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

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ABSTRACT: ***Field experiment was conducted at Agricultural College and Research Institute, Killikulam (TNAU) during Puratassipattam (September – December, 2017) to study the effect of crop geometry, fertilizer levels and foliar nutrition on the growth, growth analysis and yield 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 favoured higher growth characters (plant height, number of branches plant^{-1},dry matter production), growth analysis (leaf area index, crop growth rate, specific leaf area) and yield (seed and haulm). The grain yield increases with 29 % over the adoption of crop spacing of 30 x 10 cm with 100 % RDF without any foliar nutrition.***

Keywords: Crop geometry, fertilizer levels, foliar nutrition, growth, growth analysis, yield

Introduction

Pulses play an important role in Indian agriculture. Pulses are the main source of protein for particularly vegetarian and contribute about 14% 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 public awareness

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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. Farmers also pay poor attention to the pulses cultivation. 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 and with dense canopy. So, there is a need to increase the spacing and fertilizer level under irrigated condition.

Materials 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 60 to 80 per cent. The experiment was laid out in randomized block design consisting of twelve treatments and replicated thrice. The treatments are two spacing such as 30×10 cm and 30×15 cm, two fertilizer levels viz.,

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100 % RDF and 125 % RDF and foliar nutrition of Pulse Wonder @ 1.125% and Poly feed 1% + NAA 40ppm with different combinations.

The blackgram variety KKM 1was chosen for this study. The recommended dose of 25:50:25:20 kg of NPKS 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 Polyfeed + NAA was given twice at first flowering and 15 days after first flowering. The observations such as plant height, number of branches plant^{-1}, drymatter production (DMP), seed and haulm yield were recorded. Growth analysis of Leaf area index, crop growth rate and specific leaf area was worked out. The result of the experiment was illustrated given below.

Results and Discussion

Growth parameters

In general plant height gradually increased from initial stage to harvest stage. The plant height was not physically affected due to crop geometry, fertilizer levels and foliar nutrition. Adoption of plant spacing of 30 × 15 cm with 100 % RDF coupled with foliar spray of TNAU Pulse Wonder @ 1.125% at 50 % flowering produced taller plants of 61.1 cm (Table.1).However this was on par with the spacing of 30 × 15 cm with 125 % RDF coupled with foliar spray of TNAU Pulse Wonder @ 1.125% which recorded plant height of 57.7 cm. This may be due to less competition between inter and intra plants for sun light, water, nutrients as well as space. The enhancement of growth characters might be ascribed to the influence of nitrogen, which is the chief constituent of protein and an important compound of amino acids and co-enzymes which are of considerable biological importance (Vaiyapuri *et al.*, 2009).Shorter plants was observed under the spacing of 30 × 10 cm with 100 % RDF without foliar spray of nutrients (47.4cm).

Crop geometry of 30 × 15 cm with 125 % RDF coupled with foliar spray of TNAU Pulse Wonder @ 1.125% at 50 % flowering produced more number of branches (7.7) and it was on par with spacing 30 × 15 cm with 125 % RDF coupled with foliar spray of Poly feed 1 % + NAA 40ppm which produced 7.6 branches plant^{-1}. It might be due to wider spacing

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which results in more horizontal growth and plant canopy area due to less plant density and less competition for space, light, nutrients and moisture (Gawande *et al.*,2018.). The number of branches is lesser with closer plant spacing of 30 × 10 cm with 100 % RDF without foliar spray (6.5).

Drymatter accumulation is an important index reflecting the growth and metabolic efficiency of the plant which ultimately influence the yield of crop. The influence of plant spacing with foliar application of macro, micronutrients and growth regulators on crop growth and development could improve the dry matter accumulation. The DMP was found to be more with plant spacing of 30 × 15 cm with 100 % RDF coupled with foliar spray of TNAU Pulse Wonder @ 1.125% sprayed at 50 % flowering stage which recorded 3952 kg ha^{-1}. However it was on par with plant spacing of 30 × 15 cm with 125% RDF coupled with foliar spray of TNAU Pulse Wonder @ 1.125% (3831 kg ha^{-1}) and plant spacing of 30 × 15 cm with125 % RDF coupled with Poly feed 1% + NAA 40ppm (3731 kg ha^{-1}).This might be due to the foliar spray of nutrients on cell division and cell elongation which facilitates better crop growth (Meena, 2004). The lowest dry matter production was recorded in plant spacing of 30 × 10 cm with100 % RDF with no foliar spraying (2993 kg ha^{-1}).

Growth Analysis

Leaf area is an important factor determining the drymatter production of a crop and subsequently the yield. Leaf area index was more with spacing of 30 × 10 cm with 125 % RDF with foliar spray of TNAU Pulse Wonder @ 1.125% at 50 % flowering stage which recorded leaf area index of 3.54 at 45 DAS (Fig.1). However it was statistically on par with plant spacing of 30 × 10 cm with 125% RDF coupled with foliar spray of Poly feed 1% + NAA 40ppm (3.48). Though broader leaves and better plant stature have direct relationship with LAI, it could not compensate the cumulative leaf area obtained with more number of plants unit $area^{-1}$ in closer spacing. This might be attributed to higher number of leaves $plant^{-1}$, which resulted in more leaves leading to higher LAI (Sathyamoorthy *et al*., 2008). The lowest leaf area index of 2.61 was recorded with plant spacing of 30 × 15 cm with 100 % RDF without foliar spray of nutrients.

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The growth rate is the drymatter accumulation rate per unit land area. Crop growth rate increased rapidly from 30 to 45 DAS and tended to decline from 45 DAS to harvest. The plant spacing of 30 × 15 cm with 100 % RDF coupled with foliar spray of TNAU Pulse Wonder @ 1.125% once at 50% flowering recorded higher CGR of 62.1 kg ha^{-1} day^{-1} which was on par with plant spacing of 30 × 15 cm with 125 % RDF coupled with foliar spray of TNAU Pulse Wonder @ 1.125% (61.2 kg ha^{-1} day^{-1}) and with spacing of 30 × 15 cm with 125 % RDF coupled with foliar spray of Poly feed 1% +NAA 40ppm of 60.5 kg ha^{-1} day^{-1}(Fig.2). This might be due to more nutrients uptake in plant with wider planting geometry and favoured accumulation of more dry matter in plants resulted higher crop growth rate (Sathyamoorthy *et al*., 2008). The lowest crop growth rate of 39.6 kg ha^{-1} day^{-1} was recorded with plant spacing of 30 × 10 cm with 100% RDF without foliar spray of nutrients.

The specific leaf area was highest with the plant spacing of 30 × 10 cm with 100% RDF without foliar application of nutrients of 156 and 136 cm^2g^{-1} at 30 and 45 DAS respectively (Fig.3). However it was on par with plant spacing of 30 × 10 cm with 125 % RDF without foliar spray of nutrients (154 and 130 cm^2g^{-1} at 30 and 45 DAS respectively) and plant spacing of 30 × 15 cm with 100 % RDF without foliar spray of nutrients (150 and 87 cm^2g^{-1} at 30 and 45 DAS respectively). The higher leaf area at early stage may be due to the fact that biomass added to the leaf is minimum. The decreased SLA at rapid vegetative growth as well as flowering stage may be due to increased leaf weight (Surendar *et al*., 2013). Adoption of plant spacing of 30 × 15 cm with 100 % RDF coupled with foliar spray of TNAU Pulse wonder @ 1.125 % once at 50% flowering recorded lower specific leaf area of 122 and 92 cm^2g^{-1} at 30 and 45 DAS respectively.

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% 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% which recorded seed yield of 932 kg ha^{-1}(Table.2). The seed yield for the treatment with plant spacing of 30 × 15cm with 100 % RDF + Pulse Wonder @ 1.125 % was

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increased with 29 % over the adoption of plant spacing of 30 × 10 cm with 100 % RDF without any foliar nutrition. 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 (Hussain *et al.*, 2011). 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.

The plant spacing of 30 × 15 cm with 100 % RDF coupled with foliar spray of TNAU Pulse Wonder @ 1.125% 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% (2731 kg ha^{-1}) and plant spacing of 30 × 15 cm with 125 % RDF coupled with foliar spray of Poly feed 1% + NAA 40ppm which recorded haulm yield of 2618 kg ha^{-1} .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.

Application of TNAU Pulse Wonder, the possible reason for improvement in yield might be due to the nature of this crop booster with a combination of nutrients and growth regulators for pulses resulted in decreased flower shedding and improvement in the crop tolerance for abiotic and biotic stress in blackgram (Marimuthu and Surendran, 2015).

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Table 1.Effect of crop geometry, fertilizer levels and foliar nutrition on plant height (cm), number of branches plant^{-1} and drymatter production (kgha^{-1}) of irrigated blackgram

Treatments			Plant height	No. of branches	DMP
T_1	Spacing 30 x 10 cm	100 % RDF	47.4	6.5	2993
T_2		100 % RDF + Pulse Wonder@ 1.125 %	54.0	6.8	3507
T_3		100 % RDF + Poly feed 1 % + NAA 40ppm	53.3	6.6	3317
T_4		125 % RDF	49.5	6.8	3077
T_5		125 % RDF + Pulse Wonder@ 1.125 %	52.5	7.1	3248
T_6		125 % RDF + Poly feed 1 % + NAA 40ppm	51.4	7.0	3217
T_7	Spacing 30 x 15 cm	100 % RDF	50.3	7.2	3140
T_8		100 % RDF + Pulse Wonder @1.125 %	61.1	7.4	3952
T_9		100 % RDF + Poly feed 1 % + NAA 40ppm	53.9	7.2	3462
T_{10}		125 % RDF	53.8	7.4	3377
T_{11}		125 % RDF + Pulse Wonder @1.125 %	57.7	7.7	3831
T_{12}		125 % RDF + Poly feed 1 % + NAA 40ppm	56.0	7.6	3731
		SEd	1.95	0.24	105.4
		CD(p= 0.05)	4.05	0.49	218.5

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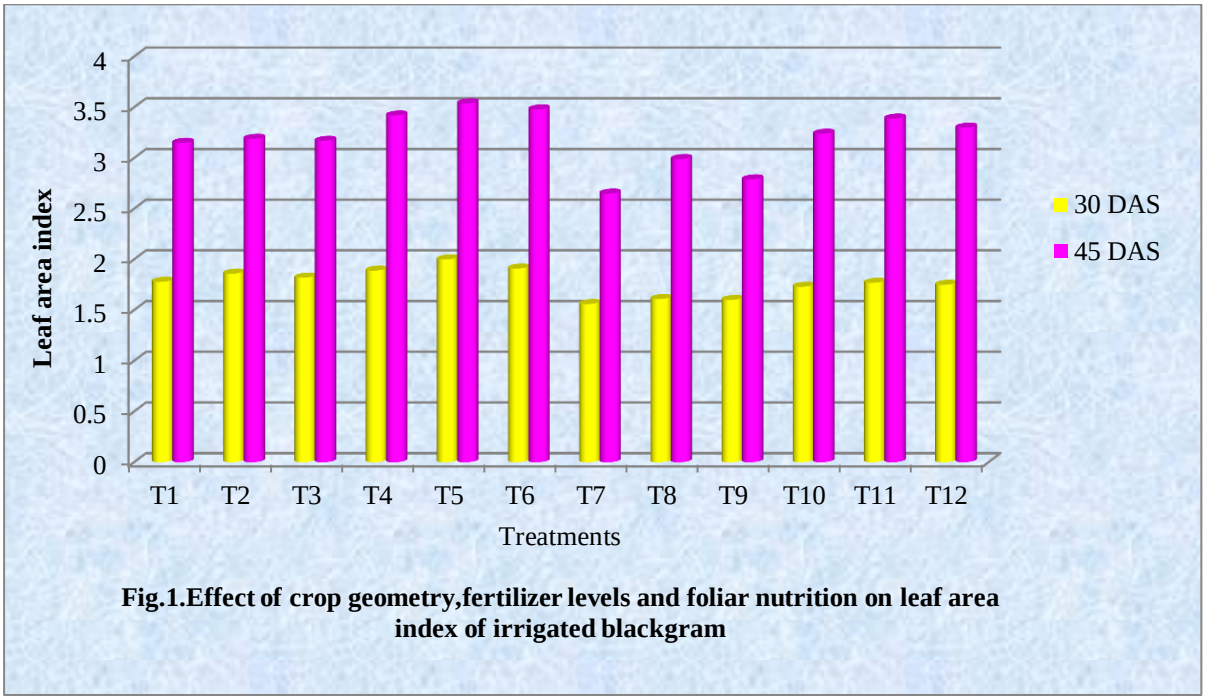

Fig.1.Effect of crop geometry,fertilizer levels and foliar nutrition on leaf area index of irrigated blackgram

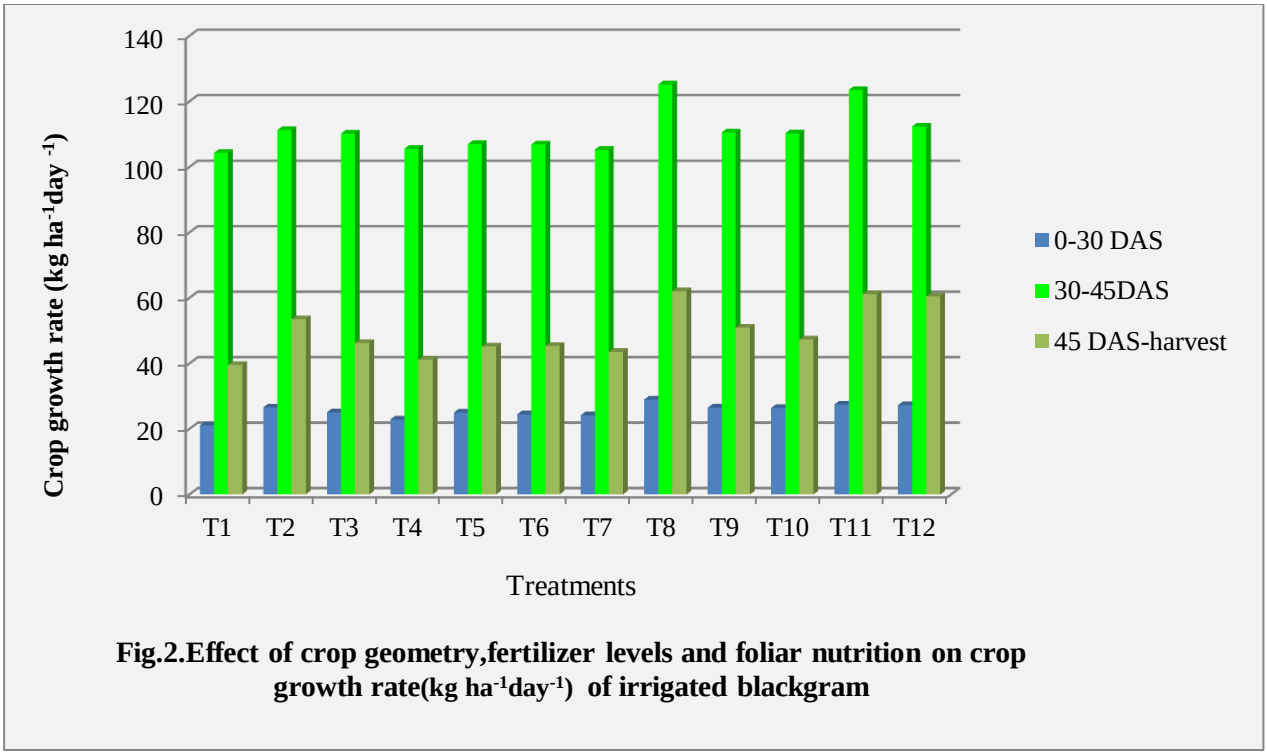

Fig.2.Effect of crop geometry,fertilizer levels and foliar nutrition on crop growth rate(kg ha^{-1}day^{-1}) of irrigated blackgram

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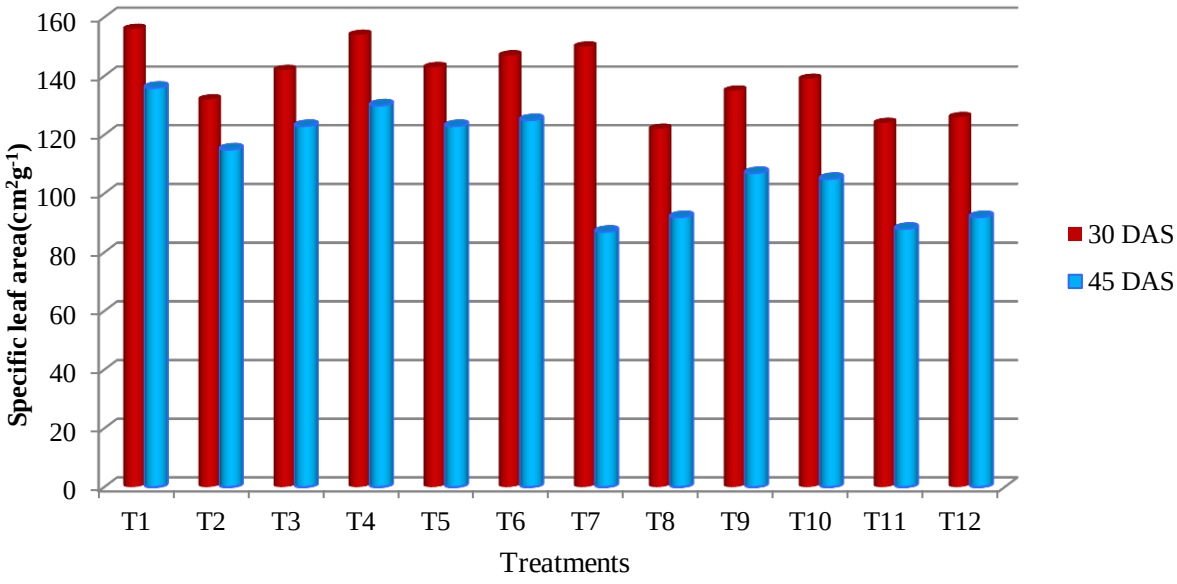

Fig.3.Effect of crop geometry,fertilizer levels and foliar nutrition on specific leaf area (cm^2g^{-1}) of irrigated blackgram

Table 2.Effect of crop geometry, fertilizer levels and foliar nutrition on seed yield, haulm yield (kg ha^{-1}) of irrigated blackgram

Treatments			Seed yield	Haulm yield
T_1	Spacing 30 x 10 cm	100 % RDF	688	2245
T_2		100 % RDF + Pulse Wonder@ 1.125 %	852	2595
T_3		100 % RDF + Poly feed 1 % + NAA 40ppm	791	2475
T_4		125 % RDF	709	2313
T_5		125 % RDF + Pulse Wonder@ 1.125 %	775	2418
T_6		125 % RDF + Poly feed 1 % + NAA 40ppm	759	2400
T_7	Spacing 30 x 15 cm	100 % RDF	725	2355
T_8		100 % RDF + Pulse Wonder @1.125 %	969	2862
T_9		100 % RDF + Poly feed 1 % + NAA 40ppm	846	2576
T_{10}		125 % RDF	824	2503
T_{11}		125 % RDF + Pulse Wonder @1.125 %	932	2731
T_{12}		125 % RDF + Poly feed 1 % + NAA 40ppm	913	2618
		SEd	25.4	77.2
		CD(p= 0.05)	52.7	166.3

