

GENETIC VARIABILITY STUDY IN SUNFLOWER INBREDS

Sujatha, H.L., Chikkadevaiah* and Nandini

University of Agricultural Sciences, GKVK, Bangalore 560065, India

*Received: January 10, 2001
Accepted: September 18, 2002*

SUMMARY

The analysis of variance of 51 inbreds and 3 checks revealed significant differences for all 15 characters studied. The range of variation was maximum for percent autogamy followed by plant height and oil yield, while it was lowest in the case of days to 50 percent flowering and stem girth. The magnitude of variation was maximum for oil yield, 100-seed weight, head diameter, percent autogamy, husk percentage, seed density, plant height, seed test weight and oil content. Except for oil content, all other characters studied were least affected by environment showing a close correspondence between phenotypic co-variance (PCV) and genotypic co-variance (GCV). High heritability estimates were obtained for all the characters studied except for oil content, the value of which was moderate. High heritability coupled with the high genetic advance was recorded for plant height, percent autogamy, percent seed set and yield per plant. High heritability along with low genetic advance was observed for the number of leaves per plant, head diameter, stem girth, days to 50 percent flowering, 100-seed weight and oil yield, suggesting that these characters cannot be effectively improved by selection.

Key words: genetic variability, genetic advance, heritability

INTRODUCTION

The development of an effective plant breeding program is dependent upon the existence of genetic variability. Hence, an insight into the magnitude of variability present in a gene pool of a crop species is of utmost importance to plant breeder for starting a judicious plant breeding program. The coefficients of variation expressed at phenotypic and genotypic levels are used to compare the variability observed among different characters. A wide range of variation has been reported for seed yield and seed number (Velkov, 1980) and other important components of yield (Virupakshappa and Sindagi, 1988). The heritability estimates aid in determining the relative amount of heritable portion in variation and thus help plant breeder in

* Corresponding author, Fax:0091-080-3330277,
e-mail: Chikkadevaiah@yahoo.com

selecting the elite inbreds from a diverse population. Heritability estimates along with genetic advance are normally more helpful in predicting the gain under selection than heritability estimates alone. Therefore the present study was undertaken to study the genetic variability, heritability and genetic advance in 51 inbreds.

MATERIALS AND METHODS

Fifty-one inbreds of sunflower of diverse geographic distribution (Table 1) were grown during the summer 2000 under irrigated conditions. The experiment was conducted in a random complete block design (RCBD) with a spacing of 60 x 30 cm. Five plants were selected at random for recording the observations. Analysis of variance, estimates of phenotypic heritability and expected genetic advance were worked out following conventional methods.

Table 1: Sunflower inbreds and their country of origin

No	Inbreds	Country	No	Inbreds	Country
1	RHA-348	USA	29	ARM-250B	France
2	CMS-234B	USA	30	CMS-852B	USA
3	RHA-801	USA	31	7-1-B	India
4	CMS-336B	USA	32	CMS-302	USA
5	RHA-356	USA	33	RHA-180	USA
6	CMS-343B	USA	34	CMS-597B	Canada
7	RHA-274-1	USA	35	HAM-69	India
8	ARM-242B	India	36	RHA-R-R-I	USA
9	CMS-207B	USA	37	CMS-234B-I	USA
10	HAM-174	India	38	CMS-89B	USA
11	ARM-244B	India	39	RHA-MR-I	USA
12	CMS-850B	USA	40	86 B ₃	France
13	ARM-246B	India	41	CMS-851B	USA
14	CMS-353B	USA	42	RHA-272-I	USA
15	ARM-243	India	43	RHA-587-II	USA
16	MR-1	India	44	CMS-335B	USA
17	ARM-245B	India	45	RHA-272-II	USA
18	CMS-351B	USA	46	RR-I	USSR
19	HAM-9R	India	47	CMS-349B	USA
20	ARM-247B	India	48	CMS-339B	USA
21	CMS-300B	USA	49	CMS-62B	France
22	HAM-196	India	50	338(C)-B	USSR
23	ARM-248B	India	51	ARM-248B	India
24	CMS-350B	USA		Checks	
25	RHA-274-II	Australia			
26	ARM-249B	India	1	GAUSUF-15	India
27	CMS-843B	USA	2	TNAUSUF-7	India
28	RHA-278	France	3	KBSH-1	India

RESULTS AND DISCUSSION

The analysis of variance revealed significant differences for all the 15 characters studied (Table 2). The range of variation was maximum for percent autogamy (5.25-142.73%) followed by plant height (65.40-170.10 cm) and oil yield (0.40-10.36 g), while it was lowest in the case of days to 50 percent flowering (47.50-58.00 days) and stem girth (91.96-3.47 cm) (Figure 1).

Table 2: Analysis of variance for 15 quantitative characters in sunflower

No.	Character	Mean sum of squares		
		Replication	Treatment	Error
		df=1	df=53	df=53
1	Plant height	10.75	1475.58**	17.90
2	No. of leaves per plant	11.86**	37.93**	5.45
3	Seed test weight	0.33	74.76**	1.64
4	Seed density	1.33	85.84**	4.44
5	Hull percentage	18.50	198.42**	31.38
6	Husk percentage	47.23**	154.34**	12.84
7	Head diameter	0.01	46.61**	5.54
8	Percent autogamy	80.13	1514.04**	161.05
9	Stem girth	0.01	0.31**	0.01
10	Days to 50% flowering	1.8	20.25**	1.51
11	100-seed weight	0.96**	6.24**	0.17
12	Percent seed set	56.44	288.29**	52.19
13	Yield per plant	19.25	555.21**	4.44
14	Oil content	0.44	56.62**	18.44
15	Oil yield	10.42**	65.13**	3.26

* Significant at 0.05 level

** Significant at 0.01 level

It is evident from Table 3 that PCV values were marginally higher than GCV values (Figure 2). This indicated the least influence of environment on the characters studied. Oil content was the most affected by environment compared with the other characters. Very high values of PCV and GCV were obtained for oil yield, 100-seed weight, head diameter, percent autogamy, husk percentage, seed density, plant height, seed test weight and oil content. These results are in accordance with the results of Patil *et al.* (1996) and Virupakshppa and Sindagi (1988). Moderate levels of PCV and GCV were obtained for the number of leaves per plant, percent seed set, hull percentage and stem girth in the decreasing order of magnitude. These results are in agreement with the report by Patil *et al.* (1996). However, low values were obtained for days to 50 percent flowering. A similar result was obtained by Satisha (1995).

In the present study, high heritability estimates were obtained for all characters studied except for oil content (Table 3). This result was in accordance with the results of Manjula (1997), Satisha (1995) and Mogali (1993). Moderate heritability of oil content was reported by Fick (1974).

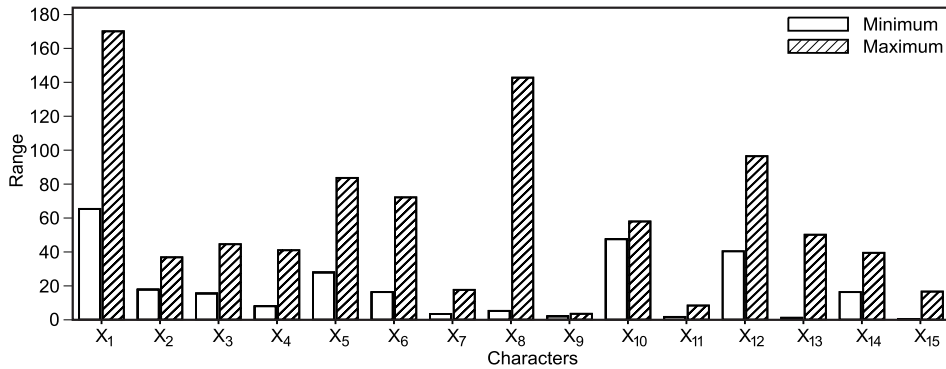


Figure 1: Range for 15 quantitative characters in sunflower

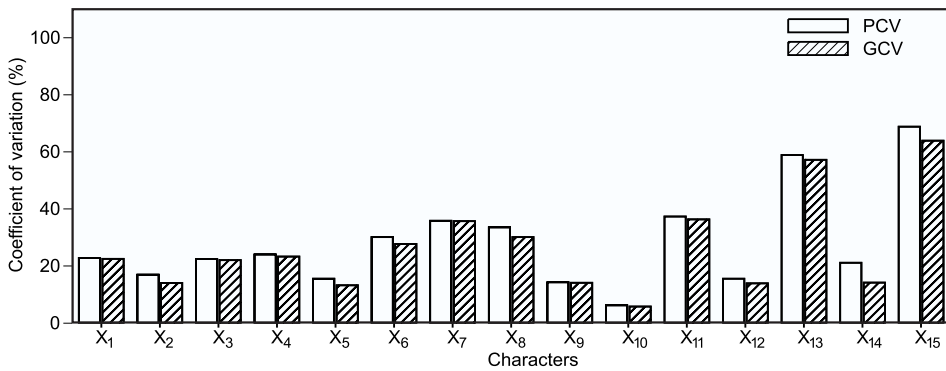


Figure 2: PCV and GCV for 15 quantitative characters in sunflower

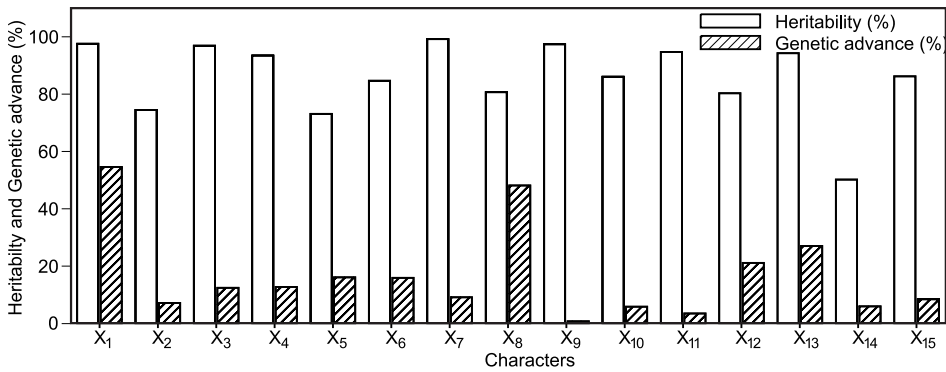


Figure 3: Heritability and genetic advance for 15 quantitative characters in sunflower

- | | | | |
|---|--------------------------------------|--|--------------------------------------|
| X ₁ =Plant height (cm) | X ₅ =Hull percentage (%) | X ₉ =Stem girth (cm) | X ₁₃ =Yield per plant (g) |
| X ₂ =Number of leaves per plant | X ₆ =Husk percentage (%) | X ₁₀ =Days to 50% flowering | X ₁₄ =Oil content (%) |
| X ₃ =Seed test weight (g/100 ml) | X ₇ =Head diameter (cm) | X ₁₁ =100-seed weight (g) | X ₁₅ =Oil yield (%) |
| X ₄ =Seed density (g/cc) | X ₈ =Percent autogamy (%) | X ₁₂ =Percent seed set (%) | |

Table 3: Range, mean, phenotypic and genotypic coefficient of variation, heritability and genetic advance for 15 quantitative characters in sunflower

No.	Character	Range		Coefficient of variability				
		Minimum	Maximum	Mean	PCV	GCV	Heritability (broad sense) (%)	Genetic advance (GCA)
1	Plant height (cm)	65.40	170.10	119.17	22.79	22.51	97.57	54.60
2	Number of leaves/plant	17.80	36.80	27.49	16.96	14.04	74.48	7.15
3	Seed test weight (g/100 ml)	15.50	44.50	27.83	22.41	22.06	96.90	12.45
4	Seed density (g/cc)	8.00	41.00	27.57	24.08	23.28	93.48	12.78
5	Hull percentage (%)	27.86	83.68	69.14	15.53	13.28	73.08	16.13
6	Husk percentage (%)	16.33	72.14	30.38	30.15	27.74	84.66	15.94
7	Head diameter (cm)	3.40	17.63	12.82	35.86	35.71	99.18	9.16
8	Percent autogamy (%)	5.25	142.73	86.24	33.58	30.16	80.69	48.13
9	Stem girth (cm)	1.96	3.47	2.78	14.32	14.13	97.34	0.80
10	Days to 50% flowering	47.50	58.00	52.93	6.23	5.78	86.10	5.85
11	100-seed weight (g)	1.65	8.35	4.79	37.36	36.36	94.69	3.49
12	Percent seed set (%)	40.39	96.40	82.05	15.58	13.96	80.29	21.14
13	Yield per plant (g)	1.18	50.13	36.95	58.89	57.18	94.28	27.06
14	Oil content (%)	16.27	39.43	30.37	21.12	14.20	50.19	5.97
15	Oil yield (g)	0.40	16.62	10.36	68.81	63.88	8620	8.48

In the present investigation, high heritability values coupled with high genetic advance (Figure 3) were recorded for plant height, percent autogamy, percent seed set and yield per plant. Similar results were reported by Srivastava and Mishra (1976) and Singh *et al.* (1977). High heritability coupled with moderate genetic advance was observed for seed test weight, seed density, hull percentage and husk percentage. These results were in accordance with the reports by Manjula (1997) and Lakshmanaiah (1980). High heritability along with low genetic advance was noticed for the number of leaves per plant, head diameter, stem girth, days to 50 percent flowering, 100-seed weight and oil yield. These results were supported by those of Kshirsagar *et al.* (1995) and Satisha (1995).

CONCLUSIONS

It can be concluded from the results that there is a better scope for selection for the percent autogamy, plant height and oil yield. The lower variability coefficients for days to 50 percent flowering indicated that there was less genetic variation for this trait in the material evaluated, which calls for search for variation for this trait in other material or for development of variability for this parameter. Selection is effective for the characters with high heritability estimate and high genetic advance.

REFERENCES

- Fick, G.N., Zimmer, D.E. and Zimmerman, D.C., 1974. Correlation of seed oil content in sunflower with other plant and seed characteristics. *Crop Sci.* 14: 755-757.
- Kshirsagar, A.R., Deshmukh, D.T. and Dudhe, R.S., 1955. Study of genetic variability in sunflower. *PKV Res. J.* 19: 175.
- Lakshmanaiah, V.H., 1980. Genetic variability and association of morphological characters with seed yield and oil content in sunflower (*Helianthus annuus* L.). *Mysore J. Agric. Sci.* 14: 259-261.
- Manjula, K., 1997. Genetic variability and path coefficient analysis in non-oilseed sunflower (*Helianthus annuus* L.) genotypes. M.Sc. (Agri.) Thesis, Univ. Agric. Sci., Bangalore, pp. 143.
- Mogali, S.C., 1993. Characterization and evaluation of sunflower (*Helianthus annuus* L.) germplasm. M.Sc. (Agri.) Thesis, Univ. Agric. Sci., Bangalore pp. 97.
- Patil, B.R., Rudraradhya, M., Vijayakumar, C.H.M., Basappa, H. and Virupakshappa, K., 1996. Genetic variability in sunflower (*Helianthus annuus* L.). *J. Oilseeds Res.* 13: 157-161.
- Satisha, 1995. Evaluation of sunflower (*Helianthus annuus* L.) germplasm for yield and yield components. M.Sc. (Agri.) Thesis, Univ. Agric. Sci., Bangalore pp. 93.
- Singh, B., Sachan, J.N. and Singh, D., 1977. Variability and correlation in sunflower (*Helianthus annuus* L.). *Panthnagar J. Res.* 2: 22-30.
- Srivastava, A.N. and Mushra, R., 1976. Genotypic and phenotypic variability in quantitative characters in sunflower. *Madras Agric. J.* 63: 209-210.
- Velkov, V.N., 1980. Relation between yield and some characters in sunflower. *Genetica Selektsiya* 13b(5): 329-338.
- Virupakshappa, K. and Sindagi, S.S., 1988. A note on germplasm collections in sunflower. *J. Oilseeds Res.* 5: 119-120.

ANÁLISIS DE VARIABILIDAD GENÉTICA DE LAS LÍNEAS CONSANGUÍNEAS DE GIRASOL

RESUMEN

Con el análisis de variabilidad genética de 51 consanguíneas y tres líneas control de girasol, se han determinado las diferencias significativas para todas las 15 características estudiadas. El rango de variación ha sido el más grande para el porcentaje de autogamia, luego para la altura de la planta y rendimiento de aceite, y el más pequeño para el número de días hasta la floración 50% de plantas y la circunferencia del tallo. El rango de variación ha sido el más grande para el rendimiento del aceite, el peso de 100 semillas, el diámetro de cabeza, el porcentaje de autogamia, porcentaje de vaina, la densidad de grano, altura de planta, el peso del grano en hectolitros y el contenido de aceite. En todas las características salvo el contenido de aceite, la menor influencia ha tenido el medio exterior, donde existía una gran similitud entre las co-variaciones fenotípica (CVF) y genotípica (CVG). Los valores de heredabilidad evaluados, han sido altos para todas las características estudiadas salvo para el contenido de aceite, donde se han obtenido los valores moderados. La alta heredabilidad, junto con el alto avance genético, ha sido observada en la altura de la planta, el porcentaje de autogamia, porcentaje de fertilización y en el rendimiento por planta. La alta heredabilidad, junto con el bajo avance genético, se ha determinado en el número de hojas por planta, el diámetro de la cabeza, la circunferencia del tallo, el número de días hasta la floración de 50% de plantas, el peso de 100 semillas y en el rendimiento de aceite, lo que indica que estas características no pueden mejorarse con éxito por vía de selección.

ANALYSE DE VARIABILITÉ GÉNÉTIQUE DANS LES LIGNES *INBRED* DE TOURNESOL

RÉSUMÉ

L'analyse de la variabilité génétique de 51 lignes *inbred* et de trois lignes de contrôle de tournesol a révélé d'importantes différences pour les 15 caractéristiques étudiées. La portée de variation était maximale pour ce qui concerne le pourcentage d'autogamie, puis pour la hauteur de la plante et le rendement en huile, et enfin minimale pour le nombre de jours avant la floraison et pour la circonférence de la tige. La magnitude de variation était la plus élevée pour le rendement en huile, la masse de 100 semences, le diamètre de la tête, le pourcentage d'autogamie, le pourcentage d'enveloppes de semence, la densité des semences, la hauteur de la plante, la masse de 100 semences, le poids des semences et le contenu en huile. L'environnement extérieur avait eu le moins d'effet sauf pour ce qui concerne le contenu en huile ce qui montre une proche correspondance entre la covariante phénotypique (PCV) et la covariante génotypique (GCV). Pour toutes les caractéristiques, les valeurs moyennes d'héritabilité étaient élevées sauf pour le contenu en huile où cette valeur était modérée. Une héritabilité élevée associée à un progrès génétique élevé a été notée pour la hauteur de la plante, le pourcentage d'autogamie, le taux de fertilité et le rendement par plante. Une héritabilité élevée associée à un progrès génétique peu élevé a été notée pour le nombre de feuilles par plante, le diamètre de la tête, la circonférence de la tige, le nombre de jours avant une floraison de 50%, le poids de 100 semences et le rendement en huile, ce qui montre que ces caractéristiques ne peuvent pas être améliorées par la sélection.

