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RESEARCH ARTICLE

Effect of Crop Geometry, Fertilizer Levels and Foliar Nutrition on the Yield Attributes, Yield and Economics of Blackgram (*Vigna mungo* L.) under Irrigated Condition

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ABSTRACT

A field experiment was conducted at Agricultural College and Research Institute, Killikulam (TNAU) during *Puratassipattam* (Sep–Dec., 2017) to study the effect of crop geometry, fertilizer levels and foliar nutrition on the yield attributes, yield and economics of irrigated blackgram. The experiment was laid out in randomized block design and replicated thrice with twelve treatments. The treatment consists of two spacings, two fertilizer levels and spraying of foliar nutrients and growth regulators. The results revealed that plant spacing of 30 × 15 cm with 100 % RDF coupled with foliar spray of TNAU Pulse Wonder @ 1.125% at 50 % flowering recorded higher yield attributes, yield and highest profit. The seed yield increases with 29 % over the adoption of crop spacing of 30 × 10 cm with 100 % RDF without any foliar nutrition.

Keywords: *Crop geometry, Fertilizer levels, Foliar nutrition, Yield attributes, Yield,Economics*

Pulses play an important role in Indian agriculture. Pulses are the main source of protein particularly for vegetarian and contribute about 14 percent of the total protein of average Indian diet. Nutritionally pulses are two to three times richer in protein than the cereal grains and have remained the least expensive source of protein for the human being since the dawn of the modern civilization. The per capita availability of pulses in India has been continuously decreasing, which is 32.52 g day^{-1} against the minimum requirement of 80 g day^{-1} per capita prescribed by Indian Council of Medical Research (ICMR). The United Nations declared 2016 as "International Year of Pulses" (IYP) to heighten the public awareness of the nutritional benefits of pulses as part of sustainable food production aimed at food security and nutrition.

The low yield in pulses is attributed to several reasons. The main reason for low productivity is less plant population, less nutrients and moisture stress under critical stages. The sluggish growth in pulse production in the country could be due to various physiological and biochemical as well as inherent factors associated with the crop. It is mostly grown as mixed crop, intercrop and bund crop, farmers will not follow the regular package of practices. Apart from these, the slow rate of dry matter accumulation during the pre-flowering phase, poor pod setting, onset of leaf senescence during the period of pod development and low partitioning efficiency of assimilates to grain were identified as the main physiological constraints for yield (Pawar and Bhatia, 1980).

In TamilNadu, the newly released variety KKM 1 is moderately resistant to Yellow Mosaic Virus. It produces higher yield, better pest and disease resistance, good cooking quality, high seedling vigour and suitable for cultivation under both irrigated and rice fallow condition. The newly released blackgram grows profusely with dense canopy. So, there is a need to increase the spacing and fertilizer level under irrigated condition.

MATERIAL AND METHODS

A field experiment was conducted during *Puratassipattam* (September –December, 2017) at Agricultural College and Research Institute, Killikulam to evaluate the crop geometry, fertilizer levels and foliar nutrition for maximizing the productivity of newly released KKM 1blackgram under irrigated condition. The soil of the experimental field was sandy clay loam with initial soil pH, EC and organic carbon of 7.2, 0.25 dS m^{-1} and 7.1 g kg^{-1} respectively. The fertility status was low in available nitrogen, medium in available phosphorus and available potassium. The mean annual rainfall is 627.6 mm received in 36 rainy days. The mean maximum and minimum temperature of the location are 33.4 °C and 23.6 °C respectively. The relative humidity ranges from

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60 to 80 per cent. The experiment was laid out in randomized block design consisting of twelve treatments and replicated thrice. The treatments consists of two spacing such as 30×10 cm and 30×15 cm, two fertilizer levels *viz*., 100 % RDF and 125 % RDF and foliar nutrition of Pulse Wonder @ 1.125% and Poly Feed 1% + NAA 40 ppm with different combinations.

The blackgram variety KKM 1was chosen for the study. The recommended dose of NPKS (25:50:25:20 kg ha^{-1}) of in the form of urea, single super phosphate and murate of potash was applied as basal. Foliar spray of TNAU Pulse Wonder once at 50% flowering and Poly Feed + NAA was given twice at first flowering and 15 days after first flowering. The observations were made on yield attributes (No. of pods $plant^{-1}$, No. of seeds pod^{-1},100 seed weight), yield (seed and haulm) and economics. The results of the experiment was illustrated below.

RESULTS AND DISCUSSION

Yield attributes

The yield attributing characters of irrigated blackgram such as number of pods $plant^{-1}$, number of seeds pod^{-1} and hundred seed weight was higher in plant spacing of 30 × 15 cm with 100 % RDF coupled with foliar spray of TNAU Pulse Wonder @ 1.125 % (T_8) which recorded 34.6 pods $plant^{-1}$ and 6.7 seeds pod^{-1} (Table 1). The increase in yield attributes at wider planting geometry of 30 × 15 cm might be due to better crop growth, resulted by utilization of more sunlight, soil nutrients and water. This is in conformity with the findings of Kumar and Jayakumar (2004) and Subramani *et al.* (2002) in blackgram. Adequate and continuous availability through soil and foliar nutrition promotes the supply of assimilates to sink or yield container, thus enlarging the yield structure. These findings was reported by Hamayun and Chaudhary (2004). The increase in yield attributes due to foliar application of TNAU Pulse Wonder might be due to supplementation of nutrients at the critical stage without physiological stress. Spacing, fertilizer dose and foliar spray do not have significant influence on test weight.

Table 1. Effect of crop geometry, fertilizer levels and foliar nutrition on yield attributes,seed yield,haulm yield and economics of irrigated blackgram

Treatments			No. of pods $plant^{-1}$	No. of seeds pod^{-1}	100 seed wt (g)	Seed yield kg ha^{-1}	Haulm Yield kg ha^{-1}	Cost of cultivation ₹ ha^{-1}	Gross return ₹ ha^{-1}	Net return ₹ ha^{1}	B:C Ratio
T_1	Spacing 30×10 cm	100 % RDF	20.70	5.40	4.94	688	2245	28106	48872	20766	1.74
T_2		100 % RDF + Pulse Wonder@ 1.125 %	26.20	6.30	5.40	852	2595	29880	60492	30612	2.02
T_3		100 % RDF + Poly Feed 1 % + NAA 40 ppm	25.37	5.90	5.29	791	2475	30149	56161	26012	1.86
T_4		125 % RDF	21.13	5.50	5.02	709	2313	28884	50315	21431	1.74
T_5		125 % RDF + Pulse Wonder@ 1.125 %	23.60	5.80	5.23	775	2418	30658	55001	24343	1.79
T_6		125 % RDF + Poly Feed 1 % + NAA 40 ppm	22.40	5.70	5.17	759	2400	30927	53889	22962	1.74
T_7	Spacing 30×15 cm	100 % RDF	21.50	5.60	5.09	725	2355	26306	51451	25145	1.96
T_8		100 % RDF + Pulse Wonder @1.125 %	34.63	6.70	5.53	969	2862	28080	68799	40719	2.45
T_9		100 % RDF + Poly Feed 1 % + NAA 40 ppm	29.27	6.20	5.37	846	2576	28349	60066	31717	2.12
T_{10}		125 % RDF	27.20	6.20	5.32	824	2503	27084	58504	31420	2.16
T_{11}		125 % RDF + Pulse Wonder @1.125 %	32.10	6.50	5.49	932	2731	28858	66172	37314	2.29
T_{12}		125 % RDF + Poly Feed 1 % + NAA 40 ppm	31.80	6.40	5.46	913	2618	29127	64847	35720	2.23
CD(P= 0.05)		SEd	1.27	0.18	0.19	25.4	77.2	-	-	-	-
		2.64	0.36	NS	52.7	166.3	-	-	-	-	

A lower value of yield attributing characters was observed in 100 % RDF alone without foliar spray (T_1) under close spaced crop. The less number of pods $plant^{-1}$ under closer spacing was due to mortality caused by mutual shading of plants during pre-flowering stage (Siddaraju *et al*., 2010) and competition between the crop plants by solar radiation and nutrients causes to reduce the source sink relationship (Vaiyapuri *et al*.,2009).

Yield

The seed and haulm yield are merely the function of yield components. The plant spacing of 30 × 15 cm with 100 % RDF coupled with foliar spray of TNAU Pulse Wonder @ 1.125% (T_8) at 50 % flowering produced higher seed yield of 969 kg ha^{-1} and it was on par with plant spacing of 30 × 15 cm with 125 % RDF coupled with foliar spray of TNAU Pulse Wonder @ 1.125% (T_{11}) which recorded seed yield of 932 kg ha^{-1}(Table.1). The seed yield for the treatment with plant spacing of 30 × 15cm with 100 % RDF + Pulse Wonder @ 1.125 % (T_8) was increased with 29 % over the adoption of plant spacing of 30 × 10 cm with 100 % RDF without any foliar nutrition (T_1). The increase in yield at wider planting geometry might be due to better crop growth rate and lesser competition for resources between plants for water and soil nutrients led to produce more pods and heavier seeds which resulted in higher yield. The application of 100 % recommended dose of fertilizers which would have increased the soil fertility and favoured for better nutrient supply during early establishment stages which resulted in better plant growth, DMP and nutrient uptake, which attributed positive influence on the yield attributes and eventually in the yield. The lowest seed yield of 688 kg ha^{-1} was recorded with plant spacing of 30 × 10 cm with 100 % RDF without foliar application of nutrients (T_1).

Table 2. Unit cost of inputs

Input	Unit	Cost ( )
Urea	1 kg	5.97
SSP	1 kg	7.20
MOP	1 kg	11.55
TNAU Pulse Wonder	1 kg	200.00
Poly Feed	1 kg	160.00
NAA	100 ml	95.00

The plant spacing of 30 × 15 cm with 100 % RDF coupled with foliar spray of TNAU Pulse Wonder @ 1.125% (T_8) at 50 % flowering had produced higher haulm yield of 2862 kg ha^{-1} and it was on par with the plant spacing of 30 × 15 cm with 125 % RDF coupled with foliar spray of TNAU Pulse Wonder @ 1.125% (T_{11}) recorded 2731 kg ha^{-1} and plant spacing of 30 × 15 cm with 125 % RDF coupled with foliar spray of Poly Feed 1% + NAA 40ppm (T_{12}) which recorded haulm yield of 2618 kg ha^{-1} . The higher drymatter production of KKM 1 might be due to its genetic potential to produce more plant height, number of branches and more number of leaves altogether increased the haulm yield. The lowest haulm yield of 2245 kg ha^{-1} was recorded with the plant spacing of 30 × 10 cm with 100 % RDF without any foliar application of nutrients (T_1).

Foliar application of TNAU Pulse Wonder increased the blackgram yield mainly due to the nature of this crop booster with a combination of nutrients and growth regulators resulted in decreased flower shedding and improvement in the crop tolerance for abiotic and biotic stress in blackgram (Marimuthu and Surendran, 2015).

Economics

Total cost of cultivation was found to be higher in 30 × 10 cm plant spacing with the application of 125 % RDF coupled with foliar spray of Poly Feed 1 % + NAA 40 ppm (T_6) (₹30,927 ha^{-1}). The reason might be due to the additional use of fertilizer dose, seed rate and labour requirement for spraying twice as compared to the conventional practice. The cost of cultivation was higher with treatments (T_1 – T_6) of plant spacing of 30 × 10 cm with a expenditure from ₹ 28,106 – ₹ 30,927 ha^{-1} than from ₹ 26,306 – ₹ 29,127 ha^{-1} under the plant spacing of 30 × 15 cm (T_7 – T_{12}).

The higher gross and net income of ₹ 68,799 & ₹ 40,719 ha^{-1} was also found in wider spacing of 30 × 15 with 100 % RDF coupled with foliar spray of 1.125 % TNAU Pulse Wonder (T_8) and the same treatment fetched more B:C ratio of 2.45 (Table1) . The increased returns for this treatment might be due to economic efficiency and viability of crop cultivation *ie*. mainly by the outcome of crop yield with lesser management cost. The fact that blackgram utilized the resources available below and above the ground very effectively thereby exhibited better growth and yield parameters. The result is supported by the findings of (Singh *et al.*, 2009) in blackgram. Further, the seed rate would have been more as compared to wider spacing of 30 × 15 cm. The higher seed productivity associated with wider plant spacing was due to full utilization of nutrients and foliar spray of TNAU Pulse Wonder @ 1.125 % resulted in increased economic returns compared to all treatments. The unit cost of inputs is given in Table 2.

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