



Effect of Integration of Fertilizers and FYM on Productivity and Soil Health of Rainfed Potato

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ABSTRACT

A field trial was conducted during two consecutive summer seasons of 2012 and 2013 at ICAR-Central Potato Research Station, Shillong, Meghalaya to evaluate the integration of nutrient sources on productivity and soil health under rainfed potato cultivation in north eastern hill region of India. There were six treatments of integrated nutrient management viz., 100% Recommended dose of fertilizers, 75% RDF through synthetic fertilizers and 25% recommended dose of nitrogen (RDN) through FYM, 50% RDF and 50% RDN through FYM, 25% RDF and 75% RDN through FYM, 100% RDN through FYM and control (no application of any sources of nutrients). The experiment was laid out in randomized block design with four replications. Nutrient management practices showed the significant improvement on growth and yield attributes of potato over control plot. Highest productivity of potato tubers (t/ha) was noticed with application of 75% RDF through synthetic fertilizers along with 25% RDN through FYM. Similarly, the maximum net return was associated with application of 75% RDF and 25% RDN through FYM under investigation. Application of 75% Recommended dose of nutrients through synthetic fertilizers in combination with 25% Recommended dose of nitrogen through FYM was more profitable for sustainable production of potato in the north eastern hill region of India.

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INTRODUCTION

Potato (*Solanum tuberosum* L.) is the one of the most important cash crop North Eastern hill region of India. The per capita consumption of this region is similar to the European country. Simultaneously, the potato productivity in this land lock region is very low and almost half of the national average. So many factors have been responsible for poor yield of potato including lack of adequate nutrient management (Singh *et al.*, 2015). The prolonged and over usages of synthetics fertilizers have resulted in human and soil health hazards along with environmental pollution (Khan *et al.*, 2006). However, the integrated use of synthetic fertilizers along with various organic sources is capable of sustaining higher crop productivity, improving soil health Application of organic manure is not only provide the essential nutrient to the crop but also improving the physical condition of soil and rectifying the micronutrient deficiency (Singh *et al.*, 2013 and Yadav *et al.*, 2013). A judicious use of inorganic fertilizers along with organic manures especially farm yard manure which is easily available in the region may be effective not only in sustaining crop productivity and soil health, but also a viable, economic and environment-friendly alternative to supplement synthetic fertilizers of the crops in the region (Singh and Kumar, 2009). Hence, a field experiment was under taken to study the effect of integrated nutrient management on yield of potato under rainfed conditions of north eastern hill region.

Materials And Methods

A field experiment was conducted during summer season of

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2012 and 2013 at ICAR- Central Potato Research Station, Shillong, Meghalaya. The geographical co-ordinates of experimental field are 25°54' N latitude and 91°84' E longitude and an altitude of 1739 meters above mean sea level. The soil was sandy loam in the texture with pH 5.03, moderately fertile, being high in organic carbon (1.60%), and medium in available nitrogen (301.6 kg/ha), low in available phosphorus (13.5 kg/ha) and high in available potassium (293.0 kg/ha). The experiment was laid out in randomized block design with four replications. There was six treatments viz., 100% RDF through synthetic fertilizers, 75% RDF and 25% recommended dose of nitrogen (RDN) through FYM, 50% RDF and 50% RDN through FYM, 25% RDF and 75% RDN through FYM, 100% RDN through FYM and control (without application of fertilizer and manure). Well-decomposed farm yard manure (0.55% N, 0.30% P and 0.60% K) collected from a nearby farm was applied into the plots as per the treatments. The recommended dose of N, P₂₀₅, and K₂O was taken as 140, 120 and 60 kg/ha for potato. Nitrogen, phosphorus and potassium were applied in the form of urea, single super phosphate and muriate of potash, respectively. Half of N and whole of phosphate and potash were applied at planting of the crop. The remaining half of the nitrogen was applied as top dressing at the time of earthing up according to treatment. Recommended package and practices for disease and insect management in the region for potato crop were followed. FYM was applied according to the treatments to replace the recommended dose of fertilizers on nitrogen basis in the experiment with a view to avoid the mixing of soil in different treatments; individual plots were thoroughly prepared by manual labour. Kufri Himalini of potato varieties having

moderately resistant to late blight was used for this experiment.

Soil was analyzed at initial stage and after completion of the studies to monitor the changes in nutrient status (Soil pH, organic carbon and available nitrogen, phosphorus and potassium contents) as per the standard methods. Data of both years were pooled and subjected to statistical analysis as per standard procedure with 5% probability level.

RESULTS AND DISCUSSION

Growth attributes

The growth attributes of potato were recorded at the time of maximum vegetative growth stage of the crop. The data presented in Table 1 shown that the significantly higher values of plant height (81%), number of shoots (30.8%) and leaf area index (56.5%) per plant were found with application of 75% RDF through synthetic fertilizers + 25% RDN through FYM over control. The prominent variation among growth attributes was shown on plant height than leaf area index and number of shoots due to different treatments. The applications of 100% RDN through FYM on nitrogen basis were not capable to enhance the growth attributes similar to those treatments of integration of fertilizers along with FYM. The rate of mineralization of organic manure might be slow in

this land lock hill region due to high altitude with low temperature in autumn season resulted poor availability of nutrients to the crop.

Yield attributes

The data presented in Table 1 shown that the highest average number of tubers (8.5) and weight (226.8 g) per plant were recorded with integration of 75% RDF along with 25% RDN through FYM on nitrogen basis which were significantly superior than 100% RDF through FYM and control. Number of tubers was not much affected as compare to weight of tubers per plant. The treatment receiving 100% RDN through FYM on nitrogen basis recorded almost similar number of tubers but slightly lower weight per plant as compared to other treatments except control during investigation. This might be due to application of fertilizers in combination with organic manure which increased the nutrient use efficiency through modification of soil physical condition and resulted in higher total uptake of nutrients because of better root penetration leading to better absorption of nutrients and moisture (Yadav *et al.*, 2013). A similar view also reported by Kushwah *et al.* (2005) that manures have sufficient residual effect on soil nutrient supply system. They also supply micro-nutrients in addition to major plant nutrients.

Table 1: Effect of different treatments on growth and yield attributes of potato (Pooled data of 2 years)

Treatment	Plant height (cm)	Shoots/plant (No)	Leaf area index	Tubers/plant (No)	Yield /plant (g)	Average tuber weight (g)
100% RDF	43.5	3.9	3.3	7.8	206.3	26.6
75% RDF and 25% N through FYM	46.3	3.9	3.6	8.5	226.8	26.8
50% RDF and 50% N through FYM	45.8	3.3	3.4	8.3	213.5	25.7
25% RDF and 75% N through FYM	35.8	3.3	2.6	8.3	167.3	20.3
100% RDN through FYM	34.0	3.2	2.6	7.6	151.5	20.0
Control	24.5	2.7	2.3	5.8	55.3	9.6
CD (P=0.05)	1.9	0.3	0.3	0.4	10.5	1.6

Economic yield

Economic yields of potato under various treatments are shown in Table 2. Application of recommended dose of fertilizers through synthetic fertilizers recorded slightly lower number of tubers than the rest of integrated treatments. However, application of 75% recommended dose of fertilizers through synthetic fertilizers along with 25% RDN through FYM brought about the significant improvement in productivity with respect to number of tubers (703.4 x103/ha). Similarly, pooled data of both years of experiments shown in Table 3 that the highest tuber yield of potato (18.8 t /ha) associated with application of 75% RDF through fertilizers in combination with 25% of RDN through farm yard manure. This is might be due to that it was observed that increase in tuber yield due to integration of synthetic fertilizers and farm yard manure might regulated supply of nutrients to potato crop through readily available nutrients from synthetic fertilizers at initial stage and later stages through mineralization of organic manure into available form of nutrients for crop (Kumar *et al.*, 2011).

Economics

Economic evaluation in terms of monetary return shows in Table 2 indicated that all the nutrient treatments provided higher net return and benefit cost ratio than the control. The highest cost of cultivation incurred (Rs. 80.2 × 103/ha) with application of 100% recommended dose of nitrogen through FYM followed by the application of 25% RDF through synthetic fertilizers in combination with 75% RDN through Farm yard manure.

The quantity of FYM required meeting the entire recommended dose of nitrogen in large quantity due to bulky in nature, resulted in higher cost of cultivation. Therefore, treatments having higher proportion of FYM shown the more cost of cultivation. Based on pooled data of two years the maximum net return (Rs.171.3 × 103/ha) and benefit cost ratio (2.3) were recorded under 75% of RDF through synthetic fertilizers and 25% RDN through Farm yard manure treatment because of higher yield as compare to other treatment.

Table 2: Effect of different treatments on productivity and economics of potato (Pooled data of 2 years)

Treatment	No. of tubers /ha(x10 ³)	Tuber yield (t/ha)	Economics (Rs x10 ³)		
			Cost of cultivation	Net return	B:C ratio
100% RDF	643.3	17.1	71.3	151.2	2.1
75% RDF and 25% N through FYM	703.4	18.8	73.4	171.3	2.3
50% RDF and 50% N through FYM	691.0	17.7	74.5	155.9	2.1
25% RDF and 75% N through FYM	684.8	13.9	77.3	103.2	1.3
100% RDN through FYM	630.8	12.6	80.2	83.3	1.0
Control	479.3	4.6	55.1	4.5	0.1
CD (P=0.05)	36.1	0.9			

Soil health

Data related to the soil reaction of experimental field are presented in Table 3 revealed that no significant improvement were found due to application of fertilizers and FYM either alone or in combination. Soil health of experimental field was highly influenced by the integration of nutrient sources regarding organic carbon content and available status of major nutrients (N, P and K) over the initial values. It is well clear in the same table that at the end of 2-year cycle, the organic carbon and available nitrogen, phosphorus and potassium contents of the experimental soil were found to the slightly increase over the initial values. Increase in available nitrogen may be attributed to higher microbial activity in the manurial treatments which favoured the conversion of the organically bound nitrogen to inorganic form. Similar increase in available nitrogen in soil due to addition of organics was observed by [Yadav *et al.* \(2013a\)](#). The soil available phosphorus was slightly improved due to addition of organic manure over the initial soil value. The available

potassium content in soil was also found to increase in all the manurial treatments as compared to the initial potassium status. This increase in available potassium content in soil due to addition of organic manures might be attributed to the direct addition of potassium in the available K pool in soil ([Yadav *et al.*, 2013b](#)).

Balance sheet of soil health after 2 years of field experimentation has been presented in Table 3. There was a negative fertility balance with application of 100% RDF through synthetic fertilizers especially for available nitrogen. However, maximum improvement in fertility was recorded with application of 100% RDN through FYM. This was might be due to the poor rate of mineralization of organic matter in the soil accompanied by the lower temperature. Further poor uptake of nutrients by potato crop due to lower availability of mineralized nutrients through farm yard manure, resulted in higher positive balance in the soil after the harvest of the crop. This result is also in conformity of [Yadav *et al.* \(2013b\)](#).

Table 3: Effect of different treatments on soil health of experimental field

Treatment	pH	OC (%)	Available nutrients (kg/ha)			Actual gain /loss (kg/ha)*			
			N	P	K	% OC	N	P	K
100% RDF	5.08	1.7	297.3	16.3	298.5	0.10	-4.4	2.8	5.5
75% RDF and 25% N through FYM	5.10	1.8	302.8	16.6	299.8	0.20	1.1	3.1	6.8
50% RDF and 50% N through FYM	5.05	1.8	307.5	17.1	305.8	0.24	5.9	3.6	12.8
25% RDF and 75% N through FYM	5.23	1.9	317.0	17.3	311.3	0.28	15.4	3.8	18.3
100% RDN through FYM	5.08	1.9	325.5	17.6	317.5	0.35	23.9	4.1	24.5
Control	5.18	1.7	265.3	13.9	282.0	0.07	-36.4	0.4	-11.0
CD (P=0.05)	NS	0.2	3.3	1.2	12.6				
Initial status	5.03	1.6	301.6	13.5	293.0				

* Actual gain/loss = (Final value of available nutrients after harvest of crop - Initial value of available nutrients)

CONCLUSION

It may be concluded that application of 75% recommended dose of fertilizers through synthetic sources along with 25% recommended dose of Nitrogen through farm yard manure

may be effective for sustainable production of potato and maintaining the soil health in the north eastern hill region of India.

REFERENCES

- Khan U, Mishra B, Pachauri P and Kumar Y. 2006. Effect of integrated nitrogen management on yield and nitrogen nutrition of irrigated rice (*Oryza sativa*). *Indian J Agr Sci.* **76** (3): 176-80.
- Kumar M, Baishya LK, Ghosh DC and Gupta VK. 2011. Yield and quality of potato (*Solanum tuberosum*) tubers as influenced by nutrients sources under rained conditions of Meghalaya. *Indian Journal of Agronomy* **56** (3):260-6.
- Kushwah VS, Singh SP and Lal SS. 2005. Effect of manures and fertilizers on potato (*Solanum tuberosum*) production. *Potato Journal.* **32** (3-4): 157-8.
- Singh AK and Kumar P. 2009. Nutrient management in rainfed dryland agro ecosystem in the impending climate change scenario. *Agril. Situ. in India.* **65**: 265-70.
- Singh AK, Singh KA, Bharati RC and Chadra N. 2013. Response of intercrops and nutrient management on the performance of tobacco based intercropping system and assessment of system sustainability. *Bangladesh J. Bot.* **42**(2): 343-8.
- Singh SK, Lal SS, Dua VK and Singh RK. 2015. Nitrogen management in maize + potato inter cropping system under eastern Indo Gangetic Plains of Bihar. *Journal of AgriSearch* **2** (4): 244-50.
- Yadav SK, Babu S, Singh Y, Yadav GS, Singh K, Singh R and Singh H. 2013 (b). Effect of organic nitrogen sources and biofertilizers on production potential and energy budgeting of rice (*Oryza sativa*)-based cropping systems. *Indian Journal of Agronomy* **58** (4): 459-64.
- Yadav SK, Babu S, Yadav MK, Singh K, Yadav GS and Pal S. 2013 (a). A review of organic farming for sustainable agriculture in Northern India. *International Journal of Agronomy.* **8** pages, doi:10.1155/2013/718145.

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