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Effect of nutrient management practices on LAI, yield attributes and yield of blackgram (*Vigna mungo* L.) under rice fallow

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Abstract

A field experiment was conducted during the rabi season of 2017-18 at the Agronomy Main Research Farm, Department of Agronomy, Orissa University of Agriculture and Technology, Bhubaneswar, to study the effect of foliar nutrient sprays on the growth and yield of black gram. The treatments included soil test-based fertilizer recommendation (STBFR), two sprays each of 2% urea, 2% DAP, and 2% NPK (18:18:18), along with their combinations—STBFR + one or two sprays of each foliar nutrient—and controls (STBFR + one water spray and one water spray alone), replicated thrice in a randomised block design. The results revealed that STBFR + two sprays of 2% NPK (18:18:18) recorded the highest leaf area index (2.67), number of pods per plant (30), seeds per pod (7.27), and test weight (31.93 g), resulting in maximum seed yield (720.40 kg ha⁻¹), haulm yield (1489.80 kg ha⁻¹), and harvest index (32.59%). Thus, combining soil test-based fertilization with two foliar sprays of NPK (18:18:18) proved most effective in enhancing growth and yield performance under the study conditions.

Keywords: DAP, haulm yield, LAI, STBFR, yield attributes

Introduction

Blackgram (*Vigna mungo* L.), commonly known as urd bean, is the fourth most important pulse crop in India. Its significance among pulses lies in its high nutritional value, short duration, adaptability to different seasons, and compatibility with diverse cropping systems. The crop fits well into intensive rotations and is widely cultivated as an intercrop, catch crop, cover crop, or sole crop.

In India, rice is the principal kharif crop, occupying over 40 million hectares. However, a substantial portion of this area, about 10-12 million hectares, remains fallow during the succeeding rabi season (Subbarao *et al.*, 2001) [6]. The nutrient management practices and cultivation methods followed in rice cultivation have a strong influence on the productivity of the succeeding blackgram crop. Hence, blackgram grown under rice fallow conditions offers a great opportunity for crop intensification and improved resource use efficiency.

Foliar application of major nutrients such as NPK has been found to be more effective than soil application in improving nutrient uptake and avoiding depletion of essential nutrients in the leaves. This practice enhances photosynthetic efficiency and facilitates nutrient translocation to developing seeds, resulting in higher yield.

Ganapathy *et al.* (2008) [2] reported that foliar feeding of 2% DAP at pre-flowering and flowering stages improved reproductive efficiency and seed yield of pulses under rice fallow conditions. Similarly, the application of 2% DAP during flowering and 15 days after the first spray is recommended for higher productivity of rice fallow blackgram in Tamil Nadu (CPG, 2005) [1].

Therefore, keeping these facts in view, the present investigation was undertaken to study the effect of different nutrient management practices, particularly foliar application of major nutrients, on the growth and yield of blackgram under rice fallow conditions.

Materials and Methods

The field experiment was conducted during the rabi season of 2017-18 at the Agronomy Main Research Station, Department of Agronomy, Orissa University of Agriculture and Technology, Bhubaneswar. The site is situated at 20°15' N latitude and 85°52' E longitude, about 65 km inland from the Bay of Bengal, at an elevation of 25.9 m above mean sea level. It falls under the East and South Eastern Coastal Plain Agro-climatic Zone of Odisha. The land was classified as lowland, and the soil was sandy loam in texture with a pH of 5.67, organic carbon content of 0.51%, available nitrogen

236.2 kg ha⁻¹, available phosphorus 59.5 kg ha⁻¹, and available potassium 252.5 kg ha⁻¹. The experiment consisted of twelve treatment combinations: soil test-based fertilizer recommendation (STBFR), two sprays of 2% urea, two sprays of 2% DAP, two sprays of 2% NPK (18:18:18), STBFR + one spray of 2% urea, STBFR + one spray of 2% DAP, STBFR + one spray of 2% NPK (18:18:18), STBFR + two sprays of 2% urea, STBFR + two sprays of 2% DAP, STBFR + two sprays of 2% NPK (18:18:18), STBFR + one water spray, and control (one water spray only). The experiment was laid out in a Randomized Block Design (RBD) with three replications, and each plot measured 4 m × 4 m. Blackgram was sown on 17 December 2017 at a seed rate of 25 kg ha⁻¹, with the recommended fertilizer dose of 25 kg N + 30 kg P₂O₅ + 40 kg K₂O ha⁻¹. Standard agronomic practices were followed throughout the crop growth period, and growth observations were recorded at

15-day intervals up to maturity. The crop was harvested on 3 March 2018, and data on grain and haulm yields were recorded at harvest.

Results and Discussion

The highest leaf area index (LAI) of 2.67 was recorded with the treatment STBFR + two sprays of 2% NPK (18:18:18) at 60 DAS, followed by STBFR + two sprays of 2% DAP (Table 1). The improvement in LAI may be attributed to the enhanced availability of major nutrients (N, P, and K) through both basal and foliar feeding during the critical stages of flowering and pod formation. This balanced nutrient supply might have maintained higher auxin levels, promoting better plant height, increased leaf area, and higher chlorophyll content, which enhanced light interception and photosynthetic efficiency, leading to greater biomass production.

Table 1: Leaf area index of blackgram at different stages as influenced by nutrient management practice

Treatment	Days after sowing			
	30	45	60	Harvest
Soil test based fertilizer recommendation (STBFR)	0.68	1.37	1.87	1.49
2 sprays of 2% urea	0.60	1.29	1.82	1.47
2 sprays of 2% DAP	0.61	1.32	1.83	1.48
2 sprays of 2% NPK	0.60	1.30	1.70	1.35
STBFR + 1 spray of 2% urea	0.73	1.50	1.92	1.54
STBFR + 1 spray of 2% DAP	0.82	1.51	1.80	1.56
STBFR + 1 spray of 2% NPK	0.85	1.61	1.92	1.76
STBFR + 2 sprays of 2% urea	0.86	1.68	1.93	1.53
STBFR + 2 sprays of 2% DAP	0.88	1.68	2.66	2.10
STBFR + 2 sprays of 2% NPK	0.97	2.33	2.67	2.19
STBFR + water Spray	0.53	1.48	1.70	1.33
Control (water spray)	0.44	1.05	1.68	1.34
SE(m)±	0.07	0.15	0.06	0.06
CD(P=0.05)	0.20	0.43	0.19	0.19

Similar results regarding the beneficial effects of foliar nutrient application on plant growth and development were also reported by Kumar *et al.* (2018)^[3] and Takankhar *et al.* (2017)^[7]. Further, foliar feeding at the later stages of crop growth might have facilitated effective translocation of nutrients from vegetative parts to reproductive organs (Kumar *et al.*, 2015)^[4].

Yield attributes and Yield

Application of STBFR + two sprays of 2% NPK (18:18:18) also resulted in the maximum number of pods per plant (30), seeds per pod (7.27), and test weight (31.93 g) (Table 2). These values were closely followed by STBFR + two sprays of 2% DAP (29.3, 6.9, and 31.7 g, respectively). The improvement in yield attributes could be attributed to the synergistic effect of basal and foliar nutrient applications, which met the nutrient demand of the crop during critical growth stages, ensuring balanced vegetative and reproductive development. The adequate and timely supply of nutrients possibly enhanced flower retention, reduced flower and pod shedding, and ensured efficient source-to-sink translocation of photosynthates, thereby increasing pod formation and seed weight. Similar findings were reported by Uma Maheswari *et al.* (2017)^[9], Thakur *et al.* (2017)^[8], and Takankhar *et al.* (2017)^[7], who observed improved yield attributes in pulses with foliar application of NPK or DAP during flowering stages.

The combined application of STBFR (25 kg N, 30 kg P₂O₅, and 40 kg K₂O ha⁻¹) + two sprays of 2% NPK (18:18:18) produced the highest seed yield of 720.4 kg ha⁻¹, which was statistically similar to STBFR + two sprays of 2% DAP (685.5 kg ha⁻¹) and STBFR + one spray of 2% NPK (680.2 kg ha⁻¹). The corresponding increases in seed yield due to STBFR + two sprays of NPK (18:18:18) and STBFR + two sprays of DAP were 40.8% and 34.0%, respectively, over STBFR alone, and 119.7% and 109.0%, respectively, over the control. The highest haulm yield (1489.8 kg ha⁻¹) was also recorded with STBFR + two sprays of 2% NPK (18:18:18), which was at par with STBFR + two sprays of 2% DAP (1461.6 kg ha⁻¹).

The superiority of these treatments may be attributed to the dual nutrient supply through soil and foliar routes, which supported continuous nutrient uptake and efficient translocation during the reproductive phase. In pulse crops, nutrient remobilization from leaves to developing pods often leads to premature senescence and reduced nodule activity. Supplementary nutrition through foliar feeding likely delayed senescence, sustained photosynthetic activity, improved root and nodule function, and enhanced pod setting. This overall improvement in physiological and biochemical processes resulted in superior growth, yield attributes, and yield performance. Similar findings were also reported by Ravisankar *et al.* (2003)^[5] and Uma Maheswari *et al.* (2017)^[10].

Table 2: Yield and yield attributes of blackgram at harvest as influenced by nutrient management practices

Treatment	Pods per plant	Seeds per pod	Test weight (g)	Seed yield (kg ha ⁻¹)	haulm yield (kg ha ⁻¹)	Harvest index (%)
Soil test based fertilizer recommendation (STBFR)	15.47	6.40	30.27	511.5	1183.3	30.18
2 sprays of 2% urea	14.37	5.70	30.13	506.4	1170.1	30.20
2 sprays of 2% DAP	14.40	5.73	30.20	507.9	1146.2	30.70
2 sprays of 2% NPK	14.23	5.70	30.23	549.9	1276.5	30.11
STBFR + 1 spray of 2% urea	23.33	6.83	30.33	627.9	1263.2	33.20
STBFR + 1 spray of 2% DAP	23.43	6.73	30.07	626.7	1290.2	32.69
STBFR + 1 spray of 2% NPK	23.73	6.83	30.53	680.2	1414.3	32.47
STBFR + 2 sprays of 2% urea	24.28	6.87	31.80	674.7	1449.2	31.77
STBFR + 2 sprays of 2% DAP	29.27	6.97	31.73	685.5	1461.6	31.93
STBFR + 2 sprays of 2% NPK	30.00	7.27	31.93	720.4	1489.8	32.59
STBFR + water Spray	20.47	6.63	30.07	542.4	1209.4	30.96
Control (water spray)	5.47	5.27	29.70	327.9	1032.5	24.10
SE(m)±	0.78	0.22	2.18	19.55	26.46	-
CD(P=0.05)	2.28	0.66	6.40	57.34	77.61	-

Conclusion

The study clearly demonstrated that the combined application of soil test-based fertilizer recommendation (STBFR) with foliar nutrient sprays significantly improved the growth, yield attributes, and productivity of blackgram under rice fallow conditions. Among the treatments, STBFR + two sprays of 2% NPK (18:18:18) applied at pre-flowering and flowering stages proved most effective, recording the highest leaf area index (2.67), seed yield (720.4 kg ha⁻¹), and haulm yield (1489.8 kg ha⁻¹). This integrated nutrient management approach ensured a balanced supply of essential nutrients during critical growth stages, enhanced photosynthetic efficiency, and improved source-sink translocation, resulting in higher productivity. The findings suggest that combining STBFR with foliar feeding of NPK not only enhances yield potential but also represents a sustainable and efficient nutrient management strategy for maximizing blackgram production in rice fallow ecosystems of coastal Odisha.

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