1993
TURKEY	Ahmet Bülbül-Thrace Agricultural Research Institute. P.O. Box 16, 22100 Edirne, Fax 90 (284) 235 8210	1992 1993
USA	Jerry F. Miller - Northern Crop Science Laboratory P.O. Box 6577. State University Station Fargo. North Dakota 58.105	1992 1993
YUGOSLAVIA	Dragan Škorić, Miroslav Mihaljčević Institute of Field and Vegetable Crops. 21000 Novi Sad. M. Gorkog 30 Fax 00381.21.621212	1992 1993