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Effect of micronutrient on survivability and plant growth of budded citrus (*Karna khatta*)

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Abstract
A field trail was carried out at Crop Research Farm, Naini Agricultural Institute, Department of horticulture, Sam Higginbottom University Agriculture, Technology and Sciences, (SHUATS), Prayagraj, (U.P.) during season 2019-21 to study. "Effect of micronutrient on survivability and plant growth of budded citrus (*Karna khatta*)". The experiment was done in complete randomized block design with eight treatment replicated three times. The factor consist (budding and micronutrient). The result which appeared that application of T1 (budding + zinc) recorded minimum day to germination (16.00) and application of T1 (budding + zinc) recorded maximum germination percentage (86.00%), survival percentage (100%), plant height (39.87cm), stem girth (1.80 cm), number of branches (12.23), number of leaves (70.00), percentage of budding success (60), percentage of budded plant survivability (70), Maximum gross return (45360), net return (27180) and B: C ratio (1:1.48) were recorded with application of T1 (Budding + zinc).

Keywords: Citrus, yield, budding, Karan khatta etc.

Introduction
The genus Citrus and its relatives are very important horticultural products which include very important fruit crops of Rutaceae such as tangerines, oranges, lemons, limes and grapes, etc. It belongs to the family and confined to 0-400 latitude from north to south of the equator which covers different regions with different pedoclimatic conditions. It is the third fruit crop in India with mango and banana. Different species of citrus have different chemical compositions. While in the candy group, the main constituents of the edible parts are sugars (glucose and sucrose) and acids (mainly citric acid and some malic acid), the fruits of the acid groups mainly contain the acids contained in fruit juice. The peel of citrus fruits is rich in pectin and some essential oils. Citrus fruits contain 25-85mg/100ml of juice, ascorbic acid, vitamin C. Citrus fruits are bottled and canned on a large scale. Citrus flowers, leaves and peels contain good quality oils and have good business value. The position of citrus in agriculture and the world economy is established by large-scale production and extensive cultivation. It is an important member of the Rutaceae family. Several citrus species are said to be native to the tropics and subtropics of Asia and the Malay Archipelago (Hooker, 1872) [5].
Citrus varieties are propagated mainly vegetatively and by seeds. It is particularly known for its polyembryony. Germinating seeds that have more than one plant and embryos come from the zygote and nuclear tissue. This development of the plant from more than one seedling was considered to be a twin by single point fission of the natural or nuclear zygotic embryo. Propagation of citrus fruits by seed takes a decade for the plant to mature. Phytophthora species have been shown to cause serious soil-borne diseases in citrus, including seedbed wetting, root and crown rot in nurseries, foot rot and fruit brown rot. Found that the disease incidence percentage ranged from 66% to 91.33%. Lima (1992) [8] explained that plants on Rangpur lime sprouted vigorously and were comparable to trees sprouted on raw lemon. The plants were large in size, but cold tolerance was minimal. In addition, they were prone to bacterial diseases.
Whereas the vegetative propagation of citrus fruits has been found to be more advantageous in the practice of propagation. It has been reported that citrus species can be reproduced by seed, but this method has some drawbacks, and the seedlings produced do not show any similarities. The method of graft propagation in cross-linked C. jambhiri encompasses a very good and novel approach, but selection of a suitable graft acts as a limiting factor in such a method. It also depends on the selection of healthy genetic material for propagation.

Second, the younger and taller branches are better suited for grafting because you react quickly. Sprouting was an innovative technique and came from the old technology of horticulture 4. The propagation of vegetative citrus species is an art of cutting stems. It depends on environmental factors, woodiness, age and nutrition of growth hormones

Viral diseases were considered the greatest difficulties for citrus production and spread in different ways, such as infected propagation material, insects and tools contaminated *C. reticulata* growing under vulnerable viral diseases that have destroyed millions of citrus orchards. Viral diseases are transferable by the bud from the regions of the nodal buds. To overcome this difficulty and for the production of virus-free rootstocks, the bud break technique is widely accepted in the propagation of citrus fruits. Likewise, Sharma (2006) [18] described grafted Rough lemon trees as vigorous and high yielding but of poor quality. However, Sharma and Srivastava (2004) [17] found that the rough lemon can be grown on a variety of soils and is very sensitive to cold conditions. At the same time, Rangpur Lime is well adjustable in saline soils and cool environment.

Plant germination is the union of two plant segments, called scion and rootstock, from two different plants of the same species. The two segments will then grow together and form a single plant. The scion consists of a shoot from which branches and stems will sprout. Grow and the rootstock functions as a root system for the new plant. Germination is done to change the size of the plant, allow propagation, increase a plant's resistance to disease, or repair damaged areas of an otherwise healthy plant.

The cultivation of budding plants has gradually developed in recent years. With the generalization of the use of this technique, the objectives have also widened until today where the budding has a spectrum of objectives, to stimulate the growth and development of plants, to control the wilt caused by pathogens. reduce viral, fungal and bacterial infections, strengthen tolerance to heat or salt stress, Increase absorption of nutrients and minerals by the germ.

Materials and Methods

Experimental site

The study was conducted in the, Department of Horticulture, Naini Agriculture Institute, SHUATS, Prayagraj, located between 25. 87° North latitude 81.15° East altitude. The altitude is 78 meters above the mean sea level.

The present investigation was carried out during winter season in the year (2019-2021) at the Department of Horticulture Sam Higginbottom University of Agriculture, Technology and Sciences. The detail of materials used, experimental methods followed and techniques adopted during the course of the present investigation are described in this chapter in detail in the subsequent paragraphs.

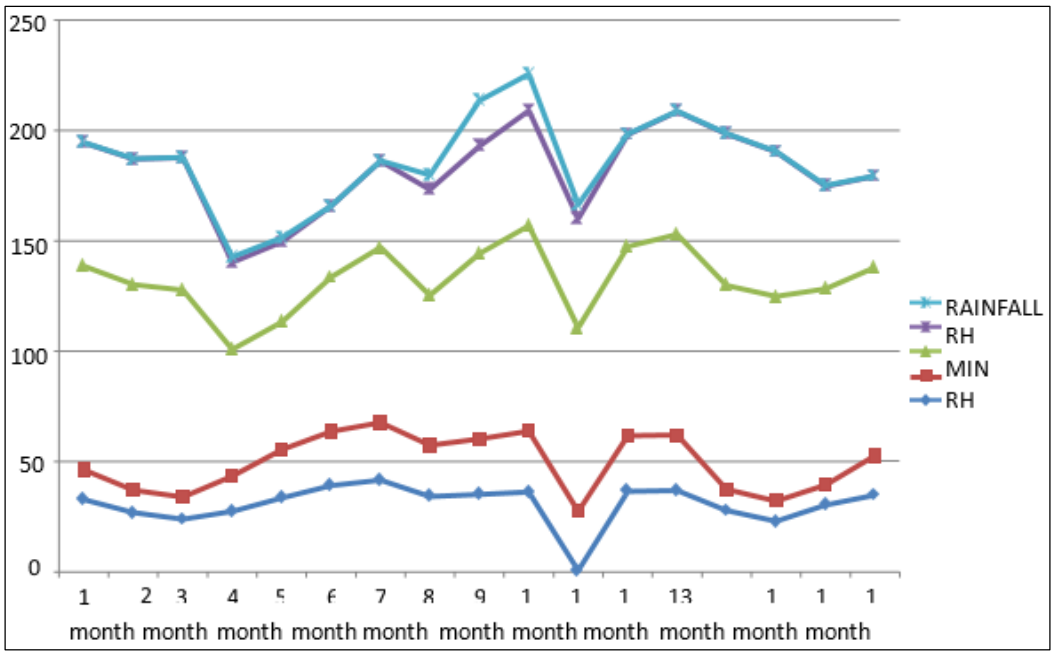

Fig 1: Metrological data Prayagraj

Soil characteristics

The soil of the region is loamy sand of uniform fertility status with low clay and high sand percentage. The soil is alluvial in nature, very deep, well drained and fairly moisture retentive. Soils respond well to manures and irrigation. Soil is suitable to variety of crops of tropical and sub-tropical regions. A composite soil sample was collected from an experimental plot to a depth of 0-15 cm before sowing. Soil was analyzed for determining the physico-chemical properties and presented in (Table 1).

Table 1: Physio-chemical properties of soil which are obtained at the experimental site of SHUATS

S. No.	Particulars	Value (0-35 cm depth
1.	Sand	55
2.	Silt	27
3.	Clay	13
4.	Textural class	Sandy loam
5.	Soil pH	6.9
6.	EC (dsm-1) at 25 ^{0}C)	0.262

7.	Organic carbon	0.113
8.	Available Nitrogen (kg/ha)	289.95
9.	Available Phosphorous (kg/ha)	8.7
10.	Available potash	223.1

Sowing of seeds

Double seed was sowed at about 1 cm depth in polybags. There were 840 seeds sown two in each polybags. All the polythene bags filled with soil were uniformly watered by watering cane.

Table 2: Forms of micronutrients application

Micronutrients	Solution concentration	Source
Zinc	0.5	Zinc sulphate
Copper	0.2	Copper sulphate
Magnesium	0.4	Magnesium sulphate
Iron	0.4	Ferrous sulphate
Boron	0.2	Boric acid
Calcium	0.5	Calcium nitrate
Molybdenum	0.2	Ammonium molybdate

Results

Day of germination

As shown in (table 3) The observations which were recorded during the experiment period was significant difference among the treatment applied T1 with 16.85 days of germination followed by T4 with 20 day of germination and the maximum day was recorded in T0 (Control) with 26.33 days of germination.

Germination percentage

As shown in (table 3) The observation which were recorded during the experiment period was significant difference among the different treatments applied, the maximum germination percentage was recorded in T1 with 86.33% germination percentage followed by T4 with 76.89 of germination percentage and the minimum germination percentage was recorded in T0 (Control) with 62.33 germination percentage.

Survival percentage

As shown in (table 3) the observation which were recorded during the experiment period was significant difference among the different treatments applied, the maximum survival percentage was recorded is T1 (100%), and the minimum germination percentage was recorded in T0 control with 66 survival percentage.

Success budding percentage

As shown in (table 3) In case of budding method maximum percentage of budding success (60%) was found T1 followed by T4 (50%). The highest percentage was found T1.

Table 3: Effect of micronutrients on DAS of Germination, Germination percentage, Survival percentage and Success budding percentage of Karna khatta seedling

Notion	Treatment	Day of germination	Germination percentage	Survival percentage	Success budding percentage
1.	Control	26.33	62.33	66	30
2.	Budding + Zinc	16.85	86.33	100	60
3.	Budding + Magnesium	20.22	76.22	100	25
4.	Budding + Iron	25	75.45	100	40
5.	Budding + Boron	20	76.89	100	50
6.	Budding + Calcium	25.33	72.33	66	30
7.	Budding + Molybdenum	22.33	65.66	66	25
8.	Budding + Copper	20.89	75.22	100	40
F Ratio		S	S	S	S
SEd		1.16	2.12	1.67	2.20
CD (5%)		2.48	4.55	3.57	4.66

Growth parameters

Plant height

The height of plant was measured at monthly interval right before 3 month of budding from November 2020 to January 2021 in centimeter with the help of a meter scale. The periodical data being graphed in the final record. Ist measurement and further growth during the budding were statistically analyzed and being presented table wise.

As shown in (Table 4) the minimum height of plant varied from T0 (control) 19cm to T1 (29.73cm) in first observation of Karna khatta. In second observation maximum height (33.93 cm) was recorded in T1 Karna khatta and it was followed by T4 (33.87cm). In third observation maximum height recorded in T1 (39.87cm) it was followed by T4 (39.73).

Stem girth (cm)

The stem girth of plant was measured at monthly interval right before 3month of budding from November 2020 to January 2021 in centimeter with the stem circumference (cm) of all the seedling in each replication was recorded with the help of side veneer calipers inches above soil level. The periodical data being graphed in the final record. Ist measurement and further growth during the grafting were statistically analyzed and being presented table wise.

As shown in (Table 4) The minimum stem girth varied from T0 (1.20cm) to T1 (1.50 cm) maximum in first observation of Karna khatta. In second observation maximum stem girth

(1.65 cm) was recorded in Karna khatta and it was followed by T4 (1.50cm) in third observation maximum stem girth in T1 (1.80 cm) it was followed by T4 (1.62cm). Jaskarni *et al*., (2002) [6] discovered that diploid kinnow trees attained more stem girth than tetraploid ones. Shah *et al*., (2016) [19] established that Meyer lemon when grafted on sour orange rootstock affected scion diameter and scion length.

Table 4: Effect of micro nutrient on plant height and Stem growth (cm) on Karna khatta

Notion	Treatment	Plant height			Stem girth (cm)		
		30 Days	60 Days	90 Days	30 Days	60 Days	90 Days
1.	Control	19	22.77	30.80	1.20	1.30	1.42
2.	Budding + Zinc	29.73	33.93	39.87	1.50	1.65	1.80
3.	Budding + Magnesium	27.67	30.83	37.63	1.24	1.40	1.52
4.	Budding + Iron	29.00	31.00	30.80	1.28	1.41	1.50
5.	Budding + Boron	29.23	33.87	39.17	1.40	1.50	1.62
6.	Budding + Calcium	26.83	30.77	35.73	1.27	1.35	1.48
7.	Budding + Molybdenum	22.77	24.52	32.60	1.30	1.38	1.55
8.	Budding + Copper	26.40	29.53	34.80	1.33	1.42	1.53
F ratio		S	S	S	S	S	S
SEd		1.52	1.61	1.83	1.61	2.20	1.50
CD (5%)		3.26	3.45	3.92	3.45	4.66	3.26

Number of branches

The number of branches was measured at monthly interval right before 3month of budding from November 2020 to January 2021 in the five plants randomly selected and tagged permanently in each treatment and used to recorded the number of branches per plant. The periodical data being graphed in the final record. Ist measurement and further growth during the budding were statistically analyzed and being presented table wise.

As shown in (Table 5) the minimum number of branches varied from T0 (5.22) to T1 (5.89) maximum in first observation of Karna khatta. In second observation maximum number of branches (8.60) was recorded in Karna khatta and it was followed by T4 (8.33) in third observation maximum number of branches in T1 (12.33) it was followed by T4 (11.88).

Number of leaves

The very young developing leaves in senescence with yellow colour were not considered while counting the leaves. The observations were recorded at 30, 60, 90 days before budding and average number of leaves for each treatment was recorded.

As shown in (Table 5) the minimum number of leaves varied from T0 (41.33) to T1 (57.66) maximum in first observation of Karna khatta. In second observation maximum number of leaves (63.50) was recorded in Karna khatta and it was followed by T4 (60.67) in third observation maximum number of branches in T1 (70.00) it was followed by T4 (65.80).

Table 5: Effect of micro nutrient on Number of branches and Number of leaves (cm) on Karna khatta

Notion	Treatment	Number of branches			number of leaves		
		30 Days	60 Days	90 Days	30 Days	60 Days	90 Days
1.	Control	5.22	7.50	9.50	41.33	48.10	54.33
2.	Budding + Zinc	5.89	8.60	12.23	57.66	63.50	70.00
3.	Budding + Magnesium	5.44	7.00	9.30	53.31	57.33	63.50
4.	Budding + Iron	5.51	7.40	9.44	47.67	53.90	58.22
5.	Budding + Boron	5.72	8.33	11.88	55.33	60.67	65.80
6.	Budding + Calcium	5.27	7.45	10.55	43.33	49.50	55.22
7.	Budding + Molybdenum	5.69	7.33	11.33	50.22	54.67	58.33
8.	Budding + Copper	5.27	7.60	9.33	51.23	56.67	60.33
F ratio		S	S	S			
SEd		0.67	0.80	1.11	1.51	1.67	1.94
CD (5%)		1.38	1.67	2.29	3.23	3.61	4.15

Gross return hectare $^{-1}$

As shown in (Table 6) the maximum gross return hectare^{-1} was obtained by T1 (INR 45360) and followed by T4 (INR 41580) and the minimum gross return hectare^{-1} was obtained by T0 (INR 33120).

Net return hectare^{-1}

As shown in (Table 6) the maximum net income hectare^{-1} was obtained by T1 (INR 27180) and followed by T4 (INR 23400) and the minimum net income hectare^{-1} was obtained by T0 (INR 14940).

Cost benefit ratio

As shown in (Table 6) among the different budding the T1 has the highest cost benefit ratio (1:1.48) followed by T4 (1:1.27) and the minimum cost benefit ratio was showed by T0 (1:0.82).

Table 6: Cost benefit ratio different by budding in citrus

Treatment	Budding	Total cost of cultivation	Plant ha^{-1}	Selling rate INR/per plant	Gross return @INR/ha	Net return INR/ha	Benefit cost ratio
To	Control	18180	184	180	33120	14940	0.82
T1	Budding + Zinc	18180	252	180	45360	27180	1.48
T2	Budding + Magnesium	18180	197	180	35460	17280	0.94
T3	Budding + Iron	18180	189	180	34020	21060	1.15
T4	Budding + Boron	18180	231	180	41580	23400	1.27
T5	Budding + Calcium	18180	201	180	36180	18000	0.99
T6	Budding + Molybdenum	18180	210	180	37800	19620	1.07
T7	Budding + Copper	18180	218	180	39240	21060	1.18

In conclusion that the treatment T1 budding + zinc found to be best in budding technique. The success of budding is 60%. And the survival percentage was recorded of the budded plants is 70%. Among the different budding the T1 has the highest cost benefit ratio (1:1.48) followed by T4 (1:1.27) and the minimum cost benefit ratio was showed by T0 (1:0.82).

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