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Effect of plant growth regulators and methods of application on growth and yield of potato (*Solanum tuberosum* L.) cv. KUFRI BADSHAH

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ABSTRACT : The present investigation of plant growth regulators and methods of application on growth and other yield components were carried out on potato. Out of 10 treatment combinations comprised of two levels of methods of application *viz*., M_1 (Seed treatment) and M_2 (Spray treatment) and five levels of plant growth regulators R_1 (control), R_2 (GA_3 25 ppm), R_3 (GA_3 50 ppm), R_4 (IBA 100 ppm) and R_5 (IBA 200 ppm). Spray treatment of IBA 200 ppm was effective in maximum germination percent, growth, number of shoots per plant, days taken for physiological maturity, number of tubers harvested per plant and yield of tuber kg ha^{-1} and application of spray of GA_3 50 ppm was superior for minimum days taken for germination and average weight of tuber.

Key Words : Potato, Plant growth regulators, Methods of application, Growth attributes, Yield attributes

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Potato belongs to the family Solanaceae, genus *Solanum* and species *tuberosum*. Potato is a native of South Africa. Potato produces more carbohydrates, fibers and vitamins per unit area and time than the other major food crops. Potato is a low energy food and it provides 138 Kcal/ 200 g of boiled potato. It is rich in potassium and phosphorus (Shekhawat *et al.*, 1992).

Gibberellin application enhanced shoot emergence, increased shoot height, stems per hill and number of tuber per hill (Khurana and Pandita, 1987). However, IBA is preferred than other growth substances as, it has low auxin activity and destroys relatively slowly by auxin degrading enzymes. IBA is persistent in nature. The application of IBA recorded its superiority over other plant growth regulators for plant height, number of branches and number of leaves; therefore, it is resulted in highest dry weight of foliage (Bhatia *et al.*, 1992). IBA at the concentration of 200 ppm should be sprayed on the potato foliage at 40 days and 55 days after planting.

RESEARCH PROCEDURE

An experiment was conducted during 2011 at Horticulture Instructional Farm, C.P. College of Agriculture, S.D. Agricultural University, Sardarkrushinagar. The experiment was laid out in Factorial Randomized Block Design with three replications. There were 10 treatment combinations comprised of two levels of methods of application *viz*., M_1 (Seed treatment) and M_2 (Spray treatment) and five levels of plant growth regulators R_1 (control), R_2 (GA_3 25 ppm), R_3 (GA_3 50 ppm), R_4 (IBA 100 ppm) and R_5 (IBA 200 ppm) (Table 1). The soil of experimental plot was sandy loam in texture, low in organic carbon and available nitrogen, medium in available phosphorus and rich in potassium status. The variety of potato was 'Kufri Badshah' and seed rate of potato was 3000 kg/ha. The potato was fertilized with 275:140:275 NPK kg/ha.

RESEARCH ANALYSIS AND REASONING

The results obtained from the present investigation have been discussed in the following sub heads:

Growth attributes:

Growth parameters like length of main shoot (at 60, 75 and 90 DAS) and number of shoot per plant were significantly affected by methods of application (Table 1), but the growth parameters like days taken for germination, germination (%),

plant height (at 30 and 45 DAS) and days taken for physiological maturity were non significant (Table 1). The maximum length of main shoot 46.42, 57.89 and 60.30 cm at 60, 75 and 90 DAS, respectively and number of shoots per plant (2.96) were found in M_2 (spray treatment) method, whereas the minimum length of main shoot and number of shoots per plant was observed in M_1 (seed treatment) method. This considerable increase in growth parameters in spray treatment might be due to more active protein synthesis and uptake of nitrogen, which cause relatively more growth of shoot, resulting in increased plant height and increase shoot length than seed treatment. These results are in conformity with the findings of Pandita *et al.* (1981), Utheib *et al.* (1981), Agrawal *et al.* (1983), Khurana and Pandita (1987), Bodlaender *et al.* (1989) and Batra *et al.* (1992).

The data pertaining to length of main shoot as affected by plant growth regulators was found significant but the days taken for germination and germination (%) were found non significant. The maximum shoot length was recorded in treatment R_5 (IBA 200 ppm) *i.e.* 20.75, 40.72, 48.05, 60.65 and 64.24 cm at 30, 45, 60, 75 and 90 DAS, respectively, whereas, significantly shortest shoot length was recorded in control (R_1) *i.e.* 18.24, 29.97, 38.97, 49.96 and 50.53 cm at 30, 45, 60, 75 and 90 DAS, respectively.

The perusal of the data revealed that the effect of plant growth regulators was found significant on number of shoots per plant at 45 DAS and days taken for physiological maturity of potato. Treatment R_5 (IBA 200 ppm) was observed highest number of shoots per plant (3.27). The minimum days taken for physiological maturity (81.95) were found in R_5 (IBA 200 ppm), while the maximum days taken for physiological maturity of potato (93.43) were observed in control (R_1) treatment. The increase in the vegetative characters might be due to enhanced cell division and quick cell multiplication. The above results are in consonance with those of Miller *et al.* (1985), Bhatia *et al.* (1991), Bhatia *et al.* (1992), Asma *et al.* (2001), Ostroshy and Struik (2008) and El-Helaly (2009).

Yield attributes:

The data presented in Table 1, indicated that the effect of method of application was found significant for yield attributes and yield. The maximum number of tubers harvested per plant (5.94), average weight of tuber (61.84 g) and yield of tuber per plant (230.75 g) was obtained in spray treatment (M_2), however, the minimum number of tuber harvested per plant (5.61), average weight of tuber (58.93 g) and

Table 1 : Effect of plant growth regulators and methods of application on growth and yield of potato

Treatments	Days taken for germination	Germination (%)	Length of main shoot (cm) at					No. of shoots/ plant (at 45 DAS)	Days taken for physiological maturity	No. of tuber harvested/plant	Average weight of tuber (g)	Yield of tuber per plant (g)	Yield of tuber kg/plot	Yield of tuber kg/ha
			30 DAS	45 DAS	60 DAS	75 DAS	90 DAS							
Methods of application (M)														
M_1=Seed treatment (Dipping tuber 20 minutes)	15.50	85.59	19.92	36.65	42.21	54.62	56.55	2.62	86.45	5.61	58.93	210.64	6.74	31205.40
M_2=Spray treatment (30 DAS)	15.93	85.57	18.74	35.62	46.42	57.89	60.30	2.96	86.90	5.94	61.84	230.75	7.38	34185.70
S.E.±	0.98	1.80	0.40	0.74	0.86	1.05	1.11	0.11	1.60	0.09	0.94	5.71	0.18	846.76
C.D. (P=0.05)	NS	NS	NS	NS	2.56	3.13	3.30	0.31	NS	0.27	2.79	16.98	0.54	2515.74
Plant growth substances (R)														
R_1= 0 ppm (Control)	16.20	80.59	18.24	29.97	38.97	49.96	50.53	2.40	93.43	4.62	52.27	178.93	5.73	26507.70
R_2=GA_3 25 ppm	15.50	84.52	18.31	35.77	41.52	54.36	56.69	2.57	87.65	5.10	63.36	190.79	6.11	28265.44
R_3=GA_3 50 ppm	14.75	86.66	20.26	36.39	45.42	56.67	59.50	2.87	84.33	5.79	59.79	234.54	7.51	34746.01
R_4=IBA 100 ppm	16.00	87.47	19.10	37.84	47.62	59.62	61.16	2.85	86.00	6.52	57.97	241.06	7.71	35712.60
R_5=IBA 200 ppm	14.80	88.68	20.75	40.72	48.05	60.65	64.24	3.27	81.95	6.87	69.14	258.02	8.26	38245.90
S.E.±	1.23	2.85	0.64	1.17	1.36	1.67	1.76	0.17	2.52	0.14	1.48	9.04	0.29	1338.43
C.D. (P=0.05)	NS	NS	1.90	3.47	4.04	4.95	5.22	0.49	7.50	0.42	4.41	26.85	0.86	3976.85
Interaction (M x R)														
S.E.±	0.52	1.72	0.94	1.24	1.92	2.18	2.48	0.23	3.57	0.20	2.10	12.78	0.41	1893.06
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.60	NS	37.97	1.21	5624.54
C.V. %	8.6	8.15	8.10	7.91	7.96	7.25	7.36	14.52	7.13	6.03	6.02	10.03	10.03	10.03

yield of tuber per plant (210.64 g) was noted in M_1 (seed treatment) method. Similarly, the data shown in Table 1, resulted that the highest yield of tuber 7.38 kg per plot and 34185.70 kg per ha was produced by M_2 (spray treatment) method, whereas, the lowest yield of tuber 6.74 kg per plot and 31205.40 kg per ha was found in M_1 (seed treatment) method. This is probably due to the foliar application of plant growth regulator which might have better penetration into leaves and increase the leaf chlorophyll content which increases in the photosynthetic rate and which in turn increased the growth of plants and resulting in to higher yield attributes and yield than seed treatment method. Similar findings have also been obtained by Agrawal *et al.* (1983), Batra *et al.* (1992), Tomar and Ramgiry (1997), Kang *et al.* (1997) and Alexopoulos *et al.* (2007).

The data presented in Table 1 resulted that the effect of plant growth regulators was found to be significant on yield attributes like number of tubers harvested per plant, average weight of tuber and yield of tuber per plant of potato. The maximum number of tubers (6.87) per plant, average weight of tuber (69.14 g) and yield of tuber (258.02 g) was fond in R_5 (IBA 200 ppm) treatment, However, the minimum number of tubers per plant (4.62), average weight of tuber (52.27 g) and yield of tuber per plant (178.93 g) was noted in R_1 (control) treatment. The above results are in agreement with those of Bodlaender *et al.* (1989).

As the Table 1 indicated that the yield of tuber was significantly affected by effect of plant growth regulators. Among different treatment of plant growth regulators, treatment R_5 (IBA 200 ppm) was produced maximum yield of tuber 8.26 kg per plot and 38245.90 kg per ha of potato, and it was at par with R_4 (IBA 100 ppm), whereas the treatment control (R_1) was produced lower yield of tuber 5.73 kg per plot and 26507.70 kg per ha of potato, which was at par with R_2 treatment. The increase in the vegetative characters may be due to enhanced cell division and quick cell multiplication while, the higher yield may be due to better carbon assimilation and better accumulation of carbohydrates in the plants. The present finding is in accordance with Bodlaender *et al.* (1989) and Bhatia *et al.* (1992).

Coonclusion:

In the view of the results obtained from this investigation, it could be concluded that for securing the higher growth, tuber yield as well as average weight of tuber, spray treatment of 200 ppm IBA and 50 ppm GA_3 can be applied.

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