CORRELATION STUDIES OF DIFFERENT METRIC TRAITS IN SUNFLOWER (*HELIANTHUS ANNUUS* L.)

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خلاصہ

پاکستان میں تیل کے بیجوں کی فصل کے طور پر سورج مکھی کی کاشت نمایاں ہے اس کی اہمیت کی وجہ موجودہ تحقیق مختلف میٹرک خصائص میں تیل کے بیجوں کی فصلوں کے مطالعہ کے تناظر میں باہمی تعلق کی جانچ کرنے پر مرکوز تھی۔ انکرن (%)، دن سے 75% پھول، دن سے 90% پختگی، پودے کی اونچائی (سینٹی میٹر)، سر کا قطر (سینٹی میٹر)، 100-بیج کا وزن (g)، سے بیجوں کا وزن ha-1(kg) اور بیج کا سر-1 جس نے سورج مکھی کے جین ٹائپس میں زیادہ تر حروف کے لیے P <0.01 پر نمایاں فرق ظاہر کیا۔ اوسط کارکردگی کے نتائج سے پتہ چلتا ہے کہ I-A نے زیادہ سے زیادہ انکرن % (91.66) ظاہر کیا، کم از کم دن سے 75% پختگی ریکارڈ کی گئی (56.66)، پودے کی کم اونچائی (103.33 سینٹی میٹر)، سر کا سب سے بڑا قطر (18.00 سینٹی میٹر) اور بیج کے سر کی زیادہ تعداد۔ 1(6.00)۔ مزید برآں، پشاور اور HO-1 میں سورج مکھی کے لیے زیادہ سے زیادہ دن سے 90 فیصد پختگی (106.55 اور 106.67) ریکارڈ کی گئی۔ چارنکا نے سب سے اونچی اونچائی (121.67 سینٹی میٹر)، 100 سے زیادہ بیج وزن (6.33 گرام) اور کم از کم بیج کا سر 1 کا بھی مشاہدہ کیا۔ ارتباطی تجزیہ سے پتہ چلتا ہے کہ بیج کی پیداوار (کلوگرام/ہیکٹر) 75 فیصد سرخی اور انکرن فیصد کے دنوں کے ساتھ مضبوط اور بامعنی تعلق ظاہر کرتی ہے۔ لہذا، A-1 اور HO-1 نے بہترین جین ٹائپس کی پیش گوئی کی ہے اور سورج مکھی کی فصل میں مزید افزائش کے لیے استعمال کیا جا سکتا ہے۔

Abstract

The cultivation of sunflowers as an oilseed crop is significant in Pakistan. Due to its importance the current research is performed. It is focused on examining the correlation within the context of oilseed crop studies in different metric traits viz'. germination (%), days to 75% flowering, days to 90 % maturity, plant height (cm), head diameter (cm), 100-Seed weight (g), seed weight ha-1(kg) and seeds head-1. All the characters showed significant differences at P<0.01 in sunflower genotypes. The mean performance results showed that A-I exhibited maximum germination percentage (91.66), minimum days to 75% flowering or heading was recorded (56.66), shorter plant height (103.33cm), largest head diameter (18.00 cm) and, greater number of seed head-1(6.00). Moreover, maximum days to 90% maturity (106.55 and 106.67) for sunflower were recorded in Peshawar and HO-1. Charinka also had the tallest height (121.67 cm), the greatest 100 seed weight (6.33 g) and minimum seed head 1. Correlation analysis revealed that seed yield (kg/ha) strongly and meaningfully associated with days to 75% heading and germination percentage. Hence, A-1 and HO-1 were predicted to best genotypes and can be used for further breeding sunflower crops.

Keywords: Sunflower; Correlation; Genotypes, Yield; Germination; Oilseed crop; Head diameter.

Introduction

Sunflower *(Helianthus annuus* L.) ranks among the most significant oilseed crops globally. Sunflower achenes contain 35-42 percent oil and 20-21 percent protein, potentially closing the gap between global supply and the utilization of edible oils and animal feed (Hussain *et al.,* 2018). Although the seeds of confectionery sunflower are also used as treats, it is mostly utilised for forested oil. Sunflower comes in fourth place after palm oil, soybean oil, and canola oil, accounting up to 12% of global vegetable oil production (Rauf *et al.,* 2017). The previous year's sunflower production was 54.96 million tonnes. The 50.04 million tonnes predicted for this year could imply a drop of 4.93 million tonnes, or 8.97 percent, in global sunflower production (2021 USDA). A 2.748 million tonnes of edible oil worth Rs: 321.535 billion ($ 2.046 billion) was imported, with indigenous production accounting for 0.680 million tonnes, or 24% of total availability, and imports accounting for the rest 1246 million tonnes (Economic Survey of Pakistan, 2019-20). Sunflower could turn into the preferred oilseed cultivation in the future, particularly considering global environmental changes, due to its ability to multiply in a variety of Agro-ecological settings and moderate drought tolerance. Even while simulations revealed that sunflower yields in northern Europe would improve because of expected climate change, Southern latitudes may experience adverse impacts on sunflower yields (Debaeke *et al.,* 2017). The sunflower hybrids' achievements in terms of appearance and performance are excellent. As a result, sunflower ranks as the second-largest hybrid crop following maize (Seiler *et al.,* 2017). The introduction of novel cultivars or hybrids could aid in the production of more oil. Open pollinated sunflower varieties can be replaced by hybrids and their parental lines that provide superior yields

(Ghaffari *et al*., 2011). To determine the relationship between two characters, correlation research is required. The direct and indirect impact of different characters on yield and yield interrelated characters is described by path analysis. This aids in the recovery of our genetic material to produce high yields (Tahir *et al*., 2018). Understanding the genetic system that controls yield and its components is helpful in determining the repentance of parents and hence assisting in the selection of parents with in-built genetic potential. For a successful selection programme, interrelationships between yield and its components are unavoidable, as is the mutual association of plant characteristics is assessed through the correlation coefficient, which helps determine the strength of the relationship between different plant traits and the component character that can serve as a basis for genetic selection. Yield improvement. However, such studies do not provide information on the proportional relevance of direct and indirect effects of each component character on yield (Baraiya *et al.,* 2018). Plant height, head diameter, seeds/head, and seed index all had positive and substantial associations with seed yield/plant, indicating that genotypes with greater levels of these attributes may be chosen in the evolution of high yielding sunflower genotypes (Baloch *et al.,* 2016). Oil content was found to be favourably connected with plant yield per plant, with a highly significant and favourable connection. During both the spring and autumn seasons, plant height, days to bloom initiation, and days to maturity demonstrated a positive and significant relationship (Tyagi *et al.,* 2013). . The sunflower researchers have utilised this strategy frequently (Pandya *et al.,* 2016).

The sunflower was assessed for its leaf traits variation against drought conditions and a decline in the overall mass such as a decrease in the area of leaf and stomata size. This will increase with the increase in the drought stress (Ashley *et al*., 2024).

Materials and Methods

The study was conducted in the year 2020-2021 during Rabi season, at oilseeds. Research Institute, Tandojam (Sindh, Pakistan). Seven different genotypes were studied for all the traits, which include: A-I, TJ-1, HO-1, Albania, PSF-025, Charanika and Peshawar-93. All these varieties were obtained from the oilseeds research institute, Tandojam. The seeds were surface sterilized before their sowing. The field was prepared with randomized complete block design (RCBD) with a net plot size of (15 m^2). A good seedbed was prepared to adopt suitable land preparation practices that are recommended for sunflower. All the genotypes replicated thrice. The recommended dose of NPK (Nitrogen, phosphorus, potassium) is 40:50:40 kg $ha^{-1.}$ At the time of sowing 50% of N and entire amount of P and K were applied in the field. After almost two weeks of sowing the thinning was performed in which the extra and unhealthy seedlings were removed from the field. After the plants become mature and flowering and fruiting takes place then following traits were observed for each genotype: Germination (%), minimum days to 75% heading or flowering, maximum days to 90 % Maturity, Plant height (cm), Head diameter (cm), Number of seed/heads, and 100 Seed weight (100-achene weight, g).

***Statistical Analysis*:** The ANOVA was conducted following the methodology outlined by Gomez and Gomez (1984). To compare the means of the genotypes for all the traits, a Least Significant Difference (LSD) test was conducted at a 1% probability (Table 2) level. Additionally, simple correlation (r) and regression coefficients (b) were computed based on the methodology described by Snedecor and Cochran (1980).

Results and Discussion

The study was done at the oilseeds Research Institute Tandojam during the Rabi season, 2020-2021, to examine the performance of the following seven different varieties of sunflower (*Helianthus annuus*): A-I, TJ-1, HO-1, Albania, PSF-025, Charanika, and Peshawar-93. The results are summarized in table 1. The table showed the mean values of all the replicates. The parameters studied were the percentage of germination which was recorded highest in A-I variety. The second column showed the difference in observations that in how many minimum days 75% maturity occur. It is then followed by how many maximum days required to attain the 90% maturity. Besides these the final plant height (in cms), the diameter of the capitulum or head, the weight of 100 seeds (in gms) and per head how many seeds develop were also recorded. The results of ANOVA are presented in Table 2. All the traits showed significant difference at probability <0.01. The correlation coefficient results are mentioned in table 3. This table give details of all the traits which are significant and non-significant.

Table-1: Overall comparative mean performance of the traits studied in all the varieties of sunflower.

Genotypes	Germination (%)	Days to 75% flowering/heading	Days to 90% maturity	Plant height (cm)	Head diameter (mm)	100-Seed Weight (gm)	Number of seed/ Head
1. A-I	91.667	56.667	86.67	103.33	18.000	6.0000	1661.0
2. TJ-1	76.667	63.333	96.67	115.00	17.333	5.0000	1050.0
3. HO-1	73.333	65.000	106.67	118.33	14.667	5.6667	1233.3
4. Albania	62.331	72.667	102.67	105.33	16.333	5.11	1250.0
5. PSF-025	63.333	71.667	101.67	109.33	17.667	5.6667	1446.7
6. Charanika	75.000	61.667	103.33	121.67	15.667	6.3333	1222.3
7. Peshawar-93	86.667	61.667	106.55	120.00	14.55	5.3333	1233.3
LSD (0.5%)	1.7252	1.5215	2.2713	3.2005	0.8341	0.6627	117.36
Std Error (Diff of 2 Means)	2.4398	2.1517	3.2121	4.5262	1.1796	0.9372	82.983

Key: LSD; Least significant difference, Std. Error; Standard error.

Table-2: Mean squares of analysis of variance (ANOVA) of the studied quantitative traits in all the seven varieties of sunflower.

Trait	Days to 75% Flowering or heading	Days to 90% maturity	Plant height (cm)	Germination (%)	Head diameter (mm)	Seed Head^{-1}	100-Seed Weight (gm)
Days to 75% maturity	0.452*						
Plant height (cm)	-0.128ns	0.580**					
Germination (%)	0.821**	-0.449*	0.051ns				
Head diameter	0.138ns	-0.6325**	-0.437*	0.026ns			
No seed head	-0.423*	-0.329ns	-0.287ns	0.542*	0.054ns		
100-Seed weight	-0.327ns	-0.156ns	-0.101ns	0.200ns	-0.167ns	0.161ns	
Seed yield	0.423*	-0.329ns	-0.287ns	0.542*	0.053ns	0.121ns	0.161ns

Table-3: Correlation analysis of different quantitative characters in sunflower genotype.

Source	D.F	Germination (%)	Days to 75%Flowering or heading	Days to 90 % maturity	Plant height (cm)	Head diameter (mm)	100-Seed Weight (gms)	Number of seed Head-^{1}
Replications	02	8.929	8.3333	15.476	38.286	2.47619	7.42857	495
Genotypes	06	344.048**	90.873**	146.429**	160.825**	5.777**	0.746**	115079**
Error	12	46.429	6.944	15.476	30.730	2.087	1.317	20659

**, * = Significant at 1% and 5% probability level and ns=non-significant

The mean squares obtained indicated significant differences for most of the characters observed in all the seven different sunflower genotypes. This suggests that genotype of investigated sunflower possess useful genetic resources, which make it more useful for the future studies to improve the varieties of sunflower. Similar findings

were observed by Memon *et al.* (2014) and Baloch *et al.* (2016) while they conduct research on variations in sunflower. Regarding mean performance, the results for germination % showed that the genotype A-I exhibited maximum germination (91.66%) and minimum germination was observed in Albania (62.33%). Maximum number of days to 75% heading/flowering was recorded in Albania (122 days), and minimum days to 75% heading/flowering was observed in A-I (56.66 days). The longest duration of 106.67 days was observed in HO-1, followed by Peshawar-93 showing 106.55 days for 90% maturity, while the shortest period of 86.67 days was observed in A-I variety.

In case of plant height, the tallest plant height was recorded in Charanika variety (121.67 cm), whereas A-I genotype attained shorter plant height of 103.33 cm. The largest head diameter of 18 mm was recorded in A-I; while, the smallest diameter of 14.55 mm was recorded in Peshawar-93. The highest weight of 100 seeds (6.33 g) was observed in Charanika, in contrast to this the smallest weight i.e. 5 g was showed in TJ-1. The maximum number of seeds/head were observed in A-I (1661.0), whereas a minimum of 1222.3 seeds/head were observed in Charanika. Overall the genotype A-I showed high performance in majority of the phenotypic characters, therefore it showed potential to be used in hybridization programs which may results in genetic advancement in sunflower. The nature, range of genetic diversity, the degree of interrelationships between yield and its key contributing features, are all important factors in crop genetic improvement. Plant breeders should consider to obtain the genetic diversity within breeding materials from other locations if such genetic variability is not locally available. This will help in developing genetic variability for enhancing different traits (Baloch *et al.,* 2016).

A positive significant association was observed in days to 75% heading with days to75% maturity (0.45*); on the other hand the germination percentage showed a negative association (-0.82**). As far as head diameter (0.13) and seed yield (0.42) was concerned the association was found to be positive but not significant. The plant height (-0.13) and seed weight (-0.32) showed negative and non-significant association. The plant height exhibited a noteworthy and negative correlation with head diameter (-0.43*), but showed non-significant with seeds head-1 (-0.28) and seed weight (-0.10). Lastly the germination percentage was found to have non-significant correlation with head diameter (0.02) and seed weight (0.20).

Conclusion

From the results and discussion it is concluded that the findings were significant at $P<0.01$ in different characters viz. germination (%), days to 75% flowering/heading, days to 90 % maturity, plant height (cm), head diameter (cm), 100-Seed wt. (g), seed wt. kg/ha and seeds/head. The mean performance results showed that A-I exhibited maximum germination % (91.66), minimum days to 75% maturity was recorded (56.66), attained shorter plant height (103.33cm), largest head diameter (18.00 cm) and greater number of seed $head^{-1}$ (6.00). Moreover, a maximum day to 90% maturity (106.55 and 106.67) for sunflower was recorded in Peshawar and HO-1. Charinka also observed tallest height (121.67 cm), greater 100 seed weight (6.33 g) and minimum seed $head^{1}$.

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