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Effect of integrated plant nutrient supply on NPK content and uptake by seed and straw in black gram

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Abstract
India is the largest producer of pulses. Black gram (urd) is one of the most important pulse crops as it has the potential to contribute on a large scale to the pulse production in India. Regardless of higher and sustainable crop productivity, manure and fertilizer maintenance in black gram crop production is also extremely desirable. The aim of present investigation was to study the "Effect of Integrated plant nutrient supply on NPK content and uptake by seed and straw in black gram" conducted in Kharif season at the research farm of Amar Singh Post Graduate College, Lakhaoti, Bulandshahar, U.P. Study concluded that Treatment T_8 (*Azoto* + *Rhizobium* + PSB + FYM + Chem.) resulted in significant increase in N, P, and K content as well as their uptake by urd crop. This was closely followed by treatments T_3 and T_7 in both the years. Therefore, for maximum productivity of urd and inherent fertility of soil for future period, the importance of integrated plant nutrient system (IPNS) in urd has raised.

Keywords: Black Gram, NPK Content, Uptake, IPNS, Seed, Straw

1. Introduction
Black gram is the 3rd important pulse crop in India. Black gram (Vigna mungo (L.) Hepper.) Popularly known as "urd bean" is one of the important seed legumes and is an excellent source of good quality protein. It comes under the family Leguminaceae and the genus Vigna. Besides, being a rich source of protein, they maintain soil fertility through biological nitrogen fixation in soil and thus play a vital role in furnishing sustainable agriculture. The low input, sustainable agriculture and reduced chemical input concepts, which focus on the reconsideration of agricultural practices, used as crop residues incorporation, green manuring, FYM and bio-fertilizer use and inclusion of legumes in crop rotation is important to maintain soil organic matter at an adequate level and to sustain reasonable productivity (Kirchner *et al.* 1993 and Grubinger, 1992). The basic concept of IPNS is the promotion and maintenance of soil fertility for sustaining crop productivity through optimizing all possible resources like organic, inorganic and biological in an integrated manner appropriate to each farming situation and its ecological, soil and economic possibilities. The influence of IPNS on black gram package include the fertilizer application as per recommendations of the soil test along with organic manure (FYM, crop residues and bio-fertilizers, *Azotobactor*, PSB and VAM). Pandey *et al*. (1999) observed that crop residue incorporation is one of the important constituents to increase the efficacy of applied fertilizers. FYM and crop residues incorporated in soil affects in three ways, firstly it benefits the soil nutritionally through its effects on soil nutrients (macro and micro) and maintenance of organic matter.
Integrated plant nutrient supply system and its management can improve the productivity of the black gram and will also improve the fertility level of soil. Therefore, the present study entitled "Effect of IPNS on NPK content and uptake by seed and straw by in black gram" was undertaken.

2. Material and method
Present investigation was conducted during the kharif season at the Agricultural Research Farm of Amar Singh (P.G.) College, Lakhaoti (Bulandshahar) to study the "Effect of Integrated plant nutrient supply on NPK content and uptake by seed and straw in black gram". The details of the material used and methodology adopted during the course of investigation are described below.

2.1 Location, Weather and Climate
The experiment was conducted at the Agricultural Research Farm of Amar Singh (P.G.) College, Lakhaoti, Bulandshahar. It lies between 28^0 N latitude and 77' E longitude at an

elevation of about 201.48 m above mean sea level.

The monsoon generally commences during the last week of June or first week of July and continues up to 15th September. The average annual rainfall of the region was 703.75 mm about 88% of which was received from June to September and the remaining (20%) during October to March. May and June are the hottest months of the year and maximum temperature was ranges between 43-45 ^{0}C while January is the coldest month with minimum temperature was ranges between 3-6 ^{0}C.

Table 1: The details of the treatments

S. No.	Treatments	Symbols
1.	T_1: Recommended dose of NPK (120: 60:40)	Recommended
2.	T_2 : Fertilizer dose based on soil test value	Test value
3.	T_3 : 10 tonnes ha^{-1} FYM + Rest through chemical fertilizers	FYM + Chemical fertilizer
4.	T_4 : Azotobacter + 75% N and full dose of P & K through chemical fertilizers	Azoto + Chemical fertilizer
5.	T_5 : Rhizobium + 50% P and full dose of N & K through chemical fertilizers	Rhizo + Chemical fertilizer
6.	T_6 : PSM (Phosphorus solubilizing bacteria) + 75% P and full dose of N & K through chemical fertilizers	PSB + Chemical
7.	T_7 : *Azotobacter* + *Rhizobium* + PSB + 75%N, 25% P and 100% K through chemical fertilizers	Azotobactor + Rhizo + PSB + Chemical fertilizer
8.	T_8 : *Azotobacter* + *Rhizobium* + PSB + 10 t ha^{-1} FYM and 33% N, no P and K through chemical fertilizers	Azoto + Rhizo + PSB + FYM + Chemical fertilizer
9.	T_9 : 2 t ha^{-1} Vermicompost + 75% Recommended dose of NPK	Vermicompost + Chemical fertilizer

2.2 Statistical Analysis

The data was tabulated for computerization and analysis of variance, by method as given by Snedecor and Cochran (1984).

3. Result and Discussion

3.1 Nitrogen content and uptake in black gram

The data related to nitrogen content and uptake in black gram by grain and straw due to IPNS treatments during both the years is summarized in Table 2 and depicted in Figure 1a, 1b.

Variations in N content and uptake in black gram grain and straw due to IPNS treatments were found significant during both the years. Maximum N content in grain was recorded in T_8 with 3.64%, 3.72% and 3.68% during 1st year and 2nd year and in average values, respectively. Average values were significantly superior to rest of the treatments. It was also recorded from the average data, the minimum N content in grain and straw with 3.54 and 1.39 per cent was associated with treatments T_5, respectively (Table 2). As regards to N uptake in grain and straw, treatment T_8, resulted in maximum uptake (28.96 and 65.92 kg ha^{-1} in average data). Where as the minimum N uptake by grain (20.57 kg ha^{-1}) and straw (33.07 kg ha^{-1}) was associated with T_5 as evident from the average data given in Table 2.

Table 2: Nitrogen content and uptake by grain straw black gram as influenced by integrated plant nutrient supply

Treatments	N Content (%)						N uptake (kg ha^{-1})					
	Grain			Straw			Grain			Straw		
	1st year	2nd year	Average	1st year	2nd year	Average	1st year	2nd year	Average	1st year	2nd year	Average
T_1	3.55	3.57	3.56	1.50	1.51	1.51	20.73	22.78	21.75	36.14	39.61	37.87
T_2	3.56	3.60	3.58	1.52	1.52	1.52	21.82	23.36	22.59	38.33	40.87	39.60
T_3	3.60	3.61	3.61	1.71	1.72	1.72	24.30	25.52	24.91	47.74	49.83	48.79
T_4	3.58	3.58	3.58	1.67	1.67	1.67	23.38	24.17	23.77	45.39	47.24	46.32
T_5	3.54	3.53	3.54	1.38	1.39	1.39	19.79	21.36	20.57	31.81	34.33	33.07
T_6	3.56	3.61	3.59	1.50	1.51	1.51	23.28	23.79	23.54	38.46	41.65	40.05
T_7	3.60	3.60	3.60	1.79	1.80	1.80	27.94	28.37	28.15	58.19	61.33	59.76
T_8	3.64	3.72	3.68	1.90	1.91	1.91	30.10	27.83	28.96	65.38	66.47	65.92
T_9	3.54	3.59	3.57	1.41	1.41	1.41	20.00	25.24	22.62	32.84	37.62	35.23
S. Em.±	0.083	0.073	0.011	0.0061	0.0074	0.0023	0.70	0.44	0.32	2.16	2.47	0.37
CD (0.05)	NS	NS	0.038	0.018	0.022	0.0077	2.10	1.51	0.97	6.47	7.42	1.05

3.2 Phosphorus content and uptake in black gram

The data on phosphorus content and uptake in black gram during both the years as affected by IPNS is presented in Table 3 and depicted in Figure 2.

Phosphorus content and uptake in black gram grain and straw were affected significantly due to various IPNS treatments during both the years and their average values. Average data (Table 3), revealed that maximum phosphorus content in grain (0.71%) and straw (0.37%) was associated with treatment T_8, which was *at par* with T_7, T_3 and T_6 in respect to grain and straw significantly superior to rest of the treatments. Whereas, T_9 resulted in minimum phosphorus content in grain (0.52%) and straw (0.26%) in the average values. Similarly, phosphorus uptake in grain of 5.59 kg ha^{-1} and in straw (12.80 kg ha^{-1}) under T_8 were found maximum in the year average values which established significant superiority over the other treatments under study. The minimum values in grain (3.26 kg ha^{-1}) and straw (6.50 kg ha^{-1}) was obtained under T_9 from average data presented in Table 3.

Table 3: Phosphorus content and uptake by grain and straw of Black gram as influenced by integrated pant nutrient supply

Treatments	P Content (%)						P uptake (kg ha^{-1})					
	Grain			Straw			Grain			Straw		
	1st year	2nd year	Average	1st year	2nd year	Average	1st year	2nd year	Average	1st year	2nd year	Average
T_1	0.55	0.57	0.56	0.27	0.27	0.27	3.21	3.64	3.42	6.50	7.08	6.79
T_2	0.60	0.60	0.60	0.30	0.30	0.30	3.68	3.89	3.79	7.57	8.07	7.82
T_3	0.61	0.63	0.62	0.33	0.33	0.33	4.12	4.45	4.29	9.21	9.56	9.39
T_4	0.53	0.54	0.54	0.27	0.27	0.27	3.46	3.65	3.55	7.34	7.64	7.49
T_5	0.57	0.58	0.58	0.28	0.28	0.28	3.19	3.51	3.35	6.45	6.92	6.69
T_6	0.60	0.62	0.61	0.33	0.33	0.33	3.92	4.09	4.00	8.46	9.10	8.78
T_7	0.64	0.65	0.65	0.35	0.35	0.35	4.97	5.12	5.04	11.38	11.92	11.65
T_8	0.70	0.72	0.71	0.37	0.37	0.37	5.79	5.39	5.59	12.73	12.88	12.80
T_9	0.52	0.51	0.52	0.26	0.26	0.26	2.94	3.59	3.26	6.06	6.94	6.50
S.Em.±	0.012	0.0088	0.0052	0.010	0.011	0.0022	0.12	0.25	0.041	0.32	0.29	0.031
CD (0.05)	0.036	0.026	0.017	0.032	0.032	0.071	0.38	0.76	0.16	0.98	0.91	0.123

3.3 Potassium content and uptake in black gram

Table 4 and Figure 3a, 3b contain data in respect of potassium content and uptake in black gram as influenced by IPNS treatment during both the years of investigation.

Variations in potassium content and uptake in black gram grain and straw due to various IPNS treatments were found significant during both the years and in average values. From the average values, it was noticed that, T_8 registered maximum potassium content (0.88% in grain and 1.79% in straw) and uptake (6.93 kg ha^{-1} by grain and 61.77 kg ha^{-1} by straw) which was closely followed by treatment T_7 but significantly superior over rest of the treatments. The minimum potassium content of 0.80% in grain and 1.69% in straw in T_1 and T_4, respectively, and minimum potassium uptake (5.11 kg ha^{-1} in grain and 42.51 kg ha^{-1} in straw) was observed in treatment T_9 (Vermicompost + Chemical fertilizer).

N, P and K content as well as their uptake by black gram grain and straw were found to be maximum with treatment T_8 (*Azoto* + *Rhizobium* + PSB + FYM + Chem.) which was closely followed by T_7 (*Azoto* + *Rhizobium* + PSB + Chem) and T_2 (Soil test based) and values were significantly superior over the other remaining treatments (Table 2, 3 & 4). Minimum nutrients (NPK) and their uptake by black gram were recorded under treatment T_9 (Vermicompost + Chem.). Similar benefits of PSB + FYM (Banik and Dey 1981); *Rhizobium* + PSB (Pandey *et al*. 1998) on nutrients uptake by black gram have also been reported. Black gram being a leguminous crop may also fix substantial amount of atmospheric N in soil and make it available to the plants. FYM improves the soil physical environment which may become favourbale for microbial (PSB and *Azotobacter*) growth and hence more nutrient become available in soil solution and consequently enhanced uptake by the black gram. Similar results were obtained by Banik and Dey (1981). Minimum uptake of nutrients (NPK) in treatment T_9 (Vermicompost + Chem. Fert.) might be because of insufficient supply of nutrients due to slow mineralization of crop residues because of higher C: N ratio.

Table 4: Potassium content and uptake by grain and straw of Black gram as influenced by integrated plant nutrient supply

Treatments	K Content (%)						K uptake (kg ha^{-1})					
	Grain			Straw			Grain			Straw		
	1st year	2nd year	Average	1st year	2nd year	Average	1st year	2nd year	Average	1st year	2nd year	Average
T_1	0.82	0.84	0.83	1.70	1.70	1.70	4.79	5.36	5.07	40.95	44.59	42.77
T_2	0.84	0.86	0.85	1.69	1.71	1.70	5.15	5.58	5.37	42.62	45.98	44.30
T_3	0.85	0.87	0.86	1.71	1.72	1.72	5.74	6.15	5.94	47.74	49.83	48.79
T_4	0.82	0.85	0.84	1.68	1.70	1.69	5.35	5.74	5.55	45.66	48.09	46.88
T_5	0.82	0.83	0.83	1.70	1.72	1.71	4.58	5.02	4.80	39.19	42.48	40.83
T_6	0.83	0.84	0.84	1.69	1.70	1.70	5.43	5.54	5.48	43.33	46.89	45.11
T_7	0.86	0.87	0.87	1.73	1.72	1.73	6.67	6.86	6.76	56.24	58.60	57.42
T_8	0.87	0.89	0.88	1.77	1.80	1.79	7.19	6.66	6.93	60.91	62.64	61.77
T_9	0.80	0.81	0.80	1.68	1.72	1.70	4.52	5.69	5.11	39.13	45.89	42.51
S. Em.±	0.0073	0.013	0.0035	0.0072	0.012	0.0075	0.19	0.16	0.067	2.33	3.11	0.75
CD (0.05)	0.021	0.039	0.011	0.021	0.036	0.024	0.61	0.47	0.22	6.99	9.29	2.19

4. Conclusion

Present investigation on "Effect of Integrated plant nutrient supply on NPK content and uptake by seed and straw in black gram" concluded that Treatment T_8 (*Azoto* + *Rhizobium* + PSB + FYM + Chem.) resulted in significant increase in N, P, and K content as well as their uptake by black gram (urd). This was closely followed by treatments T_3 and T_7 in both the years.

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