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Effect of Seed Treatment and Nutrient Schedule on the Productivity of Blackgram (*Vigna mungo* L.)

V. Yamini, A.S. Anilkumar

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ABSTRACT

Background: Blackgram (*Vigna mungo* L.) is an important short duration crop and is grown throughout the country. Seed treatment can improve seedling establishment and better crop stand; it also improves plants ability to tolerate stress at early growth stages and foliar application has the advantage of quick and efficient utilization of nutrients, elimination of nutrient losses through leaching and fixation in soil and also helps in regulating the uptake of nutrients by plants thus improving productivity.

Methods: A field experiment was conducted during *rabi* 2018 at the Instructional Farm, College of Agriculture, Vellayani, Thiruvananthapuram to assess the effect of different levels of seed treatments and nutrient schedule on the growth and yield of blackgram. The growth attributes, yield attributes and yield *viz*., number of pods per plant, seeds per pod, length of pod, 100 seed weight, grain yield, haulm yield and harvest index were favorably influenced by the treatments.

Result: Seed treatment with borax @ 1 g kg^{-1} seed and sodium molybdate @ 1 g kg^{-1} seed were observed superior in increasing plant height (135.84 cm), number of trifoliate leaves per plant (7.61), pods per plant (24.16), length of pod (5.23 cm), 100 seed weight (6.74 g), grain yield (1005 kg ha^{-1}) and harvest index (0.38). Significantly higher nodule number (41.83), effective nodule number (33.83) and weight of nodules (58.83 mg) $plant^{-1}$ at flowering were documented with sodium molybdate @ 1 g kg^{-1} seed. In case of seeds per pod significantly higher number of pods per plant (7.33) was observed with borax @ 2 g kg^{-1} seed and maximum haulm yield (1854 kg ha^{-1}) reported with sodium molybdate @ 1 g kg^{-1} seed. The basal application of ½ N + full P + ½ K followed by ½ N and ½ K as foliar spray of 13:0:45 at 15, 30, 45 and 60 DAS produced significantly more 100 seed weight (6.52 g), grain yield (872 kg ha^{-1}) and haulm yield (1750 kg ha^{-1}). Interaction effect of boron and molybdenum also showed significant influence with respect to yield attributes and yield.

Key words: Borax, Blackgram, Sodium molybdate, Yield.

INTRODUCTION

Blackgram (*Vigna mungo* L.) is an important short duration crop which is grown throughout India. It accounts for 13% of total pulse area and 10% of total pulse production in India. It contains about 24% protein which is almost twice as cereals, 60% carbohydrates, 1.3% fat, 0.194% Ca, 0.192% Mg, 0.526% K, 0.44% P, 0.09% Fe, 0.0241 mg of vitamin C 100 g^{-1}. It is also rich in essential amino acids *viz.,* 0.43% lysine and 0.07% tryptophan where cereals are normally deficient and it is also rich in phosphoric acid.

Though blackgram is used as source of human food, animal feed and also for enhancing soil fertility, the yield potential is very low as it is mainly grown in rainfed areas with poor management practices. Poor productivity may be due to various physiological, biochemical and inherent factors associated with this crop. The physiological factors *viz.,* poor pod setting due to the flower abscission, insufficient partitioning of assimilates and lack of essential nutrients during critical stages of crop growth play a major role in declined blackgram production coupled with a number of diseases and pests (Mahala *et al*., 2001). The lower production and productivity may also be due to several problems with the blackgram growing farmer's particularly improper knowledge on package of practices (Islam *et al.,* 2011).

Department of Agronomy, College of Agricuture, Vellayani, Trivandrum-695 522, Kerala, India.

Corresponding Author: V. Yamini, Department of Agronomy, College of Agricuture, Vellayani, Trivandrum-695 522, Kerala, India. Email: yaminivaddula@gmail.com

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Seed treatment can improve seedling establishment and better crop stand; it also improves plants ability to tolerate stress at early growth stages. Seed treatment also helps to reduce the environmental impact on production process; it helps in decreasing number of spray applications of agrochemicals thus reducing exposure to non-target species. Micronutrients when applied as seed treatment enhance the performance of fertilizer, also supplies nutrients to soil and improves plant growth. Boron plays an important role in sugar translocation, nitrogen fixation, protein synthesis, sucrose synthesis, cell wall composition, membrane stability and K^+ transportation. Molybdenum is associated with ammonia reduction and nitrogen fixation and its deficiency adversely affects plant growth and yield.

Seed treatment with these micronutrients is a cost effective practice for enhancement of productivity of pulses.

Foliar application has the advantage of quick and efficient utilization of nutrients, elimination of nutrient losses through leaching and fixation in soil and also helps in regulating the uptake of nutrients by plants (Manonmani and Srimathi, 2009). Foliar spray is effective in correcting the midseason discrepancies in the crop growth which may be either due to intensive growth or inappropriate supply of nutrients from the soil under abiotic stress conditions. Foliar application of major nutrients using water soluble fertilizer is one of the possible ways to enhance productivity of blackgram.

MATERIALS AND METHODS

A field experiment on 'Seed treatment and foliar nutrition for enhanced productivity of blackgram (*Vigna mungo* L.)' was conducted in block 4 of Instructional farm, College of Agriculture, Vellayani, Thiruvananthapuram during *rabi,* 2018. Co-6, released from Tamil Nadu Agricultural University, Coimbatore was used for the trial. The soil of the experimental field was red sandy clay loam in texture, acidic in reaction with pH 5.44. The soil was low in available N (225.79 kg ha^{-1}), high in available P (25.16 kg ha^{-1}) and available K (347.12 kg ha^{-1}) and medium in available B (0.732 mg kg^{-1}).

The experiment was laid out in randomized block design with six levels of seed treatments and two levels of nutrient schedule in three replications. The levels of seed treatment were s_0 - without seed treatment, s_1 - seed treatment with borax @ 1g kg^{-1} seed, s_2 - seed treatment with borax @ 2 g kg^{-1} seed, s_3 - seed treatment with sodium molybdate @ 1 g kg^{-1} seed, s_4 - seed treatment with sodium molybdate @ 1.5 g kg^{-1} seed and s_5- seed treatment with borax @ 1 g kg^{-1} seed and sodium molybdate @ 1 g kg^{-1}. Two levels of nutrient schedule were n_1- ½ N + full P + full K as basal application + ½ N as foliar spray of urea at 15 and 35 DAS and n_2- ½ N + full P + ½ K as basal application + ½ N and ½ K as foliar spray of 13:0:45 at 15, 30, 45 and 60 DAS. Recommended dose of 20: 30: 30 kg NPK ha^{-1} was adopted (KAU, 2016). Seed treatment with borax and sodium molybdate at rates as per experimental schedule were mixed thoroughly with rice gruel as sticking agent and shade dried on the day before sowing. On the day of sowing the seeds are treated with *Rhizobium* culture, common to all treatments, shade dried and dibbled into soil at spacing 25 cm × 15 cm.

The growth characters, yield attributes *viz.* number of pods per plant, seeds per pod, length of pod, 100 seed weight, grain yield and haulm yield were recorded at harvest stage. The harvest index was also worked out.

RESULTS AND DISCUSSION

The results on yield attributes and yield are presented in Table 1a, 1b and 2a, 2b were favorably influenced by treatments.

Plant height, number of leaves and branches per plant

All the growth attributes were significantly influenced by different levels of seed treatments. s_5 recorded significantly the tallest plants of 135.84 cm, higher number of trifoliate leaves (7.61) and higher number of branches per plant (6.39) at harvest respectively. Nutrient schedule also has significant influence on growth characters and maximum plant height (99.69 cm) and number of trifoliate leaves (6.68) at harvest were observed with n_2. Whereas, maximum number of branches (5.89 plant^{-1}) were registered with n_1. Treatment combination s_5n_1 registered the tallest plants (140.35 cm) and maximum number of branches per plant (6.78) at harvest, whereas; s_5n_2 documented maximum trifoliate leaves per plant (7.89) and was on par with s_5n_1.

This increase might be due to application of micronutrients which enhanced cell division and translocation of nutrients in combination with urea as foliar

Table 1a: Effect of seed treatment and nutrient schedule on plant height, number of trifoliate leaves, number of branches, nodule number, effective nodule number and weight of nodules.

Treatments	Plant height (cm)	Number of trifoliate leaves	Number of branches	Nodules	Effective nodules	Weight of nodules (mg)
Seed treatment (S)						
s_0 (Without seed treatment)	106.51	5.62	5.45	18.83	13.33	47.33
s_1 (Borax - 1 g)	122.33	6.52	5.10	28.50	21.00	51.83
s_2 (Borax - 2 g)	119.34	5.94	5.91	31.00	24.50	51.67
s_3 (Sodium molybdate - 1 g)	123.91	6.15	5.75	41.83	33.83	58.83
s_4 (Sodium molybdate - 1.5 g)	118.16	7.03	5.91	30.33	24.50	52.67
s_5 (Borax -1 g + Sodium molybdate 1 g)	135.84	7.61	6.39	31.83	27.00	51.50
SEm (±)	1.10	0.14	0.11	2.27	1.15	0.87
CD (0.05)	3.254	0.419	0.322	6.709	3.385	2.583
Nutrient schedule (N)						
n_1	120.87	6.28	5.89	27.89	22.72	51.06
n_2	121.17	6.68	5.62	32.89	25.33	53.56
SEm (±)	0.64	0.08	0.06	1.31	0.66	0.50
CD (0.05)	NS	0.242	0.186	3.874	1.954	1.492

spray which had positive effect on legume plants in enhancing growth of plants. These results are in agreement with Venkatesh *et al*. (2012), Das and Jana (2016) and Shinde *et al*. (2018).

Nodules, effective nodules and weight of nodules per plant

Seed treatment with s_3 has significantly increased number of nodules, effective nodules and weight of nodules per plant. The data also showed that nutrient schedule with n_2 has significant influence on nodule characters. There were 17.93, 11.48 and 4.9 per cent increase in number of nodules, effective and weight of nodules per plant respectively. The treatment combination s_3n_2 registered maximum number of nodules (50.33), effective nodules (42.33) and weight of nodules (64.67 mg) per plant at flowering. The Mo seed treatment might have enhanced nodule formation and promoted N fixation by *Rhizobium* as it is an important component of enzyme nitrogenase and also foliar spray of KNO_3 promoted better translocation of nutrients and improved nodulation. Similar results are also supported by Tahir *et al*. (2014) and Sanjeev (2015) in soyabean.

Number of pods per plant

Seed treatment with borax @ 1 g kg^{-1} seed and sodium molybdate @ 1 g kg^{-1} seed significantly increased number of pods per plant and recorded maximum number of pods per plant (24.16). The interaction effect of seed treatment and nutrient schedule on number of pods per plant was found significant. Maximum number of pods per plant (24.99) was

Table 1b: Interaction effect of seed treatment and nutrient schedule on plant height, number of trifoliate leaves, number of branches, nodule number, effective nodule number and weight of nodules.

Treatments	Plant height (cm)	Number of trifoliate leaves	Number of branches	Nodules	Effective nodules	Weight of nodules (mg)
S × N interaction						
s_0n_1	105.02	5.06	5.55	21.00	14.68	48.67
s_0n_2	108.01	6.19	5.36	16.68	12.00	46.00
s_1n_1	119.28	6.52	5.44	23.00	17.67	51.00
s_1n_2	125.38	6.53	4.77	34.00	24.33	52.67
s_2n_1	120.31	5.30	5.80	26.00	20.33	48.33
s_2n_2	118.37	6.58	6.03	36.00	28.67	55.00
s_3n_1	123.48	6.19	5.72	33.33	25.33	53.00
s_3n_2	124.34	6.11	5.77	50.33	42.33	64.67
s_4n_1	116.76	7.28	6.03	35.00	28.67	54.33
s_4n_2	119.57	6.78	5.80	25.67	20.33	51.00
s_5n_1	140.35	7.33	6.78	29.00	29.67	51.00
s_5n_2	131.33	7.89	5.99	34.68	24.33	52.00
SEm (±)	1.56	0.20	0.15	3.21	1.62	1.24
CD (0.05)	4.602	0.593	0.455	9.488	4.787	3.654

Table 2a: Effect of seed treatment and nutrient schedule on yield parameters and yield of blackgram.

Treatments	Pods per plant	Seeds per pod	Length of pod (cm)	100 seed weight (g)	Grain yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	Harvest index
Seed treatment (S)							
s_0 (Without seed treatment)	14.99	6.67	4.82	6.30	716	1607	0.30
s_1 (Borax - 1 g)	15.55	7.33	5.12	6.22	940	1665	0.36
s_2 (Borax - 2 g)	18.80	6.90	4.98	6.29	714	1809	0.28
s_3 (Sodium molybdate - 1 g)	20.61	7.19	5.15	6.31	803	1854	0.30
s_4 (Sodium molybdate - 1.5 g)	16.05	7.22	5.07	6.33	762	1546	0.33
s_5 (Borax - 1 g + Sodium molybdate 1 g)	24.16	7.11	5.23	6.74	1005	1624	0.38
SEm (±)	0.89	0.08	0.08	0.08	45	55	0.01
CD (0.05)	2.633	0.238	0.243	0.229	135.7	164.5	0.045
Nutrient schedule (N)							
n_1	18.22	7.04	5.01	6.21	775	1618	0.32
n_2	18.51	7.10	5.11	6.52	872	1750	0.33
SEm (±)	0.51	0.05	0.05	0.04	26	32	0.01
CD (0.05)	NS	NS	NS	0.132	78.3	94.9	NS

recorded with the treatment combination s_5n_1 which was on par with s_5n_2 and s_3n_2.

Number of seeds per pod

Seed treatment has significant influence on number of seeds per pod. Borax @ 1 g kg^{-1} seed produced significantly the highest number of seeds per pod (7.33) and was statistically on par with s_3, s_4 and s_5. The treatment combination s_5n_2 recorded maximum number of seeds per pod (7.45) and was on par with s_1n_1, s_1n_2, s_2n_1, s_3n_1, s_3n_2, s_4n_1 and s_4n_2. This might be due to the role of boron in better sugar translocation, similar results were also reported by Masuthi *et al*. (2009) in cowpea, El-Dahsourie *et al*. (2017) in common bean and Mahadhule *et al*. (2019) in French bean.

Length of pod

Seed treatment with borax @ 1 g kg^{-1} seed has significantly increased length of pod (5.23 cm) and was on par with s_1, s_3, s_4 and s_5. Maximum length of pod (5.59 cm) was recorded with treatment combination s_5n_2 whereas, minimum length of pod (4.61 cm) was observed in s_0 (without seed treatment).

100 seed weight

Seed treatment and nutrient schedule had significantly influenced 100 seed weight. Seed treatment with borax @ 1 g kg^{-1} seed and sodium molybdate @ 1 g kg^{-1} seed recorded maximum 100 seed weight (6.74 g). Scheduling the nutrients as ½ N + full P + ½ K as basal followed by ½ N and ½ K as foliar spray of 13:0:45 at 15, 30, 45 and 60 DAS recorded the highest 100 seed weight (6.52 g). The increased hundred seed weight might be due to enhanced photosynthetic activity, efficient transfer and accumulation of metabolites in the seed with the resultant increase in the size and weight of individual seed. These results were in accordance with Rahman *et al*. (2014) and Shinde *et al*. (2018) in chickpea.

Grain yield

Seed treatment with borax @ 1 g kg^{-1} seed and sodium molybdate @ 1 g kg^{-1} seed recorded the highest grain yield (1005 kg ha^{-1}), which was statistically on par with s_1. Nutrient schedule also had significant influence on grain yield. The basal application of ½ N + full P + ½ K and ½ N and ½ K as foliar spray of 13:0:45 at 15, 30, 45 and 60 DAS registered the highest grain yield (872 kg ha^{-1}). Interaction effect also significantly influenced grain yield, among different treatment combinations s_5n_2 produced maximum grain yield (1130 kg ha^{-1}) and was on par with s_1n_1. The main contributing factor for yield increase was due to increased dry matter production and efficient translocation of assimilates to developing reproductive parts thus leading to increased number of pods and higher grain yield. This might also be due to enhanced chlorophyll formation resulting in higher photosynthetic rates leading to an increase in plant attributes contributing to better seed yield. Dixit and Elamathi (2007), Manonmani and Srimathi (2009), Rahman *et al*. (2014) and Janaki *et al*. (2018) also reported similar findings.

Haulm yield

Significantly the highest haulm yield was registered with s_2 (seed treatment with sodium molybdate @ 1 g kg^{-1} seed) and was on par with s_2. Nutrient schedule of ½ N + full P + ½ K and ½ N and ½ K as foliar spray of 13:0:45 at 15, 30, 45 and 60 DAS produced the highest haulm yield of (1750 kg ha^{-1}). Among different treatment combinations s_3n_2 recorded the highest haulm yield (1899 kg ha^{-1}) and was on par with s_0n_2, s_1n_1, s_2n_1, s_2n_2, s_3n_1 and s_5n_2. This might be due to improved germination and balanced growth pattern of plants. These results were also in accordance with Tahir *et al*. 2014 in blackgram.

Harvest index

Seed treatment had significant influence on harvest index. Maximum harvest index of 0.38 was registered with s_5 (seed

Table 2b: Interaction effect of seed treatment and nutrient schedule on yield parameters and yield of blackgram.

Treatments	Pods per plant	Seeds per pod	Length of pod (cm)	100 seed weight (g)	Grain yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	Harvest index
S × N interaction							
s_0n_1	15.00	6.57	4.61	6.19	563	1470	0.27
s_0n_2	14.99	6.77	5.04	6.41	870	1744	0.33
s_1n_1	17.99	7.40	5.19	6.09	978	1744	0.36
s_1n_2	13.11	7.27	5.05	6.35	904	1585	0.36
s_2n_1	17.77	7.13	5.09	6.19	733	1807	0.29
s_2n_2	19.83	6.67	4.87	6.38	696	1811	0.27
s_3n_1	19.22	7.20	5.17	5.95	818	1807	0.31
s_3n_2	21.99	7.19	5.13	6.68	789	1899	0.30
s_4n_1	14.33	7.20	5.14	6.12	681	1437	0.32
s_4n_2	17.77	7.25	5.01	6.55	844	1655	0.34
s_5n_1	24.99	6.77	4.88	6.72	881	1444	0.38
s_5n_2	23.33	7.45	5.59	6.76	1130	1803	0.38
SEm (±)	1.26	0.11	0.12	0.11	64	78	0.02
CD (0.05)	3.724	0.337	0.344	NS	191.8	232.6	NS

treatment with borax @ 1 g kg^{-1} seed and sodium molybdate @ 1 g kg^{-1} seed) and was on par with s_4.

CONCLUSION

The results revealed that, in blackgram, seed treatment with borax and sodium molybdate @ 1g kg^{-1} seed each and scheduling nutrient application at 20: 30: 30 kg NPK ha^{-1} as ½ N + full P + ½ K as basal followed by ½ N and ½ K as foliar spray of 13:0:45 at 15, 30, 45 and 60 DAS could be recommended for realizing higher growth and yield; whereas, treatment combination s_3n_2 found to be superior in increasing nodule characters.

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