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RESEARCH ARTICLE

Effect of Varieties on Growth, Yield and Economics of Blackgram in High Rainfall Zone of Tamil Nadu

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ABSTRACT

Blackgram is the most important rice-fallow crop in Kanyakumari District, Tamil Nadu, India. Huge labor cost for multiple harvests forced the farmers to leave the land un-cultivable many of times. Hence, the farmers need a synchronized maturing variety in blackgram. Synchronized maturing varieties *viz.,* VBN (BG) 6, and Blackgram MDU 1 were test verified with the local cultivar in the rice-fallow condition during 2016 as on-farm testing. About one acre of land divided into three and VBN (BG) 6 and Blackgram MDU 1 varieties was test verified with local cultivar. Results indicated that taller plants (54.5 cm) and increased number of seeds/pod (6.7) noted with blackgram MDU 1 variety over VBN (BG) 6. The number of pods/plant were significantly higher (28.1) with VBN (BG) 6 compared to Blackgram MDU 1 and local cultivar. Similarly, 27.9 per cent of increased grain yields recorded in VBN (BG) 6 than Blackgram MDU 1. Due to higher yield, the economic parameters such as gross return, net return and B:C ratio were also higher in VBN (BG) 6 as compared with Blackgram MDU 1 and local cultivar. Yellow mosaic virus incidence was also absent in VBN (BG) 6 variety. Hence, it is concluded that VBN (BG) 6 is the best-suited blackgram variety in rice-fallow conditions of the Kanyakumari district.

Keywords: *High rainfall zone, Blackgram varieties, Rice-fallow condition, Synchronizing maturity, VBN (BG) 6 variety*

INTRODUCTION

Pulses have greater importance in Indian agriculture as they are a rich source of protein (17 to 25%) compared to that of cereals (6 to 10%). Pulses are an important constituent of the Indian diet and supply a major part of protein, essential amino acid and enrich the soil fertility through symbiotic N fixation. It maintains the normal growth, development and health of mankind (Jadhav *et al.,* 2014).

India is the largest pulse growing country in the world, which shares 30-35 per cent and 27-28 per cent of the total area and production of pulses, respectively. The pulses are grown on 304 lakh ha area in India with the production of 14.77 million tonnes, and productivity is 617 kg/ha. The increase in pulses production has been only marginal when compared with the phenomenal increase achieved in wheat and rice. With the rapid increase in the Indian population, the availability of pulses has gone down from 30g/capita/day during 2002 to around 26g/capita/day (Panotra *et al.,* 2016).

Blackgram (*Vigna mungo* L.) is being grown as one of the principles of pulse crops in India. It is the best-suited crops under the rice-fallow condition of the major rice-growing belts of India in general and particularly in Tamil Nadu. Blackgram is a perfect combination of all nutrients, which includes proteins (25-26%), carbohydrates (60%), fat (1.5%), minerals, amino acids and vitamins. It stands next to soybean in its dietary protein content. It is rich in vitamin A, B_1, B_3 and has a small amount of thiamine, riboflavin, niacin and vitamin C. It contains 78 to 80 per cent of nitrogen in the form of albumin and globulin. The dry seeds are a good source of phosphorus. It also has very high-calorie content, 100 g of blackgram has 347 calories (Verma, 2015). In India, blackgram is grown in 2.5 million ha area with a total production of 1.5 million tonnes and productivity of 600 kg/ha.

Kanyakumari is agro-climatically classified as a high rainfall zone, is one of the important blackgram growing districts in Tamil Nadu. Rice-rice-blackgram is the predominant cropping system practiced in this zone. The area under the rice-fallow blackgram is 750 ha. Nevertheless, the area is declining over years due to many reasons such as lack of water until harvest, delaying maturity which may prevent

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raising early-season rice, lack of suitable varieties, labor scarcity, poor yield, high cost of cultivation due to multiple harvests, etc. Besides, the yellow mosaic virus is another important factor threatening the farmers in growing blackgram. Therefore, the farmers are in need of synchoronized maturing varieties with resistance to YMV. The varieties such as VBN (BG) 6 and Blackgram MDU 1 possess the above characters but not recommended for this zone. Hence, these popular blackgram varieties are test verified in the farmers' field with the local variety as On-farm testing.

MATERIAL AND METHODS

On-farm testing was conducted at the farmers' field of Esanthimangalam village of Boothabandi block, Kanyakumari District, Tamil Nadu, during 2016. Kanyakumari is situated in the southernmost part of India at 08.09^{0}N latitude, 77.54^{0}E longitude, and an elevation of 37 m above mean sea level. The District is demarked as the high rainfall zone of Tamil Nadu gets an average rainfall of 1369 mm. The District receives the rainfall not only from the monsoon periods *viz.,* Southwest monsoon (June-September), and Northeast monsoon (October-December), but also during winter (January-February) and summer (March-May) seasons. Hence, the District has showers throughout the year. An average minimum and maximum temperature varied from 15^{0}C to 40^{0}C.

The on-farm testing area is having canal irrigation facilities during June-January months, but not have irrigation facilities during summer months, and during that period, the pulse crop especially blackgram is grown. The soil of the testing field was clay loam in texture, slightly alkaline in reaction, low in organic carbon (0.15-0.48%) and available nitrogen (186-235 kg/ha), high in available phosphorus (33.2-38.9 kg/ha) and potassium (336-546 kg/ha).

Five farmers were selected for the testing who have at least one acre of the land. One acre of the land was bifurcated into three almost equal fields to test the varieties. Two synchronized maturing varieties such as VBN (BG) 6 and Blackgram MDU 1 were test verified with the local cultivar (normally farmers growing variety) in rice-fallow condition. T9 is the variety with the farmers is cultivating, and some of them are growing un-known variety also. The varietal characters of test varieties are given in Table 1. The seeds had sown during the second fortnight of February after the harvest of previous rice crop. The seeds broadcasted uniformly prior to the expected rain. A seed rate of 25 kg/ha adopted. Prior to sowing, the seeds treated with Imidacloprid @ 1.5ml/kg of seeds to avoid the yellow mosaic virus. All the recommended package of practices followed to raise the crop as per CPG (2012). The crop was harvested during the first fortnight of May. For the convenience of statistical analysis, each varietal field divided into two halves to get ten plots (5 farmers and every two plots), which served as replications.

The observations on growth parameters at critical stages, yield and yield attributes recorded. Plant population/m^2 was accounted from the testing fields on 15 days after sowing (DAS) and at maturity by counting the population using Quadrat (0.25 m^2) and converted to the square metre. Plant height (at 20 and 40 DAS; and at maturity) measured in centimetres from the base of stem to the topmost leaf with the help of metre scale. The length of pod measured from the base of the pod up to its tip. Grains produced by the pod of each tagged plant separately counted and arrived the number of grains/pod. Grain and haulm yield of each field weighed and recorded. All the plants from each field harvested and left for sun drying. After threshing, grain yield per each field recorded and converted to per hectare basis. Harvest index calculated by the following formula.

$$\text{Harvest index (\%)} = \frac{\text{Economic (Grain) yield (kg/ha)}}{\text{Biological (Grain + haulm) yield (kg/ha)}} \times 100$$

Yellow mosaic virus (YMV) incidence was recorded as per the procedure (1-9 scale) suggested by Alice and Natarajan (2007).

The economics of different varieties was calculated by converting the total yield of the plot into money value. The cost of cultivation estimated based on the prevailing market rate on expense. The gross return calculated by adding the cost of grain and the cost of haulm according to prevailing market rates.

Gross return (Rs./ha) = Cost of grain (Rs./ha) + Cost of haulm (Rs./ha).

Net return obtained by subtracting the cost of cultivation from gross return.

Net return (Rs./ha) = Gross return (Rs./ha) - Total cost of cultivation (Rs./ha).

B:C ratio was calculated as per the formula given below.

$$\text{Return per rupees invested (B:C ratio)} = \frac{\text{Gross return (Rs./ha)}}{\text{Total cost of cultivation (Rs./ha)}}$$

The data subjected to statistical analysis (Gomez and Gomez, 2010).

RESULTS AND DISCUSSION

Growth parameters

Plant stand/m²

An optimum plant population for any crop is one of the major factors for securing higher productivity. A uniform and optimum plant per unit area is a pre-requisite for obtaining higher precision when it is not a variable factor or treatment under test. Data on plant stand was given in Table 2.

Table 1. Varietal characters of blackgram

Characters	VBN (BG) 6	Blackgram MDU 1
Parentage	Vamban 1 x *Vigna mungo silvestris*	ADB 2003 x VBG 66
Year of release	2011	2014
Maturity duration (days)	65-70	70-75
Grain yield (kg/ha)	890	790
100 grain weight (g)	3.8-4.0	5.2
Special features	Resistant to yellow mosaic, synchronized pod maturity, hairy pods	High yield with good batter quality (Arabinose 7.5% and globulin 12.1%)
		Long pods with bold seeds, moderately resistant to YMV and pod borer and resistant to leaf crinkle virus, suitable for cultivation in *rabi* season

Plant stand of different genotypes recorded at 15 DAS and at maturity stages was found to be non-significant. It ranged from 20.1/m² in VBN (BG) 6 variety to 22.3/m² in the case of Blackgram MDU 1. At the maturity stage, the plant stand was declined (14.6 to 15.6/m²).

Table 2. Growth characters as influenced by different varieties of blackgram in rice-fallow condition

Treatments	Plant population (m^{-2})		Plant height (cm)		
	15 DAS	At maturity	20 DAS	40 DAS	At maturity
T_1 - VBN (BG) 6	20.1	14.6	12.5	38.2	39.1
T_2 - Blackgram MDU 1	22.3	15.3	18.4	50.4	55.1
T_3 - Local	21.6	15.6	17.2	51.6	53.3
SEd	1.32	1.23	1.1	3.2	3.8
CD (at 5%)	NS	NS	2.4	6.9	8.2

Though the expected population was 33/m², the actual plant stand was lesser than a half. Poor rains had received during the cropping period (only in three rainy days with 43.0mm) was the main reason for poor crop stand. Since the management practices such as spacing, moisture condition, etc. were uniform over varieties and hence, there was no significant variation.

Plant height (cm)

The progressive plant height recorded at 20 and 40 DAS and crop maturity stages given in Table 2. The plant height, in general, enhanced by more than two times in all the varieties between 20 DAS and 40 DAS; but the growth was marginal thereafter.

Table 3. Yield attributes and yield as influenced by different varieties of blackgram in rice-fallow condition

Treatments	Number of pods/ plant	Number of grains/ pod	Pod length (cm)	Grain yield (kg/ ha)	Haulm yield (kg/ ha)	Harvest Index (%)
T_1 - VBN (BG) 6	27.4	5.9	4.08	274.4	540.4	33.68
T_2 - Blackgram MDU 1	18.1	6.7	4.74	210.2	630.6	25.00
T_3 - Local	17.4	6.1	4.12	189.6	650.3	22.57
SEd	1.7	0.3	0.17	10.6	26.3	3.54
CD (at 5%)	3.7	0.6	0.37	22.9	56.8	7.65

The plant height of blackgram over different varieties was varied significantly at different stages. The variety Blackgram MDU 1 grew significantly taller (18.4 cm) over VBN (BG) 6 (12.5 cm) at 20 DAS; but the latter was on par with the local cultivar. Later stages (40 DAS and at maturity) also, a similar trend was noticed. The overall trend indicated that the progressive increase in height among the varieties was consistent. Secondly, there were significant variations in their height at all three stages of observations. The significant variations in plant height among the varieties may be due to their genetic variability and the influence of environmental factors might be the least. The similar results reported by Bhowmick *et al.* (2008), Goswami *et al.* (2010); and Verma *et al.* (2011).

Yield attributing characters

Number of pods/plant

The formation of a number of pods/plant found to be significant among the blackgram varieties (Table 3). The variety VBN (BG) 6 had produced significantly more pods (27.4 pods/plant) compared to Blackgram MDU 1 (18.1 pods/plant) and local cultivars (17.4 pods/ plant). However, the latter two were on par with each other. Though the production of a number of pods/plant may be a genetic character, environmental conditions such as soil, climatic condition, etc. also decides the pod's number. Bhowaland and Bhowmik (2014) reported a variation of the number of pods earlier.

Length of pods

The pod length of different blackgram varieties differed significantly (Table 3). The variety Blackgram MDU 1 had produced the maximum pod length of 4.74 cm, being superior to VBN (BG) 6 (4.12 cm). The lowest pod length (4.08 cm) measured in the case of local. Length of the pod is genetically made character under optimal environmental conditions.

Here also, all three varieties had been exposed to similar environmental condition; genetic characters express the results.

Number of grains/pod

The number of grains per pod, differed significantly in different varieties of blackgram (Table 3). Blackgram MDU 1 variety had produced the maximum number of grains (6.7 grains/pod), is significantly higher than Local (6.1 grains/pod). On the other hand, the lowest number of grains (5.9 grains /pod) obtained by VBN (BG) 6 variety. The number of grains/pod was influenced by the genetic nature of the variety. Among genetic characters, pod length is the major parameter deciding the number of grains/pod. Similar results were also reported earlier by Mahalashmi *et al.* (2002); and Bhowaland and Bhowmik (2014).

Yield parameters

Grain yield (kg/ha)

Blackgram varieties had a significant influence on grain yield (Table 3). Variety VBN (BG) 6 (T_1) registered significantly higher grain yield (274.4 kg/ha) than Blackgram MDU 1 (210.2 kg/ha) and local cultivars (189.6 kg/ha). The percentage yield increase due to VBN (BG) 6 over local types was 45.0. Higher yield potential, suitability to a rice-fallow condition in addition to the resistance of yellow mosaic virus might be the reason for higher yield recorded with VBN (BG) 6 over others. A higher number of pods/plant in VBN (BG) 6 variety might have directly influenced on grain yield of blackgram. Yield variation over different varieties of blackgram was also recorded earlier (Bhowaland and Bhowmik, 2014; and Reddy *et al.,* 2014).

Haulm yield (kg/ha)

The haulm yield found to influence significantly due to different varieties of blackgram (Table 3). Among the varieties tested, local types produced significantly higher haulm yield (650.3 kg/ha) over the improved varieties tested. The lowest haulm yield (540.4 kg/ha) was produced by VBN (BG) 6. Local cultivars have indeterminate growth, which had produced the new branches continuously and increased the haulm yield. Whereas, synchronized maturing nature of the two improved varieties [(VBN (BG) 6 and Blackgram MDU 1] produced lesser haulm yield than the local variety. Gupta *et al.* (2006); and Reddy *et al.* (2014) had also reported similar variation on haulm yield over different varieties.

Harvest index

The harvest index (HI) of blackgram found to deviate significantly over the varieties under test (Table 3). The variety VBN (BG) 6 recorded the highest harvest index (33.68%), which was significantly higher than Blackgram MDU 1 (25.00%) and Local (22.57%). Higher grain yield and lower haulm yield of VBN (BG) 6 variety enhanced the HI over others. Mahalakshmi *et al.* (2002); and Ahmad *et al.* (2003) also had observed similar variations.

Table 4. Economic parameters as influenced by different varieties of blackgram in rice-fallow condition

Treatments	Cost of cultivation (Rs./ha)	Gross return (Rs./ ha)	Net return (Rs./ ha)	B:C ratio
T_1 - VBN (BG) 6	16,120	37,317	21,197	2.31
T_2 - Blackgram MDU 1	16,733	29,332	12,599	1.75
T_3 - Local	20,824	24,949	4,125	1.20

Data not statistically analysed

YMV incidence

The variety VBN (BG) 6 exhibited resistance reaction with a rating of 1.0 to 2.0 compared to Blackgram MDU 1 variety, which was moderately susceptible (4.1 to 6.0). The local cultivar also recorded a moderately susceptible score (5.0). This was mainly due to varietal characters as indicated in Table 1, wherein VBN (BG) 6 reported as resistant to YMV.

Economic studies

The data on economic analysis consisted of cost of cultivation, gross return, net return, and benefit: cost ratio summarized in Table 4.

Cost of cultivation

The cost incurred for the cultivation of different varieties shown variation. Among the three varieties tested, the expenditure incurred on cultivation was higher with local cultivar (Rs. 20,824/ha) compared to the other two improved varieties. The higher cost of cultivation incurred in local cultivar was mainly due to more pickings (2-4) compared to single picking in the improved varieties.

Gross return

Among the different varieties, VBN (BG) 6 recorded the highest gross return (Rs. 37,317/ha) followed by Blackgram MDU 1. The minimum gross return was obtained by local cultivar (Rs. 24,949/ ha). Higher gross returns with the VBN (BG) 6 were mainly due to higher grain yield obtained over others. Though the haulm yield was lower in this variety, considering the higher cost of grain, the gross return was moreover other varieties.

Net return

The net return values differed between varieties. The result of gross return was repeated with the net

return. Higher gross return in VBN (BG) 6 variety and almost equivalent cost of cultivation with the Blackgram MDU 1 variety led higher net return in VBN (BG) 6 variety. The synchronized maturity in this variety had facilitated a single harvest, which reduced the cost of cultivation and, ultimately, increased the net return. The least net return was noticed with local cultivars was mainly due to multiple harvests led to the higher cost of cultivation.

B:C ratio

The maximum benefit: cost ratio was found with VBN (BG) 6 variety (2.31) followed by Blackgram MDU 1 (1.75). The minimum benefit: cost ratio was recorded in local cultivars (1.20). Lower gross return and higher cost of cultivation in the local cultivars resulted in lower B:C ratio over-improved varieties.

CONCLUSION

On the basis of the on-farm testing, it was concluded that the blackgram variety VBN (BG) 6 and Blackgram MDU 1 were found suitable under rice-fallow conditions of Kanyakumari District. Compared to these two, VBN (BG) 6 was better by obtaining higher grain yield with better economic parameters. Hence, it is concluded that VBN (BG) 6 variety is best suited for the rice-fallow condition of the high rainfall zone of Tamil Nadu.

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