The Andhra Agric. J 56(1): 63-66, 2009

Response of Blackgram to Residual Phosphorus application to Rice in Rice-Blackgram Cropping System

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ABSTRACT

A field experiment was conducted during 2004-05 on sandy loam soil at Agricultural College Farm, Bapatla to study the effect of additional dose of phosphorus applied to rice on the yield, nutrient uptake and soil availability status of succeeding black gram. The results indicated that the additional dose of 10, 20 and 30 kg P_2O_5 ha^{-1} at tillering and 10, 20 and 30 kg P_2O_5 ha^{-1} at primordial initiation stage significantly increased the dry matter production, seed and haulm yield of black gram over the recommended dose of phosphorus applied as basal. The additional doses also gave significantly higher content and uptake of nitrogen and phosphorus of succeeding blackgram over the recommended dose of phosphorus (60 kg P_2O_5 ha^{-1}) applied as basal.

Key words : Cropping System, Phosphorus Application, Rice

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Rice- blackgram relay cropping on residual moisture and fertility is very common in the Krishna-Godavari agro climatic zone of Andhra Pradesh. Fertilizer recommendations are normally made based on nutrient requirements of individual crops ignoring the residual effect. Fertilizer phosphorous is a costly input and its relative poor utilization by the crops due to its fixation and immobilization in the soils are some of the principal factors, which have prompted attention towards the most efficient management of fertilizer phosphorus. The quantity of phosphorus absorbed from fertilizers by a single crop is often quite low and the phosphatic fertilizers have the residual value and the succeeding crop takes advantage of this residual phosphorus (Tandon, 1987). A large portion of phosphorus remaining after the first crop is not fixed but indeed available to the subsequent crops (Kundu *et al*., 1986 and Gill and Meelu 1983). The dynamics of phosphorus should be considered in a cropping system rather than a single crop for efficient and judicious management of phosphorus. This study was carried out in order to elucidate information on the residual effect of phosphatic fertilizers applied at later stages of rice on the performance of succeeding black gram.

MATERIAL AND METHODS

A field experiment was conducted during 2004-05 at Agricultural College Farm, Bapatla. The experiment was laid out in randomized block design comprising of seven treatments replicated four times. The treatments consisted of T_1-Recommended dose of phosphorus as basal, T_2- Recommended dose of phosphorus as basal +10 kg P_2O_5 ha^{-1} at tillering stage, T_3- Recommended dose of phosphorus as basal +20 kg P_2O_5 ha^{-1} at tillering stage, T_4- Recommended dose of phosphorus as basal +30 kg P_2O_5 ha^{-1} at tillering stage, T_5- Recommended dose of phosphorus as basal +10 kg P_2O_5 ha^{-1} at primordial initiation stage, T_6- Recommended dose of phosphorus as basal +20 kg P_2O_5 ha^{-1} at primordial initiation stage, T_7- Recommended dose of phosphorus as basal +30 kg P_2O_5 ha^{-1} at primordial initiation stage. A common dose of 120, 60 and 60 kg ha^{-1} of N, P_2O_5 and K_2O, respectively was applied through urea, diammonium phosphate and muriate of potash to all the treatments. Entire dose of phosphorus and potassium and one third of nitrogen were applied as basal. Remaining nitrogen was applied in two split doses of maximum tillering and panicle initiation stage. Phosphorus was applied as per the treatments. The experimental field was a sandy loam in texture with pH of 7.92. The soil had a low organic carbon of 0.38 percent and available nitrogen of 218 kg/ha and medium in available phosphorus of 23.2 kg P_2O_5 ha^{-1} and rich in available potassium 407 kg K_2O ha^{-1}. The seed of black gram variety LBG-645 was broadcasted four days before the harvest of rice and allowed to grow on the residual moisture and fertility. Soil samples were collected after harvest of rice and blackgram were processed and analysed for organic carbon, pH, E.C (Jackson, 1973). Available nitrogen (Subbiah and Asija, 1956), phosphorus (Olsen *et al.,* 1954), potassium (Muhr *et al*., 1963) and available DTPA extractable micronutrients Zn, Fe,

Cu, Mn (Lindsay and Norvell, 1978). The soil phosphorus was estimated colorimetrically, potassium by flame photometry. Plant samples were collected after harvest of blackgram and analyzed for N, P and K.

RESULTS AND DISCUSSION

Dry matter production, seed and hulm yield

Based on Analysis of variance the different between treatments was statistically tested for different parameters observed in the study. Application of additional dose of phosphorus applied at tillering and primordial initiation stages to rice significantly increased the drymatter production, seed and hulm yield of blackgram.

Highest drymatter production of blackgram 2812 kg ha^{-1} (Table 1) recorded by the treatment T_7 i.e., RDP + additional dose of 30 kg P_2O_5 ha^{-1} applied at primordial initiation stage of rice followed by 20 and 10 kg P_2O_5 ha^{-1} with 2756 and 2628 kg ha^{-1} respectively.

The seed and hulm yield of blackgram in response to the additional dose of 10, 20 and 30 kg P_2O_5 ha^{-1} applied to the preceding crop of rice at tillering or primordial initiation stage was given in Table 1. Maximum residual advantage was harvested by the application of additional 30 kg P_2O_5 ha^{-1} to rice at primordial initiation stage. Blackgram produced grain yield of 984 kg ha^{-1} and hulm yield of 1828 kg ha^{-1}. This was on par with the response due to the additional 20 kg P_2O_5 ha^{-1} applied to rice at primordial initiation stage. Its residual effect enable the blackgram crop yield to 973 kg ha^{-1} grain and 1783 kg ha^{-1} hulm yield. Patel and Thakur (1997) also obtained significant yield response in black gram owing to increase in availability of phosphorus in the soil and its absorption by the crop.

Nutrient uptake by blackgram at harvest

The uptake of nitrogen, phosphorus and potassium by blackgram increased significantly (Table 2) with increasing levels of phosphorus applied at tillering and panicle initiation stage over the basal application of recommended dose of phosphorus applied to rice.

Nitrogen uptake

Additional dose of phosphorus applied at the rate of 30 kg P_2O_5 ha^{-1} to rice at panicle initiation stage recorded highest uptake 71.4 kg ha^{-1} of nitrogen by blackgram followed by 20 kg P_2O_5 ha^{-1} with 69.7 kg ha^{-1} while the corresponding uptake of nitrogen by blackgram which received the same amount of additional dose of phosphorus at tillering stage to rice was 67.2, 65.3 kg ha^{-1} which were on par with each other and significantly higher than the treatment that received 10 kg P_2O_5 ha^{-1}.

Table 1. Effect of additional dose of phosphorus applied to rice on the dry matter production, seed and hulm yield (kg ha^{-1}) of blackgram

Treatments	Drymatter production	Seed yield	Haulm yield
T_1 - Recommended dose of phosphorus as basal	2299	845	1454
T_2- Recommended dose of phosphorus as basal +10 kg P_2O_5 ha^{-1} at tillering stage	2478	898	1580
T_3- Recommended dose of phosphorus as basal +20 kg P_2O_5 ha^{-1} at tillering stage	2623	937	1686
T_4 - Recommended dose of phosphorus as basal +30 kg P_2O_5 ha^{-1} at tillering stage	2686	951	1735
T_5 - Recommended dose of phosphorus as basal +10 kg P_2O_5 ha^{-1} at primordial initiation stage	2628	936	1691
T_6 - Recommended dose of phosphorus as basal +20 kg P_2O_5 ha^{-1} at primordial initiation stage	2756	973	1783
T_7 - Recommended dose of phosphorus as basal +30 kg P_2O_5 ha^{-1} at primordial initiation stage	2812	984	1828
C.D (0.05)	119.0	42.0	87.0

Table 2. Effect of additional dose of Phosphorus applied to rice on the uptake of N, P and K (kg ha^{-1}) by blackgram at harvest.

Treatments	Nitrogen	Phosphorus	Potassium
T_1 - Recommended dose of phosphorus as basal	56.0	5.28	24.6
T_2 - Recommended dose of phosphorus as basal +10 kg P_2O_5 ha^{-1} at tillering stage	60.9	6.39	27.9
T_3 - Recommended dose of phosphorus as basal +20 kg P_2O_5 ha^{-1} at tillering stage	65.3	7.55	30.1
T_4 - Recommended dose of phosphorus as basal +30 kg P_2O_5 ha^{-1} at tillering stage	67.2	8.15	32.0
T_5 - Recommended dose of phosphorus as basal +10 kg P_2O_5 ha^{-1} at primordial initiation stage	65.6	7.72	32.2
T_6 - Recommended dose of phosphorus as basal +20 kg P_2O_5 ha^{-1} at primordial initiation stage	69.7	8.91	34.3
T_7 -Recommended dose of phosphorus as basal +30 kg P_2O_5 ha^{-1} at primordial initiation stage	71.4	9.54	35.3
C.D (0.05)	1.98	0.76	2.0

Table 3. Effect of additional dose of phosphorus applied to rice on the available N, P and K (kg ha^{-1}) at harvest of blackgram.

Treatments	Nitrogen	Phosphorus	Potassium
T_1 - Recommended dose of phosphorus as basal	312	28.7	373
T_2- Recommended dose of phosphorus as basal +10 kg P_2O_5 ha^{-1} at tillering stage	305	34.3	372
T_3 - Recommended dose of phosphorus as basal +20 kg P_2O_5 ha^{-1} at tillering stage	297	37.9	371
T_4 - Recommended dose of phosphorus as basal +30 kg P_2O_5 ha^{-1} at tillering stage	292	38.8	370
T_5 - Recommended dose of phosphorus as basal +10 kg P_2O_5 ha^{-1} at primordial initiation stage	293	35.1	369
T_6 - Recommended dose of phosphorus as basal +20 kg P_2O_5 ha^{-1} at primordial initiation stage	287	38.6	369
T_7- Recommended dose of phosphorus as basal +30 kg P_2O_5 ha^{-1} at primordial initiation stage	283	41.3	368
C.D (0.05)	NS	2.8	NS

Phosphorus uptake

Additional dose of phosphorus applied to rice both at tillering and primordial initiation stage significantly increased the phosphorus uptake by the succeeding black gram over the basal application of recommended dose of phosphorus. The uptake values at 10, 20 and 30 kg P_2O_5 ha^{-1} additional dose applied at panicle initiation stage were 7.72, 8.91 9.54 kg ha^{-1} while the corresponding uptake values at tillering stage were 6.39, 7.55, 8.15 $kgha^{-1}$.

Potassium uptake

Potassium uptake values at 10, 20 and 30 kg P_2O_5 ha^{-1} additional dose applied at panicle initiation stage were 32.2, 34.3 and 35.3 and at tillering stage were 27.9, 30.1 and 32.0 kg ha^{-1} respectively.

The increase in uptake of nitrogen, phosphorus and potassium was attributed due to the increased root density and nodulation, which enable the plant to extract more nutrients from the soil (Nimje, 1992 and Singh *et al*., 1994).

Nutrient availability in soil after harvest of blackgram

There was no significant difference in the soil available nitrogen and potassium status with the additional dose of phosphorus applied both at tillering and primordial initiation stage to rice, but the available phosphorus status of the soil increased significantly in all the treatments due to additional dose of phosphorus applied both at tillering and panicle initiation stages. Singaram and Kothandaraman (1992) also reported that the application of higher doses of phosphorus to rice leave behind larger residues of this nutrient.

The results indicate that application of additional dose of phosphorus applied at tillering and primordial initiation stage to rice had residual effect on succeeding crop and fertilizer needs of *rabi* crop could be reduced successfully to the tune of 50 percent.

LITERATURE CITED

Gill H S and Meelu O P 1983. Studies on utilization of P and causes for its differential response to rice-wheat. Plant and Soil, 74: 211-222.

Jackson M L 1973. Soil Chemical Analysis. Prentice- Hall of India pvt. Ltd., New Delhi, pp: 40.

Kundu S, Kamath M B and Goswami N N 1986. Evaluation of residual effect of phosphate in rice-wheat-blackgram-rice cropping sequence using ^{32}P as a tracer. Journal of Nuclear and Agricultural Biology, 15(2): 115-119.

Lindsay W L and Norvell W A 1978. Development of DTPA soil test for zinc, iron, manganese and copper. Soil Science Society of American Journal, 42: 421-428.

Muhr G R, Datta N P, Shankara Subramanian H, Dever R F, Leley V K and Donahue R L 1963. Soil Testing of India. United States Agency for International Development Mission to India, New Delhi, pp: 120.

Nimje P M 1992. Effect of land treatment systems on phosphorus fertilization on grounnut (*Arachis hypogea L.*) in Vertisols. Journal of Oil Seeds Research, 9(2): 227-233.

Olsen S R, Cole C V, Watanabe F S and Dean L A 1954. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. USDA circular 939, United States Department of Agriculture, USA.

Patel S R and Thakur D S 1997. Influence of phosphorus and rhizobium on yield attributes, yield and nutrient uptake of groundnut (*Arachis hypogea L.*). Journal of Oil Seeds Research, 14(2): 189-193.

Singaram P and Kothandhraman G V 1992. Residual effect of different phosphatic fertilizers on available phosphorus of soil in a cropping sequence. Journal of Indian Society of Soil Science, 40: 213-215.

Singh Ved Sharma S K, Verma B L and Siag R K 1994. Effect of irrigation schedule and phosphorus fertilization on yield , water use and phosphorus uptake by groundnut (*Arachis hypogea L.*) in north west Rajasthan. Indian Journal of Agronomy, 39(1): 58-61.

Subbiah B V and Asija C L 1956. A rapid procedure for estimation of available nitrogen in soils. Current Science, 25: 328.

Tandon H L S 1987. Phosphorus research and agricultural production in India. Fertilizer Development and Consultation Organization, New Delhi, pp: 160.

(Received on 21.06.2008 and revised on 29.12.2008)