

# Effect of different doses of nitrogen and potassium on growth and yield of potato (*Solanum tuberosum* L.) under New Alluvial Zone of West Bengal

## Abstract

An experiment was conducted during *the rabi* season of 2012-13 and 2013-14 at Instructional Farm, Jaguli, Nadia, West Bengal to find out the different doses of nitrogen and potassium on growth and yield of potato. The experiment was designed in RBD with 10 treatments replicated thrice in potato cultivated variety *Kufri Jyoti*. Different doses of nitrogen and potassium were considered as treatments. For all the treatments  $P_2O_5$  dose was  $150\text{ kg ha}^{-1}$ . The size of the experimental plots were 12 square meter and seed tubers were planted with 50 cm X 20 cm spacing. In this experiment, it was observed that the growth attributes like plant height, leaf area index, dry matter accumulation of tubers at 80 DAP, crop growth rate at 60-80 DAP were highest with the application of  $250\text{ kg ha}^{-1}\text{ N}$ ,  $200\text{ kg K}_2\text{O}$  ( $T_9$ ) and statistically at par with  $300\text{ kg ha}^{-1}\text{ N}$ ,  $150\text{ kg ha}^{-1}\text{ K}_2\text{O}$  ( $T_{10}$ ). Again among the yield parameters,  $T_9$  recorded the highest tuber number per square meter and tuber yield which was closely followed by  $T_{10}$ . Highest B:C ratio was also observed in  $T_9$ . This result proves that  $T_9$  can be recommended to get better growth and economic yield of potato than  $T_{10}$  (farmer practice does) in the new alluvial soil of West Bengal.

**Keywords:** potato, different doses of nitrogen and potassium, tuber growth and yield

## INTRODUCTION

Worldwide one of the most important food crops is potato (*Solanum tuberosum* L.). After rice and wheat in terms of human consumption, its rank is third. Its tubers are a good source of carbohydrates, proteins, vitamins, and minerals for human nutrition (Blagoeva *et al.*, 2004). Potato can provide necessary nutrients for the people of the low-income group through meeting vegetable demand (Islam *et al.*, 2009; Hossain and Miah, 2012). It can produce more dry matter per unit area and per unit time compared to cereals. The high rate of dry matter production results in a large amount of nutrient removal per unit time and most of the soils are unable to meet the demand. Thus it is essential to apply nutrient from external sources such as fertilizers. The production of potato depends on many factors, among them, judicious application of nitrogen (N) and potassium (K) play a vital role. For producing 25 to 30 tonne  $\text{ha}^{-1}$  tuber a mature potato crop removes 120 to 140  $\text{kg N ha}^{-1}$  (Patel and Patel, 2001). Tuber dry matter yield and the nitrogen content in potato plants are increased through nitrogen fertilization (Sharifi *et al.*, 2007; Neshev *et al.*, 2014). This crop feeds heavily on soil potassium and the tubers remove 1 to 5 times the amount of nitrogen and 4 to 5 times the amount of phosphate. Because of its high K requirement potato also acts as an indicator crop for K (Fageria *et al.*, 1997). Potassium-deficient plants are short with pale-green leaves and later in vegetation, the leaves end and tops become necrotic (Kerin and Berova, 2008; Kumar and Sharma, 2013). Considering the significance of N and K on the productivity of potato an

experiment was conducted to study the effect of different levels of nitrogen and potassium on the yield of potato grown on new alluvial soils.

## MATERIALS AND METHODS

A field experiment was conducted in Gangetic alluvial sandy loam neutral soil (pH 6.9) at the Instructional Farm, Jaguli of Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia (22.93°N, 88.53°E and 9.75 m altitude) during *rabi* season of 2012-13 and 2013-14. The experiment was designed with three replication in randomized block design (RBD), considering ten treatments [T<sub>1</sub>: 150 kg ha<sup>-1</sup> N, 100 kg ha<sup>-1</sup> K<sub>2</sub>O, T<sub>2</sub>: 150 kg ha<sup>-1</sup> N, 150 kg ha<sup>-1</sup> K<sub>2</sub>O, T<sub>3</sub>: 150 kg ha<sup>-1</sup> N, 200 kg ha<sup>-1</sup> K<sub>2</sub>O, T<sub>4</sub>: 200 kg ha<sup>-1</sup> N, 100 kg ha<sup>-1</sup> K<sub>2</sub>O, T<sub>5</sub>: 200 kg ha<sup>-1</sup> N, 150 kg ha<sup>-1</sup> K<sub>2</sub>O, T<sub>6</sub>: 200 kg ha<sup>-1</sup> N, 200 kg ha<sup>-1</sup> K<sub>2</sub>O, T<sub>7</sub>: 250 kg ha<sup>-1</sup> N, 100 kg ha<sup>-1</sup> K<sub>2</sub>O, T<sub>8</sub>: 250 kg ha<sup>-1</sup> N, 150 kg ha<sup>-1</sup> K<sub>2</sub>O, T<sub>9</sub>: 250 kg ha<sup>-1</sup> N, 200 kg ha<sup>-1</sup> K<sub>2</sub>O, T<sub>10</sub>: 300 kg ha<sup>-1</sup> N, 150 kg ha<sup>-1</sup> K<sub>2</sub>O] in 4.0 x 3.0 m size plots. For all the treatments P<sub>2</sub>O<sub>5</sub> dose was 150 kg ha<sup>-1</sup>. Seed tubers of cultivated variety *Kufri Jyoti* were planted with 50 cm X 20 cm spacing in the third week of November and harvested in the fourth week of February. All other standard agronomic practices including plant protection measures recommended for potato tuber production were followed. Observations on plant height, leaf area index (LAI), dry matter accumulation of tuber, tuber number per square meter, tuber yield were recorded and analyzed using the analysis of variance technique (One way ANOVA). Crop growth rate (gm<sup>-2</sup> day<sup>-1</sup>) was derived by adopting the procedure recommended by Watson (1958) with certain modification.

$$\text{Crop growth rate (CGR)} = \frac{W_2 - W_1}{t_2 - t_1}$$

Where W<sub>2</sub> and W<sub>1</sub> were the dry weight of sample plants on two different times t<sub>2</sub> and t<sub>1</sub> respectively.

Economic analysis was performed considering local market rates for inputs and the produce.

## RESULTS AND DISCUSSION

### Plant height

At 80 DAP (days after planting) among all the treatments 250 kg ha<sup>-1</sup> N and 200 kg ha<sup>-1</sup> K<sub>2</sub>O (T<sub>9</sub>) recorded the highest plant height i.e. 71.10 cm whereas lowest plant height (44.97 cm) was found in 150 kg ha<sup>-1</sup> N and 100 kg ha<sup>-1</sup> K<sub>2</sub>O (T<sub>1</sub>). These observations corroborate the findings obtained by Kumar *et al.*, 2008 and Zelelew *et al.*, 2016. According to Kumar *et al.* (2008), there was an increased plant height in potato due to increased N dose up to 180 kg ha<sup>-1</sup>. Zelelew *et al.*, 2016 demonstrated that application of 150 kg ha<sup>-1</sup> K<sub>2</sub>O recorded the highest plant in potato.

### Leaf area index

250 kg ha<sup>-1</sup> N and 200 kg ha<sup>-1</sup> K<sub>2</sub>O (T<sub>9</sub>) resulted in the highest i.e. 1.652 (Table 1) leaf area index (LAI) at 80 DAP which established the fact that nitrogen and potassium had a profound influence on the growth of the potato. However, these observations are in

consistency with the findings obtained by Watson *et al.* (1963) and Veeranna and Khalak (1997). 200 kg ha<sup>-1</sup> N and 100 kg ha<sup>-1</sup> K<sub>2</sub>O (T<sub>4</sub>) recorded the lowest (1.173) LAI at 80 DAP.

#### **Crop growth rate**

The highest crop growth rate (15.56 gm<sup>-2</sup> day<sup>-1</sup>) was observed at 60-80 DAP by the application of 250 kg ha<sup>-1</sup> N and 200 kg ha<sup>-1</sup> K<sub>2</sub>O (T<sub>9</sub>) which is statistically at par with 300 kg ha<sup>-1</sup> N and 150 kg ha<sup>-1</sup> K<sub>2</sub>O (T<sub>10</sub>) (15.35 gm<sup>-2</sup> day<sup>-1</sup>). The lowest crop growth rate i.e. 8.25 gm<sup>-2</sup> day<sup>-1</sup> was found in by the application of 150 kg ha<sup>-1</sup> N and 100 kg ha<sup>-1</sup> K<sub>2</sub>O (T<sub>1</sub>). This result had a similar trend with the observations of Yadav *et al.* (1999).

#### **Dry matter accumulation of tuber**

At 80 DAP T<sub>9</sub> (application of 250 kg ha<sup>-1</sup> N and 200 kg ha<sup>-1</sup> K<sub>2</sub>O) recorded maximum (622.57 gm<sup>-2</sup>) tuber dry matter accumulation. The minimum dry matter accumulation of tuber was observed in T<sub>1</sub> (application of 150 kg ha<sup>-1</sup> N, 100 kg ha<sup>-1</sup> K<sub>2</sub>O) at 80 DAP in potato. Comparable dry matter accumulation of tuber was observed by Zhao *et al.* in 2005.

#### **Tuber number per square meter**

The maximum number of tuber per square meter was found in T<sub>9</sub> (application of 250 kg ha<sup>-1</sup> N and 200 kg ha<sup>-1</sup> K<sub>2</sub>O) i.e. 69.70 m<sup>-2</sup> which was statistically at par with T<sub>8</sub> (application of 250 kg ha<sup>-1</sup> N and 150 kg ha<sup>-1</sup> K<sub>2</sub>O) and T<sub>10</sub> (application of 250 kg ha<sup>-1</sup> N and 150 kg ha<sup>-1</sup> K<sub>2</sub>O). This result reveals that higher levels of N and K increase the number of tuber per square meter.

#### **Tuber yield**

The tuber yield differed significantly due to different doses of nitrogen and potassium on the crop. T<sub>9</sub> (application of 250 kg ha<sup>-1</sup> N and 200 kg ha<sup>-1</sup> K<sub>2</sub>O) produced the highest yield (27.03 t ha<sup>-1</sup>) (Table 1). The next best treatment was T<sub>10</sub> (application of 250 kg ha<sup>-1</sup> N and 150 kg ha<sup>-1</sup> K<sub>2</sub>O) which recorded 25.35 t ha<sup>-1</sup> tuber yield. The increase in tuber yield due to the application of N and K is also documented by Sharma and Arora in 1988.

#### **B:C ratio**

Maximum B:C ratio was obtained (1.74) in T<sub>9</sub> (application of 250 kg ha<sup>-1</sup> N and 200 kg ha<sup>-1</sup> K<sub>2</sub>O) followed by T<sub>10</sub> (application of 250 kg ha<sup>-1</sup> N and 150 kg ha<sup>-1</sup> K<sub>2</sub>O) i.e. 1.66 and T<sub>8</sub> (application of 250 kg ha<sup>-1</sup> N and 150 kg ha<sup>-1</sup> K<sub>2</sub>O) i.e. 1.62. The minimum B:C ratio was found in T<sub>1</sub> (application of 150 kg ha<sup>-1</sup> N and 100 kg ha<sup>-1</sup> K<sub>2</sub>O) i.e. 0.99 due to poor growth and productivity of the crop.

### **CONCLUSION**

From the experiment it can be concluded that application of 250 kg ha<sup>-1</sup> N and 200 kg ha<sup>-1</sup> K<sub>2</sub>O significantly increased the plant height, leaf area index, crop growth rate, dry matter accumulation of tuber and tuber number per square meter which eventually increased the tuber yield and B:C ratio in *Kufri Jyoti* variety of potato. Therefore, it can be recommended that farmers of the new alluvial zone of West Bengal may apply 250 kg ha<sup>-1</sup> N and 200 kg ha<sup>-1</sup> K<sub>2</sub>O along with 150 kg K<sub>2</sub>O ha<sup>-1</sup> to get optimum tuber yield and maximum B:C ratio.

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**Table 1: Effect of different doses of nitrogen and potassium on plant height, leaf area index, crop growth rate, dry matter accumulation, tuber number per square meter and tuber yield of potato (*Two years pooled data*)**

<b>Treatment</b>	<b>Details</b>	<b>Plant height at 80 DAP (cm)</b>	<b>Leaf area index at DAP</b>	<b>Crop growth rate (g m<sup>-2</sup> day<sup>-1</sup>) at 60-80 DAP</b>	<b>Dry matter accumulation of tuber at 80 DAP (g m<sup>-2</sup>)</b>	<b>Tuber number per square meter</b>	<b>Tuber yield (t ha<sup>-1</sup>)</b>	<b>B:C ratio</b>
<b>T<sub>1</sub></b>	150 kg ha <sup>-1</sup> N, 100 kg ha <sup>-1</sup> K <sub>2</sub> O	44.97	1.271	8.25	209.07	36.34	14.52	0.99
<b>T<sub>2</sub></b>	150 kg ha <sup>-1</sup> N, 150 kg ha <sup>-1</sup> K <sub>2</sub> O	46.84	1.433	11.53	298.10	43.90	15.70	1.05
<b>T<sub>3</sub></b>	150 kg ha <sup>-1</sup> N, 200 kg ha <sup>-1</sup> K <sub>2</sub> O	50.07	1.283	13.71	351.44	57.20	18.82	1.24
<b>T<sub>4</sub></b>	200 kg ha <sup>-1</sup> N, 100 kg ha <sup>-1</sup> K <sub>2</sub> O	46.98	1.173	11.98	345.21	54.56	16.70	1.12
<b>T<sub>5</sub></b>	200 kg ha <sup>-1</sup> N, 150 kg ha <sup>-1</sup> K <sub>2</sub> O	52.08	1.383	14.82	512.12	58.91	21.99	1.45
<b>T<sub>6</sub></b>	200 kg ha <sup>-1</sup> N, 200 kg ha <sup>-1</sup> K <sub>2</sub> O	59.99	1.482	14.02	580.31	62.28	23.21	1.51
<b>T<sub>7</sub></b>	250 kg ha <sup>-1</sup> N, 100 kg ha <sup>-1</sup> K <sub>2</sub> O	58.11	1.421	14.22	598.41	64.40	22.94	1.53
<b>T<sub>8</sub></b>	250 kg ha <sup>-1</sup> N, 150 kg ha <sup>-1</sup> K <sub>2</sub> O	65.05	1.382	14.97	600.40	68.03	24.96	1.62
<b>T<sub>9</sub></b>	250 kg ha <sup>-1</sup> N, 200 kg ha <sup>-1</sup> K <sub>2</sub> O	71.10	1.652	15.56	622.57	69.70	27.03	1.74
<b>T<sub>10</sub></b>	300 kg ha <sup>-1</sup> N, 150 kg ha <sup>-1</sup> K <sub>2</sub> O	70.09	1.531	15.35	611.45	67.87	25.35	1.66
<b>S. Em(±)</b>		<b>1.11</b>	<b>0.05</b>	<b>0.27</b>	<b>3.42</b>	<b>1.93</b>	<b>0.54</b>	
<b>CD(at 5%)</b>		<b>3.29</b>	<b>0.14</b>	<b>0.8</b>	<b>10.15</b>	<b>5.73</b>	<b>1.61</b>	