Effect of Balanced Fertilization on Pulse Crop Production in Red and Lateritic Soils

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Considering the potential for improving the productivity of pulses, an effort was made to assess the effects of proper nutrient management on yield levels and associated yield characteristics of greengram and blackgram in red and lateritic soils.

In India, pulses are mostly cultivated on marginal soils under rainfed situations with minimum external nutrient input. Farmers often fail to apply essential nutrients. The result is very low crop yields—the current average hovers at about 700 kg/ha. Whatever is spent on fertilizer goes almost entirely to nitrogen (N). Thus, pulse crop production has become non-remunerative and has left a large gap between domestic requirement and actual production. Despite the importance of pulses in the human diet and production advantages gained from including a legume in the crop rotation, pulse production in West Bengal is failing to maintain pace with population growth. For a population of 80 million people, the pulse requirement is 1.2 million metric tons (M t). With current production at 220,000 t, the opportunity for improving the productivity of pulses through efficient nutrient management is great.

Red and lateritic soils are major soils in the state of West Bengal. Crop productivity levels are usually low, owing to various soil related constraints such as low pH, organic matter, and nutrient availability. Rice is the major summer, wet season crop. However, inclusion of a short duration pulse crop holds promise for increasing and sustaining productivity of these soils through biological N fixation and reduced disease via crop rotation. Being deep rooted, they use moisture efficiently from lower soil strata.

Materials and Methods

An on-farm field experiment, conducted to assess the effect of balanced fertilization on the performance of greengram (*Vigna radiata*) and blackgram (*Vigna mungo*), was established at Bolpur on a typical red and lateritic soil. The soil had 0.62% organic carbon (C) and the available N, phosphorus (P), and potassium (K) contents were 312, 19, and 101 kg/ha, respectively. Available boron (B) and molybdenum (Mo) were considered low. Seven treatments included: a zero fertilizer control ($N_0P_0K_0$), recommended rates of 20 kg N, 40 kg P_2O_5, and 40 kg K_2O/ha applied as N, NP, NPK, NPK plus 10 kg borax/ha, NPK plus 1 kg ammonium molybdate/ha, and the complete NPKBMo treatment. Greengram variety Pusa Baishakhi and blackgram variety Kalindi (B-76) were grown

Table 1. Different growth parameters of greengram and blackgram in response to test treatments, West Bengal.

Treatments	Plant height, cm 60 DAS	Dry weight, g/m^2 60 DAS	Crop growth rate, $g/m^2/day$ 40-60 DAS
		Greengram	
$N_0P_0K_0$	44.7	325.2	8.9
NP_0K_0	48.7	341.2	9.3
NPK_0	52.6	346.0	9.3
NPK	54.5	360.8	9.4
NPKB	56.3	371.1	9.6
NPKMo	59.5	380.6	9.5
NPKBMo	63.7	397.8	9.5
SEm (±)	0.7	0.6	0.04
C.D. (p=0.05)	2.3	1.9	0.1
		Blackgram	
$N_0P_0K_0$	24.9	175.6	5.4
NP_0K_0	25.4	183.4	5.4
NPK_0	27.7	190.4	5.6
NPK	28.6	202.6	6.1
NPKB	30.5	215.3	6.3
NPKMo	33.9	225.6	6.6
NPKBMo	37.7	233.3	6.8
SEm (±)	0.7	0.8	0.1
C.D. (p=0.05)	2.1	2.3	0.1

during the pre-monsoon season in two separate randomized blocks with similar management practices.

Results and Discussion

The data on plant height, dry matter production, and crop growth rate (CGR) of the two crops are presented in **Table 1**. The complete NPKBMo treatment produced significantly higher plants than any other treatment at 60 days after seeding (DAS). Similar results were found for dry matter production in both crops. Treatments having a co-application of macronutrients and micronutrients tended to have enhanced CGR values.

After 5 weeks of growth, the Mo-containing treatments produced much better plant chlorophyll than the NPK or NPKB treatments (**Table 2**). Since Mo is a prominent constituent of nitrate reductase, the presence of adequate N along with Mo

Table 2. Chlorophyll, root nodule, and yield components of greengram and blackgram in response to test treatments, West Bengal.

Treatments	Chlorophyll content, mg/g, total	No. of nodules/plant 5 Weeks	Nodule dry weight/plant, mg 5 Weeks	Test weight, g	No. of pods/plant	No. of seeds/pod
			Greengram			
$N_0P_0K_0$	1.173	24.53	18.27	21.29	12.43	7.42
$N_{20}P_0K_0$	1.413	29.33	19.37	22.54	12.45	7.49
$N_{20}P_{40}K_0$	2.454	30.53	20.47	22.67	14.62	8.23
$N_{20}P_{40}K_{40}$	2.648	33.46	24.80	23.50	17.45	9.25
NPKB	2.902	40.27	29.13	23.57	19.21	10.43
NPKMo	3.295	49.00	36.27	23.64	21.47	10.83
NPKBMo	3.724	49.57	39.16	24.01	24.78	10.94
SEm (±)	0.001	0.765	0.673	0.051	0.009	0.021
C.D. (p=0.05)	0.004	2.360	2.074	0.157	0.030	0.064
			Blackgram			
$N_0P_0K_0$	1.301	25.43	13.67	32.97	10.29	2.62
$N_{20}P_0K_0$	1.551	25.50	16.20	33.22	10.41	2.65
$N_{20}P_{40}K_0$	1.915	25.80	18.90	33.43	15.51	3.28
$N_{20}P_{40}K_{40}$	2.191	29.07	21.53	33.49	17.41	4.39
NPKB	2.742	30.33	27.37	33.52	18.39	4.42
NPKMo	3.655	37.70	32.50	33.59	21.19	4.73
NPKBMo	3.786	38.43	35.73	33.73	23.15	4.81
SEm (±)	0.001	0.784	0.358	0.013	0.054	0.018
C.D. (p=0.05)	0.004	2.415	1.104	0.042	0.166	0.054

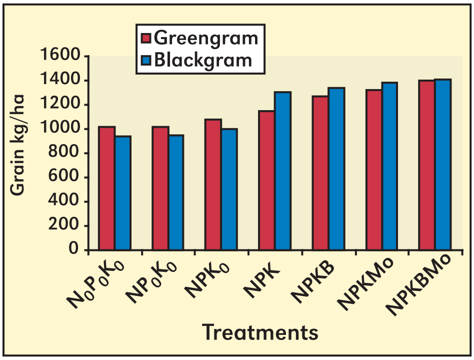

Figure 1. Effect of various treatments on grain yield of greengram and blackgram.

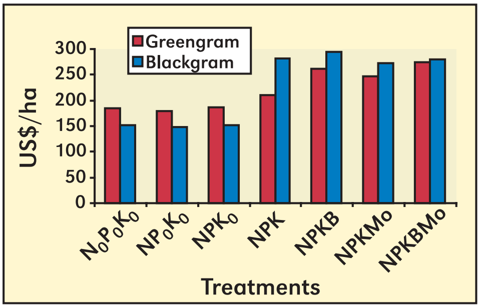

Figure 2. Balanced fertilization improves net profit in blackgram and greengram.

is assumed to enhance the nitrate assimilation rate, and in turn, activate leaf chlorophyll as well as increase the rate of photosynthesis.

Plant root nodulation (numbers and weight) kept pace with plant growth until flower initiation (**Table 2**). The numbers of nodules per plant were highest in the Mo-containing treatments, an expected result due to the known role Mo plays in nodule formation. Despite this, nodule dry weight per plant was greatest in plots which received the complete treatment. Nodules entered their senescence phase 5 weeks after planting. Thus the active period for nodule growth and development is restricted to about one-third of the total growth period.

The grain yield component data presented in **Table 2** show that the numbers of pods per plant and seeds per pod increased steadily as nutrient application became less limiting. The combined benefit is reflected in amounts of harvested grain (**Figure 1**). In both crops, plots receiving no fertilizer or N only exhibited similarly poor yields. Plots treated with the complete NPKBMo treatment returned the highest greengram yield (1,398 kg/ha). A similar yield response was observed in blackgram although the response to micronutrients appeared less prominent.

Balanced application of NPK along with B and Mo will be an effective solution for higher grain yield of pulses in red and lateritic soils. Adequate NPK fertilization increased green and blackgram yields by 13% and 38% over the control. Further inclusion of B and Mo improved yield by 38% for greengram and 50% for blackgram over the control. An economic evaluation of each treatment reveals that the complete treatment was most profitable in greengram (**Figure 2**). However, NPK plus B alone returned the highest profits in blackgram as marginal yield gains obtained with Mo could not support the current added cost. BC

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