

## Original Research Article

<https://doi.org/10.20546/ijcmas.2017.605.186>**Impact of Bio-fertilizer on Growth Parameters and Yield of Potato**

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Application of different bio-fertilizers alone or in combination with others as seed, soil and foliar spray revealed that the bio-fertilizers have stimulatory effect on germination, sprouting behaviour and growth parameter of potato. The maximum germination and number of bud with 5 in number per tuber was recorded from T<sub>7</sub> treatment in which treatment was given as soil application FYM @ 150gm/pot + Mustard cake @ 150 gram/pot + tuber treatment with *T. viride* + foliar spray with bio-formulation of *T. viride*. It was also cleared that bio-fertilizers have stimulatory effect on vigour of plants. The maximum plant height was recorded in treatment T<sub>7</sub> (soil application of mustard cake + tuber treatment and foliar spray with *T. viride*) with the value of 11.16cm at 30 day age of plant followed by treatment T<sub>4</sub> (soil application of mustard cake + tuber treatment and foliar spray with *Azotobacter*), T<sub>1</sub> (soil application of neem cake + tuber treatment with PSB), representing value of 11.06cm and 10.73cm, respectively. The effect of seed treatment and foliar spray with bio-fertilizer on tuber size and yield was recorded that maximum number of large size tubers (5) and yield (844.85gm) was found in T<sub>7</sub> treatment, where treatment was given as soil application FYM @ 150gm/pot + mustard cake @150gm/pot + tuber treatment with *T. viride* + foliar spray with bio-formulation of *T. viride*

**Introduction**

Potato (*Solanum tuberosum* L.) is being a high yielding, nutrient exhaustive and short duration crop needs higher quantities of fertilizers and pesticides as compare to other crops. A normal potato crop yielding 30 t/ ha removes about 100 kg N/ ha from soil (Pandey *et al.*, 2006). Nitrogen and phosphorus are the major nutrients need in potato cultivation along with potassium. However, continuous and excessive use of chemical fertilizers is causing ecological and health hazards as well as deteriorating the soil health resulting decline in crop yields. Under these circumstances, organic sources play a

vital role in improving the soil fertility and productivity of crop. The bio-fertilizers *viz.* *Azotobacter*, *Phosphobacteria* and *Bacillus* have been recognized as cheapest fertilizer input for improving soil health and fertility for optimum crop production. However, their effects depend on types of the crops, soil and environmental conditions. Singh, (2001) reported that the ability of *Azotobacter* and *Phosphobacteria* to proliferate in the rhizosphere of crop suggests an increased nutrient availability to the plants. Pfeiffer, (1984) reported that defined biodynamic approach as working with the energy from

cosmos, earth, cow and plants are systematically and synergistically harnessed, which create and maintain life. Pathak, and Ram. (2005) reported that the application of biodynamic with compost or field sprays (BD) gave higher yield and better return in vegetables. Considering above point in view, the study was undertaken in the present study as “Impact of Bio-fertilizer on growth parameters and yield of potato”.

## **Materials and Methods**

### **Effect of different bio-fertilizers on germination and growth parameters of potato**

#### **Tuber seed treatment**

The packets of *Azotobacter* containing 200gm inoculum were obtained from Department of Soil Science (Microbiology), Chandra Shekhar Azad University of Agriculture and Technology Kanpur. The seed tubers of potato variety *Kufri Sindhuri* was used to conduct the experiment. Seed tubers were treated with *Azotobacter* @ 2g/10g of tuber seed. 10gm Jaggery was also added to make slurry and mixed it with seed tuber (Biswas *et al.*, 2016). Then the tubers were kept in shade for dry.

On the other hands, seed tubers were also treated with formulation of neemcake, mustard cake @ 25% and bio-formulation of *Trichoderma viride*, *Trichoderma harzianum* and phosphorus solubilising bacteria @ 2g/10gm of the tuber seeds. The seed tubers were treated by dipping the tuber in prepared solution separately. The treatments were given for 2 hours before the sowing of tuber.

#### **Germination and growth parameters of potato**

The experiment was conducted in the Glass house complex, Department of Plant

Pathology, C.S.A. University of Agriculture and Technology, Kanpur. The 30cm earthen pots were used to conduct the experiment. The pots were previously filled with a mixture of sterilized sandy loam soil and farm yard manure in the ratio of 2:1. In each pot, 1 seed tuber was sown and watered as per need base. The details of the treatments were given as below:-

T1 = Soil application FYM @150gm/pot + neem Cake @150gm/pot + tuber treatment with *T. harzianum* + foliar spray with bio-formulation of *T. harzianum*

T2 = Soil application with FYM @150 gm/pot + Tuber treatment with PSB + foliar spray with bio-formulation of PSB

T3 = Soil application FYM @150gm/pot + tuber treatment with *Azotobacter* + foliar spray with bio-formulation of *Azotobacter*

T4 = Soil application FYM @150gm/pot + mustard cake @ 150gm/pot + tuber treatment with *Azotobacter* + foliar spray with bio-formulation of *Azotobacter*

T5 = Soil application FYM @150gm/pot + neem cake @ 150gm/pot + tuber treatment with PSB + foliar spray with bio-formulation of PSB

T6 = Soil application FYM @150gm/pot + tuber treatment with *T. harzianum* + foliar spray with bio-formulation of *T. harzianum*

T7 = Soil application FYM @150gm/pot + mustard cake @ 150gm/pot + tuber treatment with *T. viride* + foliar spray with bio-formulation of *T. viride*

T8 = Soil application with FYM @150gm/pot + Tuber treatment with *Azotobacter* + foliar spray with bio-formulation of *Azotobacter*

T9 = Soil application with FYM 300gm (Control).

The experimental design was laid out in simple Complete Randomise Design. Three replications were kept for each treatment. Three pots were sown with untreated seed tubers served as control. The observations

pertaining the effect of different treatments were taken on germination pattern and plant height (cm) at every 24hrs. up to 30 day age of plant. The tuber size and yield of crop, were also taken after harvest of crop.

### **Germination pattern**

Seed tuber was treated with different bio-fertilizers might be responsible for early breaking of seed tuber dormancy and thereby increasing the germination percentage of seed tuber. The observation on pattern of germination of tuber was taken at every 24 hours up to 3 days after sowing.

### **Plant height**

For this purpose, three plants were selected randomly and shoot height was measured (in cm) from the soil surface at basal portion to tip of leaf of plant with the help of meter scale at every 24 hrs upto 30 days age of plant. Three replications were kept for each treatment. The average of three plants height was divided by 3 for obtaining their mean to consider plant height.

### **Effect of bio-fertilizers on tuber size and yield**

To explore the possible effect of bio-fertilizer on tuber size and yield, the potato was harvested and grading the tuber as number of large, medium and small size was also weight by electric balance separately from individual treatment and yield was calculated by weight of the total tubers per treatment.

## **Results and Discussion**

### **Effect of bio-fertilizer on growth parameters of potato plants**

The effect of tuber seed treatment with bio-fertilizer on growth parameters and seed

germination in glass house condition shows that bio-fertilizer were effective in increasing seed sprouting and vigor of plants (Table 1a & b) &2).

### **Germination pattern**

The stimulatory effect of different bio fertilizers on germination pattern of potato might be responsible for early breaking of seed dormancy. The observation on date of first germination & number of sprouting branches were recorded and data presented in the table showed that first sprouting of tuber was recorded from T1 and T7 treatments at 12 day after sowing (Table 1a). Among the treatment, late sprouting was found in T3 treatment which is also at par with control plant.

As per concern on the number of sprouting bud, the maximum number of bud with 5 per tuber was found in T<sub>7</sub> treatment where treatment was given as soil application with FYM @ 150gm/pot + Mustard cake @ 150 gram/pot + tuber treatment with *T. viride* + foliar spray with bio-formulation of *T. viride* which was followed by T<sub>4</sub> treatment (Soil application FYM @ 150gm/pot + Mustard cake @ 150gm/pot + tuber treatment with *Azotobacter* + foliar spray with bio-formulation of *Azotobacter*) and T<sub>1</sub> treatment (Soil application FYM @ 150gm/pot + Neem cake @ 150 gm/pot + tuber treatment with *T. harzianum* + foliar spray with bio formulation of *T. harzianum*, representing the value 4 and 3, respectively (Table 2).

Among the treatment, least number of buds was found in case of T<sub>3</sub>, and T<sub>6</sub>, representing 1 bud per tuber in each. Shanmugaiah *et al.*, (2009) observed cotton seeds treated with *T. viride* increased seed germination, root and shoot length, fresh and dry weight and vigor index over control.

**Table.1a** Effect of tuber treatment with bio-fertilizer on height of potato

	Plant height (in cm.) after 12 days of sowing ( 1 to 15 Days )														
Treatment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<b>T<sub>1</sub></b>	0.16	0.36	0.43	0.7	0.96	1.73	2.5	2.96	3.03	3.3	3.7	3.86	4.03	4.33	4.8
<b>T<sub>2</sub></b>	0	0	0	0	0	0	0.1	0.1	0.16	0.3	0.4	0.43	0.46	0.76	0.9
<b>T<sub>3</sub></b>	0	0	0	0	0	0	0	0	0	0.13	0.23	0.33	0.66	1	1.7
<b>T<sub>4</sub></b>	0	0	0	0.16	0.3	0.5	0.76	0.9	0.96	1.16	1.43	2	2.43	2.9	3.3
<b>T<sub>5</sub></b>	0	0	0	0	0	0	0.1	0.1	0.23	0.3	0.36	0.4	0.63	1.93	1.73
<b>T<sub>6</sub></b>	0	0	0	0.16	0.26	0.36	0.46	0.5	0.53	0.73	1.06	1.43	1.76	1.96	2.63
<b>T<sub>7</sub></b>	0.06	0.13	0.3	0.6	0.93	1.23	1.83	2.03	2.23	2.4	2.56	3.03	3.5	4.2	4.56
<b>T<sub>8</sub></b>	0	0	0	0	0.06	0.26	0.63	1	1.46	2.13	2.16	2.8	3.4	3.73	4.4
<b>T<sub>9</sub></b>	0	0	0	0	0	0	0	0	0	0.06	0.1	0.13	0.3	0.43	0.63
<b>S.E.</b>	0.08	0.18	0.24	0.34	0.48	0.76	1.10	1.21	1.21	1.30	1.39	1.41	1.51	1.44	1.49
<b>C.D.</b>	0.17	0.38	0.52	0.73	1.01	1.60	2.32	2.54	2.55	2.74	2.92	2.97	3.17	3.04	3.13

**Table.1b** Effect of tuber treatment with bio-fertilizer on plant height of potato

	Plant height (in cm.) after 12 days of sowing ( 16 to 30 Days )														
Treatment	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
T <sub>1</sub>	5.1	5.36	5.5	6.1	6.66	7.16	7.56	7.93	8.36	8.73	9.13	9.46	9.86	10.3	10.73
T <sub>2</sub>	1.16	1.4	2.4	2.2	2.36	2.73	3.1	3.5	3.96	4.3	4.73	5.1	5.5	5.86	6.26
T <sub>3</sub>	1.7	2.1	2.43	2.83	3.16	3.63	4.03	4.46	5	5.36	6	6.4	6.8	7.16	7.56
T <sub>4</sub>	3.63	3.93	4.2	5.2	5.56	6.2	6.83	7.9	8.43	8.86	9.3	9.76	10.2	10.6	11.06
T <sub>5</sub>	1.73	2.03	2.33	3.5	4.25	4.2	4.6	5.23	5.93	6.4	6.93	7.36	7.8	8.26	8.7
T <sub>6</sub>	2.63	3	3.26	3.6	3.96	4.26	4.83	5.4	6.03	6.46	6.93	7.56	7.8	8.2	8.56
T <sub>7</sub>	4.9	5.13	5.5	6.33	6.7	7.13	7.56	8	8.5	8.83	9.3	9.8	10.26	10.8	11.16
T <sub>8</sub>	4.4	4.8	5.16	6.33	6.66	7.13	7.66	7.06	7.66	8.16	8.66	9.06	9.46	9.93	10.4
T <sub>9</sub>	0.86	1.16	1.5	1.76	2.1	2.36	2.76	3.1	3.6	4.03	4.53	4.93	5.36	5.76	6.2
S.E.	1.49	1.48	1.49	1.85	2.04	2.12	2.17	2.38	2.43	2.45	2.45	2.48	2.51	2.54	2.59
C.D.	3.14	3.12	3.15	3.86	4.25	4.46	4.57	5.01	5.11	5.14	5.16	5.22	5.28	5.33	5.44

**Table.2** Effect of bio-fertilizer on sprouting of seed tuber

Treatment	No of bud emerge out from each seed tuber
T1 = Soil application FYM @150gm/pot + neem Cake @150gm/pot + tuber treatment with <i>T. harzianum</i> + foliar spray with bio-formulation of <i>T. harzianum</i>	3
T2 = Soil application with FYM @150 gm/pot + Tuber treatment with PSB + foliar spray with bio-formulation of PSB	2
T3 = Soil application FYM @150gm/pot + tuber treatment with Azotobacter + foliar spray with bio-formulation of Azotobacter	1
T4 = Soil application FYM @150gm/pot + mustard cake @150gm/pot + tuber treatment with Azotobacter + foliar spray with bio-formulation of Azotobacter	4
T5 = Soil application FYM @150gm/pot + neem cake @150gm/pot + tuber treat with PSB + foliar spray with bio-formulation of PSB	2
T6 = Soil application FYM @150gm/pot + tuber treatment with <i>T. harzianum</i> + foliar spray with bio-formulation of <i>T. harzianum</i>	1
T7 = Soil application FYM @150gm/pot + mustard cake @150gm/pot + tuber treatment with <i>T. viride</i> + foliar spray with bio-formulation of <i>T. viride</i>	5
T8 = Soil application with FYM @150gm/pot + Tuber treatment with Azotobacter + foliar spray with bio-formulation of Azotobacter	2
T9 = Soil application with FYM 300gm (Control).	1

**Table.3** Effect of bio-fertilizer on tuber size and yield of potato (glass house condition)

Treatment	Large (>50gm)		Medium (25-49.5gm)		Small (<25gm)		Yield
	No	Wt	No	Wt	No	Wt	
T1	2	159.63	5	171.53	22	185.13	516.6
T2	1	51.64	2	80.83	12	182.97	315.30
T3	2	102.80	4	111.41	22	137.69	370.40
T4	3	164.72	9	245.72	55	348.53	760.03
T5	2	101.40	8	212.63	20	105	419.05
T6	0	0	8	194.56	28	205.7	400.50
T7	5	261.27	12	465.9	55	118	844.85
T8	2	65.6	4	141.4	36	212.96	420.00
T9	0	0	3	80.83	22	85.00	165.60
S.E.D. (±)	0.647	1.004	1.030	1.318	1.594	0.356	
C.D.	1.361	2.110	2.164	2.770	3.350	0.748	

Biswas *et al.*, (2015) also found that seed treatment with bio-fertilizers *viz.*, *Azotobacter chroococum*, *PGPR*, *Trichoderma harzianum*, *Trichoderma viride*, *PSB*, *Rhizobium*, significantly increased germination of wheat seed and increased tillering.

### **Plant height**

The effect of soil application with FYM and seed treatment with various bio-fertilizers on plant height of potato was studied under Glass house complex in pot culture experiment. The observation on plant height was taken at every 24 hrs. up to 30 days after sowing (Tables 2 and 3). The data presented in table 1a and 1b showed that biofertilizers have stimulatory effect on vigour of plants.

The maximum plant height was recorded in treatment T<sub>7</sub> (soil application of mustard cake + tuber treatment and foliar spray with *T. viride*) with the value of 11.16cm at 30 day age of plant followed by treatment T<sub>4</sub> (soil application of mustard cake + tuber treatment and foliar spray with *Azotobacter*), T<sub>1</sub> (soil application of neem cake + tuber treatment with *PSB*), representing value of 11.06cm and 10.73cm, respectively.

From the data presented in table 1a and 1b, it is also cleared that all the treatments were able to increase the growth of plant over control.

Ravindra *et al.*, (2015) found that the yield of tomato crop significantly increase by the combined application of seed treatment with *T. harzianum* + soil application of neem cake powder + foliar spray of Carbendazim. Barik and Goswami (2003) found the efficacy of biofertilizers with nitrogen levels on growth, productivity and economy in wheat.

Rasool *et al.*, (2011) reported that the *Trichoderma* isolates increased seedling growth and nutrient uptake in tomato.

### **Effect of bio-fertilizers as seed treatment and foliar spray on tuber size and yield of potato**

The effect of seed treatment and foliar spray with bio-fertilizer on tuber size and yield was studied after harvesting. Tubers were graded as large (more than 50gm), Medium (25 gm - 49.5gm) and small (less than 25 gm) (Table 3). It has found that maximum number of large tuber was found in T<sub>7</sub> treatment, representing with weight of tuber is 261.27gm, where treatment was given as soil application FYM @ 150gm/pot + mustard cake @150gm/pot + tuber treatment with *T. viride* + foliar spray with bio-formulation of *T. viride* which was followed by T<sub>4</sub> treatment (Soil application of FYM @150gm/pot + mustard cake @150gm/pot + tuber treatment with *Azotobacter* + foliar spray with bio-formulation of *azotobacter*). Similar observations have also seen reported in case of medium and small size tubers. But highest number of small size tuber was found in case of T<sub>4</sub> treatment. From the table, it is also cleared that in case of T<sub>6</sub> and T<sub>9</sub>, there is no formation of large tuber and least number of tuber was found in case of T<sub>2</sub> treatment, showing 1, 2, and 12 in number against large, medium and small, respectively.

As per yield is concerned, the highest yield (844.85gm) was recorded from treatment T<sub>7</sub> (soil application of FYM @ 150gm/pot mustard cake @ 150gm/pot + tuber treatment and foliar spray with *T. viride*), followed by treatment T<sub>4</sub> (soil application of FYM @ 150gm/pot + mustard cake @ 150gm/pot + tuber treatment and foliar spray with *Azotobacter*), and T<sub>1</sub> treatment (Soil application FYM @150gm/pot + neem Cake @150gm/pot + tuber treatment with *T. harzianum* + foliar spray with bio-formulation of *T. harzianum*) with the value of 760.03 gm, 516.60gm, respectively. Kachroo and Razdan (2006) reported that combined application of *Azotobacter* + *Azospirillum* with different

levels of N fertilizer significantly increase the grain yield of wheat. Bhattari and Hess (1993) found that the increased yield response in cultivation of spring wheat (*Triticum aestivum* L.) with *Azospirillum* spp. of Nepalese origin. Yadav *et al.*, (2000) also found that *Azotobacter* increases yield and nitrogen economy in wheat under field condition.

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