Original Research Article

STUDIES ON GENETIC PARAMETERS IN SUNFLOWER (*Helianthus annuus* L.) GERMPLASM LINES FOR YIELD AND ITS CONTRIBUTING TRAITS

ABSTRACT

Availability of appropriate genetic resources is a key to any crop improvement programme. The understanding and knowledge of genetic variation and genetic similarities present within individuals or populations are useful for the efficient use of genetic resources in breeding programme.Therefore, the present investigation was carried out to assess the variability, heritability and genetic advance in thirty-two sunflower germplasm lines for morphological characters. The analysis of variance revealed the presence of significant variability among the landraces of rice under study. Variability studies indicated that the estimates of phenotypic coefficient of variation were slightly higher than genotypic coefficient of variation for all the traits, indicating less influence of environment.Among all the characters under study, single plant yieldexhibited highest PCV (38.64) and GCV (37.72), whereas lowest PCV ((3.91) and GCV (3.49) were recorded fordays to maturity. High heritability coupled with high genetic advance as per cent of mean estimates were recorded for plant height, 100-seed weight and single plant yield, which indicated the preponderance of additive gene action in controlling these traits. Hence direct selection of these characters would be effective in improving the seed yield. Emphasis should be given on these characters, while selection is made to improve yield potential.

Keywords : Sunflower, germplasm, varibility, genetic parmeters

INTRODUCTION

Oilseed crops occupy a prime position in agricultural economy after food grainsand among them sunflower (*Helianthus annuus* L.) is one of the prominent oilseed crops grown in world as well as in India. It is the fourth most important oilseed crop next to soybean, groundnut and rapeseed.The crop has much importance especially for its oil content due to presence of high concentration of polyunsaturated fatty acids with 55 to 60% of linoleic acid and 25 to 30% of oleic acid, which reduces the risk of coronary diseases by reducing blood cholesterol levels (Joksimovic *et al.,* 2006).Due to its high economic importance, designing of effective breeding programme in order to develop hybrids with superior yield and quality traits is need of the hour.

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The development of an effective plant breeding program is dependent upon the existence of genetic variability. The efficiency of selection largely dependson the magnitude of genetic variability present in the plant population. Thus, the success of genetic improvement in any character depends on the nature of variability present in the gene pool for that character. Hence an insight into the magnitude of variability present in the gene pool of a crop species is of utmost importance to a plant breeder for starting a judicious plant breeding program.

The progress of a breeding program is conditioned by the magnitude and the nature of the genotypic and non-genotypic variation in the various characters. Since, most of the economic characters are complex in inheritance and are greatly influenced by various environmental conditions, it is very difficult to judge whether observed variability is heritable or not. Heritability indicates the extent of transmissibility of a character into future generations. Moreover, knowledge of heritability is also essential for selection of component traits for yield improvement.

Again, the heritable portion of the total variation might not be always due to additive gene action. Thus, estimates of heritability alone will not give a clear indication of the associating genetic progress that would result from selecting the best plants. It is also essential to find out the relative magnitude of additive and non-additive genetic variances with regard to the characters of concern. Therefore, it should be combined with information on genetic advance. Heritability estimates along with genetic advance are normally more helpful in predicting the gain under selection than heritability estimates alone. Keeping in view the importance of aforesaid aspects, the present investigation was undertaken to study the genetic variability, heritability and genetic advance among the germplasm lines of sunflower for yield and its attributing characters.

MATERIAL AND METHODS

The field experiment was conducted during *kharif,* 2019 at Agricultural Research Station, Tornala, Telangana,situated at Latitude N 18^{o}6’40’’, Longitude E 78^{o}44’33’’ and 675 m altitude above mean sea level. A total of thirty-two sunflower germplasm lines received from ICAR-Indian Institute of Oilseeds Research (IIOR), Hyderabad along with three checks were sown in 2 rows of 4.5 m length by adopting a spacing of 60 cm between rows and 30 cm between plants with in a row in Randomized Block Design replicated twice. All the necessary precautions were taken to maintain uniform plant population of each genotype per replication. All the recommend package of practices was adopted besides providing necessary prophylactic plant protection measures to raise a good crop.

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Data were recorded on a total of eightcharacters. Among themplant height (cm), head diameter (cm) and single plant yield (g) were recorded on five randomly selected plants in each plot. Days to 50 % flowering (days) and days to maturity (days) were recorded on plot basis. 100-seed weight (g), volume weight (g/100 ml) and oil content (%) were recorded per replication in each genotype as per the standard procedures. The data collected on all the characters were subjected to standard methods of analysis of variance (Panse and Sukhatme, 1985). Phenotypic and genotypic coefficient of variation was calculated as suggested by Falconer (1981). Heritability (broad sense) (Johnson *et al*., 1955), genetic advance (Burton, 1952) and genetic advance as a percent of mean (Johnson *et al*., 1955) were also estimated.

RESULTS AND DISCUSSION

The analysis of variance revealed the existence of significant differences among the genotypes for all the traits (Table 1),indicating the presence of considerable genetic variability among the experimental material under study. Thus, there is ample scope for improvement of characters under study through selection. The mean values, genotypic and phenotypic coefficient of variation, heritability, genetic advance and genetic advance as per cent of mean (Table 2) of 32 sunflower germplasm lines and 3 checks were calculated for yield and its contributing traits parameters.

For all the characters under study, phenotypic coefficient of variation values were slightly higher than the corresponding genotypic coefficient of variation values and the difference between them was narrow indicating that the characters were less influenced by the environment. Therefore, response to direct selection may be effective in improving these traits.

The characters studied in the present investigationexhibited low (less than 10 %), moderate (10-20 %) and high (more than 20 %) phenotypic and genotypic coefficients of variationand represented in graphical form in figure 1. High phenotypic and genotypic coefficients variations were observed for single plant yield (38.64/37.72)These results are in confirmity with the findings ofSujatha *et al.* (2002), Dudhe *et al*. (2019) and Sree *et al*. (2021). The estimates of phenotypic and genotypic coefficients of variation were low for oil content (6.50/4.74), days to 50 % flowering (6.20/5.33) and days to maturity (3.91/3.49). These findings are in accordance with those of Dudhe *et al*. (2019) and Sree *et al*. (2021) for oil content and days to 50 % flowering and Singh *et al*. (2019) and Abu (2020) for days to maturity. Whereas, phenotypic and genotypic coefficients of variation were moderate for 100-seed weight (15.15/12.92), plant height (14.97/14.01), head diameter (14.30/11.28) and volume weight (11.26/10.38). Similar results were reported by Baraiya *et al*. (2018) and

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Singh *et al*. (2019) for 100-seed weight and plant height and Sree *et al*. (2021) for head diameter.

All the characters under investigation except oil content expressed high estimates of heritability in broad sense ranging from 62.25% (head diameter)to 95.34 % (single plant yield).High heritability estimates indicate that the selection for these characters will be effective being less influenced by environmental effects. Heritability estimates have been found to be useful in indicating the relative value of selection based on phenotypic expression of different charactersand there could be greater correspondence between phenotypic and breeding values. However, moderate value of heritability in broad sense was reported for oil content (52.87 %).

Genetic advance as a per cent of mean is classified as low (less than 10 %), moderate (10-20 %) and high (more than 20 %).Among the traits under study, days to 50 % flowering (9.44 %), oil content (7.08 %) and days to maturity (6.42 %) expressed low genetic advance as per cent of mean. However, single plant yield (75.88 %), plant height (26.99 %) and 100-seed weight (22.69 %) recorded high estimates of genetic advance as per cent of mean. Remainingtraits *viz.*, volume weight (19.70 %) and head diameter (18.34 %) exhibited moderate estimates of genetic advance as per cent of mean.

The graphical representation of heritability and genetic advance as a percent of mean was given in given in figure 2. Among all the characters under study, days to 50 % flowering and days to maturity exhibited high heritability coupled with low genetic advance as a per cent of mean. Similar results were reported bySupriya*et al.* (2016)**.** High heritability coupled with low genetic advance as a per cent of mean indicates that the expression of the trait is under the control of non-additive type of gene action, and its response to selection would be poor. In such case hybridization programme is rewarded.Head diameter and volume weight expressed high heritability coupled with moderate genetic advance as a per cent of mean, which suggested that the expression of this trait was mostly influenced by additive type of gene action.Hence its response to selection would be effective.Sujatha *et al.* (2002) found similar results for volume weight.High heritability coupled with high genetic advance as per cent of mean estimates were recorded for plant height, 100-seed weight and single plant yield, indicating the preponderance of additive gene action in controlling the traits. Hence direct selection of such characters would be effective in improving the yield. Similar results were observed bySupriya*et al.* (2016)**,**Singh *et al*. (2019) and Sree *et al*. (2021).However, oil content had moderate heritability coupled with low genetic advance as per cent of mean estimates which is in confirmity with the findings of Joksimovic *et al.* (2006).

CONCLUSIONS:

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An insight intoassociation studies at phenotypic and genotypic levels revealed that there is less influence of environment on the characters under study. Hence, response to direct selection may be effective in improving these traits.Traits *viz*., plant height, 100-seed weight and single plant yieldexhibited high heritability coupled with high genetic advance as a per cent of mean values, which indicated the preponderance of additive gene action in controlling these traits. Hence direct selection of these characters would be effective in improving the seed yield. Head diameter and volume weight recorded high heritability coupled with moderate genetic advance as per cent of mean suggesting that the expression of this trait was mostly influenced by additive type of gene action. Hence, its response to selection would be effective in improving the seed yield. While, high heritability coupled with low genetic advance as per cent of mean values were registered for days to 50 % flowering and day to maturity indicating that the expression of this trait was under the control of non-additive type of gene action, hence its response to selection would be poor.

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Table 1. ANOVA for yield and its contributing characters in sunflower *(Helianthus annus* L.) germplasm lines

S. No.	Character	Mean sum of squares		
		Replication (d.f. = 1)	Genotypes (d.f. = 34)	Error (d.f. = 34)
1.	Days to 50 % flowering	0.129	21.798**	3.276
2.	Days to maturity	0.357	21.671**	2.445
3.	Plant height (cm)	25.441	483.842**	32.294
4.	Head diameter (cm)	0.329	4.962**	1.154
5.	100-seed weight (g/100 ml)	0.014	0.974	0.154
6.	Volume weight (g)	0.357	13.459**	1.100
7.	Oil content (%)	0.001	6.366**	1.963
8.	Single plant yield (g)	0.252	128.831**	3.077

*Significant at 5 per cent level **Significant at 1 per cent level

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Table 2. Estimation of genetic parameters for yield and its contributing characters in sunflower*(Helianthus annus* L.) germplasm lines

S. No	Character	Mean	Range		Phenotypic variance	Genotypic variance	PCV (%)	GCV (%)	Heritability in broad sense (h^2) (%)	GA (5 %)	GA as percent of mean (5 %)
			Min.	Max.							
1.	Days to 50 % flowering	57.10	50.50	63.50	12.53	9.26	6.20	5.33	73.87	5.39	9.44
2.	Days to maturity	89.00	83.00	94.50	12.05	9.61	3.91	3.49	79.72	5.70	6.42
3.	Plant height (cm)	107.37	75.50	134.00	258.06	225.77	14.97	14.01	87.49	28.95	26.99
4.	Head diameter (cm)	12.20	9.30	15.10	3.05	1.90	14.30	11.28	62.25	2.24	18.34
5.	100-seed weight (g)	4.95	3.50	6.75	0.56	0.41	15.15	12.92	72.70	1.13	22.69
6.	Volume weight (g/100 ml)	24.00	16.75	28.75	7.28	6.18	11.26	10.38	84.89	4.72	19.70
7.	Oil content (%)	31.31	28.56	35.68	4.164	2.02	6.50	4.73	52.87	2.22	7.08
8.	Single plant yield (g)	20.93	9.65	37.85	65.95	62.87	38.64	37.72	95.34	15.95	75.88

Min.-Minimum, Max.-Maximum

PCV- Phenotypic Coefficient of Variation; GCV- Genotypic Coefficient of Variation; GA- Genetic Advance

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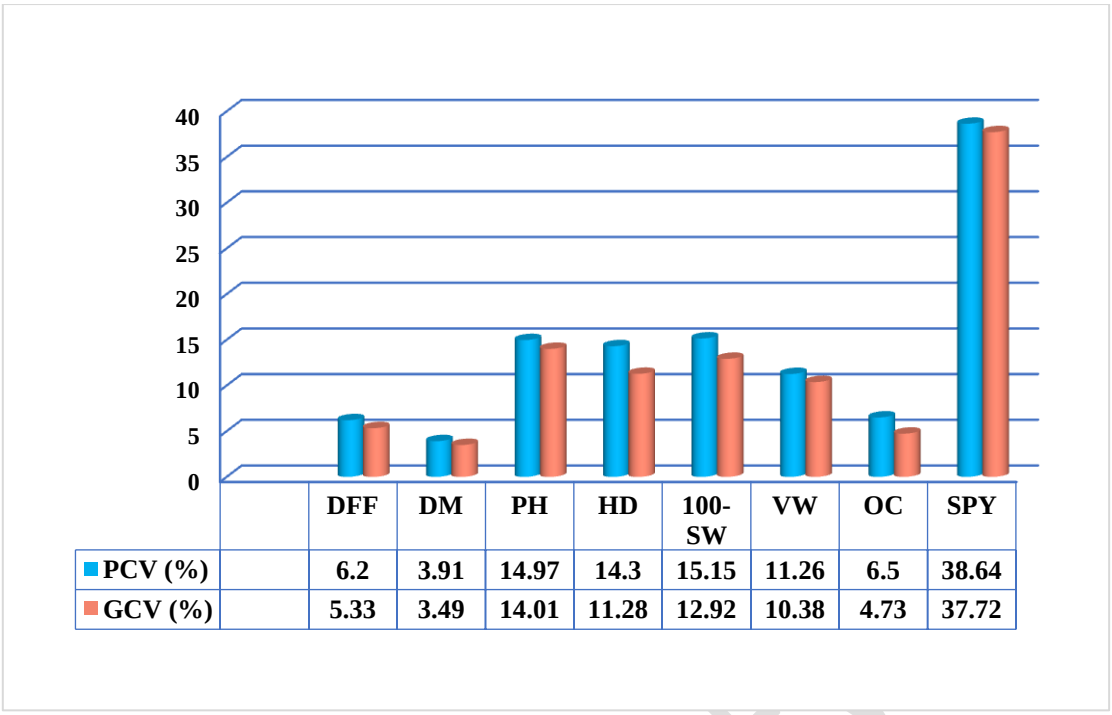
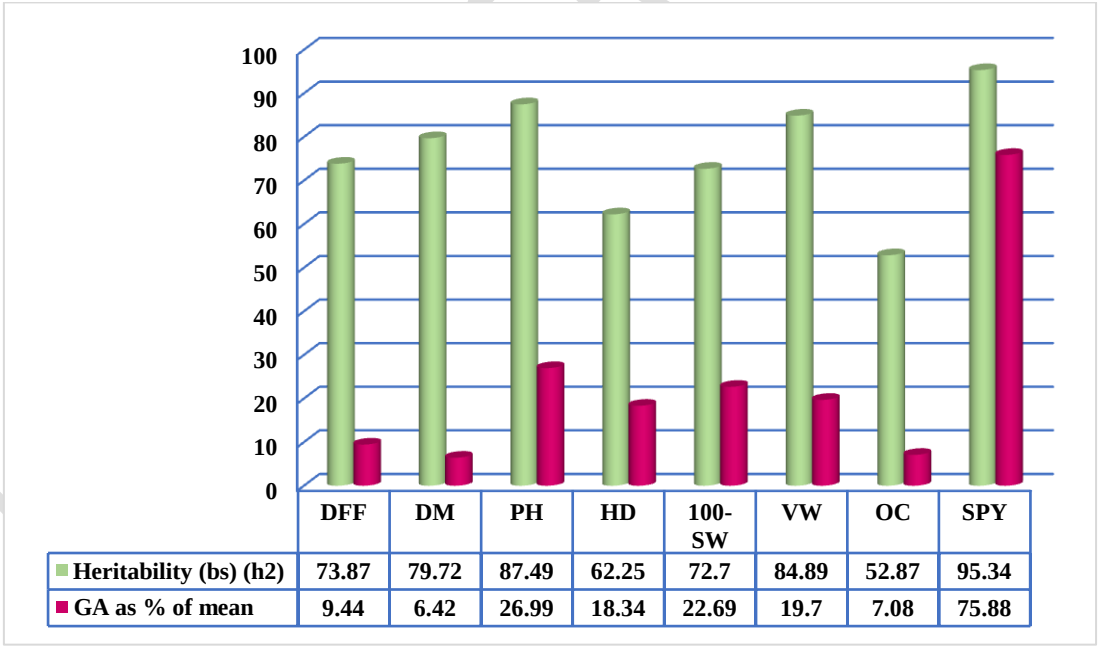


	DFF	DM	PH	HD	100-SW	VW	OC	SPY
PCV (%)	6.2	3.91	14.97	14.3	15.15	11.26	6.5	38.64
GCV (%)	5.33	3.49	14.01	11.28	12.92	10.38	4.73	37.72

Figure 1. Graphical representation of phenotypic and genotypic coefficients of variation for various characters in sunflower (*Helianthus annus* L.) germplasm lines



	DFF	DM	PH	HD	100-SW	VW	OC	SPY
Heritability (bs) (h2)	73.87	79.72	87.49	62.25	72.7	84.89	52.87	95.34
GA as % of mean	9.44	6.42	26.99	18.34	22.69	19.7	7.08	75.88

Figure 2. Graphical representation of heritability in broad sense and genetic advance as a percent of mean (5 %) for various characters in sunflower(*Helianthus annus* L.) germplasm lines

DFF- Days to 50 % flowering; DM-Days to maturity; PH-Plant height (cm); HD-Head diameter (cm); 100-SW-100-seed weight (cm); VW-Volume weight (g/100 ml); OC-Oil content (%); SPY-Single plant yield (g)