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Standardization of Method for Propagation of Potato Economics by Stem Cutting

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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. 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 500ppm, T_2: IAA 1000ppm, T_3: IAA 1500ppm, T_4: IAA 2000ppm, T_5: IBA 500ppm, T_6: IBA 1000ppm, T_7: IBA 1500ppm, T_8: IBA 2000ppm and T_9: Control-Water. The crop economic parameters like maximum total cost of cultivation Rs. 100305.5 ha^{-1}, gross return Rs. 295142.75 ha^{-1}, net return Rs. 196637.25 ha^{-1} and B: C ratio Rs. 2.00 ha^{-1} were found higher in the treatment T_7 (IBA 1500ppm) and which was at par with the result of treatment T_6 (IBA 1000ppm) and T_3 (IAA 1500ppm), while minimum was recorded in treatment T_9 (Control-Water). On the basis of overall performance, the treatment T_7 (IBA 1500ppm) was found with higher yield and economic return. However, based on the nature of agricultural experiments, common challenges such as weather variations, pest and disease infestations, and management of field operations may have been encountered.

Keywords: Stem cutting, RBD, IAA, IBA, Cost of cultivation, B: C ratio

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 (Gul, 2022). About 90% of potato in India are grown as a short-day plant during the winter months (Anonymous 2019).

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; Nascimento *et al.* 2020). 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).

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).

Thus, two synthetic auxins, Indole-3-butyric acid (IBA) and Indole acetic acid (IAA), were shown to be more effective for rooting than natural or synthetic indole-3-acetic acid (IAA) (Blythe *et al*., 2008). IBA and IAA are the most commonly used auxins for rooting stem cuttings and micro cuttings from tissue culture. It has been repeatedly confirmed that auxin is required for stem adventitious root initiation, and indeed the division of the first root-initiating cell has been shown to be dependent on applied or endogenous auxin (Gul 2022; Ramavath *et al.* 2021; Gasper and Hofinger 1989). It also promote the production of ethylene, which is beneficial for rooting.

Propagation of potato by apical stem cuttings was developed in 1960 (Jones, 1991) as a means of crop improvement, pest and diseases elimination normally carried over by tuber propagation (Nascimento *et al.,* 2020). 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) (Romeida *et al.,* 2020).

MATERIALS AND METHODS

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 economics of potato crop production were determined by using prevailing potato prices as well as the inputs used. Current pricing for various inputs were used to determine the cost of growing potato tubers. On the basis of market pricing, the production of potato tubers was converted to gross profit (Rs. ha^{-1}). The B: C Ratio was calculated with the help of following formula:

Benefit: Cost ratio = Net returns (Rs. ha^{-1})/Cost of cultivation (Rs. ha^{-1})

A. Cost of cultivation (Rs. ha^{-1}) - The expenditure incurred for pre and post-harvest treatments were worked out and expressed as rupees per ha.

B. Gross return (Rs. ha^{-1}) - Based on the marketable tuber yield obtained and its prevailing selling rate the gross return was worked out and expressed as rupees per ha.

C. Net return (Rs. ha^{-1})- Net return was obtained by subtracting the cost of treatment from gross returns for each treatment.

RESULTS AND DISCUSSION

Data pertaining to economic parameters influenced by 9 treatments has been given in Table 1 & 2 and Fig. 1 & 2.

Total tuber yield (kg/ha) ranges between 11805.71 to 7664.76. The maximum total tuber yield (11805.71 kg/ha) was reported in treatment T_7 (IBA 1500ppm) which is found statically *at par* with T_6 (IBA 1000ppm) (11514.29 kg/ha) and T_3 (IAA 1500ppm) (11177.14 kg/ha). While the minimum total tuber yield (7664.76 kg/ha) was reported in T_9 (Control-Water). In present experiment better result was reported at 1000 and 1500 ppm IAA and IBA due to more number of marketable tuber yield/plot and total tuber yield/plant. Similar result was also reported by Abdullah-Al-Mamun *et al.* (2015); Ahmed *et al.* (2018).

Table 1: Total tuber yield of potato as influenced by different treatment.

Tr. No.	Treatment Details	Total Tuber Yield (kg/ha)
T_1	IAA 500ppm	8297.14
T_2	IAA 1000ppm	10523.80
T_3	IAA 1500ppm	11177.10
T_4	IAA 2000ppm	9438.10
T_5	IBA 500ppm	8952.38
T_6	IBA 1000ppm	11514.30
T_7	IBA 1500ppm	11805.70
T_8	IBA 2000ppm	10061.00
T_9	Control-Water	7664.76

The Total cost of cultivation data revealed that the maximum total cost of cultivation Rs. 100305.5 ha^{-1} were calculated for treatment T_8 (IBA 2000ppm), followed by T_4 (IAA 2000ppm) (99105.5) and T_7 (IBA 1500ppm) (98505.5), while the minimum Rs. 93105.5 ha^{-1} for T_9 (Control-Water). The results of the total cost of cultivation indicate that the use of synthetic auxins, specifically IBA and IAA, can increase the cost of cultivation compared to the control treatment. This is likely due to the additional cost of purchasing and applying these growth hormones. However, the use of IBA at a concentration of 1500ppm in treatment T_7 resulted in the highest net return and B:C ratio, indicating that the increased cost of cultivation was offset by the increased yield and economic return. These findings suggest that the use of synthetic auxins can be a cost-effective approach for improving crop yield and economic return, but the optimal concentration for each crop and treatment should be carefully determined to maximize the benefits while minimizing the cost. These outcomes are consistent with findings of Uzoigwe *et al.* (2019).

The detailed of gross returns (Rs. ha^{-1}) data revealed that the maximum gross returns Rs. 295142.75 ha^{-1} was obtained in treatment T_7 (IBA 1500ppm), followed by Rs. 287857.25 ha^{-1} obtained in T_6 (IBA 1000ppm) and while the minimum gross returns Rs. 191619.00 ha^{-1} was obtained in T_9 (Control- Water).

The data of net returns (Rs. ha^{-1}) revealed that the maximum net returns Rs. 196637.25 ha^{-1} was obtained in treatment T_7 (IBA 1500ppm), followed by Rs. 191151.75 ha^{-1} obtained in T_6 (IBA 1000ppm) and while the minimum net returns Rs. 98513.50 ha^{-1} was obtained in T_9 (Control- Water). The results from the study showed that the application of IBA and IAA at specific concentrations significantly affected the gross and net returns of potato cultivation. Treatment T_7, which used IBA at 1500ppm, had the highest gross and net returns, followed by T_6 which used IBA at 1000ppm. In contrast, the control treatment T_9 which used water only had the lowest gross and net returns. These findings suggest that the use of appropriate auxin concentrations in potato cultivation can result in higher financial growth. These outcomes are consistent with findings of Uzoigwe *et al.* (2019).

The detailed of B: C Ratio data revealed that the maximum B:C ratio Rs. 2.00 ha^{-1} was obtained in treatment T_7 (IBA 1500ppm), followed by Rs. 1.98 ha^{-1} obtained in T_6 (IBA 1000ppm) and while the minimum B:C ratio Rs. 1.06 ha^{-1} was obtained in T_9 (Control-

Water). Result shown that concentration of IBA and IAA at 1000 and 1500 ppm is more affective with respectively higher in fresh weight of tuber/plot, more numbers of tuber/plants and total tuber yield (kg/ha) due to increase in B: C ratio. Similar results were also observed by Liljana *et al.* (2012).

Table 2: Economics of potato as influenced by different treatment.

Tr. No.	Treatment Details	Total Cost (Rs/ha)	Gross Return (Rs/ha)	Net Return (Rs/ha)	B:C Ratio
T_1	IAA 500ppm	94605.5	207428.50	112823.00	1.19
T_2	IAA 1000ppm	96105.5	263095.25	166989.75	1.74
T_3	IAA 1500ppm	97605.5	279428.50	181823.00	1.86
T_4	IAA 2000ppm	99105.5	235952.50	136847.00	1.38
T_5	IBA 500ppm	94905.5	223809.50	128904.00	1.36
T_6	IBA 1000ppm	96705.5	287857.25	191151.75	1.98
T_7	IBA 1500ppm	98505.5	295142.75	196637.25	2.00
T_8	IBA 2000ppm	100305.5	251523.75	151218.25	1.51
T_9	Control-Water	93105.5	191619.00	98513.50	1.06

Potato Selling Price = Rs. 20/kg

Plate 1. PGR treated of stem cuttings.

Plate 2. Potato seedling.

Plate 3. T_9 (Control-Water).

Plate 4. T_7 (IBA 1500ppm)

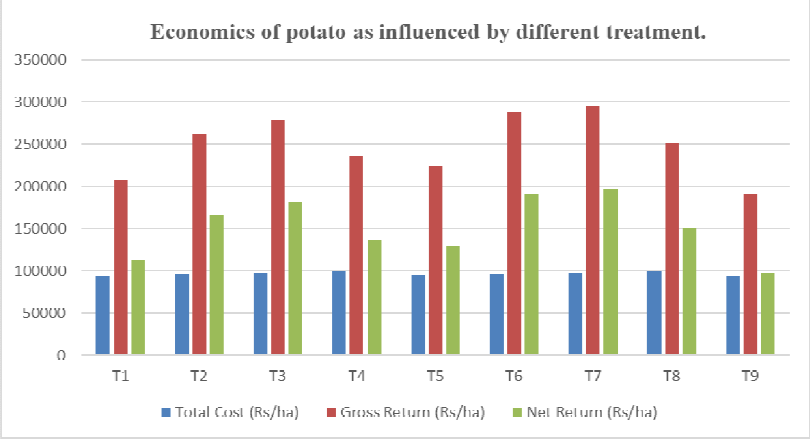

Fig. 1. Economics of potato as influenced by different treatment.

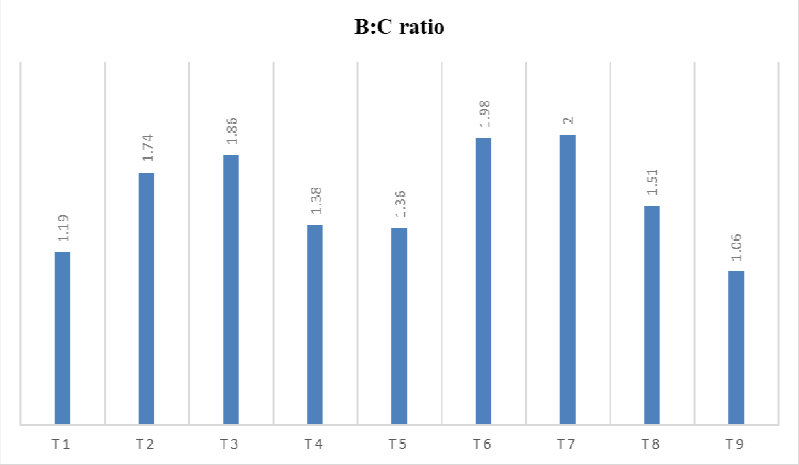

Fig. 2. B:C ratio.

CONCLUSIONS

In conclusion, the study showed that the application of synthetic auxins, specifically IBA and IAA, at specific concentrations can significantly affect the total cost of cultivation, gross and net returns, and the B:C ratio of potato cultivation. While the use of these growth hormones can increase the cost of cultivation, treatment T_7, which used IBA at 1500ppm, resulted in the highest net return and B:C ratio, indicating that the increased cost was offset by the increased yield and economic return. These findings suggest that the use of appropriate auxin concentrations can be a cost-effective approach for improving crop yield and financial growth.

The outcomes of this study are consistent with the findings of previous research, highlighting the potential benefits of using synthetic auxins in crop cultivation. However, it is important to note that the optimal concentration for each crop and treatment should be carefully determined to maximize the benefits while minimizing the cost.

In summary, the study provides valuable insights into the potential of using synthetic auxins for potato cultivation, highlighting the importance of carefully selecting the appropriate concentration for each treatment to achieve optimal results. The findings of this study can be useful for potato farmers and agricultural researchers seeking to improve crop yield and financial growth while minimizing costs.

FUTURE SCOPE

The current study focused on the effect of different concentrations of IBA and IAA on potato cultivation. However, future studies can be conducted to investigate the effect of other growth regulators on potato cultivation. Additionally, the present study can be extended to investigate the impact of these growth regulators on other crops. The results of this study can also be utilized for conducting further research on the optimal concentration of auxins for different crops under different environmental conditions.

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Conflict of Interest. None.

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