

## Effect of Biofertilizers and their Methods of Inoculation on Growth and Yield of Potato (*Solanum tuberosum* Linn.)

R. Kumar, S.N.S. Chaurasia<sup>1</sup> and G. Singh

Udai Pratap College  
Varanasi-221 002  
Uttara Pradesh, India

**ABSTRACT.** Biofertilizers are natural fertilizers containing microorganisms that enhances crop productivity through nitrogen fixation, solubilizing of plant nutrients and producing plant growth regulators. However, little is known on effects of biofertilizer on growth and yield of potato. Consequently, this study aims to identify the effect of biofertilizers and their methods of inoculation on growth and yield of potato. The experiment was carried out at the Indian Institute of Vegetable Research, Varanasi, during 2000-2001. Four biofertilizers (*Azotobactor*, phosphate solubilizing microorganism, *Azospirillum* and vesicular arbuscular mycorrhiza) and control, and two methods of inoculation were tested in a randomized completely block design with three replications. Growth and yield parameters were measured and analysed statistically. Results of the study revealed that the potato yield can be significantly increased by the application of biofertilizer.

### INTRODUCTION

Potato (*Solanum tuberosum* Linn.) occupies a premier place as a vegetable crop throughout the world. It is one of the main cash crop in India which is grown in the plains during winter and in the hills during summer. As a source of human energy, none other crop can compete with potato in terms of energy production per day per unit area and unit time. Thus, it has significant role in solving the food problems, particularly in developing countries and usually enters into diet of both poor and rich groups. However, production of crops depends on the contribution of many factors such as fertilizer (45%), irrigation (20%), improved seed (13%), soil improvement and spacing (9%) and plant protection (7%). Among the various fertilizers, biofertilizers are important sources of nutrients. Biofertilizers are natural fertilizers containing micro-organism which help in enhancing the productivity by biological nitrogen fixation or solubilization of insoluble phosphate or producing hormones, vitamins and other growth regulators required for plant growth (Bhattacharya, 2000). Recent reports indicates that self perpetuating bodies of biofertilizers can make significant contribution in productivity improvement. Thus, the objective of this study was to identify effect of biofertilizers and their methods of inoculation on growth and yield of potato.

---

<sup>1</sup> Indian Institute of Vegetable Research, Varanasi, Uttara Pradesh, India.

## MATERIALS AND METHODS

The experiment was carried out at the Indian Institute of Vegetable Research, Varanasi during 2000-2001 using potato *cv* Kufri Badshah. The treatments comprised of four biofertilizers namely, *Azotobacter* (B1), phosphate solubilizing microorganism (PSM) (B2), *Azospirillum* (B3), and vesicular arbuscular mycorrhiza (VAM) (B4) and control (B0), and two methods of application, soil (M1) and seed inoculations (M2) before planting of the potato tubers. The tubers were planted in the well prepared and fertilized field (with NPK at a rate of 150:60:80 kg ha<sup>-1</sup>) and biofertilizers were applied as treatment in a randomized block design in three replication. Full dose of phosphorus and potassium and half dose of nitrogen was applied at the time of final field preparation and the other half of N was applied 30 days after planting as top dressing. The soil of the experimental field was sandy loam with organic carbon 0.32%, available phosphorus 49.3 kg ha<sup>-1</sup>; available K 208.8 kg ha<sup>-1</sup>, available sulphur 14.6 and available calcium 5.42 mg/100 g. The maximum and minimum temperatures were 32°C (in November) and 5.6°C (in January), respectively. The relative humidity was ranged from 75 to 91%.

Soil inoculation was done by mixing the biofertilizers in well decomposed farm yard manure for their uniform broadcasting in the field and mixing in the soil, while tuber inoculation was done by preparing a slurry using biofertilizer, molasses (gur), soil and water. After inoculation of tubers they were spread in shade for drying and then used for planting. The well sprouted potato tubers were planted on 19<sup>th</sup> November 2000 under open field condition at spacing of 60×20 cm. Weeding, earthing, irrigation and plant protection measures were carried out according to recommendation. The emergence, growth and yield were recorded and analysed statistically.

## RESULTS AND DISCUSSION

The results revealed that the application of biofertilizers and their methods of inoculation significantly affect the growth and yield parameters of potato. Interaction between biofertilizers and method of inoculation was significant ( $P < 0.05$ ). Among the treatment combinations, VAM applied as soil application significantly increased the plant growth parameters (Table 1). The increase in the height of the plants and number of leaves by VAM application might be due to the better photosynthesis activity from comparatively large photosynthetic area which accumulated in the plants and thereby increased the plant height. The increase on internodal length of plants may be due to the increase in the uptake of the phosphorus by changing its solubility. The present findings are also agreed with the outcome of Ghosh and Das (1998) and El-Gamal (1996).

The application of different biofertilizers and application methods also influenced the yield of potato (Table 2). The maximum number of large sized tubers were recorded with PSM applied as seed treatment. Similar results were also obtained by Dubey and Billore (1992). The maximum number of medium sized tubers was noted under VAM applied as soil treatment. The increase in the large sized tuber was due to the fact that rock phosphate increased the availability of micro elements which is essential for uptake of NPK, and which ultimately increased the rate tuberization (Subba Rao, 1998). However, the highest number of tuber per plot were recorded in *Azotobacter* and PSM applied plots as seed treatment. Similar observations were also recorded by Banerjee and Singh Mahapatra

(1986) and Panigrahi and Behera (1993). The maximum yield was recorded under VAM applied as soil treatment followed by PSM applied as seed treatment (Table 2). The VAM increases the uptake of minor elements which are essential for utilization of nitrogen and other major elements. The present findings are in conformity of Sharma *et al.* (1979), Grewal *et al.* (1981) and Singh (1999).

**Table 1.** Effect of biofertilizers and their methods of inoculation on growth parameters of potato.

Treatments	Plant height (cm)	No. of leaves per plant	Internodal length (cm)
M <sup>0</sup> B <sup>0</sup>	27.29	13.73	2.98
M <sup>1</sup> B <sup>1</sup>	23.80	12.06	2.60
M <sup>1</sup> B <sup>2</sup>	26.40	13.06	2.82
M <sup>1</sup> B <sup>3</sup>	29.53	14.00	3.24
M <sup>1</sup> B <sup>4</sup>	34.10	14.73	2.97
M <sup>2</sup> B <sup>1</sup>	26.97	13.80	3.38
M <sup>2</sup> B <sup>2</sup>	33.08	14.60	3.78
M <sup>2</sup> B <sup>3</sup>	24.67	13.73	2.81
M <sup>2</sup> B <sup>4</sup>	33.80	14.40	2.92
CD 5%	5.20	1.48	0.65

M<sup>0</sup> - control; M<sup>1</sup> - soil inoculation; M<sup>2</sup> - seed inoculation; B<sup>0</sup> - control; B<sup>1</sup> - *Azotobacter*; B<sup>2</sup> - phosphate solubilizing microorganism; B<sup>3</sup> - *Azospirillum*; B<sup>4</sup> - vesicular arbuscular mycorrhiza

**Table 2.** Effect of biofertilizers and their methods of inoculation on yield parameters of potato.

Treatments	Tubers/plot				Yield of different grade tubers (kg/plot)			Yield (q/ha)
	L	M	S	T	L	M	S	
M <sup>0</sup> B <sup>0</sup>	80.00	160.67	91.30	332.00	3.16	10.00	11.03	297.89
M <sup>1</sup> B <sup>1</sup>	67.33	145.33	72.67	290.23	3.93	12.40	12.00	377.68
M <sup>1</sup> B <sup>2</sup>	78.00	154.67	89.00	321.67	3.27	15.50	11.73	406.12
M <sup>1</sup> B <sup>3</sup>	74.33	152.67	82.67	311.67	4.63	16.67	15.53	424.33
M <sup>1</sup> B <sup>4</sup>	89.33	181.00	91.33	361.67	6.67	17.06	17.00	542.97
M <sup>2</sup> B <sup>1</sup>	79.00	182.00	128.00	369.00	5.30	11.86	13.73	411.89
M <sup>2</sup> B <sup>2</sup>	89.67	179.00	99.00	367.67	6.33	12.33	18.33	493.21
M <sup>2</sup> B <sup>3</sup>	76.67	152.33	85.37	314.00	5.27	11.50	12.67	392.74
M <sup>2</sup> B <sup>4</sup>	75.33	153.30	84.33	313.00	3.13	14.90	16.33	458.10
CD 5%	9.52	12.09	5.87	19.43	1.71	2.28	2.05	44.13

M<sup>0</sup> - control; M<sup>1</sup> - soil inoculation; M<sup>2</sup> - seed inoculation; B<sup>0</sup> - control; B<sup>1</sup> - *Azotobacter*; B<sup>2</sup> - phosphate solubilizing microorganism; B<sup>3</sup> - *Azospirillum*; B<sup>4</sup> - vesicular arbuscular mycorrhiza. L, M, S and T represent large, medium, small and total number of tubers.

## CONCLUSIONS

Growth and yield parameters of potato can be increased by application of biofertilizers.

## REFERENCES

- Bhattacharya, S.K. (2000). Current facets in potato research. Proceed. Souvenir and Abstracts, National Seminar, Indian Potato Assoc., C P R.S., Modipuram Meerut, Dec. 13-15. pp. 8-9.
- Banerjee, N.C. and Singh Mahapatra, D.K. (1986). Effect of different organic manures and biofertilizer on growth and yield of potato. *Indian Agriculturist*. 30(2): 117-123.
- Dubey, S.K. and Billore, S.D. (1992) Phosphate solubilizing microorganism (PSM) as inoculant their role in augmenting crop productivity in India. A Review. *Crop Res. (Hisar)* 5 (Suppl.) 11.
- El-Gamal, A.M. (1996). Response of potato in the newly reclaimed areas to mineral nitrogen fertilizer levels and nitrogen fixing biofertilizer HALEX-2. *Assiut J. Agric. Sci.* 27(2): 88-89.
- Ghosh, D.C. and Das, A.K. (1998). Effect of biofertilizers and growth regulators on growth and productivity of potato (*Solanum tuberosum* L.) *Indian Agriculturist*. 42(2): 109-113.
- Grewal, J.S., Negi, A.S., Upadhyay, N.C., Bhattacharjee, A.K., Sahota, T.S., Lal, S.S., Sharma, A.K. (1981). Efficient and Economic Use of Fertilizers. 34(9)SN: 76-40.
- Panigrahi, U.C. and Behera, B. (1993). Response of *Azotobacter* inoculants on total nitrogen, organic carbon and microbial population of soil and yield of potato. *Indian J. Agric. Chemistry*. 26(1): 17-23.
- Singh, K. (1999). Role of biofertilizers in increasing the efficiency of nitrogen to potato crop under north east hill conditions. *Global Conference on Potato, New Delhi* 6-11, 1999. Pp. 150.
- Subba Rao, N.S. (1988). *Biofertilizers in Agriculture*. Mohan Pramlani, Oxford and IBH Publishing Co. Pvt. Ltd., 66 Janpath, New Delhi. 110001.
- Sharma, R.C., Grewal, J.S., Sharma, A.K., Vaswani, L.K., Singh, S.N. and Negi, A.S. (1979). *Azotobacter* inoculation of potato tubers to economize on N input. *Field Crop Abstracts*. 32(7): 4984.