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INTEGRATED NUTRIENT MANAGEMENT BY USING ENRICHED COMPOST, VERMI COMPOST AND BIOFERTILIZER ON GROWTH AND YIELD OF POTATO

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ABSTRACT
Innumerable experiments have been carried out to establish the yield response of potato to the rate of nitrogen (N) supply. Chemical fertilizers are the main source of nutrient to the potato crop. However, continuous cropping and dependence on chemical fertilizers has resulted in nutritional imbalance, depletion of soil organic matter, soil erosion, adverse effect on biodiversity as well as on human health. Considering their harmful effects of fertilizers, it is necessary to find out an alternative that besides improving the productivity and quality of potato should also be eco-friendly to the environment. Experiment was conducted during rabi seasons of 2014-15 and 2015-16 at Assam Agricultural University, India. This experiment consisting of eight treatments *viz.*, 100% recommended dose (RD) of Nitrogen (T_1), 75% recommended dose of Nitrogen + 25% Nitrogen through enriched compost (EC) (T_2), 75% recommended dose of Nitrogen + 25% Nitrogen through vermi compost (VC) (T_3), 50% recommended dose of Nitrogen + 50% Nitrogen through enriched compost (T_4), 50% recommended dose of Nitrogen + 50% Nitrogen through vermi compost (T_5), 50% recommended dose of Nitrogen + 25% Nitrogen through enriched compost + 25% Nitrogen through vermi compost (T_6), 50% recommended dose of Nitrogen + 25% Nitrogen through enriched compost (T_7) and 50% recommended dose of Nitrogen + 25% Nitrogen through vermi compost (T_8) was laid out in randomized block design with three replications. The experimental findings revealed that T_6 (50% recommended dose of Nitrogen + 25% Nitrogen through enriched compost + 25% Nitrogen through vermi compost) recorded maximum values for most of the growth and yield attributing characters. Based on the results of two years experimentation, it can be concluded that the integrated use of inorganic and organic sources of nutrients proved superior to inorganic alone in respect of yield and other growth characters.

KEYWORDS: Bio fertilizer, Enriched compost, Potato and Vermi compost.

INTRODUCTION

To meet the food and nutritional demand of the fast growing population of the country like India it is becoming essential to make a futuristic plan. A shift in the food behaviour so as to include the high productivity crops like roots and tubers as food sources in place of the commonly used low yielding cereal staple food crops may be one of the important approach in this regard. Potato being highly productive and nutritive it easily stands out from this group of crops. Besides being a good source of carbohydrate and protein, potato provides vitamins viz., Vit-C and Vit-B, minerals and some essential amino acids like lysine. Potato as food is most nutritious in proportion to its calorie contents. This unique combination of qualities justifies it as a crop best suited for the masses of developing countries (Gaur, 1990). Potato popularly known as "The king of vegetables" has emerged as fourth most important food crop in India after rice, wheat and maize in terms of dry matter production per unit area per unit time. Application of organic manures in conjunction with fertilizers improves physical, chemical and biological properties of the soil besides improving fertilizer use efficiency and crop yield. A suitable combination of organic and inorganic sources of nutrients is necessary for a sustainable agriculture that will provide food with good quality and maintain a sound environment. Potato demands high level of soil nutrients due to relatively poorly developed and shallow root system in relation to yield (Perrenoud, 1993). Compared with cereals crops, Potato produces much more dry matter in a shorter cycle (Singh and Trehan, 1998). Great opportunities exist to increase potato yield and quality by improving nutrient management. Potato, being a heavy feeder of nutrients, requires high amounts of nitrogen, phosphorus and potassium. Chemical fertilizers are the main source of nutrient to the potato crop. However, continuous cropping and dependence on chemical fertilizers has resulted in nutritional imbalance, depletion of soil organic matter, soil erosion, low availability of water, contamination of food and water, adverse effect on biodiversity as well as on human health. Considering their harmful effects of fertilizers, it is necessary to find out an alternative that besides improving the productivity and quality of potato should also be eco-friendly to the environment. Supplying of nutrients through the organic source can be opted for avoiding the hazardous effects of fertilizers and maintaining sustainability. The experiments done in the country have clearly indicated that there is a need to integrate both organic and inorganic for sustainable crop production, maintenance of soil fertility and conservation

of natural resources. It is also argued that use of only organics in the form of organic farming or natural farming to the present Indian agriculture may not be justifiable as use of only organics has not helped in enhancement of crop yield to the required extent. Therefore, it is envisaged that for sustainability of agricultural production in the country, integrated nutrient management appears to be promising.

MATERIALS & METHODS

A field experiment titled "Effect of biofertilizer and integrated nutrient management on yield of potato and soil microbial activity" was conducted during rabi seasons of 2014-15 and 2015-16 at the Instructional-cum- Research farm of Assam Agricultural University. The experiment was laid out in Randomized Block Design with three replications and eight different treatments. Twenty four treatments consisting combination of both organic and inorganic fertilizers were allocated randomly.

Application of biofertilizer: In approximately 2.0L of water in a bucket, gum from 5 numbers of commercially available gum tubes each containing 15ml were poured and mix thoroughly with water in the bucket. The solution is sprinkled over the tubers and biofertilizer was mixed thoroughly with the tubers. So that each tuber gets a coating of the biofertilizer. The treated tubers were kept in the shade over night for drying (Fig 1).

FIGURE 1- Tubers treated with Bio fertilizer before planting in main plot

Seed rate, Spacing and planting

I. **Seed rate:** A seed rate of 22.5q/ha was used for planting potato
II. **Spacing:** The recommended spacing for potato was 50cm×20cm
III. **Planting:** Potato tubers were planted manually on 11th and 10th November during 2014-15 and 2015-16 respectively. The experiment was carried out under irrigated condition and three irrigations were applied at 20days (Stolon formation stage), 55days (tuber formation stage) and 75 days (tuber development stage) after emergence of sprouts.

Tuber yield (total and different grades)

The harvested tubers were sorted out into four different grades viz., <25g, 25-50g, 50-75g and >75g. The weight of each grade of tubers per plot was recorded in kilogram and later converted into t/ha. Similarly the total tuber yield per plot was recorded in kilogram and later converted into t/ha.

RESULTS & DISCUSSION

Data on grade wise tuber yield (t/ha) of potato as influenced by different INM practices are presented in Table 1.

The effect of different nutrient management practices on <25g grade tuber yield of potato was found to be highest in T_6 during both the years. The tuber yield was found highest (6.83 and 7.91 t/ha) under the tuber grade of 25-50g in T_6 during both the years. Highest tubers yields of 8.82 and 7.93 t/ha under 50-75g grade tuber were recorded at T_6 during both the years. Highest yields of >75g grade tuber were also recorded at T_6 during both the years.

TABLE 1. Grade wise tuber yield (t/ha) as influence by different INM practices

Treatments	Grade wise tuber yield (t/ha)							
	<25g		25-50g		50-75g		>75g	
	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
T_1	2.63	3.16	3.71	6.57	7.69	4.71	5.86	2.19
T_2	2.81	3.06	5.06	6.64	6.35	4.87	6.05	1.88
T_3	3.44	3.21	5.44	6.48	6.27	5.20	5.97	1.74
T_4	4.27	4.38	5.66	6.91	9.09	7.96	7.76	2.35
T_5	3.55	3.99	5.71	5.39	7.43	5.60	5.44	1.53
T_6	4.84	5.16	6.83	7.91	9.82	7.93	8.06	2.74
T_7	3.35	3.19	5.83	5.43	7.66	5.65	5.98	2.28
T_8	3.94	3.07	5.83	6.05	6.47	4.73	5.72	1.86
S.Em(±)	0.39	0.39	0.55	0.48	0.76	0.59	0.57	0.22
CD(p=0.05)	1.18	1.18	NS	1.45	2.30	1.79	1.73	0.67
CV %	18.96	18.49	17.26	12.89	17.31	17.56	15.53	18.77

INM-Integrated nutrient management, NS – Non-significant

Yield of <25g tuber (t/ha)

In 2014-15, highest tuber yield of 4.84t/ha was recorded at T_6 and was statistically significant over T_3 (3.44t/ha), T_1 (2.63t/ha) and T_2 (2.81t/ha). The yields recorded at T_4 (4.27t/ha), T_5 (3.55t/ha) and T_7 (3.94t/ha) were at par with T_6.

While in 2015-16, the highest tuber yield of 5.16 t/ha was recorded by T_6 and was statistically significant over T_1 (3.16t/ha), T_2 (3.06t/ha), T_3 (3.21t/ha), T_7 (3.19t/ha) and T_8 (3.07t/ha). The yields recorded at T_4 and T_5 were statistically at par with T_6.

Yield of 25-50g tuber (t/ha)

No significant differences in tuber yields were observed in the first year of experimentation. However, the yield was highest at T_6 (6.83t/ha).

While in 2015-16, the highest tuber yield of 7.91 t/ha was recorded at T_6 and was statistically significant over the yields recorded at T_5 (5.39t/ha), T_7 (5.43t/ha) and T_8 (6.05t/ha). The yields registered at T_1, T_2, T_3 and T_4 were at par with yield at T_6.

Yield of 50-75g tuber (t/ha)

In 2014-15, the highest tuber yield of 9.82t/ha was observed at T_6 and was statistically significant over T_2 (6.35t/ha), T_3 (6.27t/ha) and T_8 (6.47t/ha). The yields recorded at T_1 (7.69t/ha), T_4 (9.09t/ha), T_5 (7.43t/ha) and T_7 (7.66t/ha) were at par with T_6. However, the lowest tuber yield was recorded at T_3.

While in 2015-16, the highest tuber yield of 7.96 t/ha was recorded at T_4 and was statistically significant over the yields recorded at T_1 (4.71t/ha), T_2 (4.87t/ha), T_3 (5.20t/ha), T_5 (5.60t/ha), T_7 (5.65t/ha) and T_8 (4.73t/ha). However, the yield recorded at T_6 (7.93t/ha) was at par with yield T_4. And the lowest yield was recorded at T_1.

Yield of >75g tuber (t/ha)

In 2014-15, significantly higher tuber yield of 8.06t/ha was observed at T_6 as compared to the yield values of 5.86t/ha, 6.05t/ha, 5.97t/ha, 5.44t/ha, 5.98t/ha and 5.72t/ha at T_1, T_2, T_3, T_5, T_7 and T_8. However, T_4 was statistically at par with yield T_6.

While in 2015-16, the highest tuber yield of 2.74 t/ha was recorded at T_6 and was statistically significant over the yields recorded at T_2 (1.88t/ha), T_3 (1.74t/ha), T_5 (1.53t/ha), and T_8 (1.86t/ha). However, the yields recorded at T_1 (7.93t/ha), T_4 (2.35t/ha) and T_7 (2.28t/ha) were at par with yield at T_6.

Total tuber yield (t/ha)

Data on total tuber yield (t/ha) of potato at harvest as influenced by different INM practices are presented in Table 2.

TABLE 2. Total tuber yield (t/ha) as influenced by different INM practices

Treatments	Total tuber Yield(t/ha)		
	2014-15	2015-16	Pooled
T_1 :100% RD of N	22.26	16.62	19.46
T_2:75% RD of N + 25% N through Enriched compost	20.28	16.45	18.37
T_3: 75% RD of N + 25% N through Vermicompost	21.12	16.63	18.88
T_4: 50% RD of N +50% N through Enriched compost	26.89	21.60	24.25
T_5: 50% RD of N + 50% N through Vermicompost	22.51	16.52	19.52
T_6: 50% RD of N + 25% N through Enriched compost + 25% N through Vermicompost	29.55	23.73	26.63
T_7: 50% RD of N + 25% N through Enriched compost	22.81	16.55	19.68
T_8: 50% RD of N + 25% N through Vermicompost	21.96	15.71	18.84
S.Em (±)	1.42	0.99	0.87
CD (P=0.05)	4.32	3.01	2.52
CV%	10.52	9.56	10.27

INM- Integrated nutrient management, NS- Non- significant

The highest tuber yields of 29.55t/ha and 23.73t/ha were recorded at T_6 {50% RD of N + 25% N through Enriched compost + 25% N through Vermi compost} during both the years and were statistically significant over T_1, T_2, T_3, T_5, T_7 and T_8. This was followed by tuber yields of 26.89 and 21.60t/ha at T_4 during both the years and was at par with T_6. Pooled data also indicated that among the nutrient management treatments T_6 showed the highest tuber yield of 26.63t/ha which was at par with T_4 (24.25t/ha). In 2014-15, the lowest yield was observed at T_2 and during second year lowest tuber yield was recorded at T_8.

Different Integrated Nutrient Management practices could not exert significant influence on per cent plant emergence during both the years. In general, the per cent plant emergence was quite satisfactory due to the use of good quality planting material and moisture level maintained during planting.Significant influence of INM on total tuber yields and the highest values of 29.55 and 23.73t/ha were obtained at T_6 {50% recommended dose of Nitrogen + 25% Nitrogen through Enriched compost + 25% Nitrogen through Vermicompost} during both the years. This was followed by tuber yields of 26.89 and 21.60t/ha at T_4 which were at par with T_6. The increase in total tuber yield is the result of the cumulative increase in grade wise tuber yields.Integrated Nutrient Management significantly influenced the concentration of N, P and K and their total uptake by crop during both the years of experimentation. The uptake of N, P and K were recorded highest at T_6 during both the years and were statistically superior to rest of the treatments. Higher uptakes were due to significantly higher N, P, and K content in tuber, haulm and superior dry matter yield under integrated use of both organic and inorganic nutrients. Similar observations were made by Sharma (1989), Sharma (1992), Sud *et al.* (1992) and Sujatha and Krishnappa (1995).

CONCLUSION

Based on the results of two years experimentation, it can be concluded that the integrated use of inorganic and organic sources of nutrients proved superior to inorganic alone in respect of yield and other growth characters. The INM treatment equally improved the physico-chemical and biological properties of the soil. Among the different INM practices T_6 was found to be the best suitable combination of inorganic and organic sources of nutrients on growth, yield and economics of potato as well as to improve the biological properties of soils.

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