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Response of Integrated Nutrient Management on Nutrient Content as Well as Uptake of Buckwheat Varieties and its Residual Effect on Mung Bean under Terai Region of West Bengal, India

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A B S T R A C T

A field experiment entitled, "Response of integrated nutrient management on nutrient content as well as uptake of buckwheat varieties and its residual effect on mung bean under terai region of West Bengal" was conducted during *rabi* season of 2015-16 and 2016-17 at an Instructional Farm of Uttar Banga Krishi Vishwavidyalaya, Pundibari, Cooch Behar, West Bengal to study the production potential of buckwheat- mung bean cropping sequence under different integrated nutrient management practices. The treatment consisted of three levels of varieties *viz*., V_1 = Himpriya, V_2 = Shimla B-1 and V_3 = VL Ugal-7 as main plot treatments and four levels of integrated nutrient management practices *viz*., N_1 = 100% RDF (Recommended dose of fertilizer @40:20:20 kg ha^{-1} $N:P_20_5:K_2O$), N_2 = 100% substitution through Vermicompost + *Azotobacter*, N_3 = 75% RDF and 25% substitution through Vermicompost + *Azotobacter* and N_4 = 50% RDF and 50 % substitution through Vermicompost + *Azotobacter* as sub plot treatments replicated three times in split plot design. Irrespective of different varieties, seed yield was significantly highest under Shimla B-1 over other two varieties. But Straw yield was found to be higher under the variety Himpriya followed by Shimla B-1. Seed N, P and K content was higher under the variety VL Ugal-7 followed by Shimla B-1. Higher straw N, P and K content was recorded under Himpriya which was followed by Shimla B-1. Similarly total N, P and K uptake by buckwheat were recorded highest under Shimla B-1 and lowest were recorded under VL Ugal-7. Seed and straw N, P and K content including total uptake by buckwheat was higher under combined application of 75% RDF and 25% substitution through Vermicompost + *Azotobacter* and the lowest was under the treatment receiving 100% substitution through Vermicompost + *Azotobacter*. Similarly, during summer season the residual effect of VL Ugal-7 applied to rabi buckwheat recorded highest seed and straw yield as well as nutrient content (N, P and K) and their uptake which was followed by Himpriya. Seed and straw yield as well as nutrient content (N, P and K) and their uptake by mung bean was obtained highest at application of 100% substitution through Vermicompost + *Azotobacter* during both the years of experimentation which was followed closely by 50% RDF and 50 % substitution through Vermicompost + *Azotobacter*.

Keywords

Buckwheat, Nutrient content and uptake, Mung bean, Vermicompost.

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Introduction

Buckwheat is one of the traditional under exploited crop which has high food value, can be grown in harsh climatic condition. Buckwheat grains are highly nutritious in

terms of mineral, protein and amino acids (Dogra and Awasthi, 2009). Potassium, magnesium, calcium, phosphate, zinc and iron are abundant in buckwheat flour (Gopalan *et al.*, 1989a and 1989b). Cropping systems has to be evolved based on climate, soil and water availability for efficient use of available natural resources This cropping system should provide enough food for the family, fodder for cattle and generate sufficient cash income for domestic and cultivation expenses. Application of imbalanced and/or excessive nutrients led to declining nutrient-use efficiency making fertilizer consumption uneconomical and producing adverse effects on atmosphere and groundwater quality causing health hazards and climate change. Therefore, to overcome these problem there is need to develop integrated nutrient management which conserve land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable.

The interactive advantage of combining organic and inorganic sources of nutrients together with biofertilizer has proved superior to use of each component separately (Palaniappan and Annadurai, 2007). Organic manure on the other side, provide a good substrate for the growth of the micro-organism and maintain a favourable nutrient supply environment to the crop. Buckwheat-mung bean is one of the important cropping system which can be adopted in India. The productivity of the system mainly depends on proper nutrient management practices. Low organic matter content in soil coupled with low and imbalanced application of macro nutrients to the crop limits the full potential of yield (Tandon, 1992). Integrating chemical fertilizers with organic manures was quite promising, in maintaining higher productivity. Hence, the present experiment was conducted to find out suitable management strategies for sustaining productivity of buckwheat-mung bean cropping sequence under Terai region of West Bengal.

Materials and Methods

The investigation entitled, "Response of integrated nutrient management on nutrient content as well as uptake of buckwheat varieties and its residual effect on mung bean under terai region of West Bengal" was conducted during *rabi* and summer seasons of 2015-16 and 2016-17 at Instructional Farm of Uttar Banga Krishi Viswavidyalaya at Pundibari, Cooch Behar, West Bengal. The soil of the experimental field was sandy loam in texture and acidic in reaction (pH 5.44), high in organic carbon (0.545%), low available nitrogen (184.24 kg/ha), high in available phosphorus (24.60 kg/ha) and low in available potassium (103.50 kg/ha).

The treatment consisted of three levels of varieties *viz*., V_1=Himpriya, V_2=Shimla B-1 and V_3=VL Ugal-7 as main plot treatments and four levels of integrated nutrient management practices *viz*., N_1=100% RDF (Recommended dose of fertilizer @40:20:20 kg ha^{-1} $N:P_20_5:K_2O$), N_2=100% substitution through Vermicompost + *Azotobacter*, N_3=75% RDF and 25% substitution through Vermicompost + *Azotobacter* and N_4= 50% RDF and 50 % substitution through Vermicompost + *Azotobacter* as sub plot treatments replicated three times in split plot design. Plant samples of seed and straw of buckwheat and mung bean collected at harvest were ground in willey mill to pass through 40 mesh sieve.

The ground material was collected in butter paper bags and later used for chemical analysis. Nitrogen, phosphorus and potassium content from seed and straw were estimated using standard procedures given by Jackson (1967). The nutrient (NPK) uptake was

worked out by using of nutrient content and biomass production data. The data on various variables were analysed by using statistical procedures as described by Gomez and Gomez (1984).

Results and Discussion

Effect of Varieties

Data presented in Table 1 and 2, revealed that the difference in yield as well as nutrient content (N, P and K) and their uptake in buckwheat seed and straw of the three varieties were significant during both the years of experimentation. Increase seed yield was achieved with Shimla B-1 over Himpriya and VL Ugal – 7. Himpriya resulted significantly highest amount of straw during both the years of experimentation which was at par with Shimla B-1 as compared to VL Ugal – 7. The nutrient content (N, P and K) in the seed was higher in VL Ugal – 7 which was followed by Shimla B-1.

The nutrient content (N, P and K) in the straw was higher in Himpriya followed by Shimla B-1. Total N uptakes by buckwheat varieties were significant during both the years of experimentation. Shimla B-1 recorded the highest N, P and K uptake which were followed by Himpriya. Lowest uptake was recorded by VL Ugal – 7. This might be due the fact that increased absorption of nutrients and their assimilation by Shimla B-1 compared to other two varieties of buckwheat. The results of present investigation are in close agreements the findings of Inamullah *et al.,* (2012).

Maximum seed and straw yield of mung bean was obtained under VL Ugal – 7 as compared to Himpriya and Shimla B-1. N, P and K content of mung bean seed and N content in straw was found to be non-significant under the residual effect of different varieties of buckwheat during both the years of experimentation. Significantly highest P and K content in the straw were found under mung bean grown after VL Ugal – 7. Total N, P and K uptake was found to be higher with the residual effect of the variety VL Ugal-7 which was significantly higher over Shimla B-1 but was at par with Himpriya.

Effect of Integrated Nutrient Management

There was a significant variation in seed yield due to the effect of levels of different levels of integrated nutrient management practices during both the years of experimentation. The highest seed and straw yield was recorded under 75% RDF and 25% substitution through Vermicompost + *Azotobacter* which was at par with 100% RDF but was significantly superior over 100% substitution through Vermicompost + *Azotobacter* and 50% RDF and 50% substitution through Vermicompost + *Azotobacter* during both the years of experimentation. Combined application of vermicompost and chemical fertilizers might have helped in improving soil physical condition on one hand and improving the nutrient availability in the soil on the other and thereby improved the seed yield.

The results corroborated the experimental findings of Dietrych *et al.,* (2008) and Inamullah *et al.,* (2012). Supply of N in balanced quantity enabled the plants to assimilate sufficient photosynthetic products and thus increased the dry matter accumulation. The increased seed and straw yields can also be ascribed to the effect of adequate availability of NPK in soil solution, may cause increase in root growth, thereby increasing uptake of nutrients. These findings are in close agreement with the results obtained by Tetarwal *et al.,* (2011) and Joshi *et al.,* (2013). Similar results were also reported by Singh *et al.,* (2015).

Table.1 Effect of varieties and integrated nutrient management practices on seed and straw yield of buckwheat and mung bean (Pooled data of 2 years)

TREATMENT	Seed yield (q/ha)		Straw yield (q/ha)	
A) Main Plot-Varieties (V)				
	Buckwheat	**Mung bean**	**Buckwheat**	**Mung bean**
V_1 = Himpriya	20.08	8.66	33.41	19.47
V_2 = Shimla B-1	25.35	8.21	33.07	18.65
V_3 = VL Ugal – 7	18.09	9.05	19.72	20.12
SEm±	0.74	0.06	0.41	0.16
CD(P=0.05)	2.91	0.23	1.59	0.64
B) Sub plot- Integrated Nutrient Management (N)				
N_1 = 100% RDF (Recommended dose of fertilizer @40:20:20 kg ha^{-1} $N:P_20_5:K_2O$)	21.61	7.55	29.13	17.05
N_2 = 100% substitution through Vermicompost + *Azotobacter*	19.39	9.54	27.39	21.92
N_3 = 75% RDF and 25% substitution through Vermicompost + *Azotobacter*	23.01	8.51	30.11	18.41
N_4 = 50% RDF and 50 % substitution through Vermicompost + *Azotobacter*	20.70	8.95	28.30	20.26
SEm±	0.54	0.07	0.33	0.38
CD(P=0.05)	1.59	0.20	0.97	1.13
C) Interaction effect (AB)				
SEm±	0.84	0.12	0.57	0.66
CD(P=0.05)	NS	NS	NS	NS

Table.2 Effect of Varieties and Integrated Nutrient Management Practices on Nutrient (N, P and K) content and uptake by Buckwheat (Pooled data of 2 years)

TREATMENT									
A) Main Plot-Varieties									
	N content (%)			**P content (%)**			**K content (%)**		
	Seed	**Straw**	**Total N uptake (kg ha^{-1})**	**Seed**	**Straw**	**Total P uptake (kg ha^{-1})**	**Seed**	**Straw**	**Total K uptake (kg ha^{-1})**
V_1 = Himpriya	2.14	1.66	98.20	0.40	0.29	17.85	0.68	1.42	61.13
V_2 = Shimla B-1	2.18	1.62	108.79	0.41	0.27	19.39	0.72	1.31	61.73
V_3 = VL Ugal – 7	2.23	1.56	69.71	0.42	0.26	12.41	0.76	1.26	38.22
SEm±	0.007	0.011	2.59	0.001	0.002	0.47	0.013	0.002	0.96
CD(P=0.05)	0.029	0.042	10.19	0.005	0.008	1.84	0.051	0.007	3.77
B) Sub plot- Integrated Nutrient Management									
N_1 = 100% RDF (Recommended dose of fertilizer @40:20:20 kg ha^{-1} N:P_2O_5:K_2O)	2.18	1.62	93.81	0.42	0.28	17.20	0.75	1.35	55.58
N_2 = 100% substitution through Vermicompost + *Azotobacter*	2.16	1.57	84.87	0.40	0.24	14.34	0.63	1.26	46.95
N_3 = 75% RDF and 25% substitution through Vermicompost + *Azotobacter*	2.23	1.67	100.85	0.42	0.31	19.13	0.82	1.41	61.09
N_4 = 50% RDF and 50 % substitution through Vermicompost + *Azotobacter*	2.16	1.59	89.40	0.40	0.25	15.52	0.68	1.31	51.14
SEm±	0.011	0.010	1.16	0.002	0.001	0.20	0.019	0.021	0.92
CD(P=0.05)	0.033	0.031	3.44	0.007	0.004	0.58	0.055	0.063	2.74
C) Interaction effect (AB)									
SEm±	0.019	0.018	2.00	0.004	0.002	0.34	0.032	0.037	1.59
CD(P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table.3 Residual Effect of Varieties and Integrated Nutrient Management Practices on Nutrient (N, P and K) content and uptake by Mung bean (Pooled data of 2 years)

TREATMENT									
A) Main Plot-Varieties									
	N content (%)			**P content (%)**			**K content (%)**		
	Seed	**Straw**	**Total N uptake (kg ha^{-1})**	**Seed**	**Straw**	**Total P uptake (kg ha^{-1})**	**Seed**	**Straw**	**Total K uptake (kg ha^{-1})**
V_1 = Himpriya	3.56	0.89	48.33	0.301	0.141	5.38	1.229	1.642	42.71
V_2 = Shimla B-1	3.53	0.88	45.51	0.296	0.136	4.99	1.199	1.626	40.27
V_3 = VL Ugal – 7	3.59	0.91	51.00	0.308	0.152	5.86	1.235	1.686	45.22
SEm±	0.056	0.008	0.764	0.002	0.001	0.04	0.016	0.003	0.33
CD(P=0.05)	NS	NS	2.999	0.008	0.004	0.17	NS	0.013	1.29
B) Sub plot- Integrated Nutrient Management									
N_1 = 100% RDF (Recommended dose of fertilizer @40:20:20 kg ha^{-1} N:$P_2$0$_5$:K_2O)	3.39	0.85	40.11	0.289	0.136	4.50	1.198	1.586	36.13
N_2 = 100% substitution through Vermicompost + *Azotobacter*	3.65	0.93	55.24	0.318	0.151	6.35	1.249	1.714	49.55
N_3 = 75% RDF and 25% substitution through Vermicompost + *Azotobacter*	3.59	0.89	46.94	0.299	0.141	5.14	1.207	1.641	40.50
N_4 = 50% RDF and 50 % substitution through Vermicompost + *Azotobacter*	3.61	0.91	50.82	0.302	0.145	5.64	1.229	1.665	44.75
SEm±	0.032	0.011	0.54	0.002	0.001	0.06	0.011	0.009	0.76
CD(P=0.05)	0.095	0.032	1.61	0.005	0.003	0.18	0.034	0.026	2.25
C) Interaction effect (AB)									
SEm±	0.055	0.019	0.94	0.003	0.001	0.11	0.020	0.015	1.31
CD(P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Significantly higher N, P and K content in buckwheat seed and straw as well as nutrient (N, P and K) uptake was recorded with the treatment effect of 75% RDF and 25% substitution through Vermicompost + *Azotobacter* which was followed by 100% RDF, 100% substitution through Vermicompost + *Azotobacter* and 50% RDF and 50% substitution through Vermicompost + *Azotobacter* during both the years of experimentation. Increased nutrient (N, P and K) uptake might be due to consistent supply of nutrients and reduced nutrient loss during the process of decomposition of organic manure. Organic manures improved root growth and its functional activity which helped in greater extraction of nutrient. This was due to the increased growth, nutrient influx and photosynthetic rate which resulted in more absorption and translocation of those nutrients to the seed and straw. The result of the present investigation is in conformity with the findings of Kathuria *et al.*, (2004) and Sindhi *et al., (*2016b).

Seed and straw yield was recorded maximum under residual effect of 100% substitution through Vermicompost + *Azotobacter* which was statistically superior over rest of the treatments. N, P and K content in the mung bean seed and straw (succeeding crop) observed significantly higher magnitudes in the residual effect of plot receiving 100% substitution through Vermicompost + *Azotobacter* over rest of the treatments. The increase in nutrient content in the mung bean seed and straw might be due to the application of organic manure (vermicompost) which mineralized the nutrients and slowly releasing them up on the action of microorganisms with lapse of time. These findings are in agreement with those of Singh *et al.*, (2011), Sindhi *et al.*, (2016a) and Sindhi *et al.*, (2016b). Total N, P and K uptake was also higher under 100% substitution through Vermicompost + *Azotobacter* which was significantly superior over rest of the treatments. It might be due to improvement in soil physical, chemical and biological properties of soil through application of organic and inorganic fertilizers due to preceding crop buckwheat. These findings are in agreement with those of Saha *et al.*, (2010).

From this research work, it can be concluded that for getting maximum yield, buckwheat should be nourished with 75% RDF (30:15:15 kg ha^{-1} $N:P_20_5:K_2O$) and 25% substitution through Vermicompost (625 kg ha^{-1}) along with seed treatment of *Azotobacter* for the variety Shimla B-1 and mung bean (Pusa Baisakhi) under terai region of West Bengal.

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