

EVALUATION OF 26 SUNFLOWER CULTIVARS AT ISLAMABAD

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SUMMARY

Twenty six sunflower (*Helianthus annuus* L.) cultivars were evaluated at National Agricultural Research Centre, Islamabad. The trial was planted on March 3, July 23, and February 5, during 1984, 1985 and 1986, respectively. Data on seed yield, days to flower initiation, days to flower completion, plant height, head diameter and days to maturity were recorded. Simple correlations between all traits were worked out and direct effects of agronomic characters on seed yield from path coefficient analysis were calculated.

Two hybrids, NS-Condor from Yugoslavia and IH-173 from Hungary, were high yielding with average seed yield of 2374 and 2184 kg/ha, respectively. Days to flower initiation, days to flower completion and days to maturity ranged from 68.4 to 78.1, 73.3 to 85.0 and 96.8 to 109.7, respectively. Cultivars Triumph 570, Peredovik (an open-pollinated) and Citosol-F1, Citosol-4, and NS-Flower were taller than all other entries. Hybrid NK-212 was most consistent for plant height and head diameter.

All cultivars grew taller, took more days to flower and maturity and also gave higher yields in 1986 than both in 1984 and 1985. Variety x year interaction was highly significant for all the traits.

Days to flower initiation, days to flower completion and days to maturity were strongly and positively correlated with each other. Days to maturity showed significant and positive correlation with plant height. The only significant correlation with yield was that of head diameter.

Direct effects from path coefficient analysis indicated that head diameter had a strong and positive direct correlation with seed yield while days to flower completion had a strong but negative correlation with seed yield.

INTRODUCTION.

Sunflower as an oil crop was introduced in Pakistan during early 1960s and research work on it was initiated in 1964-65. Experimental and on-farm testing results have indicated that sunflower, in general, can be successfully grown in different parts of Pakistan. For commercial planting, seed of sunflower hybrids is imported and distributed by a government agency called Ghee Corporation of Pakistan (GCP). Since there is no established system of seed production of sunflower hybrids in the country GCP has to import seed of various hybrids from USA and Australia every year. Therefore, a need was felt to evaluate sunflower hybrids/cultivars from different countries to identify the best adapted and high yielding ones in the local environment.

Several studies conducted in the country (Raja and Khan, 1984) and abroad (Ehdaie, (undated); Sistachs and Leon, 1976; Leoni and Palmiori, 1981; Fereres et al., 1982; and Brigham and Young, 1984;) have indicated that the sunflower open-pollinated

varieties and hybrids exhibit significant differences in their yielding ability, maturity time and other important agronomical traits. This suggests that selection for well-adapted sunflower cultivars along with other desirable characteristics is possible.

Table 1. Means for seed yield and days to flower initiation of sunflower cultivars grown at NARC, Islamabad for three years, 1984, 1985 and 1986

S.No	Cultivar		Yield (kg/ha)				DFI			
			1984	1985	1986	Av.	1984	1985	1986	Av.
1.	NS-Condor	Romania	1597	1642	3883	2374	71	57	89	72.3
2.	IH-173	Hungary	1284	1884	3383	2184	72	56	91	73.0
3.	Cargill-207	USA	1306	1214	3733	2084	72	56	88	71.9
4.	Adalid-8	Spain	1208	1426	3591	2075	78	56	91	74.9
5.	Pacifik-308	Australia	1286	1377	3346	2003	77	57	97	70.0
6.	NS-Shine	Yugoslavia	1361	1666	2969	1999	66	56	86	69.3
7.	IH-51	USA	1639	1824	2527	1997	69	54	82	68.4
8.	NS-Flowers	USA	1410	1130	3414	1985	69	56	88	71.0
9.	NK-212	Yugoslavia	1438	1510	2970	1973	77	47	87	70.1
10.	Sigco-448	Australia	1264	1539	3104	1969	71	54	91	72.1
11.	NS-Helios	Romania	1319	1114	3463	1965	71	56	88	71.8
12.	Hysun-32	Hungary	1333	1495	2942	1923	74	57	96	75.7
13.	Hundulea-55	Romania	1089	1146	3495	1910	71	56	89	71.8
14.	IBH-160	Hungary	1272	1367	3056	1905	78	53	92	74.4
15.	Fundulea-56	Romania	875	1253	3566	1898	76	55	89	73.3
16.	Select	Romania	1333	890	3359	1861	70	55	87	70.9
17.	Super	Romania	1333	1054	3167	1851	70	56	88	71.4
18.	IS-7111	USA	1347	1480	2650	1825	74	54	83	70.2
19.	Citosol-F1	Hungary	1146	1053	3010	1736	71	56	95	74.0
20.	Florem-305	Romania	1278	1188	2572	1979	71	56	95	70.7
21.	Koflor-3	Hungary	889	1212	2782	1628	74	54	93	78.9
22.	Felix	Romania	861	874	3137	1624	71	55	88	71.4
23.	Citosol-4	Hungary	736	992	3120	1616	81	56	98	78.1
24.	Peredovik	Bulgaria	1083	1045	2180	1436	80	59	90	76.0
25.	HNO-617	Bulgaria	979	969	2256	1401	72	53	81	68.8
26.	Triumph-570	USA	811	849	2263	1308	80	54	93	75.4
LSD (5%)			629	NS	776	378	3.6	NS	3.0	2.1

DFI = Days to flower initiation.

NS = Non-significant.

Climate of most of the Pakistan is such that two main sunflower crops can easily be grown in a year, i.e., first crop is planted in the first fortnight of February (called spring crop), and second crop in the month of July (called autumn crop). Pakistan has an intensive agricultural system where mostly 250% cropping intensity is realized. Therefore, high yielding but short duration sunflower hybrids/varieties are required so that it can be adjusted in the existing cropping system without disturbing the main crops.

MATERIALS AND METHODS

Twenty six sunflower cultivars (25 hybrids and one open-pollinated variety) from different countries (Table 1) were grown at National Agricultural Research Centre (NARC), Islamabad, during 1984, 1985 and 1986. Islamabad is situated at the latitude 33 degrees 75 min. north and the longitude 73 degrees east having an altitude of 550 meters. The seeds of these cultivars were obtained from FAO Rome network and ICOPT, Fundulea, Romania.

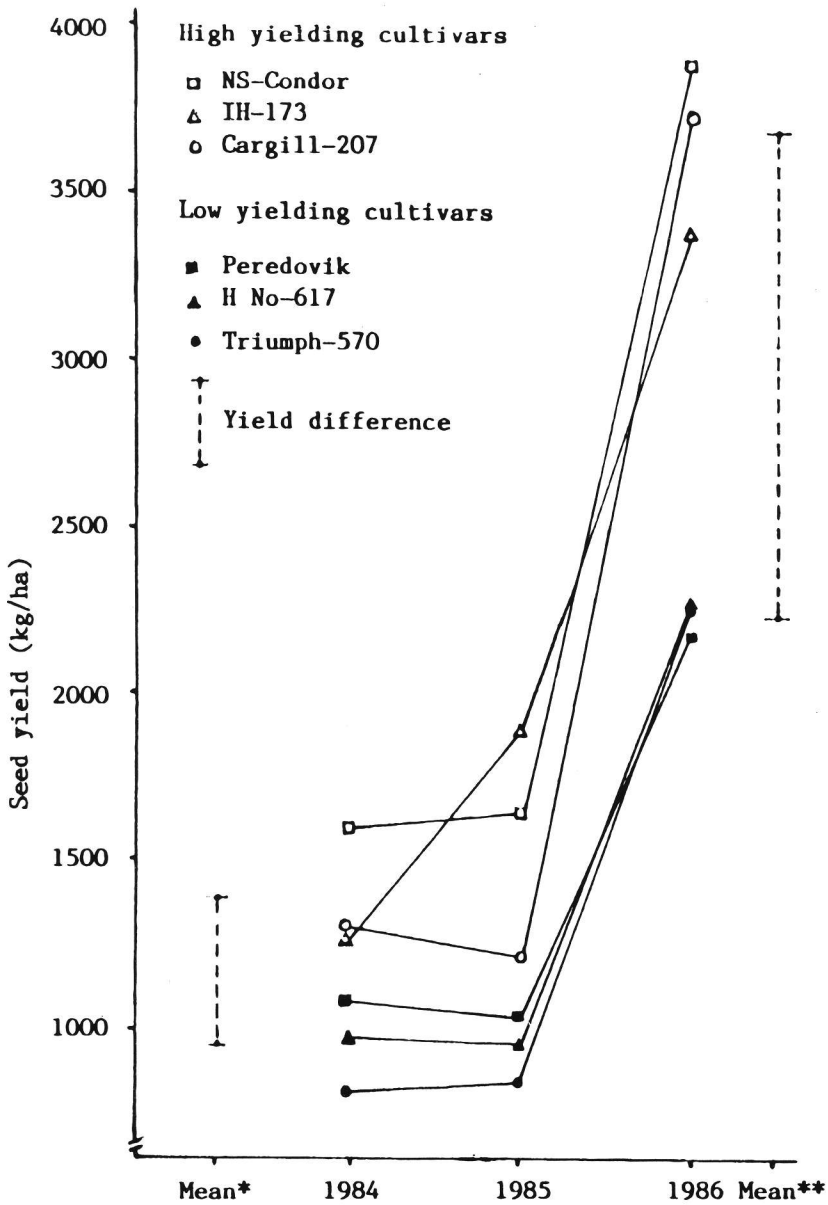


Fig. 1. Seed yield of three high yielding and three low yielding sunflower cultivars for each year and the difference in the yield during 1984 and 1986. Figure also depicts the variety x year interaction for seed yield.

* Mean of three low and three high yielding cultivars for 1984.

** Mean of three low and three high yielding cultivars for 1986.

The trials were planted on 6th March, 23rd July and 5th February during 1984, 1985 and 1986, respectively. Each trial was planted in a randomized complete block design with three replications. Plots were 5 meter long having 4 rows which were 75 cm apart. The plants were spaced at 20 to 25 cm apart, i.e., 80 to 100 plants per plot corresponding to 53,000 to 66,600 plants per hectare. Hybrid NK-212 was included in the trial as a check cultivar, seed of which was obtained from GCP.

The experiment during 1985 was completely rainfed while the trials of 1984 and 1986 were supplemented with one irrigation of about 8 cm to overcome the prolonged drought period at grain filling stage.

The experiments of 1984 received 75 kg of nitrogen and 40 kg of P_2O_5 per hectare all at seedbed preparation. During 1986 the fertilizer dose was increased to 100 kg/ha of

Table 2. Means for days to flower completion and days to maturity of sunflower cultivars grown at NARC, Islamabad for two years, 1985 and 1986

S.No.	Cultivar	Days to flower comp.			Days to maturity		
		1985	1986	Average	1985	1986	Average
1.	Ns-Condor	57	94	75.7	81	125	103.0
2.	IH-173	56	98	76.8	75	127	101.3
3.	Cargill-207	56	94	74.7	79	124	101.3
4.	Adalid-8	56	99	77.5	81	130	105.3
5.	Pacific-308	57	103	80.3	85	134	109.7
6.	NS-Shine	57	95	75.8	81	123	101.7
7.	IH-51	54	93	73.3	78	116	96.8
8.	NS-Flower	56	95	75.2	77	126	101.5
9.	NK-212	56	100	77.6	78	127	102.7
10.	Sigco-448	54	101	77.7	75	128	101.7
11.	NS-Helios	56	94	75.3	81	124	102.5
12.	Hysun-32	57	101	79.2	78	134	105.8
13.	Fundlea-55	57	96	75.7	77	126	101.7
14.	IBH-160	53	101	77.0	76	131	103.7
15.	Fundlea-56	55	96	75.3	77	126	101.5
16.	Select	55	95	75.0	79	125	102.2
17.	Super	56	98	77.2	77	128	102.5
18.	IS-7111	54	95	74.3	76	122	98.7
19.	Citasol-F1	61	101	81.0	77	130	102.0
20.	Florem-305	56	95	75.5	76	120	98.3
21.	Koflor-3	54	102	77.7	76	131	103.7
22.	Felix	55	94	74.5	83	125	104.3
23.	Citasol-4	56	109	82.3	78	136	106.7
24.	Peredovik	59	111	85.0	79	135	107.2
25.	HNO-617	53	95	74.2	77	119	98.0
26.	Triumph-570	54	103	78.2	78	134	106.3
LSD (5%)		3.3	3.1	3.1	2.6	2.7	1.9

N and 50 kg/ha of P_2O_5 . Nitrogen and P_2O_5 were applied in the form of urea and diammonium phosphate, respectively.

Data on days to flower initiation, days to flower completion, plant height, days to maturity, head diameter and seed yield were recorded. Date for flower initiation was noted when 5 percent plants started flowering and date for flower completion was noted when 95 percent plants flowered. All the traits including seed yield were recorded from two central rows. Statistical analyses were done by using randomized complete block design in two factorial factor in split configuration keeping years in main plots. Correlation coefficients were calculated using variety means over replications and years between all traits to determine the degree of association between a pair of traits. To find out direct effects of agronomic traits on the yield of sunflower, path coefficient analysis was also computed of which only direct effects (standard partial regression coefficients) are reported.

Table 3. Means for days to flower completion and days to maturity of sunflower cultivars grown at NARC, Islamabad for two years, 1985 and 1986

S.No.		Plant height (cm)				Head diameter (cm)			
		1984	1985	1986	Av.	1984	1985	1986	Av.
1.	Ns-Condor	141	146	187	157.9	18	16	19	17.9
2.	IH-173	146	93	170	136.4	12	15	20	15.7
3.	Cargill-207	152	110	171	144.6	13	12	19	14.6
4.	Adalid-8	121	108	155	128.2	15	15	20	16.8
5.	Pacific-308	116	129	176	140.4	17	16	19	17.4
6.	NS-Shine	91	142	177	136.7	15	15	18	16.0
7.	IH-51	129	102	144	124.8	16	16	19	16.8
8.	NS-Flower	125	110	195	143.2	16	12	19	15.9
9.	NK-212	171	162	180	171.0	16	17	17	16.7
10.	Sigco-448	133	103	179	138.2	13	14	19	15.2
11.	NS-Helios	124	122	181	142.3	14	14	18	15.4
12.	Hysun-32	120	102	196	139.3	16	13	19	16.2
13.	Fundlea-55	134	104	158	132.2	13	12	20	15.4
14.	IBH-160	154	113	196	154.3	14	12	17	14.5
15.	Fundlea-56	145	96	150	130.0	13	12	21	15.1
16.	Select	132	108	158	132.8	15	13	19	15.5
17.	Super	121	139	167	142.3	13	13	20	15.4
18.	IS-7111	164	104	157	141.7	18	13	19	16.9
19.	Citasol-F1	122	109	200	143.8	17	13	21	17.0
20.	Florem-305	140	110	156	135.0	16	13	20	16.5
21.	Koflor-3	143	101	174	139.6	16	12	22	16.8
22.	Felix	146	108	163	138.9	21	13	17	13.8
23.	Citasol-4	158	104	193	151.9	13	12	20	14.8
24.	Peredovik	136	127	207	156.4	13	14	17	14.5
25.	HNO-617	131	105	153	129.9	15	13	18	15.1
26.	Triumph-570	131	113	207	150.2	14	14	19	15.6
	LSD (5%)	29	12	17	12.1	3.6	2.8	2.7	1.9

RESULTS AND DISCUSSION

The mean data over three years of the 26 cultivars for different characteristics studied, i.e., seed yield, days to flower initiation (DFI), days to flower completion (DFC), plant height (PH), head diameter (HD) and days to maturity (DM), are presented along with their country of origin in Tables 1, 2 and 3.

Seed yield: Cultivar yield means differed significantly and are given in Table 1 in descending order. Two hybrids, NS-Condor from Yugoslavia and IH-173 from Hungary, produced the highest yields of 2374 and 2184 kg/ha, respectively. Four other hybrids, viz., Cargill-207, Adalid-8, Pacific-308 and NS-Shine which did not differ significantly from the two top yielding ones are from USA, Spain, Australia and Yugoslavia, respectively.

NK-212 is grown on commercial scale in Pakistan and is considered the check hybrid. It yielded 1972 kg/ha and falls in the medium yielding group of cultivars and the over-all average seed yield ranged from 1308 to 2374 kg/ha. Six hybrids, Florem-305, Koflor-3, Felix, Citosol-4, Hno-617 and Triumph-570, and one open-pollinated variety, Peredovik, yielded poorly and fall in the lowest yielding group.

Annual means for seed yield for three years differed from each other significantly (Table 2). Higher yield in 1986 can be attributed to the response of cultivars to the high doses of fertilizer application (see Materials and Methods), prolonged rainfall in spring season and mild temperatures which extended the growth period in 1986. It is interesting to note (Fig.1) that high yielding cultivars, NS-Condor, IH-173 and Cargill-207, responded more to increased doses of fertilizer and favourable climatic conditions than the low yielding cultivars, Peredovik, HNO-617 and Triumph-570.

Seed yield of sunflower cultivars ranged from 2180 to 3883, 849 to 1883 and 811 to 1639 kg/ha during 1986, 1985 and 1984, respectively. Yields of 1986 were encouraging and indicated that very good yields of sunflower can be obtained by applying optimum inputs in a good year.

Variety x year interaction was significant and is clearly visible in Figure 1. This as well as significant year x variety interaction pointed out that there is a need to select different hybrids/varieties for sowing in autumn and spring seasons or cultivars with stability in yield over the seasons and years can be selected.

Days to flower initiation, days to flower completion and days to maturity. Sunflower cultivars differed significantly for DFI, DFC and DM. A considerable range of variability was observed for these traits. DFI, DFC and DM exhibited ranges from 68.4 to 78.1, 73.3 to 85.0 and 96.8 to 109.7, respectively (Tables 1 and 2). These characters are critical and important for recommending the cultivars for general cultivation in the country and the difference of even six days will be of great significance in selecting a cultivar because it will ensure the timely sowing of the succeeding crop.

IH-51, HNO-617, Florem-305 and IS-7111 are early maturing hybrids. IH-51 belongs to medium yielding group and rest of the three are low yielding cultivars. Among the high yielding hybrids, IH-173, Cargill-207 and NS-Shine are comparatively of early maturity. Whereas Adalid-8 and Pacific-308 are late and very late cultivars respectively, thus can not be recommended for planting in the country.

Annual means for DFI, DFC and DM differed significantly (Table 4). The spring crops of 1984 and 1986 took considerably more days (73.3 and 89.4, respectively) for

flower initiation than the autumn crop of 1985 (55.1) because the temperature during early growth period (February to April) was low which helped in prolonging the vegetative growth. The spring crop of 1986 was planted earlier, i.e., on 5th February, therefore, it enjoyed an even longer period of low temperature than the spring crop of 1985 (planted on 3rd March), thus took many more days for flower initiation than the 1985 crop. For the same reason the spring crop of 1986 took more days (127.1) to mature than the autumn crop of 1985 which took only 78.3 days to mature.

Variety x year interactions for DFI, DFC and DM were highly significant. Hybrid IH-173 was the earliest to flower (took 75 days with the range of 75-85) in autumn 1985 but medium in maturity in spring 1986 (took 127 days with the range of 116-136). Some other cultivars such as IH-51 and Cargill-207 were consistent in their behaviour over years in all three traits.

Plant height. The cultivars differed significantly for plant height, on average (Table 3). The mean height for three years ranged from 124.8 cm to 171.0 cm and the range of means of each year, collectively, was 91 cm to 207 cm. On average for three years the tallest hybrid was NK-212 (171.0 cm) and the shortest hybrid was IH-51 (124.8 cm). However, data for individual years indicated that NK-212 was of a medium height while some others such as Triumph-570, Peredovik, Citosol-F1, Citosol-4, NS-Flower, IBH-160 and Hysun-32 were taller having the height of 207, 207, 200, 193, 195, 196 and 196 cm, respectively, during 1986. NK-212 behaved consistently for height while other cultivars exhibited differential heights over three years.

In general, the cultivars were taller during 1986 and shorter during 1985 (Table 4). In 1985 the experiment was planted on 23rd of July and the growth period (July, August and September) was very hot which enhanced the reproductive phase and maturity and resulted in shorter plant heights.

Table 4. Behaviour of agronomic characters in different years, 1984 to 1986, at NARC, Islamabad

Characteristic	1984	1985	1986	LSD at 5%
Yield (kg/ha)	1211.5	1276.7	3074.5	124.2
DFI	73.3	55.1	89.4	0.7
DFC	—	55.7	98.4	2.5
Plant height (cm)	135.6	114.2	175.1	4.1
Head diameter (cm)	14.7	13.6	19.2	0.6
Days to maturity	—	78.3	127.1	2.0

Variety x year interaction for plant height was also highly significant. The cultivars were shorter in 1985 than in 1984 but tallest during 1986. However, there were some exceptions to this general trend. Hybrids such as NS-Condor, Pacific-308, NS-Shine and Super were taller in 1985 than in 1984, whereas NS-Helios, NS-Flower, Citosol-F1 and Peredovik exhibited almost the same height in 1985 and in 1984. Most consistent entry among the 26 cultivars for height was NK-212 which was 171, 162 and 180 cm tall during 1984, 1985 and 1986, respectively.

Head diameter. The means of three years for head diameter ranged from 13.8 to 17.9 cm (Table 3). The cultivars differed highly significantly for head diameter from each other. The highest seed yielding hybrid NS-Condor also exhibited the highest average diameter

(17.9 cm). Other high yielding hybrids Adalid-8, Bcitic-308 and NS-shine also had large head diameters of 16.8, 17.4 and 16.0, respectively. Felix, Peredovik and IBH-160 on average had small heads, 13.8, 14.5 and 14.5, respectively.

During 1986, cultivars in general had bigger heads (19.2 cm) and during 1984 the smallest heads (Table 4) and differed significantly from each other. The range of means for head diameter during the three years was from 12 to 22 cm.

Variety x year interaction was highly significant showing differential response of cultivars during the three years, however, NK-212 was most consistent hybrid for this trial and had 16, 17, and 17 cm head size during 1984, 1985 and 1986, respectively.

Relationship among different characters. A correlation coefficient matrix between different agronomic characters is given in Table 5. As expected, days to flower initiation, days to flower completion and days to maturity were strongly and positively correlated with each other. Days to maturity was significantly and positively correlated with plant height indicating that taller plants matured late. Head diameter was significantly and positively correlated with seed yield which is quite logical, i.e., the bigger head size the more seeds and thus the higher yield. These results agree with those obtained by Venturi et al. (1981). All other traits, DFI, DFC, PH and DM, showed negative correlation with yield but these correlations were small and non-significant. These results are in partial agreement with those of Venturi et al. (1981).

Table 5. Correlation coefficients between different agronomic characters of sunflower grown during three years at NARC, Islamabad

Variable	DFI	DFC	PH	HD	DM
	----- (+) -----				
DFC	0.797**				
PH	0.283				
HD	-0.059	-0.026	0.460*		
DM	0.857**	0.732**	0.408*	-0.075	
Yield	-0.180	-0.319	-0.033	0.397*	-0.134

* Significant at 5% level

** Significant at 1% level

+ Correlations are calculated from the means of three years.

DFI = days to flower initiation; DFC = days to flower completion,

PH = plant height; HD = head diameter; DM = days to maturity.

Direct effects (standard partial regression coefficients) calculated from path analysis are given in Table 6. Direct effects from path coefficient analysis indicate more important and realistic relationship between two traits which usually remain hidden in the correlation coefficients. Direct effects indicate that days to flower completion had a strong negative correlation with seed yield. It indicated that the cultivars which took more days to flower completion (i.e., have prolonged flowering period) were low yielding. Head diameter had a strong positive correlation with seed yield, i.e., cultivars with bigger head gave higher seed yield. Direct effects of seed yield with DFI, PH and DM were positive but very small.

It is clear that hybrids which are higher yielding and earlier than NK-212 in the environment of Islamabad, can be obtained. Among those Hybrid IH-51 would be a better choice in places where other crops such as wheat have to follow immediately after the sunflower crop but where the next crop will be sown in spring or summer and land has to remain fallow for few months NS-Condor, IH-173 and Cargill-207 will be a good choice.

Table 6. Direct effects (from path analysis) of different agronomic traits on the seed yield of sunflower

Agronomic Traits	Direct effect on yield*
Days to flower initiation	0.175
Days to flower completion	-0.615
Plant height	0.141
Head diameter	0.402
Days to maturity	0.139

*Standard partial regression coefficient.

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EVALUATION DE VINGT SIX CULTIVARS DE TOURNESOL A ISMALABAD.

RÉSUMÉ:

Vingt six cultivars de tournesol (*Helianthus annuus* L.) ont été testés au Centre National de Recherche Agricole à Islamabad. L'essai a été semé le 3 mars, 3 juillet et 5 février respectivement en 1984, 1985 et 1986. Les paramètres suivants ont été enregistrés: rendement en grain, nombre de jours à l'initiation florale, nombre de jours à la fin floraison, hauteur des plantes, diamètre des capitules et nombre de jours à la maturité. Des corrélations simples ont été déterminées entre tous ces paramètres et les effets directs des caractères agronomiques sur le rendement en grain ont été calculés à partir de l'analyse des "path coefficients".

Deux hybrides, NS Condor (Yougoslavie) et IH-173 (Hongrie) ont eu un rendement en grain élevé avec respectivement 2374 et 2184 kg/ha. Le nombre de jours à l'initiation florale, à la fin floraison et à la maturité ont varié respectivement de 68,4 à 78,1 jours, de 73,3 à 85,0 jours et 96,8 à 109,7 jours. Les cultivars Triumph-570, Peredovik (population à pollinisation libre), Cytosol F-1, Cytosol-4 et NS-Flower avaient une hauteur supérieure à tous les autres cultivars. L'hybride NK-212 était le plus constant pour la hauteur des plantes et le diamètre des capitules.

Tous les cultivars les plus hauts ont nécessité un nombre de jours plus important pour la floraison, la maturité, ils ont donné également les plus meilleurs rendements aussi bien en 1984, 1985 qu'en 1986.

L'interaction années x variétés était hautement significative pour tous les paramètres.

Les nombres de jours à l'initiation florale, à la floraison et à la maturité étaient fortement et positivement corrélés les uns aux autres. Le nombre de jours à la maturité est caractérisé par une corrélation positive et significative avec la hauteur des plantes. La seule corrélation positive avec le rendement concernait le diamètre du capitule. Les effets directs, d'après l'analyse du path coefficient, ont indiqué avec le rendement en grain et le nombre de jours à fin floraison est fortement mais négativement corrélé avec le rendement en grain.

EVALUACION DE 26 CULTIVARES DE GIRASOL EN ISLABAMAD

RESUMEN

Veinte y seis cultivares de girasol (*Helianthus annuus* L.) fueron evaluados en el Centro Nacional de Investigación Agraria en Islabamad. El ensayo se sembró en Marzo 3, Julio 23 y Febrero 5 durante 1984, 1985 y 1986 respectivamente. Datos sobre rendimiento, días a iniciación y finalización de la floración, altura de la planta, diámetro del capítulo y días a maduración fueron determinados. Se calculó la correlación simple entre todos los caracteres así como los efectos directos de caracteres agronómicos sobre el rendimiento utilizando el análisis de los coeficientes de sendero.

Dos híbridos, NS-Condor de Yugoslavia y IH-173 de Hungría fueron los más altos en rendimiento con medias de rendimiento de 2374 y 2184 Kg/Ha respectivamente. Los días a inicio y finalización de la floración y días a maduración variaron entre 68.4 y 78.1, 73.3 y 85.0 y 96.8 y 109.7 respectivamente. Los cultivares Triumph 570, Peredovick (una variedad de polinización libre) y Citosol-F1, Citosol-4 y NS-Flower fueron más altos que todas las demás entradas. El híbrido NK-212 fue más consistente para altura de planta y diámetro del capítulo.

Todos los cultivares mostraron más altura, y más días a floración, maduración y dieron también rendimientos más altos en 1986 que en ambos, 1984 y 1985. La interacción variedad x año fue altamente significativa para todos los caracteres.

Los días a iniciar y finalización de la floración y maduración, tuvieron una alta y positiva correlación entre ellos. Los días a maduración mostraron una alta y positiva correlación con la altura de la planta. La única correlación significativa con el rendimiento fue el diámetro del capítulo.

Los efectos directos del análisis del coeficiente de sendero indicaron que el diámetro del capítulo que estuvo correlacionado de forma directa y positiva con el rendimiento en semilla y días hasta el final de la floración estuvo fuertemente correlacionado pero negativamente con el rendimiento en semilla.