International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(5): 1339-1342

Received: 06-07-2020
Accepted: 08-08-2020

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Growth and yield of blackgram as influenced by water soluble fertilizers and plant growth promoting rhizomicrobial consortia under rainfed condition in southern transition zone of Karnataka

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DOI: https://doi.org/10.22271/chemi.2020.v8.i5s.10486

Abstract
A field experiment was carried out during *Kharif*-2019 at College of Agriculture, University of Agricultural and Horticultural Sciences, Shivamogga, to study the influence of water soluble fertilizers and liquid plant growth promoting rhizomicrobial consortia on black gram (*Vigna mungo* L.) under rainfed condition in Southern Transition Zone of Karnataka. Experimental design adopted was RCBD with three replications and thirteen treatments consisting of different combinations of water soluble fertilizers *viz.*,19:19:19 (N: P: K) and Mono potassium phosphate (0:52:34) sprayed at 30 and 45 days after sowing with or without liquid plant growth promoting rhizomicrobial consortia application along with the package of practice. The Results revealed that, foliar application of 19:19:19 (N: P: K) and Mono potassium phosphate (0:52:34) @ 1 per cent each at 30 and 45 days after sowing + PGPR along with a package of practice recorded significantly higher plant height (67.16 cm), number of branches plant^{-1} (10.63), number of leaves plant^{-1} (16.95), leaf area (5.57 dm^2 plant^{-1}), total dry matter production (15.84 g plant^{-1}), number of pods plant^{-1} (25.20), pod length (7.92 cm), number of seeds pod^{-1} (6.53), seed yield (1167.62 kg ha^{-1}) and haulm yield (2019.37 kg ha^{-1}) over package of practice.

Keywords: Water soluble fertilizers, PGPR, black gram, growth and yield

Introduction

Pulses are generally known as food legumes, belonging to family Fabaceae are an important group among staple food crops next to cereals. India is the largest producer and consumer of pulses in the world and they occupy a unique position in every system of Indian farming as a main, catch, cover, green manure and intercrop. In India, pulses occupy an important position in the Indian economy next to cereals and oilseeds with an area of 29.99 M ha accounting for 25.23 M t production with a productivity of 728 kg ha^{-1} (Anon, 2018). Among the grain legumes, black gram (*Vigna mungo* L.) commonly called urdbean is an ancient and well known leguminous crop of Asia. Though it is cultivated in every part of Asia, Africa and the West Indies, it is not much important in other countries as compared to India. Besides, it is adapted to a wide range of agro-climatic conditions because of its morphological parameters perfectly suiting for intercropping and sole cropping systems. It is extensively grown as a grain legume and guaranteed considerable importance from the point of food and nutritional security as it contains 24 per cent protein and 60 per cent carbohydrates with calorific value of 347 Kcal per 100g. In India, black gram contributes about 13 per cent of total pulse area and 10 per cent of their total production and it was cultivated over an area of about 4.5 M ha with a production of 3.56 Mt. with a productivity of 654 kg ha^{-1}. In Karnataka, it is cultivated over an area of 1.38 lakh ha with a production of 0.47 lakh tonnes (Anon, 2018) [1]. It is majorly grown in the states of Madhya Pradesh, Maharashtra, Andhra Pradesh, Tamil Nadu, Karnataka and Uttar Pradesh.

Black gram is highly priced pulse having a wider gap between the potential yield and actual yield associating with several factors. Imbalanced nutrition and moisture stress is the major challenges to bridge the gap. Soil application of nutrients was often not sufficient to meet the nutrient demand of the crops, majorly in short duration crops like black gram. So, nutritional management is imperative to assure better crop production on low fertile soils. Black gram is indeterminate in flowering and fruiting habit and there was a continuous competition for available assimilates between vegetative and reproductive sinks in the complete growth period. To increase the productivity of the black gram regular supply of nutrients during the crop growth period is crucial. Among several strategies to boost the productivity and quality of black gram, foliar application of major nutrients will be vital. As it is extensively cultivated under rainfed conditions even the application of fertilizer at right time and right quantity may not be efficient due to soil moisture, Microbial consortia application resulted in efficient absorption and translocation of nutrients applied to soil as well as through foliar nutrition. Foliar application of nutrients was considered as an important method of fertilization, since the foliar application of nutrients usually penetrate the leaf cuticle or stomata and enters the cells facilitating easy and rapid utilization of applied nutrients. Keeping these things in view the present, experiment on "Growth and yield of black gram as influenced by water soluble fertilizers and plant growth promoting rhizomicrobial consortia under rainfed condition in Southern Transition zone of Karnataka" was undertaken.

Material and Methods

A field experiment was conducted during *Kharif* season of-2019 at College of Agriculture, UAHS, Shivamogga which is situated in the STZ (Zone-7) of Karnataka. The geographical reference point of the experimental site was 13° 58' to 14° 1' North latitude and 75° 34' to 75° 42' East longitude and at an altitude of 650 m above the mean sea level. The soil was sandy loam in texture, slightly acidic pH (6.19) and normal in electrical conductivity (0.70 dS m^{-1}), low organic carbon 4.56 g kg^{-1} and low in available nitrogen (242.22 kg ha^{-1}), high in phosphorus (75.08 kg P_2O_5 ha^{-1}) and medium in potassium status (135.63 kg K_2O ha^{-1}). During the cropping period, the total actual rainfall received was 1088.8 mm.

Field experiment was laid out in Randomized Complete Block Design with thirteen treatments and three replications. Treatments consisting of different combinations of water soluble fertilizers *viz.*,19:19:19 (N: P: K) and Mono potassium phosphate (0:52:34) sprayed at 30 and 45 days after sowing with or without liquid plant growth promoting rhizomicrobial consortia application along with the package of practice *viz.*, T_1: Package of practice(6.5 t ha^{-1} FYM, 13:25:25 kg NPK ha^{-1} + 4 kg $ZnSo_4$ as basal dose), T_2: T_1+19:19:19 @1 per cent at 30 DAS, T_3: T_2 + PGPR, T_4: T_1 +19:19:19 @1 per cent at 30 and 45 DAS, T_5: T_4+ PGPR, T_6: T_1+MPP @1 per cent at 30 DAS, T_7: T_6 + PGPR, T_8: T_1+MPP @1 per cent at 30 and 45 DAS, T_9: T_8 + PGPR, T_{10}: T_1+19:19:19@1 per cent + MPP @1 per cent at 30 DAS, T_{11}: T_{10} + PGPR, T_{12}: T_1+19:19:19 @1 per cent + MPP @1 per cent at 30 and 45 DAS and T_{13}: T_{12} + PGPR. Variety used is Rashmi (LBG-625) it matures in 70 to 75 days with average yield ranging from 8 to 9 q ha^{-1}. Liquid plant growth promoting rhizomicrobial consortia (*Rhizobium leguminosarum*, *Pseudomonas* sp. and *Bacillus* sp.) mixed with farm yard manure at the rate of 750 ml ha^{-1} incorporated to soil as per treatments at the time of sowing. The 1 per cent solution of water soluble fertilizers 19:19:19 and mono potassium phosphate was used for foliar spraying at 30 and 45 days after sowing as per the treatments. All the biometric observations are recorded were subjected to analysis.

Results and Discussion

Influence of water soluble fertilizers and liquid plant growth promoting rhizomicrobial consortia on growth parameters of black gram

Significantly higher growth parameters were recorded in the treatment received T_1+ 19:19:19 + Mono potassium phosphate each @ 1 per cent at 30 and 45 DAS + PGPR (T_{13}) at 45, 60 DAS and at harvest except at 30 DAS.

Plant height is an important growth parameter that reflects the vegetative growth behaviour of the crop to the applied nutrients. The plant height was progressively increased as the age of crop advanced up to harvest, significantly higher plant height (45.58, 59.30 and 67.16 cm was recorded at 45, 60 DAS and at harvest, respectively). However, the rate of increase in plant height was higher from the date of sowing to 60 DAS than 60 DAS to harvest stage of the crop. Increased plant height in black gram may be due to increase in the meristematic cell activity, increased rate of cell division and rapid cell elongation with the application of nutrients through foliar spray directly to the foliage through water soluble fertilizers and maintaining the favourable soil condition through the application of PGPR to the soil as they are known to have favourable effects on metabolic process and better vegetative growth of the plant. PGPR showed synergistic interactions with microorganisms within the rhizosphere, which indirectly boosts plant growth rate. The findings are in line with the Basim and Raghu (2015) [2].

Branching is the important growth parameter in pulse crops like black gram, as tillering in cereals, number of branches per plant decides the number flowers and pods in the black gram. Significantly maximum number of branches (8.72, 9.96 and 10.63 $plant^{-1}$ at 45, 60 DAS and at harvest, respectively) and maximum number of leaves $plant^{-1}$ (18.25, 24.95 and 16.95 $plant^{-1}$ at 45, 60 DAS and at harvest, respectively) was noticed in the treatment T_{13}. The higher number of branches and leaves might be due to hastening various metabolic process *viz.*, photosynthesis, symbiotic biological N_2 fixation process and higher nutrient availability at the initial stage of the crop because of PGPR application, increases the sprouting of auxiliary buds.

The maximum leaf area at peak flowering contributes to better yielding ability in grain legumes, which is a pre-requisite to maximise the photosynthetic activity which decides the assimilatory surface area. The higher leaf area (5.43, 6.48 and 5.57 dm^2 $plant^{-1}$ at 45, 60 DAS and at harvest, respectively) and leaf area index (1.81, 2.16 and 1.86 at 45, 60 DAS and at harvest, respectively) was noticed in the treatment T_{13}. The increased leaf area was directly due to the higher number of leaves $plant^{-1}$. Foliar application of nutrients and PGPR application increases the accumulation and translocation of assimilates this result in prolonged vegetative phase and greater photosynthetic ability of the plant producing higher leaf area, LAI was directly attributed to the higher leaf area. The leaf area index increased progressively from 30 to 60 DAS but declined as the crop reached harvest stage due to loss of assimilatory surface and senescence of lower leaves at the maturity stage.

Increasing the total dry matter output (TDM) per plant is the first prerequisite for higher yields. Accumulation of dry matter is a significant index representing the plant's growth and metabolic efficiency which ultimately influences crop yield. The amount of TDM produced is an indication of the overall efficiency of resource utilisation and better interception of light. Significantly higher total dry matter production (5.64, 9.34 and 15.84 g $plant^{-1}$ at 45, 60 DAS and at harvest, respectively) were produced in the treatment T_{13}. Greater total dry matter accumulation was associated with the higher plant height, the number of branches and number of leaves and in turn leaf area which led to higher accumulation photosynthates. Fact that PGPR and foliar application of NPK fertilizers increase the nutrient uptake which might help in maintaining higher auxin content level which might have resulted in better plant height, number of leaves and leaf area of the crop. This resulted in better interception, absorption and utilization of intercepted solar energy, leading to a higher photosynthetic rate and finally reflected on the accumulation of more dry matter by the plants. The increase in dry matter accumulation due to foliar application of nutrients has also been reported by Manonmani and Srimathi (2009) [5] in black gram.

Influence of water soluble fertilizers and liquid plant growth promoting rhizomicrobial consortia on yield and yield parameters of black gram

Seed yield governed by number of factors which have direct or indirect impacts. The improvement in seed yield is achieved through improvement in yield attributing characters *viz.*, number of pods per plant, pod weight per plant, number of seeds per pod, pod length and test weight.

In the present investigation, application of 19:19:19 and Mono potassium phosphate each @ 1 per cent at 30 and 45 DAS + PGPR along with a package of practice was increased the yield attributing characters and it may be due to the greater assimilatory leaf area as it is a major source for supplying assimilates to developing organs and seeds in crops. Significantly higher number of pods plant^{-1} (25.20), pod weight (9.54 g plant^{-1}), pod length (7.92 cm), number of seeds pod^{-1} (6.53), pod weight plant^{-1} (9.54 g) and test weight (44.92 g). This might be because of proper absorption of nutrients applied through foliar nutrition and PGPR application which reflected on the better activity of effective root nodules resulted in increased nutrient mobilization and absorption from the root zone which reflected on more assimilatory leaf area which might have caused efficient translocation of photosynthates from source to sink this reflects on the production of better yield attributing parameters. Due to increase in yield attributing characters, which finally increased the seed yield (1067 kg ha^{-1}) and haulm yield (2019 kg ha^{-1}) to the extent of 45.43 and 25.43 per cent seed and haulm yield respectively. Increased grain yield increased the harvest index (0.37) might be due to the increased mobilization of metabolites to reproductive sinks. These results are in similar to the results of Jadhav *et al*. (2017), Gupta *et al.* (2011) and Meena *et al.* (2016).

Conclusion

Use of 19:19:19 @ 1 per cent + Mono potassium phosphate @ 1 per cent at 30 and 45 days after sowing + liquid plant growth promoting rhizomicrobial consortia along with of RDF + FYM @ 6.5 t ha^{-1} + $ZnSO_4$ @ 4 kg ha^{-1} (POP) is more beneficial and economically advantageous to improve grain yield and haulm yield (1167 kg ha^{-1} and 2019 kg ha^{-1}, respectively) of the black gram under rainfed condition in Southern Transition Zone of Karnataka..

Table 1: Influence of water soluble fertilizers and liquid plant growth promoting rhizomicrobial consortia on growth parameters of black gram

Treatments	Plant height			No. of branches plant^{-1}			No. of leaves plant^{-1}			Leaf area (dm^2 plant^{-1})			Leaf area index			Total dry matter (g plant^{-1})		
	45 DAS	60 DAS	At harvest	45 DAS	60 DAS	At harvest	45 DAS	60 DAS	At harvest	45 DAS	60 DAS	At harvest	45 DAS	60 DAS	At harvest	45 DAS	60 DAS	At harvest
T_1	27.27	35.32	37.15	4.71	6.47	6.87	11.80	15.79	10.30	3.92	3.94	2.68	1.31	1.28	0.93	3.06	4.71	7.40
T_2	32.83	38.59	42.02	5.35	7.68	7.89	13.93	16.33	12.51	3.95	4.05	3.30	1.32	1.35	1.10	3.29	5.95	9.24
T_3	35.07	42.02	46.67	5.80	8.42	8.64	14.55	17.10	13.53	3.99	4.47	3.60	1.33	1.49	1.20	3.42	6.04	9.72
T_4	32.80	40.99	45.71	6.20	8.36	8.81	14.28	18.53	13.64	4.12	4.97	3.83	1.37	1.66	1.32	3.50	5.57	10.41
T_5	35.07	50.66	56.37	7.73	8.63	8.79	15.25	21.19	14.33	4.30	5.38	4.62	1.43	1.79	1.54	4.01	8.54	11.28
T_6	32.53	39.95	45.54	5.30	7.85	7.87	13.75	16.71	12.55	3.95	4.09	3.33	1.32	1.36	1.11	3.27	6.05	9.35
T_7	33.70	42.22	47.38	5.94	8.47	8.58	14.49	17.29	13.36	4.02	4.45	3.75	1.34	1.48	1.25	3.41	6.19	9.92
T_8	32.53	41.11	45.35	6.23	8.44	8.74	14.17	19.07	14.11	4.12	4.91	3.84	1.37	1.64	1.28	3.49	6.32	10.83
T_9	37.93	50.85	56.55	8.23	8.60	8.73	15.29	21.36	14.34	4.62	5.43	4.64	1.52	1.81	1.55	4.38	9.19	13.38
T_{10}	36.20	44.16	51.30	6.20	8.41	8.75	14.69	17.84	13.89	4.38	5.39	4.19	1.46	1.80	1.40	4.23	8.32	12.76
T_{11}	41.12	57.36	64.49	8.30	9.63	9.76	17.50	23.40	15.77	5.23	5.97	5.03	1.74	1.99	1.68	5.05	9.23	14.52
T_{12}	38.40	51.22	57.27	7.83	8.60	8.76	15.32	21.47	14.36	4.46	5.40	4.59	1.49	1.80	1.53	4.44	8.75	13.31
T_{13}	45.58	59.30	67.16	8.72	9.96	10.63	18.25	24.95	16.95	5.43	6.48	5.57	1.81	2.16	1.86	5.64	9.34	15.84
S. Em.±	2.4	2.66	3.2	0.50	0.4	0.6	0.96	1.23	0.87	0.30	0.35	0.29	0.10	0.11	0.09	0.32	0.34	0.80
CD @ 5%	6.9	7.77	9.3	1.47	1.3	1.8	2.81	3.59	2.54	0.90	1.01	0.86	0.28	0.33	0.26	0.93	0.99	2.34

Table 2: Influence of water soluble fertilizers and liquid plant growth promoting rhizomicrobial consortia on yield and yield parameters of black gram

Treatments	No. of pods plant^{-1}	No. of seeds pod^{-1}	Pod length (cm)	Test weight (g)	Pod dry weight (g plant^{-1})	Seed yield (kg ha^{-1})	Haulm yield (kg ha^{-1})
T_1	14.34	4.40	4.23	38.16	4.20	802	1603
T_2	15.53	4.60	5.54	40.08	4.80	869	1640
T_3	17.40	4.70	6.09	40.16	5.20	876	1653
T_4	18.13	4.75	6.21	40.54	5.75	883	1708
T_5	20.53	4.97	6.73	41.32	6.10	965	1767
T_6	16.87	4.63	5.57	40.09	4.86	868	1624
T_7	17.87	4.73	6.16	40.19	5.27	877	1657
T_8	20.07	5.04	6.28	40.59	6.10	886	1715
T_9	21.27	5.43	6.88	41.62	8.10	967	1753
T_{10}	20.33	5.40	6.81	42.97	7.67	955	1733

T_{11}	23.73	5.73	7.30	44.68	8.88	1085	1861
T_{12}	19.53	5.30	6.73	43.16	8.05	994	1706
T_{13}	25.20	6.53	7.92	44.92	9.54	1167	2019
S. Em.±	1.05	0.32	0.34	1.7	0.45	44.69	72.20
CD @ 5%	3.08	0.94	1.01	4.9	1.51	130.46	210.81

References

1. Anonymous, 3rd Annual report, Ministry of agriculture and farmers welfare, Govt. of India, 2018.
2. Basim KH, Raghu RM Evaluation of PGPR and organic manure applications on soil fertility, growth, nodulation and yield of black gram. Int. J Agric. Sci. Res. 2015; 5(2):183-192.
3. Gupta SC, Sangeev K, Khandwe. Effect of biofertilizer and foliar spray of urea on symbiotic traits, nitrogen uptake and productivity of chickpea. J Food leg. 2011; 24(2):155-157.
4. Jadhav SM, Takankhar VG, Kumbhar S. Studies on foliar nutrition in black gram (*Vigna mungo* L.) under rainfed condition. Trend Biosci. 2017; 10(27):5842-5847.
5. Manonmani V, Srimathi P. Influence of mother crop nutrition on seed and quality of black gram. Madras Agric. J. 2009; 96(16):125-128.
6. Meena S, Swaroop N, Dawson J. Effect of integrated nutrient management on growth and yield of green gram (*Vigna radiata* L.). Agric. Sci. Digest. 2016; 36(1):63-65.