GENETIC IMPROVEMENT IN LINSEED
(*LINUM USITATISSIMUM* L.) THROUGH VARIABILITY
HERITABILITY AND GENETIC ADVANCE

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ABSTRACT

Genetics improvement studies in linseed (*Linum usitatissimum* L.) through
variability, heritability, and genetic advance were conducted in Oilseed
Research Institute, AARI, Faisalabad during 2011-12. All characters showed
higher phenotypic coefficient of variance values than their corresponding
genotypic coefficients of variance. Number of branches per plant (29.405,
32.024), capsules per plant (20.830, 23.609), and seed yield per plant (25.199,
25.468) had higher GCV and PCV values indicating their favourable response to
selection. Most of the traits showed higher heritability indicating the chances
of improvement through heritability estimation. The highest heritability was
observed for seed yield (0.979), subsequently plant height (0.978) as well as
days to 50 percent flowering (0.928). Lowest values of heritability were found
for seeds per capsule (0.615%) followed by number of capsules per plant
(0.778%). Highest values of genetic advance (GA) were noted for seed yield
(10.178%) and number of branches per plant (9.827%). The traits like primary
branches per plant, plant height, capsules per plant, seeds per capsule and
seed yield per plant, revealed high heritability as well as genetic advance.
Hence these traits must be kept in consideration for future selections.

KEYWORDS: *Linum usitatissimum* L.; linseed; genotypes; genetic
improvement; heritability; genetic advance; GCV; PCV; Pakistan.

INTRODUCTION

Linseed (*Linum usitatissimum* L.) occupies an important position in oilseed
crops of the world and Pakistan due to its uniqueness of producing both oil
from seeds and fibre from its stem. It may be grown commercially for oil or
fibre crop separately (6, 21). Linseed oil covers a very decent equilibrium of
omega-3 and omega-6 fatty acids. Omega-3 is of supreme importance as it

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is thought to lower blood cholesterol level and cardiovascular disorders in human beings if included in diet chain successfully (19). Oil contents of linseed vary from 33 to 45 percent having protein contents of 24 percent (8). Higher contents of linoleic acid (45-60%) in linseed oil are advantageous for commercial purposes while lesser linoleic acid content is obligatory for its human intakes. Its oil is being used through centuries as drying oil in paints, varnishes, printing ink, and resins. Its oil cake has no use in animal feed.

Yield is one of the prime objectives for crop breeder and grower as well. It is controlled by number of genes therefore; direct selection for yield improvement in linseed is challenging mainly because of multiple control and environmental influence on it. It is rather more successful to improve yield through indirect selection of yield parameters (7). Currently average yield and area of linseed in Pakistan is very miserable and need urgent attention. It is cultivated on 4018 hectares with total production of 2779 tons with average yield of 692 kg per hectare (1). Due to increasing demand and utilization of this miraculous crop, there is dire need to increase its yield potential so that nutritional deficiency of essential fatty acids can be addressed.

Information regarding the accurate estimates of genetic variation of quantitative characters is gathered from genetic traits as; heritability, genetic advance, and coefficients of variation (12). Variability calculations for yield and yield related characters become indispensable before planning for any breeding scheme for genetic perfection. Genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) are parameters useful for detecting the extent of variability present in germplasm (3). Heritability together with high genetic advance would be a helpful tool in forecasting the subsequent effect in selecting the best genotypes for yield and yield associated traits. Present study was carried out for assessment of variability for seed yield and its yield contributing characters in linseed.

**MATERIALS AND METHODS**

This study was carried out in Oilseed Research Institute, Ayub Agricultural Research Institute, Faisalabad during Rabi 2011-2012. The experiment was laid out in RCBD and repeated thrice. Thirty promising linseed strains along with a check (Chandni) were sown in 30 cm apart rows maintaining plant-to-plant distance of 10 cm in plots measuring 1.80 x 5.0 meters on 14th November 2011 using 20 kg seed per hectare. The genotypes included were LS-29, LS-50, LS-147, LS-151, LS-152, LS-165, LS-1002, LS-1007, LS-1008, LS-1018, LS-1023, LS-1102, LS-1106, LS-1108, LS-1113, LS-1115,
Genetic improvement in linseed


LS-1121, LS-1123, LS-7007, LS-7008, LS-7023, LS-7024, LS-7032, LS-7033, LS-7038, LS-7044, LS-7049, LS-7078, LS-9015, LS-9037 and Chandni (check). Fertilizer NP@ 58:58 kg per hectare were applied at sowing. All other agronomic operations were as per standard. Data on plant height (cm), branches per plant, capsules per plant, seeds per capsule, 1000 seed weight (g), seed yield per plant (g), days to 50 percent flowering and days to maturity were recorded by tagging 100 plants selected at random and then averages were calculated. The data were subjected to analysis of variance using the method devised by Steel et al. (20). Genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV), heritability in broad sense (h²) and genetic advance (GA) as percent of means were estimated by the formula suggested by Burton and DeVane (6) and Johnson et al. (10).

RESULTS AND DISCUSSION

Analysis of variance showed significant difference among genotype studied for all traits (Table 1). It specifies that ample quantity of genetic variation is existent for its effective management to detect superior genotypes.

Table 1. Mean square values for yield and yield contributing traits of linseed genotypes.

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>MS( VAR/TR )</th>
<th>MS(Replicates)</th>
<th>MS (Error)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant height (cm)</td>
<td>385.078**</td>
<td>6.457</td>
<td>2.807</td>
</tr>
<tr>
<td>Branches/plant</td>
<td>7.186**</td>
<td>0.075</td>
<td>0.42</td>
</tr>
<tr>
<td>Capsules/plant</td>
<td>113.371**</td>
<td>0.333</td>
<td>9.822</td>
</tr>
<tr>
<td>Seeds/capsule</td>
<td>3.504**</td>
<td>1.548</td>
<td>0.604</td>
</tr>
<tr>
<td>1000 seed weight (g)</td>
<td>0.223**</td>
<td>0.008</td>
<td>0.01</td>
</tr>
<tr>
<td>Days to 50% flowering</td>
<td>97.341**</td>
<td>8.055</td>
<td>2.454</td>
</tr>
<tr>
<td>Days to maturity</td>
<td>44.575**</td>
<td>6.948</td>
<td>2.068</td>
</tr>
<tr>
<td>Seed yield</td>
<td>370782.9**</td>
<td>1794.581</td>
<td>2626.314</td>
</tr>
</tbody>
</table>

MS = Mean squares, VAR = Variety, TR = Treatments.

Genotypic and phenotypic coefficients of variation

All characters expressed higher values of PCV than its corresponding GCV showing the environmental influence (Table 2). Highest PCV was observed in branches per plant (32.02) and lowest for days to maturity (2.31). Maximum GCV was detected for branches per plant (29.41) and minimum for days to maturity (2.16) (Table 2). Intermediate to low GCV values were recorded for seeds per capsule (13.80), plant height (13.30), 1000 seed weight (4.36), and days to 50 percent flowering (5.70). GCV values for capsules per plant and seed yield were 20.83 and 25.20, respectively. Higher values of both GCV and PCV indicated the possibility of getting more selection response to these
characters. Moderate estimates of GCV and PCV were detected mainly for plant height. Likewise, days to 50 percent flowering, days to maturity and 1000-seed weight had lower GCV and PCV values showing lesser response to selection in these characters. Pal et al. (19), Bhateria et al. (4), Awasthi and Rao (17) have reported similar results for seed yield per plant, Naik and Satapathy (16) for primary branches per plant. Awasthi and Rao (2) for secondary branches per plant and number of capsules per plant. High values of GCV designated the opportunity for further accomplishment of these traits. Parallel inferences were also stated by Mahto and Mahto (18) and Mishra and Yadav (14).

Heritability

High heritability estimates were obtained for most of the traits. The highest heritability was observed for seed yield (0.979), subsequently plant height (0.978) and days to 50 percent flowering (0.928). Lowest values of heritability were found for seeds per capsule (0.615) followed by number of capsules per plant (0.778) (Table 2). However, it is not always necessarily important that the characters having higher heritability values should also have higher genetic advance (9). Branches per plant, 1000-seed weight and days to maturity indicated moderate values of heritability i.e. 0.843, 0.871, and 0.873; respectively (Table 2). Khan and Gupta (11) also reported similar findings.

Table 2. Components of variation for yield and yield components of linseed genotypes.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>G.VAR.</th>
<th>P.VAR</th>
<th>GCV</th>
<th>PCV</th>
<th>$h^2$ (%)</th>
<th>GA (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant height</td>
<td>127.424</td>
<td>130.231</td>
<td>13.299</td>
<td>13.444</td>
<td>0.978</td>
<td>7.387</td>
</tr>
<tr>
<td>Branches/plant</td>
<td>2.256</td>
<td>2.675</td>
<td>29.405</td>
<td>32.024</td>
<td>0.843</td>
<td>9.827</td>
</tr>
<tr>
<td>Capsules/plant</td>
<td>34.516</td>
<td>44.338</td>
<td>20.83</td>
<td>23.609</td>
<td>0.778</td>
<td>7.787</td>
</tr>
<tr>
<td>Seeds/capsule</td>
<td>0.967</td>
<td>1.571</td>
<td>13.791</td>
<td>17.579</td>
<td>0.615</td>
<td>5.312</td>
</tr>
<tr>
<td>1000 seed weight</td>
<td>0.071</td>
<td>0.081</td>
<td>4.363</td>
<td>4.674</td>
<td>0.871</td>
<td>3.879</td>
</tr>
<tr>
<td>Days to 50% flowering</td>
<td>31.629</td>
<td>34.083</td>
<td>5.698</td>
<td>5.915</td>
<td>0.928</td>
<td>4.649</td>
</tr>
<tr>
<td>Days to maturity</td>
<td>14.169</td>
<td>16.237</td>
<td>2.161</td>
<td>2.314</td>
<td>0.873</td>
<td>2.736</td>
</tr>
<tr>
<td>Seed yield</td>
<td>122718.9</td>
<td>125345.2</td>
<td>25.199</td>
<td>25.468</td>
<td>0.979</td>
<td>10.178</td>
</tr>
</tbody>
</table>

G.VAR = Genotypic variation, P.VAR = Phenotypic variation, GCV = Genotypic coefficient of variance, PCV = Phenotypic coefficient of variance, $h^2$ = Heritability, GA = Genetic advance.

Genetic advance

Highest values of genetic advance were noted for seed yield (10.178) and number of branches per plant (9.827). Moderate genetic advance values were found for capsules per plant (7.787) and plant height (7.387). Rest of the characters exhibited low values of genetic advance (Table 2). Similar findings were observed by Payasi et al. (8) and Muhammad et al. (15).
CONCLUSION

A through screening of the material under study revealed that sufficient amount of variability is present in it which should be utilized further in any crop improvement programme. The traits like plant height, primary branches per plant, capsules per plant, seeds per capsule and seed yield per plant revealed high heritability as well as high genetic advance. Hence these traits must be considered in selection process for the development of elite genotypes of linseed.

REFERENCES


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