Pak. J. Agri. Sci., Vol. 30, No. 2, 1993

ASSOCIATION BETWEEN SEED WEIGHT AND VARIOUS SEEDLING TRAITS OF A RANDOM MATED POPULATION OF SUNFLOWER

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Forty S_1 families of sunflower *(Helianthus annuus* L.) developed from a random mated population were evaluated in the laboratory to determine the extent of relationship between seed weight and ten seedling traits. The results indicated that seed weight had significant negative phenotypic correlation with emergence. The estimates of phenotypic correlation coefficients of seed weight with fresh shoot weight and fresh shoot length were found to be significant and positive. The magnitude of genotypic correlation coefficients between seed weight and the seedling traits were little higher than their corresponding phenotypic correlation coefficients. However, the genotypic correlation between seed weight and fresh shoot weight was positive and significant.

INTRODUCTION

Successful crop production primarily depends upon proper stand establishment which in turn depends on good quality seed followed by vigorous seedlings. Seed weight has been one of the important factors in determining the vigour of the seedlings and early growth of crop plants. Bourland (1980) indicated that low seed weight and short roots of cotton seedlings were important in explaining variability in stand establishment. Hoy and Gamble (1981) observed that large soybean seeds had significantly lower emergence, speed of emergence, final stand and number of plants contributing to yield. Adamo *et al.* (1984) reported that different classes of seed size has no significant influence on seed yield, seed weight, germination, seedling dry weight or oil content of sunflower.

The relationship between seed weight and various seedling traits of sunflower can help to know whether seed weight has a predictive role in determining the vigour of seedlings and early growth of plants which can further be correlated with field performance and yield. Such studies have been reported by Koscielniak and Dubert (1985) in maize seedlings. They concluded that in maize 79-95% of yield variation was due to seedling characteristics. The study of correlations between seed weight and seedling traits under field conditions is a complicated process since correlations can be biased due to large environmental influences. Therefore, the present study was carried out under laboratory conditions with the objectives to find out the estimates of genotypic, phenotypic and environmental correlations that exist between seed weight and other seedling traits of a random mated sunflower population.

MATERIALS AND METHODS

The research studies reported in this paper were conducted in the laboratory of the Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad during April, 1988. The experimental material comprised of 40 S_1 progenies of sun-

flower developed from a random mated population. The S_1 progenies were grown in the laboratory by using a randomized complete block design with three replications. Twenty filled and healthy seeds from each S_0 progeny were weighed and multiplied with 5 to obtain 100-seed weight. Then these seeds were raised in each replication in polythene bags of 23 x 8 cm size at the depth of 3 cm. Each polythene bag contained approximately 500 g of sun-dried river sand and accommodated single plant. Adequate moisture levels were maintained by watering the seedlings with tap water. Ten plants from each S_1 family in each replication were randomly selected and data on emergence, emergence index and emergence rate index were recorded till 13 days after planting (DAP). Emergence index (EI) is an estimate of rate of emergence for each S_1 family in each replication and was calculated according to the formula (Smith and Millet, 1964; Mock and Eberhart, 1972):

$$EI = \frac{\Sigma \text{ (Plants emerged in a day) (DAP)}}{\text{(Plants emerged by 13 DAP)}}$$

Emergence rate index for each S_1 family was calculated as the ratio of emergence index to emergence percentage.

The randomly selected seedlings were carefully washed free of sand at 13 days after planting and divided at the cotyledonary node into their respective shoot and root portions. Then the data on shoot length, root length, fresh shoot weight, fresh root weight, dry shoot weight, dry root weight and root/shoot ratio (dried root weight/dried shoot weight) were recorded on per seedling basis.

Genotypic, phenotypic and environmental correlation coefficients were calculated for all the pairs of traits according to the formula given by Kwon and Torrie (1964). The significance of phenotypic correlation coefficients were tested by using *t*-test (Steel and Torrie, 1980). The standard errors of genotypic correlation coefficients were calculated according to the formula devised by Tallis (1959). The genotypic correlation coefficients were considered significant if their absolute value exceeded twice their respective associated standard errors.

RESULTS AND DISCUSSION

The phenotypic correlation coefficient (Table 1) was negative and significant ($P<0.01$) between seed weight and emergence. This is in agreement with the results of Hay and Gamble (1981). These results are in contradiction with those of Adamo *et al.* (1984) who showed different seed size classes of sunflower to have no significant effect on percentage germination. This contrast may be due to the fact that in the present study, S_1 families were obtained at random from a random mated population of sunflower and for their selection no distinct classes of seed size or seed weight were made. It also indicated that S_1 families which possessed lighter seed weight had better emergence percentage.

The phenotypic correlation coefficient was positive and significant ($P<0.05$) between seed weight and fresh shoot weight while the same estimate was positive and significant ($P<0.05$) between seed weight and fresh shoot length. The estimate of phenotypic correlation coefficients of seed weight with emergence index was smaller in magnitude. The emergence index estimates the rate of emergence of the seedlings, hence it can be concluded that the rate of emergence of the sunflower seedlings in S_1 families is not influenced by variations in seed weight. Eagles and Hardacre (1979) have reported very small value of phenotypic correlation coefficient between seed weight

Table 1. Estimates of phenotypic correlation coefficients (rp), genotypic correlation coefficients (r_g) along with their respective associated standard error (S.E. of r_g) in parenthesis and environmental correlation coefficients (r_e) between seed weight and ten seedling traits of sunflower

Seedling trait	r_p	r_g	r_e
Emergence (%)	-0.415**	-0.500 (0.581)	0.161
Emergence index	0.009	-0.043 (0.764)	0.518
Emergence rate index	0.186	0.217 (0.722)	-0.038
Fresh shoot length (cm)	0.235*	0.258 (0.687)	-0.056
Fresh root length (cm)	0.147	0.204 (0.747)	-0.217
Fresh shoot weight (mg)	0.643**	0.711 (0.365)	-0.193
Fresh root weight (mg)	-0.060	-0.061 (0.778)	-0.108
Dry shoot weight (mg)	0.187	0.254 (0.744)	-0.136
Dry root weight (mg)	-0.077	-0.088 (0.737)	0.044
Dry root weight/ Dry shoot weight	-0.131	-0.173 (0.735)	0.238

*, ** Significant at 0.05 and 0.01 probability levels, respectively.

and emergence time in the seedlings of some S_1 lines of maize. The phenotypic correlation values between seed weight and the root weights (both fresh and dry) were also small.

The magnitude of genotypic correlation coefficients between seed weight and the seedling traits were a little higher than their corresponding phenotypic correlation coefficients, although the directions were almost

similar. However, the genotypic correlation coefficients between seed weight and all the other seedling traits were non-significant when tested against their respective associated standard errors.

We conclude from our findings that the roots of small seedlings grow more or less independently of seed weight and are the least affected by variations in seed weight. However, increasing seed weight can increase fresh shoot length and fresh shoot weight. Rate of emergence of the sunflower seedlings in S_1 families is not influenced by seed weight. Moreover, S_1 families of sunflower which possess lighter seed weight has better emergence percentage.

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