Nature Environment and Pollution Technology
An International Quarterly Scientific Journal

ISSN: 0972-6268	Vol. 15	No. 2	pp. 465-470	2016

Original Research Paper

Assessment of Spentwash Derived Biocompost for Chemical Fertilizers Substitution by Monitoring Soil Fertility and Crop Productivity of Potato (*Solanum tuberosum* L.) in Sandy Loam Soil

U. P. Shahi*, Mamta*, Ashish Dwivedi†, Ashok Kumar* and B. P. Dhyani***
*Department of Soil Science, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut-250 110, India
**Department of Agronomy, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut-250 110, India
†Corresponding author: Ashish Dwivedi

Nat. Env. & Poll. Tech.
Website: www.neptjournal.com

Received: 29-05-2015
Accepted: 24-06-2015

Key Words:
Biocompost
Spentwash
Chemical fertilizers substitution
Soil fertility

ABSTRACT

A thrice replicated field experiment was conducted to study the effect of biocompost and inorganic fertilizers on yield and quality of potato. The experimental results revealed that, highest tuber yield was recorded in 100% NPK followed by 87.5% NPK with the least in control. Application effect of biocompost @ 12 t ha^{-1} was found to be similar to 50% NPK in respect of potato yield, while the application of inorganic fertilizers above 50% NPK showed superiority in terms of yield over all the doses of biocompost. Among the various treatments of inorganic fertilizers and biocompost, treatment where 100% RDF of NPK was applied proved to be superior to other treatments in terms of growth parameters, tuber yield and macronutrients content. However, micronutrient content in tuber was found higher in the treatments of biocompost application. By comparing the tuber yields obtained in the different treatments at harvesting, it was found that 50% inorganic NPK can be saved with the application of biocompost @ 12 t ha^{-1}. Micronutrients content in soil was buffered to its initial value with the application of different doses of biocompost while declined in case of inorganic fertilization.

INTRODUCTION

The sugar industry is the second largest agro-based industry in India. These agro-based industries are producing huge quantities of byproducts or wastes. Pressmud and molasses are produced as byproducts during the manufacturing process of white sugar. Molasses is utilized in the distillery unit for the production of alcohol. The distilleries release a huge quantity of spentwash. For every litre of alcohol produced 14 to 15 litre of effluent is discharged. Every distillery unit is discharging 5 to 10 lakh litre of raw effluent every day. Pressmud is produced @ 3% by weight of cane in sulphitation factories and 7% in carbonation factories. However, its composition varies with the locality, cane variety, milling efficiency and methods of clarification. Moreover, in organic farming composts, organic manures and their extracts are used for improving soil fertility and in combating pests and diseases (Khadem et al. 2010).

Disposal of agro industrial wastes is a major problem in many industries. So these wastes can be successfully utilized for the production of biocompost. The biocompost is produced by spraying distillery effluents on stacks of pressmud called windrows. The period required to produce usable fertilizers varies with the process used. Biocompost application to the soil provides a full complement of nutritional nourishment and improves the soil health for sustainable growth of crop plants. It provides all the essential macro and micronutrients with high organic carbon content and microbial activity. It also enhances the enzymatic activity of the plant, giving rise to increased chlorophyll synthesis, resulting in higher productivity and the quality of the fruit.

Dry matter of tubers is significantly affected by the interaction effect of zinc and phosphorus, the maximum dry matter being obtained with the application of 225 kg ha^{-1} phosphorus + 50 kg ha^{-1} zinc (Taheri et al. 2012). Thus, utilization of distillery effluents in agriculture would save costs on fertilizers and facilitate reduction in pollution load on aquatic ecosystems. Hence, the aim of the study was to examine the effects of biocompost application on potato yield and quality.

MATERIALS AND METHODS

A field experiment was conducted in summer season 2007 to study the substituting capacity of different levels of biocompost prepared from pressmud and distillery effluent and enriched pressmud to NPK levels by recording the yield and quality of potato (Kufri bahar) at Horticulture Research Centre of Sardar Vallabhbhai Patel University of Agriculture and Technology Meerut (U.P.) during *rabi* season. The biocompost (BC) was provided by the group of Bajaj Hindustan Distillery Unit, Kinauni, Meerut. The chemical composition of the biocompost is given in Table 1. The soil of experimental field was sandy loam in texture, neutral in reaction, having bulk density of 1.26 mg m^{-3}, pH and electrical conductivity of 1:2 solution 7.21 and 0.28 dSm^{-1}, respectively. Soil was low in organic carbon (0.32%) and available N (113.40 kg ha^{-1}), medium in available P (12.80 kg ha^{-1}) and K (241.30 kg ha^{-1}). The DTPA extractable micronutrients Zn, Fe, Mn and Cu in soil were 0.29, 11.25, 11.4 and 1.25 mg kg^{-1}, respectively. The treatments consisted application of 25%, 37.5%, 50%, 62.5%, 75%, 87.5% and 100% NPK through chemical fertilizers and 2, 4, 6, 8, 10 and 12 t ha^{-1} of biocompost as an organic source of nutrients. The soil of the experimental field was sandy loam in texture, neutral in reaction, low in available N and medium in P and K. The treatments consisted of 25%, 37.5%, 50%, 62.5%, 75%, 87.5% and 100% of inorganic fertilizers and 2, 4, 6, 8, 10 and 12 t ha^{-1} of biocompost as an organic source of nutrients. The organic treatments were applied 15 days before planting of tubers in the field.

Normal cultivation practices were followed for raising the crop. Fresh and dry tuber yield was recorded at 60, 90 DAP (Days after planting) and at harvest using spring balance. Crude protein content and micronutrients content (Fe, Mn, Zn and Cu) were analysed by adopting standard procedures given by Page (1980). The results so obtained were statistically analysed using computer package O P Sheoron applying the ANOVA technique (Gomez & Gomez 1984).

RESULTS AND DISCUSSION

Performance of the Crop

Plant height: Plant height measured at 90 DAP was affected significantly by different treatments. In T_8, maximum plant height (40.85 cm) was statistically similar to the plant height recorded in T_7 and significantly higher than the rest of the treatments (Table 2). At this sampling, plant height remained unaffected due to application of graded doses of biocompost, while a significant effect of graded doses of inorganic fertilizers was noticed. From the results it was found that the effect of inorganic fertilizers application upto 50% on plant height was similar to the effect of biocompost application upto 12 t ha^{-1}. The effect of 62.5 and 75% NPK was similar to the application effect of 6, 8, 10 and 12 t ha^{-1} biocompost while none of biocompost level was found to similar to 87.5 and 100% NPK in respect of plant height. Minimum plant height (34.13 cm) was recorded in T_1, although it was statistically similar to all the treatments of biocompost and as well as 25 and 37.5% NPK. Lower plant height with the application of biocompost may be due to inadequate nutrient supply to plant owing to slower mineralization of biocompost in the absence of an ideal climatic condition. These findings confirm the results of Sood (2007).

Table 1: Chemical composition of biocompost.

SN	Characteristics	Chemical Composition
1	pH	6.89
2	EC (dSm^{-1})	3.89
3	Organic carbon (%)	19.50
4	N (%)	1.30
5	P (%)	2.84
6	K (%)	1.46
7	Fe ($mg.kg^{-1}$)	7280
8	Mn ($mg.kg^{-1}$)	306
9	Zn ($mg.kg^{-1}$)	58
10	Cu ($mg.kg^{-1}$)	120

Number of shoots: Increased doses of inorganic fertilizers resulted in the increment in the number of shoots per hill (Table 2). Similarly, with the increasing doses of biocompost, the number of shoot per hill also increased with the exception of T_9 where lowest dose of biocompost was applied. The number of shoots per hill counted in T_1 were significantly lower than the rest of the treatments. No significant variation was noticed among the treatments of biocompost, while the treatment comprising application of 100% NPK recorded significantly higher number of shoots than the remaining treatments of inorganic fertilizer. The number of shoots per hill was statistically similar in treatments having application of 37.5 to 87.5 % NPK.

Number of compound leaves: At 90 DAP also no significant effect of graded doses of biocompost on number of compound leaves per hill was noticed, while in case of inorganic fertilizer treatments number of compound leaves per hill (34.70) in T_8 (100% NPK) was significantly higher than the rest of the treatments (Table 2). Significantly lower number of compound leaves per hill (23.64) than the rest of the treatments was recorded in T_1 (control). No significant effect of graded doses of NPK upto 62.5% NPK on number of compound leaves per hill was noticed, however the number of compound leaves per hill recorded in 75 and 87.5% NPK was significantly higher than the compound leaves per hill recorded in T_2 and T_3 where 25 and 37.5 % NPK was applied. These findings are also supported by Upadhayay & Khan (2008).

Fresh biomass production: At harvest stage, fresh biomass production ranged from 260.12 to 378.0 q ha^{-1}, lowest being in control while highest in T_8 (100% NPK). With exception of T_7, biomass increased significantly with increasing levels of NPK (Table 2). In case of T_7, fresh biomass production was similar to the biomass produced in T_6. Application of 12 t ha^{-1} produce significantly higher biomass than T_9, T_{10} and T_{11} while biomass production in T_{11}, T_{12} and T_{13} was significantly higher than T_9 and T_{10}. The application effect of different doses of biocompost was found equivalent to application effect of NPK upto 37.5% at harvesting.

Fresh weight of tubers: The fresh weight of tubers at harvest was maximum (245.66 q ha^{-1}) in T_8 (100% NPK) and minimum (167.83 q ha^{-1}) in control (Table 2). The tuber fresh weight recorded in T_1 at harvest was significantly lower than the tubers fresh weight recorded in rest of the treatments. Graded doses of biocompost did not show any significant effect as the tubers fresh weight recorded in all the treatments of biocompost was statistically at par. However, the effect of graded doses of NPK on tubers fresh weight was significant. T_2 and T_3 were statistically at par while T_4, T_5, T_6 and T_7 were also at par. Tubers fresh weight recorded in T_8 was significantly higher than the tubers fresh weight recorded in T_2, T_3, T_4 and T_5. The effect of biocompost application upto 10 t ha^{-1} was similar to the effect of application of inorganic fertilizers upto 37.5%. The effect of biocompost application @ 12 t ha^{-1} was found similar to the effect of 50% NPK, while the application of inorganic fertilizers above 50% showed superiority over all the doses of biocompost. The variation may be attributed to less number of compound leaves in T_1, which will lead to less photosynthesis. Secondly, in the absence of phosphorus, root growth may be poor which will cause a poor tuberisation. These findings confirm the results of Kushwah et al. (2006)

Macronutrient Content and Uptake

At harvest, the nitrogen content of tubers ranged between 0.62 to 1.21% (Table 3). The N content was not influenced significantly by application of different doses of NPK as well as biocompost. It may be due to more plant growth in case of NPK treated plots, thereby diluting the concentration and better availability of nitrogen due to mineralization of biocompost. Work of Chettri & Thapa (2002) also support our results. Whereas, the highest P content (0.20%) and K content (1.91%) was observed with the application of 100% NPK when compared with the control (0.11 and 0.91%), respectively. The P and K content varied significantly over control with the application of different doses of NPK as well as biocompost. Though, no significant effect of varying levels of NPK as well as biocompost on tuber content was found. The variation may be due to less availability of phosphorus to crop owing to slower mineralization of biocompost in unfavourable climatic conditions.

At harvest, the N, P and K uptake increased significantly with the increasing doses of inorganic fertilizers. The highest N, P and K uptake (71.13, 11.78 and 112.80 kg ha^{-1}) was found with 100% NPK compared with the lowest (24.70, 4.41 and 39.07 kg ha^{-1}) found in control. Moreover, the N uptake by the tubers did not varied significantly with the application of 25, 37.5, 50 and 62.5 % NPK, while other (P and K) varied significantly; except P uptake at 25 % NPK, any significant effect of increasing doses of biocompost was not noticed in both N and P. Assimilation of nitrogen in T_2, T_3, T_4 and all the treatments involving biocompost was statistically similar to T_1 (control) in N, whereas, P and K uptake varied significantly with the application of 2, 4, 6, 8, 10 and 12 t ha^{-1} of biocompost. K uptake did not varied significantly with the increasing levels of biocompost while in case of NPK treatments a significant effect was noticed. The probable reason was mainly due to higher tuber yield.

Micronutrient Content and Uptake

It is clear from the Table 4 that with the exception of Mn, the Fe, Zn and Cu content of potato tuber were significantly affected by different treatments. The iron content in potato tuber ranged from 86.97 to 106.99, 15.84 to 18.9 and 1.2 to 1.86 mg kg^{-1} Fe, Zn and Cu, respectively. Iron content in potato tuber remained unaffected due to application of 25 and 37.5 % NPK. Among the inorganic fertilizer treatments, iron content of potato tuber in T_8 (100% NPK) was found significantly higher than the other treatments with the exception of T_7. However, the effect remained similar upto 75 % NPK as the Zn content of tuber was statistically similar in the treatments having application of NPK from 25 to 75 %, while increased significantly over some treatments of lower doses with the application of 100% NPK. Moreover, with exception of T_2, the copper content remained unaffected with the application of remaining doses of NPK. Potato tuber copper content in T_2 was found statistically similar to T_1, T_3 and T_4. Although biocompost treated plots showed significantly higher tuber iron content than the inorganically treated plots in all micronutrients. Iron content of tuber remained unaffected upto the application of 10 t ha^{-1} and thereafter increased significantly with the application of 12 t ha^{-1} biocompost. Significantly lower tuber iron content than the remaining treatment was found in control. Furthermore, application of biocompost resulted in significantly higher Zn content of potato, while compared with the inorganically fertilizer plot but no significant variation due to application of graded doses of biocompost was observed. Tuber Zn content in control (15.83 mg kg^{-1}) was found significantly lower than the remaining all treatments. However, copper content of potato tuber also remained unaffected with the application of various doses of biocompost. Copper content of tuber found in T_1 was similar to the content found in T_2, T_3 and T_4. Though, no significant effect of different treatments on Mn content of potato tuber was observed.

The manganese content of potato varied from 11.60 to 13.87 mg kg^{-1}. Mn content of potato was higher in biocompost treated plot when compared with inorganically treated plots. It may be explained, due to better root growth with higher NPK which will exploit more soil for different nutrients. These results are in accordance with the findings of Walia & Kler (2007).

Assimilation of Fe, Zn, Cu and Mn by potato tuber varied from 350.36 to 586.05, 63.75 to 105.26, 4.84 to 11.05 and 46.79 to 76.23 g ha^{-1}, respectively (Table 2). The lowest being in case of control while the highest in T_8 (100% NPK). Among the inorganic fertilizer treatments, assimilation of iron by tuber remained unaffected with the application of NPK upto 37.5 % thereafter increased significantly with the application of 50% NPK. Whereas, assimilation of zinc by potato tuber remained unaffected with the application of NPK upto 50 %, thereafter increased significantly with the application of 62.5 % NPK. The zinc assimilation in T_8 was significantly higher than the T_2, T_3, T_4 and T_5. Moreover, assimilation of copper by tuber did not varied significantly due to application of 25 and 37.5 % NPK while it increased with the application of 50, 62.5 and 75 % NPK when compared with the assimilation in 25% NPK. In general, lower doses of NPK assimilated significantly lower copper than the higher doses. Furthermore, no significant effect of NPK application upto 50 percent on uptake of Mn by tuber was found. Uptake of Mn increased significantly due to application of 62.5, 75, 87.5 and 100% NPK when compared with 25% NPK. Though, assimilation of micronutrients, except Mn, varied significantly due to application of graded doses of biocompost.

Residual Soil Properties

Available macronutrient: Organic carbon after harvesting remained constant in the treatments where inorganic fertilizers were applied (Table 5). However, with the application of increasing doses of biocompost, the organic carbon (%) increased from 0.32 to 0.36%. Moreover, N at harvest, the T_6 was statistically at par with T_{12}, T_{13} and T_{14}. The treatment T_4 was comparable with T_{11}. In general, availability of N increased with the application of increasing doses of NPK and biocompost. Furthermore, the availability of P and K at harvest was highest (18.52 and 251.98 kg ha^{-1}) in T_8 (100% NPK) when compared with the control (10.54 and 207.14 kg ha^{-1}), respectively. All treatments varied significantly over control with the application of different doses of inorganic fertilizers and biocompost. All the treatments of NPK as well as biocompost varied significantly from each other in respect of available P, but such condition was not followed with NPK application in available K. The variation may be related to the slower mineralization of biocompost in absence of optimum temperature, which will affect microbial activity, while application of NPK will increase, available N and P in soil as losses of these will be comparatively lower. These results are in accordance with the findings of Soundarrajan et al. (2007).

Available micronutrient: Application of graded doses of inorganic fertilizers as well as biocompost did not affect the availability of copper in soil although the availability of copper decreased from its initial value with the application of inorganic fertilizers from 25 to 100% while increased with the increasing levels of biocompost application from 2 to 10 t ha^{-1}. Variation in available copper due to application of different treatments was between -19.2 to 16.0 percent, highest being in case of T_8 and least -0.8 in control (T_1).

Table 2: Effect of inorganic fertilizers and biocompost application on growth and yield of potato.

Treatments	No. of shoot/hill	Plant height (cm)	No. of compound leaves/hill	Biomass yield (t ha^{-1})	Tuber Yield (t ha^{-1})
T_1 control	2.77	34.13	23.64	26.01	16.78
T_2 25% NPK	3.38	35.33	26.58	28.87	18.70
T_3 37.5 % NPK	3.57	35.50	27.08	31.36	20.42
T_4 50% NPK	3.79	36.89	28.027	33.64	21.85
T_5 62.5% NPK	3.83	37.44	28.37	34.53	22.59
T_6 75 % NPK	3.95	37.58	29.28	36.06	23.38
T_7 87.5% NPK	4.02	39.85	31.05	36.64	23.76
T_8 100% NPK	4.63	40.85	34.70	37.80	24.56
T_9 BC@2tha^{-1}	3.33	35.25	26.30	28.87	18.70
T_{10}BC@4tha^{-1}	3.26	35.29	26.55	29.04	18.73
T_{11}BC@6tha^{-1}	3.42	35.81	26.65	30.01	19.54
T_{12}BC@8tha^{-1}	3.48	35.48	26.53	30.47	19.80
T_{13}BC@10tha^{-1}	3.49	36.12	26.55	30.54	19.83
T_{14}BC@12tha^{-1}	3.54	36.24	26.98	31.09	20.10
CD=0.05	0.53	2.04	2.19	0.96	1.93

Table 3: Effect of inorganic fertilizer and biocompost application on macronutrient content and uptake by tuber.

Treatments	Content (%)			Uptake kg.ha^{-1}		
	N	P	K	N	P	K
T_1 control	0.62	0.11	0.97	24.70	4.41	39.07
T_2 25% NPK	0.66	0.12	1.69	28.98	5.33	75.57
T_3 37.5 % NPK	0.77	0.13	1.74	37.37	6.40	85.10
T_4 50% NPK	0.81	0.13	1.83	42.61	6.83	96.05
T_5 62.5% NPK	0.86	0.15	1.86	46.27	8.10	101.00
T_6 75 % NPK	0.96	0.17	1.89	53.55	9.51	106.37
T_7 87.5% NPK	1.01	0.17	1.90	58.02	9.63	108.10
T_8 100% NPK	1.21	0.20	1.91	71.13	11.78	112.80
T_9 BC@2tha^{-1}	0.68	0.11	1.63	30.68	4.99	73.15
T_{10}BC@4tha^{-1}	0.65	0.12	1.65	29.06	5.35	74.32
T_{11}BC@6tha^{-1}	0.65	0.12	1.66	30.71	5.64	77.73
T_{12}BC@8tha^{-1}	0.82	0.14	1.67	38.33	6.62	79.63
T_{13}BC@10tha^{-1}	0.74	0.14	1.68	34.58	6.66	80.40
T_{14}BC@12tha^{-1}	0.80	0.14	1.70	38.73	6.70	81.70
CD=0.05	NS	0.03	0.27	19.91	1.63	16.85

Table 4: Effect of inorganic fertilizer and biocompost application on micronutrient content and uptake by tuber.

Treatments	Content (%)				Uptake mg kg^{-1}			
	Zn	Fe	Cu	Mn	Zn	Fe	Cu	Mn
T_1 control	15.83	86.97	1.20	11.60	63.75	350.36	4.84	46.79
T_2 25% NPK	16.62	92.39	1.29	11.84	74.60	414.65	5.76	52.96
T_3 37.5 % NPK	16.67	90.61	1.52	12.40	81.67	444.09	7.43	60.66
T_4 50% NPK	16.71	95.75	1.56	11.68	81.66	502.15	8.19	61.32
T_5 62.5% NPK	17.23	96.76	1.73	12.77	93.50	524.79	9.33	69.17
T_6 75 % NPK	17.27	97.13	1.69	12.76	97.00	545.29	9.43	71.99
T_7 87.5% NPK	17.57	97.85	1.83	12.81	100.29	557.85	10.42	73.12
T_8 100% NPK	17.85	99.41	1.84	11.94	105.26	586.05	11.05	76.23
T_9 BC@2tha^{-1}	18.80	104.31	1.79	13.01	84.67	468.14	8.08	58.60
T_{10}BC@4tha^{-1}	18.81	104.87	1.78	12.11	85.07	471.15	8.06	54.13
T_{11}BC@6tha^{-1}	18.81	103.98	1.81	13.38	88.20	487.78	8.49	62.66
T_{12}BC@8tha^{-1}	18.89	104.77	1.82	13.87	89.70	498.02	8.67	66.33
T_{13}BC@10tha^{-1}	18.93	105.51	1.84	13.19	90.03	502.31	8.80	62.79
T_{14}BC@12tha^{-1}	18.99	106.99	1.86	13.08	91.67	516.02	8.92	63.18
CD=0.05	0.72	1.80	0.38	NS	8.85	48.23	2.01	15.00

Table 5: Effect of inorganic fertilizer and biocompost application on residual soil fertility.

Treatments	Available macronutrients (kg.ha^{-1})				Available micronutrients (mg.kg^{-1})			
	OC (%)	N	P	K	Zn	Fe	Cu	Mn
T_1 control	0.32	89.89	10.54	207.17	0.29	11.18	1.24	10.81
T_2 25% NPK	0.31	98.88	11.33	209.84	0.29	11.26	1.22	10.34
T_3 37.5 % NPK	0.31	112.39	12.03	226.08	0.29	10.01	1.20	10.29
T_4 50% NPK	0.31	109.99	12.42	227.90	0.25	09.94	1.19	10.22
T_5 62.5% NPK	0.32	112.98	15.04	225.93	0.22	09.14	1.18	10.06
T_6 75 % NPK	0.32	117.78	16.43	245.24	0.20	08.99	1.16	10.47
T_7 87.5% NPK	0.31	142.29	17.59	246.24	0.17	08.26	1.13	10.09
T_8 100% NPK	0.32	147.74	18.52	251.98	0.16	07.76	1.01	09.32
T_9 BC@2tha^{-1}	0.32	99.98	11.84	208.99	0.22	10.01	1.41	11.33
T_{10}BC@4tha^{-1}	0.34	101.39	11.38	213.11	0.28	10.02	1.39	11.21
T_{11}BC@6tha^{-1}	0.34	108.65	13.49	225.62	0.29	10.06	1.40	11.28
T_{12}BC@8tha^{-1}	0.35	118.98	12.40	229.21	0.30	11.03	1.43	11.53
T_{13}BC@10tha^{-1}	0.35	117.70	12.03	237.77	0.30	11.60	1.44	11.59
T_{14}BC@12tha^{-1}	0.36	118.48	12.82	247.98	0.32	12.02	1.45	11.68
Initial	0.32	113.40	12.80	241.30	0.29	11.25	1.25	11.40
CD=0.05	NS	1.93	0.00	1.79	0.11	1.85	NS	NS

The availability of manganese decreased with the increasing levels of inorganic fertilizers. However, it was recorded to increase with the increasing levels of biocompost application in soil. The availability of Mn ranged between 9.32 to 11.68 mg kg $^{-1}$ with the highest in T_{14} (12 t ha^{-1} biocompost) while lowest in T_8 (100% NPK). In the inorganic fertilizer treatments as well as in the control, available soil manganese declined from its initial value of 11.64 mg kg $^{-1}$ while in case of biocompost treated plots it increased. Variation over initial value due to application of different treatments ranged between -0.61 to -18.25 percent, lowest being observed in T_9 and the highest in T_8. In case of available soil manganese, build up was found in T_{12}, T_{13} and T_{14}.

Iron availability decreased significantly with the increment in inorganic fertilizer levels as seen in case of T_2 to T_8, while the availability increased with the increasing levels of biocompost i.e., from 2 to 12 t ha^{-1}. Availability of iron in soil among the inorganically fertilized plot did not varied significantly with the application of NPK upto 50 %, while availability declined significantly with the application of 100% NPK when compared with the treatments having NPK application upto 50%. Among the treatments of biocompost, the application effect upto 10 t ha^{-1} was more or less similar while a significant variation was found between T_{14} and T_9, T_{10} as well as T_{11}. The variation in available iron in the soil was found between 0.09 to -31.02 percent due to application of different treatments, the highest -31.02 being in case of T_8. Available soil iron build up from its initial value only in three treatments while in the rest it declined.

Available zinc in soil (mg kg^{-1}) affected significantly by graded doses of NPK as well as biocompost is shown in (Table 5). Available soil zinc ranged from 0.16 to 0.32 (mg kg^{-1}) in different treatments. As seen from the table that the available soil zinc declined with the increasing NPK levels and it was significantly lower in case of T_7 and T_8 when compared to T_2 and T_3. It implies that higher levels of NPK resulted in more mining of available zinc. With the exception of T_2 and T_3 where estimated available soil zinc did not vary from its initial value, the available zinc in rest of the treatments of varying NPK levels declined from initial value. With the application of biocompost 2 and 4 t ha^{-1}, available zinc declined from its initial value remained unchanged with the application of 6 and 8 t ha^{-1} biocompost and slightly increased with the application of 10 and 12 t ha^{-1} of biocompost. Variation in available soil zinc was found between 0 and -44.83 percent. The lowest being in case of T_2, T_3, T_{11} and T_{12} and highest in T_8. Availability of micronutrients in soil declined with the increasing levels of NPK while increased with biocompost. Reduced availability with increasing NPK level may be ascribed due to continuous mining from soil without any addition while increased availability with biocompost may be due to solubilization of different minerals as well as addition to the soil contained by biocompost. The results fall in accordance with the findings of Mutharaju et al. (2005) and Soundarrajan et al. (2007).

CONCLUSION

Based on the above experimental findings, it can be concluded that 50% inorganic NPK can be saved with the application of biocompost @ 12 t ha^{-1}. Moreover, micronutrients content in soil was buffered to its initial value with the application of different doses of biocompost while declined in case of inorganic fertilization. These values can be improved by the application of biocompost.

REFERENCES

Chettri, M. and Thapa, U. 2002. Integrated nutrient management with farm yard manure on potato (Solanum tuberosum L.) under Gangetic plains of West Bengal. Environ. and Eco., 22 (spl 4): 766-769.

Gomez, K. A. and Gomez, A. A. 1984. Statistical Procedure for Agricultural Research-An International Rice Research Institute Book. John Willey and Sons, 2nd edition, pp. 329.

Khadem, S.A., Galavi, M., Ramrodi, M., Mousavi, S.R., Rousta, M.J. and Rezvani Moghadam, P. 2010. Effect of animal manure and super absorbent polymer on corn leaf relative water content, cell membrane stability and leaf chlorophyll content under dry condition. Aus. J. Crop Sci., 4(8): 642-647.

Kushwah, V.S., Singh, S.P. and Lal, S.S. 2006. Effect of manures and fertilizers on potato (Solanum tuberosum L.) productions. Potato J., 32(3/4): 157-158.

Mutharaju, A., Ravi, M.V. and Siddaramappa, R. 2005. Effect of application of enriched pressmud on the changes in physicochemical properties of an alfisol. Mysore J. Agric. Sci., 39(2): 207-213.

Page, A L. 1982. Methods of Soil Analysis: Part 2. Chemical and Microbiological Properties. American Society of Agronomy, Soil Science Society of America, Madison, WI, USA.

Sood, M.C. 2007. Integrated nutrient supply and management for production in mid hills of Shimla. Potato J., 34(1-2): 101-102.

Soundarrajan, M., Anandkrishnan, B., Baskar, M., Dawood, M.S., Anthoniraj, S. and Murugesan, M. 2007. Effect of judicious combination of composted pressmud, inorganic fertilizes and biofertilizes on soil physicochemical properties and yield of sugarcane. Adv. Pl. Sci., 20(1): 207-209.

Taheri, N., SharifAbad, H.H., Yousefi, K. and Roholla Mousavi, S. 2012. Effect of compost and animal manure with phosphorus and zinc fertilizer on yield of seed potatoes. J. Soil Sci. Plant Nutr., 12(4): 705-714.

Upadhayay, N.C. and Khan, M.A. 2008. Producing organic potato for health conscious people. Indian Horticulture, Nov-Dec, 32-34.

Walia, S.S. and Kler, D.S. 2007. Effect of organic, integrated and chemical farming on micronutrients in soil and their uptake under soybean-wheat system. Extended Summaries 3rd National Symposium on Integrated Farming System. Oct 26-28, pp. 229-230.