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EFFECT OF RECURRENT SELECTION ON VARIABILITY AND GENETIC PARAMETERS OF YIELD AND YIELD ATTRIBUTES IN SUNFLOWER

K. G. S. SENEVIRATNE
Field Crops Research and Development Institute, Mahailluppallama
M. GANESH
Department of Genetics and Plant Breeding, ANG Ranga Agriculture University, Hyderabad, India.
and
A. R. G. RANGANATHA
Directorate of Oilseeds Research, Hyderabad, India.

ABSTRACT

This investigation was carried out to improve the population of sunflower (*Helianthus annuus* L.) to develop superior inbred lines with high genetic variability and high genetic potential in yield and oil, to utilize them for the development of super hybrids, at Directorate of Oilseeds Research, Hyderabad, India during dry season and wet season, 2001 adopting simple recurrent selection procedures. A high degree of variability was observed in plant height, head diameter, days to 50% flowering, days to maturity, 100 seed weight, seed yield, oil content and oil yield in the base population. Phenotypic and genotypic variability was high in seed yield and oil yield. The cyclic and directional selection resulted positive selection differential for plant height, head diameter, seed yield and oil yield. The heritability was high for days to 50% flowering, days to maturity, plant height, head diameter, 100 seed weight, seed yield, oil content and oil yield. High broad sense heritability coupled with high genetic advance was observed for head diameter and oil yield indicating additive gene action controlling these traits. Plant height, 100 seed weight and oil content are controlled by both additive and non-additive gene action.

KEYWORDS: Genetic advance, Heritability, Recurrent selection, Sunflower.

INTRODUCTION

Large-scale cultivation of sunflower (*Helianthus annuus* L.) was started in India in 1972 with the introduction of Russian varieties. The crop has contributed substantially to the oilseed production because of the development of several high yielding varieties and hybrids suitable for cultivation in different agroclimatic regions. In the recent years, the yield of sunflower reached to stagnant level. Therefore, there is a need to develop superior inbreds, so that, these inbreds can be utilized to develop super hybrids. The development of superior inbreds from the population involves several selection programs. Systematic population improvement programmes helps the breeder to generate superior populations with improved performance by directional selection followed by intermating of the re-selects will give impetus for the development of elite inbred lines. Further it enables for developing superior hybrids, synthetics, composites and also these inbreds act as a potential genetic resource.

Miller *et al*., (1977) obtained an increment of 12.2 percent of oil content after 3 cycles of simple recurrent selection. Miller and Hammand (1985) reported an increase in seed yield by 6.3 percent after 3 cycles of selection. The present study was undertaken to improve the base population by adopting simple recurrent selection with a progeny testing for yield and yield attributes of sunflower.

MATERIALS AND METHODS

Present study was undertaken in the third cycle (C3) of improvement, at Directorate of Oilseeds Research, Hyderabad, India from summer, 2001. Using seeds of second selection cycle (C2) a population of about 20,000 plants were grown in bulk, about 2000 plants were selected and selfed. Out of these 2000 individuals, based on high autogamy, high oil content, higher number of filled seeds and high seed yield, the best performing 200 plants were selected for progeny test during *kharif* (wet season), 2001 and they were evaluated along with two checks (Morden and KBSH-1) in Randomized Block Design, replicated twice. Observations were recorded for plant height, days to 50 percent flowering, days to maturity, head diameter, 100 seed weight, oil content, seed yield and oil yield. The mean performance of 2000 individuals and mean, range, variance, Phenotypic Coefficient of Variation (PCV), Genotypic Coefficient of Variation (GCV), heritability in broad sense, genetic advance, genetic advance as percent of mean and selection differential for 202 progenies were worked out following RCBD and genetic parameter analysis.

RESULTS AND DISCUSSION

The genotypes exhibited considerable variation for seed yield and yield contributing characters (table 1). Plant height, head diameter, seed yield per plant, unfilled seed weight, number of filled seeds per plant, number of unfilled seeds per plant, days to maturity and oil content showed high variability, in the third base population.

Table 1. Variability parameters of the third cycle base population (C_3) in sunflower.

Character	*Mean*	*Range*
Days to maturity	92.7	84 - 105
Plant height (cm)	145.53	82 - 200
Head diameter (cm)	11.14	6 - 21
Number of filled seeds per plant	373	0 - 1545
Number of unfilled seeds per plant	120	0 - 1427
Unfilled seed weight per plant (g)	1.78	0 - 15.4
Seed yield per plant (g)	15.11	0 - 61.8
Oil content (%)	32.47	19.82 - 44.30

Considerable amount of variability could be noticed in the selected progenies for days to 50% flowering, days to maturity, plant height, head diameter, 100 seed weight, seed yield, oil content and oil yield (table 2). The selection imposed has narrowed down the variability of plant height, days to maturity, head diameter, seed yield, oil content and oil yield. These parameters indicated the extent of genetic variability in the population, which is very essential for selection and to achieve improvement in particular traits. Analysis of variance revealed highly significant differences among genotypes for all the characters among the progenies of third cycle, it indicates the existence of high variability of various characters studied. Positive selection differential values were observed in plant height, head diameter, seed yield per plant and oil yield per plant, whereas, days to maturity (in desirable direction) and oil content showed negative values (table 3).

Table 2. Variability parameters for seed yield and its attributes in progenies of sunflower.

Character	*Mean*	*Range*
Days to 50% flowering	54.95 ± 1.13	46 - 67
Days to maturity	84.95 ± 1.08	76 - 97
Plant height (cm)	150.19 ± 2.13	99.3 - 195.67
Head diameter (cm)	13.69 ± 0.37	9.67 - 19.33
100 seed weight (g)	4.33 ± 0.27	2.5 - 6.4
Seed yield/plant (g)	18.81 ± 1.87	8.03 - 33.74
Oil content (%)	31.99 ± 0.61	18.96 - 40.48
Oil yield per plant (g)	6.04 ± 0.62	1.6 - 13.32

Virupakshappa and Sindagi (1987) and Salera and Detti (1990) observed high range of variation for plant height, 100 seed weight, seed yield and oil content. Teklewold *et al*., (1999) recorded high range of values for number of filled seeds, percent autogamy, seed yield per plant and percent seed set.

Table 3: Range, mean and selection differential for seed yield and its attributes in sunflower.

Character		*Range*	*Mean*	*Selection differential*
Plant height (cm)	P	82 - 200	145.53	4.66
	S_1	99.33 - 195.67	150.19	
Head diameter (cm)	P	6 - 21	11.14	2.55
	S_1	9.67 - 19.33	13.69	
Days to maturity	P	84 - 105	92.70	- 8.2
	S_1	76 - 97	84.50	
Seed yield/plant (g)	P	0 - 61.8	15.11	3.7
	S_1	8.03 - 33.74	18.81	
Oil content (%)	P	19.82 - 44.3	32.47	-0.48
	S_1	18.96 - 40.48	31.99	
Oil yield/plant (g)	P	0 - 11.25	5.63	0.41
	S_1	1.6 - 13.32	6.04	

P = population of the third cycle; S_1 = progenies of the selected plants

The range in mean performance reflects the extent of phenotypic variance present in the material being studied. Thus, it would be erroneous to infer on the magnitude of variability present based on range as a parameter, since it is composed of genetic and non-genetic components. Hence, partitioning of the total variability into genetic and non-genetic variance is required. The phenotypic variance indicates the amount of variance which is due to differences in phenotypic value, whereas, the genotypic variance indicates the magnitude of variance arising from the differences in genotypic values. Higher estimates of these coefficients indicate wider diversity and vise versa.

The values of phenotypic coefficient of variance (PCV) and genotypic coefficient of variance (GCV) were high for seed yield and oil yield per plant showing wider diversity of these traits (table 4). These findings were in accordance with the findings by Teklewold *et al*., (1999). Plant height, head diameter, 100 seed weight and oil content showed moderate PCV and GCV values. Moderate PCV and GCV values were reported for oil content by Teklewold *et al*., (1999). Among the characters, days to 50 percent flowering and days to maturity exhibited low PCV and GCV values. These results were in consonance with the results of Teklewold *et al*., (1999) and Ashok *et al*., (2000).

The heritability estimates indicate the expressivity of trait with which a genotype can be assessed by its phenotype and its effective utilization in judging the phenotypic selection. High heritability (h^2b) estimates were observed for plant height, days to 50 percent flowering, head diameter, days to maturity, 100 seed weight, oil content, seed yield per plant and oil yield (table 4). Similar results were also reported by Teklewold *et al*. (1999), Ashok *et al*. (2000) and Khan (2001).

Table 4. Genetic variability parameters for seed yield and its attributes in 202 lines of sunflower.

Character	*Mean*	*Coefficient of variation (%)*		*Heritability (%) (Broad sense)*	*Genetic advance*	*Genetic advance as per cent of mean*
		Phenotypic	*Genotypic*			
Days to 50% flowering	54.95	6.26	5.53	78.25	4.73	8.61
Days to maturity	84.95	4.03	3.60	79.94	4.81	5.66
Plant height (cm)	150.19	10.20	10.00	96.12	25.92	17.26
Head diameter (cm)	13.69	13.02	12.43	91.23	2.86	20.89
100 seed weight (g)	4.33	15.85	13.08	68.18	0.82	18.94
Seed yield/plant (g)	18.81	27.84	24.05	74.59	6.87	3.65
Oil content (%)	31.99	10.52	10.17	93.48	5.54	17.32
Oil yield/plant (g)	6.04	30.87	27.23	77.81	2.55	42.22

Heritability values alone can not provide any indication of the amount of progress that would result from selection because, heritability in broad sense includes both additive and non-additive gene action, therefore, high heritability estimates in broad sense would be a reliable tool of selection if accompanied by high genetic advance as per cent of mean. High heritability associated with high genetic advance as percent of mean were recorded for head diameter and oil yield per plant indicating lesser environmental influence on these characters and the role of additive gene action. Similar observations for head diameter and oil yield were also reported by Teklewold *et al*., (1999) and Ashok *et al*., (2000).

High heritability estimates associated with moderate genetic advance as percent of mean was recorded for plant height, 100 seed weight and oil content suggesting that these characters were less influenced by environment but governed by both additive and non-additive gene action. These findings were in true agreement with the results obtained by Muhammad *et al*., (1992). High heritability estimates associated with low genetic advance recorded for days to 50 percent flowering, days to maturity and seed yield showed that these characters are influenced by the environment due to its non-additive gene action.

CONCLUSIONS

The selection followed for the improvement of sunflower population indicated the enormous amount of variability present, to operate the directional selection effectively. This has made the cyclic selection more effective and recorded substantial amount of genetic gain for the traits. The elite genotypes with high seed yield, number of filled seeds and oil content can be utilized to develop superior inbred lines for the development of superior synthetics and hybrids. Hence, the population improvement program is at most essential to any crop improvement. It will give a new flow gene pool to search for the improvement of trait(s). Thus, it becomes an important tool for the breeders lexicon.

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