

## Effect of seed treatment chemicals and pruning on seed-potato (*Solanum tuberosum*) production of 'Kufri Bahar' under Allahabad condition

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### ABSTRACT

The effects of seed treatment chemicals [no seed treatment (control set)], Gibberellic acid, Benzyl adenine and urea and pruning: no tipping (control set), tipping, tipping + Maleic hydrazide, tipping + Triodo benzoic acid were assessed in 'Kufri Bahar', a semi-vigorous, input-responsive mid-season potato variety at Allahabad during 2007–08. Tipping was found to have significant effect over non-tipping treatment. Plant height was increased significantly (62.83 cm) by the seed treatment chemicals. Gibberellic acid treatment showed maximum plant height, followed by urea (nitrogen) and Benzyl adenine, respectively. Tipping reduced plant height but insignificantly. Pruning chemicals (Maleic hydrazide and Triodobenzoic acid) were found to reduce plant height significantly when applied after tipping. Those inhibitors were also found to suppress the effect of seed treatment chemicals (Gibberellic acid, Benzyl adenine and urea). Plant height was recorded in the range of 62.83 cm in T<sub>4</sub> to 34.80 cm in T<sub>2</sub>.

Number of shoots/plant, top fresh weight, underground fresh weight, top dry weight and underground dry weight were significantly affected by seed treatment chemicals and pruning and the range was 12.25–3.45, 290.88–176.76 g, 54.26–28.68 g, 159.44–96.44 g and 30.78–14.98 g, respectively. Number of tubers/plant were also influenced by the treatments. Gibberellic acid yielded more number of tubers followed by urea, Benzyl adenine and minimum in the control set. Maleic hydrazide and Triodobenzoic acid were found to reduce number of tubers/plant. Tipping with chemical seed treatment increased number of tubers/plant significantly. Contrary to this, number of economic tubers/plant were recorded more when seed-treated plants were tipped, followed by Maleic hydrazide and or Triodobenzoic acid spray. Number of seed tubers/plant was adversely affected by tipping. Seed treatment chemicals yielded higher number of seed tubers/plant. Tipping followed by Maleic hydrazide and or Triodobenzoic acid spray displayed significantly better results and highest number of seed tubers/plant (10.73) were observed in T<sub>7</sub>, while lowest (5.57) was observed in T<sub>2</sub>. Similarly, yield of seed-tubers/ha was highest (35.66 tonnes/ha) in T<sub>7</sub> and lowest (13.06 tonnes/ha) in T<sub>2</sub>.

Seed treatment chemicals and tipping were found to enhance the vigour and productivity of potato plant. Seed treatment with GA<sub>3</sub> @ 50 mg/litre. water and tipping at 25 days after seed sowing, followed by spraying with Triodobenzoic acid @ 15 mg/litre at day 3 of tipping may be recommended to the farmers to get higher yield of seed-potato in cv. 'Kufri Bahar' under Allahabad condition.

**Key words:** Benzyl adenine, Gibberellic acid, Maleic hydrazide, Plant growth, Potato, Pruning, Regulators, Seed tuber, Tipping, Triodobenzoic acid, Urea, Yield

Potato constitutes staple food in many countries worldwide. It possesses inbuilt genetic potential to yield huge biomass in short time/unit land. In India, farmers have been regularly growing this crop even under acute price fluctuation and shortage of cold storage facilities.

Potatoes are commercially multiplied through tubers. Tubers are most important basic input to forecast yield and also it accounts ~40% of cost of cultivation.

Farmers generally use these seed-tubers either whole or

cut-pieces. Whole potatoes are far better over cut-pieces in terms of yield and quality potato production. Generally, 40–65 g tuber is found to be ideal as seed-tuber but occurrence of heterogeneous population of tuber in field crop is a common phenomenon. Plant growth regulators and cultural modifications are some of the feasible propositions at farmer's end to practice.

Gibberellic acid and Benzyl adenine are known growth promoters, can be effectively used to modify growth behaviour of potato plants. Nitrogen helps in attaining luxuriant vegetative growth of potato plants when supplied in sufficient quantity. Maleic hydrazide and Triodobenzoic acid are growth inhibitors suppress growth and bud sprouting.

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Those chemical pruners also nullify the effect of pruning up to certain level.

Keeping all these aspects in purview, the present study was undertaken to find out certain feasible combination of seed treatment chemicals, pruning and inhibitors to enhance high quality seed-potato production with maximum productivity.

#### MATERIALS AND METHODS

The experiment was conducted at the Department of Horticulture KAPG, College, Allahabad during 2007–08. Four levels of each seed treatment chemicals and pruning were tried. Seed treatment chemical, viz (T<sub>0</sub>=no seed treatment, T<sub>1</sub> = seed treatment with Gibberellic acid @50 mg/l of water for 5 min, T<sub>2</sub>=seed treatment with Benzyl adenine @25 mg/l of water for 5 min. and T<sub>3</sub>=seed treatment with urea@ 20 g/l of water for 30 min. and pruning (P<sub>0</sub>=no tipping, P<sub>1</sub>=tipping of shoot apex, P<sub>2</sub> = tipping, followed by spray of Maleic hydrazide@40 mg/l water, P<sub>3</sub>=tipping, followed by spray of Triodobenzoic acid@15 mg/l water.

Thus 15 treatment combinations along with a control were formed as mentioned below.

No seed treatment + no tipping. T<sub>1</sub> (T<sub>0</sub>P<sub>1</sub>) no seed treatment + tipping. T<sub>2</sub> (T<sub>0</sub>P<sub>2</sub>) no seed treatment + tipping, followed by Maleic hydrazide spray. T<sub>3</sub> (T<sub>0</sub>P<sub>3</sub>) no seed treatment + tipping, followed by Triodobenzoic acid spray. T<sub>4</sub> (T<sub>1</sub>P<sub>0</sub>) seed treatment with Gibberellic acid + no tipping. T<sub>5</sub> (T<sub>1</sub>P<sub>1</sub>) seed treatment with Gibberellic acid + tipping. T<sub>6</sub> (T<sub>1</sub>P<sub>2</sub>) seed treatment with Gibberellic acid + tipping, followed by Maleic hydrazide spray. T<sub>7</sub> (T<sub>1</sub>P<sub>3</sub>) seed treatment with Gibberellic acid + tipping, followed by Triodobenzoic acid. T<sub>8</sub> (T<sub>2</sub>P<sub>0</sub>) seed treatment with Benzyl adenine + no

tipping. T<sub>9</sub> (T<sub>2</sub>P<sub>1</sub>) seed treatment with Benzyl adenine + tipping. T<sub>10</sub> (T<sub>2</sub>P<sub>2</sub>) seed treatment with Benzyl adenine + tipping, followed by Maleic hydrazide spray. T<sub>11</sub> (T<sub>2</sub>P<sub>3</sub>) seed treatment with Benzyl adenine + tipping, followed by Triodobenzoic acid spray. T<sub>12</sub> (T<sub>3</sub>P<sub>0</sub>) seed treatment with urea + no tipping. T<sub>13</sub> (T<sub>3</sub>P<sub>1</sub>) seed treatment with urea + tipping. T<sub>14</sub> (T<sub>3</sub>P<sub>2</sub>) seed treatment with urea + tipping, followed by Maleic hydrazide spray. T<sub>15</sub> (T<sub>3</sub>P<sub>3</sub>) seed treatment with urea + tipping, followed by Triodobenzoic acid spray.

Tipping was done after 25 days of sowing and 5 cm leader tip was detached with the help of sharp blade. Third day after tipping Maleic hydrazide and or TIBA as chemical pruners were sprayed on the standing crop. The 4<sup>2</sup> factorial RBD with 3 replications (total number of 16 treatment) were laid to conduct the experiment. Spacing was kept 60 cm × 25 cm. between rows and plants. Plot size was kept 3 m × 3 m<sup>2</sup> (60 plants/plot and total 2 880 plants were studied). After soil testing fertilizers @80, 60, 100, NPK kg/ha + 20 tonnes/ha organic manure (FYM+vermicompost) and 10 kg/ha *Tichoderma* was applied.

All the intercultural operations were done as recommended for the crop. Sowing was done on 15 October, dehauling on 10 February and digging on 20 February in both the years of experiments. Data for plant height was taken at maximum plant growth stage, i e at 50 days after sowing. Number of shoots/plant, top fresh and dry weight, underground fresh and dry weight, were also taken at 50 days after sowing.

Number of tubers/plant were counted as largest to smallest size of swellings found at the time of harvesting. The tuber < 10 g in weight were considered as uneconomic, which were left over in the field during harvesting.

Table 1 Effect of seed treatment chemicals and pruning on vigour of potato cv 'Kufri Bahar' (pooled data)

Treatment	Plant height (cm)	shoots/plant	Top fresh weight (g)	Underground fresh weight (g)	Top dry weight (g)	Underground dry weight (g)
T <sub>0</sub>	50.93	9.88	240.22	43.20	134.73	26.00
T <sub>1</sub>	49.73	12.51	236.84	42.78	130.04	24.08
T <sub>2</sub>	34.80	3.45	176.76	28.68	96.44	14.98
T <sub>3</sub>	35.23	4.06	184.01	29.96	100.23	16.55
T <sub>4</sub>	62.83	12.25	290.88	54.26	159.44	30.78
T <sub>5</sub>	57.81	14.38	260.08	49.24	143.73	27.00
T <sub>6</sub>	40.21	5.73	204.60	33.40	120.11	21.39
T <sub>7</sub>	41.83	7.39	229.94	34.44	126.44	24.00
T <sub>8</sub>	59.60	10.73	269.40	50.22	145.44	27.13
T <sub>9</sub>	51.33	13.14	246.91	45.64	137.70	25.11
T <sub>10</sub>	35.83	5.10	192.88	29.98	110.11	17.93
T <sub>11</sub>	36.78	6.78	196.92	30.10	115.01	18.74
T <sub>12</sub>	61.68	11.33	279.40	53.02	154.32	38.53
T <sub>13</sub>	52.33	13.73	255.10	44.16	140.23	26.53
T <sub>14</sub>	39.25	5.73	202.30	31.33	118.42	20.41
T <sub>15</sub>	40.73	6.88	224.36	32.80	123.12	23.33
SE ±	1 787.00	1.516	8.332	2.395	4.372	2.711
CD (P=0.05)	4.380	3.730	20.830	5.870	10.930	6.590

The tuber > 10 g in weight were counted as economic tuber. Tuber weight range between 65 and 35 g was considered as seed-tuber. All sorts of tuber were calculated as in numbers/plant, kg/plant and tonnes/ha.

RESULTS AND DISCUSSION

Seed treatment chemicals showed significant effect on plant height. Gibberellic acid displayed discernible effect more followed by urea, Benzyl adenine and control, respectively. Plant height was reduced with chemical pruners. Maleic hydrazide had maximum plant height, followed by Triodobenzoic acid when applied after shoot tipping. Even control was better over T<sub>1</sub> (untreated seed + shoot tipping) treatment. Tallest plant (62.83 cm) was observed in T<sub>4</sub> (GA<sub>3</sub> seed treated + no tipping) while the shortest plant (34.80 cm.) was observed in T<sub>2</sub> (no seed treatment + shoot tipping + Maleic hydrazide) treatment.

Shoot elongation predominantly governs by Gibberellic acid level present at the tip and auxiliary bud. Nitrogen and Benzyl adenine also increased the height of the plant. Maleic hydrazide and Triodobenzoic acid are the inhibitors and arrests auxiliary growth, therefore the effect of those chemical pruners (Maleic hydrazide and Triodobenzoic acid) was observed in growth suppression. Pruning is a dwarfing process, to reduce plant height of tipped plant. The findings of the study supported and corroborated by the findings of Kumar *et al.* (2009), Ravichandran *et al.* (2007) and Yenagi (2000).

Number of shoots/plant were found to be influenced by seed treatment chemicals. GA3 produced highest number of shoots/plant, followed by urea and Benzyl adenine. Untreated seed produced plants with minimum shoots. Tipping had more number of shoots/plant over untipped (control). MH was found to kill auxiliary buds more efficiently, than TIBA and minimum shoots were observed with MH-treated plants. Maximum shoots/plant (14.38) were observed in T<sub>5</sub> (GA3 seed treatment + tipped plant), while minimum number (3.45) were recorded in T<sub>2</sub> (untreated seed + shoot tipping+MH) treatment. Tipping encourages the shooting. GA3 had pronounced than urea and BA, respectively. MH and TIBA kill the auxiliary buds hence and thereby shooting also. This finding is in the conformity with the findings of Alexopoulos *et al.* (2007), Behera *et al.* (2009) and Birbal *et al.* (2009)

Top fresh weight/plant and underground fresh weight/plant were found to be influenced severely by seed treatment chemicals, tipping and pruning chemicals. Plant height displayed positive co-relation with the top and underground fresh weight/plant. Highest top fresh weight 290.88 g/plant and underground fresh weight (54.26 g/plant) was recorded in T<sub>4</sub> while the lowest top and underground fresh weight/plant (176.76g. and 28.68g.), respectively were observed in T<sub>2</sub>.

Similar pattern was also observed in top dry weight and underground dry weight/plant. The values were maximum

Table 2 Effect of seed treatment chemicals and pruning on seed tuber yield of potato cv 'Kufri Bahar' (pooled data)

Treatment	No. of tubers/plant	No. of economic tubers/plant	No. of uneconomic tubers/plant	No. of seed tubers/plant	Weight of tubers/plant (kg)	Weight of economic tubers/plant (kg)	Weight of uneconomic tubers/plant (kg)	Weight of seed tubers/plant (kg)	Yield of tubers (tonnes/ha)	Yield of economic tubers (tonnes/ha)	Yield of uneconomic tubers (tonnes/ha)	Yield of seed tubers (tonnes/ha)
T <sub>0</sub>	18.15	9.63	8.50	6.93	0.837	0.481	0.085	0.271	37.52	31.76	5.66	18.06
T <sub>1</sub>	22.36	8.35	14.01	5.57	0.807	0.417	0.140	0.196	36.83	27.52	9.31	13.06
T <sub>2</sub>	14.45	9.82	4.63	7.03	0.813	0.491	0.046	0.276	35.46	32.40	3.06	18.39
T <sub>3</sub>	14.65	9.03	5.62	6.70	0.765	0.451	0.056	0.258	33.49	29.76	3.73	17.19
T <sub>4</sub>	22.05	11.82	10.23	8.01	1.023	0.591	0.102	0.330	45.79	39.00	6.79	21.99
T <sub>5</sub>	27.93	9.98	17.95	6.17	0.907	0.499	0.179	0.229	44.89	32.93	11.93	15.26
T <sub>6</sub>	15.22	10.36	4.86	10.08	1.065	0.518	0.048	0.499	37.37	34.18	3.19	33.26
T <sub>7</sub>	17.84	11.04	6.80	10.73	1.155	0.552	0.068	0.535	40.96	36.43	4.53	35.66
T <sub>8</sub>	20.16	10.74	9.42	9.00	1.016	0.537	0.094	0.385	41.70	35.44	6.26	25.66
T <sub>9</sub>	23.33	8.63	14.60	5.67	0.778	0.431	0.146	0.201	38.17	28.44	9.73	13.39
T <sub>10</sub>	15.14	10.30	4.84	8.70	0.931	0.515	0.048	0.368	37.12	33.93	3.19	24.53
T <sub>11</sub>	16.95	10.44	6.51	8.86	0.964	0.522	0.065	0.377	38.18	34.45	4.33	25.13
T <sub>12</sub>	20.99	12.16	9.83	9.80	1.135	0.608	0.098	0.429	46.65	40.12	6.53	28.59
T <sub>13</sub>	26.15	9.35	16.80	5.92	0.850	0.467	0.168	0.215	42.01	30.82	11.19	14.33
T <sub>14</sub>	15.16	10.31	4.85	10.04	1.060	0.515	0.048	0.497	37.18	33.99	3.19	33.13
T <sub>15</sub>	17.12	9.68	6.74	9.55	1.021	0.484	0.067	0.470	36.40	31.94	4.46	31.33
SE ±	1.18	0.491	1.20	0.510	0.047	0.042	0.041	0.057	1.155	1.179	1.559	1.551
CD(P=0.05)	2.85	1.51	2.94	1.19	0.117	0.099	0.097	0.134	2.83	2.89	3.79	3.77

(159.44 and 30.78g) in T<sub>4</sub> and lowest (96.44 and 14.98g), respectively in T<sub>2</sub> treatment.

Fresh and dry weight was found directly related to the plant height being prominent site of metabolites accumulation. Number of shoots also influenced the weight but little lesser as compared to plant height. It might be due to the lighter weight of foliage as compared to juicy stem. The result corroborates with the study of Aggrey *et al.* (2005), Badoni and Chauhan (2010), Gayathri *et al.* (2008).

Number of tubers/plant was greatly influenced by the treatment factors. Tipping increased the number of tubers/plant. MH and TIBA were found to have adverse effect on number of tubers/plant. Seed treatment increased number of tubers/plant. Highest number of tubers (27.93/plant) were observed in T<sub>5</sub> (seed treatment with GA3 + tipping), followed by T<sub>13</sub> (seed treatment with urea + tipping). Minimum value (14.45 tubers/plant) was observed in T<sub>2</sub> (no seed treatment + tipping), followed by (14.65 tubers/plant) in T<sub>3</sub> (no seed treatment + tipping + TIBA spray). Number of uneconomic tubers (<10g)/plant was also observed more with more number of tubers/plant. This might be owing to the competition for food, space and congenial environment.

Maximum number of uneconomic tubers/plant (17.95) were observed in T<sub>5</sub>, followed by T<sub>13</sub> (16.80) and T<sub>9</sub> (14.60) and lowest number of uneconomic tubers/plant (4.63) were recorded in T<sub>2</sub>, followed by T<sub>10</sub> (4.84), T<sub>14</sub> (4.85) and T<sub>6</sub> (4.86) treatments.

Number of seed tubers/plant were found to be increased with the application of chemical pruners (Maleic acid and Triodobenzoic acid). Number of shoots/plant had inverse relation to number of seed-potato, hence tipping was found to discourage the recovery of seed-potato/plant. Seed treatment chemicals (Gibberellic and Benzyl adedine and urea) produced more seed tubers/plant as compared to untreated one. Maximum number of seed tubers/plant was recorded (10.73) in T<sub>7</sub>.

The weight of seed tubers/plant and seed tuber yield tonnes/ha also were recorded highest (0.535 g/plant and 35.66 tonnes/ha), in T<sub>7</sub> treatment: Economic yield/plant (0.608g) and/ha (40.12 tonnes/ha) was recorded highest in T<sub>13</sub> treatment.

Genetic potential to produce more number of tubers/plant was found to be very high but each tuber could not attain an economic size hence yield/plant reduced greatly. Pruning invigorates the plant but tuber yield could not accelerate proportionally. It might be due to the imbalance of vegetative to reproductive growth. The partition of limited photosynthetic to greater plausibly sink side forced to develop undersize tuber.

GA3 solubilized the stored seed-food quickly and aroused vigorous seedlings. Tipping breaks apical dominance and auxiliary buds containing higher GA3 sprout quickly. Chemical pruners like MH and TIBA retards auxiliary bud sprouting and only limited buds succeed to sprout and exceed

food mobilized towards stolen which enhanced development of more number of seed tubers.

Similar results were also observed by Kumar *et al.* (2005) and Lal and Khurana (2007).

Seed treatment with plant growth regulators, viz Gibberellic acid, Triodobenzoic acid, Maleic hydrazide, Benzyl adenine and urea was found to influenced potato plant vigour and tuber yield significantly. Seed treatment with GA3 @ 50 mg/l. water and tipping at 25 days after seed sowing followed by spraying with Triodobenzoic acid @ 15 mg/l. at day 3 of tipping may be recommended to the farmers to get higher yield of seed-tubers in cv. 'Kufri Bahar' under Allahabad condition.

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