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Validation of potato apical rooted cuttings for their performance under field conditions

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Abstract
The experiment entitled "Validation of potato apical rooted cuttings for their performance under field conditions" was carried out during 2021 - 2022 under irrigated condition. The experiment was laid out with six treatments and four replications in Randomized Complete Block Design (RCBD) at RHREC (Regional Horticulture Research and Extension center), UHS Campus, GKVK, Bengaluru under the University of Horticultural Sciences, Bagalkot (Karnataka). Observations were recorded for plant height (cm), number of stems per hill, leaf length (cm), number of compound leaves per plant, days to maturity, number of tubers per plant, average tuber weight (g) total tuber yield per plant (g) total tuber yield per plot (kg) and late blight disease incidence (%). Among the six treatments, treatment (T_2 – Kufri Himalini apical rooted cuttings) performed better for the all the studied characters except for leaf length, treatment T_1 – Kufri Jyoti apical rooted cuttings had better performance for leaf length.

Keywords: Potato, ARC, apical rooted cuttings, seed tubers, validation

1. Introduction

Potato (*Solanum tuberosum* L.) from genus Solanum belongs to the family Solanaceae, is an annual crop, with the chromosome number; 2n=48. It was originated in the Andes near the border of Peru and Bolivia in South America. It was introduced from South America to Europe by the end of the 16th century, first to Spain and then to England. Among various root and tuber crops grown in India, potato has the largest share and has attained production of 473.00 thousand MT tons from an area of 29.74 thousand hectares in Karnataka (Anonymous., 2021-2022). Among different constraining factors for yield, the limited availability of quality seed material is considered as the most important factor leading to lower yield levels in eastern states. The high cost of seed which accounts for 40-50 per cent of the total cost of production, has been a key deterrent for small farmers to take up production in many of these states. Apical rooted cuttings could be the answer to India's long-standing potato seed problem by decentralizing seed production and bringing it closer to the production belts. The apical cuttings are alternative to the current aeroponic seed production system. Both aeroponics and apical cuttings involve tissue culture plantlets. In aeroponic, tissue culture plantlets are used to produce mini tubers using capital intensive aeroponic technology in screening houses, whereas in apical cuttings the tissue culture plantlets are used as mother plants in cocopeat bed for producing cuttings.

Apical cuttings originate from tissue culture material where, the mother plant is maintained in a juvenile state throughout the production cycle. It is also essential to investigate methods to increase the number of plantlets produced from disease free *in vitro* plantlets. The tubers produced from the apical rooted cuttings are considered as G_0 tubers, which are used as seed material. Therefore, new techniques must be promoted in seed production. If a low-cost technology can be made available to produce seed potato at cheaper price, then the Eastern and Southern states have immense potential to increase potato production by improving productivity and lowering cost of production. The soil and environment in many parts of the Eastern and Southern regions are suitable for cultivating potato seed in Rabi season (October-March) and in some areas like Hassan, Dharwad and Belgaum in Karnataka and Koraput in Odisha during Kharif season (July-October).

2. Material and Methods

The study was conducted on the potato (*Solanum tuberosum* L.) crop at the Regional

Horticultural Research and Extension Centre (RHREC) located in Bengaluru, Karnataka. The experiment aimed to evaluate the performance of different potato treatments. Six treatments were implemented, including Kufri Jyoti apical rooted cuttings (T_1), Kufri Himalini apical rooted cuttings (T_2), Kufri Jyoti tubers produced through apical rooted cuttings (G_0) (T_3), Kufri Himalini tubers produced through apical rooted cuttings (G_0) (T_4), Commercial Kufri Jyoti seed tubers (T_5) and Commercial Kufri Himalini seed tubers (T_6). The experiment was designed with four replications using a Randomized Complete Block Design (RCBD). Each plot had a size of 3 m × 2 m, and the spacing between plants within a plot was maintained at 60 cm × 20 cm and recommended dose of fertilizers were applied for the crop at different growth stage. Standard cultural, manurial and plant protection practices were followed to ensure a healthy crop growth. Observations recorded for 16 characters *viz*., plant height at 45, 60 and 75 days after planting (cm), number of stems per hill, leaf length at 45, 60 and 75 days after transplant (cm), number of compound leaves per plant at 45, 60 and 75 days after transplant, days to maturity, number of tubers per plant, average tuber weight (g) total tuber yield per plant (g) total tuber yield per plot (kg) and late blight disease incidence (%). The stastical analysis was done using ANOVA tool.

3. Results and Discussion

Growth parameters

The significant differences were found among the different treatments with respect to plant height, number of stems per hill, leaf length and number compound leaves per plant. Among different treatments, Kufri Himalini apical rooted cuttings revealed better growth with respect to plant height, number of stems per hill and number compound leaves per plant except leaf length as compared to other treatments at 45, 60 and 75 DAP during field conditions (Table 1 & 2). In general, the growth of all the cultivars increased gradually as the days advanced. While commercial Kufri Jyothi seed tubers recorded lowest plant height, number of stems per hill, leaf length and number compound leaves per plant. Thus, the increased plant height, number of compound leaves, and number of stems per hill helped in better synthesis of carbohydrates and their utilization for build-up of new cells, apart from better absorption of nutrients resulting in increased dry matter production. Whereas different varieties excelled better than the other varieties across seasons can be attributed to the fact that the genetic characteristic and its interaction with the prevailing environment conditions play a vital role in the performance of a variety. Such variations in the growth among the varieties were reported by Basavanagowda (2005) [1], Birksew (2016) [2], Hari (2007) [5], Santhosh (2010) [9], Nandekar *et al*. (1995) [8] and Sharma *et al*. (2015) [10].

Yield parameters

Earliness is considered as one of the most important characters in any crop improvement programme and most of the varieties or accessions are preferred when high yield is coupled with earliness. Duration of any crop mainly depends on variety. The present study also brought out certain varieties with significant earliness with respect to days to maturity. A variety Kufri Himalini apical rooted cuttings was taken minimum number of days to harvest and Kufri Jyoti commercial seed tubers was taken maximum number of days to harvest (Table 3). The difference in varietal responses to days to physiological maturity might be due to genetic inheritance of the variety. These findings are in confirmation with the earlier results of Dlamini *et al*. (2016) [4].

With respect to number of tubers per plant, average tuber weight, total tuber yield per plant and total tuber yield per plot, Kufri Himalini apical rooted cuttings performed well as compared to other treatments during field conditions. However, least performance was exhibited by Kufri Jyoti commercial seed tubers for the above said parameters (Table 3). The difference in tuber number per plant might be due to genetic inheritance and varietal character. The difference in average tuber weight, tuber weight per plant and plot among the varieties may be due to its genetic make-up and its better adaptability to the prevailing environmental conditions The increased tuber weight may be due to increased accumulation of photosynthates and vice versa. Similar results were revealed by Hari (2007) [5], Santhosh (2010) [9]. A large sized tuber production might be due to rapid plant emergence, better plant growth and genetic inheritance. Similar results were reported by Chettri *et al*. (2001) [3] and Dlamini *et al*. (2016) [4].

Out of six treatments, a non-significant difference among the treatments was observed with respect to late blight incidence in which least incidence was noticed in the variety Kufri Himalini apical rooted cuttings during cropping period in field conditions. Whereas, highest per cent incidence was showed in Kufri Jyoti commercial seed (Table 3). The level of resistance or susceptibility of a variety to a particular disease mainly depends on the genotypic character as well as prevailing weather conditions during the cropping period. These results are in agreement with the findings of Santhosh (2010) [9], Joseph *et al*. (2011) [6] and Kaushik *et al*. (2007) [7].

Table 1: Effect of different treatments on plant height and number of stems per hill in potato

Sl. No.	Treatments	Plant height (cm)			Number of stems per hill		
		45 DAP	60 DAP	75 DAP	45 DAP	60 DAP	75 DAP
1	Kufri Jyoti apical rooted cuttings	50.98	57.58	62.64	5.13	6.15	7.05
2	Kufri Himalini apical rooted cuttings	55.51	60.21	64.12	5.83	6.61	7.28
3	Kufri Jyoti tubers produced through apical rooted cuttings (G_0)	46.94	54.63	58.42	4.88	5.39	6.23
4	Kufri Himalini tubers produced through apical rooted cuttings (G_0)	50.06	56.35	61.57	5.07	6.05	6.38
5	Commercial Kufri Jyoti seed tubers	41.06	48.86	52.52	4.20	4.75	5.40
6	Commercial Kufri Himalini seed tubers	41.48	50.55	54.54	4.50	4.90	5.43
	Mean	47.67	54.70	58.97	4.94	5.64	6.30
	S.Em. ±	2.09	1.99	2.72	0.36	0.23	0.30
	CD at 5%	6.29	6.01	8.19	1.10	0.70	0.89
	CV (%)	10.79	11.29	9.25	15.12	8.25	9.38

G_0- Tubers produced from apical rooted cuttings

Table 2: Effect of different treatments on leaf length and number of compound leaves per plant in potato

Sl. No.	Treatments	Leaf length (cm)			No of compound leaves per plant		
		45 DAP	60 DAP	75 DAP	45 DAP	60 DAP	75 DAP
1	Kufri Jyoti apical rooted cuttings	8.35	8.89	9.15	30.52	42.61	46.59
2	Kufri Himalini apical rooted cuttings	7.87	7.90	8.81	33.55	47.53	51.76
3	Kufri Jyoti tubers produced through apical rooted cuttings (G_0)	6.94	8.33	8.73	26.97	37.81	42.80
4	Kufri Himalini tubers produced through apical rooted cuttings (G_0)	6.30	7.61	8.36	29.46	40.04	45.20
5	Commercial Kufri Jyoti seed tubers	6.09	7.09	8.23	22.81	33.09	40.46
6	Commercial Kufri Himalini seed tubers	5.70	6.93	8.17	25.20	36.48	43.06
	Mean	6.88	7.79	8.58	28.09	39.59	44.98
	S.Em ±	0.26	0.20	0.34	2.14	1.92	2.28
	CD at 5%	0.77	0.58	1.03	6.45	5.79	6.86
	CV (%)	8.46	5.62	7.99	15.24	9.73	10.12

G_0- Tubers produced from apical rooted cuttings

Table 3: Effect of different treatments on yield parameters and late blight incidence in potato

Sl. No.	Treatments	Days maturity	Number of tubers per plant	Average tuber weight (g)	Total tuber yield per plant (g)	Total tuber yield per plot (kg)	Late blight incidence (%)
1	Kufri Jyoti apical rooted cuttings	82.75	14.36	72	881	12.68	8.96
2	Kufri Himalini apical rooted cuttings	80.25	16.12	75	955	14.78	7.80
3	Kufri Jyoti tubers produced through apical rooted cuttings (G_0)	83.75	12.27	58	816	10.05	11.59
4	Kufri Himalini tubers produced through apical rooted cuttings (G_0)	81.00	12.75	64	860	10.96	9.31
5	Commercial Kufri Jyoti seed tubers	97.00	10.33	69	782	8.07	13.30
6	Commercial Kufri Himalini seed tubers	94.00	11.13	66	801	8.91	12.56
	Mean	86.46	12.83	67.33	849.17	10.91	10.59
	S. Em ±	2.48	0.62	0.05	0.04	0.90	NS
	CD at 5%	7.32	1.88	0.16	0.11	2.71	NS
	CV (%)	7.14	9.81	16.60	8.66	16.51	NS

G_0- Tubers produced from apical rooted cuttings

4. Conclusion

It may be concluded that the variety Kufri Himalini apical rooted cuttings performed well in open field conditions for growth and yield parameters. Producing seeds on farm from apical rooted cutting is economical and produce high quality seed. With this technology flexibility of potato cultivation is possible during both *Kharif* and *Rabi* season. Apical rooted cuttings enable potato farmers to access high quality, disease pathogen free planting material in time at low cost.

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