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Studies on the effect of integrated nutrient management on growth parameters of irrigated blackgram

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Abstract
A Field experiment was conducted at the Experimental Farm, Department of Agronomy, Annamalai University to study the effect of integrated nutrient management on the growth and yield of irrigated blackgram during February-April 2023. The experiment was laid out in Randomized Block Design (RBD) with twelve treatments replicated thrice by using blackgram variety ADT 5. Among the different treatments under study application of vermicompost @ 2.5 t ha^{-1} + 100% P_2O_5 ha^{-1} through PROM + TNAU Pulse wonder @ 5 kg ha^{-1} foliar spray at peak flowering stage recorded highest values of all growth parameters *viz*., plant height (21.65, 32.94 and 37.22cm at 30DAS 45DAS and at harvest stage), number of branches $plant^{-1}$ (9.14), chlorophyll content (48.27), number of effective nodules $plant^{-1}$ (29.2), LAI at 50 DAS (3.98), Dry matter production (1397, 2178 and 3145 kg ha^{-1} at 30 DAS, 45DAS and at harvest) of blackgram respectively.

Keywords: Blackgram, prom, vermicompost, TNAU pulse wonder

Introduction
Pulses are the most important food crop widely cultivated across India with higher nutrient sources. For a sizable portion of the vegetarian populace in developing nations like India, grain legumes constitute an essential source of protein. Pulses are also known as "poor man's meat" as they are the most economical source of protein, they are inexpensive and high in nutrients. Among many pulse crops, blackgram (*Vigna mungo* L.) is one of the important pulse crops which belong to the family "Fabaceae". It is commonly consumed in the form of 'Dal'. Blackgram is a favourable pulse crop as it can be grown in short duration and thrives in all seasons, whether as a sole crop, intercrop, or a fallow crop. It is also resistant to adverse climatic conditions and recovers soil fertility by fixing atmospheric nitrogen in the soil (Tyagi and Singh, 2019) [10]. In India, Blackgram occupies an area of about 4.14 million hectares with a production of 2.23 million tonnes and an average productivity of 538 kg ha^{-1} (Anonymous, 2022) [3]. India has made remarkable strides in achieving self-sufficiency in food grain production and has attained a growth rate that is adequate to fulfill the needs of its growing population. India is the largest producer of pulses with 25% of the world's total production and also the largest importer (27%) of pulses in the world. However, during the last decade, pulse production has remained stagnant at around 13 to 15 million metric tonnes. In India, pulses are cultivated both as rabi and kharif crops. They play a significant role in Indian cuisine and provide 30% of the daily requirement for protein. Even though production is higher, the supply of pulses per capita is substantially lower (30g) than the WHO's recommendation (80g). The existing blanket recommendation for crops does not ensure efficient and economic use of fertilizers, as it does not take into account of the fertility variations resulting in imbalanced use of fertilizer nutrients. Among many crop production constraints, appropriate phosphorus levels are the most important, which contribute substantially to the seed yield of the blackgram (Rashmitha *et al*., 2021) [8]. Adoption of INM leads to maintaining the soil fertility to an optimum level for higher crop production and to obtain the maximum profit in the unit area. INM is a positive initiation to address both concerns of nutrient *viz*. excess application and nutrient depletion. Phosphorus application to legumes not only benefits the particular crop but also improves the soil nitrogen content for the succeeding non-legume crops and it requires lower doses of nitrogen application.

It is also an essential constituent of the majority of enzymes which are of greater importance in the transformation of energy, carbohydrate metabolism, fat metabolism and also in respiration (catabolism of carbohydrates) of plants. It is closely related to cell division and cell development. Foliar application facilitates quick and efficient utilization of nutrients, elimination of losses through leaching and fixation, and helps in regulating the uptake of nutrients by plants. As fertilizers application is complicated to apply through top dressing or placement, foliar fertilization is best suited for kharif pulses. Vermicompost helps in enhancing the activity of microorganisms by reducing soil pH at microsites in soil, chelating action of organic acids thus increases the solubility and availability of nutrients to plants.

Materials and Methods

The field experiment was conducted at the Experimental farm, Department of Agronomy, Faculty of Agriculture, Annamalai Nagar, Tamil Nadu, India. The experimental field is geographically located at 11°38'N latitude and 79°72'E longitude and at an altitude of ± 5.79 m above the mean sea level. The soil of the experimental field is clay loam in texture with low in available nitrogen, medium in available phosphorus and high in available potassium. The blackgram variety ADT 5 was chosen for the study. The experiment was laid out in randomized block design (RBD) with three replications. The spacing of 30 cm between the rows and 10 cm within plants was adopted. The treatments are T_1 - control (N:K_2O – 25:25 kg ha^{-1}), T_2 - 50% P_2O_5 ha^{-1} through PROM, T_3 - 75% P_2O_5 ha^{-1} through PROM, T_4 - 100% P_2O_5 ha^{-1} through PROM, T_5 - Control (N:K_2O – 25:25 kg ha^{-1}) + TNAU Pulse wonder @ 5 kg ha^{-1} foliar spray at peak flowering, T_6 - 50% P_2O_5 ha^{-1} through PROM + TNAU Pulse wonder @ 5 kg ha^{-1} foliar spray at peak flowering, T_7 - 75% P_2O_5 ha^{-1} through PROM + TNAU Pulse wonder @ 5 kg ha^{-1} foliar spray at peak flowering, T_8 - 100% P_2O_5 ha^{-1} through PROM + TNAU Pulse wonder @ 5 kg ha^{-1} foliar spray at peak flowering, T_9 - vermicompost @ 2.5 t ha^{-1} + control (N:K_2O – 25:25 kg ha^{-1}) + TNAU Pulse wonder @ 5 kg ha^{-1} foliar spray at peak flowering, T_{10} - vermicompost @ 2.5 t ha^{-1} + 50% P_2O_5 ha^{-1} through PROM + TNAU Pulse wonder @ 5 kg ha^{-1} foliar spray at peak flowering, T_{11} - vermicompost @ 2.5 t ha^{-1} + 75% P_2O_5 ha^{-1} through PROM + TNAU Pulse wonder @ 5 kg ha^{-1} foliar spray at peak flowering, T_{12} - vermicompost @ 2.5 t ha^{-1} + 100% P_2O_5 ha^{-1} through PROM + TNAU Pulse wonder @ 5 kg ha^{-1} foliar spray at peak flowering. The data on growth and growth characters were statistically analyzed and interpreted.

Results and Discussion

The growth parameters *viz*., plant height, number of branches plant^{-1}, chlorophyll content, number of effective nodules plant^{-1}, leaf area index and dry matter production were significantly influenced by integrated nutrient management practices in blackgram (Table 1&2). Among the different treatments, application of vermicompost @ 2.5 t ha^{-1} along with 100% P_2O_5 through PROM and foliar spraying of TNAU Pulse wonder @ 5 kg ha^{-1} during peak flowering stage (T_{12}) recorded maximum plant height (37.22cm), number of branches plant^{-1} (9.14), chlorophyll content (48.27), number of effective nodules plant^{-1} (29.2), leaf area index (3.98) and dry matter production (3145kg) respectively. This may be due to an increase in the availability of phosphorus resulting from the application of PROM, helped in early root development, promoting better growth of plant height, branches plant^{-1} and dry matter accumulation. There was higher translocation of assimilates to various parts of the plant for promoting meristematic development in potential apical parts and intercalary meristems, enhancing the root and shoot development in terms of all the growth parameters. The process of photosynthesis and breakdown of stored carbohydrates (ATP and ADP) provides energy to the plant for growth, resulted in an increase in plant size. These results are in conformity with the findings of Patel *et al*. (2013) [6] and Yadav *et al*. (2017) [12]. The addition of PROM improved the population and activity of Rhizobium bacteria in the roots, resulting in an increase in the number of effective and total root nodules opined by Singh *et al*. (2015) [9]. Vermicompost can supply plant nutrients and increase the availability of native nutrients in the soil through increased microbial activity and secretion of organic acids. The present results were in agreement with the findings of Jat *et al*. (2012) [4] and Anasuyamma *et al*. (2022) [2].

Foliar spraying TNAU Pulse wonder may have accelerated various metabolic processes in plants due to the presence of macro and micronutrients, as well as growth promoters. This could lead to increased plant growth and yield, as found by Kumar and Yadav (2018) [5] and Umamageswari *et al*. (2019) [11]. The increased leaf area observed with the use of Pulse wonder may be due to nitrogen and other micronutrients that prevent chlorophyll degradation and promote the synthesis of photosynthetic enzymes. Additionally, they maintain higher auxin levels, resulting in better plant height, leaf area, higher chlorophyll content, and more assimilatory surface area for longer periods. The foliar application of TNAU Pulse wonder aided in intensifying metabolic activity and efficient utilization of N. These findings were well supported by the work of Rajeskumar *et al*. (2017) [7].

Table 1: Effect of integrated nutrient management practices on growth parameters irrigated blackgram

Treatment	Plant height (cm)			Number of branches plant^{-1}	Chlorophyll content (SPAD Reading)	No of effective nodules plant^{-1}	Leaf area index 50 DAS
	30 DAS	45 DAS	At harvest				
T_1	12.93	14.79	16.48	3.02	29.14	14.2	2.10
T_2	15.40	20.46	22.01	4.78	34.34	18.13	2.61
T_3	17.77	24.18	27.99	6.51	39.54	22.47	3.14
T_4	20.10	29.94	33.76	8.14	44.81	26.31	3.65
T_5	13.77	18.20	19.43	3.68	30.86	15.33	2.27
T_6	16.18	21.87	23.24	5.32	36.06	19.33	2.79
T_7	18.53	26.41	29.35	7.09	41.24	23.53	3.31
T_8	20.89	30.93	35.41	8.65	46.56	28.13	3.82
T_9	14.56	19.46	20.70	4.17	32.59	16.53	2.43
T_{10}	16.99	23.17	26.32	5.89	37.8	21.2	2.97
T_{11}	19.33	28.40	32.27	7.59	43.05	24.8	3.48
T_{12}	21.65	32.94	37.22	9.14	48.27	29.2	3.98
S.Ed	0.33	0.48	0.55	0.22	0.73	0.42	0.07
CD (P=0.05)	0.68	0.99	1.12	0.46	1.52	0.88	0.16

Table 2: Effect of integrated nutrient management practices on dry matter production and yield of irrigated blackgram

Treatment	Dry matter production (kg ha^{-1})			Seed yield (kg ha^{-1})
	30 DAS	45 DAS	At harvest	
T_1	931	1487	2253	831
T_2	1062	1679	2505	968
T_3	1191	1866	2740	1107
T_4	1317	2057	2980	1247
T_5	975	1550	2332	875
T_6	1105	1746	2580	1013
T_7	1232	1924	2817	1150
T_8	1356	2116	3063	1306
T_9	1017	1615	2416	922
T_{10}	1152	1807	2661	1056
T_{11}	1274	1993	2898	1195
T_{12}	1397	2178	3145	1361
S.Ed	18.15	26.38	34.96	19.16
CD (p=0.05)	37.64	54.72	72.54	39.74

Conclusion

From the above study, it can be concluded that application of vermicompost @ 2.5 t ha^{-1} along with 100% P_2O_5 through PROM and foliar spraying of TNAU Pulse wonder @ 5 kg ha^{-1} during peak flowering stage (T_{12}) could provide higher productivity, profitability and promising economic feasible technology for blackgram growers of Tamil Nadu.

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