

## Effect of GA<sub>3</sub> and NAA on Growth and Yield of Seed Potato Crop

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**ABSTRACT** Efficacy of plant growth regulators (PGR) like GA<sub>3</sub> and NAA was studied on various plant growth and yield attributes in cv. Kufri Jyoti which ultimately contribute to tuber number and yield. GA<sub>3</sub> and NAA increased the plant growth characters measured in terms of emergence and plant height. Plant height was significantly higher in GA<sub>3</sub> treatment over control. Significantly higher total number and weight of tubers were recorded with GA<sub>3</sub> followed by NAA. Likewise, the GA<sub>3</sub> treated plants recorded more number and weight of seed size tubers. The plant growth regulator treatments also recorded higher cost benefit ratio over control.

**Key words:** Growth regulator, GA<sub>3</sub>, NAA, seed tuber, seed potato

Potato (*Solanum tuberosum* L.) is one of the most widely distributed crops in the world. It is grown in the tropical, sub-tropical and temperate regions and forms an important food crop. In countries with agriculture based economy, potato production is an important contributing factor in the agricultural produce. Tuberization in potato, is a complex process that results in the differentiation of an underground stolon, a modified stem, into a specialized storage organ, the tuber. The process is characterized by significant anatomical, hormonal and bio-chemical changes [1]. The plant growth regulators are capable of influencing plant physiology in terms of growth, increased number of stolans etc. It has been reported that the plant growth regulators increase the yield upto 15 per cent [2]. Therefore, it seemed appropriate to compare the field grown plants, treated with GA<sub>3</sub> (Dip) and NAA (Spray) at 25 and 50 days after planting with untreated plants in terms of their morphology, tuber number and yield in order to see how these differ from untreated control plants.

### MATERIALS AND METHODS

After two year preliminary studies on a small area, the present experiment was conducted on large scale (2.0 ha) at Central Potato Research Station, Gwalior during *rabi* season of 2004 and 2005. Variety Kufri Jyoti was used in this experiment. The experiment was laid out in Randomized Block Design and replicated eight times. After removing from the cold store, the seed tubers were spread in the shed for sorting 30-40 g tubers. For pre-planting treatments, tubers were dipped in GA<sub>3</sub> @ 10 ppm solution for 30 minutes and then spread on the floor, while the tubers of NAA and control treatments were left on the well ventilated floor for chitting. After 20 days, the seed tubers were planted at 60 x 20 cm spacing in plots of 21 m x 24 m size. The crop was planted on 7<sup>th</sup> November 2004 and 2005. Recommended dose of 180 Kg N/ha, 80 kg P/ha and 100 kg K/ha was applied. Half of the dose of Nitrogen was applied in the form of Ammonium Sulphate at the time of planting along with full dose of P in the form of Single Super Phosphate and K in the form of Muriate of Potash. Remaining half dose of N was applied

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in the form of urea at the time of earthing up. In all, five irrigations were given to the crop. In post planting treatment, NAA was sprayed twice at 25 and 50 days after planting (DAP) and the haulms were cut at 80 days after planting as the crop was grown for seed purpose. The data pooled over two years were statistically analyzed using Randomized Block Design.

## RESULTS AND DISCUSSION

### *Plant emergence and growth characters*

The plant emergence recorded at 30 days after planting was higher in GA<sub>3</sub> treated plants. However, the differences were non-significant (Table 1). Significantly higher plant height (25.7 and 50.1 cm) was recorded in GA<sub>3</sub> @ 10 ppm treated plants over NAA @ 50 ppm (20.3 and 48.6 cm) and control (19.9 and 41.5 cm) at 30 and 75 days after planting respectively. Similarly, stem number per plant also showed significant differences among the treatments. Significantly higher stem number (5.10) was recorded in GA<sub>3</sub> @ 10 ppm treatment. It may be due to increase in the growth of important sinks (all auxiliary buds) which, intern might change the distribution pattern of assimilates. These results are in conformity with the findings of Pandita *et al.* [3].

### *Tuber number*

Tubers were divided into four grades after

harvest *viz.*, <20 g, 21-80 g, 81-120 g and >120g and counted in lacs per hectare (Table 1). Number of tubers showed a trend similar to that of stems, probably this may be a direct correlation of number of tubers with number of stems and ultimately the number of stolons. Seed size tubers were significantly higher over small and over size tubers in all the treatments. It was higher (3.12 lac/ha) in GA<sub>3</sub> @ 10 ppm treatment. Similarly, application of growth regulators proved effective in reducing the number of under size tubers in the produce. Alexopoulos *et al.*, [4] also found that application of Gibberellic acid increased the vegetative growth and number of tubers per plant grown from true potato seed. Likewise, the number of tubers per hectare was also recorded higher (3.61 lac) in GA<sub>3</sub> treatment compared to NAA @ 50 ppm sprayed at 25 and 50 days after planting (3.21 lac) and control (2.80 lac).

### *Tuber yield*

The data presented in Table 2, indicated that seed size tuber yield and total tuber yield were influenced by the use of plant growth regulators. Significantly maximum seed size (21-80 g) tuber yield per hectare (159.0 q/ha) was obtained by the application of GA<sub>3</sub> @ 10 ppm. Whereas, the control treatment recorded the lowest seed size tubers (111.0 q/ha). This increase was more pronounced with GA<sub>3</sub>. Similar findings were also recorded by Puste and Kundu [5] in potato.

Table 1. Plant growth parameters and number of tubers as influenced by growth regulators in potato seed crop

Treatments	Emergence (%)	Plant height (cm)		No. of stems/plant	Grade-wise no. of tubers (lac/ha)				Total no. of tubers (lac/ha)
		30 DAP	75 DAP		<20g	21-80g	81-120g	>120g	
T <sub>1</sub> :GA <sub>3</sub> -10ppm (Dip treatment)	91.4	25.7	50.1	5.10	0.03	3.12	0.38	0.08	3.61
T <sub>2</sub> :NAA-50ppm (Spray)	84.4	20.3	48.6	4.20	0.02	2.69	0.40	0.10	3.21
T <sub>3</sub> :Control: (No dip & no spray)	86.5	19.9	41.5	4.40	0.05	2.18	0.47	0.10	2.80
S. EM+	-	0.90	1.50	0.38	0.001	0.03	0.01	0.01	0.04
CD at 5%	NS	4.70	8.00	1.20	0.003	0.18	0.05	0.05	0.19

Table 2. Tuber yield (q/ha) as influenced by growth regulators in potato seed crop

Treatments	Grade-wise tuber yield (q/ha)				Total tuber yield (q/ha)
	<20g	21-80g	81-120g	>120g	
T <sub>1</sub> : GA <sub>3</sub> - 10ppm (Dip treatment)	0.50	159.0	40.5	11.0	211.0
T <sub>2</sub> : NAA - 50 ppm (Spray)	0.30	130.5	44.5	17.7	193.0
T <sub>3</sub> : Control (No dip & no spray)	1.00	111.0	42.0	20.0	174.0
S. EM±	0.01	1.00	0.80	0.50	1.40
CD at 5%	0.05	5.10	4.20	2.40	7.40

Furthermore, the total tuber yield was also significantly higher (211 q/ha) in GA<sub>3</sub> @ 10 ppm dip treated plants over NAA (193 q/ha) and control (174 q/ha) treatment. These findings are in close agreement with findings of Birbal *et al.*, [6]. This increase in yield may be contributed by superiority of vegetative growth in terms of increased plant height, number of stems, number of stolons per hill and number and weight of tubers per plant.

#### Cost benefit ratio

Gross and net returns showed a variation among the treatments (Table 3). The seed tubers treated with GA<sub>3</sub> solution were found to be more economical than rest of the treatments. It has recorded the highest gross income (Rs. 2,53,200/ha) and net income (Rs. 1,80,294/ha) followed by the crop sprayed with NAA @ 50 ppm at 25

and 50 DAP. Which recorded the gross income of Rs 2,31,600/ha and net income of 1,66,822/ha. However, the C:B ratio was highest (3.57) in NAA sprayed treatment followed by GA<sub>3</sub> (3.47). This was mainly due to the high cost of GA<sub>3</sub> over NAA. The control treatment recorded the least (3.23) C:B ratio.

Field experiment conducted during the autumn season of 2004 and 2005 to study the effect of GA<sub>3</sub> and NAA on growth and yield of seed potato crop indicated that, the application of GA<sub>3</sub> @ 10 ppm followed by NAA @ 50 ppm sprayed at 25 and 50 DAP improved the yield attributes and yield of seed potatoes. The application of growth regulators increased the number of stems per hill, leaf area, number of tubers and yield. The chemical treated plants appeared to be more efficient in photosynthesis compared to control.

Table 3. Gross income, net income and cost benefit ratio as influenced by growth regulators in potato seed crop

Treatments	Gross income (Rs/ha)	Approximate cost of cultivation	Additional cost on chemicals and labourers (Rs)	Total cost of cultivation (Rs)	Net profit (Rs)	C:B ratio
T <sub>1</sub> : GA <sub>3</sub> - 10ppm (Dip treatment)	2,53,200	64,366	8540	72,906*	1,80,294**	3.47
T <sub>2</sub> : NAA - 50 ppm (Spray)	2,31,600	64,366	412	64,778*	1,66,822**	3.57
T <sub>3</sub> : Control (No dip & no spray)	2,08,800	64,366	140	64,506*	1,44,434**	3.23

\*The cost of seed was Rs. 1200/q; \*\*The sale rate of produce was Rs. 1200/q

REFERENCES

1. EWING, E. & P.C. STRUIK (1992). Tuber formation in potato: induction, initiation and growth. *Hort. Rev.*, **14**: 89-198.
2. JAVED, M.D. & M.D. ARSHAD (1998). Yield promotion of potato by plant growth promoting rhizobacteria under field conditions. *Fertilizer News*, **45**: 61-63.
3. PANDITA, M.L., R.D. BHUTANI & A.S. SIDHU (1981). Effect of growth regulators on yield and tuber size in relation to seed production in potato Cv. Kufri Chandramukhi. *J. Indian Potato Assoc.*, **8**: 171-176.
4. ALEXOPOULOS, A.A., G. AIVALAKIS, K.A. AKOUMIANAKIS & H.C. PASSAM (2007). Effect of foliar application of gibberellie acid or daminozide on plant growth, tuberization and carbohydrate accumulation in tubers grown from true potato seed. *J. Hort. Sci. and Biotech.*, **82**: 535-540.
5. PUSTE, A.M. & A.L. KUNDU (1995). Effect of phosphorus, growth regulators and irrigation frequency on potato yield, *J. Indian Potato Assoc.*, **22**: 136-139.
6. BIRBAL, R.K. SINGH & V.S. KUSHWAH (2003). Effect of plant growth regulators on potato production. *J. Indian Potato Assoc.*, **30**: 195-96.