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Influence of plant growth regulators and nutrients on biometric, growth and yield attributes in Blackgram (*Vigna mungo* L.)

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Key Words: Blackgram, Plant growth regulators, TNAU Pulse Wonder, transport efficiency.**Abstract**

A study was carried on the transport efficiency of blackgram as influenced by the foliar application of plant growth regulators and nutrient mixture during *rabi*, 2017-18 as pot culture experiment at glass house of the Department of Crop Physiology. Foliar application of salicylic acid (SA) (250 ppm), mepiquat chloride (MC) (250 ppm), chlorocholine chloride (CCC) (150 ppm) were applied at flower initiation stage and 15 days after the first spray, on blackgram with and without the seed treatment of salicylic acid (50 ppm). TNAU Pulse Wonder (1%) was applied as foliar spray at peak flowering stage. Among the treatments, TNAU Pulse Wonder recorded higher plant height, leaf area, leaf area index and seed yield plant⁻¹. It is concluded that TNAU Pulse Wonder improved the source-sink relationship compared to other treatments with enhanced biometric, growth parameters and yield of blackgram.

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Introduction

Agriculture still remains the backbone of Indian economy in spite of various technological advancements and industrial development with 70 % of people dependent on agriculture and 25 % of country's Gross Domestic Product (GDP) coming from agricultural sector. In Indian agriculture, pulses play an important role and India is a major pulse growing country. The pulses fit well in crop rotation and crop mixture thus forming an

integral part of cropping system of Indian farmers. Pulses are the cheapest source of quality protein and they provide the protein component for a balanced diet of the people (Sritharan *et al.*, 2015). The per capita consumption of pulses in our country is just 40 g which is lower than the recommendation of the Indian Council of Medical Research (ICMR) and World Health Organization (WHO) which is 45g and 80g respectively. Thus, the requirement of pulses as per the

recommendations of ICMR and WHO for billion people would be 17.15 million tonnes and 29.2 million tonnes respectively (Jagannathan et al. 2000).

Blackgram [*Vignamungo*(L.) Hepper] occupies an important place among the premier pulse crops in India. Blackgram is an extensively grown grain legume and belongs to Fabaceae family and got noticeable significance from the point of food and nutritional security in the world (Thakur et al. 2017). Blackgram is a perfect combination of all nutrients which include 20 to 25% proteins, 40 to 47% starch, ash fats, carbohydrates and essential vitamins (Manjri *et al.*, 2018). Regarding the states, Uttar Pradesh and Maharashtra occupy the first two positions, contributing over 32%. Individually, Madhya Pradesh and Andhra Pradesh contribute 14% each to the total production (GoI, 2014-15). In Tamil Nadu, blackgram is cultivated in 0.365 m ha with a production of 0.31 million tonnes with an average productivity of 851 kg ha⁻¹ (TNstat, 2014). Plant growth regulators are chemicals which provide optimum vegetative growth and increased source partitioning in the reproductive organs so that the yield is sufficiently increased by regulating plant growth and architecture. Ever since their invention, plant growth regulators have emerged as “magic chemicals” that could increase agricultural yield at an appealing rate. Plant growth regulators when added to the plant in a very minute concentration at critical growth periods stimulate the regulatory mechanism from seed germination to senescence in a variety of crop plants. The

increased source-sink relationship using growth regulators include enhanced transport of assimilates from source and thereby increases productivity (Shinde, Univ. Agril. Sci, Dharwad, Unpublished data 2010).

Material and Methods

The pot culture experiment was conducted in the Glass house of the Department of Crop Physiology, Tamil Nadu Agricultural University, Coimbatore during *rabi*, 2017-18 with blackgram variety CO 6. The location is in Western Agro-Climatic Zone of Tamil Nadu at 11.01°N latitude and 76.39°E longitude and at an altitude of 426.7 m above MSL. Red sandy soil was used for pot culture experiment at glass house. Soil mixture was prepared by using red soil, sand and farmyard manure (FYM) in the ratio of 2:1:1. Medium size pots were filled with 12 kg of soil. The experimental design was completely randomized design with 10 treatments and 3 replications. Crop received recommended dose of fertilizers (25 kg N + 50 kg P₂O₅ + 25 kg K₂O ha⁻¹). The treatment included foliar spray of salicylic acid (250 ppm), mepiquat chloride (250 ppm), Chlorocholine chloride (150 ppm) and TNAU Pulse Wonder (1%) and control. The treatments were similarly given to seed treated (salicylic acid, 50 ppm) and non-treated blackgram plants. SA, MC, CCC were applied at flower initiation and 15 days after first spray. Plant height was measured from the ground level to the tip of the growing point and expressed as cm. Leaf area plant⁻¹ was measured using leaf area meter (LICOR, Model LI 3000) and expressed as cm² plant⁻¹. The leaf area existing on unit ground area

was proposed by Watson (1952) as an appropriate measure of crop growth. This measure is known as leaf area index. It is a dimensionless ratio and calculated by following formula.

$$LAI = \frac{\text{Leaf area}}{\text{Ground Area}}$$

Specific leaf weight was calculated by using the formula of Pearce *et al.* (1968) and expressed in mg cm^{-2} .

$$SLW = \frac{\text{Leaf dry weight per plant}}{\text{Leaf area per plant}}$$

The plants harvested from each treatment were threshed and the seed yield was recorded and expressed in grams plant^{-1} from the dried whole plant sample.

Results and Discussion

Plant height

It is an important parameter that determines the growth and development of a plant. Generally, the plants with vigorous growth usually produce taller plants until maturity and are expected to give higher yield. In the present study, seed treatment with salicylic acid 50 ppm and foliar application of nutrients significantly influenced plant height of blackgram over control. The maximum mean height (40.46 cm) during pre-flowering phase was recorded

in the seed treated (SA, 50 ppm) plants compared to the average height (36.93 cm) of the non-seed treated plants. This result was in close conformity with the findings of Brunes *et al.* (2014) in soybean and also similar results were reported by Jadhav & Bhamburdekar (2011) in groundnut cultivars. The plant height increased during post treatment stage and the highest was registered in TNAU Pulse Wonder spray (53.03 cm) along with the seed treatment followed by salicylic acid (52.53 cm) with seed treatment and TNAU Pulse Wonder (52.07 cm) without seed treatment. Significant increase in plant height upon foliar application can be attributed to the fact that micronutrients enhance plant vigour and strengthen the stalk as reported by Das (1999). The application of growth retardants like CCC (1.49%) and mepiquat chloride (0.68%) decreased the plant height compared to control as shown in Figure 1. The decrease in plant height may be attributed to the hindrance in gibberellic acid biosynthesis by the plant growth retardants and these observations were in close agreement with Dhaka and Anamika (2003) who reported similar results in broad bean while Jeya kumar and Thangaraj (1996) observed similar findings in groundnut.

Figure 1. Effect of plant growth regulators and nutrients on plant height (cm)

Leaf area

The leaf area is an important component that is closely related to physiological processes controlling the dry matter production and yield. The index of photosynthesizing surface is represented by leaf area. The result of the present study indicates the influence of PGRs and nutrients on leaf area improvement. Seed treatment with 50 ppm SA exhibited a profound effect on leaf enlargement. These findings were confirmed by the result of Kaydan *et al.* (2007) in wheat. This can be attributed to the increased seed vigour, disease resistance and growth imparted by salicylic acid. The leaf area exhibited an increasing trend from 30 to 55 days after sowing due to the application of plant growth regulators. TNAU Pulse Wonder as foliar spray and seed treatment registered highest leaf area (1648.76 cm²) over control which was followed by Chlorocholine chloride (1154.92 cm²) with

seed treatment and TNAU Pulse wonder without seed treatment (1063.58 cm²). Application of mepiquat chloride and salicylic acid also exhibited an increase in leaf area over control. These results were supported by the observations of Amutha *et al.* (2012) and Marimuthu and Surendran (2015) in blackgram (Table 1). The increased leaf area by pulse wonder can be attributed to the fact that nitrogen and other micro nutrients arrested chlorophyll degradation and promoted the synthesis of photosynthetic enzymes and maintained higher auxin level which might have resulted in better plant height, leaf area, higher chlorophyll content and more assimilatory surface area for longer time. The growth retardants reduce the plant height and increases branching thereby increasing the photosynthetic leaf area. This was in justification with the findings of Prakash *et al.* (2003) in blackgram and Chandrababu *et al.* (1995) in groundnut.

Table 1. Effect of PGRs and nutrients on leaf area ($\text{cm}^2 \text{ plant}^{-1}$)

Treatments	Pre-flowering (30 DAS)			Post-flowering (55 DAS)		
	C ₁	C ₂	Mean	C ₁	C ₂	Mean
T ₁ – Control	299.92	231.81	265.87	643.16	636.56	639.86
T ₂ – Salicylic acid (250 ppm)	298.87	278.03	288.45	794.07	715.07	754.57
T ₃ – Mepiquat chloride (250ppm)	323.29	261.65	292.47	903.00	845.24	874.12
T ₄ – Chlorocholine chloride (150 ppm)	311.18	267.83	289.51	1154.92	894.23	1024.58
T ₅ – TNAU Pulse Wonder (1%)	321.52	261.55	291.54	1648.76	1063.58	1356.17
Mean	310.96	260.17		1028.78	830.94	
SEd		6.57			22.45	
CD (P=0.05)		13.71			46.83	

C₁: Seed treatment with 50 ppm Salicylic acid, C₂: Without seed treatment ; DAS: Days after sowing

Leaf area index

LAI is one of the standard factors prompting canopy net photosynthesis of the crop plants. Leaf area index was also greatly influenced by salicylic acid seed treatment as recorded in the present study. During pre-flowering stage, average leaf area index was found to be more in seed treated plants (Figure 2). During the post treatment stage, TNAU Pulse Wonder (3.36) with seed

treatment showed more LAI than that of control, which was followed by CCC (2.35) with seed treatment and TNAU Pulse Wonder without seed treatment (2.17). Increased LAI can be attributed to the increased leaf area upon plant growth regulators application and these findings were in close conformity with the results of Marimuthu and Surendran (2015) in blackgram and Chandrababu *et al.* (1995) in groundnut.

Figure 2. Effect of plant growth regulators and nutrients on leaf area index

Specific leaf weight

SLW is an excellent parameter to assess the translocation efficiency of crop plants. Specific leaf weight, a measure of leaf thickness, has been reported to have a strong positive correlation with leaf photosynthesis of several crops as reported by Bowes *et al.* 1972. This study revealed that the average SLW during vegetative phase was noticed to be more in seed treated plants. After the application of treatments TNAU Pulse Wonder with seed treatment was found to increase the SLW by 12.24% over control which was closely followed by SA with seed treatment (10.20%) and CCC with seed treatment (10.20%) (Figure 3). This findings

were in close conformity with Kulkarni (University of Agricultural Sciences, Unpublished results, 1993) who reported similar observations in sunflower. Dornhoff & Shibles (1970) reported that higher SLW might be associated with higher cell surface to volume ratio which might lower mesophyll resistance to CO₂ entry and increases photoassimilate accumulation in soybean. Thicker leaves would have more number of mesophyll cells with high density of chlorophyll and, therefore, have a greater photosynthetic capacity than thinner leaves (Craufurd et al. 1999; Balai et al. 2017).

Figure 3. Effect of plant growth regulators and nutrients on specific leaf weight (gcm⁻²)

Seed yield plant⁻¹

The yield was markedly increased by the application of foliar nutrients. In the current study TNAU Pulse Wonder with seed treatment increased the seed yield (4.13g) over control followed by TNAU Pulse Wonder without seed treatment (3.77g) whereas CCC

(3.57g) and salicylic acid (3.52g) with seed treatment had also increased the seed yield plant⁻¹ (Table 2). The increased in yield might be due to enhanced yield attributes like number of pods plant⁻¹, number of seeds pod⁻¹. It is due to increased uptake of nutrients by

blackgram by effective translocation of nutrients from sink to reproductive area of crop. Supporting these findings, Shinde (Univ. Agril. Sci., Dharwad, Unpublished data, 2010) reported that the application of CCC, TIBA and pro-gib and 500 ppm CCC resulted in increased number of pods and seeds thereby increasing the total seed yield. Similar results were obtained by Prabhakar Reddy (2002) that the foliar application of salicylic acid in

greengram increased seed yield. The increased seed yield by TNAU Pulse Wonder might be attributed to the composition of this nutrient mixture and was in conformity with Jayabel *et al.* (1999) who reported that foliage applied macro and micronutrients at critical stages of the crop might be effectively absorbed and transported to the developing pods, producing more number of pods with better filling in soybean.

Table 2. Impact of PGRs and nutrients on seed yield plant⁻¹ (g)

Treatments	Seed yield plant ⁻¹		
	C ₁	C ₂	Mean
T ₁ - Control	2.96	2.89	2.93
T ₂ - Salicylic acid (250 ppm)	3.52	3.45	3.49
T ₃ - Mepiquat chloride (250 ppm)	3.06	2.99	3.03
T ₄ - Chlorocholine chloride (150 ppm)	3.57	3.46	3.52
T ₅ - TNAU Pulse Wonder (1%)	4.13	3.77	3.95
Mean	3.55	3.31	
SEd		0.06	
CD (P=0.05)		0.12	

C₁: Seed treatment with 50 ppm Salicylic acid

C₂: Without seed treatment

Conclusion

The different plant growth regulators and nutrients used, TNAU Pulse Wonder improved the overall transport efficiency and assimilate partitioning in black gram. It was followed by growth retardant Chlorocholine chloride. Growth promoter salicylic acid and growth retardant mepiquat chloride also had impact on source-sink relationship but the effect was less effective compared to the TNAU Pulse Wonder. TNAU Pulse Wonder improved the source-sink relationship than the other treatments and enhanced the physiological, biometric, growth parameters and yield of blackgram.

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