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# Gene action for fodder yield and its components in clusterbean (*Cyamopsis tetragonoloba* (L.) Taub)

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**Abstract**

**The nature of gene effects for fodder yield and its components in clusterbean was analysed in three crosses involving three diverse parents through generation mean analysis. Green fodder yield per plant appeared to be influenced by both additive and nonadditive gene actions. Only leaf length was controlled by additive gene action and dominance was prevalent in expression of leaf breadth. Epistatic components were found to be important for other characters. Complementary type of interaction was predominantly involved in inheritance of most of the characters. For genetic improvement of fodder yield utilising nonadditive components, intermating among selected segregates in early generation or reciprocal recurrent selection would be effective approach.**

**Key words :** Clusterbean, generation mean, gene action, fodder yield

## Introduction

Information on nature and relative magnitude of genetic components of variation (additive and nonadditive) of a character is essential for making an effective breeding programme for its genetic improvement. Clusterbean (*Cyamopsis tetragonoloba* (L.) Taub) is an important kharif legume especially suited for cultivation in arid region to augment the fodder demand. However, the information on gene reaction for its fodder attributes is very meager. In view of this, the present investigation was carried out with the objective of assessing the nature and magnitude of gene action for fodder yield and its components in clusterbean through generation mean analysis.

## Materials and methods

The experimental material comprised six generations, $P_1$, $P_2$, $F_1$, $F_2$, $BC_1$, $BC_2$ of three crosses viz., Bundel Guar 1 X Bundel Guar 2, Bundel Guar 1 × HG 75 and Bundel Guar 2 × HG 75. These were raised during *kharif* 2000 in a randomised block design with three replications. Each net plot had two rows for nonsegregating generation ($P_1$, $P_2$, $F_1$), four rows for backcross generations and eight rows for $F_2$ generation. Each row was of 3m length spaced at 30 cm. Observations on eight metric traits relating to fodder yield were recorded in each replication on five randomly selected plants from parental and $F_1$ generation, 15 plants from backcrosses and 30 plants from $F_2$ generation.

The scaling test was performed to test the adequacy of three-parameter (additive-dominance) model [1]. When the additive-dominance model was inadequate, the estimates of gene effects - both allelic and nonallelic were obtained using the digenic epistatic model [2] and in absence of non-allelic interaction, mean (m), additive (d) and dominance (h) components were estimated following three-parameter model given by Jinks and Jones [3].

## Results and discussion

Out of three scaling tests, at least two significantly differed from zero for all the characters in the three crosses except leaf length and leaf breadth (Table 1) and this suggests the influence of non-allelic interaction in inheritance of these components except leaf length and leaf breadth.

In crosses Bundel Guar 1 × Bundel Guar 2 and Bundel Guar 1 × HG 75, all the gene effects were found to be significant for green fodder yield/plant. So additive, dominance and all three epistatic interactions were prevalent for its inheritance for these two crosses. In cross Bundel Guar 2 × HG 75, additive, additive × dominance and dominance × dominance components predominantly controlled this trait. The presence of nonadditive gene action is a limiting factor to exercise selection for evolving pure line. In such a situation, maximum gain could be achieved by maintaining considerable heterozygosity through mating of selected plants in segregating generation or by following some forms of recurrent selection [4-6]. The same sign of (h) and (l) estimates in crosses Bundel Guar 1 ×

**Table 1.** Scaling test and gene effect for fodder yield and its components in clusterbean

| Cross | Scale | | | Genetic component | | | | | | Nonallelic interaction |
|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | m | d | h | i | j | l | |
| Green fodder yield/plant | | | | | | | | | | |
| $C_1$ | 17.62** | 10.94** | –4.61 | 107.63** | 10.29** | 10.21** | 13.69** | 10.49** | 22.84** | C |
| $C_2$ | 4.27 | 29.48** | 15.12** | 110.20** | 14.50** | 17.93** | 14.10** | 16.37** | 11.30** | C |
| $C_3$ | 12.65** | 10.84** | 18.44** | 113.26** | 12.90** | –3.66 | 4.32 | 23.14** | 19.25** | D |
| Dry fodder yield/plant | | | | | | | | | | |
| $C_1$ | 7.80** | 10.88** | 8.91** | 29.62** | 3.56 | 5.94* | 2.38 | 7.64** | 9.63** | C |
| $C_2$ | 11.69** | –4.32 | 5.98* | 37.20** | 5.40* | 7.88** | 9.13** | 10.56** | 11.20** | C |
| $C_3$ | –2.94 | 6.94* | 7.62** | 32.16** | 1.33 | 13.58** | –0.60 | 12.64** | 11.52** | C |
| Plant height | | | | | | | | | | |
| $C_1$ | 15.24** | 5.10 | –10.43** | 90.62** | 5.61 | 4.26 | 3.20 | 12.02** | –2.04 | D |
| $C_2$ | 11.90** | 12.54** | –9.15* | 112.68** | 6.98 | 7.64 | –2.06 | 9.13* | –4.64 | D |
| $C_3$ | 12.58** | –5.02 | 16.32** | 106.74** | 3.22 | –2.64 | 5.20 | –1.28 | 19.62** | D |
| Leaves/plant | | | | | | | | | | |
| $C_1$ | 9.46* | 4.93 | 11.08** | 55.67** | –6.72 | 1.22 | 2.31 | 1.98 | 10.64** | C |
| $C_2$ | 13.62** | –9.90* | –2.49 | 69.22** | 5.66 | –0.22 | 9.69* | –4.62 | 2.42 | D |
| $C_3$ | 11.15** | 4.06 | 10.26** | 71.66** | 3.08 | 2.94 | –1.44 | 3.22 | 11.68** | C |
| Leaf length | | | | | | | | | | |
| $C_1$ | 0.11 | 0.39 | 0.03 | 7.12** | 0.60* | 0.01 | - | - | - | - |
| $C_2$ | 0.07 | –0.19 | 0.17 | 8.12** | 0.92* | –0.06 | - | - | - | - |
| $C_3$ | –0.21 | 0.18 | –0.13 | 6.65** | 0.57* | 0.10 | - | - | - | - |
| Leaf breadth | | | | | | | | | | |
| $C_1$ | 0.21 | 0.17 | –0.15 | 5.08** | 0.15 | 0.94** | - | - | - | - |
| $C_2$ | –0.06 | 0.12 | 0.23 | 5.89** | 0.29 | 0.68* | - | - | - | - |
| $C_3$ | 0.16 | 0.09 | 0.14 | 5.62** | –0.13 | 1.01** | - | - | - | - |
| Stem diameter | | | | | | | | | | |
| $C_1$ | 0.22** | 0.06 | 0.19** | 0.69** | 0.07 | –0.01 | 0.19** | 0.12* | 0.18* | D |
| $C_2$ | –0.07 | 0.23** | 0.11* | 0.76** | 0.16* | 0.05 | –0.15 | 0.11* | 0.08 | C |
| $C_3$ | 0.24** | 0.12* | 0.18* | 0.84** | –0.04 | 0.01 | 0.10* | –0.17* | 0.20** | C |
| Leaf:stem ratio | | | | | | | | | | |
| $C_1$ | 0.02 | –0.10* | 0.26** | 0.29** | 0.02 | 0.12* | –0.01 | 0.08 | –0.13* | D |
| $C_2$ | 0.20** | 0.17* | 0.12* | 0.37** | –0.07 | 0.07* | 0.11** | 0.21* | 0.18* | C |
| $C_3$ | –0.15* | –0.08 | 0.21** | 0.31** | –0.06 | –0.01 | 0.03 | 0.16** | –0.07 | C |

C1: Bundel Guar 1 × Bundel Guar 2, C2: Bundel Guar 1 × HG 75, C3: Bundel Guar 2 × HG 75; C : Complementary, D : Duplicate;
*, ** : Significant at 5% and 1% level respectively.

Bundel Guar 2 and Bundel Guar 1 × HG 75 indicated the presence of complementary gene action suggesting the possibility of considerable amount of heterosis in this crosses for green fodder yield, whereas opposite sign indicated duplicate gene action in Bundel Guar 2 × HG 75.

All the allelic and nonallelic interactions were prevalent in inheritance of dry fodder yield per plant in cross Bundel Guar 1 × HG 75, whereas only nonadditive components were important in Bundel Guar 1 × Bundel Guar 2 and Bundel Guar 2 × HG 75. However, all the three crosses exhibited complementary interaction for this trait.

The (j) type of component was positive and highly significant indicating greater role of additive × dominance for plant height in two crosses- Bundel Guar 1 × Bundel Guar 2, Bundel Gaur 1 × HG 75 and dominance × dominance was prevalent in Bundel Guar 2 × HG 75.

Number of leaves per plant was prevalently under the control of dominance × dominance component in Bundel Guar 1 × Bundel Guar 2 and Bundel Guar 2 × HG 75 with complementary gene action. In Bundel Guar 1 × HG 75 additive × additive was found to be important suggesting efficiency of selection for more number of leaves per plant in segregating generation of this cross.

Only additive gene action was found important for leaf length in all the three crosses revealing that selection in early segregating generation would be effective for obtaining genetic gain of this character, whereas only dominance component predominantly influenced the expression of leaf breadth and selection should be postponed till the advance generation.

All the epistatic components of variation were important in expressing stem diameter in Bundel Guar 1 × Bundel Guar 2 and Bundel Guar 2 × HG 75, whereas in Bundel Guar 1 × HG 75, additive and additive × dominance were significant.

The magnitude of dominance and dominance × dominance were found to be high for ratio of leaf to stem in Bundel Guar 1 × Bundel Guar 2 with duplicate gene action. All three nonallelic interactions were prevalent in Bundel Guar 1 × HG 75. In cross Bundel Guar 2 × HG 75, additive × dominance component prevalently influenced the expression of this trait.

As green fodder yield per plant in clusterbean was influenced by both additive and nonadditive gene action and other fodder attributes except leaf length and leaf breadth were under the control of nonallelic gene action, simple selection could not be effective for genetic improvement of fodder yield. Multiple crossing followed by selective mating of plants in early generation which will maintain heterozygosity may be appropriate to utilise nonadditive gene action. As complementary interaction was prevalent in most cases, the development of hybrid may be an alternative. Reciprocal recurrent selection may also be practised for developing elite population.

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