Research Article

Heritability and correlation for yield attributes in Sunflower

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Abstract

Heritability and correlation coefficients are two genetic parameters being extensively utilized in breeding populations. The present study was planned to estimate heritability and correlation among oil traits and seed yield in sunflower. Ten sunflower genotypes were evaluated for yield performance name under viz, 17492, 17594, 17595, 17596, 17597, 17599, 17604, 17605, 17606 and 17607 in randomized complete block design. Parameters studied were 50% days to flowering, plant height, , plant population, 100 grain weight and grain yield. Association and heritability estimates were studied among various yield related attributes. Both genetic correlations and phenotypic were significant except days to flowering and plant height with head diameter with plant height in phenotypic correlation. Seed yield is positively correlated with all traits except plant height both at genetic and phenotypic level. In genetic correlation head diameter is negatively correlated with plant height. High heritability estimates were calculated for all characters. Minimum heritability estimates of 60% and 76% were found for 100 seed weight and seed yield, respectively.

Key words: Sunflower; Genotypic correlation; Heritability; Seed yield; Plant height

Introduction

In economy of Pakistan for oil production Sunflower (*Helianthus annuus* L.) can play a fundamental role due to its high yield potential, drought resistance, salt tolerance and adjustment in the current cropping pattern. It is a non-conventional oilseed crop and not strictly seasonal-bound, short duration and can be grown twice a year. It can be grown in main barani and irrigated zones of Pakistan [1]. Sunflower seed

contain 45% oil content and 40% protein [2].

Heritability estimates give evidence about calculating the response to selection in the succeeding generation's and is all so give information about genetic variation. Heritability rely on the gene action nature [3]. For a best quality genotypes selection character associations and heritability estimates are computed and also designing useful breeding program in future pointing-out the possibilities and limitations of

simultaneous improvement of desirable characters are must [4]. The Plant breeders can easily notice and quantify phenotypic variation in plant population caused by the joint effects of environment and genotypic variation. Due to heritable nature of genetic portion the success of every breeding scheme, therefore, rely on the presence of the ample genetic variability for a trait which is amenable to selection. The degree of genetic variability that is transferable to the offspring called as heritability is of great importance for the improvement of any quantitative attribute. To compare the variability observed among different characters the coefficients of variation expressed at genotypic and phenotypic levels are used. A wide range of variation has been concluded for grain number and grain yield [5] and other main attributes of yield [6]. The heritability estimates help in concluding selection of the elite inbreds from a different population. The heritability thus help plant breeder in the wide variability present in the existing germplasm suggests good possibility for improvement of the crop through breeding technique. Correlation studies also aid to enhance different characters at the same time [7]. The correlation actually decrease the chance of doubts to occurs, thus the estimates based on correlation study are likely to be very close to reality. Grain yield was positively and significantly correlated with head diameter and 100-seed weight as observed by [8] and [7]. Days to flowering and days to maturity was negatively correlated with grain yield [9]. The present study was planned to estimate heritability and correlation among oil traits and seed yield in sunflower.

Material and Methods

The research was conducted at Agriculture Research Institute Swat, Pakistan in randomized complete block design (RCBD) design in March, 2015. Ten Sunflower genotypes namely 17492, 17594, 17595,

17596, 17597, 17599, 17604, 17605, 17606 and 17607 were provided Pakistan Plant genetic Resources, NARC, Islamabad. The plot size was kept 3×4 m². Plant to plant and row to row distance was 0.3m and 0.75m in each plot, respectively. Recommended fertilizers 80:50:50 kg ha⁻¹ NPK were applied at sowing time to exploit their potential. Two or three seeds were dibbled in each hill for better emergence and to provide uniform stand of plants. Thinning was practiced after 10 to 12 days of sowing to retain one healthy seedling hill⁻¹. Data were taken on various parameters including days to flowering, head diameter (cm), plant height (cm), 100-seed weight (g) and seed yield (kg ha⁻¹). Weather data showed in figure 1. For each trait heritability and expected selection response were estimated as under;

Genetic variance

$$V_g = (GMS - EMS)/r$$

Error variance

$$V_e = EMS$$

Phenotypic variance

$$V_p = V_g + V_e$$

Heritability

$$h^2_{BS} = V_g / (V_g + V_e) = V_g / V_p$$

Expected selection response

$$(Re) = i\sqrt{V_p}h^2$$

Genotypic and phenotypic correlation coefficients were estimated among the traits following the method given by [10].

Results and discussion

The Statistical analysis of the data revealed that days to flowering, plant height, head diameter, plant population and seed yield were highly significant at 1% level of probability showed in table 1. The results pertaining to phenotypic and genotypic correlations among various attributes are presented in Table 2. Days to flowering showed positive and significant correlation with all studied traits except, plant height where the association was positive and non-significant ($P \leq 0.05$) both at phenotypic and

genetic level. Both phenotypic and genetic correlation of plant height with seed yield was negative and significant ($P \leq 0.05$). Negative association of plant height with head diameter showed that an increase in plant height will cause a decrease in head diameter and eventually seed yield. Selection for dwarf plants can have an increasing effect on the total number of grain per head and can start genetic improvement of the grain yield. The cause might be the better remobilization that occurs in dwarf sunflower cultivars and causes the grains to be filled better. More care must be taken for considering the traits such as the plant height as selection criteria. The reason is if the plant is very dwarf, it

might cause reduction of the struggle of plant to get sun light and other ecological factors, thus the seed yield would reduce. Therefore, it is necessary that the best plant height is studied more carefully. Negative correlation between plant height and head diameter was also reported by [7]. The strongest correlation of seed yield was found with head diameter and 1000-grain weight at genotypic level ($r = 0.99$, $r = 0.70$) showed in (Table 2). Yield components i.e. head diameter, 1000 grain weight and seed yield had significant and positive correlation with each other. [11, 12] obtained the same results in sunflower genotypes.

Figure 1. Metrological conditions prevailing during the crop period are given as under at agriculture research institute, Swat during 2015

Table 1. Mean square values DF, PH, HD, PP, 100-SW and SYLD in sunflower at Agriculture Research Institute, Swat during 2015

Source of variance	Reps	Genotype	Error
Degree of freedom	2	9	18
DF	35.03	132.30**	26.18
PH	1824.60	2223.50**	235.50
HD	37.43	64.52**	23.21
PP	38.63	57.87**	12.74
100-SW	1.33	2.97**	5.77
SYLD	0.09	0.13**	0.04

DF = Days to flowering, PH = Plant height, HD = Head diameter, PP= Plant population,

100-SW = 100-Seed weight, SYLD= Seed yield

Table 2. Estimation of genotypic and phenotypic correlations among yield related traits in sunflower at agriculture research institute, Swat during 2015

Traits		DF	PH	HD	PP	HSWT	SYLD
DF	rp	1					
	rg	1					
PH	rp	0.058 ^{non}	1				
	rg	0.004 ^{non}	1				
HD	rp	0.458**	0.032**	1			
	rg	0.969**	-0.063 ^{non}	1			
PP	rp	0.311**	0.337**	0.269**	1		
	rg	0.764**	0.226*	0.363*	1		
HSWT	rp	0.111*	0.263**	0.404**	0.353**	1	
	rg	0.304*	0.464**	0.544**	0.407*	1	
SYLD	rp	0.449*	-0.249**	0.489**	0.113*	0.366**	1
	rg	0.571**	-0.229*	0.999**	0.607**	0.700**	1

DF = Days to flowering, PH = Plant height, HD = Head diameter, PP= Plant population,

100-SW = 100-Seed weight, SYLD= Seed yield

*,** = significant at 5% and 1% probability level

Heritability estimates varied from moderate to high level in magnitudes for studied traits (0.60 to 0.96) indicating potential of genetic improvement in most attributes. For improvement in quality traits of sunflower and yield significant genetic variability mostly helpful. Heritability estimates remained variable depending upon the traits studied and the genetic nature of genotypes. The heritability estimates in broad sense for various plant traits of sunflower are depicted in (Table 3). Maximum heritability estimate 0.96 was calculated for plant height (Table 3). The heritability estimates for various traits were recorded as for days to flowering% ($h^2_{BS} = 93\%$), plant height ($h^2_{BS} = 96\%$), head diameter ($h^2_{BS} = 89\%$), plant population ($h^2_{BS} = 93\%$), 100-seed weight ($h^2_{BS} = 60\%$), seed yield (h^2_{BS}

$=0.76\%$). The higher heritability estimates for majority of the attributes recommended that selection for such traits is helpful. Broad sense heritability were high for head diameter (97.47%), plant height (78.10%) and seed yield (67.74%) [13]. High values of heritability indicate that genetic variance plays a major part in total variance, contra to low values which indicate that environmental variance is of importance. Our results of high heritability for plant height were confirmed by [14-16] who also reported high values in the broad sense heritability for this trait. Seed yield is moderately heritable as compared to other traits, [16, 17] reported low values of heritability for this trait. Head diameter showed high heritability, similar values in the broad sense heritability [13].

Table 3. Mean components of variance, heritability and selection response in percent of mean for seed yield and yield related traits in sunflower at Agriculture Research Institute, Swat during 2015

	DTF	Ph	HD	PP	HSWT	SYLD
Variance component						
Vg	132.30	2223.54	64.52	57.86	2.96	0.04
Ve	26.18	235.49	23.21	12.74	5.77	0.04
Vp	141.00	2302.00	72.26	62.11	4.88	0.05
Heritability (h^2_{BN})	0.94	0.96	0.89	0.93	0.60	0.76
Selection Response	15.60	64.90	10.60	10.30	1.90	0.20

DF = Days to flowering, PH = Plant height, HD = Head diameter, PP= Plant population, 100-SW = 100-Seed weight, SYLD= Seed yield

Conclusion

From The present study it can be concluded seed yield has positive and significant association with head diameter and 100 seed weight at both genotypically and phenotypically. The selection of these yield related traits would become effective to bring about simultaneous improvement for yield in sunflower.

Authors' contributions

Conceived and designed the experiments: A Khan & F Ahmad, Performed the experiments: Alia, Analyzed the data: IH Khalil, Contributed reagents/ materials/ analysis tools: M Noor & Durishiwar, Wrote the paper: M Noor & Alia.

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