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Virendra Kumar
Assistant Professor, Agriculture, School of Agriculture and Development Studies, Uttarakhand Open University, Haldwani, Uttarakhand, India

Manoj Raghav
Department of Vegetable Science, College of Agriculture, G.B.P.U.A. &T., Pantnagar, U.S. Nagar, Uttarakhand, India

Rajendra Bhatt
Department of Vegetable Science, College of Agriculture, G.B.P.U.A. &T., Pantnagar, U.S. Nagar, Uttarakhand, India

Corresponding Author:
Virendra Kumar
Assistant Professor, Agriculture, School of Agriculture and Development Studies, Uttarakhand Open University, Haldwani, Uttarakhand, India

Influence of nitrogen levels in growth and yield of potato varieties under north-western hills

Virendra Kumar, Manoj Raghav and Rajendra Bhatt

Abstract
Present investigation was conducted at farmer's field in Nainital district of Uttarakhand to know the response of two potato varieties to various levels of nitrogen yield attributes and yield of potato tubers during the 2020-2021. Data revealed that the plant emergence per cent, plant height, number of tubers per hectare, tuber yield per hectare and harvest index recorded maximum with variety Kufri Himalini while number of haulms/hill was recorded with variety Kufri Jyoti. The result showed a significant effect of nitrogen levels on yield attributing characters and yield. The application of 100kg N/ha gave maximum number of tubers, total tuber yield per hectare and harvesting index. Thus it can be concluded that the variety Kufri Himalini with application of 100 kg N/ha is suitable for having higher yield of potato in Northwestern hills of Uttarakhand.

Keywords: Variety, nitrogen, plant height, tuber yield, harvest index

Introduction
Potato (*Solanum tuberosum* L.) has played a major role in the crop diversification and food security of India since its introduction about 400 years ago. It is an important cash crop after wheat, rice and maize and India ranks second in potato production in the world after China. The crop is grown in widely varying ecologies in the country, such as lowland plains, plateaus and hills. Seasonally it is grown during summers in the hills, autumn in the plains and winters in the warmer areas and climatically under long-day conditions in the hills and short-day conditions in the plains. Young plants grow best at a temperature of 24 °C and later growth is favored at 15-18 °C. Tuber production reaches a maximum at 18-20 °C and decreases with rise in temperature and tuber production stops entirely at about 30oC temperature. Short days are beneficial for tuber production (*Kumar et al*. 2010). Nitrogen is an essential constituent of protein and chlorophyll. Potato is highly responsive to nitrogen nutrient and it is usually the most limiting essential nutrient for growth and development. The imbalance fertilizer use not only stagnate crop yields, but also soil quality (Akhtar and Khan, 2002).Meager information is available regarding nitrogen requirement of potato cv. Kufri Jyoti and Kufri Himalini in northwestern hills. Keeping this in view, the present experiment was conducted to find out the response of potato varieties to various levels of nitrogen for growth, yield attributes and yield.

Materials and Methods
The present experiment was conducted at farmer's field at village Chandrapur navad, Kaladhudi, Nainital, Uttarakhand during *rabi* season of 2020-2021. The soil of the experiment field was sany loam having pH 6.10 and available nitrogen (129023kg/ha), phosphorous (20.93kg/ha), K 9169.12kg) and organic carbon (0.85%). The experiment consisted of four levels of nitrogenous fertilizer *viz.*, 0(N0), 50 (N1), 100(N2) and 150(N3) kg/ha and two potato varieties *viz.*, Kufri Jyoti (V1) and Kufri Himalini (V2) taken as treatments. The experiment was laid out in factorial randomized block design with three replications having eight treatments combinations. The half dose of each level of nitrogen was applied as basal and remaining half amount top dressed after 30 days of planting. The source of nitrogen was urea (46% N). Well- sprouted seed tubers of potato varieties Kufri Jyoti and Kufri Himalini, size 40-50g were planted during third week of October. Crop was dehaulmed at 80 days after planting. Rest of the agronomic package of practices adopted was as recommendation for potato cultivation. Observations like emergence per cent, plant height, number of haulms/hill, number of tubers/ha and tuber yield/ha was recorded. The data was analyzed by using STPR3 programme, designed and developed by Department of Mathematics and Statistics, College of Basic Sciences and Humanities, G.B. Pant University of Agriculture & Technology, Pantnagar, and Uttarakhand.

Results and Discussions

Plant growth characters

Emergence per cent shows significant differences in varieties (table-1) and it was found maximum with variety Kufri Himalini (98.95%). Plant height was not significantly affected by varieties, although Kufri Himalini (V2) had more plant height (49.50 cm) then the variety Kufri Jyoti (V1) *i.e.*49.50cm. Similar results were also reported by Chandra *e al.* (2015) [2]. The number of haulms/hill showed non-significant difference between the varieties. Variety Kufri Jyoti had more number of haulms (5.21) then variety Kufri Himalini (4.99), however, the differences were non-significant. This type of effect of varieties on growth characters was also reported by Kumar and Maurya (2013) [5]. The crop growth traits such as emergence per cent, plant height and number of haulms/hill were significantly affected by nitrogen levels. The maximum emergence per cent plant height and number of haulms/hill were recorded with the treatment N3 (150kg/ha). This might be due to better availability of nitrogen and the enhancing effect of nitrogen on vegetative growth by increasing cell division and cell elongation. These findings are in agreement with the findings of Chandra *et al.* (2015) [2] Singh *et al.* (2016) [7] Nagar *et al.* (2019) [6]. The interaction effect between varieties and nitrogen levels showed non-significant effect on growth parameters.

Yield attributes and yield

More numbers of tuber/ha (1058.58, 000/ha) and tuber yield/ha (28.65t/ha) was recorded with variety Kufri Himalini (V2), although the impact were found non-significant (table-1). Favorable response of nitrogen on number of tubers/ha and yield/ha were observed. The results were also supported by the findings of Chandra *et al.* (2015) [2]. The tuber number per hectare and yield per hectare significantly increased as the nitrogen level increased up to 100kg N/ha after that, these parameters decreased gradually with increasing nitrogen level. Application of 100kg N/ha (N2) recorded maximum number of tubers/ha (1248.36, 000/ha) and tuber yield/ha (30.69 t/ha), followed by treatments N3 (150kg N/ha) for tuber number (1292.13, 000/ha) and for tuber yield (26.25 t/ha).The increase in tuber number and tuber yield per hectare might be due to increased photosynthetic activity and translocation of photosynthates to the tuber which might help in the initiation of more stolons in potato plant. Similar results were also reported by Chandra *et al.* (2015) [2]. The interactive effect of variety and nitrogen levels significantly affected the number of tubers/ha and yield/ha. The findings are in agreement with Chandra *et al.* (2015) [2], Nagar *et al.* (2019) [6].

Varieties have non-significant effect on harvesting index while, nitrogen levels showed significant effect on harvest index. With the increasing levels of nitrogen, harvest index increased up to 100kg N/ha (N2) and thereafter it decreased. Effect of nitrogen on biological yield was higher than economical yield and because of this after a certain level the harvesting index decreased. The maximum harvesting index (44.52%) was recorded with the application of 100kg N/ha and minimum (41.52%) in case of 0kg N/ha application. A similar result was also reported by Mahmoodabad *et al.* (2011) [3], Kumar and Chandra (2014) [4], Chandra *et al.* (2015) [2]. The interactive effect of variety Kufri Jyoti with 75 kg N/ha application gave maximum harvest index (59.99%).

Selection of high yielding variety along with application of optimum nitrogen is essential to have optimum yield of potato. On the basis of present experimental results it can be concluded that application of 100kg nitrogen for high yielding variety Kufri Himalini can be recommended for higher yield of potato.

Table 1: Effect of varieties and nitrogen levels on growth, yield attributes and yield characters of potato plant

Treatments	Emergence (%)	Plant height (cm)	Number of haulms/hill	Number of tubers/ha (000, thousand)	Tuber Yield (t/ha)	Harvest index (%)
Variety						
V1	96.23	45.28	5.21	1020.58	26.21	58.88
V2	98.95	49.50	4.99	1058.23	28.65	60.58
S.Em±	0.59	0.24	0.14	3068	0.12	0.26
CD at 5%	1.24	NS	NS	NS	NS	NS
Nitrogen						
N0	95.36	33.65	3.26	1069.35	20.13	41.52
N1	97.05	36.25	4.28	1109.25	23.36	43.56
N2	97.89	42.45	4.98	1348.36	27.69	44.52
N3	98.65	45.56	5.12	1292.13	26.25	43.50
S.Em±	0.61	0.36	0.20	6.58	0.23	0.29
CD at 5%	2.14	1.87	0.75	21.36	0.86	1.02
Interaction (V x N)						
V1N0	95.68	38.45	3.78	1002.13	22.31	59.21
V1N1	96.98	40.15	4.89	1109.14	25.96	59.99
V1N2	96.54	41.29	5.12	1399.85	28.99	58.91
V1N3	96.98	43.18	5.98	1199.21	26.56	57.21
V2N0	97.00	37.89	3.98	1013.25	23.96	55.24
V2N1	98.56	41.59	4.19	1258.01	26.99	56.29
V2N2	99.00	42.12	4.99	1396.25	29.16	58.99
V2N3	98.57	44.28	5.24	1158.12	28.69	51.23
S.Em±	1.02	0.59	0.38	10.01	0.56	0.46
CD at 5%	NS	NS	NS	29.26	2.16	1.26

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