INFLUENCE OF ORGANIC AND INORGANIC FERTILIZERS ON GROWTH, YIELD AND ECONOMICS OF POTATO CROPS UNDER CHHATTISGARH PLAINS

Eshu Sahu, D.A. Sarnaik, P.K. Joshi, Pravin Kumar Sharma and Smita Bala Barik

Department of Horticulture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.)
Email: eshusao@gmail.com

Abstract: The field experiment was conducted at the All India Coordinated Research Project on Potato , Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh during *Rabi* 2013-2014 in factorial randomized block design with fifteen treatment combinations consisting of different levels of RDF as (75%, 100% and 150% NPK) and different organic fertilizers as (FYM, PSB and *Azotobacter*) were replicated three times. Among the inorganic fertilizer treatments 150% RDF performed better over other treatments, while in case of organic fertilizer treatments PSB + *Azotobacte*r was found superior than others. The interaction between organic and inorganic fertilizers was found differ non significantly. The results indicated that the highest gross return (Rs 271480 ha^{-1}), net return (Rs 192827.52 ha^{-1}) and benefit: cost ratio (Rs 2.45) was obtained under 150% RDF with PSB + *Azotobacte*r.

Keywords: Potato, fertilizers, biofertilizers, yield

INTRODUCTION

Potato (*Solanum tuberosum* L.) is one of the most important vegetable crops having high production per unit area and time. It can fulfill the requirement of food for human consumption to a greater extent. It is a rich source of carbohydrates (22.6 g/ 100g) as well as starch (16.3 g/ 100 g) and protein. It is good source of raw material for processing industries.

Potato produce higher yield from lesser span of time resulting soil exhausting very rapidly. The repeatedly cultivation of potato needs profuse application of nutrients, currently most of the nutrient requirements have fulfilled through inorganic fertilizers. The continuous application of inorganic fertilizers affects the soil health adversely whereas combination of inorganic and organic fertilizer or pure organic fertilizers may maintain soil health properly and subsequentely improve soil quality, health in sustainable manner (Densilin *et al*., 2010).

MATERIAL AND METHOD

The experiment was conducted at the All India Coordinated Research Project on Potato, Indira Gandhi Krishi Vishwavidylaya, Raipur (C.G.), in winter season of 2013-14 to study the influence of organic and inorganic fertilizers on growth and yield of potato under Chhattisgarh plains. Fertilizer was applied in the three level F1- 75%, F2- 100% and F3- 150% RDF, nitrogen was applied in the form of urea 75%, 100% and 150% N, half at planting and the remaining half 30 days after planting the first earthing up. Phosphorus in the form of single super phosphate and potassium in the form of muriate of potash were applied as basal dose. The organic fertilizers were also used as per treatments. In treatment O1- no organic manure, O2 - FYM @ 20 t/ha, O3 - PSB@ 5kg/ha, O4 – *Azotobacter* @ 5kg/ha and O5 -PSB @ 5kg/ha + *Azotobacter* @ 5kg/ha. It was applied in ridges and furrows area then tuberlets were immediately planted in the field at spacing of 60 X 20cm. Data were taken on the plant emergence, plant height, number of shoots, number of leaves, number of stolons, no of tubers per plant, fresh weight and dry weight of tubers per plant, marketable tuber yield and total tuber yield.

RESULT AND DISCUSSION

Influence of inorganic fertilizers

Results of investigation under inorganic fertilizer treatments revealed that growth parameters like plant emergence at 30 DAP (%), plant height (cm), number of shoots plant $^{-1}$, number of compound leaves plant^{-1}, fresh weight of shoot plant $^{-1}$, dry weight of shoot plant $^{-1}$ were influenced with the increased per cent of RDF. The highest values for all the above parameters were recorded under the treatment in which 150% RDF was applied (F_3) and lowest value recorded under the treatments 75% RDF. Higher dose of NPK significantly increased the plant height. Nitrogen is an essential element for cell division, cell enlargements and it increases the protoplasm. Phosphorus has got direct impact on shoot growth and root development whereas, potassium is one of the important constituents of cell and helps to provide resistance against disease and pests. Similar results had also been reported by Al Moshileh *et al.* (2005), *Banafar et al*. (2005), Alam *et al.* (2007), Singh *et al.* (2007), Nag *et al.* (2008), Najm *et al.* (2010), Patel *et al.* (2010), Yadu (2011) and Baishya *et al.* (2013).

Yield parameters like number of tubers plant $^{-1}$, fresh weight of tubers plant $^{-1}$, dry weight of tubers plant $^{-1}$, marketable tuber yield and total tuber yield were also influenced with the increased per cent of RDF. The highest values for all the yield parameters were recorded under the treatment in which 150% RDF was applied (F_3) and lowest value recorded under 75% RDF.. This might be due to the optimum vegetative growth with the application of higher level

of RDF, which ultimately responsible for accumulation of higher photosynthetes in the developing tubers and produced higher fresh weight of tubers per plant. The results are conformity with the findings of Al-Moshileh *et al*. (2005) and Yadu (2011) observed that with the increase in RDF application from 50 to 150 % brought about 176 and 119% increase in marketable tubers, respectively over the control.

Influence of organic fertilizers

Results of investigation under organic fertilizer treatments revealed that growth and yield parameters like plant emergence at 30 DAP (%), plant height (cm), number of shoots plant $^{-1}$, number of compound leaves plant $^{-1}$, fresh weight of shoot plant $^{-1}$, dry weight of shoot plant $^{-1}$, number of tubers plant $^{-1}$, fresh weight of tubers plant $^{-1}$, dry weight of tubers plant $^{-1}$, marketable tuber yield and total tuber yield were found highest under the treatment O_5 (PSB @ 5 kg/ha+ Azotobacter @ 5 kg/ha) and lowest value recorded under no organic manure. This may be due to the application of biofertilizers (PSB and Azotobacter). *Azotabacter* fixed the nitrogen and increased the availability of nitrogen from soil, crop residue, as it was associated with crop. As phosphorus is very less available to plant due to its high fixation in soil, the PSB increases the availability of soil P and also increases the release efficiency of P from the organic resource. Due to this a sufficient amount of P is made available to plant, which increase the tuber yield. Similar results have been reported by Singh *et al*. (2002), Nag (2008) and Verma *et al*. (2011).

The interaction between organic and inorganic fertilizers was found differ non significantly.

Economics

Table 3 indicates highest net return (Rs 192827.52/ha) and B:C ratio (2.45) in treatment combination F3O5 followed by F3O4 with corresponding values of Rs 187312.52/ha and 2.38 respectively. The minimum net return (Rs 63319.62/ha) and B:C ratio (0.93) was calculated for F1O1. On the basis of the present results, it can be stated that the combined application of PSB @ 5 kg/ha+ *Azotobacter* @ 5 kg/ha has may be the best approach among all the treatments to increase tuber yield and therefore, economic return for the farmer. It can, therefore, be concluded that the biofertilizers (PSB and *Azotobacter*) are a beneficial sources of nutrients for sustainable organic agriculture in crop that requires, high amounts of nutrients, like potato.

Table1: Influence of organic and inorganic fertilizers on growth parameters of potato crops

Treatments	**Per cent emergence at 30 DAP**	**Plant height (cm)**	**Number of compound leaves plant^{-1}**	**No of shoots plant^{-1}**	**Fresh weight of shoots plant^{-1} (g)**	**Dry weight of shoots plant^{-1} (g)**
INORGANIC FERTILIZER						
F_1 – 75 % RDF	89.33	36.52	42.61	4.93	91.30	13.09
F_2 – 100 % RDF	91.48	40.03	48.91	5.11	96.35	13.42
F_2 – 150 % RDF	94.77	46.51	53.61	7.08	111.41	17.87
SEM±	**1.02**	**0.98**	**1.64**	**0.18**	**3.37**	**0.42**
CD	**2.97**	**2.85**	**4.75**	**0.53**	**9.75**	**NS**
ORGANIC FERTILIZER						
O_1 – No organic manure	88.11	36.27	40.90	4.48	86.33	11.47
O_2 – Organic manure (FYM) @ 20 t/ha	91.47	38.99	47.31	5.36	94.37	14.24
O_3 – PSB @ 5kg/ha	90.55	41.21	48.43	5.81	99.46	14.65
O_4 – Azotobacter @ 5kg/ha	92.03	43.39	50.89	6.16	106.72	16.10
O_5 – PSB @ 5 kg/ha+ Azotobacter @ 5 kg/ha	93.35	45.24	54.33	6.74	111.57	17.53
SEM±	**1.32**	**1.27**	**2.12**	**0.24**	**4.35**	**0.54**
CD	NS	**3.68**	**6.14**	**0.69**	**12.59**	**NS**
INORGANIC X ORGANIC FERTILIZERS						
SEM±	**2.28**	**2.19**	**1.64**	**0.41**	**7.53**	**0.94**
CD	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Table2: Influence of organic and inorganic fertilizers on yield parameters of potato crops

Treatments	No of tubers plant^{-1}	Fresh weight of tubers plant^{-1} (g)	Dry weight of tubers plant^{-1} (g)	Marketable tuber yield q/ha	Total tuber yield q/ha
INORGANIC FERTILIZER					
F_1 – 75 % RDF	7.68	221.70	49.63	164.23	177.91
F_2 – 100 % RDF	8.50	299.79	54.47	202.44	211.81
F_2 – 150 % RDF	10.58	348.38	63.51	237.88	244.83
SEM±	**0.19**	**14.20**	**1.91**	**6.09**	**6.18**
CD	**0.54**	**41.13**	**5.55**	**17.63**	**17.89**
ORGANIC FERTILIZER					
O_1 – No organic manure	7.75	223.60	48.13	158.43	170.46
O_2 – Organic manure (FYM) @ 20 t/ha	9.18	264.13	53.22	181.19	190.79
O_3 – PSB @ 5kg/ha	7.50	300.50	55.24	210.20	220.20
O_4 – Azotobacter @ 5kg/ha	8.84	316.51	59.80	226.06	234.54
O_5 – PSB @ 5 kg/ha+ Azotobacter @ 5 kg/ha	11.32	345.01	62.97	231.70	241.60
SEM±	**0.24**	**18.33**	**2.47**	**7.86**	**7.97**
CD	**0.69**	**53.09**	**7.16**	**22.76**	**23.09**
INORGANIC X ORGANIC FERTILIZERS					
SEM±	**0.41**	**31.74**	**4.28**	**13.61**	**13.81**
CD	**NS**	**NS**	**NS**	**NS**	**NS**

Table 3: Economics of potato as influenced by different organic and inorganic fertilizer treatments

Treatments	Yield (q/ha)	Cost of cultivation per ha			Cost per ha		Sale price (Rs/q)	Net returns* (Rs/ha)	B:C Ratio
		Seed	Fertilizer	Cultivation	Inputs	Produce			
F1O1	131.29	40000	5232.08	22738.30	67970.38	131290	1000	63319.62	0.93
F2O1	172.87	40000	6976.12	22738.30	69714.42	172870	1000	103155.58	1.47
F3O1	207.22	40000	10464.18	22738.30	73202.48	207220	1000	134017.52	1.83
F1O2	155.37	40000	10232.08	22738.30	72970.38	155370	1000	82399.62	1.12
F2O2	183.61	40000	11976.12	22738.30	74714.42	183610	1000	108895.58	1.45
F3O2	233.37	40000	15464.18	22738.30	78202.48	233370	1000	155167.52	1.98
F1O3	191.25	40000	10457.08	22738.30	73195.38	191250	1000	118054.62	1.61
F2O3	223.00	40000	12201.12	22738.30	74939.42	223000	1000	148060.58	1.97
F3O3	246.34	40000	15689.18	22738.30	78427.48	246340	1000	167912.52	2.14
F1O4	205.88	40000	10457.08	22738.30	73195.38	205880	1000	132684.62	1.81
F2O4	231.99	40000	12201.12	22738.30	74939.42	231990	1000	157050.58	2.09
F3O4	265.74	40000	15689.18	22738.30	78427.48	265740	1000	187312.52	2.38

F1O5	205.70	40000	10682.08	22738.30	73420.38	205700	1000	132279.62	1.80
F2O5	247.59	40000	12426.12	22738.30	75164.42	247590	1000	172425.58	2.29
F3O5	271.48	40000	15914.18	22738.30	78652.48	271480	1000	192827.52	2.45

REFERENCES

Al-Moshileh, A.M., Errebhi, M.A. and Motawei M.I. (2005). Effect of various potassium and nitrogen rates and splitting methods on potato under sandy soil and arid environmental conditions.*Emir. J. Agric. Sci.***17**(1): 01-09.

Alam, M.N., Jahan, M.S., Ali, M.K., Ashraf, M.A. and Islam, M.K. (2007). Effect of Vermicompost and Chemical Fertilizers on Growth, Yield and YieldComponents of Potato in Barind Soils of Bangladesh. *Journal of Applied Sciences Research*, 3(12): 1879-1888.

Baishya, L.K., Gupta, V. K., Lal, S. S., Das, B.K. and Kumar, M. (2013). Effect of biofertilizers on growth and yield of potato in north eastern hills of india. *Potato J.* **32**: 3-4.

Banafar, R.N.S. Billore, M. and Kushwah, S. S. (2005). Integrated plant nutrition approaches for potato. *Potato J.* **32**: 3-4.

Densilin D.M., Srinivasan S., Manju P. and Sudha S. (2010). Effect of Individual and Combined Application of Biofertilizers, Inorganic Fertilizer and Vermicompost on the Biochemical Constituents of Chilli. *Journal Biofertilezers & Biopesticides* 2:104.

Nag, G.P., Sarnaik, D.A., Verma, Satish K. and Tamrakar S.K. (2008). Integrated nutrient management in potato for Chhattisgarh plains. *The Orissa J. of Horticulture*, Vol. **36** (2): 158-161.

Najm A.A., Haj Seyed Hadi M.R., Fazeli F., Taghi Darzi M. and Shamorady R. (2010). Effect of Utilization of Organic and Inorganic Nitrogen Source on the Potato Shoots Dry Matter, Leaf Area Index and Plant Height, During Middle Stage of Growth. *International Journal of Agricultural and Biological Sciences* 1:1.

Patel, C.K., Chaudhari, P.P., Patel, R.N. and Patel, N.H. (2010). Integrated nutrients management in potato based cropping system in North Gujrat. *Poatao J.* **37**(1-2): 68-70.

Singh,V., Chaurasia, S.P.R. and Sharma, J.S. (2002). An economic analysis of farm income distribution on potato Specialized farms in Agra district of Uttar Pradesh. *India J. of Agri*. Eco. **57**(4): 741-750.

Singh, K.P., Singh, R.K., Singh, S.N., and Singh V.K. (2007). Effect of fertilizer level, seed rate and seed size on yield of potato in acidic soils of Manipur. *Potato J.* **34**(1-2): 93-94.

Verma, Satish, K., Asati B.S., Tamrakar, S.K., Nanda, H.C. and Gupta, C.R. (2011). Effect of organic components on growth, yield and economic returns in potato. *Potato J.* **38** (1):51-55.

Yadu D. (2011). Effect of varying levels of NPK fertilizers and size of seed tubers on growth and yield of potato (*Solanum tuberosum* L.) in Alfisol. *M. Sc. (Ag.) IGKVV Raipur*.