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Original Research Article

A study on morphological, physiological and yield alterations occur in Blackgram (*Vigna mungo* L.) Genotype LBG 17 resistant to Powdery mildew

Tirupathiswamy N[1*], K Babu[2], G Rosaiah[2] and K Srinivasa Rao[3]
[1]Department of Botany, Government Degree College, Naidupet, Nellore, A.P, INDIA
[2]Department of Botany and Microbiology, Acharya Nagarjuna University, Nagarjunanagar – 522510, Guntur, A.P. INDIA
[3]Department of Botany, Government Jr. College, Mamidikuduru, East Godhavari, A.P. INDIA

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Abstract: Blackgram is a very important pulse crop grown in Kharif and Rabi seasons. It is especially cultivated for vegetable protein. But the crop is easily subjected to fungal, bacterial and viral diseases. Of them fungal disease such as powdery mildew damage the crop worst leads to less yields. LBG 17 is a hybrid variety of Blackgram produced to with stand to the powdery mildew. But the traits which are responsible for the tolerance and higher yields are not yet studied. An experiment was conducted to study these changes at Botanical garden of Acharya Nagarjuna University, Andhra Pradesh, India. Morphological characteristics such as plant height, Root length, no of root nodules, shoot length. Physiological responses like root dry weight shoot dry weight, total plant dry weight, leaf area, seed protein content, chlorophyll a, b and total chlorophyll content were studied. In addition to these, yield parameters like no of clusters per plant, 100seed weight, seed yield per plant were studied in susceptible Nethiminumu, Chikkuduminimu and resistant LBG 17 black gram cultivars. The resistant cultivar LBG 17 is found to be exhibited high values in respect to morphological, physiological and yield characteristics. However reduction was more prominent in susceptible cultivar than in resistant ones. Hence the results indicated that the changes developed through conventional plant breeding were responsible for the better performance of the LBG 17 in rice fallows than its parents Nethiminumu and Chikkuduminumu. Further it can be suggested that LBG 17 may be used as a source material for future studies involving molecular basis of resistance diseases.

Keywords: Blackgram, LBG 17, Powdery Mildew, Resistance, Seed Yield.

Introduction

Blackgram (*Vigna mungo* L.) is one of the most important pulse crop grown widely throughout India and in AP, it is particularly cultivated in both kharif and rabi seasons. It is grown for its dry beans which are excellent source of high quality vegetable protein and used in our diets only after fermentation. Blackgram is rich in protein food. It contains 26 percent protein, which is almost three times of the cereals. Blackgram supplies a major share of protein requirements of vegetarian population in the country. It is consumed in the form of split pulse as well as whole pulse. In addition being an important source of human and animal food, it is suitable for dry land farming. Blackgram crop is affected by several fungal and viral diseases of which Powdery mildew is a very important disease. This disease is wide spread all over the country. Erisiphae polygoni DC is an obligate parasite, which causes powdery mildew and it requires living material to feed on and to develop. The disease caused by this fungus is characterized by the formation of white floury patches mostly confined on the upper surface of leaves. The effected leaves finally turn to reddish brown and whither off. The seeds get shriveled and the yield was affected. Loss in yield and yield component parameters were also reported in susceptible varieties of sugarcane by Alexander (1975), Goyal *et al.,* (1982), Padmanabhan *et al.,* (1988), in cotton by Ashraf and Zafar (1999).

Acharya N.G. Ranga Agricultural University, Regional Agriculture Research Station located at Lam, Guntur district, developed a powdery mildew resistant variety LBG 17, from a cross between Nethiminumu and Chikkuduminumu. This variety has officially released in September 1985 in the

***Corresponding Author:**
Dr. N. Tirupathiswamy,
Lecturer in Botany,
Department of Botany,
Government Degree College,
Naidupet, Nellore (Dt),
Andhra Pradesh (INDIA).

name of Krishnaiah. The requirement of blackgram varieties for rice fallows was mainly quick initial growth and resistance to powdery mildew. These characters were fully agreed with the characters of LBG 17 and because of which it was successful in rice fallows with farmer's acceptability. Hence it is felt very important to study the morphological, physiological and yield differences in blackgram cultivars in relation to powdery mildew.

Materials and Methods

The present work has been carried out by using Blackgram varieties viz., Nethiminumu and Chikkuduminumu and their cross LBG 17 at Botanical Garden of Acharya Nagarjuna University. The seeds were sown in the field in eight replications in complete randomized block design. The seeds were sown in 5 rows of 5m length with plant to plant and row to row spacing of 10 cm and 30 cm respectively. The plants were inoculated with spore suspension (10^6 conidia/ml) on healthy leaves after 30 days of sowing. Disease scoring was performed through visual observation of the powdery spots, which appeared on the leaves and compared with a 0 to 9 scale. Observations on morphological, physiological and yield attributes were recorded by taking 5 randomly selected plants in each replication.

Morphological traits

The characters studied include Days to flowering, Days to Maturity, Plant height (cm), Number of branches at 35 and 70 days after sowing (DAS), Number of leaves at 35 and 70 days after sowing (DAS), root length (cm) at 35 and 70 days after sowing (DAS), shoot length (cm) at 35 and 70 days after sowing (DAS), Number of root nodules per plant at 35 and 70 days after sowing (DAS).

Physiological characteristics

The physiological attributes such as leaf area was measured by using systronic portable leaf area meter -211. Chlorophyll a, b and total chlorophyll, carotenoids, xanthophylls were measured according to Hiscox and Israelstam (1979) by using dimethyl sulfoxide (DMSO) method. Fully matured third leaf (Three leaf lets) of each plant at the time of anthesis after the removal of midrib was taken for analysis of Chlorophyll a, Chlorophyll b and Carotenoids. Finely cut leaf samples 25 mg were dissolved in 5 ml of Dimethyl Sulphoxide (DMSO) and the tubes were incubated overnight in the dark. The resultant chlorophyll containing solution was measured at 645nm and 663nm by spectrophotometer. The amount of chlorophyll present in the leaves was calculated in terms of milligrams of chlorophyll per gram of leaf tissue as follows.

$$\text{Chl a} = (12.7 \times \text{O.D. } 663) - (2.69 \times \text{O.D. } 645) \times \frac{V}{1000} \times w$$

$$\text{Chl b} = (22.9 \times \text{O.D. } 645) - (4.68 \times \text{O.D. } 663) \times \frac{V}{1000} \times w$$

Total chlorophyll = Chlorophyll 'a' + Chlorophyll 'b'

The leaf extract obtained was measured at 480nm and 510nm for estimating carotenoids. The amount of carotenoids present in the Black gram leaves was expressed as of milligrams of chlorophyll per gram of leaf tissue as fallows.

$$\text{Carotenoids} = 7.0\,(A_{480}) - 1.47\,(A_{510}) \times \frac{V}{W \times 1000}$$

Where,

A= Absorbance
V= Final volume of the solution (ml)
W= Weight of the sample (g)

Nitrogen percent was estimated using Micro-kjeldahl 'N' method developed by AOAC (1978). Oven dried sample (0.1g) was digested with 3 ml of conc.H_2 SO_4 in the presence of 1:4 ratio of K_2SO_4 and $CuSO_4$ mixture till the solution became colourless or clear. The digest was then neutralized with 40 percent NaOH, distilled and the liberated ammonia was collected in 4 percent boric acid containing mixed indicator. The distillate was titrated against the standard acid. It was taken that 1ml of N/50 H_2SO_4 is equivalent to 0.00028 g of total Nitrogen. The crude protein content was estimated using the formula.

Percent crude protein = Percent nitrogen × 6.25

Yield Attributes

Yield parameters like number of clusters per plant, number of pods per plant, pod length (cm), number of seeds per pod, 100-Seed weight (g), seed yield per plant (g). The mean value of 5 plants was taken as the value of that character of genotype in that particular replication.

Results and Discussion

The results obtained on the morphological parameters indicated that the number of root nodules per plant, number of branches per plant, number of pods per plant

and seed yield were significantly high in LBG 17 compared to its parents Nethiminumu and Chikkuduminumu (Table 1). Loss in yield and yield component parameters were also reported in susceptible varieties of sugarcane by Alexander (1975), Goyal *et al.,* (1982), Padmanabhan *et al.,* (1988), in cotton by Ashraf and Zafar (1999).

Table 1: Mean values of different morphological characters of blackgram varieties

variety→ Character↓	Blackgram			Mean	SEM	CD
	Nethi minumu	Chikkudu minumu	LBG 17			
Days to flowering	52.40	48.30	45.00	48.50	0.48	01.92
Days to maturity	79.60	75.00	67.60	74.00	0.77	03.02
Plant height (cm)	25.00	27.00	30.30	27.40	1.40	NS
Number of Branches at 35 DAS	02.30	02.40	03.60	02.70	0.38	NS
Number of Branches at 70 DAS	04.30	05.00	06.00	05.10	0.60	NS
Number of Leaves at 35 DAS	06.00	06.60	08.00	06.80	0.77	NS
Number of Leaves at 70 DAS	12.30	11.60	12.6	12.10	0.38	NS
Root Length (cm) at 35 DAS	16.30	15.40	18.10	16.60	0.30	01.20
Root Length (cm) at 70 DAS	19.40	19.30	20.90	19.80	0.40	NS
Shoot Length (cm) at 35 DAS	16.10	16.90	15.60	16.20	0.30	NS
Shoot Length (cm) at 70 DAS	31.70	35.90	35.40	34.30	0.90	NS
Number of Root Nodules at 35 DAS	30.00	25.60	44.00	33.20	2.67	10.49
Number of Root Nodules at 70 DAS	33.60	28.40	46.70	36.20	2.82	11.08
Number of Clusters/plant	10.00	10.50	14.00	11.30	0.88	NS
Number of Pods /Plant	40.00	41.30	65.30	48.80	2.02	07.94
Pod length (cm)	05.30	05.00	06.00	05.40	0.77	NS
Number of Seeds /pod	06.60	06.80	08.60	07.20	0.33	01.30
100 seed weight (g)	05.10	05.80	06.90	05.93	0.09	00.35
Seed Yield /Plant (g)	13.40	10.60	19.30	14.40	0.21	00.82

The physiological parameters such as root dry weight (g), Shoot dry weight (g), total plant dry weight (g), leaf area (sq.cm), seed protein content (%), chlorophyll a (mg/g), chlorophyll b (mg/g), total chlorophyll (mg/g) and carotenoids (mg/g) measured in the present study differed significantly resistant (LBG 17) versus susceptible plants (Table 2). The decrease in chlorophyll content in cowpea was reported by Gupta *et al.,* (1983), in rice by Sridhar *et al.,* (1976), in wheat by Rosyara *et al.,* (2007), in cotton by Ashraf and Zafar, (1999), in tomato by Lodh *et al.,* (1973), Singh (1977) and Sasikumaran *et al.,* (1979), in betelvine leaves by Nema (1991). The decrease in chlorophyll and carotenoid content in susceptible varieties was reported in cassava and pigeon pea by Ramakrishnan and Nambiar (1968), in chillies by Jayarajan and Ramakrishnan (1971), in rice by Chowdhury and Mukhopadhyay (1974), in cucumbers by Joshi and Dubey (1975). The increase in physiological parameters in LBG 17 compared to Nethiminumu and Chikkuduminumu indicating that the photosynthetic efficiency of LBG 17 in terms of yield is several times higher when compared to susceptible ones. Nuhu *et al.,* (1960) reported increased protein content of tomato leaves infected with viral disease.

Table 2: Mean values of Physiological characters of blackgram varieties

Variety→ Character↓	Blackgram			Mean	SEM	CD
	Nethi minumu	Chikkudu minumu	LBG 17			
Root dry weight (g)	00.23	00.21	00.26*	00.23	0.01	0.03
Shoot dry weight (g)	01.80	01.90	02.30*	02.00	0.01	0.07
Total Plant dry weight (g)	02.10	02.30	02.50*	02.30	0.02	0.11
Leaf area (sq.cm)	155.00	147.50	170.70*	157.70	0.82	3.24
Seed protein content (%)	26.20	25.10	27.80*	26.30	0.16	0.63
Chlorophyll a (mg/g)	01.20*	01.00	01.10*	01.10	0.10	0.05
Chlorophyll b (mg/g)	00.80	00.85*	00.90*	00.85	0.10	0.07
Total chlorophyll (mg/g)	01.60	02.00*	02.10*	01.90	0.10	0.05
Carotenoids (mg/g)	00.70	00.77*	00.80*	00.76	0.10	0.05

*****Significant at 5% level

Association analysis worked out between yield and yield component characters and among themselves have been showed that seed yield was found to have significant positive association with root nodules per plant (0.979**), number of clusters per plant (0.939**), number of pods per plant (0.934**), number of seeds per pod (0.944**), 100 seed weight (0.564*), leaf area (0.975**), total plant dry weight (0.947**), seed protein content (0.995**) (Table 3) and (Fig 1-5). These findings are in agreement with Singh and Malhotra (1970), Giriraj and Kumar (1974), Bhaumik *et al.,* (1976), Sandhu *et al.,* (1979), Upadhyaya *et al.,* (1980), Parida *et al.,*(1982) and Gupta *et al.,* (1982) on mungbean.

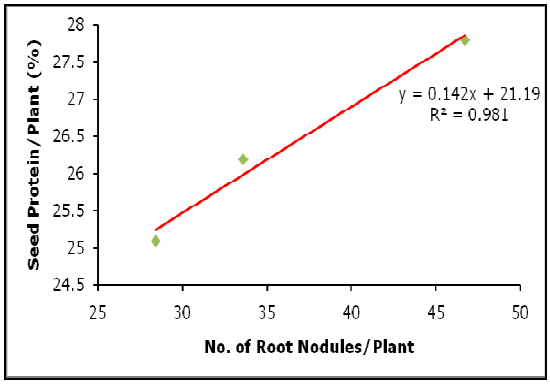

Fig 1: Correlation between root nodules and seed protein/plant

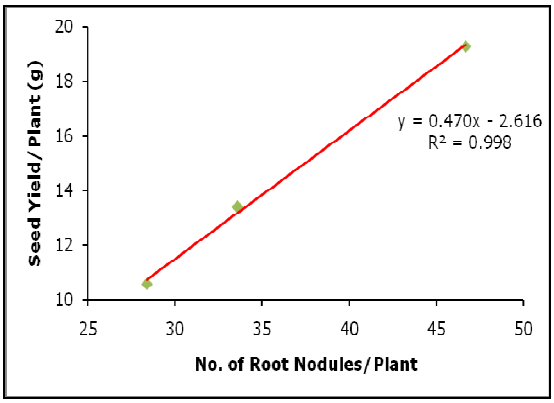

Fig 2: Correlation between root nodules and seed yield/plant

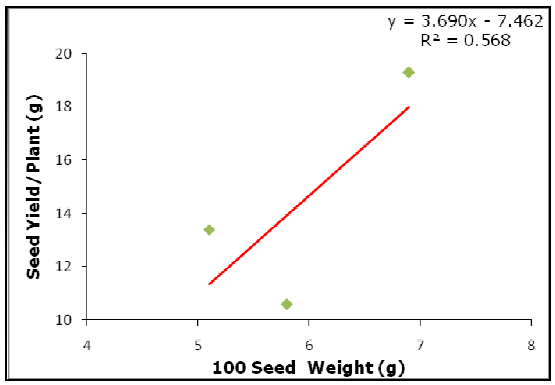

Fig 3: Correlation between No. of clusters/plant and seed yield

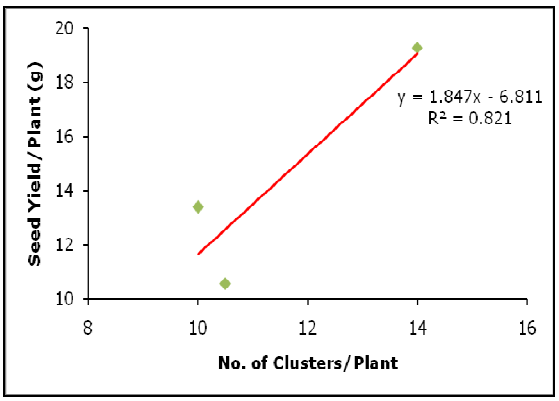

Fig 4: Correlation between 100 seed weight and seed yield/plant

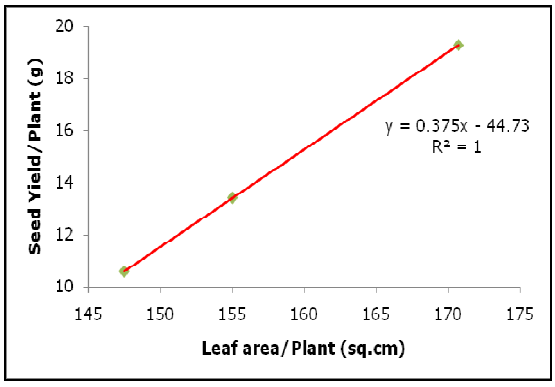

Fig 5: Correlation between leaf area and seed yield/plant

The positive correlation of these resistance conferring characteristics with yield and other yield component characters suggesting that they are not only essential in defense mechanism but also required to drive other operations at optimal level to get higher yields.

Conclusion

An overview the results indicated that the resistance developed through conventional plant breeding was responsible

for the better performance of the LBG 17 in rice fallows. Further it can be suggested that LBG 17 may be used as a source material for future studies involving molecular basis of resistance to diseases.

Table 3: Correlation coefficients among yield and other component traits

Character	Number of Root Nodules/ plant	Number of clusters/ plant	Number of pods/ plant	Number of seeds/ pod	100seed weight (g)	Leaf area (sq.cm)	Total plant dry wt (g)	Seed protein content (%)	Total chloro phyll (mg/g)	Carotenoids (mg/g)
Number of clusters/plant	0.961**									
Number of pods/plant	0.948**	0.969**								
Number of seeds/pod	0.951**	0.907**	0.949**							
100 Seed weight (g)	0.597*	0.795**	0.822**	0.785**						
Leaf area (sq. cm)	0.989**	0.947**	0.933**	0.919**	0.562*					
Total plant dry weight (g)	0.962**	0.921**	0.937**	0.957**	0.795**	0.938**				
Seed protein content (%)	0.991**	0.914**	0.895**	0.913**	0.482	0.996**	0.912**			
Total Chlorophyll (mg/g) 0.421	0.655*	0.688*	0.652*	0.979**	0.382	0.654*	0.292			
Carotenoids (mg/g)	0.242	0.500*	0.539*	0.501*	0.923**	0.200	0.505*	0.106	0.982**	
Seed yield/plant (g)	0.979**	0.939**	0.934**	0.944**	0.564*	0.975**	0.947**	0.995**	0.383	0.202

* Significant at 5% level **Significant at 1% level

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