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Standardization of method for propagation of potato plant growth by stem cutting

Heena Sahu, Jitendra Singh, Versha Kumari and Rekha Singh

Abstract
The experiment was carried out in the field of department of Vegetable Science at Pt. KLS College of Horticulture and Research Station, Rajnandgaon (C.G.) in the year 2021-22 in the field of Vegetable Science with a view to study the "Standardization of method for propagation of potato plant growth by stem cutting". The crop Potato of variety Kufri Lalima were used to grown in 9 number of treatments with 3 replications into the field in a Randomized Block Design (RBD). The soil of experimental field was sandy clay soil. Recommend dose of manure and fertilizer were applied during the field preparation in 9 treatments *viz.*, T_1: IAA 500 ppm, T_2: IAA 1000 ppm, T_3: IAA 1500 ppm, T_4: IAA 2000 ppm, T_5: IBA 500 ppm, T_6: IBA 1000 ppm, T_7: IBA 1500 ppm, T_8: IBA 2000 ppm and T_9: Control-Water. The crop growth parameters like maximum survival percentages (84.00), plant establishment (%)(86.84), plant height (60.00 cm), no. of shoot (7.50), no. of compound leaves/plants (54.20), fresh weight of shoot (182.00 gm/plant) and dry weight of shoot (22.75 gm/plant) were reported in treatment T_6 (IBA 1000 ppm) which is found statically *at par* with treatment T_7 (IBA 1500 ppm) and T_3 (IAA 1500 ppm), while minimum was recorded in treatment T_9 (Control-Water). On the basis of overall performance, the treatment T_6 (IBA 1000 ppm) was found best for growth of potato.

Keywords: Stem cutting, Kufri Lalima, RBD, IAA, IBA, survival, shoot, growth of potato, propagation method and sandy clay soil

Introduction
Potato (*Solanum tuberosum* L.) is one of the most important auto-tetraploid (2n=48) vegetable crop of the world. In India, potato is being cultivated not only for local consumption but also for exportation. Potato globally ranks 4th next to rice, wheat and maize. The crop has high nutritional value as well as great yield potential. About 90% of potato in India are grown as a short day plant during the winter months (Anonymous 2019, Kumar *et al.*, 2022) [2, 12].
India is the world's second-largest potato producer country after China and it is one of the most important cash crop of India. It is cultivated on an average 2.16 million hectares with a production of 51.30 million tons with a productivity of 23.75 tonnes ha^{-1} (Anonymous, 2020) [3]. Uttar Pradesh is the major potato producing state with a 31.26% share followed by West Bengal, Bihar, Gujarat, Madhya Pradesh, Punjab, and Assam respectively. It accounts for nearly 3/4 of the area and contributes to 82% of total potato production in the country. (Anonymous, 2020b) [4].
In Chhattisgarh, potato occupies about 42,750 hectares with a production of 61,4056 tones and a productivity of 14.36 tonnes per hectare. The highest area (6742 ha) and production (93065 tonnes) was reported in Surguja district followed by Balrampur, Bilaspur and Raigarh districts of Chhattisgarh (Anonymous, 2020c) [5].
Stem cuttings treated with plant growth regulators at optimum concentration resulted healthy rooting compared to untreated one. Effect of growth regulator is based on the concentration of hormone applied which differs with type of species and cuttings etc. IBA and IAA are well known to improve rooting of different types of cuttings. The development of root primordium cells depends on the endogenous auxins in the cutting and synergic composite such as a diphenol. These substances lead to the synthesis of ribonucleic acid (RNA), which act upon root primordium initiation (Hartmann *et al.*, 2002) [6].
Propagation of potato by apical stem cuttings was developed in 1960 (Jones, 1991) [11] as a means of crop improvement, pest and diseases elimination normally carried over by tuber propagation. Apical stem cutting is the mostly used rapid multiplication of potato now a day and at the same time effect of synthetic auxin was reported more effective. Thus, the present work was planned to investigate the possibility of producing potato through apical stem cuttings from tuber of cultivar (Kufri Lalima).

Materials and Methods

The experiment was carried out in the field of department of Vegetable Science at Pt. KLS College of Horticulture and Research Station, Rajnandgaon (C.G.). Rajnandgaon is located in central plane of Chhattisgarh at latitude 21.10° N, and longitude 81.03° E and an altitude of 330.70 meters above the mean sea level. The soil of experimental field was sandy clay soil. The soil was neutral in reaction, medium in organic carbon, low in nitrogen and medium in phosphorus and potash content.

Seed tuber of potato variety Kufri Lalima was planted in the nursery bed (50% sand: 50% vermi compost). The stem cuttings are utilized (after 20 days of transplanting) as planting material. The stem cutting /sprouts was treated with growth hormones and planted in the protray with growing media coco peat and vermicompost (1:1 ratio). After 20 old protray potato seedling/sprouts were planted in the main field under replicated trial.

The experimental layout was made by preparation of ridges and furrow at a distance of 60 x 20 cm (R x P) by manually as per the approved programme. Recommend dose of manure and fertilizer were applied during the field preparation. Potato tubers were harvested after 90 days of planting of stem cutting, before harvesting field was light irrigated for easy uprooting of the crops. The observations related to various growth parameters attributing traits were recorded from five randomly selected competitive plants of each plot from each replication. The mean of five plants was used for statistical analysis.

Results and Discussion

Data pertaining to growth parameters influenced by 9 treatments has been given in Table 1 and Fig 1 to 7.

Survival percentage ranges between 84.00 to 81.30. The maximum percentage (84.00) reported in treatment T_7 (IBA 1500 ppm) which was statistically *at par* with T_6 (IBA 1000 ppm) and T_3 (IAA 1500 ppm), while the minimum survival percentages (81.30) was reported in treatment T_9 (Control-Water). Result indicated that concentration of IBA and IAA at 1000 and 1500 ppm is more affective with respect to higher concentration of both routing hormone. The results obtained in the present study are supported by the works of Jamal *et al.* (2016) [10] and Nikmatullah *et al.* (2018) [15].

Plant establishment percentage ranges between 86.84 to 60.53. The maximum percentage (86.84) reported in treatment T_6 (IBA 1000 ppm) which was found statistically *at par* with treatment T_7 (IBA 1500 ppm) and T_3 (IAA 1500 ppm). While the minimum plant establishment (%) (60.53) was reported in treatment T_9 (Control-Water). Result reported that root formation and growth was found significantly more at 1000 and 1500 ppm for both routing hormone because root initiation and elongation was found best at this concentration in initial stage. It also depends on the physiological stage. Similar results were also observed by Hossain and Nahar (2012) [7].

Plant height (cm) ranges between 60.00 to 48.30. The maximum plant height (60.00 cm) was reported in treatment T_6 (IBA 1000 ppm) which was found statically *at par* with treatment T_7 (IBA 1500 ppm) and T_3 (IAA 1500 ppm). While the minimum plant height (48.30 cm) was reported in treatment T_9 (Control-Water). In present experiment better result was reported at 1000 and 1500 ppm IAA and IBA due to apical dominate effect, which increase total height of the plant. Also similar results were reported by Tsoka *et al.* (2012) [17], Ahmed *et al.* (2018) [1] and Nikmatullah *et al.* (2018) [15]. Number of shoot ranges between 7.50 to 4.00. The maximum no. of shoot (7.50) was reported in T_5 (IBA 500 ppm) which was found statically *at par* with treatment T_6 (IBA 1000 ppm) and T_1 (IAA 500 ppm). While the minimum no. of shoot (4.00) was reported in T_9 (Control-Water). In case of IBA and IAA @ 500 ppm of lower concentration induced shoot bud and gradual increase till 1000 ppm. However, in case of shoot bud formation IAA is less effect than IBA. Similar result was also reported by Gad and Ibrahim (2018) [8].

Number of compound leaves/plants ranges between 54.20 to 45.10. The maximum no. of compound leaves/plants (54.20) reported in treatment T_5 (IBA 500 ppm) which is found statically *at par* with treatment T_6 (IBA 1000 ppm). While the minimum no. of compound leaves/plants (45.10) was reported in T_9 (Control-Water). Number of compound leaves/plants was found significantly more at 500 to 1000 ppm, because low concentration of IBA and IAA increased more shoot bud and shoot length which result is more no. of compound leaves/plants. Also similar results were reported by Jamal *et al.* (2016) [10].

Fresh weight of shoot (gm/plant) ranges between 182.00 to 170.50. The maximum fresh weight of shoot (182.00 gm/plant) was reported in treatment T_5 (IBA 500 ppm) which is found statically *at par* with T_6 (IBA 1000 ppm) and T_1 (IAA 500 ppm). While the minimum fresh weight of shoot (170.50 gm/plant) was reported in T_9 (Control-Water). Result shown that concentration of IBA and IAA at 500 and 1000 ppm is more affective with respect to higher concentration in fresh weight of shoot/plants. Due to the maximum shoots length, inter nodal length and nutrient uptake and its accumulation in plants. Similar finding also observed by Mishra *et al.*, (2017) [14]. Dry weight of shoot (gm/plant) ranges between 22.75 to 21.31. The maximum dry weight of shoot (22.75 gm/plant) was reported in treatment T_5 (IBA 500 ppm) which is found statically *at par* with T_6 (IBA 1000 ppm) and T_2 (IAA 1000 ppm). While the minimum dry weight of shoot (21.31 gm/plant) was reported in T_9 (Control-Water). Dry weight of shoot/plants was found significantly superior with concentration of IBA and IAA at 500 and 1000 ppm with respectively higher concentration of both routing hormone. Due to higher number of fresh weight/plant, shoot weight/plants and less moisture loss. Similar results were also observed by Ahmed *et al.* (2018) [1].

Table 1: Growth parameters of potato by stem cutting

Tr. No.	Treatments	Survival Percentage (%)	Plant Establishment (%)	Plant Height (cm)	No. of shoot- 90 days after planting	No. of Compound Leaves/plants	Fresh Weight of Shoot (gm/ plant)	Dry Weight of Shoot (gm/ plant)
T1	IAA 500 ppm	81.60	64.47	50.00	7.00	51.60	179.00	22.01
T2	IAA 1000 ppm	83.00	78.95	54.60	6.10	50.40	177.60	22.38
T3	IAA 1500 ppm	83.40	81.58	57.20	4.60	47.10	173.20	21.65
T4	IAA 2000 ppm	82.40	72.11	53.00	5.80	48.30	172.00	21.85
T5	IBA 500 ppm	82.00	68.42	51.53	7.50	54.20	182.00	22.75
T6	IBA 1000 ppm	83.70	86.84	60.00	7.20	53.00	181.15	22.64
T7	IBA 1500 ppm	84.00	84.21	58.40	5.30	46.00	176.10	21.50
T8	IBA 2000 ppm	82.70	75.00	56.03	6.80	49.05	174.80	22.20
T9	Control-Water	81.30	60.53	48.30	4.00	45.10	170.50	21.31
SEm (±)		0.31	2.49	0.98	0.24	0.96	2.15	0.30
CD (5%) =		0.91	7.49	2.93	0.73	2.89	6.46	0.92
CV (%) =		0.64	5.79	3.12	6.99	3.37	2.12	2.40

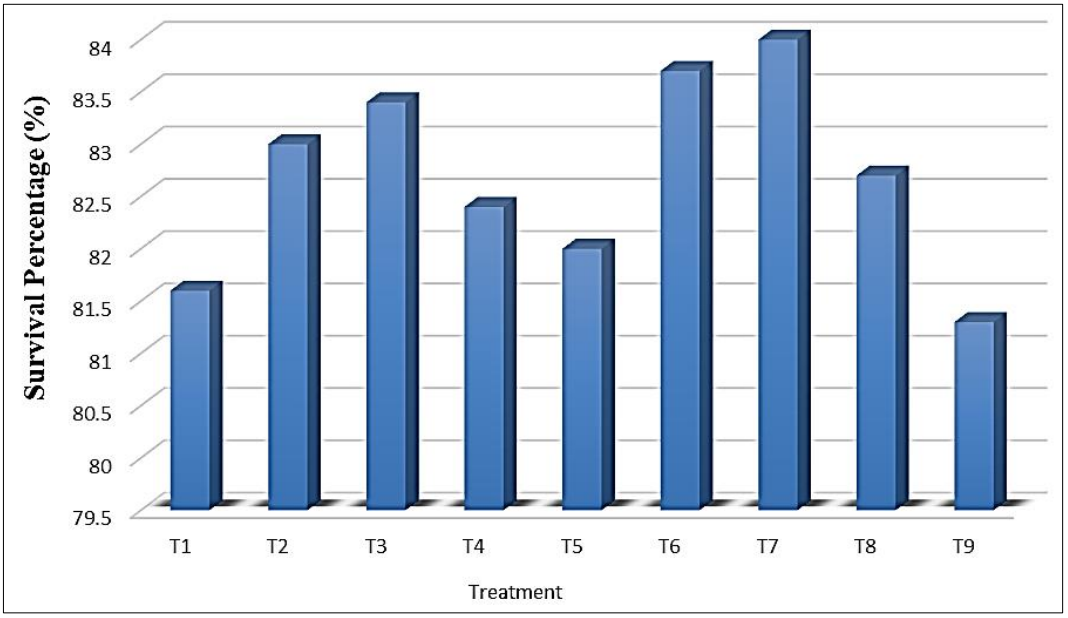

Fig 1: Survival Percentage (%) of potato by stem cutting.

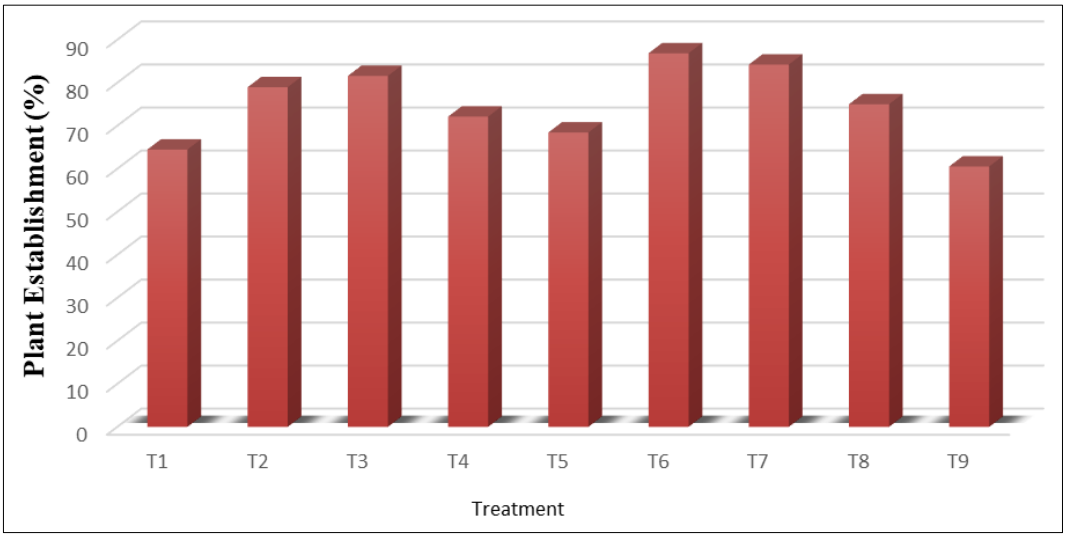

Fig 2: Plant Establishment (%) of potato by stem cutting

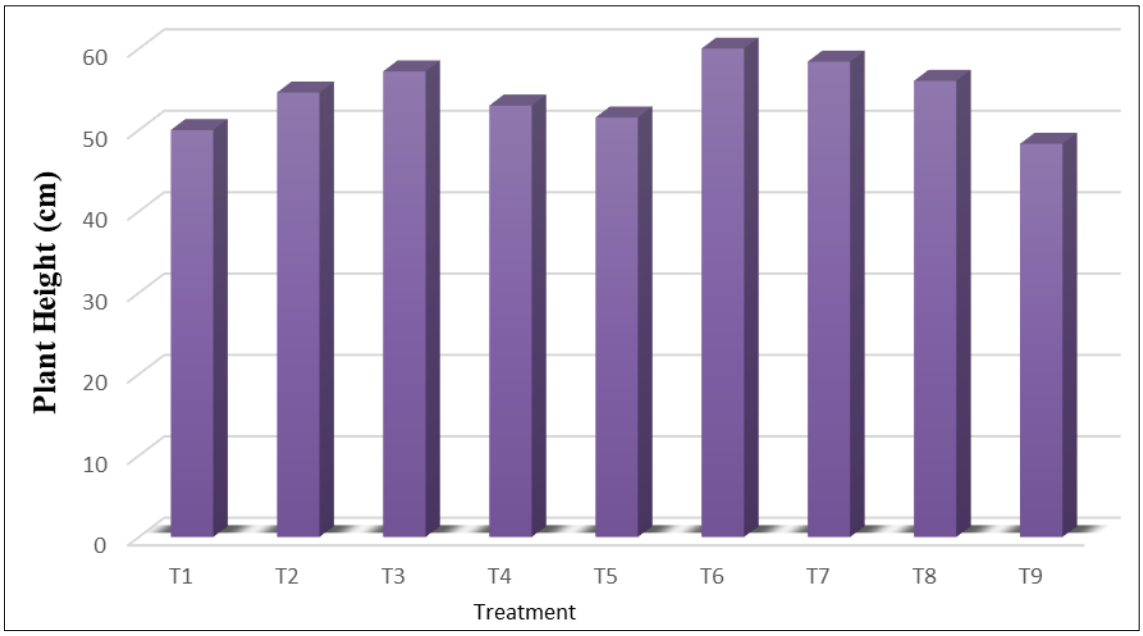

Fig 3: Plant Height (cm) - 90 days after planting of potato by stem cutting.

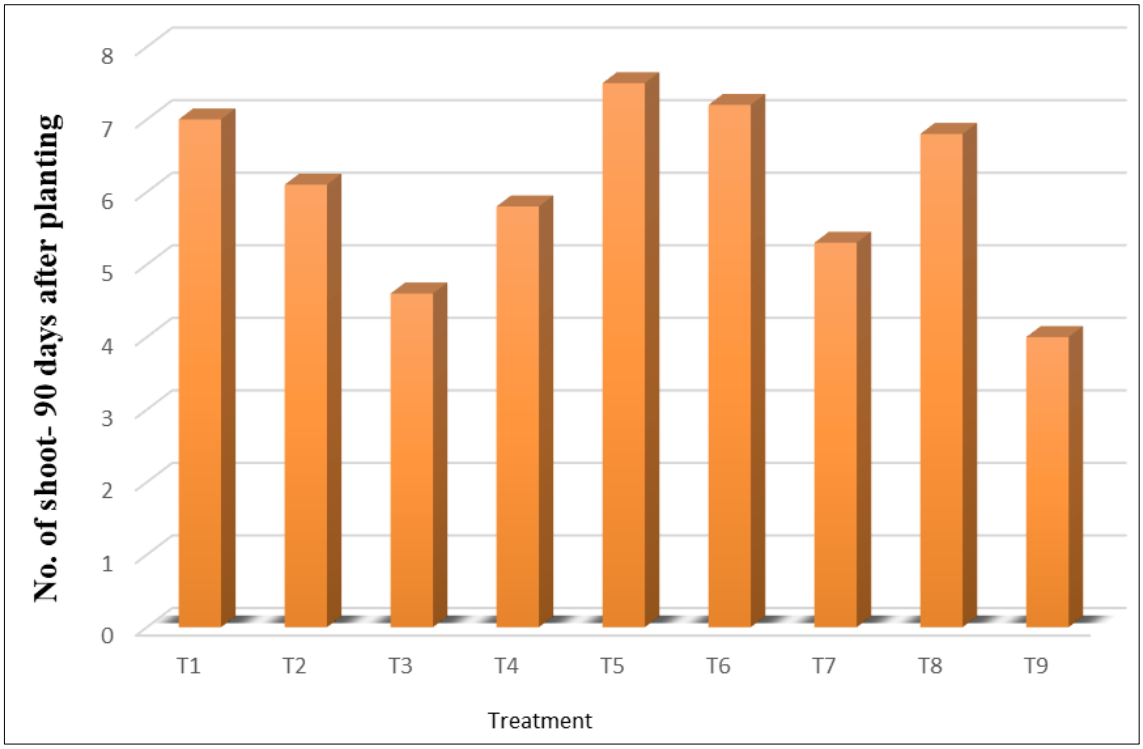

Fig 4: No of shoot- 90 days after planting of potato by stem cutting.

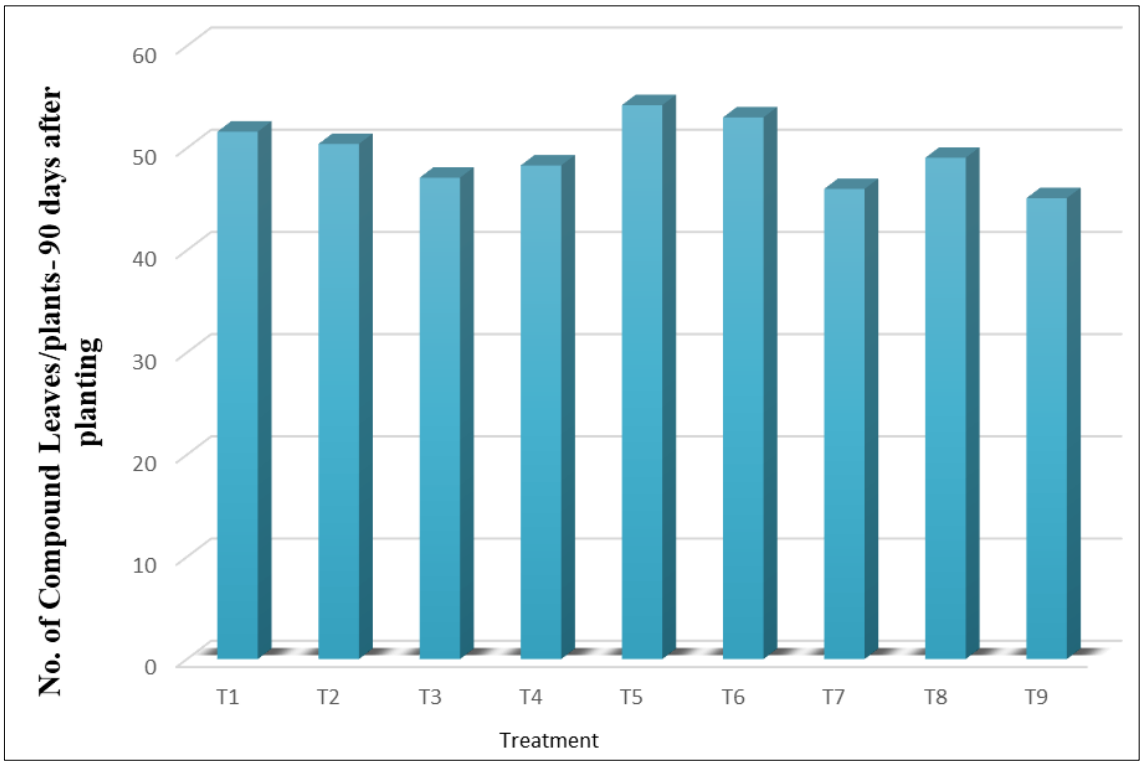

Fig 5: No. of Compound Leaves /plants- 90 days after planting of potato by stem cutting.

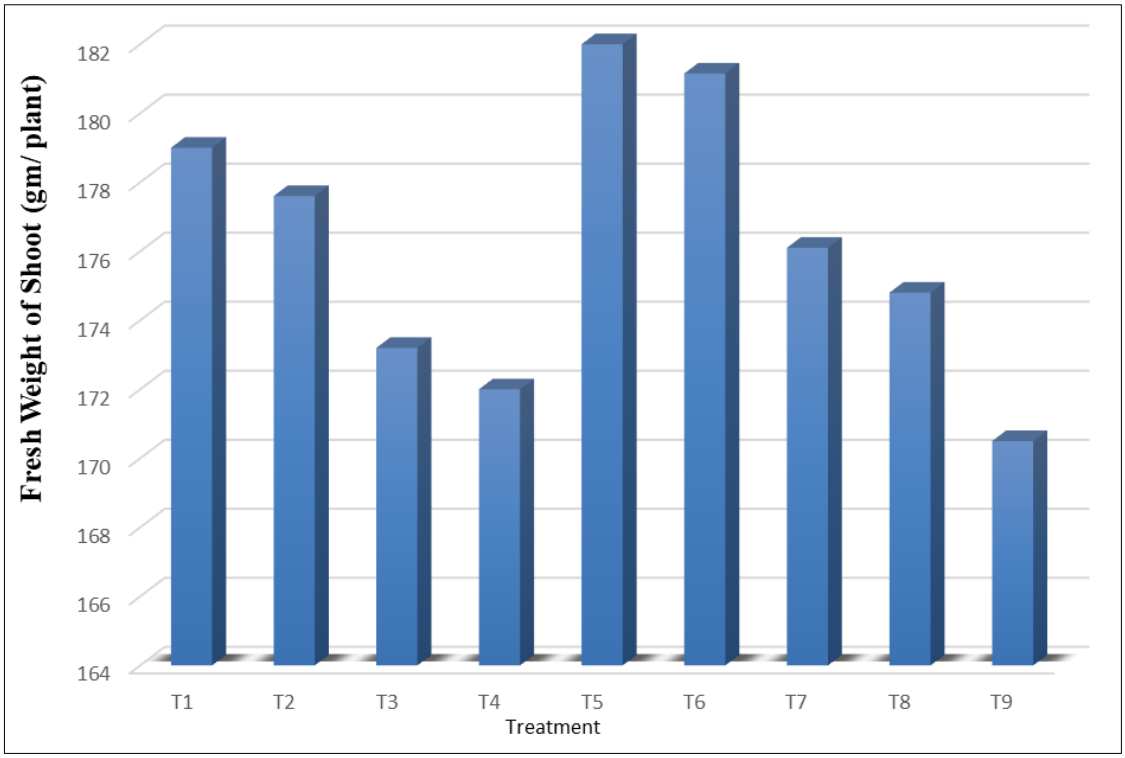

Fig 6: Fresh Weight of Shoot (gm/ plant) of potato by stem cutting.

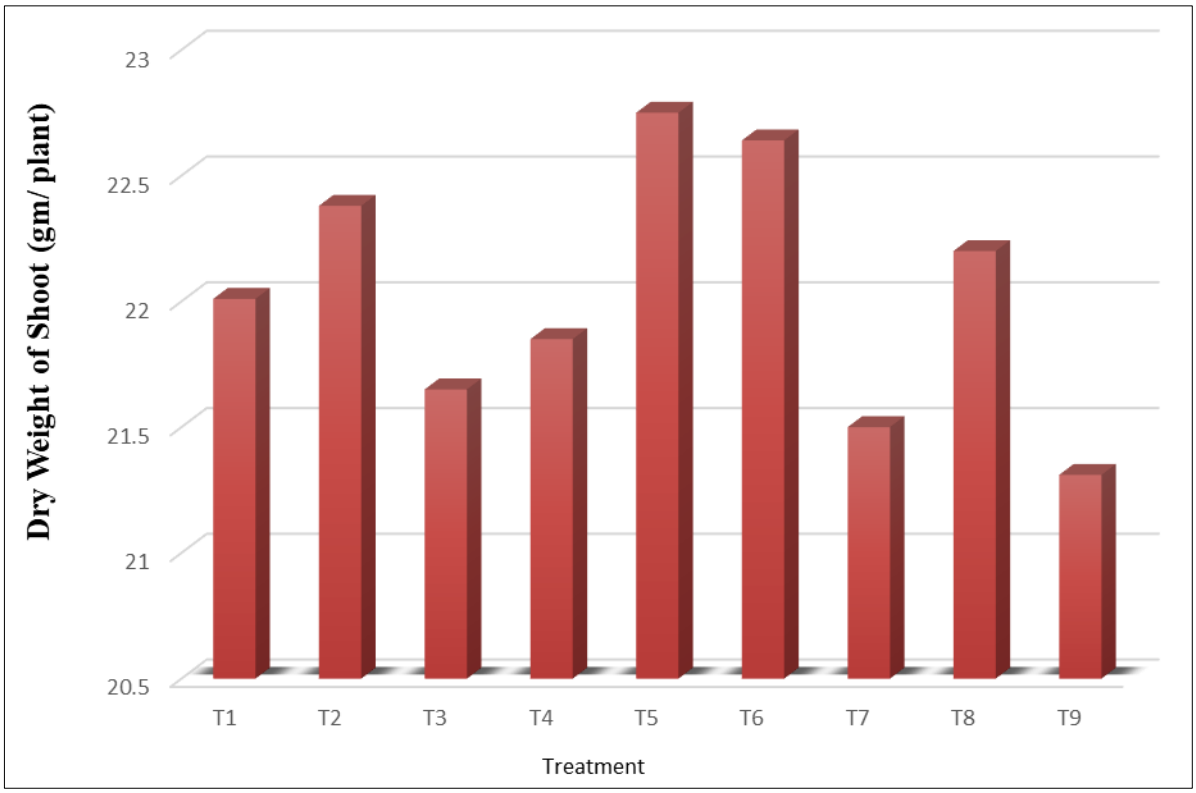

Fig 7: Dry Weight of Shoot (gm/ plant) of potato by stem cutting.

Conclusion

All observations of growth parameters *viz*. survival percentage (%), plant establishment (%), plant height (cm)- 90 days after planting, no. of shoot- 90 days after planting, no. of compound leaves/plants- 90 days after planting, fresh weight of shoot (gm/ plant) and dry weight of shoot (gm/ plant were found significantly higher in treatment T_6 (IBA 1000 ppm) and which was at par with treatment T_7 (IBA 1500 ppm) and T_3 (IAA 1500 ppm).

The finding of present study revealed that potato crop can be raised by stem cuttings (Treated with IBA 1000 ppm) with higher yield and growth of potato.

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