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Original Article

Effect of INM on Nutrient Uptake, Growth and Biomass Yield of Buckwheat (*Fagopyrum Esculentum* L.) in *Tarai* Region of Uttarakhand

Sobaran Singh*, Uday P. Shahi, Kewlanand*****

Author's Affiliation: *Professor, Department of Soil Science, ***Professor, Department of Agronomy, G.B Pant University of Agriculture and Technology, Pantnagar- 263 145 (Uttarakhand),**Assistant Professor, Sardar Vallabhbhai Patel University of Agriculture and Technology, Modipura, Meerut (Uttar Pradesh).

Abstract

A field experiment was conducted to evaluate the effect of Integrated Nutrient Management on growth, biomass yield and nutrient uptake by buckwheat and nitrogen, phosphorus and potassium status of soil after harvest of crop. The experiment having fifteen treatments including recommended dose of nitrogen, phosphorus and potassium alone and various combinations of Farm Yard Manure, *Azotobacter* and Phosphorus Solubilising Microorganisms with rest of recommended dose of nitrogen, phosphorus and potassium was conducted in Randomised Block Design at Crop Research Center of the Govind Ballabh Pant University of Agriculture and Technology, Pantnagar. Growth parameters, i.e., plant height and numbers of branches were not influenced by various INM treatments, however, biomass yield and nitrogen uptake were significantly superior over control. Organic carbon and available phosphorus and potassium status were not affected by various INM treatments.

Keywords

Buckwheat; FYM; *Azotobacter;* PSM; Soil Fertility; NPK Uptake.

Introduction

Buckwheat is considered to be psedocereal belonging to family polygonaceae. It is widely cultivated as a main or subsidiary food crop in several part of the world. In India it is grown for leafy vegetables in addition to food crop in Uttarakhand. The leaves stem, and flowers are rich in rutin. Rutin has shown to offered protection against to harmful effect of x-rays. For exploring the possibilities of this crop in *tarai* region of Uttarakhand, the experiment was conducted to study the effect of nutrient management on growth, biomass and biometrics of this crop in *tarai* of Uttarakhand.

Materials and Methods

A field experiments was conducted in *rabi* season at Crop Research Center of the G.B. Pant university of Agriculture and Technology, Pantnagar. The soil of experiment site had clay loam having pH 7.3, EC 0.37 d Sm^{-1}, organic carbon 0.94 percent, available N 240 kg ha^{-1}, available P 38.52 kg ha^{-1} , and available K 256.20 kg ha^{-1}. The experiment was planned in RBD with 15 treatments consisting of inorganic fertilizer, FYM and biofertilizers (*Azotobacter* & PSB). Before sowing, seed was treated with *Azotobacter chroococcum* and PSM (*Bacillus megatheriens*) culture as per the treatment requirement. The treatment consisted of : Control (T_1); Recommended dose of NPK (T_2); T_2 + *Azotobacter* (T_3); T_2 + FYM @6.25t ha^{-1} (T_4); T_2 + *Azotobacter* + FYM (T_5); T_2 + PSM (T_6); T_2 + *Azotobacter* PSM (T_7); T_2 + *Azotobacter* + PSM + FYM (T_8); *Azotobacter* + $N_{37.5}P_{40}K_{40}$ (T_9); FYM + $N_{37.5}P_{34}K_{27.5}$ (T_{10}); *Azotobacter* + FYM + $N_{25}P_{34}K_{27.5}$ (T_{11}); PSM + $N_{50}P_{27}K_{40}$ (T_{12}); PSM + FYM + $N_{37.5}P_{21}K_{27.5}$ (T_{13}); *Azotobacter* + PSM + FYM + $N_{25}P_{21}K_{27.5}$ (T_{14}) and FYM @18t ha^{-1} + *Azotobacter* + PSM (T_{15}). Recommended agronomic practices were followed during crop growth period. Growth parameters recorded i.e., plant height (cm), number of branches and fresh weight were recorded at flowering stage, i.e., 50 days after sowing from each plot. For dry biomass, fresh weights were recorded at flowering stage, i.e. 50 days after sowing from each

Corresponding Author: Sobaran Singh, Professor,
Department of Soil Science,
G.B Pant University of Agriculture and Technology,
Pantnagar- 263 145 (Uttarakhand)
E-mail: drsobaransingh@gmail.com

plot. For dry biomass, fresh samples from each plot were air-dried and then dried in hot air oven at 65^{0}C for 24 hours. The same samples after grinding was used to determined N, P and K content in them. Using data of dry biomass and nutrient content by standard procedure [1]. N, P and K uptake value of each plot also calculated. After harvest of crop, soil samples were collected at 0-15 cm depth from each plot. After processing these soil samples were analyzed for organic carbon [2], available phosphorus [3] and available potassium [4].

Results and Discussion

Growth and Yield

Most of INM treatments had significant effect on fresh and dry biomass yield over control. T_8 and T_{15} resulted significantly higher fresh and dry biomass yield than recommended dose of fertilizers (Table 1). It indicates organic sources may be adjusted with recommended dose of fertilizer. Plant height and number of branches show non-significant effect by various treatments. The results of a field study have also reported significant increase in yield and dry matter of cotton and groundnut in the treatment which received 50% NPK + FYM + *Azotobacter* + PSB over the treatments which received only recommended dose of NPK through fertilizer [5].

Nutrient Content and Uptake

Effect of various treatments on nitrogen, phosphorus and potassium content (per cent) and their uptake (kg / ha) are presented in Table 2. Various INM treatments showed non-significant effects on N, P and K content of dry herbage. Maximum uptake of N, P and K was associated with treatment T_8 followed by treatment by T_{15}. All the treatments were

Table 1: Effect of INM on growth and yield of buckwheat (*Fagopyrum Esculentum* L.)

Treatments	Plant height (cm)	No. of branches/plant	Fresh Biomass (q/ha)	Dry Biomass (q/ha)
T_1 Control (0:0:0)	41.4	5.5	16.27	4.07
T_2 Reco. dose of NPK (50:40:40 kg ha^{-1})	59.5	8.7	30.07	8.52
T_3 T_2 + *Azotobacter*	59.8	7.7	29.27	7.57
T_4 T_2 + FYM @ 6.25 t ha^{-1}	65.0	7.8	30.13	8.30
T_5 T_2 + *Azotobacter* + FYM	66.3	7.6	30.30	8.15
T_6 T_2 + PSM	60.3	9.1	31.00	8.00
T_7 T_2 + *Azotobacter* PSM	61.4	9.0	33.33	8.19
T_8 T_2 + *Azotobacter* + PSM + FYM	66.0	10.1	45.00	12.51
T_9 *Azoto.* + Rest dose of Reco. NPK	62.3	8.6	31.00	9.70
T_{10} FYM + Rest dose of Reco. NPK	66.3	8.1	33.93	10.00
T_{11} *Azoto.* + FYM + Rest dose of Reco. NPK	64.0	8.2	38.73	10.25
T_{12} PSM + Rest dose of Reco. NPK	64.0	8.0	35.60	8.17
T_{13} PSM + FYM + Rest dose of Reco. NPK	65.0	7.1	33.47	9.00
T_{14} *Azoto.* + PSM + FYM + Rest of T_2	68.8	7.2	23.27	8.75
T_{15} FYM @ 18 t ha^{-1} + *Azoto.* + PSM	68.3	12.0	44.80	13.0
CD (p = 0.05)	NS	NS	7.93	1.98

Table 2: Effect of INM on nutrient content and uptake by buckwheat (*Fagopyrum Esculentum* L.)

Treatments	N (%)	P (%)	K (%)	Uptake N	Uptake P	Uptake K
T_1 Control (0:0:0)	1.18	0.20	0.35	4.80	0.81	1.43
T_2 Reco. dose of NPK (50:40:40 kg ha^{-1})	1.65	0.28	0.29	14.06	2.38	2.47
T_3 *T_2+Azotobacter*	1.64	0.27	0.29	12.41	2.04	2.19
T_4 **T_2** + FYM @ 6.25 t ha^{-1}	1.63	0.30	0.28	13.52	2.49	2.32
T_5 **T_2** + *Azotobacter* + FYM	1.40	0.31	0.30	12.25	2.71	2.62
T_6 **T_2** + PSM	1.63	0.38	0.30	13.04	3.04	2.40
T_7 **T_2** + *Azotobacter* PSM	1.65	0.39	0.32	13.51	3.19	2.62
T_8 **T_2** + *Azotobacter* +PSM + FYM	2.16	0.41	0.34	27.02	5.63	4.25
T_9 *Azoto.*+Rest dose of Reco. NPK	1.60	0.30	0.31	14.40	2.70	2.79
T_{10} FYM + Rest dose of Reco. NPK	1.73	0.33	0.32	17.30	3.30	3.20
T_{11} *Azoto.* + FYM + Rest dose of Reco. NPK	1.70	0.32	0.30	17.42	3.28	3.07
T_{12} PSM +Rest dose of Reco. NPK	1.77	0.39	0.31	14.46	3.19	2.53
T_{13} PSM + FYM +Rest dose of Reco. NPK	1.79	0.39	0.28	16.11	3.51	2.52
T_{14} *Azoto.* + PSM + FYM+Rest of T^2	1.80	0.40	0.28	15.75	3.50	2.45
T_{15} FYM @ 18 t ha^{-1}+*Azoto. + PSM*	2.01	0.45	0.30	26.13	5.28	3.90
CD (p = 0.05)	NS	NS	NS	2.95	1.06	0.50

significantly superior over control for uptake of N, P and K. Most of the INM treatments were at par to each other in reference to NPK uptake. This trend may be due to short duration crop, i.e. 50 days only where, treatments may not produce their possible effects. In treatments which had *Azotobacter,* FYM with inorganic fertilizers increased NPK uptake due to growth promoting hormones, which ultimately increased nitrogen uptake. Similar result was also obtained [6]. Increase in uptake of N due to *Azotobacter* inoculation [7] and application of FYM [8] have also been reported earlier.

Soil Fertility

Effect of various treatments on organic carbon (%), available phosphorus and potassium in soil after harvest crop is presented in Table 3.

Effect of various treatments on organic carbon, available phosphorus and potassium were non-significant. Due to short duration of the crop, variation in soil fertility is not expected. Moreover prior to sowing of crop, experimental field has high to medium status in these nutrients and uptake was also low by this crop.

Adjustment of recommended dose of fertilizer with *Azotobacter,* PSM, FYM gave better response over recommended dose of fertilizers. The various INM treatments did not affect the nutrient content in biomass, but biomass yield and nutrient uptake by the plants were significantly higher over the control. Due to short duration of crop (50 days) residual soil fertility status did not change significantly.

Table 3: Effect of INM on soil fertility status after harvest of buckwheat (*Fagopyrum esculentum* L.)

Treatments	OC (%)	P (%)	K (%)
T_1 Control (0:0:0)	0.95	22.07	214.93
T_2 Reco. dose of NPK (50:40:40 kg ha^{-1})	1.18	29.04	248.26
T_3 T_2 + *Azotobacter*	1.16	33.23	237.06
T_4 T_2 + FYM @ 6.25 t ha^{-1}	1.07	28.42	250.13
T_5 T_2 + *Azotobacter* + FYM	1.09	29.09	233.33
T_6 T_2 + PSM	1.20	28.40	231.46
T_7 T_2 + *Azotobacter* PSM	1.11	31.69	233.33
T_8 T_2 + *Azotobacter* + PSM + FYM	1.04	38.78	250.13
T_9 *Azoto.* + Rest dose of Reco. NPK	1.16	29.78	246.40
T_{10} FYM + Rest dose of Reco. NPK	1.21	28.73	257.63
T_{11} *Azoto.* + FYM + Rest dose of Reco. NPK	1.17	33.47	214.93
T_{12} PSM + Rest dose of Reco. NPK	1.17	33.08	257.60
T_{13} PSM + FYM + Rest dose of Reco. NPK	1.18	29.24	229.60
T_{14} *Azoto.* + PSM + FYM + Rest of T_2	1.23	28.50	237.06
T_{15} FYM @ 18 t ha^{-1} + *Azoto.* + PSM	1.16	28.73	214.66
CD (p = 0.05)	NS	NS	NS

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