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PHENOTYPIC STABILITY FOR QUANTITATIVE CHARACTERS IN SUNFLOWER (*HELIANTHUS ANNUS* L.) IN MANIPUR

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ABSTRACT

Eleven genotypes, grown in three artificially created environments for two seasons, were analysed for stability for plant height, days to 50% flowering and maturity, head diameter, 100-seed weight, percent seeds filled per head, seed yield per plant, and oil content. Genotype x environment interaction was significant for all the characters studied. Both linear and nonlinear components were important in all characters, except plant height and seeds filling in which only nonlinear component was predominant. Genotype IET-23 was stable for most characters. Genotypes IET-27 and IET-29 were stable in better environment. The variety Morden was most unstable for all the characters under study.

Key words: Stability, sunflower, G x E interaction, quantitative characters.

Sunflower (*Helianthus annus* L.) is a new introduction in the State of Manipur, therefore, determination of its adaptability is of important. Productivity of a population is the function of its adaptability whereas, stability is the statistical measure of genotype x environment interaction [1]. The present investigation has been taken up to study the reaction of different genotypes to different environments and identify genotypes suitable for the State of Manipur.

MATERIALS AND METHODS

Eleven genotypes of sunflower, viz. AV-01, AV-02, AV-04, AV-05, AV-07, IET-23, IET-25, IET-27, IET-28, IET-29 and Morden, received from the All-India Coordinated Project on Sunflower, USA, Bangalore, were grown in three artificially created environments for two seasons (November–March and April–July) in randomised block design with 3 replications. The environments in both seasons were created with different fertilizer doses: (i) 90:90:45 kg N:P:K/ha, (ii) 60:60:30 kg N:P:K/ha, and (iii) 30:30:15 kg N:P:K/ha. The plot size was 2.40 m x 3.60 m, and spacing between rows and plants were 60 cm and 30 cm, respectively.

Observations on 10 random plants per plot were recorded for nine quantitative characters. Oil content was determined by the cold percolation method. The data were analysed for stability parameters according to the model suggested by [2]. The significance of stability parameter (bi) and its deviation from unity were determined by t test.

RESULTS AND DISCUSSION

Pooled analysis of variance (Table 1) revealed the presence of significant genetic variability in the materials as well as variation in environments under study for all characters. Further splitting of the component environment + (genotype x environment)

Table 1. Pooled analysis of variance (M.S.S.) for different characters in sunflower

Source	d.f.	Days to flowering	Days to maturity	Plant height	Head diameter	100-seed weight	Seed filling	Seed yield	Oil content
Genotypes (G)	10	45.9**	98.9**	342.4**	1.6**	0.7**	12.9**	43.1**	18.2**
Environments (E) + (GxE)	55	437.1**	543.3**	550.8**	2.4**	1.8**	11.6**	60.8**	5.0**
Environment (linear)	1	23460.0**	29037.3**	25907.9**	79.1**	85.4**	329.2**	1984.8**	43.3**
G x E (linear)	10	22.0**	20.3**	221.1**	1.2**	0.2	7.7	53.1**	4.8**
Pooled deviation	44	8.2**	14.6**	49.4	0.9**	0.9**	5.2	18.9*	4.2**
Pooled error	120	3.9	5.2	50.8	0.3	0.1	6.5	11.6	0.9

*,**Significant at 5% and 1% levels, respectively.

indicated that interaction was largely contributed by highly significant mean squares due to environment (linear) and genotype x environment (linear), which shows that there were considerable differences among the environments created in the experiments which played significant role in the expression of all the characters. Mean square due to pooled deviation was significant for most of the characters, except plant height and seed filling. Nonsignificant mean squares due to pooled deviation for these characters suggested that differences in stability for these characters among the group of varieties studied were not due to deviation from regression and hence prediction for these characters over different environments was possible.

Based on the positive value of environmental indices, winter sowing of sunflower favoured expression of seed yield per plant and 100-seed weight whereas unfavourable for plant height, days to 50% flowering and maturity. The seasons did not affect oil content,

head diameter, stem diameter and seed filling per head. Our findings are in agreement with earlier reports on the effect of sowing season on the expression of different characters in sunflower [3].

Stability analysis for plant height, days to flowering and maturity revealed that the varieties IET-23, IET-28 and IET-29 were most stable for these characters. Their mean values were less than the population mean and shows significant bi values nondeviating from unity and nonsignificant S^2di. Similar significant G x E interactions for these characters in sunflower were reported [4, 5]. The variety Morden was most unstable for these environments because it showed highly significant deviations and stability parameter significantly deviating from unity.

Table 2. Estimates of stability parameters

Variety	Days to flowering			Days to maturity			Plant height			Head diameter		
	$\bar{x}$	b_i	S^2d_i	$\bar{x}$	b_i	S^2d_i	$\bar{x}$ (cm)	b_i	S^2d_i	$\bar{x}$ (cm)	b_i	S^2d_i
AV-01	87.8	1.0**	0.8	116.9	1.1**	5.8	108.3	0.6**	–27.5	12.9	0.5*+	–0.3
AV-02	84.1	0.9**	9.1*	111.3	0.9**	7.7*	94.5	1.4**+	–34.7	12.3	1.5**+	–0.1
AV-04	85.1	0.9**	5.3	114.7	1.0**	16.5**	101.2	0.7*	12.7	12.1	0.8	1.5**
AV-05	86.1	0.9**	0.7	116.2	1.1**	2.2	113.9	1.0**	–1.0	12.8	0.6	0.3
AV-07	86.0	0.9**	6.7*	112.1	0.8**+	76.9**	107.8	0.9**	17.5	11.3	0.8**	–0.2
IET-23	84.2	0.9**	–2.0	115.5	1.1**	–3.6	109.4	0.7**	–43.9	13.1	1.0*	0.6
IET-25	86.1	1.1**+	4.9	113.4	1.0**	163.4**	106.9	0.9**	–25.9	12.8	0.8**	–0.3
IET-27	88.3	1.2**++	17.6**	118.9	1.1**	–1.1	115.9	0.8**	–21.3	12.9	0.6**	–0.3
IET-28	88.5	1.1**	–2.6	118.1	1.1**	1.9	101.4	1.1**	–35.9	13.0	1.5**+	0.1
IET-29	83.5	0.9+	1.4	113.6	0.9**	0.9	97.5	1.2**	31.8	12.4	1.2**	–0.1
Morden	78.7	0.8++	5.2	104.2	0.6**++	–2.1	92.5	1.6**+	112.9**	12.3	1.6*+	1.5**

+,++Significantly deviated from unity at 5% and 1% levels, respectively,

*,**Significant at 5% and 1% levels, respectively.

Stability analysis for seed yield per plant and its components, viz. head diameter, seed filling, 100-seed weight, revealed that linear component of stability was important for head diameter and 100-seed weight, whereas nonlinear component was important for seed filling and seed yield per plant in all the varieties studied. It was reported earlier that linear component of G x E interaction was nonsignificant for seed filling, and had higher magnitude for 100-seed weight as well as seed yield per plant [6]. The genotype IET-23 was most stable for head diameter, AV-01 for seed filling, and IET-23 and AV-04 for 100-seed

weight, having high mean values and regression coefficient near unity, and nonsignificant deviation from regression. Other genotypes (IET-27, IET-25 and AV-05) for head diameter, IET-25 for seed filling, and AV-01 for 100-seed weight can also be considered to be stable (in order of ranking).

In the present study, the magnitude of regression coefficient and deviation from regression for seed yield per plant varied from genotype to genotype, indicating that genotypes were responsive to the environmental variations (Table 2). Five out of 11 genotypes under study had regression coefficient more than 1, two genotypes equal to 1, and four less than 1. They can be categorised as above average, average and below average, respectively. Interestingly, the high yielding variety Morden has negative coefficient which

of different characters in sunflower

Seed filling			100-seed weight			Oil content			Plant yield		
$\bar{x}$ %	b_i	S^2d_i	$\bar{x}$ (g)	b_i	S^2d_i	$\bar{x}$ %	b_i	S^2d_i	$\bar{x}$ (g)	b_i	S^2d_i
60.8	1.4^{**}	-4.5	5.6	1.1^{**+}	-0.1	39.1	0.2	1.0	23.4	1.6^{**+}	2.6
58.4	0.9	-2.1	5.2	0.8^{*}	0.4^{**}	36.3	0.6	-0.1	22.5	0.8	18.5^{*}
56.9	-0.1^{++}	-4.5	5.9	1.1^{**}	0.2	36.9	1.1	4.7^{**}	24.2	1.1^{**}	20.1^{*}
58.5	1.2^{**}	-5.2	5.5	0.9^{**}	-0.1	38.6	3.9^{++}	26.6^{**}	24.1	1.4^{**}	-6.0
58.1	0.5^{+}	-1.8	5.6	1.0^{**}	-0.1	40.8	0.2	0.5	19.8	0.8	1.4
58.6	1.2	0.5	5.9	1.1^{**}	-0.1	40.5	0.7	1.3	26.9	1.1^{**}	-9.9
59.6	1.1	9.6^{*}	5.4	1.1^{**}	0.0	40.2	0.1^{+}	0.1	24.9	1.4^{**}	5.4
61.8	1.8^{*++}	1.3	6.2	1.1^{**+}	0.4^{**}	41.8	2.0	1.3	27.9	1.5^{*}	17.8^{*}
58.4	1.2^{*}	-2.2	5.0	0.7^{*++}	0.2	38.8	0.7	0.1	25.2	0.9^{**}	-6.3
57.9	0.7	-3.0	5.4	0.9^{**}	-0.1	38.4	1.2	0.6	25.2	0.6	1.9
57.1	0.9	-1.7	5.6	0.9^{**}	-0.0	37.1	0.3	0.2	19.0	-0.3^{++}	24.5^{**}

significantly deviated from unity, its deviation from regression was also highly significant, and performance highly unstable.

Stability analysis for seed oil content revealed that all the genotypes under study were insensitive to the environments created and genotype x environmental interaction in these genotypes for oil content was not functional on the regression analysis. Similar findings were reported earlier [7].

Among all the genotypes, IET-23 was found to be most stable for most characters and, therefore, could be recommended for commercial cultivation in the Manipur Valley. The genotypes IET- 27 and IET-29 are suitable only for favourable conditions. The variety Morden was unstable for all the characters studied. It was reported that the open-pollinated variety Morden behaves more like a self-fertile variety. Individual as well as population buffering increased with the rising heterozygosity and heterogeneity in the population in different environmental gradients [9, 10]. As a result the open-pollinated varieties and three-way hybrids are more stable than the more or less homogeneous single-cross hybrids [11, 12]. The variety Morden was found to be highly unstable, probably because of its self-fertile nature.

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