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Effect of Integrated Nutrient Management on Nutrient Uptake, Post Harvest Soil Properties and Nutrient Recovery by Spinegourd (*Momordica dioica*)

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ABSTRACT

A field experiment was undertaken in the Campus of College of Agriculture, Orissa University of Agriculture and Technology, Bhubaneswar, during *kharif* 2008. Recommended dose of N, P, K, biofertilizers and amendments showed significant effect on nutrient uptake, postharvest soil properties and nutrient recovery in case of spinegourd crop. Spinegourd plant treated with biofertilizer (azotobacter + azospirillum + phosphate solubulizing bacteria + *arbuscular mycorrhiza* @6 kg/ha) + chemical fertilizer (N, P, K @ 70:40:60 Kg/ha) + amendment (lime @ 20% LR i e 1 t/ha applied to the soil) produced higher yield which is significantly superior than the control due to maximum utilization of N, P and K which results in increased vegetative growth which has been reflected in higher foliage production, taller plant, more production of fruits and finally the yield along with higher recovery of nutrients.

Key words: Spinegourd, Biofertilizer, Nutrient uptake, Soil properties, Nutrient recovery

Spinegourd (*Momordica dioica* Roxb.) is one of the underexploited cucurbitaceous vegetable. It is considered as highly nutritious vegetable for its high seed protein content and absence of bitterness in fruits. Manures and fertilizers play an important role in increasing production and improving the quality of produce (Umamaheswarappa *et al*. 2005). Increased fertilizer cost and possibility of environment pollution due to fertilizer runoff, necessitated the use of biofertilizer for the fertility management programme. Biofertilizers are lucrative, ecologically sound and are self generating sources without any negative influence on environment, improves crop growth as well as the quality of produce. Micro-organisms also act as nutrient mobilizers. Nutrient management practice helps spinegourd crop to sustain the production (Ismail *et al*. 1994). The work on the effect of integrated nutrient management on spinegourd crop is very less. No systematic guideline has been generated scientifically till today. Keeping the above background in view, the present study was undertaken with the following objectives to study the nutrient uptake and recovery by the spinegourd crop and also to study the effect of INM on postharvest soil properties.

MATERIALS AND METHODS

A field experiment entitled integrated nutrient management in spinegourd was undertaken in the Campus of College of Agriculture, Orissa University of Agriculture and Technology, Bhubaneswar, during *kharif* 2008. The experimental soil was sandy loam of *p*H 5.9 with available N 217 kg/ha, P_2O_5 45 kg/ha and K_2O 275 kg/ha with 6.48 g/ha of organic carbon. There were 6 treatments comprising of control (T_1), recommended dose of fertilizers (T_2), recommended dose of fertilizers with lime (T_3), recommended dose of fertilizers with bioinoculants (T_4), recommended dose of fertilizers + lime + bioinoculants (T_5) and75% recommended dose of fertilizers + lime + bioinoculants as (T_6) in a randomized block design with 4 replications. 3 node stem plant cuttings are planted at a distance of 50 × 50 cm. Twenty kg of well decomposed FYM were applied just before last ploughing. The fertilizer dose of 70:40:60 kg N, P and K per ha were applied. Lime @ 20% LR i e 1 t/ha was applied to the soil as per treatment allocation. Biofertilizers @ 6 kg/ha were applied in the soil before transplanting. Recommended package of practices were followed to raise the crop. Ten plants were selected in each plot to record the observation time to time. Analysis of fruit dry weight, plant dry weight, uptake of nutrients, soil analysis was done as per standard methods.

RESULTS AND DISCUSSION

Nutrient uptake

The spinegourd crop removes more K than N the nutrient followed the order K>N>P>S>Ca. Removal of N was more (ranging from 18.4 to 42.6 kg/ha) through fruits than vine (ranging from 7.93 to 14.9 kg/ha) and the total amount varied between 26.3 and 57.5 kg/ha. The amount of P uptake was third in abundance amongst the other nutrients. Its uptake was more through vine than fruits. Quantity wise uptake of K by the crop was highest among the nutrient studied. Uptake through vine was higher than through fruits. The total uptake ranged from 45.5 to 86.2 kg/ha. Uptake of Ca through fruit was slightly more than through vine. The uptake of S through vine was more than the total uptake varied between 6.2 and 10.2 kg/ha which was more than calcium (Okur and Yagmur 2004). Application of inorganic fertilizers as well as biofertilizers with amendments has increased the productivity of spinegourd crop. Chemical fertilizers particularly nitrogen may be available to the plant in some quantity, but major portion may leach whereas, phosphorus will remain in bound form in the soli which will be gradually available to the crop (Alan 1989). The biofertilizers act as a chelating agent where by different nutrients except nitrogen will be made available in sufficient quantity to the plant which in turn utilize and produce maximum yield. The highest uptake value with respect to N,P,K,Ca, and S were recorded when 100% NPK combined with biofertilizers and amendments applied to spinegourd crop.

Table 1 Nutrients uptake as influenced by Integrated Nutrient Management in Spine gourd

Treatments	N			P			K			Ca			S		
	Fruit	Vine	Total	Fruit	Vine	Total	Fruit	Vine	Total	Fruit	Vine	Total	Fruit	Vine	Total
T_1: Control	18.4	7.9	26.3	1.11	11.0	12.1	16.6	28.9	45.5	1.9	1.3	3.2	2.4	3.8	6.2
T_2: Recommended dose of fertilizer (RD)	28.9	10.9	39.8	2.18	16.0	18.2	21.0	38.3	59.3	2.7	2.0	4.7	3.3	4.8	8.1
T_3: RD + Lime (0.2 LR)	37.7	14.6	52.2	2.70	18.8	21.5	27.3	50.3	77.6	3.7	2.8	6.5	4.1	6.0	10.1
T_4: RD + BI (Azot.+Azs+PSB+AM)	35.9	13.9	49.8	2.91	17.8	20.7	26.9	50.8	77.7	3.5	2.5	6.0	4.5	6.5	10.6
T_5: RD + lime + BI	42.6	14.9	57.5	3.20	21.6	24.8	29.8	56.4	86.2	4.0	3.3	7.3	4.8	7.2	12.0
T_6: 75% RD + Lime + BI	29.0	13.8	42.8	2.20	17.4	19.6	22.6	49.1	71.7	2.9	2.4	5.3	3.5	6.7	10.2
SE (m) ±	0.205	0.157	0.284	0.114	0.151	0.292	0.195	0.160	0.210	0.148	0.081	0.177	0.121	0.173	0.160
$CD_{0.05}$	0.61	0.47	0.86	0.34	0.45	0.88	0.59	0.48	0.63	0.45	0.24	0.53	0.36	0.52	0.48

Table 2 Dry matter production as influenced by integrated nutrient management in spinegourd

Treatments	Dry matter production (q/ha)			Ratio (Fruit drymatter to vine drymatter)	HI
	Fruit	Vine	Total		
T_1: Control	4.05	3.90	7.95	1.04:1	0.52
T_2: RD of fertilizers	5.78	4.95	10.73	1.16:1	0.54
T_3: RD + Lime (0.2 LR)	6.65	6.35	13.00	1.15:1	0.54
T_4: RD + BI	6.78	5.97	12.8	1.14:1	0.53
T_5: RD + Lime + BI	7.98	6.59	14.6	1.21:1	0.55
T_6: 75% RD + Lime + BI	6.05	5.75	11.8	1.05:1	0.51
SE (m) ±	0.18	0.19	-	-	-
$CD_{0.05}$	0.54	0.57	0.61	-	-

Table 3 Apparent recovery (%) of nutrients as influenced by integrated nutrient management in spinegourd

Treatments	Apparent recovery (%)			
	Nitrogen	Phosphorus	Potassium	Sulphur
T_1: Control	-	-	-	-
T_2: RD of fertilizers	19	35	29	6
T_3: RD + Lime (0.2 LR)	37	52	67	13
T_4: RD + BI	34	49	67	15
T_5: RD + Lime + BI	45	73	85	19
T_6: 75% RD + Lime + BI	32	57	73	18

Dry matter production

The fruit dry matter production was more than vine dry matter production and their ratio varying between 1.21:1 to 1.04:1. The total dry matter production varied between 7.95 and 14.6 q/ha, lowest with control and highest with the application of recommended dose of fertilizers, soli ameliorated with lime and integrated with biofertilizer application. The harvesting index (fruit yield compared to total dry matter production) ranged from 0.52 to 0.55. There was significant influence for the application of recommended dose of fertilizers, its integration either with soil amelioration or bioinoculation or mostly with the combination of both (Umamaheswarappa *et al*. 2005a). Reduced harvesting index indicates the response of the crop to inorganic sources of nutrients.

Apparent recovery of nutrients

The apparent recovery of N by the crop ranged from 19 to 45%, P from 35 to73%, K from 29 to 85% and S from 6 to 19%. The recovery percent of nutrients differed from nutrients to nutrients and from treatment to treatment based on the nature of treatments. Soil amelioration for acidity and bioinoculation either alone or preferably together increased the recovery percent of the nutrients. Reducing the recommended dose by 25% but integrating it with soil ameliorative measures and bioinoculation increased the recovery percent 1.5 to 3 times as compared to recommended dose alone (Wu and Chen 2004). This signifies the importance of soil ameliorative measures and bioinoculants practice in regulating the nutrients utilization by the crop.

Post harvest soil properties

The postharvest soil properties show that limed soil had increased the soil *p*H (decreased the acidity) and unlimed soil had turned acidic (due to removal of basic cations by crops) and/or some loss through leaching. The organic carbon and available nitrogen status but in control treatment these two parameters decreased. Biomass addition (leaf fall, root growth) under better nutrient management systems had exhibited such improvements. As P is less used by the crop, its availability status increased where it was applied. However, its status decreased in control treatment because no P was supplemented from external sources. The available potash status in soil after the harvest of the crop decreased invariably in all the treatments irrespective of its application indicating its use by the crop (mostly) or some loss through leaching under coarse textural soil condition.

Table 4 Post harvest soil properties as influenced by integrated nutrient management in spinegourd

Treatments	*p*H	Soil EC (ds m^{-1})	Organic carbon (g kg^{-1} soil)	Available nutrients (kg ha^{-1})		
				N	P	K
T_1: Control	5.84	0.0016	6.0	200	5.4	211
T_2: RD of fertilizers	5.47	0.014	10.3	212	14.9	249
T_3: RD + Lime (0.2 LR)	6.52	0.0022	7.2	217	11.1	179
T_4: RD + BI	5.40	0.0031	8.1	228	11.8	244
T_5: RD + Lime + BI	6.53	0.0014	6.8	232	17.8	196
T_6: 75% RD + Lime + BI	6.73	0.0015	6.5	210	11.8	190
Initial soil	5.90	0.013	6.5	280	45.8	275

Ameliorating the acid soil using lime had created better growing environment (physical, chemical, nutritional and biological) for the crop by neutralizing the acidity, deactivating Al, Fe, Mn etc the toxic elements present in the acid soil, improving the availability of Ca, P, K and many other desired nutrients by crop. Lime also improves the soil structure (through calcium addition), the by improve aeration, water holding capacity hence creating a better environment for root growth. Liming of acid soil also favours better microbial growth in soil particularly the bacterial population, there by the better microbial activity in support of plant growth (Bagwar *et al*. 2004). Bioinoculation of crop in addition to N_2 fixation and phosphorous solubilization, though the enzymatic activity influencing root growth, root CEC (secreating IAA, GA, cytokinin etc) for better nutrient absorption had helped the crop to produce higher yields with higher nutrient recovery. Combination of liming practice and bioinoculation with recommended dose of fertilizers acted like catalyst in influencing the crop performances.

The present study thus proposes the integration of soil ameliorative measures like lime application for acid soil with bioinoculation of crop with *azotobacter*, *azospirillum*, *phosphate solubilizing bacteria* and *arbuscular mycorrhiza* and application of recommended dose of fertilizers are very much essential for higher productivity of spinegourd crop.

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