CORRELATION, REGRESSION AND PATH ANALYSIS OF SEED AND OIL YIELD IN SUNFLOWER (HELIANTHUS ANNUUS L.) GENOTYPES

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ABSTRACT

Correlation and path coefficient analyses were studied in twenty-five diverse genotypes of sunflower in order to understand the relationship and contribution on eight characters towards the seed yield. The seed yield exhibits highly significant and positive correlation with plant height, oil yield and number of seeds per head. Days to full flowering and head diameter showed significant and negative correlation with seed yield. Path coefficient analysis revealed that no. seed/head had the highest and positive direct effect on seed yield. On the other hand, days to full flowering and head diameter showed the highest and negative direct effect on seed yield. On the other hand, the traits no. seed/head, 1000-seed weight and plant height showed the positive and direct effects on oil yield. Over all, the study revealed the importance of selection for the higher amounts of these traits and lower amounts of days to full flowering as the best indirect selection criteria to improve seed and oil yield in sunflower breeding programs especially in early generations.

KEYWORDS: Sunflower, genetic improvement, regression and path coefficient analysis, indirect selection

INTRODUCTION

Seed and oil yields are the most economic characters in oil crops. Yield is a complex entity and inheritance of yield depends upon a number of characters, which are often polygenic in nature and are highly affected by environmental factors (Nadarajan and Gunasekaran, 2005). Knowledge of genetic system controlling yield and its components is useful in understanding the prepotency of the parents and thus help to select parents possessing in-built genetic potential. For efficient selection, programmed interrelationship between yield and its components is inevitable and mutual association of plant characters, which is determined by correlation coefficient and is used to find out the degree (strength), mutual relationship between various plant characters and the component character on which selection can be relied upon the genetic improvement of yield. But information on the relative importance of direct and indirect effects of each component characters towards yield is not provided by such studies.

Path coefficient is helpful in partitioning the correlation into direct and indirect effects so that relative contribution of each component character to the yield could be assessed (Jannati, 2002). In other words, path analysis measures the direct and indirect contribution of various independent characters on a dependent character. (Taghdiri et al.,2006) have suggested that the number of plant is the main and effective factor in creating seed yield. The results obtained by (Teklewold et al, 2006) showed that the head diameter had the highest direct effect on seed yield and also the seed filling percentage and plant height had the highest indirect effect on seed yield through head diameter. Earlier in sunflower, (Punia and Gill ,1994), (Shankar et al,2006; Farratullah et al,2006) applied path coefficient by partitioning the genotypic correlations into direct and indirect effects of the traits. Moreover, other researchers (Arshad et al., 2006; Ghafoor and Ahmad, 2005) have used these techniques along with diversity study for investigating genetic parameters. Therefore, the present investigation was undertaken to determine the mutual association among thirteen selected traits in twenty-five sunflower genotypes and their direct and indirect effects on seed and oil yield by using correlation, regression and path coefficient analysis.

MATERIALS AND METHODS

The materials for the present study consisted of twenty-five genotypes of sunflower that were introduced from Karadj Agriculture Research Institute, Tehran, Iran. The field experiment (3 × 2.4 m) was laid out in randomized block design with three replications at Experimental Center, College of Agriculture, Islamic Azad University, Isfahan Branch, Isfahan, Iran during 2013-2014 farming season. Geographically the farm located at 51° 23’ northern latitude and 32° 32’ eastern longitude. Elevation from sea level is 1590 m. Climate is semi-dry and dry with heat and dry summer based on Copene method.
Annual mean of precipitation and temperature were 130mm and 14 °C, respectively. Field capacity and wilting point were 38 and 9 percent of weighted humidity. The land was under clover cultivation in previous year. Soil texture was silty-loam with 1.5% of organic carbon, 0.02% of nitrogen, 20 p.p.m of available phosphorus, 504 p.p.m of available potassium, acidity of 7.8 and 3.5 mmohs/cm electrical conductivity in 0-30 cm depth. Out of the recommended dose of fertilizers (40:50:40 kg of NPK ha-1), 50% of N and entire dose of P and K were applied at the time of sowing and 2 - 3 seeds were dibbed per hill following a spacing of 60 x 30 cm. After 14 days of sowing, the excess seedlings were thinned out, retaining only one healthy seedling/hill. Five competitive plants were tagged at random in each treatment and in each replication for recording detailed observations. The observations were recorded on nine quantitative characters viz., days to bud stage, days to flowering initiation, days to 70% flowering, days to full flowering, days to ripening, plant height, head diameter, no. seed/head, 1000-seed weight, seed yield, oil percentage, oil yield and harvest index. Mean values were subjected to different statistical and biometrical analysis. Simple correlation coefficients were estimated according to Pearson’s method and path coefficient analyses were done as according to (Dewey and Lu, 1959). Data analysis was conducted by using Path2 and SAS3 statistical software.

RESULTS AND DISCUSSION

Correlation analysis indicated that traits plant height, oil yield and total number of seeds per head has positive and highly significant relationship with seed yield. Further, days to full flowering and head diameter showed a negative relation with seed yield. The correlation of other traits with seed yield weren't significant. The regression analysis of seed yield as dependent variable according to step-wise method demonstrated that just traits such as total number of seeds per head and weight of 1000-seeds entered to regression model and totally justified 98% of the variation exist in seed yield. At last, the following regression model was obtained for indicating the relationship between the seed yield and these traits as independent variables:

Seed yield = -1635.18 + 6.02 no.seed/head + 35.44 seed weight

On the other hand, days to full flowering and head diameter have a negative correlation as well as direct and negative effect on seed yield (table 1). Thus, selection for the lowest amounts of this trait can increase the seed yield. In other words, it is possible that the choices of genotypes, which enter the generative stage sooner and also terminate the flowering stage faster, causes the plant to escape preventing it from encountering the heat of end of the season. This mechanism leads to enhancement the yield in stress conditions of the end of season (Richards, 1996). For considering the traits such as the plant height as selection criteria more care must be taken. Because, if the plant is too much dwarf, it might lead to reduce the competition of plant to get light and other environmental parameters, thus the seed yield would diminish. Therefore, it is necessary that the best plant height be studied more carefully. (Shankar et al, 2006) obtained the same results in sunflower genotypes. Correlation analysis (table 1) also indicated that such traits plant height, no. seed/head, seed yield and seed oil percentage had a positive and very meaningful correlation with oil yield. However, the traits such as days to bud stage, days to full flowering and 1000-seed weight showed the negative correlation with oil yield.

The regression analysis of oil yield as dependent variable and based on step-wise method designated that just the traits including no.seed/head, 1000-seed weight and seed oil percentage entered the regression model and totally accounted for 97.6% of changes in the oil yield. The following multiple linear regression models indicates the relationship between the oil yield and these traits as independent variables:

Oil yield = -2032 + 3.11 no. seed/head + 7.32 seed weight + 14.63 oil percent

The path analysis was done for the oil yield according to the independent traits i.e, days to bud stage, days to full flowering, plant height, no. seed/head and 1000-seed weight, which had a significant correlation with the oil yield (table 2). Meanwhile, some traits involving no. seed/head and 1000-seed weight had the highest direct and positive effect on the oil yield. So, choosing for higher amounts of these traits would bring the genetic improvement of oil yield.
in sunflower genotypes. Furthermore, days to full flowering has the highest direct and negative effect on the oil yield. Hence, selection for the genotypes that enter the flowering stage sooner and also terminate their flowering stage faster, might cause the plant to prevent from encountering the heat of the end of season and escape. This mechanism leads to increase the seed and oil yield under stress conditions at the end of season (Richards, 1996). The plant height has a direct and positive impact on the oil yield, but its indirect impact on no.seed/head is positive and considerable (table 2). So, the tall genotypes have higher oil yield. For this trait, its indirect effects on the oil yield, especially on the no.seed/head should be considered. The days to bud stage has also a negative and indirect effect on the oil yield, indicating the negative impact of this trait. Namely, the genotypes, which enter the budding stage sooner, have the higher oil yield. Preventing the plant from encounter with the stress conditions in generative phase might be the reason for this matter. The same mechanism also applies about days to full flowering, which prevents from reduction of the seed and oil yield. These results are in agreement with the findings of Faratullah and Khalil (2006) and Mokhtassi et al. (2006).

**Table 1. Path analysis of seed yield (dependent variable) in sunflower genotypes**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Days to full flowering</th>
<th>Plant height</th>
<th>Head diameter</th>
<th>No.seed/head</th>
<th>Total effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days to full flowering</td>
<td>-0.315</td>
<td>-0.003</td>
<td>-0.184</td>
<td>-0.138</td>
<td>-0.271</td>
</tr>
<tr>
<td>Plant height</td>
<td>-0.008</td>
<td>-0.108</td>
<td>0.193</td>
<td>0.424</td>
<td>0.503</td>
</tr>
<tr>
<td>Head diameter</td>
<td>0.120</td>
<td>0.042</td>
<td>-0.482</td>
<td>-0.075</td>
<td>-0.394</td>
</tr>
<tr>
<td>No.seed/head</td>
<td>0.056</td>
<td>-0.060</td>
<td>0.046</td>
<td>0.765</td>
<td>0.809</td>
</tr>
<tr>
<td>Residual effects</td>
<td>0.400</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 2. Path analysis of oil yield (dependent variable) in sunflower genotype**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Days to bud stage</th>
<th>Days to full flowering</th>
<th>Plant height</th>
<th>No.seed/head</th>
<th>1000-seed weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days to bud stage</td>
<td>-0.002</td>
<td>-0.077</td>
<td>-0.029</td>
<td>-0.196</td>
<td>0.004</td>
</tr>
<tr>
<td>Days to full flowering</td>
<td>-0.001</td>
<td>-0.114</td>
<td>0.003</td>
<td>-0.182</td>
<td>-0.27</td>
</tr>
<tr>
<td>Plant height</td>
<td>0.001</td>
<td>-0.003</td>
<td>0.124</td>
<td>0.562</td>
<td>-0.114</td>
</tr>
<tr>
<td>No.seed/head</td>
<td>0.001</td>
<td>0.020</td>
<td>0.069</td>
<td>1.014</td>
<td>-0.229</td>
</tr>
<tr>
<td>1000-seed weight</td>
<td>-0.001</td>
<td>0.008</td>
<td>-0.039</td>
<td>-0.634</td>
<td>0.366</td>
</tr>
<tr>
<td>Residual effects</td>
<td>0.337</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In conclusion, in order to improve the seed yield in sunflower genotypes it is better to select for the higher amounts of no.seed/head and lower days to full flowering. For oil yield, no.seed/head, 1000-seed weight and plant height are the best indirect selection criteria. The higher amount of these traits plus lower days to full flowering is promising in sunflower oil and seed genetic improvement programs.

**REFERENCES**


