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Growth parameters of organic blackgram as influenced by the nutrient management techniques

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Abstract
Field experiments were conducted in two locations of Tamil Nadu Agricultural University at Agricultural Research Station, Bhavanisagar (Site-I) and Wetlands Farm, Department of Agronomy, Coimbatore (Site-II) to study the influence of application of organic manures and liquid manures on the performance of Blackgram under complete organic farming conditions. Experiments were conducted in split plot design, replicated thrice with four organic manures applied as basal and incorporated in the main plots and, five liquid manures were applied as foliar sprays twice in sub plots, at first flowering and 10 days later.
The organic manures were Farm Yard Manure (FYM) @ 12.5 t ha^{-1}, vermicompost @ 2.5 t ha^{-1}, enriched FYM @ 0.75 t ha^{-1} and enriched vermicompost @ 1 t ha^{-1} and the foliar sprays were Panchagavya @ 3%, Fermented Egg Extract @ 5%, Fermented Fish Extract @ 5%, Farmers Effective Microorganisms @ 5% and Jeevamruth @ 5%.
The results showed a non-significant influence on germination parameters. Enriched FYM in Site-I and vermicompost in Site-II showed significant influence on the growth parameters such as plant height (cm), shoot length (cm), number of nodules $plant^{-1}$, fresh weight of nodules $plant^{-1}$ (g), primary branches $plant^{-1}$, whereas foliar spray of Panchagavya showed significant influence on plant height (cm) at harvest. The interaction effect was observed only in dry matter alone. For better growth performance in organic blackgram, application of enriched FYM @ 0.75 t ha^{-1} + Panchagavya spray @ 3% and vermicompost @ 2.5 t ha^{-1} + Panchagavya spray @ 3% is recommended.

Keywords: Blackgram, growth parameters, nodules, manures, organic farming, nutrient management

Introduction
Blackgram is one of the important pulse crop of India. 100 grams of Blackgram consists of 25.2 grams of protein, 1.64 g of fat, 1.64 g of fiber, 7.57 mg of iron, 267 mg of magnesium, 379 mg of phosphorous, 983 mg of potassium, 3.35 mg of zinc and 0.981 mg of copper (FAO, 2016). In India Blackgram acreage was 3.16 m h, where the production was 2.24 mt and productivity was 710 kg ha^{-1} for the year 2024-25.
Blackgram productivity often fluctuates and mostly remains low due to various constraints such as low availability of quality seeds, lack of improved short duration varieties, cultivation on marginal lands, low input usage such as deficit fertilizer application, inadequate pest and disease management and improper harvesting and storage practices (Singh *et al.*, 2025) [10]. Among these, nutrient management is one of the improved factors contributing to low productivity. To overcome this, overall management aimed at meeting the requirement of balanced nutrition is essential (Joshi *et al.*, 2023) [6].
The study was conducted at two locations to observe the influence of decomposed organic manures applied and incorporated as basal, along with the application of liquid manures applied as foliar sprays twice, to meet the nutrient demand throughout the crop growing period of blackgram.

Materials and Methods
The field experiments were carried out at Agriculture Research Station, Bhavanisagar, Erode considered as Site-I and at Wetlands Farm, Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu considered as Site-II. The experiments were conducted during *kharif*, 2022 where the rainfall during this period at Site-I was 219.2 mm and at Site-II was

239.0 mm. Soil pH at Site-I was 6.71 and at Site-II was 8.40. Here, the variety sown was VBN-8 and the spacing adopted was 30 x 10 cm. Other than nutrient management practices, the irrigation and weeding schedule was followed as per TNAU crop production guide.

Experiments were carried out in split plot design replicated thrice with four levels of organic manures in main plot applied as basal and incorporated before sowing *viz*., Farm yard manure (FYM) @ 12.5 t ha^{-1}, Vermicompost (VC) @ 2.5 t ha^{-1}, enriched FYM (EFYM) @ 0.75 t ha^{-1} and enriched VC @ 1 t ha^{-1}. In sub plot, five liquid manures were applied as foliar sprays twice, at first flowering where, at least 30% flowers were initiated in all plots and 10 days after the first spray *viz*., Panchagavya @ 3%, Fermented Egg Extract (FEE) @ 5%, Fermented Fish Extract (FFE) @ 5%, Farmers Effective Microorganisms (FEM) @ 5% and Jeevamruth @ 5%.

Here, the germination percentage was calculated by using a quadrant in the plot and multiplied for the whole plot area and expressed as a percentage. Maximum duration required for germination was observed and expressed as number of days for maximum germination. The plant height was measured from the base of the plant to the growing tip, whereas the shoot length was measured from collar region to the tip of the primary shoot of the plant and both were expressed in cm. The nodules were collected from plants, averaged and expressed as number of nodules plant^{-1}. The nodules after separating from the plant were cleaned, weighed and the fresh weight of the nodules was recorded and expressed in grams plant^{-1}. For dry matter the plant samples were collected from each plot, which were shade dried and oven dried at 65 ± 5 °C for 24 hours, weighed and expressed as kg ha^{-1}.

The readings were taken at 20 DAS, before 1st spray, before 2nd spray and at harvest. For nodule parameters the harvest stage readings were not taken. The crop data was analyzed by the method of analysis of variance (ANOVA) given by Panse and Sukhatame, 1954 [8].

Results

The germination percentage (Fig. 1a) and duration (Fig. 1b) did not show any significance while the germination percentage in Site-I ranged from 95 to 97% and in Site-II it ranged from 98 to 100%.

The plant height (Table 1) progressed from 20 DAS to harvest across all treatments. Significant difference was not noted from the flower initiation stage. By harvest, the plant height was higher with EFYM (51.5 cm) which was on par with VC application (50.1 cm) in Site-I and VC (46.9 cm) which was on par with EFYM (44.9 cm) application in site-II, respectively. In Site-I and II, highest plant height was recorded by Panchagavya application (50.7 & 45.8 cm), respectively.

Shoot length (Fig. 1c) was recorded higher with EFYM application (11.6 cm) at Site-I, and at Site-II, with the VC application (9.7 cm). Primary branches plant^{-1} (Fig. 1d) were recorded to be higher with EFYM application (5.99 plant^{-1}) in Site-I and with VC application (5.64 plant^{-1}) in Site-II.

Number of nodules plant^{-1} (Fig. 2), Showed significant effect with the application of manures and non-significant application with the foliar sprays. Sizeable difference was observed between 20 DAS stage and before 1st spray during flowering. Before 2nd spray readings, showed significant higher number of nodules under EFYM application (53.5 plant^{-1}) in Site-I and with VC application (60.3 plant^{-1}) in Site-II. Similarly, the fresh weight of the nodules (Fig. 2) progressed with growth until the stage before 2nd spray. By the stage before 2nd spray, the application of EFYM (0.6356 g) recorded increased fresh weight in Site-I and the application of VC (0.6802 g) recorded highest weight in Site-II.

Dry matter production (Table 2) showed significant influence with the application of manures as well as foliar sprays. At 20 DAS there was no significance difference for both the treatments. At the stage before 1st spray, the manures showed significant influence and later at the stage before 2nd spray the significant difference was observed with both the main and sub plots. At harvest the interaction effect was seen among the treatments. At harvest significantly higher dry weight was recorded with the application of EFYM (3930 kg ha^{-1}) and Panchagavya spray (3845 kg ha^{-1}) in Site-I and with the application of VC (3719 kg ha^{-1}) and Panchagavya spray (3623 kg ha^{-1}) in Site-II, respectively. Interaction effect showed significant dry matter production with the treatment EFYM @ 0.75 t ha^{-1}+ Panchagavya spray @ 3% (4356 kg ha^{-1}) in Site-I and with VC @ 2.5 t ha^{-1} + Panchagavya spray @ 3% (4058 kg ha^{-1}) in Site-II, respectively.

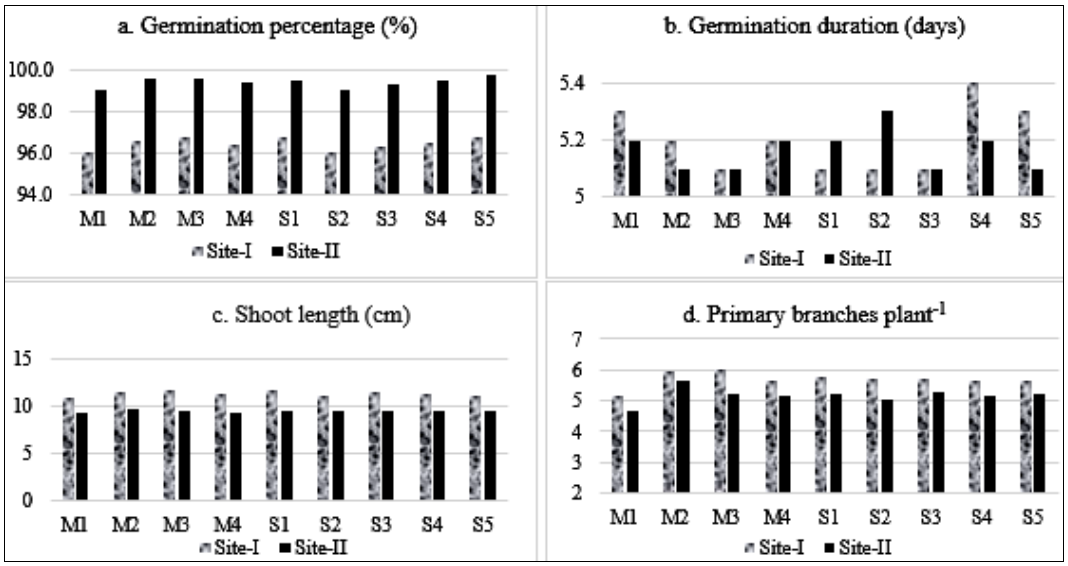

Fig 1: Effect of organic manures and foliar sprays on a. germination percentage, b. germination duration, c. shoot length (cm) and primary branches plant^{-1} of organic blackgram

Table 1: Effect of organic manures and foliar sprays on the plant height (cm) of organic blackgram

Treatments	Plant height (cm)							
Organic manures (M)	Site-I				Site-II			
	20 DAS	Before 1st flo.*	Before 2nd flo.*	Harvest	20 DAS	Before 1st flo.*	Before 2nd flo.*	Harvest
FYM @ 12.5 t ha^{-1}	16.2	34.2	40.8	44.2	14.2	28.6	37.4	40.3
VC @ 2.5 t ha^{-1}	16.9	42.7	46.4	50.1	15.3	38.9	43.4	46.4
EFYM @ 0.75 t ha^{-1}	17.1	44.5	48.0	51.5	14.9	36.2	42.1	44.9
EVC @ 1 t ha^{-1}	16.6	36.6	43.2	47.3	14.4	31.9	39.9	42.8
CD (p=0.05)	NS	2.35	1.97	2.24	NS	2.88	1.82	1.93
Foliar sprays (S)								
Panchagavya @ 3%	17.1	40.1	47.1	50.7	14.6	34.1	42.9	45.8
FEE @ 5%	16.4	39.1	42.3	46.1	14.8	33.5	38.9	41.8
FFE @ 5%	16.9	39.5	45.7	48.9	14.4	33.9	40.5	43.5
FEM @ 5%	16.7	39.7	44.9	48.5	14.7	33.9	41.3	44.3
Jeevamruth @ 5%	16.5	39.2	43.1	47.0	14.9	34.1	39.7	42.6
CD (p=0.05)	NS	NS	2.55	2.59	NS	NS	1.90	1.91

Discussion

Better performance by blackgram was recorded during the kharif season in the current study, as conditions such as adequate distribution of temperature and rainfall were favorable for crop growth due to higher moisture availability and improved nutrient uptake (Vanaja *et al.*, 2015) [13]. Enrichment enhances the nutrient content of the manures, along with improvement in soil properties and increased soil organic carbon content, thereby supporting plant development.

Improved nodule growth may be attributed to an increase in the root volume and surface area, which provides better opportunities for nodule formation and enhances plant performance as a result of better nutrient availability, leading to increased fresh weight of the nodules in the case of the enriched FYM and vermicompost (Thiagarajan and Somasundaram, 2019 and Ajaykumar *et al.*, 2022) [12, 11, 1].

In addition to higher nutrient content, the availability of nutrients both from the soil through manures and directly to the foliage through foliar spray, might have created complementary maturation conditions leading to greater dry matter accumulation. Vermicompost has been reported to have a lower pH and C:N ratio and to reduce soil EC, which may enhance soil conditions and thereby plant growth, particularly in problematic soil conditions compared to the FYM, which has a higher pH and C:N ratio (Dey *et al.*, 2019) [3]. The influence of Panchagavya on crop growth at both locations indicates its ability to improve the biochemical properties of the plant, while the increase may also be due to the presence of beneficial microorganisms (Somasundaram *et al.*, 2020; Kumar *et al.*, 2011; Divyavani *et al.*, 2020 and Singh, 2017) [11, 7, 4, 9].

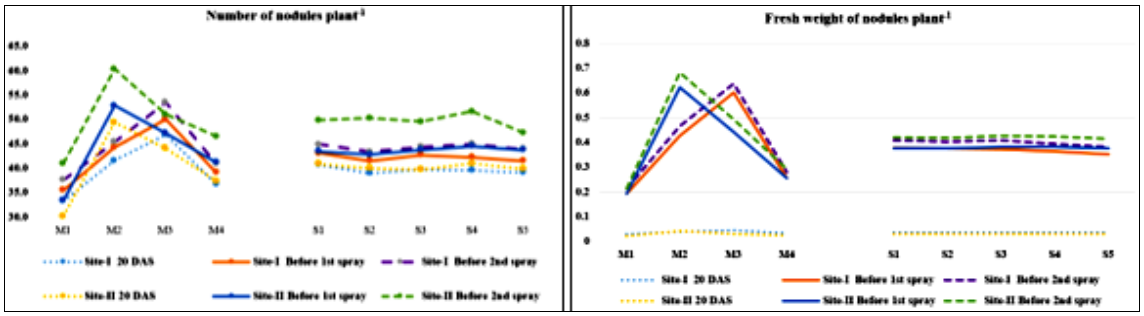

Fig 2: Effect of organic manures and foliar sprays on the number of nodules and fresh weigh of nodules plant^{-1} (g) in organic blackgram

Table 2: Effect of organic manures and foliar sprays on dry matter production (kg ha^{-1}) of organic blackgram

Treatments	Dry matter production (kg ha^{-1})							
Organic manures (M)	Site-I				Site-II			
	20 DAS	Before 1st flo.	Before 2nd flo.	Harvest	20 DAS	Before 1st flo.	Before 2nd flo.	Harvest
FYM @ 12.5 t ha^{-1}	472	1387	1872	3148	391	1552	1859	2973
VC @ 2.5 t ha^{-1}	476	1705	2516	3704	432	2053	2646	3719
EFYM @ 0.75 t ha^{-1}	483	1880	2734	3930	419	1911	2397	3489
EVC @ 1 t ha^{-1}	477	1519	2145	3332	401	1690	2020	3135
CD (p=0.05)	NS	96.1	130.5	166.4	NS	89.2	149.3	132.4
Foliar sprays (S)								
Panchagavya @ 3%	482	1629	2654	3845	413	1798	2511	3623
FEE @ 5%	473	1622	2026	3255	408	1808	2006	3092
FFE @ 5%	476	1624	2471	3659	410	1804	2217	3313
FEM @ 5%	475	1614	2318	3534	415	1796	2335	3446
Jeevamruth @ 5%	479	1626	2115	3349	410	1802	2084	3171
CD (p=0.05)	NS	NS	119.2	106.8	NS	NS	128.3	102.8
M_1S_1	483	1401	2340	3460	395	1560	2201	3309
M_1S_2	465	1382	1653	2937	385	1558	1706	2817
M_1S_3	470	1385	1855	3158	390	1555	1770	2908
M_1S_4	466	1370	1800	3112	397	1540	1873	2963

M_1S_5	475	1396	1713	3070	390	1548	1746	2870
M_2S_1	480	1704	2811	4017	435	2039	2872	4058
M_2S_2	466	1710	2101	3293	431	2055	2450	3446
M_2S_3	480	1705	2799	3957	428	2081	2612	3649
M_2S_4	480	1697	2575	3821	436	2035	2781	3932
M_2S_5	473	1710	2295	3433	430	2055	2515	3510
M_3S_1	480	1880	3066	4356	419	1898	2683	3789
M_3S_2	482	1873	2480	3600	416	1927	1969	3091
M_3S_3	477	1882	2952	4127	422	1897	2535	3579
M_3S_4	485	1875	2632	3877	420	1915	2665	3721
M_3S_5	490	1889	2540	3691	418	1918	2136	3264
M_4S_1	485	1532	2399	3548	401	1694	2288	3336
M_4S_2	480	1521	1869	3191	398	1690	1900	3014
M_4S_3	475	1522	2279	3394	400	1682	1951	3116
M_4S_4	470	1512	2266	3325	405	1696	2020	3166
M_4S_5	477	1508	1910	3200	403	1688	1939	3042
M at S	NS	NS	NS	252.4	NS	NS	NS	225.7
S at M	NS	NS	NS	213.6	NS	NS	NS	205.5

Conclusion

The study conducted in two distinct locations to evaluate the performance of organic manures and foliar sprays on the growth of blackgram in complete organic conditions showed noticeable results. Progressive growth was observed with the treatment application where the treatments did not show any influence on germination while the manures have shown positive influence on plant height, shoot length, number and fresh weight of the nodules and primary branches. The influence of foliar application was shown in the plant height. Interaction effect of the manure application and foliar sprays was shown significantly on the plant dry matter production. All the parameters excluding the nodule growth showed better performance in Site-II. The results clearly show the effect of the treatments and how the time of application influence the growth of the crop. Here, distinct results were observed in the locations indicating the influence of soil type on the performance of manures. For better growth of the crop, combined application of manures along with utilizing multiple sources is productive.

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