Genetic variability, heritability and genetic advance study in ridge gourd [Luffa acutangula L. (Roxb.)] germplasm

Pushpendra Kumar** and M. K. Singh*
Research Scholar**, Assistant Professor*
Department of Vegetable Science, NDUAT, Kumarganj Faizabad-224229
School of Agriculture, Lovely Professional University, Phagwara, Punjab

Abstract

The present investigation conducted with objective to assess the genetic variability among thirty two genotypes of ridge gourd for eleven traits viz., node number to anthesis of first staminate flower, node number to anthesis of first pistillate flower, days to anthesis of first staminate flower, days to anthesis of first pistillate flower, days to first fruit harvest, average fruit length (cm), average fruit diameter (cm), number of fruits per plant, average fruit weight (g), total fruit yield/plant (kg) and vine length (m).

Keywords: Ridge gourd, PCV, GCV, genetic advance, heritability

Introduction

Ridge gourd [Luffa acutangula L. (Roxb.)] is one of the most popular vegetable both as spring summer and rainy season crop. The crop originated in India. It is cultivated in India, Indonesia, Malaysia, Myanmar, Philippines, Sri Lanka and Taiwan. Wide genetic variation for various morphological and fruit characteristics is observed in different parts of India. Among the cucurbitaceous vegetables grown in India, gourd vegetables occupy an area of 73273 ha with an annual production of 685224 tonnes. In India, it is largely grown in Karnataka, Andhra Pradesh, Kerala, Tamil Nadu, Uttar Pradesh, Madhya Pradesh and Maharashtra states. In Karnataka, it occupies an area of 2,753 ha with an annual production of 18,706 tonnes (Anonymous, 2014).

Ridge gourd fruits contain moisture (95.2g), fat (0.1%), minerals (0.5g), energy (17kcal), protein (0.5%), calcium (18mg), phosphorus (26mg), carbohydrate (3%), iron(0.5mg), carotene (33mg) and vitamin C (5 mg) in per 100 g of edible portion. It has great medicinal value. A glycoprotein was isolated from seeds of L. acutangula L., which was found to be immunologically distinct from abortifacient proteins isolated from other members of the Cucurbitaceae family Yeung et al., (1991). Recently, this crop has been tested for its antioxidant (free radical scavenging-FRS) activity confirming the great interest of the nutraceutical sciences Ansari et al., (2005). Effectiveness of its extract as larvicide Prabakar and Jebanesan, (2004) and its seed oils as grain protectant against certain insects are not very far discoveries Mishra et al., (2007). Varietal uniformity is one of the main requirements for the improved cultivars.

Ridge gourd being most important to growers and consumer, there is pressing need to increase its productivity to fulfil the increasing demands throughout the year. The information usually needed for developing high yield varieties in a particular species pertains to the extent of genetic variability for desirable traits in the available germplasm. Evaluation of germplasm is the basic tool for identification of important genotypes. The great extent of natural variation present in various characters among the genotypes suggests
good scope of improvement in economic traits. Large variability ensures better chance of selecting new
genotypes. Variability parameters like genotypic and phenotypic coefficient of variation, heritability and
genetic advance, as well as degree of association between the various characters along with direct and indirect
effect of yield contributing characters on total yield, and genetic divergence among the genotypes for
quantitative traits is of paramount significance in formulating an appropriate breeding strategy aimed to exploit
the inherent variability of the original population

Materials and methods

The experimental material for the present investigation comprised of 32 germplasm of ridge gourd collected
from different places in India and being maintained at Main Experiment Station in the Department of Vegetable
Science, N.D. University of Agriculture & Technology, Kumarganj, Faizabad (U.P.). The experiment was
conducted in Randomized Block Design with three replications during summer season in 2014 to assess the
performance of 32 germplasm. Six plants were maintained in each row and replicated thrice. Sowing was done
at a spacing of 2.5 cm between row to row and 50 cm plant to plant having net plot size of 3x2.5 m. The
germplasm were sown in 23-03-2014. All the recommended agronomic package of practices and plant
protection measures were followed to raise a good crop. Observations were recorded on randomly selected six
plants from each germplasm in each replication for the following characters, node number to anthesis of first
staminate flower, node number to anthesis of first pistillate flower, days to anthesis of first staminate flower,
days to anthesis of first pistillate flower, days to first fruit harvest, average fruit length (cm), average fruit
diameter (cm), number of fruits per plant, average fruit weight (g), total fruit yield/plant (kg) and vine length
(m). The mean squares for error was subtracted from the mean squares due to genotypes and the difference was
divided by number of replications for obtaining the genotypic variance. Environmental variance is the mean
squares due to error. Phenotypic variance was calculated by adding genotypic variance and environmental
variance, which was suggested by Burton and de Vane (1953). Heritability in broad sense (h²bs) was calculated
using the formula suggested by Burton and de Vane (1953). Genetic advance (GA) was estimated by the
method suggested by Johnson et al. (1955).

Results

The data recorded on eleven traits from the experiment were subjected to analysis of variance. Mean
squares due to genotypes were highly significant for all the eleven traits (Table 1), indicating therefore
significant differences among the genotypes with respect to the traits under study. The estimates of phenotypic
coefficients of variation (PCV) were higher than genotypic coefficient of variation (GCV) for the all traits.
High magnitudes of variability was observed in case of node number to anthesis of first staminate flower
(30.58%) followed by total fruit yield per plant (23.96%), node number to anthesis of first pistillate flower
(21.26%) and vine length (20.83%) whereas, days to first fruit harvest (7.80%) had lowest coefficients of
variation. The heritability in broad sense ranged from 59.18 (days to anthesis of first staminate flower) to 91.58
per cent (average fruit length). Highest estimates of heritability (>63.79%) were observed for all character
except days to anthesis of first staminate flower which indicated moderate heritability 59.18 per cent.
Highest estimates of genetic advance in per cent of mean was recorded for node number to anthesis of first staminate flower (55.61%), node number to anthesis of first pistillate flower (37.28%), vine length (34.84%), average fruit length (34.75%) whereas, days to first fruit harvest (10.25%) showed low genetic advance in per cent of mean.

Discussion:

Coefficient of variability is the relative measure of dispersion. The phenotypic coefficient of variability is the product of genotypic and environmental of interaction (error variation).

The genetic variability present in the genotypes provided the raw material for plant breeding programme on which selection acts to evolve superior genotypes. Thus, higher the amount of variation present for character in the breeding material greater is the scope for its improvement through selection.

The phenotypic and genotypic coefficient of variations was estimated to assess the existing variability. In general the phenotypic coefficient of variability was higher than genotypic coefficient of variability which indicated that environment influenced considerably in expression of these traits.

The higher magnitude of coefficient of variation at phenotypic as well as genotypic levels were observed for phenotypic in node number to anthesis of first staminate flower, total fruit yield/plant (kg), node number to anthesis of first pistillate flower and vine length. Lower values were recorded in days to first fruit harvest and days to anthesis of first pistillate flower. Genotypic coefficient of variation higher value were observed in node number to anthesis of first staminate flower, total fruit yield/plant (kg), node number to anthesis of first pistillate flower, whereas days to first fruit harvest and days to anthesis of first staminate flower showed lower value of genotypic coefficient of variability result obtained in present investigations are in agreement with the finding of Singh (2006) in bitter gourd.

Heritability estimate which provides the assessment of transmissible genetic variability to total variability happens to be most important basic factor in determining the genetic improvement and response to selection.

However, the degree of improvement attained through selection is not only depending on heritability but also on the amount of genetic variation present in the breeding material and extent of selection pressure applied by the breeder. The parameter genetic advance in per cent of mean (\(\text{GA}\)) is more reliable index for understanding the effectiveness of selection to improve the traits because its estimate is derived by involvement of heritability, phenotypic standard deviation and intensity of selection. Thus, heritability and genetic advance in per cent of mean in combination provides clear picture regarding the effectiveness of selection for improving the plant characters.

The high magnitude of heritability in broad sense was observed for most of the traits except days to anthesis of first staminate flower and days to first fruit harvest which indicate lower magnitude of heritability in broad sense. The finding obtained in present study indicates good response to selection for these characters. The presence of high heritability coupled with high genetic advance in per cent of mean were observed for node
number of anthesis of first staminate flower, node number to anthesis of first pistillate flower total fruit yield/plant and average fruit length, which indicated that these characters may also provide good response to selection owing to their high transmissibility and variability and genetic advance showing additive gene effect. The above mentioned findings are in agreement with earlier reports Rajput et al. (1996) and Singh (2006) in bitter gourd; Amaral et al. (1994) in pumpkin and Karuppaiah et al. (2005) in ridge gourd genotypes.

References


Table-1 Analysis of variance (mean squares) for eleven quantitative characters in ridge gourd germplasm

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Characters</th>
<th>Source of variation</th>
<th>d.f.</th>
<th>Replications</th>
<th>Treatments</th>
<th>Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Node number to anthesis of first staminate flower</td>
<td></td>
<td></td>
<td></td>
<td>0.01</td>
<td>13.43**</td>
</tr>
<tr>
<td>2</td>
<td>Node number to anthesis of first pistillate flower</td>
<td></td>
<td></td>
<td></td>
<td>0.01</td>
<td>17.00**</td>
</tr>
<tr>
<td>3</td>
<td>Days to anthesis of first staminate flower</td>
<td></td>
<td></td>
<td></td>
<td>0.26</td>
<td>30.04**</td>
</tr>
<tr>
<td>4</td>
<td>Days to anthesis of first pistillate flower</td>
<td></td>
<td></td>
<td></td>
<td>0.13</td>
<td>45.49**</td>
</tr>
<tr>
<td>5</td>
<td>Days to first fruit harvest</td>
<td></td>
<td></td>
<td></td>
<td>0.51</td>
<td>46.46**</td>
</tr>
<tr>
<td>6</td>
<td>Average fruit length (cm)</td>
<td></td>
<td></td>
<td></td>
<td>0.03</td>
<td>53.32**</td>
</tr>
<tr>
<td>7</td>
<td>Average fruit diameter (cm)</td>
<td></td>
<td></td>
<td></td>
<td>0.005</td>
<td>0.83**</td>
</tr>
<tr>
<td>8</td>
<td>Number of fruits per plant</td>
<td></td>
<td></td>
<td></td>
<td>0.05</td>
<td>26.03**</td>
</tr>
<tr>
<td>9</td>
<td>Average fruit weight (g)</td>
<td></td>
<td></td>
<td></td>
<td>0.13</td>
<td>446.09**</td>
</tr>
<tr>
<td>10</td>
<td>Total fruit yield/plant (kg)</td>
<td></td>
<td></td>
<td></td>
<td>0.02</td>
<td>0.66**</td>
</tr>
<tr>
<td>11</td>
<td>Vine length (m)</td>
<td></td>
<td></td>
<td></td>
<td>0.001</td>
<td>1.15**</td>
</tr>
</tbody>
</table>

Significant at 1% probability levels
Table-2 Range, grand mean, phenotypic (PCV), genotypic (GCV) coefficient of variation, heritability in broad sense, genetic advance in per cent of mean (GA) for eleven characters in ridge gourd germplasms

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Characters</th>
<th>Range</th>
<th>Grand mean</th>
<th>Variability</th>
<th>Heritability in broad sense (h²bs)</th>
<th>Genetic Advance</th>
<th>Genetic advance in per cent of mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min.</td>
<td>Max.</td>
<td>PCV (%)</td>
<td>GCV (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Node number to anthesis of first staminate flower</td>
<td>3.33</td>
<td>12.67</td>
<td>7.21</td>
<td>30.58</td>
<td>28.73</td>
<td>88.28</td>
</tr>
<tr>
<td>2</td>
<td>Node number to anthesis of first pistillate flower</td>
<td>6.67</td>
<td>15.67</td>
<td>11.80</td>
<td>21.26</td>
<td>19.61</td>
<td>85.14</td>
</tr>
<tr>
<td>3</td>
<td>Days to anthesis of first staminate flower</td>
<td>31.67</td>
<td>44.33</td>
<td>37.51</td>
<td>9.89</td>
<td>7.61</td>
<td>59.18</td>
</tr>
<tr>
<td>4</td>
<td>Days to anthesis of first pistillate flower</td>
<td>38.67</td>
<td>56.00</td>
<td>45.89</td>
<td>9.51</td>
<td>7.92</td>
<td>69.34</td>
</tr>
<tr>
<td>5</td>
<td>Days to first fruit harvest</td>
<td>50.33</td>
<td>64.33</td>
<td>57.96</td>
<td>7.80</td>
<td>6.23</td>
<td>63.79</td>
</tr>
<tr>
<td>6</td>
<td>Average fruit length (cm)</td>
<td>14.50</td>
<td>32.93</td>
<td>23.56</td>
<td>18.42</td>
<td>17.63</td>
<td>91.58</td>
</tr>
<tr>
<td>7</td>
<td>Average fruit diameter (cm)</td>
<td>2.23</td>
<td>4.53</td>
<td>3.38</td>
<td>16.45</td>
<td>15.13</td>
<td>84.51</td>
</tr>
<tr>
<td>8</td>
<td>Number of fruits per plant</td>
<td>12.47</td>
<td>24.40</td>
<td>18.71</td>
<td>16.45</td>
<td>15.38</td>
<td>87.34</td>
</tr>
<tr>
<td>9</td>
<td>Average fruit weight (g)</td>
<td>101.33</td>
<td>159.67</td>
<td>131.39</td>
<td>10.18</td>
<td>8.80</td>
<td>74.74</td>
</tr>
<tr>
<td>10</td>
<td>Total fruit yield/plant (kg)</td>
<td>1.35</td>
<td>3.05</td>
<td>2.21</td>
<td>23.96</td>
<td>19.78</td>
<td>68.14</td>
</tr>
<tr>
<td>11</td>
<td>Vine length (m)</td>
<td>2.01</td>
<td>4.10</td>
<td>3.18</td>
<td>20.83</td>
<td>18.77</td>
<td>81.17</td>
</tr>
</tbody>
</table>