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Yield and quality of potato (*Solanum tuberosum*) tubers as influenced by nutrient sources under rainfed condition of Meghalaya

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ABSTRACT

Field experiment was conducted in three consquitive summer seasons of 2005 to 07 at Shillong, Meghalaya to study the effect of integrated nutrient management on productivity, storage and quality of potato (*Solanum tuberosum* L.) under rainfed condition. The experiment was laid out in a split plot design with eight nutrient management practices [organic manures, *viz.* farmyard manure (FYM), poultry manure (PM), vermicompost (VC) and their combinations with inorganic fertilizers] in the main–plots and seed treatment with three biofertilizers (*Azotobacter*, PSB and *Azotobacter* + PSB) in the sub-plots. The results showed that the crop receiving 50% of the recommended dose of NPK through inorganic fertilizers and remaining 50% recommended dose of N (RDN) through organic manures (FYM, PM or VC) or 100% recommended dose of NPK (120 kg N, 120 kg P_2O_5 and 60 kg K_2O/ha) through inorganic fertilizers alone favorably influenced yield of different grades tubers and total tuber yield. Seed treatment with combination of *Azotobacter* and phosphorus solubilising bacteria proved better in enhancing the tuber yield, as compared to sole treatment of either *Azotobacter* or PSB. Three years pooled yield revealed that integrated application of 50% recommended dose of NPK through inorganic sources and 50% RDN through PM recorded highest tuber yield (22.73 t/ha), closely followed by 100% NPK through inorganic fertilizers (22.20 t/ha), which were 228% and 223% higher over the control respectively. Maximum dry matter content (20.29%) and specific gravity (1.084) were found in treatment with 100% RDN through organic manures. Protein content was found 10.18% in the combination of 50% RDN through FYM and 50% recommended dose of NPK through inorganic fertilizers. Use of biofertilizers for seed treatment did not cause much variation in dry matter content, specific gravity and protein content. Physiological loss in weight, decay loss, total weight loss were recorded maximum with 100% recommended dose of NPK and minimum in the combination of 50% RDN through VC and 50% recommended dose of NPK through inorganic fertilizers.

***Key words*:** Bio-fertilizers, Inorganic fertilizers, Organic manures, Potato, Quality, Storage

Potato is one of the major world food crops. Potato contributes to world food basket just after rice, wheat and maize. It contains 20.6% carbohydrates, 2.1% protein, 0.3% fat, 1.1% crude fibre and 0.9% ash. It also contains good amount of essential amino acids like *leucine*, *tryptophane* and *isolucine* (Paul Khurana and Naik, 2003). In green revolution, intensive use of synthetic agrochemicals, such as fertilizers and pesticides with adoption of nutrient responsive high yielding varieties of crops has boosted the production to a great extent. Of late, concern has been raised time and again over its adverse effects on degradation of soil health, environment and food quality. There is an urgent need to minimize the environmental degradation as much as possible and restore the productivity of degraded soils. Integrated nutrient management is one of the options to achieve this goal.

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Organic foods are generally considered healthier than conventionally grown products. The demand for organic products is gradually increasing. Several agronomic factors affect potato yield and quality. Organic farming has potential for reducing some of the negative impacts of conventional agriculture to the environment and an option to restore the productivity degraded soils (Ghosh *et al.*, 2007). Kumar *et al*. (2005) recorded prolonged effect of organic manures on fertility and soil moisture balance. It also reduces the chemicals needed for pest control, besides improve soil physical properties in long run. But organic farming alone may not meet the requirements of agricultural productivity and solve food, fodder and energy problems. Proportionate combination of organic and inorganic sources of plant nutrients has been found to be the best option for increasing productivity and maintaining sustainability in crop production. As no single source is

capable of supplying the required amount of plant nutrients, integrated use of all sources of plant nutrients is a must to supply balanced nutrition to the to the crops (Arora, 2008). The present study was under taken to investigate the effect of integrated use of organic manures, inorganic fertilizers and biofertilizers on post harvest quality of potato tuber with respect to grade, total tuber yield, dry matter content, specific gravity, protein content and, also to study the storage behavior of tuber, viz. physiological loss in weight, decay loss and sprouting.

MATERIALS AND METHODS

A field experiment (2005 to 2007) was laid out in a split plot design with eight nutrient management in main–plots and three seed tuber treatment with bio-fertilizers in sub–plots and replicated thrice. Nutrient management practices were Control, 100% recommended dose of nitrogen (RDN) through FYM, 100% RDN through poultry manure (PM), 100% RDN through vermicompost (VC), 50% recommended dose of NPK through inorganic fertilizers + 50% RDN through FYM, 50% recommended dose of NPK through inorganic fertilizers + 50% RDN through poultry manure(PM), 50% recommended dose of NPK through inorganic fertilizers + 50% RDN through vermicompost (VC), 100% recommended dose of NPK through inorganic fertilizers and biofertilizers seed tbers treatment were with *Azotobacter*, phosphate solublising bacteria (PSB) and *Azotobacter* + PSB. 'Kufri Giriraj' potato hybrid was sown in March and harvested in the month of July in all the three years. The average duration of the crop was 120 days. FYM 23.0 t/ha, PM 8.0 t/ha and VC 10.0 t/ha were used to supply 100% RDN (120 kg N/ha) to the potato crop.

For seed tubers treatment, half kg each of *Azotobacter* and PSB biofertilizers were dissolved in 40 litres of water separately. Slurry was prepared by boiling 2 kg jaggary in one litre of water. After cooling, it was added to each solution of biofertilizers. In case of combined application of both the biofertilizers, 250 g of each biofertilizer were dissolved in 40 litres of water and added to the jaggary solution. In this way three solutions of biofertilizers (solution of *Azotobacter,* solution of PSB and solution of *Azotobacter* + PSB) were prepared. 'Kufri Giriraj' potato tubers were dipped in the biofertilizer solution for 30 minutes as per treatment and shade dried.

The tubers were planted at 20 cm apart in the furrows of 60 cm distance and covered immediately after planting. Well decomposed FYM, PM and VC as per treatment were applied 15 days before final land preparation. Half dose of N and full dose of P and K were applied as per treatment as basal dose before planting. The earthing up was done at 35 days after planting along with weeding to facilitate the development of tubers at the stolon tips. During earthing up the remaining nitrogen dose was side dressed and mixed thoroughly with the soil. Except late blight there was no major incidence of insect pest and disease. For controlling of late blight disease two sprays of mancozeb and one spray of ridomil MZ (metalaxyl + mancozeb) were sprayed. The crop was harvested manually at maturity in bright sunny day. All the tubers were dried and graded in shade and their weight and number were recorded as grades A (50g and above), B (30-50 g) and C (less than 30 g). Tuber yield of different plots were estimated and converted into ton/hectare. Dry matter content, specific gravity and protein content as per method described by Ranganna (1995). Potato tubers (medium sized 5 kg) harvested from each treatment was kept at room temperature (22 ±2°C and 85±5% RH) for 120 days. Quality of tubers were evaluated in terms of physiological loss in weight (PLW, %), decay loss (%), total weight loss (%) and sprouting (%) during the storage.

RESULTS AND DISCUSSION

Grade-wise and total tuber yield

There was significant effect of nutrient management practices on grade–wise tuber yield of potato during all the three years. In general, there was maximum production of 'B' grade tubers followed by grade 'A' and 'C'. Integrated use of 50% recommended dose of NPK (RDNPK) through inorganic fertilizers and remaining 50% RDN through organic sources (FYM, PM or VC) and application of RDNPK through inorganic fertilizers recorded higher tuber yield of all grades (grade A, B and C) which were significantly greater than other fertility treatments during all the three years. Highest tuber yield of different grades were obtained with the application of 50 % RDNPK through inorganic fertilizers and remaining 50% RDN through PM, which were at par with the crop receiving 50 % RDNPK through inorganic fertilizers and remaining 50% RDN through FYM or VC and 100% RDNPK through inorganic fertilizers. The results (Table 1) emphasized the need of integrated use of 50 % RDNPK through inorganic fertilizers and remaining 50% RDN through organic sources (FYM, PM or VC) for producing high tuber yield of different grades at hill region of Meghalaya. The results further indicated that supply of 100% nutrients through only organic manures was not much helpful in recording higher production of different grades tubers. This might be due to slow mineralization of organic manures under low temperature condition prevailing in the north eastern hill region. The favourable effect of integrated nutrient management through both inorganic fertilizers and organic manures on increasing the different grades tuber production was also reported by Kumar *et al.*

(2008) and Das *et al.* (2009). Use of biofertilizer exerted significant effect on influencing yield of different grades of tubers during all the three years of study. Seed treatment with combination of *Azotobacter* and PSB recorded the highest tuber yield of different grades which were significantly greater than those of the crop receiving either *Azotobacter* or PSB only.

The results showed significant variation in total tuber yield (Table 1) due to the different nutrient management practices. The highest tuber yield was obtained with the application of 50 % RDNPK through inorganic fertilizers and remaining 50% RDN through PM, but it was statistically at par with 50% RDNPK through inorganic fertilizers and remaining 50% N through FYM or VC or 100% RDNPK through inorganic fertilizers only during all the three years. These yields were significantly superior to sole application of 100% RDN either through FYM or PM or VC as well as control. Individual application of PM, FYM and VC also recorded significantly higher tuber yield than control. There was 128% increase in tuber yield due to combined application of 50% RDNPK through inorganic fertilizers and remaining 50% N through PM and 123% with 100% RDNPK through inorganic fertilizers over the control respectively. Seed treatment with combination of *Azotobacter* and PSB recorded significantly higher tuber yield compared to either *Azotobacter* or PSB alone during all the years. The results corroborate the findings of Kumar *et al.* (2001) and Raghav and Kamal (2008).

Economics

The crop at 50% recommended dose of through inorganic fertilizers and remaining 50% recommended dose of N through organic sources (FYM, PM or VC) and 100% RDNPK through inorganic fertilizers paid higher return per rupee invested than other fertility treatments during all the three years. Crop with 100% RDN through organic manures (FYM or PM) recorded higher return per rupee invested over control plots, but these treatments were found less effective in increasing return per rupee invested as compared to the crop receiving combined application of both inorganic fertilizers and organic manures during all the three

Table 1. Effect of integrated nutrient management and bio-fertilizers on tuber yield and economics of potato production

Treatment	Grade-wise/total tuber yield (t/ha)													Net returns (×10³ ₹/ha)			B: C ratio		
	2005			2006			2007			2005	2006	2007	Pooled	2005	2006	2007	2005	2006	2007
	Grade A	Grade B	Grade C	Grade A	Grade B	Grade C	Grade A	Grade B	Grade C										
Nutrient Management																			
Control	1.70	5.48	3.42	1.61	4.98	3.05	1.6	4.94	3.10	10.60	9.64	9.64	9.96	23.7	27.9	28.0	1.67	1.79	1.79
RDN* through FYM	3.82	8.46	3.37	4.06	9.04	3.15	4.31	9.26	3.1	15.65	16.25	16.67	16.19	36.7	40.1	42.0	1.90	1.98	2.02
RDN through PM	4.06	8.9	3.54	4.58	9.5	2.96	4.62	9.52	2.95	16.46	17.05	17.08	16.86	37.2	41.7	42.0	1.86	1.96	1.97
RDN through VC	3.94	8.72	3.43	4.28	9.24	3.12	4.40	9.37	3.1	16.09	16.64	16.88	16.54	33.5	36.2	37.3	1.71	1.77	1.79
50% RDNPK + 50% RDN through FYM	6.46	10.73	4.17	6.76	11.68	3.41	6.79	11.73	3.4	21.37	21.85	21.92	21.71	64.2	68.9	69.8	2.57	2.69	2.71
50% RDNPK + 50% RDN through PM	6.63	11.28	4.27	7.07	12.16	3.61	7.24	12.39	3.55	22.18	22.85	23.17	22.73	69.7	71.2	71.8	2.65	2.69	2.70
50% RDNPK + 50% RDN through VC	6.53	11.06	4.41	6.88	11.86	3.52	6.87	11.91	3.42	22.01	22.27	22.21	22.16	66.6	67.3	68.5	2.51	2.53	2.56
100% RDF through inorganic fertilizers	6.59	10.83	4.22	6.95	12.02	3.41	7.03	12.17	3.37	21.64	22.38	22.58	22.20	67.9	71.6	71.7	2.67	2.76	2.76
SEm+	0.097	0.193	0.082	0.112	0.201	0.078	0.182	0.273	0.85	0.53	0.54	0.52	0.53						
CD (P=0.05)	0.294	0.581	0.245	0.336	0.607	0.235	0.509	0.765	2.54	1.61	1.62	1.56	1.26						
Bio-fertilizer																			
Azotobacter	4.75	9.24	3.69	5.05	9.81	3.07	5.13	9.92	30.42	17.69	17.93	18.09	17.90	42.6	45.7	46.5	1.93	2.00	2.02
PSB	4.87	9.33	3.85	5.20	9.92	3.17	5.32	10.10	32.40	18.05	18.29	18.66	18.33	44.6	47.4	49.9	1.98	2.04	2.09
Azotobacter + PSB	5.28	9.73	4.11	5.57	10.45	3.6	5.63	10.46	34.63	19.12	19.62	19.55	19.43	50.3	54.5	53.6	2.10	2.19	2.17
SEm+	0.071	0.085	0.069	0.065	0.105	0.062	0.101	0.118	0.74	0.27	0.29	0.30	0.20						
CD (P=0.05)	0.215	0.253	0.206	0.194	0.312	0.179	0.301	0.352	2.08	0.80	0.88	0.89	0.59						

*RDN (Recommend dose of N) = 120 kg N/ha; RDNPK (Recommended doses of NPK) = 120 kg N/ha, 120 kg P2O5/ha and 60 kg K2O/ha respectively; PM: Poultry manure; VC: Vermicompost; FYM: Farmyard manure, PSB: Phosphorus solubilizing bacteria.

years. Vermicompost was found less economic due to its high price which reduced the return per rupee invested comparable to that of the control plots. The results emphasized the need of integrated use of 50% RDNPK through inorganic fertilizers and remaining 50% RDN through organic sources (FYM, PM or VC) for obtaining higher return per rupee invested in potato cultivation under Meghalaya hill region. The results are in conformity with the findings of Kumar *et al.* (2008) and Baishya (2009). Seed treatment with both biofertilizers (*Azotobacter* and PSB) recorded higher returns per rupees invested as compared to crop receiving single treatment of either *Azotobacter* or PSB during all the three years.

NPK Uptake

The highest total uptake of N, P and K by potato was obtained with crop receiving 50% RDNPK through inorganic fertilizers and remaining 50% N through PM (Table 2). The results emphasized the need of integrated use of 50% RDNPK through inorganic fertilizers and remaining 50% N through organic sources (particularly PM or VC) for enhancing the uptake of N, P and K by potato. Favourable effect of integrated nutrient management using inorganic fertilizers and organic manures on increasing the uptake N, P and K by potato was also noticed by Kumar *et al.* (2008) and Baishya (2009). Seed treatment with combination of *Azotobacter* and PSB recorded the highest total uptake of N, P and K by potato which was significantly greater than sole *Azotobacter* seed treatment during all the years, but at par with sole PSB seed treatment in respect of N uptake in 2005 and 2007 and K uptake during all the years. Seed treatment with PSB alone registered significantly higher total uptake of N, P and K by the crop over those of *Azotobacter* treatment during all the three years except N uptake in 2005.

Dry matter content, protein content and specific gravity of tuber

Qualities of tubers were studied in terms of dry matter content, protein content and specific gravity of the harvested tubers during all the three years (Table 3). Significant reduction in dry matter content and specific gravity were recorded with 100% RDNPK through inorganic fertilizers irrespective of nutrient sources. Maximum dry matter content and specific gravity were found with the treatment 100% RDN through organic manures compare to combination of organic and inorganic fertilizers. Protein content (on dry weight basis) recorded significantly higher (10.18%) in the treatment combination of 50% RDN through FYM and 50% RDNPK through inorganic fertilizers. Use of biofertilizers for seed treatment did not cause much variation in any of the above quality parameters of the tubers in any of the three years of study. Tuber dry matter content (%), specific gravity and protein content

Table 2. Effect of integrated nutrient management and bio–fertilizers on NPK uptake (kg/ha) in potato.

Treatment	Nutrient uptake in tubers + haulms uptake (kg/ha)								
	2005			2006			2007		
	N	P	K	N	P	K	N	P	K
Nutrient management									
Control	56.4	11.2	70.0	58.8	13.3	78.0	59.0	12.81	76.5
RDN* through FYM	80.2	18.3	102.2	85.5	20.9	109.8	89.0	22.34	113.4
RDN through PM	85.0	19.9	109.3	91.0	23.6	114.4	93.5	24.46	117.5
RDN through VC	83.3	19.2	108. 3	88.5	21.4	113.1	92.4	22.68	115.3
50% RDNPK + 50% RDN through FYM	103.6	27.1	138. 9	111.6	28.9	142.8	114.4	32.88	146.2
50% RDNPK + 50% RDN through PM	115.1	30.6	148.1	118.7	33.7	151.0	122.5	36.62	152.1
50% RDNPK + 50% RDN through VC	110.2	28.5	145.1	116.2	32.0	148.8	118.1	34.52	150.0
100% RDNPK through inorganic fertilizers	113.6	30.4	146.5	116.3	33.0	149.8	118.0	35.2	149.6
SEm±	1.8	0.7	2.4	1.2	0.7	2.0	2.0	1.0	2.2
CD (P=0.05)	4.9	2.1	6.6	3.3	1.9	6.0	5.8	2.8	6.2
Bio-fertilizer									
Azotobacter	91.6	21.4	117.2	96.3	24.1	121.7	98.0	25.6	123.6
PSB	93.7	23.2	121.4	98.3	26.1	127.1	101.2	27.9	127.9
Azotobacter + PSB	95.0	24.9	124.5	100.3	27.3	129.1	103.3	29.6	131.2
SEm±	1.1	0.4	1.45	0.7	0.3	1.7	1.06	0.59	1.6
CD (P=0.05)	3.0	1.0	4.17	2.00	1.0	5.0	3.12	1.64	4.3

*RDN (Recommend dose of N)=120 kg N/ha; RDNPK (Recommended doses of NPK) = 120 kg N/ha, 120 kg P_2O_5/ha and 60 kg K_2O/ha respectively; PM: Poultry manure; VC: Vermicompost; FYM: Farmyard manure, PSB: Phosphorus solubilizing bacteria.

(%) did not vary significantly due to different biofertilizer treatments in any of the three years.

Physiological loss in weight

The physiological loss (%) in weight (PLW) recorded after deducting the decay loss of stored tubers during the three years were statistically analyzed and presented in Table 4. The results revealed that nutrient management practices significantly affected the PLW (%) of stored tubers during all the years. The highest percentages of PLW of stored tubers were obtained when the crop received 100% RDNPK through inorganic fertilizers and it was significantly greater than those recorded at all other nutrient management treatments except crop receiving PM either alone or in combination with inorganic fertilizers (50% RDNPK through inorganic fertilizers and remaining 50% N through PM) during all the years. Use of FYM either alone (100% RDNPK) or in combination with inorganic fertilizers (50 % RDNPK through inorganic fertilizers and remaining 50% RDN through FYM) and combined application of 50% RDNPK through inorganic fertilizers and remaining 50% RDN through vermicompost also enhanced the PLW of stored tubers which was significantly different to other fertility treatments during the experiment. The lowest PLW of stored tubers was noted when the crop did not receive any applied nutrient (control) and it was on par with those of the crop having only VC (100% RDN) during all the three years. Both the fertility treatments significantly lower down the PLW of stored tubers as compare to those obtained at other fertility treatments of study. The results clearly showed that use of 100% RDNPK through inorganic fertilizers or 100% RDN through PM or combined use of 50% RDNPK through inorganic fertilizers and 50% RDN through PM though enhanced tuber yield of potato but accelerated physiological weight loss of stored tubers. Use of biofertilizers for seed treatment did not cause much variation PLW of stored tubers during all the three years under the study.

Decay loss

The data on decay loss (%) recorded on stored tubers during the three years were statistically analyzed and presented (Table 4). The results showed that decay loss (%) by number and weight of tubers varied significantly among the different nutrient management treatments during all the three years of the experiment. The highest percentages of decay loss (%) by number and weight of tubers were observed when the crop received 100% RDNPK through inorganic fertilizers and it was significantly greater than those recorded at all other nutrient management treatments during three years of study. Use of PM either alone (100% RDN) or in combination with inorganic fertilizers (50% RDNPK through inorganic fertilizers and 50% RDN through PM) also enhanced rotting of tubers during storing which was significantly higher than those of the crop at remaining fertility treatments under the study. The lowest percentage of decay loss (%) by number and weight of tubers in the storage was noticed when the

Table 3. Effect of integrated nutrient management and bio-fertilizers on quality of potato tubers

Treatment	Dry matter content (%)			Specific gravity			Protein content (%)		
	2005	2006	2007	2005	2006	2007	2005	2006	2007
Nutrient management									
Control	19.99	19.94	19.95	1.081	1.082	1.080	9.27	9.64	9.47
RDN* through FYM	20.24	20.16	20.15	1.082	1.083	1.084	10.08	10.50	10.72
RDN through PM	20.29	20.15	20.11	1.083	1.082	1.083	10.27	10.41	10.71
RDN through VC	20.23	20.04	20.10	1.080	1.081	1.081	10.20	10.48	10.67
50% RDNPK + 50% RDN through FYM	20.15	20.15	20.08	1.080	1.081	1.081	10.05	10.27	10.78
50% RDNPK + 50% RDN through PM	20.12	20.08	20.07	1.081	1.081	1.082	10.13	10.41	10.72
50% RDNPK + 50% RDN through VC	20.13	20.05	20.11	1.082	1.082	1.081	10.16	10.28	10.75
100% RDNPK through inorganic	19.50	19.45	19.43	1.075	1.074	1.076	10.08	10.29	10.69
SEm±	0.12	0.16	0.18	0.0018	0.0015	0.0014	0.17	0.12	0.11
CD (P=0.05)	0.33	0.42	0.52	0.005	0.004	0.004	0.48	0.33	0.30
Bio-fertilizer									
Azotobacter	19.95	19.91	19.91	1.080	1.080	1.081	9.92	10.17	10.50
PSB	20.03	19.96	19.96	1,081	1.081	1.082	10.01	10.28	10.66
Azotobacter + PSB	20.12	20.04	20.06	1.082	1.082	1.083	10.13	10.40	10.70
SEm±	0.11	0.14	0.12	0.004	0.005	0.005	0.11	0.10	0.11
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

*RDN (Recommend dose of N)=120 kg N/ha; RD (Recommended dose of NPK)=120 kg N/ha, 120 kg P_2O_5/ha and 60 kg K_2O/ha respectively; PM: Poultry manure; VC: Vermicompost; FYM: Farmyard manure, PSB: Phosphorus solubilizing bacteria

Table 4. Effect of integrated nutrient management and bio-fertilizers on storage (120 days after harvesting) behavior of potato tuber

Treatment	Physiological weight loss (%)			Decay loss (%)						Total weight loss (%)		
				2005	2006	2007	2005	2006	2007	2005	2006	2007
	2005	2006	2007									
Nutrient treatment												
Control	7.29	6.39	4.99	1.92	1.10	1.69	2.66	2.17	2.24	9.85	7.76	6.83
RDN* through FYM	10.31	8.66	7.68	2.33	1.35	2.34	3.30	2.37	2.72	13.81	11.13	10.30
RDN through PM	12.15	12.10	8.91	3.92	1.95	4.59	5.88	4.17	4.64	18.53	17.17	14.14
RDN through VC	8.28	6.85	5.88	2.02	1.10	2.30	3.21	2.21	2.40	10.69	9.36	7.84
50% RDNPK + 50% RDN through FYM	10.17	8.59	7.85	2.19	1.61	3.61	2.79	2.56	2.90	13.66	11.55	10.27
50% RDNPK + 50% RDN through PM	12.25	12.22	9.12	4.13	2.14	4.63	6.08	4.47	4.72	18.83	17.29	14.35
50% RDNPK + 50% RDN through VC	10.27	8.56	7.76	2.18	1.17	2.23	3.34	2.31	2.47	13.51	10.97	10.15
RDNPK through inorganic fertilizers	13.47	13.32	9.17	5.33	3.24	5.39	7.48	5.80	5.69	19.95	17.62	15.26
SEm ±	0.64	0.55	0.38	0.29	0.18	0.27	0.32	0.21	0.24	0.85	0.92	0.82
CD (P=0.05)	1.94	1.62	1.13	0.82	0.50	0.79	0.95	0.62	0.71	2.52	2.74	2.42
Bio-fertilizer												
Azotobacter	10.49	9.54	7.63	2.95	1.68	3.25	4.23	3.28	3.40	14.72	13.02	11.03
PSB	10.47	9.58	7.64	3.04	1.70	3.45	4.32	3.25	3.47	14.79	12.63	11.11
Azotobacter + PSB	10.61	9.64	7.74	3.06	1.75	3.35	4.48	3.28	3.55	15.09	12.92	11.29
SEm ±	0.28	0.25	0.21	0.18	0.11	0.13	0.15	0.14	0.13	0.31	0.34	0.28
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

*RDN (Recommend dose of N)=120 kg N/ha; RD (Recommend dose)=120 kg N/ha, 120 kg P_2O_5/ha and 60 kg K_2O/ha respectively; PM: Poultry manure; VC: Vermicompost; FYM: Farmyard manure, PSB: Phosphorus solublizing bacteria

crop did not receive any applied nutrient (control) and it was on par with those of the crop receiving FYM or VC either alone (100% RDN) or in combination with inorganic fertilizers (50% RDNPK through inorganic fertilizers and remaining 50% RDN through FYM or VC) during all the three years. The results showed that use of 100% RDNPK through inorganic fertilizers or combined use of 50% RDNPK through inorganic fertilizers and 50% RDN through PM though gave very high tuber yield of potato but accelerated decay loss of tubers in storage. Use of biofertilizers for seed treatment did not cause much variation in decay loss of the tubers in the storage during all the three years of study.

Total weight loss

The data on total weight loss (%) recorded on stored tubers during the three years were statistically analyzed and presented in Table. 4. The results on total weight loss followed a trend similar to that of physiological weight loss. Nutrient management practices significantly affected the total loss of weight (%) of stored tubers during all the three years. The highest percentages of total weight loss of stored tubers were obtained when the crop received 100% RDNPK through inorganic fertilizers and it was on par with those of the crop receiving PM either alone (100% RDN) or in combination with inorganic fertilizers (50% RDNPK through inorganic fertilizers and remaining 50% RDN through PM), but was significantly greater than all other nutrient management treatments during three years of study. Use of FYM either alone or in combination with inorganic fertilizers and combined application of 50% RDNPK through inorganic fertilizers and remaining 50% RDN through VC also enhanced the loss of total weight of stored tubers which was significantly higher than remaining fertility treatments during all the three years. The lowest loss of total weight of stored tubers was noted when the crop did not receive any applied nutrient (control) and it was at par with crop receiving only VC (100% RDN) during all the three years. Use of biofertilizers did not cause much variation in the loss total weight of stored tubers during.

Sprouting of tuber

The results showed that sprouting of tubers varied within a very narrow range (96.3-98.5%) in different years of study (Fig 1). As a result, the sprouting of tubers during storage did not vary significantly among the crops having different nutrient management treatments during all the three years. Use of biofertilizers for seed treatment did not cause much variation in sprouting of tubers during storage in all the three years. Similarly interaction effect of nutrient management and biofertilizers was found not significant in influencing the sprouting of tubers during storage in all the three years under the study.

Based on the findings, it may be concluded that potato crop receiving 50% RDNPK through inorganic fertilizers and remaining 50% RDN through PM along with seed tubers treatment with bio-fertilizers (*Azotobacter* and

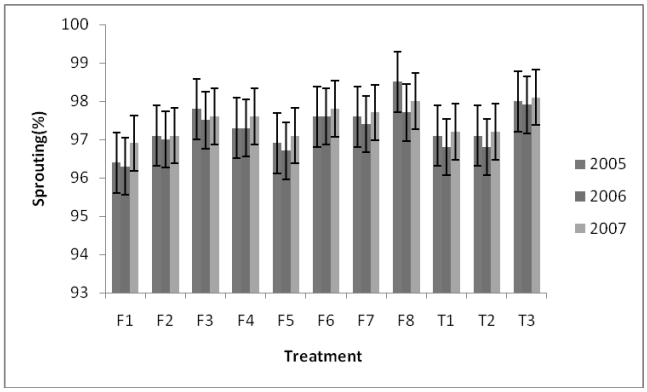

Fig. 1. Effect of different treatment combination on sprouting percentage at 120 days after harvesting of potato tuber during 2005-07.

PSB) recorded higher productivity, nutrient uptake, protein content and benefit cost ratio followed by 50% RDNPK through inorganic and remaining 50% RDN through FYM along with seed tubers treatment with biofertilizers.

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