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Influence of Seed Fortification on Growth and Seed Yield in Blackgram (*Vigna mungo* L.) cv. Rashmi

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A B S T R A C T

Field experiment was conducted during *Rabi*-2016 to study the effect of seed fortification on growth and seed yield in blackgram (*Vigna mungo*L.) cv. Rashmi**,** The experiment consisted of fourteen treatments which were replicated thrice in RCBD design. Experimental results indicated that micro and macronutrients mixture (mixture of Borax, $CaCl_2$, $FeSO_4$, $ZnSO_4$, $MgSO_4$, water soluble DAP- 12:61:0, Water soluble 19:19:19, water soluble 13:0:45) @ 1 % significantly increased growth attributes, seed yield and benefit cost ratio in black gram seed production over control.

Introduction

Black gram [*Vigna mungo* L.) is one of the most important pulse crops among the various grain legumes in India. According to Vavilov (1951) it is native to India, belong to the family Leguminaceae. It is a rich protein food, contains about 26 % protein, 1.2 % fat and 56.6 % carbohydrates on dry weight basis and also rich source of calcium and iron. This crop is cultivated mostly on marginal lands in mono/ mixed cropping system without any fertilizers under rainfed conditions.

In crop plants, nutrients may be applied through soil and foliar spray or added as seed treatments. Soil application of fertilizers is considered to be the most common and easily manageable way, but because of nutrients availability being influenced by soil chemical and physical properties, the plant roots are unable to absorb these nutrients adequately from dry topsoil. Similarly, foliar sprays have been more effective in yield improvement and grain enrichment, but timely and precise application restricted its wider adaption. Moreover, foliar application is done at later growth stages when crop stands are already established. Soil and foliar applications are the most prevalent methods of nutrient addition. At the initial phases of seed germination, nutrients are mobilized from endosperm or cotyledon, while further phases required nutrients from soil or from some other means. At initial stages seedling can't absorb nutrient from soil. Nutrient seed treatments, which include seed fortification and seed coating or pelleting, are an attractive and easy alternative.

Seed fortification is a physiological method of impregnation of the needy substance into the seed through the imbibition phase and enriches the endogenous level of the needy bioactive substances that aids in improving the initial stamina of the seed that helps in improving the initial field stand and that of the final yield (Hegarty, 1970). In seed fortification, seeds are partially hydrated to allow metabolic events to occur without actual germination, and then re-dried (near to their original weight) to permit routine handling. Such seeds germinate faster than non-fortified seeds.

Materials and Methods

The field experiment was conducted during *Rabi*- 2016 at Zonal Agricultural Research Station, V. C. Farm, Mandya. The experiment was laid out in Randomized Complete Block Design (RCBD) with 14 treatments and three replications using popular variety Rashmi.

Treatments

T_0: Control (hydropriming),
T_1: Borax(1.0 %),
T_2: $CaCl_2$ (1.0 %),
T_3: $FeSO_4$ (1.0 %),
T_4: $ZnSO_4$ (1.0 %),
T_5: $MgSO_4$ (1.0 %),
T_6: Water soluble DAP- 12:61:0 (1.0 %),
T_7: Water soluble 19:19:19 (1.0 %),
T_8: Water soluble 13:0:45 (1.0 %),
T_9: Micronutrient mixture (0.5 %),
T_{10}: Micronutrient mixture (1.0 %),
T_{11}: Macronutrient mixture (0.5 %),
T_{12}: Micro and Macronutrients mixture (0.5 %),
T_{13}: Micro and Macronutrients mixture (1.0 %).

The graded seeds were subjected to soaking in micro and macronutrients (Borax, $CaCl_2$, $FeSO_4$, $ZnSO_4$, $MgSO_4$, Water soluble DAP-12:61:0, Water soluble 19:19:19, Water soluble 13:0:45) at one per cent and their combinations as micronutrient mixture (Borax $CaCl_2$, $FeSO_4$, $ZnSO_4$, $MgSO_4$ @ 0.5 and 1 %) , macronutrient mixture (Water soluble DAP- 12:61:0, Water soluble 19:19:19, Water soluble 13:0:45 @ 1 %) and combination of both micro and macronutrients at @ 0.5 and 1 % for 3 hours adopting the seed to solution ratio of 1:3. Then the seeds were shade dried for one day in lab condition to bring back to their original moisture content and used for sowing, keeping hydro primed seeds as control. Five plants per plot were selected randomly in the net plot area and tagged for recording growth and yield parameters. The results were analyzed statistically to draw suitable inference as per standard ANOVA technique as described by Gomez and Gomez (1984).

Results and Discussion

Effect on growth attributes

Significant differences were noticed on growth, seed yield and yield attributing characteristics of black gram among the seed fortification treatments. Seeds fortified with micro and macronutrient mixture @ 1 % recorded higher plant height (27.07), number of branches per plant (4.57) and number of leaves (9.87) at harvest compared to rest of the treatments at harvest of recording observation (Table 1).

Increase in plant height was possibly attributed to internodal elongation by cell division by enhanced carbohydrate metabolism and metabolic and physiological processes by plants (Ashour and Reda, 1972) and increased cell division. The micro and macro elements are involved in biosynthesis of plant harmones, indole acetic acid, auxin metabolism (Krishnasamy, 2003). The increase in number of leaves and branches might be due to better nutrient availability at early stage of plant might have ascribed to their pivotal role in several physiological and biochemical processes, *viz*., root development, photosynthesis, energy transfer reaction and symbiotic biological N fixation process (Rathinavel andDharmalingam, 1999).

Effect on yield attributes and yield:

A perusal of data (Table 1-2) revealed that yield attributes *viz*., number of pods plant^{-1} (17.03), number of pods cluster^{-1} (2.94), pod weight plant^{-1} (5.66 g), pod length (5.08 cm), number of seeds pod^{-1} (6.18), seed yield plant^{-1} (4.30 g), seed yield hectare^{-1} (13.14 q), graded seed yield (12.11 q), shelling % (86.11) increased significantly with the seed fortified with micro and macronutrient mixture @ 1 % in black gram over control.

The increased seed yield attributes might be due to early emergence of fortified seeds resulted in increased number of leaves which increased supply nutrients to sink through translocation and accumulation of photosynthates in the economic sinks (Rathinavel and Dharmalingam, 1999) and enhanced vegetative growth and synergistic effect of use of micro and macronutrients involved in improvement in crop performance. The multi nutrients treatment improved the growth of the plant during early stages of the crop which increased the vigour and associated stronger root system, in turn derived the available soil moisture and nutrients enabling better growth, resulting in higher yield (Jagathambal, 1996).

Fig.1 Gross returns and net returns of black gram as influenced by seed fortification

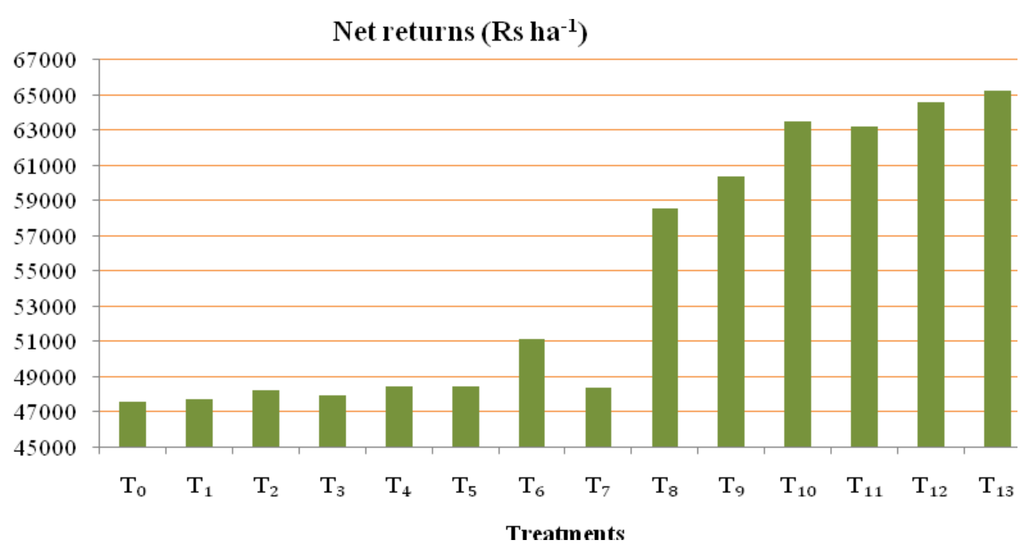

Table.1 Growth and yield parameters of black gram as influenced by seed fortification

Treatments	Plant height (cm) @ harvest	Number of leaves	Number of branches	Number of clusters/plant	Number of pods/plant	Number of pods/cluster	Pod length (cm)	Number of seeds/pod
T_0: Control	20.07	7.13	3.59	4.30	13.03	1.88	4.00	4.96
T_1: Borax (1.0 %)	21.17	8.20	4.00	5.13	13.80	2.24	4.31	5.08
T_2: $CaCl_2$ (1.0 %)	21.80	8.33	4.07	5.27	13.87	2.35	4.37	5.13
T_3: $FeSO_4$ (1.0 %)	21.53	8.00	4.10	5.33	14.20	2.36	4.38	5.17
T_4: $ZnSO_4$ (1.0 %)	21.20	8.33	4.20	5.60	14.30	2.37	4.50	5.23
T_5: $MgSO_4$ (1.0 %)	21.40	8.13	4.27	5.80	14.43	2.41	4.50	5.32
T_6: Water soluble DAP- 12:61:0 (1.0 %)	21.40	8.27	4.37	5.60	15.23	2.42	4.53	5.34
T_7: Water soluble 19:19:19 (1.0 %)	21.73	8.07	4.33	5.87	14.73	2.49	4.57	5.39
T_8: Water soluble 13:0:45 (1.0 %)	22.03	7.80	4.37	5.73	14.97	2.55	4.63	5.54
T_9: Micronutrient mixture (0.5 %)	22.00	8.07	4.23	6.33	15.20	2.60	4.68	5.59
T_{10}: Micronutrient mixture (1.0 %)	22.67	7.93	4.27	6.43	15.37	2.63	4.69	5.71
T_{11}: Macronutrient mixture (0.5 %)	24.53	8.60	4.40	6.50	15.53	2.66	4.77	5.73
T_{12}: Micro and Macronutrients (0.5 %)	25.50	9.47	4.53	6.70	16.53	2.69	5.01	6.02
T_{13}: Micro and Macronutrients (1.0 %)	27.07	9.87	4.57	6.97	17.03	2.94	5.08	6.18
Mean	**22.44**	**8.30**	**4.24**	**5.83**	**14.87**	**2.47**	**4.57**	**5.46**
S.Em ±	**1.30**	**0.45**	**0.20**	**0.43**	**0.81**	**0.17**	**0.19**	**0.25**
C.D. (P= 0.05)	**3.77**	**1.31**	**0.58**	**1.25**	**2.34**	**0.49**	**0.55**	**0.71**
C.V (%)	**10.02**	**9.43**	**8.21**	**12.73**	**9.38**	**11.73**	**7.15**	**7.80**

Table.2 Yield parameters, seed yield and economics of black gram seed production as influenced by seed fortification treatments

Treatments	Pod weight /plant	Seed yield/ plant (g)	Shelling (%)	Seed yield (q/ha)	Graded seed yield (q/ha)	Cost of cultivation (Rs. ha^{-1})	Gross return (Rs. ha^{-1})	Net return (Rs. ha^{-1})	B:C Ratio
T_0: Control	4.11	3.62	51.51	11.07	10.04	40889	88352	47565	2.160
T_1: Borax (1.0 %)	4.44	3.63	64.82	11.10	10.08	40980	88704	47723	2.164
T_2: $CaCl_2$ (1.0 %)	4.51	3.65	65.54	11.16	10.14	40989	89232	48242	2.176
T_3: $FeSO_4$ (1.0 %)	4.57	3.64	66.08	11.12	10.10	40989	88880	47891	2.168
T_4: $ZnSO_4$ (1.0 %)	4.59	3.66	68.47	11.18	10.16	40986	89408	48422	2.180
T_5: $MgSO_4$ (1.0 %)	4.63	3.66	66.93	11.18	10.16	40991	89408	48416	2.181
T_6: Water soluble DAP- 12:61:0 (1.0 %)	4.64	3.76	70.04	11.50	10.47	40984	92136	51152	2.248
T_7: Water soluble 19:19:19 (1.0 %)	4.70	3.66	70.46	11.18	10.16	41027	89408	48381	2.179
T_8: Water soluble 13:0:45 (1.0 %)	4.74	4.04	73.67	12.33	11.31	40985	99528	58543	2.428
T_9: Micronutrient mixture (0.5 %)	4.73	4.11	79.17	12.53	11.54	41174	101552	60378	2.466
T_{10}: Micronutrient mixture (1.0 %)	4.82	4.23	80.30	12.91	11.89	41140	104632	63491	2.543
T_{11}: Macronutrient mixture (0.5 %)	4.87	4.22	80.54	12.89	11.87	41233	104456	63222	2.533
T_{12}: Micro and Macronutrients (0.5 %)	5.41	4.27	81.34	13.06	12.03	41258	105864	64605	2.565
T_{13}: Micro and Macronutrients (1.0 %)	5.66	4.30	86.11	13.14	12.11	41323	106568	65245	2.578
Mean	4.74	3.89	71.78	11.88	10.86	-	-	-	-
S.Em ±	0.23	0.19	5.05	0.59	0.59	-	-	-	-
C.D. (P= 0.05)	0.68	0.56	14.68	1.72	1.71	-	-	-	-
C.V (%)	8.49	8.58	12.18	8.61	9.39	-	-	-	-

Micronutrients are constituent of several dehydrogenase enzymes and also an activator of other enzymes. The increased pod yield might also due to unaborted reproductive structures that could have resulted due to higher photosynthetic activity. As far as the increase in the seed yield per plant is concerned, the physio-chemical treatments could have triggered the biosynthesis of nucleic acids, proteins and the consequential enhancement of cell division, besides, the enhanced metabolic activity of the plants resulting on the increased uptake and more availability of nutrients which enhanced pod setting, pod formation and responsible for increased pod and grain yield of black gram (Poongothai and Chitdeshwari, 2003, Vanitha and Kathiravan, 2016, Suman, 2002).

Economics of the treatments

Significantly higher maximum net return (Rs. 65245 ha^{-1}) and B:C ratio (2.58) was recorded with seed fortified with micro and macronutrient mixture @ 1 % over rest of the treatments and control (Table-2) which was followed by micro and macronutrient mixture @ 0.5 % (Rs 64605, 2.56). Significantly increased net return and benefit cost ratio could be explained on the basis of increased yield under the influence of sources of inorganic nutrients in the present investigation (*Fig* 1)**.**

Thus the study revealed that seed fortification with 1 *per cent* micro and macronutrients mixture could be adopted as a pre-sowing seed treatment for Black gram seed production for enhanced seed yield, quality and net returns.

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