www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(2): 507-511

www.thepharmajournal.com
Received: 04-11-2021
Accepted: 14-12-2021

Arvind Patel
M.Sc., Department of Horticulture, College of Agriculture, Gwalior, Madhya Pradesh, India

Dr. PKS Gurjar
Scientist, Department of Horticulture, RVSKVV, Gwalior, Madhya Pradesh, India

Premshankar Patel
M.Sc., Department of Horticulture, College of Agriculture, Gwalior, Madhya Pradesh, India

Corresponding Author:
Arvind Patel
M.Sc., Department of Horticulture, College of Agriculture, Gwalior, Madhya Pradesh, India

Study on the effect of organic manures and bio-fertilizers on growth, yield and quality of Potato (*Solanum tuberosum* L.)

Arvind Patel, Dr. PKS Gurjar and Premshankar Patel

Abstract
The present investigation entitled "Study on the effect of organic manures and biofertilizers on growth, yield and quality of potato (*Solanum tuberosum* L.)" was conducted at Research area, College of Agriculture, Gwalior M.P. during Rabi 2020-2021 under agro-climatic and soil conditions of Northern Madhya Pradesh. Potato *(Solanum tuberosum* L.) is one of the most important vegetable crops widely grown in the world. It belongs to the family solanaceae and considered to be originated in South America. Potato is world's fourth important food crop after wheat, rice and maize. The widely grown potato is an auto tetraploid with 2n=48.It is a heavy feeder of plant nutrients having very high requirement of nitrogen, phosphorus, potassium and other nutrients. The organic manures not only supply the nutrients but also improve the physical environment for better plant and tuber growth. The manures are low analysis nutrient carriers yet play a significant role in the fertilizer economy. Farm yard manure (FYM) is the most common organic manure used in India. Biofertilizers (*Azotobacter* +PSB) have been recognized as cheapest fertilizer input for developing countries like India as source of supplement on the application of chemical fertilizer for better crop production. The experiment was laid out in the Randomized Block Design with three replications. Each replication was comprised of 11 treatment combinations. The following treatment combinations involving RDF dose of fertilizers, vermicompost, *Azotobactor* and PSB were applied before planting in potato varietyKufri Chipsona-1.The result clearly shows that huge variation was noticed among the different treatment studied in this investigation for all the morphological parameters, yield parameters and quality parameters as well as economic parameters of potato. Results showed that the treatment T_8 (75% RDF + 25% Vermicompost + *Azotobacter*+ PSB) is the best application of organic manure and biofertilizers with different level of RDF doses and had significant effect on morphological, yield and quality parameters as well as economic parameters of potato. Treatment T_8 (75% RDF + 25% Vermicompost + *Azotobacter*+ PSB) gave maximum morphological parameters, yield parameters, quality parameters and economics parameters of potato as compared to all other treatments, however the minimum morphological, yield, quality and economics parameters were observed in treatment T_4 (50% RDF + 25% FYM + 25% Vermicompost).

Keywords: Potato, biofertilizers, FYM, vermicompost, RDF, growth, yield

Introduction
Potato (*Solanum tuberosum* L.) is one of major crops contributing to the world's food security. Potato is one of the most important field crops not only to its local consumption but also to increase income through its exportation in different countries in the world. It is a member of Solanaceae family. Post harvest improvement such as fast and cheap transportation, storage and processing will help to make potato production more profitable for farmers by improving their access to markets, raising local value addition. Several products like chips, flakes, French fries, finger chips and flour are made out of potato tubers. This also fits well in multiple cropping systems prevalent under tropical and subtropical agro-climatic conditions. Potato is being a high yielding, nutrient exhaustive and short duration crop needs higher quantities of fertilizers and pesticides as compare to other crops.

In India, The area and production of potato are 2164.05 thousand ha. and 46545.62 thousand metric tons/ha (Anon, 2018-19). In Madhya Pradesh the total area under potato cultivation is 1156.20 thousand ha. and production 3134.46 thousand metric tons (Anon, 2018-19).

Application of organic sources in conjunction with fertilizers ensures Organic agriculture is a holistic production management system which promotes and enhances agro-ecosystem health, including bio-diversity, biological cycles and soil-biological activity. It emphasizes the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adopted systems.

Farm yard manure (FYM) is the most common organic manure used in India. Bio-fertilizers (*Azotobacter* + PSB) have been recognized as cheapest fertilizer input for developing countries like India as source of supplement on the application of chemical fertilizer for better crop production

Materials and Methods

The present investigation was carried out at the field Experimentation Centre, Department of Horticulture and Vegetable Science studies in post-graduation, R.V.S.K.V.V., Gwalior, (M.P) during Rabi season 2020-2021. The experiment was laid out in randomized block design (RBD) at Variety - Kufri Chipsona-1, plot size - 3 m x 3 m, distance between replications - 1.5 m, distance between plots - 0.5m. Recommended dose of fertilizers was 180:80:120 N, P2O5and K2O kg/ha, respectively. Date of planting was 10-11-2020. Pre-planting tuber seed dipping treatment was done with Mancozeb 0.2% solution for 10 minutes and spread at a cool and moist place so that to check fungal infection. Healthy, uniform medium sized tubers (35 – 45 mm or 45 – 50 g) at the rate of 30 - 35q/ha were used. Shallow furrows were opened 6 cm apart with the help of pickaxe manually and tubers were dibbled at a spacing of 60 cm row to row and 20 cm plant to plant, with three replication and eleven treatments which comprised of organic manures (farmyard and vermicompost) and biofertilizers (*Azotobacter* and PSB) and their combinations. Two biofertilizers were inoculated as soil application. Five plants were randomly tagged in each treatment as per replication and data was recorded according to morphological, quality, yield *viz*. days required for emerging plant, plant height at 60 DAP, number of compound leaves per plant at 60 DAP, fresh weight of shoots per plant (g), dry weight of shoots per plant, diameter of stem (cm) at 60 DAP and number of haulms per plant at 60 DAP), yield parameters (*viz*., tubers yield per plot (kg), per hectare (q), number of tubers per plant at harvest, average diameter of tubers per plot and average tuber weight per plot), quality parameters (*viz*., dry matter content per 100g of edible portion, TSS at harvest and starch content of tubers at harvest). Treatments were T_1 - 100%RDF (Dose/ha), T_2 - 75% RDF + 25% FYM, T_3 - 75% RDF + 12.5% FYM + 12.5% Vermicompost, T_4 - 50% RDF + 25% FYM + 25% Vermicompost, T_5 - 75% RDF + 12.5% FYM + 12.5% Vermicompost +*Azotobacter*, T_6 - 75% RDF + 12.5% FYM + 12.5% Vermicompost + PSB, T_7 - 75% RDF + 25% FYM +*Azotobacter* + PSB, T_8 - 75% RDF + 25% Vermicompost + *Azotobacter*+ PSB, T_9 - 50%RDF + 12.5% FYM +12.5% Vermicompost + *Azotobacter* + PSB, T_{10} - 75%RDF + 25%FYM + PSB**,** T_{11} **-** 75%RDF + 25% Vermicompost + *Azotobacter*. Farm yard manure (FYM) – 25t/ha, Vermicompost 10t/ha, Biofertilizers –Aztobactcor 1liter/ha & PSB 1liter/ha each and RDF (180:80:120) NPK/ha.

Nitrogen, phosphorus and potassium were applied, through urea, single super phosphate and murate of potash, respectively. A uniform dose of 180 kg N/ha and 100 kg P2O5/ha was applied to all the plots. Vermicompost and potassium as per treatment were applied in respective plot before planting. Full quantity of phosphorus potassium fertilizer and vermicompost along with half dose of nitrogen was applied before planting while, the rest half nitrogen was applied in two split doses during was earthing up. After planting of potato tubers, irrigation was given as per need of the crop. Over all, six irrigations were applied during entire crop season. Earthing up was done at 25 DAP to protect the tuber from sunlight and potato tuber moth. Weeding was done manually at different growth stages to check the growth of weeds. Imidachlorprid 0.2% (@ 6 ml /15litre water) or thiomethoxan0.25% for control of Aphids and Jassid, alternately to keep the crop free from pest during crop growth period. Growth and yield observations were recorded at 60DAP and at harvest.

Harvesting of the crop was done treatment-wise on 30th March, 2021. Firstly one border row from both sides and two plants from both ends were harvested to eliminate the border effect from each plot. Harvesting was done by digging of plants with the help of sickle axe. After harvesting, tubers were separated according to the treatment and weighed on double pan balance for each treatment separately. After this, weight of tuber from each plot was converted from kilograms to tonnes/ha by multiplying with the appropriate factor. For different treatments total cost was calculated on the basis of prevailing market rates of fertilizer, field preparation, planting of seeds, labourers charge, cultural and intercultural operations etc.

Results and Discussion

Morphological parameters

It was evident from the result that the treatment T_8 (75% RDF + 25% Vermicompost + *Azotobacter* + PSB) is significantly superior to other dose of organic manures and biofertilizers with different levels of RDF and had significant effect on morphological parameters of potato. The maximum morphological parameters (*viz*., plant height at 60 DAP, number of compound leaves per plant at 60 DAP, fresh weight of shoots per plant (g), dry weight of shoots per plant, diameter of stem (cm) at 60 DAP and number of haulms per plant at 60 DAP) were recorded under treatment T_8 (75% RDF + 25% Vermicompost + *Azotobacter* + PSB) and it was found significantly superior to other treatments and the minimum morphological parameters were found in treatment T_4 (50% RDF + 25% FYM + 25% Vermicompost), respectively. While the minimum days required for emerging plant was recorded under treatment T_8 (75% RDF + 25% Vermicompost + *Azotobacter* + PSB) and the maximum days required for emerging plant was recorded in treatment T_4 (50% RDF + 25% FYM + 25% Vermicompost) (Table 1). This could be due presence of enzymes, hormones, growth regulators along with plant nutrients in vermicompost while Azotobacter and PSB are biofertilizers which improves the nutrient up take and provide better condition for plant growth. Vermicompost promoting growth by enhanced biosynthesis and accumulation of proteins, amino acids and enzymes which are responsible for cell division and cell elongation thus resulted in improvement in length and width of leaves and diameter of stem. *Azotobacter* and PSB are improves the availability of nitrogen and phosphorus by nitrogen fixation and phosphorus solubilization. Similar results for most of the characters were also reported by Choudhary *et al.* (2010) [6], Jaipaul *et al*. (2011) [9], Kumar *et al*. (2015) [13], Kumar *et al.* (2015) [13], Shirzadi (2015), Singh *et al.* (2017), Koodi *et al.* (2017) [10], Brijesh *et al.* (2017) [5], Ramandeep *et al.* (2018) [18], Ali *et al.* (2019) [2], Ali *et al*. (2020) [3], Saxena and Singh (2020) [19] and Gangele *et al.* (2020) [7].

Table 1: Effect of organic manures and biofertilizers on Morphological characters in Potato

Treatment Code	Days required for emerging plant	Plant height (cm) at 60 DAP	Fresh weight of shoots per plant (g)	Dry weight of shoots per plant (g)	Diameter of stem (cm) at 60 DAP	Number of haulms per plant at 60 DAP
T1	8.21	46.33	183.01	27.20	11.59	7.33
T2	11.80	37.37	170.39	21.87	7.52	5.67
T3	10.47	39.89	172.39	22.19	8.25	6.00
T4	13.01	32.02	165.01	20.02	6.50	5.00
T5	7.60	47.37	185.47	28.56	12.49	7.67
T6	9.58	42.05	175.04	24.63	9.89	6.67
T7	8.63	45.26	182.03	26.25	11.07	7.00
T8	7.00	48.00	188.06	29.01	13.00	8.00
T_9	12.38	34.21	167.26	21.05	6.93	5.33
T_{10}	10.25	41.41	174.25	24.11	9.12	6.33
T_{11}	8.91	43.35	179.14	25.25	10.71	7.00
S.Em ±	0.242	0.549	1.014	0.500	0.248	0.486
CD 5%	0.714	1.618	2.992	1.475	0.732	1.434

Yield characters

The investigation revealed that the treatment T_8 (75% RDF + 25% Vermicompost + *Azotobacter*+ PSB) is the best application of organic manure and biofertilizers with different level of RDF. The maximum yield parameters (*viz*., tubers yield per plot (kg), per hectare (q), number of tubers per plant at harvest, average diameter of tubers per plot and average tuber weight per plot) were found in treatment T_8 (75% RDF + 25% Vermicompost + *Azotobacter*+ PSB) and it was significantly superior to other treatments while the minimum yield parameters were recorded in treatment T_4 (50% RDF + 25% FYM + 25% Vermicompost) (Table 2). The application of vermicompost, Azotobacter and PSB might have significantly enhanced the availability of native and applied macro and micro nutrients, vitamins, enzymes, antibiotics, growth hormones and insoluble nutrients to the plants, as consequence of which increase the yield of potato tubers and plant. Tuber yield was influenced to great extent by growth, nutrient and moisture supply. The increase in yield with the application of vermicompost, Azotobacter and PSB could be attributed to corresponding increase in leaf area and insoluble nutrients to soluble form, which was responsible for synthesizing photosynthate and increase in number and weight of tuber. The results are in confirmation with the results achieved by Kumar *et al*. (2011) [11], Narayan *et al.* (2013) [14], Kumar *et al*. (2015) [13], Sharma *et al.* (2015), Kumar and Singh (2016) [12], Singh *et al.* (2017), Koodi *et al.* (2017) [10], Islam *et al*. (2017) [8], Sikder *et al.* (2017) [20], Brijesh *et al.* (2017) [5], Ramandeep *et al*. (2018) [18], Ali *et al.* (2019) [2], Ali *et al*. (2020) [3] and Saxena and Singh (2020) [19].

Table 2: Effect of organic manures and biofertilizers on yield characters in Potato

Treatment Code	Tuber yield per plot (kg)	Tuber yield per hectare(q)	Number of tubers per plant at harvest	Average diameter of tubers (cm) per plot at harvest	Average tuber weight (g) per plot
T1	29.29	351.47	10.33	5.64	56.70
T2	16.01	192.09	7.00	4.57	45.76
T3	17.21	206.53	7.33	4.76	46.94
T4	12.59	151.12	6.00	4.03	42.04
T5	30.36	364.35	10.67	5.90	57.04
T6	21.57	258.81	8.67	5.03	49.74
T7	25.00	300.06	9.33	5.36	53.58
T8	31.93	383.20	11.00	6.00	58.01
T_9	13.77	165.21	6.33	4.42	43.41
T_{10}	19.37	232.41	8.00	4.87	48.47
T_{11}	23.26	279.11	9.00	5.13	51.75
S.Em ±	1.460	17.522	0.584	0.102	0.488
CD 5%	4.308	51.692	1.724	0.300	1.440

Quality parameters

The result revealed that the treatment T_8 (75% RDF + 25% Vermicompost + *Azotobacter* + PSB) is significantly superior to other dose of organic manures and biofertilizers with different levels of RDF and had significant effect on quality parameters of potato. The maximum quality parameters (*viz*., dry matter content per 100g of edible portion, TSS at harvest and starch content of tubers at harvest) were observed in treatment T_8 (75% RDF + 25% Vermicompost + *Azotobacter* + PSB) and it was significantly superior to other treatments. However, the minimum quality parameters were observed in treatment T_4 (50% RDF + 25% FYM + 25% Vermicompost) (Table 3). It might be due to application of vermicompost, *Azotobacter* and PSB that played a positive role in affecting quality parameters of potato like dry matter content, TSS and starch content. The highest tuber TSS content might be due to maximum moisture content, dry weight of tuber because organic fertilizers carry almost all micro and macro nutrients that are required for the plants growth and the continued application of vermicompost increase photosynthesis of plant and due to enhancement of photosynthesis, sugar, starch and cellulose synthesis might have improved. These results are supported by the findings of Prasad (2010) [16], Jaipaul *et al.* (2011) [9], Abdel and Shams (2012) [1], Bhat *et al.* (2017) [4], Koodi *et al.* (2017) [10], Islam *et al.* (2017) [8], Brijesh *et al.* (2017) [5], Ram *et al.* (2017) [17] and Gangele *et al.* (2020) [7].

Table 3: Effect of organic manures and biofertilizers on Quality characters in Potato

Treatment Code	Dry matter content per 100g of edible portion	TSS (^{0}Brix) at harvest	Starch content (%) of tubers at harvest
T1	22.20	4.66	18.62
T2	19.85	4.56	16.03
T3	20.06	4.58	16.93
T4	19.50	4.50	15.02
T5	22.86	4.69	19.67
T6	20.55	4.60	17.94
T7	21.39	4.64	18.18
T8	23.02	4.70	20.06
T_9	19.69	4.54	15.55
T_{10}	20.35	4.59	17.27
T_{11}	20.94	4.61	18.12
S.Em ±	0.272	0.010	0.172
CD 5%	0.803	0.030	0.507

Economics parameters

Results showed that that treatment T8 (75% RDF + 25% Vermicompost + Azotobacter+ PSB) is the best application of organic manure and biofertilizers with different level of RDF and had significant effect on economical yield of potato. The maximum cost of cultivation, gross income and net income was recorded in treatment T8 (75% RDF + 25% Vermicompost + Azotobacter+ PSB), while maximum B:C was found in treatment T5 (75% RDF + 12.5% FYM + 12.5% Vermicompost + Azotobacter) and T8 (75% RDF + 25% Vermicompost + Azotobacter+ PSB). However, the minimum cost of cultivation was recorded in treatment T1 (100% RDF (Dose/ha)) while gross income, net income and B:C was recorded in treatment T4 (50% RDF + 25% FYM + 25% Vermicompost) (Table 4). Findings are in agreement with those of Verma *et al*. (2010) [22], Verma *et al*. (2011) [21], Kumar *et al*. (2011) [11] and Gangele *et al*. (2020) [7].

Table 4: Economics of the treatments in Potato

Treatment Details	Cost of cultivation (₹/ha)	Gross income (₹/ha)	Net income (₹/ha)	B:C ratio
T_1 –100% RDF (Dose/ha)	122000	369044	247044	3.0
T_2 –75% RDF + 25% FYM	125000	230503	105503	1.8
T_3 –75% RDF + 12.5% FYM + 12.5% Vermicompost	128250	247841	119591	1.9
T_4 –50% RDF + 25% FYM + 25% Vermicompost	134500	181349	46849	1.3
T_5 –75% RDF + 12.5% FYM + 12.5% Vermicompost +*Azotobacter*	129750	437225	307475	3.4
T_6 – 75% RDF + 12.5% FYM + 12.5% Vermicompost + PSB	130050	310570	180520	2.4
T_7 – 75% RDF + 25% FYM +*Azotobacter* + PSB	128300	360067	231767	2.8
T_8 –75% RDF + 25% Vermicompost + *Azotobacter*+ PSB	134800	459835	325035	3.4
T_9 – 50% RDF + 12.5% FYM +12.5% Vermicompost + *Azotobacter* + PSB	128550	198247	69697	1.5
T_{10} – 75% RDF + 25%FYM + PSB	126800	278894	152094	2.2
T_{11} –75% RDF + 25% Vermicompost + *Azotobacter*	133000	334926	201926	2.5

Conclusion

From present investigation, it can be concluded that huge variation was noticed among the different treatment studied all the morphological parameters, yield parameters and quality parameters of potato. Results showed that the treatment T_8 (75% RDF + 25% Vermicompost + *Azotobacter* + PSB) is the best application of organic manure and biofertilizers with different level of RDF doses and had significant effect on morphological, yield and quality parameters, Treatment T_8 (75% RDF + 25% Vermicompost + *Azotobacter* + PSB) gave maximum morphological parameters, yield parameters, quality parameters and economics parameters of potato as compared to all other treatments, however the minimum morphological, yield, quality and economics parameters were observed in treatment T_4 (50% RDF + 25% FYM + 25% Vermicompost).

Reference

1. Abdel-Salam MA, Shams AS. Feldspar-K fertilization of potato (*Solanum tuberosum* L.) augmented by bio-fertilizer. American-Eurasian-Journal-of-Agricultural-and-Environmental Sciences. 2012;12(6):694-699.
2. Ali AM, Awad M, Hegab SA, Abd El-Gawad A. Promoting effect of potassium solubilizing bacteria (*Bacillus cereus*) on nutrients availability and yield of potato. Archives of Agriculture Sciences Journal. 2019;2(2):43-54.
3. Ali AM, Awad MYM, Hegab SA, Abd El Gawad AM, Mamdouh Eissa A. Effect of potassium solubilizing bacteria (Bacillus cereus) on growth and yield of potato. Journal of Plant Nutrition. 2020;44(3):1-10.
4. Bhat Tariq A, Wani KP, Sheikh AA, Mushtaq F, Asif MR, Ejaz A, *et al*. To study effect of organic sources and pruning patterns on growth and yield of sweet pepper (Capsicum annuum var. Grossum) cv. Shalimar hybrid-2 under protected conditions. International Journal of Chemical Studies. 2017;5(4):93-96.
5. Brijesh, Singh BN, Kumar H. Impact of various organic treatments on growth, yield and quality parameters of potato. Int. J Pure Applied Bioscience. 2017;5(3):643-647.
6. Choudhary AK, Rahi S, Singh A, Yadav DS. Effect of vermi-compostand bio-fertilizers on productivity and profitability in potato in north-western Himalayas. Current Advances in Agricultural Sciences. 2010;2(1):18-21.

7. Gangele P, Bajpai R, Kashyap A, Rai S, Ahirwar SK. Effect of biofertilizers and levels of zinc and potassium on growth of potato (*Solanum tuberosum* L.). Journal of Pharmacognosy and Phytochemistry. 2020;9(5):863-866.
8. Islam MA, Islam S, Akter A, Rahman MH, Nandwani D. Effect of organic and inorganic fertilizers on soil properties and the growth, yield and quality of tomato in Mymensingh, Bangladesh. Agriculture. 2017;7(18):2-7.
9. Jaipaul S, Sharma, Sharma AK. Effect of different organic fertilizers was studied on potato yield and other quality attributes under rainfed conditions of central Himalayan region of Uttarakhand. Potato Journal. 2011;38(2):176-181.
10. Koodi S, Singh SP, Rolaniya MK, Gathala S, Choudhary R. Effect of NPK, FYM and vermicompost on growth, yield and quality of sweet potato (Ipomoea batatas Lam.). Chemical Science Review and Letters. 2017;6(21):495-499.
11. Kumar M, Baishya LK, Ghosh DC, Gupta VK. Yield of potato (*Solanum tuberosum*) tubers as influenced by nutrient source under rainfed condition of Meghalaya. Indian Journal of Agronomy. 2011;56:3.
12. Kumar R, Singh ND. Effect of inorganic and organic sources of nutrients on nutrient uptake, yield and economics of processing potato (*Solanum tuberosum* L.). International Journal of Advanced Research. 2016;4(4):498-503.
13. Kumar R, Singh A, Hooda V, Singh Rk, Singh M. Effect of organic manures, bio-fertilizer and mulching on growth and yield of potato (*Solanum tuberosum* L.) The Bio Scane 2015;(1):403-406. (Supplement on Agronomy).
14. Narayan S, Kanth RH, Narayan R, Khan FA, Singh P, Rehman SU. Effect of integrated nutrient management practices on yield of potato. Potato J. 2013;40(1):84-86.
15. National Horticulture database, NHB. Horticulture Statistics Division Dept. of Agri. Cooperation and Horticulture at a Glance 2018-19 Govt. of India, Gurgaon, India, 2018-19. http://www.nhb.gov.in.
16. Prasad KK. Effect of different organic source on growth, yield and quality of potato (*Solanum tuberosum*) varieties. Abstract of PhD thesis, Rajendra Agricultural University, Bihar, Pusa (Samastipur), India, 2010, p: 2.
17. Ram B, Singh BN, Kumar H. Impact of Various Organic Treatments on Growth, Yield and Quality Parameters of Potato, Int. J Pure App. Biosci. 2017;(3):643-647.
18. Ramandeep, Singh S, Kumari S, Singh SK. Impact of bio-fertilizers and fertilizers on potato (*Solanum tuberosum* L.) cv. Kufri Pukhraj and Kufri Jyoti cultivation. International Journal of Chemical Studies. 2018;6(4):29-31.
19. Saxena AK, Singh S. Effect of bio fertilizers and inorganic fertilizers on growth and yield of potato (*Solanum tuberosum* L.) Cv. Kufri Chandramukhi and Kufri Jyoti International Journal of Current Advanced Research. 2020;9(06):22535-22538.
20. Sikder RK, Rahman MM, Bari Washim SM, Mehraj H. Effect of organic fertilizers on the performance of seed potato. International Journal of Tropical Plant Research. 2017;4(1):104-108.
21. Verma SK, Asati BS, Tamrakar SK, Nanda HC, Gupta CR. Effects of organic components on growth yield and economics returns in potato. Potato Journal. 2011;38:51-55.
22. Verma SK, Asati BS, Tamrakar SK, Nanda HC, Gupta CR. Response of potato to organic sources with inorganic fertilizers under Chhattisgarh plain. Advances in Plant Sciences. 2010;23(2):645-647.