Interspecific hybridization and crossability studies of cultivated varieties of *Vigna mungo* L. Hepper with *Vignamungo var silvestris*

V. Jayashree¹, A. Muthuswamy¹*, P. Jayamani¹ and K. K. Kumar²

¹Department of Pulses, Centre for Plant Breeding and Genetics, TNAU, Coimbatore-3, Tamil Nadu, India.
²Centre for Plant Molecular Biology and Bioinformatics, TNAU, Coimbatore-03, Tamil Nadu, India.
*E-Mail: swami2k2002@yahoo.co.in

Abstract

Interspecific hybridization was carried out with two cultivars (CO 6 and VBN8) and one wild species *Vigna mungo var. silvestris* 22/10 in black gram. The crossability and pollen fertility studies were conducted during investigation. Qualitative traits are recorded in the F₁ generation. The hybrid from CO 6 cross had twining tendency, terminal leaflet shape, petiole colour, pod pubescence, and growth pattern similar to *Vignamungo var. silvestris* 22/10 (male parent). The hybrid from VBN8 cross resembled the male parent for the characters viz., twining tendency and growth pattern. Hence, these qualitative traits can be used to confirm hybridity at the early stage of the crop.

Keywords

black gram, crossability, pollen fertility, and qualitative traits.

Black gram is one of the most highly prized pulses in India. It supplies a dietary nutrition viz., protein, carbohydrates, calcium, and phosphoric acid is popular for its fermenting action. The legume seeds or pulses, sometimes termed as ‘grain legumes’, are second only to the cereals as a source of human food and provide the much needed proteins to our predominantly vegetarian population. Interspecific hybridization is important for the genetic enhancement of crop plants to transfer desirable characteristics from the related species. For better utilization of variability, it is essential to attempt interspecific crosses and to develop viable hybrids. Realizing the importance of developing resistant varieties along with high yield, the present investigation was undertaken on black gram to understand the crossability through interspecific hybridization programme.

The present investigation was carried in the year 2018 – 2019 at the Department of Pulses, Centre for Plant Breeding and Genetics (CPBG), Tamil Nadu Agricultural University, Coimbatore. Two black gram cultivars (CO 6 and VBN8) and one wild species *Vignamungo var. Silvestris* 22/10 were raised during *Kharif* 2018 in crossing block. Interspecific hybridization was carried out by using two black gram varieties (CO 6 and VBN8) as female and one wild accession *Vignamungovar. silvestris* 22/10 as male. The female and male parents used in interspecific hybridization are given in Table 1.

The pollen fertility analysis was studied in the parents and hybrids by Iodine Potassium Iodide (I₂ - KI) staining technique. Matured anthers were collected from the parents and the hybrids and squashed on a microscopic slide with one per cent I₂ - KI solution. The slides were observed under a light microscope and the pollen counts were taken for three microscopic fields. Swollen and stained pollen were counted as fertile while, shrunken and unstained pollens were counted as sterile. The crossed seeds were raised during summer 2018-19 along with parents. The qualitative traits observed in the parents and F₁ includes, germination type, hypocotyl colour, twining tendency, terminal leaflet shape, petiole colour, corolla colour, flowering period, pod pubescence and growth pattern.
Interspecific hybridization and crossability studies

Table 1. List of genotypes used in interspecific hybridization

| Female Parents | Male Parent               |
|----------------|---------------------------|
| CO – 6         | Vignamungo var. silvestris |
| VBN -8         | Vignamungo var. silvestris |

The cultivated varieties of black gram [C06 and VBN8] were crossed with wild species Vignamungo var. Silvestris 22/10. The crosses were attempted by using black gram cultivars as the female parents as success rate was higher in these crosses as reported by Biswas and Dana (1975) in black gram, Chen et al., (1983) in black gram and green gram, Bharathi et al., (2006) in green gram, and Sehrawat et al., (2016) in black gram.

The pod set ranged from 24 to 40 per cent. Among the two crosses, maximum pod set was observed from the cross between VBN-8 and Vignamungo var. Silvestris 22/10 (40 per cent). The pod set per cent for the cross CO6 x Vignamungo var. Silvestris 22/10 was only 24 per cent (Table 2). Hence, the black gram VBN 8 is found to be more compatible to cross with Vignamungo var. Silvestris 22/10 than CO 6 variety.

Table 2. Cross ability percent in crosses of Vignamungo and Vignamungo var. Silvestris

| Sl. No | Characters             | Co 6 x Vignamungo var. Silvestris 22/10 | VBN 8 x Vignamungo var. Silvestris 22/10 |
|--------|------------------------|----------------------------------------|----------------------------------------|
| 1      | Number of flowers crossed | 25                                      | 20                                      |
| 2      | Number of pods set      | 6                                       | 8                                       |
| 3      | Pod set percent         | 24.00                                   | 40.00                                   |

Nine qualitative characters were recorded in the hybrids and parents (Table 3). The hybrid CO-6xVignamungo var. Silvestris 22/10 resembled the male parent for the characters viz., twining tendency, terminal leaflet shape, petiole colour, pod pubescence, and growth pattern. The hybrids were found to be intermediate between the parents for the character corolla colour. The hybrid VBN8xVignamungo var. silvestris22/10 resembled the male parent for the characters viz., twining tendency, terminal leaflet shape and growth pattern. The hybrids were found to be intermediate between the parents for the character corolla colour exhibiting incomplete dominance. Similar findings are reported by Muhammad et al. (2005), Pandiyan et al. (2012) and Jayamani et al. (2014).

Table 3. Evaluation of parents and hybrids

| Sl. No | Characters             | CO-6     | VBN-8    | Vignamungo var. silvestris 22/10 | CO 6 x Vignamungo var. silvestris 22/10 | VBN - 8 x Vignamungo var. silvestris 22/10 |
|--------|------------------------|----------|----------|----------------------------------|----------------------------------------|---------------------------------------------|
| 1      | Germination            | Epigeal  | Epigeal  | Epigeal                          | Epigeal                                | Epigeal                                     |
| 2      | Hypocotyl color        | Purple   | Green    | Purple                           | Dark purple                           | Dark purple                                 |
| 3      | Twining tendency       | Absent   | Absent   | Intermediate                     | Intermediate                          | Intermediate                               |
| 4      | Terminal leaflet shape | Ovate    | Lanceolate| Ovate-lanceolate               | Green                                  | Yellow                                     |
| 5      | Petiole colour         | Greenish purple spots | Green | Greenish purple | Greenish purple | Greenish purple | Greenish purple | Greenish purple | Greenish purple | Greenish purple |
| 6      | Corolla colour         | Yellow   | Purple yellow | Yellow                      | Purple yellow                          | Yellow                                     |
| 7      | Flowering period       | Synchronous | Synchronous | Asynchronous | Asynchronous | Synchronous | Synchronous | Synchronous |
| 8      | Pod pubescence         | Glabrous  | Dense    | Dense                            | Dense                                  | Dense                                      |
| 9      | Growth pattern         | Determinate | Determinate | Indeterminate | Indeterminate  | Indeterminate |

The pollen fertility of the parents ranged from 92.88 to 94.25 per cent. Bhanu et al. (2017) recorded a pollen fertility of 1.6 to 3.4 per cent for the hybrids obtained from the green gram x rice bean cross. The fertility status of the parents and hybrids are presented in Table 4 and Fig.2. Three parents exhibited maximum pollen fertility. The pollen fertility studies in F1 hybrids revealed that the both crosses showed high pollen fertility status. The hybrid from the CO 6xVignamungo var. silvestris 22/10 recorded 89.77 per cent pollen fertility and VBN 8 x Vignamungo var. silvestris 22/10 recorded 87.33 per cent pollen fertility. Both the crosses exhibited complete pod set.
CO 6 x Vignamungovar. silvestris 22/10

Fig. 1. Pod pubescence in parents and hybrids

VBN 8 x Vignamungovar. silvestris 22/10
Table 4. Pollen fertility of parents and hybrids

| Sl. No. | Parents/Hybrids                        | Pollen Fertility (per cent) |
|---------|----------------------------------------|-----------------------------|
| 1       | Co 6                                   | 94.25                       |
| 2       | VBN – 8                                | 92.88                       |
| 3       | Vignamungo var. *silvestris* 22/10     | 93.03                       |
| 4       | CO 6 x Vignamungo var. *silvestris* 22/10 | 89.77               |
| 5       | VBN 8 x Vignamungo var. *silvestris* 22/10 | 87.33               |

The cross ability and pollen fertility studies of interspecific hybridization studies, using two black gram varieties (CO 6 and VBN8) as female and one wild accession *Vignamungo var. Silvestris* 22/10 as male revealed that the pod set ranged from 24 to 40 per cent. The pod set per cent recorded a maximum of 40 per cent for the cross VBN8 × *Vignamungo var. Silvestris* 22/10. The pollen fertility studies showed that the hybrids viz., CO 6 x *Vignamungo var. Silvestris* 22/10 and VBN 8 x *Vignamungo var. Silvestris* 22/10 recorded 89.77 per cent and 87.33 per cent for pollen fertility respectively. It clearly indicated that the high pollen fertility for both the hybrids Interspecific hybridization resulted in the development of fertile hybrids. Both the hybrids resembled the male parent for the characters viz., twining tendency and growth pattern. Hence, these qualitative traits can be used to confirm hybridity at the early stage of the crop. The outcome will be useful to improve the yield, pest and disease resistance in black gram.

Fig. 2. Pollen Fertility Studies in Hybrids
REFERENCES

Bhanu, A.N., Kumar, P., Singh, M. N., Srivastava, K., and Hemanatrajan, A. 2017. “Assessment of genetic purity of inter-specific F1 hybrids involving Vignaradiata and Vignaumbellate.” Journal Of Experimental Biology, 5 (5):636-643. [Cross Ref]

Bharathi, A., Vijay Selvaraj, K., Veerabadhiran, P., and Subba Lakshmi, B. 2006. “Crossability barriers in mungbean (Vignaradiata L. Wilczek): with its wild relatives.” Indian Journal of Crop Science, 1 (1and2):120-124.

Biswas, M.R., and Dana, S. 1975. “Black gram × Rice bean cross.” Cytologia, 40 (3-4):787-795. [Cross Ref]

Chen, N., Baker, L., and Honma, S. 1983. “Interspecific crossability among four species of Vigna food legumes.” Euphytica, 32 (3):925-937. [Cross Ref]

Jayamani, P., Srimathy, M., and Sathya, M. 2014. “Characterization of blackgram genotypes based on qualitative traits.” Madras Agricultural Journal, 101 (1/3):12-15.

Muhammad, A., Abdul, G., and Sharif, Q. A. 2005. “Inheritance of qualitative traits and their linkage in blackgram.” Pakistan Journal Of Botany, 37 (1):41-46.

Pandiyan, M., Senthil, N., Suersh, R., Chakravarthy, N., Packiaraj, D., and Jagadeesh, S. 2012. “Interspecific hybridization of Vignaradiata and Vignatriolobata.” Euphytica, 35:1017-1022.

Sehrawat, N., Yadav, M., Bhat, K. V., Sairam, R. K., and Jaiwal, P. K. 2016. “Introgression of mungbean yellow mosaic virus resistance in Vigna mungo (L.) Hepper and purity testing of F1 hybrids using SSRs.” Turkish Journal Of Agriculture and Forestry, 40 (1):95-100. [Cross Ref]