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# Inheritance Study of Qualitative and Quantitative Traits in Cowpea (*Vigna unguiculata* (L.) Walp)

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**Abstract:** ***Two parents namely Konkan Sadabahar and Fodder cowpea-1 were used to study inheritance of four qualitative characters (i.e., growth habit, flower colour, seed coat colour and seed coat colour pattern) and four quantitative characters i.e. pod length (cm), number of pods/plant, number of seeds/pod and seed size (g). The qualitative characters were studied using chi-square test. Out of four qualitative traits growth habit, flower colour and seed coat colour pattern revealed monogenic nature of inheritance segregating in Mendelian ratio (3:1) and seed coat colour was inherited digenically indicating dominant epistasis (12:3:1). Joint segregation was studied and linkage was revealed only between seed coat colour and seed coat colour pattern. The quantitative characters were studied by comparison of range, mean, standard deviation, and coefficient of variation in parents, $F_1$ and $F_2$ generation. The amount of variability generated in $F_2$ for number of grains/pod was more than both the parents. This result can be used for further selection of plant progenies for crop improvement programme.***

**Keywords:** Cowpea, qualitative traits, quantitative traits, $X^2$ test, joint segregation.

## 1. Introduction

Pulses occupy a unique position in the world agriculture by virtue of their high protein content. Pulses are the backbone of Indian agriculture. In many of the developing countries, pulses are the major source of dietary protein. Pulses occupy 68.32 million hectare area and contribute 57.51 million tones to the world food basket. India is a major pulse growing country in the world, occupying an area of 23.47 million ha producing 13.34 million tonnes annually with an average productivity of 781 kg/ha. It has the useful ability to fix the atmospheric nitrogen through its root nodules and it grows well in poor soils with more than 85% sand and with less than 0.2% organic matter and low levels of Phosphorus (Singh B. et al, 2003). and covers the ground so well that it checks the soil erosion. As a leguminous crop, it fixes about 70 – 240 kg nitrogen per ha per year. Cowpea seed is reported to contain 24% crude protein, 53% carbohydrates, and 2% fat (FAO, 2012). The leaves and flowers can also be consumed. It can also be used as forage, hay, and silage. When used as forage, it should only be lightly grazed after flowering (FAO, 2012). If there are several buds left after defoliation, the plant will regenerate. When used as silage, it can be mixed with sorghum, maize, or molasses to provide sugar for fermentation (FAO, 2012).

Great research work on inheritance of various qualitative and quantitative characters is being done since long time as India is the largest producer and consumer of pulses in the world. India produces a quarter of the world's pulses. The genetics of these characters is not well understood and there is controversy with regard to the nature of inheritance i.e. number of genes controlling the same character, type of gene action and segregation pattern (whether independent assortment, interactions or linkages). For example a single character "growth habit" has been reported to be controlled by single, double and triple genes. Brittingham (1950) stated its inheritance as simple Mendelian monogenic segregation and trailing being dominant. Kolhe (1970) stated that growth habit is digenically controlled and having the duplicate gene action. While Singh and Jindla (1971) stated that the two complementary and one independent gene control growth habit i.e. three genes are responsible for same character. Harland (1919) and Pethe (1990) stated that flower colour is monogenically controlled. While Vishwanath (1978) stated that it is digenically controlled showing inhibitory gene action (13:3) and Lokprakash (1979) stated that it is controlled by two genes exhibiting complimentary gene action (9:7).

Yields can be improved by eliminating undesirable genes/ traits linked with desirable genes / traits by breaking the linkages. There is lot of scope for improvement in yield by gene manipulation. This is possible only when the genetic construction of plant is known. As such it is emphasized that the knowledge of inheritance of various characters in cowpea is a prerequisite as it is in other crop plants. The cowpea variety Konkan Sadabahar is widely grown in around Konkan region. It is characterized by erect growth habit, brown seed coat colour, Watson eye pattern, seed size, i.e. around 12 g/100 seeds. In contrast to this, Fodder cowpea-1 has some distinct features.

The present investigation was taken up with following objectives such as to study the inheritance of qualitative characters *viz.*, growth habit, Flower colour, seed coat colour and seed coat colour pattern and quantitative characters *viz.*, Pod length (cm), Number of pods per plant, Number of seeds per pod and seed size (g) and to identify the promising segregants for further use in future breeding programmes and combining the desirable characters present in both the parents.

## 2. Material and Methods

A field experiment was conducted at Research Farm, Department of Agricultural Botany, College of Agriculture, Dr. B. S. K. K. V., Dapoli. to study the inheritance of qualitative and quantitative characters in cowpea (*Vigna unguiculata* (L.) Walp) from October 2012 - March

2014.Two parents' *viz.,* Konkan Sadabahar and fodder cowpea-1 were obtained from germplasm collection maintained by pulse project, Department of Agricultural Botany, College of Agriculture, Dapoli. In *Rabi* season of 2012 crossing of two parents was taken up. In the month of November 2013 the $F_2$ seeds were obtained. The $F_1$ and $F_2$ seeds along with parents were grown simultaneously in January 2014 to observe the inheritance of characters under study.

The spacing between and within rows was maintained at 30 X 30 cm. The spacing was same for parents, $F_1$ and $F_2$ seeds. The standard cultivation practices were adopted. Plant protection measures were applied as and when required to crop to maintain the plant population and health of crop. Data collected for all the qualitative traits were tested against expected ratios using chi-square goodness of fit test. Collected data for quantitative characters was analyzed for calculating mean, range. Standard deviation and coefficient of variation.

## 3. Results and Discussion

### I. Qualitative Characters

Behavior of Parents $F_1$ and segregating $F_2$ generation are presented in Table 1. In cross Konkan Sadabahar X Fodder cowpea-1, erect growth habit was dominant over viny. Light violet standard colour was dominant over violet standard colour and violet wing colour was dominant over deep violet colour. Reddish brown seed coat colour was dominant over brown seed coat colour. Holstein seed coat colour pattern was dominant over Watson seed coat colour pattern.

Growth habit was controlled by single gene (3:1) (Table 2). This report is in accordance with the reports of Brittingham (1950), Saunders (1960), Premshekhar and Raman (1972). Flower colour in cowpea is controlled monogenically (Table 2). Premsekar and Raman (1972) effected crosses between coloured X white flower and reported a monogenic segregation in 3:1 ratio. Ukarande (1985) from crosses V-50 X CM-11 and C0-1 X V-50 reported monogenic segregation in 3:1 ratio. Pethe (1990) from cross wali-1 X VCM-8 reported monogenic ratio for flower colour. Seed coat colour pattern was also controlled by a single gene (Table 2) as reported by Spillman (1911) and Saunders (1960). The Reddish brown seed coat colour was dominant over brown seed coat colour which was digenically controlled (Table 2), indicating dominant epistasis (12:3:1). This study supported by Saunders (1959), (12:3:1) Digenically controlled. The present findings of seed coat colour are in accordance with the reports of Ukarande (1985) and Pethe (1990) with regard to two genes but they differed in gene interaction.

Joint segregation of growth habit was considered with other characters, each of which was governed by a single gene *(*standard colour, wing colour and seed coat colour pattern) and character governed by two genes (seed coat colour), a combined phenotypic ratio of 9:3:3:1 and 36:9:3:12:3:1 was obtained respectively. This indicates that single gene governing the growth habit was independent to the single gene controlling the other characters. And also the single gene of growth habit was independent and it assorted independently from each of the two pairs of genes governing seed coat colour that indicated dominant epistasis type of gene interaction. Joint segregation of standard colour with wing colour, seed coat colour pattern andseed coat colour revealed independence of characters Joint segregation of wing colour with seed coat colour pattern indicated a combined phenotypic ratio of 9:3:3:1, which indicated gene for wing colour is independent to the gene for seed coat colour pattern. Joint segregation of wing colour with seed coat colour was considered, a combined phenotypic ratio of 36:9:3:12:3:1 was realized. It shows independent assortment of wing colour gene from two genes governing seed coat colour.

When joint segregation of digenically controlled seed coat colour (rrbb) was considered with monogenically controlled seed coat colour pattern (HH), linkage was observed. The total $X^2$ value on the basis of ratio 36:9:3:12:3:1 was higher than table value (370.59 > 11.07). Since P value was below 0.001, there was possibility of linkage, hence linkage value was worked out and the cross over value 3% was obtained. The results are in agreement with Pethe (1990) who reported linkage between these two characters with cross over value of 5.74%.

### II. Quantitative Characters

The pod length in $F_1$ population varied from 12.2-14.5 cm which was higher than $P_1$. There was segregation in pod length of $F_2$ population which varied from 10-19 cm. Mean pod length of $F_2$ population was 14 cm which was tending towards long pod length of $P_2$.Number of pods per plant in $F_1$ varied from 12-20 which exceeded lower value of both the parents. Number of pods per plant segregated in $F_2$ population from 8-28 which exceeded higher value of both the parents. The mean of number of pods per plant in $F_1$ and $F_2$ was 15.27 and 15.66 respectively. It was indicated that mean of number of pods per plant in $F_1$ and $F_2$ was intermediate between mean of number of pods per plant of both the parents. (Table 3)

The number of grains per pod in $F_1$ varied from 11-14 which was tending towards number of grains per pod of $P_2$. In case of $F_2$ number of grains per pod segregated from 9-16 which exceeded higher value of $P_2$. The mean of number of grains per pod in $F_1$ and $F_2$ was 12.27 and 12.31. This indicated that $F_1$ and $F_2$ was superior over both the parents. There was difference in seed size of $P_1$ and $P_2$. Seed size of $F_1$ population varied from 12-17 grams which was tending towards seed size of $P_1$. Seed size of $F_2$ population varied from 9-30 grams and the mean of seed size of $F_2$ population is 14.52 gram which was higher than mean of $P_1$ (Table 3).

In present study it was indicated that mean pod length of $F_1$ was 13.05 cm which was intermediated between both the parents and mean pod length of $F_2$ was 14 cm and it did not exceed mean pod length of Fodder cowpea-1 ($P_2$) which was 15.03 cm i.e Pod length in $F_2$ population was found superior over $F_1$ and $P_1$. Brittingham (1990) reported same results in cross Asparagus Bean X Lady Cream Pea.

Mean number of pods/plant of $F_1$ and $F_2$ (15.27 and 15.66 respectively) was found to be intermediate between mean number of pods/plant of both the parents. This indicated that there is presence of dominance. Mean number of grains/pod of $F_1$ and $F_2$ (12.27 and 12.37 respectively) was found

superior over mean of number of grains/pod of both the parents. This indicated the presence of over dominance. Seed size of $F_1$ and $F_2$ was tending towards Konkan Sadabahar. These results were obtained for first time in cowpea.

## 4. Conclusion

There was evidence of the linkage between seed coat colour and seed coat colour pattern in the cowpea used in the experiment. Knowledge on seed coat genetics can be very useful in cowpea breeding as it is important in farmer and customer preference. Furthermore, linkage between the traits studied can be expanded to other important ones such as maturity period, post-harvest storability and palatability. The finding could be very useful to gene banks in their conservation activities to prevent genetic loss in cowpea germplasm. The knowledge should be used to identify within accession variability in cowpea germplasm to protect each type from being loss. $F_2$ Pod length is superior over $F_1$ and $P_1$. And it is almost similar to the pod length of $P_2$. As mean number of grains/pod of $F_2$ was superior over $F_1$ and both the parents, these progenies can be used for further selection of plants in crop improvement programme.

## References

[1] Agricultural Statistics at a Glance, 2013, Directorate of Economics and Statistics, Ministry of Agriculture. Directorate of Economics and Statistics - http://eands.dacnet.nic.in
[2] Brittingham, W.M. 1950. The inheritance of date of pod maturity, pod length, seed shape and seed size in the Southern pea (*Vigna sinensis*). *Proc. Amer. Soc. Hort.* Sci., **56** : 381-388.
[3] Food and Agriculture Organization (FAO). 2012. Grassland species index. *Vigna unguiculata*
[4] Harland, S.C. 1919. Inheritance of certain characters in the cowpea (*Vigna sinensis*)I. *J. Genet.*,**8** : 101-132.
[5] Kolhe, A.K. 1970. Genetic studies in *Vigna* sp. *Poona Agric. Coll. Mag.*,**59** : 126-137.
[6] Lokprakash, 1979. Genetic studies in cowpea (*Vigna unguiculata* L. Walp). *Pl. Breed. Abstract*, **7** : 234-235.
[7] Premsekar, S. and Raman, V.S. 1972. A genetic analysis of the progenies of the hybrid *Vigna sinensis* (L) Savi and *Vigna sesquipedalis* (L) Fruw. *Madras Agric. J.*,**159** : 449-456.
[8] Pethe, U. B. 1990. Inheritance Study of Qualitative Characters in Cowpea (*Vigna unguiculata* (L.) Walp). M.Sc. thesis submitted to Dr. BalasahebSawant Konkan Krishi Vidyapeeth, Dapoli.
[9] Saunders. A.R. 1960 a. Inheritance in the cowpea II : seed coat colour pattern, flower, plant and pod colour. *S. Afr. J. Agric. Sci.*, **3** : 141-162.
[10] Singh, B.; Ajeigbe, H. A.; Tarawali, S. A.; Fernandez-Rivera, S.; Abubakar, M. (2003). "Improving the production and utilization of cowpea as food and fodder". *Field Crops Research* **84**: 169–150.
[11] Singh, K.B. and Jindla, L.N. 1971. Inheritance of bud and pod colour, pod attachment and growth habit in cowpea. *Crop Sci.*, **11** : 928-929.
[12] Spillman, W.J. 1911. Inheritance of eye in *Vigna. American Naturalist*, **45** : 513-523.
[13] Ukarande, S.S. 1985. Inheritance of seven qualitative characters in cowpea (*Vigna unguiculata* (L.) Walp). M.Sc. thesis submitted to Dr. BalasahebSawant Konkan Krishi Vidyapeeth, Dapoli.
**[14]** Vishwanath. K.P. 1978. Inheritance studies of few qualitative characters in cowpea (*Vigna unguiculata* (L.) Walp). *Pl. Breed. Abstract*, **6.**

**Tables**

**Table 1:** The details of morphological characters of the parents and their hybrid in cross Konkan Sadabahar X Fodder cowpea-1

| Sr. No. | Characters | Parents | | Hybrid |
|---|---|---|---|---|
| | | Konkan Sadabahar | Fodder cowpea-1 | |
| 1. | Growth habit | Erect | Viny | Erect |
| 2. | Flower colour: | | | |
| | i) Standard colour | Light violet | Violet | Light violet |
| | ii) Wing colour | Violet | Deep violet | violet |
| 3. | Seed coat colour | Brown | Reddish-brown | Reddish brown |
| 4. | Seed coat colour pattern | Watson | Holstein | Holstein |

**Table 2:** Segregation pattern of the progeny of a cross Konkan Sadabahar X Fodder cowpea-1 in $F_2$ generation

| Sr. No. | Characters | Ratio tested | Number of plants in $F_2$ generation | | | | $X^2$ | P |
|---|---|---|---|---|---|---|---|---|
| 1. | Growth habit | 3:1 | O | 114 | 36 | | 0.14 | 0.70-0.50 |
| | | | E | 112 | 38 | | | |
| 2. | Flower colour: | | | | | | | |
| | i)Standard colour | 3:1 | O | 106 | 44 | | 1.268 | 0.30-0.20 |
| | | | E | 112 | 38 | | | |
| | ii)Wing colour | 3:1 | O | 105 | 45 | | 1.727 | 0.20-0.10 |
| | | | E | 112 | 38 | | | |
| 3. | Seed coat colour | 12:3:1 | O | 108 | 31 | 11 | 0.74 | 0.95-0.70 |
| | | | E | 112.44 | 28.11 | 9.37 | | |
| 4. | Seed coat colour pattern | 3:1 | O | 109 | 41 | | 0.317 | 0.70-0.50 |
| | | | E | 112 | 38 | | | |

*** O – Observed value, E – Expected value**

**Table 3:** Segregation of quantitative characters in cross Konkan Sadabahar X Fodder cowpea-1

| Character | Generation | Range | Mean | S.D. | C.V. |
|---|---|---|---|---|---|
| Pod length (cm) | Konkan Sadabahar ($p_1$) | 9-11.8 | 10.23 | 0.83 | 8.20 |
| | Fodder cowpea-1 ($p_2$) | 13.8-16.5 | 15.03 | 0.77 | 5.14 |
| | $F_1$ | 12.2-14.5 | 13.05 | 0.60 | 4.53 |
| | $F_2$ | 10-19 | 14 | 1.69 | 12.09 |
| No. of pods/plant | Konkan Sadabahar ($P_1$) | 10-21 | 16.41 | 3.13 | 19.11 |
| | Fodder cowpea-1 ($P_2$) | 12-24 | 17.68 | 3.02 | 17.10 |
| | $F_1$ | 12-20 | 15.27 | 2.49 | 16.32 |
| | $F_2$ | 8-28 | 15.66 | 3.93 | 25.14 |
| No. of grains/pod | Konkan Sadabahar | 7-11 | 8.90 | 1.01 | 11.36 |
| | Fodder cowpea-1 ($P_2$) | 11-15 | 12.10 | 0.99 | 8.21 |
| | $F_1$ | 11-14 | 12.27 | 1.10 | 8.99 |
| | $F_2$ | 9-16 | 12.31 | 1.47 | 11.94 |
| Seed size (g) (100 seed weight) | Konkan Sadabahar ($P_1$) | 9-16 | 12.03 | 1.90 | 15.83 |
| | Fodder cowpea-1 ($P_2$) | 16-30 | 21.08 | 3.96 | 18.82 |
| | $F_1$ | 12-17 | 14.45 | 1.63 | 11.31 |
| | $F_2$ | 9-30 | 14.52 | 3.80 | 26.19 |