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Effect of integrated use of organic and inorganic sources of nutrients on potato (*Solanum tuberosum*) production

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ABSTRACT

A field experiment was conducted at Central Potato Research Station, Gwalior during winter seasons (*rabi*) of 2001-02 and 2002-03 to study the effect of organic and inorganic sources of nutrients on potato (*Solanum tuberosum* L.) production. The treatments included 25, 50, 75 and 100% doses of NPK with and without organic manures (farmyard manure and Nadep compost @30 tonnes/ha). Application of 100% NPK + 30 tonnes FYM/ha resulted in significantly higher tuber yield of 456 q/ha compared with that of other treatments except 100% NPK + 30 tonnes Nadep/ha and 75% NPK + 30 tonnes FYM/ha. The effect of organic manures (FYM and Nadep compost) in combination with inorganic fertilizers was more pronounced compared with that of organic manures alone. However, FYM was found more effective than Nadep compost in producing higher tuber yield. Maximum net return of Rs 63,627/ha was also obtained from 100% NPK + 30 tonnes FYM/ha. However, benefit: cost ratio was almost same under 75% NPK with 30 tonnes/ha FYM or Nadep compost and 100% NPK with 30 tonnes/ha FYM or Nadep compost.

Key words : Nadep compost, Farmyard mannure (FYM), Rate of multiplication of potato, Soil fertility

Potato (*Solanum tuberosum*) is highly resposive to application of organic mannures (Mondal *et al.*, 2005). Many physical, chemical and biological limitations of soil are often associated with low levels of organic matter content in the soil. In this context the concept of low-input sustainable agriculture (Grubinger, 1992), which lays focus on reconsideration of agricultural practices such as green-manuring, recycling crop residues and animal manures, and the inclusion of legumes in rotation, is important. However, such a practice cannot provide total nutrient needs of modern agriculture, integrated use of nutrients from fertilizers and organic sources seems to be more useful for sustaining yields. Integrated nutrient supply and management (INSM) is essential for sustaining crop productivity on long-term basis (Chettri *et al.*, 2004), especially because higher use of agro-chemicals creates pollution problems. To augment the availability of organic sources of nutrients, good-quality compost can be prepared from farm wastes by Nadep composting method. Nadep compost becomes ready for use after 3 months of filling the tank. Therefore, the present study was undertaken to generate information on the effect of different sources of nutrients on yield and economics of potato through their integrated use.

MATERIALS AND METHODS

A field experiment was conducted at fixed site for two consecutive years during 2001-03 at Central Potato Research Station, Gwalior (M.P.). The available N, P and K contents of the soil were 198, 17.9 and 332 kg/ha, respectively, with pH 7.5, electrical conductivity 0.3 dS/m and organic carbon 0.44 %. The N, P_2O_5 and K_2O contents of Nadep compost were 0.3, 0.2 and 0.4% and of FYM 0.4, 0.3 and 0.3%. There were 12 treatment combinations of four doses of NPK and three levels of manure in addition to the control (Table 1). The experiment was laid out in randomized block design with four replications. Nitrogen was applied in two equal splits, viz. at planting and hoeing, through ammonium sulphate and urea respectively. Phosphorus and potassium were applied at planting through single superphosphate and muriate of potash respectively.

Potato crop was planted on 19 November 2001, and 13 November 2002. Two manual weedings were done at 20 and 40 days after planting during both the years. Hoeing and earthing up were done on 22 December 2001 and 21 December 2002.

During 2001-02, the surface (0-15 cm) composite soil sample was collected randomly before planting of potato, whereas, during 2002-03 the soil samples were collected

Table 1. Growth and yield attributes, yield, rate of multiplication and economics of potato as affected by different treatments (pooled data for 2001-02 and 2002-03)

Treatment Fertilizer + manure (NPK) (t/ha)	Plant height (cm)	Number of tubers ('000/ha) Large (>75 g)	Medium (25-75 g)	Small (<25 g)	Total	Yield of tubers (q/ha) Large (>75 g)	Medium (25-75 g)	Small (<25 g)	Total	Rate of multiplication by number	Net return (Rs/ha)	B:C ratio
25% RDF+control	30.6	53	413	555	1,021	63	180	53	296	12.3	29,805	1.7
25% RDF+30 Nadep	31.4	62	497	596	1,155	64	207	53	324	13.9	36,995	1.9
25% RDF+30 FYM	32.1	52	491	576	1,119	57	216	56	329	13.4	38,595	1.9
50% RDF+control	39.4	75	556	689	1,320	79	220	59	358	15.9	43,782	2.0
50% RDF+30 Nadep	36.7	80	524	723	1,327	80	218	62	360	15.9	42,572	2.0
50% RDF+30 FYM	39.5	76	526	630	1,232	76	242	59	377	14.8	48,672	2.0
75% RDF+control	46.5	96	552	688	1,336	91	230	61	382	15.7	47,560	2.0
75% RDF+30 Nadep	45.5	102	570	712	1,384	102	250	64	416	16.6	54,950	2.2
75% RDF+30 FYM	45.2	113	547	631	1,291	116	260	52	428	15.5	59,550	2.3
100% RDF+control	48.4	91	548	656	1,295	96	243	65	404	15.6	51,037	2.1
100% RDF+30 Nadep	52.1	97	576	813	1,486	105	258	72	435	17.9	56,927	2.2
100% RDF+30 FYM	51.5	99	600	769	1,468	111	278	67	456	17.6	63,627	2.3
Control	25.7	42	365	510	917	36	149	49	234	11.1	16,528	1.4
CD (P=0.05)	4.3	18	73	130	169	18	22	12	35	2.0		

RDF=Recommended dose of fertilizer: 180 kg N, 80 kg P_2O_5 120 kg K_2O/ha; cost of seed Rs 800/q; cost of N (Rs 19.00/kg), P_2O_5 (Rs 16.38/kg), K_2O (Rs 7.76/kg), FYM (Rs 0.10/kg), Nadep (Rs 0.10/kg); rate of tubers: large (Rs 200/q), medium (Rs 300/q) and small (Rs 100/q)

from each plot.

RESULTS AND DISCUSSION

Plant height

Highest plant height was recorded with 100% NPK + 30 tonnes Nadep compost treatment, which was significantly higher than other treatment combinations comprising 25, 50 and 100% of recommended dose of fertilizers with and without manures.

Number of tubers

Highest number of large-size tubers was recorded with 75% NPK + 30 tonnes FYM, of medium-size tubers with 100% NPK + 30 tonnes FYM and of small-size tubers with 100% NPK + 30 tonnes Nadep compost. The highest total number of tubers (14,86,000/ha) was recorded with 100% NPK + 30 tonnes/ha Nadep compost, which was significantly higher than with 100% NPK alone (Table 1).

Tuber yield

The highest total tuber yield of 456 q/ha was recorded with 100% NPK + 30 tonnes FYM/ha, which was significantly higher than all other treatments except with 75% NPK + 30 tonnes FYM and 100% NPK + 30 tonnes Nadep compost/ha (Table 1). Tuber yield of medium-size tubers was significantly higher with 100% NPK + 30 tonnes FYM or Nadep/ha compared with 75 and 100% NPK alone. However, there was no significant effect of these treatments on the yield of small- and large-size tubers. Datt *et al.* (2002) and Emin Caliskan *et al.* (2004) reported that organic manures are not only the source of nutrients but also have stimulatory effect of better efficiency of chemical fertilizers. Manures not only add NPK but also improve the physico-chemical properties of soil and mitigate micronutrient deficiency (Sharma and Kumar, 2000; Reust and Neyround, 2003).

Rate of multiplication

Rate of multiplication by number was significantly lower with 25% NPK with or without FYM or Nadep compared with 50, 75 and 100% NPK. The difference

Table 2. Chemical properties of soil as affected by different treatments

Treatment Fertilizer + manure (NPK) (t/ha)	Organic C (%)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)
25% RDF + control	0.44	198.3	16.3	391.0
25% RDF + 30 Nadep	0.47	206.3	14.1	398.0
25% RDF + 30 FYM	0.55	231.5	13.5	395.0
50% RDF + control	0.51	211.3	14.0	372.0
50% RDF + 30 Nadep	0.46	201.0	13.5	345.0
50% RDF + 30 FYM	0.52	212.3	10.5	387.0
75% RDF + control	0.45	198.8	15.3	355.0
75% RDF + 30 Nadep	0.44	197.3	14.0	391.0
75% RDF + 30 FYM	0.46	200.8	10.0	369.0
100% RDF + control	0.45	205.0	11.7	383.0
100% RDF + 30 Nadep	0.49	213.0	11.6	385.0
100% RDF + 30 FYM	0.45	202.8	12.3	355.0
Control	0.44	199.3	10.5	354.0
CD (P=0.05)	NS	NS	NS	42.37
Initial value	0.44	198.0	17.9	332.0

among 50, 75 and 100% NPK was found to be non significant (Table 1).

Economics

The net return was highest (Rs 63,627/ha) with 100% NPK + 30 tonnes FYM/ha (Table1). However, benefit: cost ratio was almost the same under 75% NPK with 30 tonnes/ha FYM or Nadeop compost and 100% NPK with 30 tonnes/ha FYM or Nadep compost. Hence 25% NPK may be saved by adopting treatment comprising 75% NPK + 30 tonnes/ha FYM or Nadep compost.

Soil fertility

Soil-fertility status of the soil with reference to organic carbon, available N and P in different treatments remained unchanged at the end of 2 years, which were on a par statitistically. There was a build-up of potassium in 25% NPK treatment after 2 years of experimentation, which may be due to lower tuber yields and lower uptake, as potato is a heavy feeder of potassium (Table 2).

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