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Effect of node number of cuttings on survival and growth of apical cuttings in potato (*Solanum tuberosum*. L.)

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Abstract

A field experiment was conducted on apical cuttings in potato to standardize the node number of apical cuttings of different potato varieties for better rooting and survival percentage at Horticultural Research Station, Dr. Y. S. R. Horticultural University, Chintapalli, Andhra Pradesh, India during *Rabi* 2022. Observations were recorded for five randomly selected plants from each treatment combination for growth variables *viz.*, including the survival percentage of cuttings, relative height of plantlets (cm), average growth rate (%), the number of roots per cutting and the length of the longest root (cm). Kufri Lima exhibited the highest survival percentage of cuttings, relative height of cuttings, number of roots per cutting, and length of the longest root. Additionally, two-node cuttings were found to have a significant effect on the number of roots per cutting and the length of the longest root. The interaction between varieties and node numbers also yielded a significant effect on the number of roots per cutting. Therefore, for improved growth in apical cuttings, the use of two-node cuttings in Kufri Lima is recommended.

Keywords: Potato, apical rooted cuttings, HAT Zone, relative height, average growth rate

Introduction

Potato (*Solanum tuberosum* L.) belongs to the family Solanaceae. It is tetraploid ($2n = 4X = 48$) in nature. Native to the highland tropics of the Andean Mountains of Northern Bolivia and Southern Peru in South America (Luthra *et al.*, 2006) ^[1], it ranks as the third most important food crop after wheat and rice due to its high yield potential and nutritional value. Potato is traditionally propagated using seed tubers. However, this method encourages the accumulation of tuber-borne viruses, fungi and bacteria in subsequent seasons, resulting in significant losses in tuber quality and yield over time (Muthuraj *et al.*, 2016) ^[2]. Therefore, an alternative solution for this issue in potato cultivation is necessary in the country.

Apical rooted cuttings technology offers a promising alternative to traditional tuber propagation. In this method, plantlets are propagated from apical cuttings taken from disease-free and tissue culture plants of desirable variety. Subsequently, these plantlets are propagated in pro-trays and transplanted into main field. This technology has been utilized by farmers in Southeast Asia, particularly in Vietnam (Tran *et al.*, 1990) ^[3], for decades with the assistance of the International Potato Center (CIP), Peru (Vanderzaag and Escobar, 1990) ^[4].

While this technology has been successfully integrated into potato breeders seed production in India (Buckseth *et al.*, 2019) ^[5] and is being utilized by farmers in the Hassan region of Karnataka, the suitable varieties and the optimum number of nodes have yet to be standardized. Hence, this study aims to standardize this novel, cost-effective, and farmer-friendly technology in terms of identifying suitable varieties and determining the required number of nodes to recommend to the High Altitude and Tribal zone of Andhra Pradesh.

Material and Methods

The present investigation was laid out in 2 Factorial Completely Randomized Design (FCRD) with 15 treatment combinations and two replications in a shade net at Dr. Y. S. R. Horticultural University - Horticultural Research Station, Chintapalli, Andhra Pradesh, India during *Rabi*, 2022. The location falls under the Agro-climatic zone of High Altitude and Tribal Zone with an average annual rainfall from South-West monsoon of more than 1300 mm, a maximum temperature range of 17 to 35 °C, a minimum temperature range from 5 °C to 24 °C and is located at an altitude of 933 m MSL.

The geographical situation is 170.13' N latitude and 840.33' E longitude (Sivakumar *et al.*, 2020) [6]. The experimental material consisted of 15 days old tissue culture plantlets of five varieties *viz.*, Kufri Himalini, Kufri Jyothi, Kufri Lima, Kufri Mohan and Kufri Uday obtained from the regional center of International Potato Centre, Bangalore, Karnataka. Three types of cuttings (Single node cuttings, two node cuttings and three node cuttings) were studied in each variety. The tissue culture plantlets from laboratory were transferred to pro-trays filled with clean and well-decomposed cocopeat for acclimatization and further growth. Apical cuttings, each denoted with a specific node number for the respective treatment combination were taken from well-established mother plants with simple leaves that were 20 days old. These cuttings were planted in pro-trays filled with cocopeat. After 15 days of planting, these cuttings developed roots and could be used for further multiplication or for field transplantation. Observations were recorded for five randomly selected plants from each treatment combination for growth parameters *viz.*, Survival percentage of cuttings, relative height of cutting (cm), average growth rate (%), number of roots per cutting and length of the longest root (cm).

The data collected was statistically analysed by adopting Fisher's method of analysis of variance using OPSTAT software developed by HAU, Hisar. The level of significance employed in the F-test was at the probability of P -0.05. The critical difference was calculated wherever the F-test yielded significant results.

Results and Discussion

Growth parameters of potato cuttings such as survival percentage of cuttings, relative height of cutting, number of roots per cutting, average growth rate and length of longest root were measured at 15 days after planting.

Results indicate that among the five varieties, Kufri Lima recorded significantly higher growth parameters like survival percentage (100%), relative height of cutting (2.02 cm), average growth rate (57.40%), number of roots per cutting (56.40) and Length of the longest root (11.77 cm) followed by Kufri Uday with survival percentage (100%), relative height of cutting (1.25 cm), Average growth rate (32.13%), Length of the longest root (7.70 cm). Kufri Himalini recorded the lowest survival percentage (76.67%) and average growth rate (17.36%) while Kufri Jyothi has a low relative height of cutting (0.57 cm), least number of roots per cutting (7.47) and length of the longest root (5.43 cm). This might be due to their inherent genetic makeup, response to environmental conditions, adaptability to particular environment (Nikmatullah 2018) [7]

Node number was found to be significant in number of roots per plantlet and length of the longest root of plantlet but not in survival percentage. This is in confirmation with the findings of Tran *et al.* (1990) [3] and Vanderzaag and Escobar (1990) [4] whose results reveal that number of nodes per cutting, length of the cutting and number of nodes buried in the soil does not have any significant effect on survival percentage (%) of cuttings. Two node apical cuttings produced more number of roots per cutting (30.48) and maximum length of the longest root (8.90 cm) followed by three node apical cuttings with number of roots per plantlet (26.20) and length of the longest root (7.92 cm) whereas single node apical cuttings have less number of roots per plant (20.14) and minimum length of the root (6.47 cm).

This confirms the findings of Vanderzaag and Escobar (1990) [4], Uyen and Vanderzaag (1983) [8] who revealed that the number of nodes had a significant effect on the number of roots per plant. Specifically, cuttings with a length of 2 to 3 cm (containing 2 nodes) produced the longest roots.

The interaction of varieties and node number was found to be significant only in number of roots per plantlet. Two node apical cuttings in Kufri Lima (70.22) had the highest number of roots per plant followed by three node cuttings (55.50) and single node cuttings (43.50) of the same variety whereas single node cuttings in Kufri Jyothi had the least number of roots per plantlet (4.60).

Table 1: Effect of varieties and node number on survival percentage of apical cuttings in potato.

Survival percentage of cuttings (%)				
Varieties	Node number			Mean
	1 node	2node	3node	
Kufri Himalini	65.00	70.00	95.00	76.67
Kufri Jyothi	75.00	90.00	70.00	78.33
Kufri Lima	100.00	100.00	100.00	100.00
Kufri Mohan	90.00	100.00	100.00	96.67
Kufri Uday	100.00	100.00	100.00	100.00
Mean	86.00	92.00	93.00	

Factors	V	N	V X N
SE (m)±	3.575	2.769	6.191
C.D.	10.873	N/A	N/A

Table 2: Effect of varieties and node number on relative height of apical cuttings in potato

Relative height of cutting (cm)				
Varieties	Node number			Mean
	1 node	2 node	3 node	
Kufri Himalini	0.70	0.65	1.00	0.78
Kufri Jyothi	0.35	0.75	0.60	0.57
Kufri Lima	1.55	2.75	1.75	2.02
Kufri Mohan	0.95	1.25	1.05	1.08
Kufri Uday	1.25	1.35	1.15	1.25
Mean	0.96	1.35	1.11	

Factors	V	N	V X N
SE (m)±	0.185	0.143	0.320
C.D.	0.563	N/A	N/A

Table 3: Effect of varieties and node number on Average growth rate (%) in apical cuttings of potato.

Average growth rate (%)				
Varieties	Node number			Mean
	1 node	2 node	3 node	
Kufri Himalini	18.25	20.16	13.67	17.36
Kufri Jyothi	18.40	12.57	22.96	17.98
Kufri Lima	53.51	77.26	41.41	57.40
Kufri Mohan	34.93	35.95	22.99	31.29
Kufri Uday	41.81	34.95	19.63	32.13
Mean	33.38	36.18	24.13	

Factors	V	N	V X N
SE (m)±	5.157	3.994	8.931
C.D.	15.685	N/A	N/A

Table 4: Effect of varieties and node number on number of roots per apical cutting of potato.

Number of roots per cutting				
Varieties	Node number			Mean
	1 node	2 node	3 node	
Kufri Himalini	8.10	5.10	11.80	8.33
Kufri Jyothi	4.60	11.10	6.70	7.47
Kufri Lima	43.50	70.20	55.50	56.40
Kufri Mohan	22.70	33.70	30.90	29.10
Kufri Uday	21.80	32.30	26.10	26.73
Mean	20.14	30.48	26.20	

Factors	V	N	V X N
SE (m)±	1.670	1.294	2.893
C.D.	5.081	3.936	8.800

Table 5. Effect of varieties and node number on length of the longest root in apical cuttings of potato.

Length of longest root (cm)				
Varieties	Node number			Mean
	1 node	2 node	3 node	
Kufri Himalini	6.20	6.35	8.05	6.87
Kufri Jyothi	4.90	5.90	5.50	5.43
Kufri Lima	10.60	13.75	10.95	11.77
Kufri Mohan	6.85	8.80	6.85	7.50
Kufri Uday	5.15	9.70	8.25	7.70
Mean	6.74	8.90	7.92	

Factors	V	N	V X N
SE (m)±	0.582	0.451	1.008
C.D.	1.770	1.371	N/A

Conclusions

Multiplication of potato with Kufri Lima can be suggested for better growth in the high altitude region of Andhra Pradesh. Two node apical cutting is superior to apical cuttings with single node and three nodes with respect to number of roots and length of the longest root.

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