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Production potential of potato cv. K. Surya as influenced by different levels of nitrogen application

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Abstract
Effects of different levels of nitrogen on growth and yield parameters of potato variety Kufri Surya revealed that plant height, number of shoots and total tuber yield were influenced by various nitrogen levels. However, nitrogen level at 150 kg/ ha to 300 kg/ ha differs non-significantly. Plant emergence of potato was non-significantly influenced by nitrogen levels. Highest plant emergence 92.19% was found with the application of 150 kg Nitrogen per hectare. It has observed that the trait plant height was highly influenced by the varying level of Nitrogen application. Higher the nitrogen application showed higher plant height. However, the response of higher nitrogen was not noticed. The highest number of shoots per plant 3.55 was recorded under replication of 150 kg nitrogen per hectare. Numerically maximum total tuber yield was recorded with nitrogen application of 300 kg/ha (28.20 t/ha) followed by 225 kg/ha (26.89 t/ha) and 150 kg/ha (23.62 t/ha).

Keywords: Potato, *Solanum tuberosum* L., fertilizers, nitrogen levels

Introduction
Potato (*Solanum tuberosum* L.) belongs to family Solanaceae and is one of the most important vegetable cum starch supplying crop having high production per unit area per unit time. Potato, an underground tuber occupies prime position among the cash crops in India. Potatoes are rich source of vitamins, especially C and B and also minerals. Tubers contain 70-80% water, 20.6% carbohydrate, 2.1% protein, 0.3% fat, 1.1% crude fibre and 0.9% ash (Banjare, *et al.* 2014) [7]. Potato is an important food crop and ranks fourth among the major food crops of the world. Potato is a short duration crop which is highly responsive to high inputs and capable to produce high yield under wide range of soil and climate.

Amongst the vegetable, potato is the most cultivated vegetable accounting for 27% of the total production of vegetable in the India (Anon, 2016) [2]. Presently, in world scenario India is the second largest potato producer after China. India produced 41.56 MT potatotubers from 1.97 M ha area with an average yield of 21.10 t/ha of potatoes that contribute to approximately 8% of the world total produce (Anon, 2014) [1]. In Chhattisgarh, it is cultivated in an area of about 37.89 Mha with a production of 5.56 lakh metric tons with a productivity of 38.92 t/ha (Anon, 2014) [1]. Due to its suitability and high returns, the area of potato is increasing every year in Chhattisgarh. In this state, potato is mainly cultivated in Surguja, Raigarh, Jashpur, Bilaspur and Raipur districts in rabi season except in hilly region of Chhattisgarh, where this crop is grown during both *kharif* and *rabi* season.

The growth, development and yield of potato are mainly governed by availability of major nutrients required for its cultivation. Potato is a highly responsive to fertilizer as it is heavy feeder of nutrients. Nitrogen is the major nutrient applied in potato production (Sahu *et al.*, 2014) [17]. Nitrogen plays an important role in crop growth and development, resulting in increased size and number of tubers ultimately enhancing total yield (Sharma, *et al.* 2007). In addition, under or over supply of nitrogen may affect tuber production. Moreover, maintaining and adequate supply of nitrogen in the root zone of potato without leaching is important for optimal production of marketable quality tubers. On the contrary, excessive application leads to delayed maturity, poor tuber quality and occasional reduction in tuber yield (Alva, 2004). Keeping this in view the present study was conducted at horticultural research Farm, College of Agriculture, IGKV, Raipur (C.G.) with aim to optimize nitrogen requirement of the potato crop for higher productivity. The experiment was laid out in randomized block design with

four replications having five levels of nitrogen application *viz.* N_0: 0 kg N/ha, N_1: 75 kg N/ha, N_2:150 kg N/ha, N_3: 225 kg N/ha and N_4:300 kg N/ha to investigate the effects of different levels of nitrogen on growth and yield parameters.

Materials and Methods

The study was conducted during *rabi* season of 2015-16 at horticultural research Farm, College of Agriculture, IGKV, Raipur (C.G.). The soil of experimental field was sandy loam and texture with high organic carbon, pH was about to neutral, available nitrogen, phosphorous and potassium was represented in Table 1.

Table 1: Soil fertility status of the experimental plot

Treatments	Soil fertility status of the experimental plot				
	OC*	pH	Av N	Av P	Av K
T1	0.58	7.02	240.3	22.53	354.52
T2	0.58	7.02	240.5	22.51	354.55
T3	0.57	7.01	240.6	22.55	354.51
T4	0.58	7.02	240.5	22.51	354.55
T5	0.59	7.02	240.2	22.50	354.60

OC*= Organic carbon content of soil.

The experiment was laid out in randomized block design with four replications having five levels of nitrogen application *viz.* N_0: 0 kg N/ha, N_1: 75 kg N/ha, N_2:150 kg N/ha, N_3: 225 kg N/ha and N_4:300 kg N/ha with the variety of Kufri Surya on 11.11.2015. The gross and net plot size were 4.8 X 3.4 m^2 and 3.6 X 3.0 m^2, respectively. Soil sample taken before planting of potato crop were analyzed for their physio-chemical properties employing standard procedure. Tuber of 30-40 gm each was planted on ridges in plot with depth of 3-4 cm and spacing was 60 X20 cm. the tubers finally covered with soil. Phosphorous and potassium were applied at their recommended dose *i.e.* 100 kg/ha.

Nitrogen, phosphorous and potassium were applied through urea, single super phosphate and murate of potash respectively. Half dose of nitrogen (as per treatment), full dose of phosphorus and potassium were applied as basal rest half dose of nitrogen was topped dressed in two equal part at 30 days after planting and at earthing–up. Pre- emergence application of Sencor (Metribuzine) @ 0.75 Kg a. i./ha was done at three days after planting followed by one hand weeding at 20 days after planting to promote early crop growth. Haulms were cut at the last week of February after the crop attains maturity. Haulm cuttings were performed manually by sickle at 90 days after planting on18.02.2016. Potato tubers were dugout from each plot manually on 25.02.2016.

Observation on plant emergence (%), plant height (cm), No. of shoots per plant, grade wise tuber yield (t/ha), total tuber yield (t/ha), dry matter content (%) and yield of tuber on dry weight basis (t/ha).

Results and Discussion

Growth Parameters

Plant emergence: Plant emergence was ranges from 89.22 to 92.19%. There was no significant effect observed for different levels of nitrogen application on plant emergence. The highest emergence percent (92.19%) was recorded with the application of nitrogen @ 150 kg/ha in potato. On the contrary of this treatment result Sahu *et al.* (2016) [18] found the highest emergence percent (87.31%) at 30 days after planting with the application of nitrogen @ 225 kg/ha and 100% by Singh (1995) [20] with the application of nitrogen @ 200 kg/ha.

Plant height: Plant height was noticed to be influenced by various nitrogen levels. Application of nitrogen at different levels increased the plant height of potato by 45.1 to 54.85 cm. Increasing trend in case of plant height was observed with the increase in nitrogen levels. The highest plant height was observed with the application of nitrogen @300 kg/ha followed by the application of nitrogen @ 225 kg/ha. This result is also supported by the findings of Banjara *et al*., (2014).

Number of shoots: It is clear from the Table I that the number of shoots per plant ranges from 3.36 to 3.55. The highest number of shoots per plant (3.36) was recorded with the application of nitrogen @ 150 kg/ha. However, there is no any significant difference among the treatment. This result is also supported by the findings of Adhikari and Karki (2006), Bose *et al.* (2008) [9] and Nag *et al.* (2000). They reported that number of shoots per plant was not influenced with the increasing level of nitrogen.

The increase in plant height and shoot with increase in nitrogen levels may be due to the fact that higher nitrogen concentration stimulated the assimilation of carbohydrates and protein, which in turn enhanced cell division and formation of more tissues that resulted in enhanced vegetative growth of the plant (Anabousi, *et al*., 1997) [3] and also in the production of stem and axillary branches.

Yield Parameter

Graded total tuber yield: Data regards to yield (t/ha) at different grade (0-25 g, 25-50 g, 50-75g, >75 g) were significantly affected by different level of nitrogen. Experimental results also revealed that application of300 kg/ha recorded highest amount of 25-50 g grade tubers (4.28 t/ha), 50-75 g (7.35 t/ha), >75 g (14.57 t/ha) whereas, 0-25 g grade tuber (2.07 t/ha). Application of nitrogen fertilizer significantly increased with the total tuber yield of potato. Response to higher fertilization may be linked to the increasing total leaf area, which in turn increased the amount of solar radiation intercepted and more photo-assimilate might has been produced and assimilated to the tubers (Baishya *et al.*, 2013) [6]. Belanger *et al.* (2000) [8] found that application of appropriate amounts of nitrogen resulted in more favorable effects than higher rates. Zelalem *et al.* 19 also observed that for higher tuber yield optimum nitrogen management was important.

Total tuber yield: Total tuber yield showed increasing trend with the increase in nitrogen levels up to 300 kg nitrogen/ha. The highest total tuber yield (28.20 t/ha) was recorded in 300 kg N/ha. However, no significant difference was observed between the treatments 300 kg N/ha and other treatments *viz*., 150 kg N/ha and 225 kg N/ha for this character. Reiter *et al*. (2012) [16] also observed that substantial inorganic N fertilizer sources are necessary for optimal production. Minimum total tuber yield was recorded in the control (13.57 t/ha). This result collaborated with the finding of Sharma *et al.*, 2015 [19], Banjara, *et al*. (2014), and Sahu *et al*., (2014) [17]. Higher yield obtained with application of higher dose of nitrogen would have helped in increase in tuberization as well as increased duration of tuber bulking which would have resulted in higher production Kotsyuk (1995) [12]. Moreover, with increasing nitrogen application, number of stolon, number of tuber and

consequently yield were increased Zabihi *et al.*, (2010) [23]. Marguerite *et al*. (2006) [13] and Maiti *et al.* (2004) [14] revealed that tuber yield per unit area increased with increasing nitrogen fertilizer up to a suitable level only.

Tuber dry matter: The increase in dry matter percentage with nitrogen application might be due to the fact that higher doses of nitrogen might have helped in the production of photosynthesis, resulting in the accumulation of dry matter to be higher in the storage part *i.e.* tuber (Jha *et al*., 2008) [11]. These results have been found to be in conformity with the findings of Banjara *et al*., (2014), Sinha (2007) [21] and Etemad and Sarajuoghi (2012) [10].

Table 2: Percent Plant emergence, plant height (cm), No. of shoots per plant, grade wise tuber yield (t/ha) and total tubers yield/ha

Treatment	% Emergence	Plant height (cm)	No. of shoots/ plant	Yield of tubers				Total yield (t/ha)	% Dry Matter Content
				0-25g (t/ha)	25-50g (t/ha)	50-75g (t/ha)	>75g (t/ha)		
N0	89.22	45.10	3.36	1.36	2.33	3.61	6.27	13.57	19.28
N1	89.97	48.81	3.45	1.68	3.06	4.87	10.15	19.76	19.94
N2	92.19	48.95	3.55	2.01	3.65	6.45	11.5	23.62	20.10
N3	91.75	51.11	3.35	2.07	4.12	6.97	13.73	26.89	20.70
N4	90.83	54.85	3.34	2.00	4.28	7.35	14.57	28.2	20.77
SE(d)	2.47	1.65	0.42	0.22	0.32	0.89	1.65	2.48	0.16
C.D.	NS	3.64	NS	0.49	0.71	1.96	3.64	5.46	0.35

Conclusion

It can be concluded from this experiment that, optimum nitrogen application is essential to improve potato tuber yield. Although with the increase in nitrogen levels, vegetative parameters of crop growth increased with maximum values achieved on application of 300 kg N/ha but application of 150 kg N/ha proved to be superior for obtaining higher yield and yield attributing characters. Thus, application of optimum dose of 150 kg N/ha was observed to be superior in terms of yield, as well as more profitable and can, therefore, be economically recommended for cultivation of potato variety Kufri Surya under Chhattisgarh plains agro-climatic zone.

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