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Effect of different micronutrients on the establishment of papaya (*Carica papaya* L.) cv. Red lady

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Abstract
The present investigation entitled "Effect of different rooting hormone on cuttings of Pomegranate (*Punica granatum*) under protected condition in Prayagraj agro-climatic conditions" was conducted at shade net, Horticulture research farm, Department of horticulture, Naini agriculture college, SHUATS, Prayagraj (U.P.) during the academic year 2022-24. Plant growth hormones combination treatments include T_0 (Control), T_1 Zn(60 mg/l) + FYM +cocopeat (2:1:1) + GA3(100 ppm),T_2 Zn(90 ml/l) + FYM +cocopeat (2:1:1) + GA3(100 ppm), T_3 Zn(120 ml/l) + FYM +cocopeat (2:1:1) + GA3(100 ppm), T_4 Zn(150 ml/l) + FYM +cocopeat (2:1:1) + GA3(100 ppm), T_6 Mg(6 mg/l) + FYM +cocopeat (2:1:1) + GA3(100 ppm), T_7 Mg(9 mg/l) + FYM +cocopeat (2:1:1) + GA3(100 ppm) The leaf, shoot parameters and survival percentage on transplanting of the cuttings of each treatment was done up to 90 days and all the observations were recorded at every 30 days interval. The leaf number and shoot length (cm) were recorded highest in the treatment T_4 during research which were (15.08cm) and (52.68 cm) respectively. Days of first shoot initiation and Days of first leaf initiation had increasing trend during research work and lowest days recorded (6.59) and (7.02) in T_7 treatment respectively at 15 days. On the basis of our experimental findings, it is concluded that the T_7 (IBA @3000 ppm + PG @5000 ppm) was found to be best in the terms of days to first shoot initiation, days to first leaf initiation, shoot lengths, number of leaves, number of new shoots, root lengths, fresh weight of roots, dry weight of roots. After the transplantation of the Pomegranate cuttings, T_7 (IBA @3000 ppm + PG @5000 ppm) was found to be best in the terms of number of new shoots, shoot length, number of new leaves. In terms of rooting percentage and earliness of shooting, T_7 (IBA @3000 ppm + PG @5000 ppm) was found to be best. The survivability or the establishment percentage found to be the highest in T_7(IBA @3000 ppm + PG @5000 ppm). It is also concluded that the best treatment of Pomegranate cuttings for Prayagraj agro-climatic conditions was found to be T_7(IBA @3000 ppm + PG @5000 ppm) for establishment.

Keywords: Papaya, seedlings, zinc, magnesium

Introduction
Papaya (*Carica papaya* L.) is an important fruit crop of the tropical world and has long been known as the wonder fruit of the tropics. The highest productivity and its ability to produce fruits throughout the year have added to gain popularity and commercial importance. Besides this, papaya is a wholesome fruit with high nutritive value and therapeutic value. The fruit contains high amount of vitamin A, vitamin C and iron. Ripe fruits are largely used as a fresh desert, while green fruits are often used in salads and pickles or cooked as a vegetable. Papain, a proteolytic enzyme present in the latex, collected mainly from the fruits, has various uses in the beverage, food, pharmaceutical and tanning industries. Also, papaya leaves have medicinal values. Because of these, papaya has been called as "common man's fruit". Papaya is a member of the Caricaceae family and the 2n chromosome number is 18. It is native to tropical America and it was introduced in India in the 16th century from Malacca. It is an interesting plant that produces fruits of many uses and grown under tropical and subtropical conditions. It is popularly known as pawpaw or papaw (British), mamao (Brazil) and lechosa (Venezuela). Papaya is a fast-growing, short lived herbaceous plant and unbranched which bears fruits within a year. The plant is 2-10 m in height with a straight, cylindrical, soft and hollow trunk surrounded by the apex portion and forming a crown. The fruits are borne on the growing axils of the plant. Being a quick and heavy yielding crop, it is grown widely all over India; both commercially as well as in home gardens Micronutrients

are essential elements that plants require in small quantities for optimal growth, development, and productivity. They play a crucial role in various physiological processes, including photosynthesis, enzyme function, protein synthesis, and plant hormone regulation. Micronutrients are necessary for plants to complete their life cycle, from seed germination to fruit production. Without sufficient micronutrients, plants may exhibit deficiency symptoms, such as stunted growth, yellowing or discoloration of leaves, reduced fruit set, and increased susceptibility to diseases and pests.

Materials and Methods

The present investigation entitled "Effect of different micronutrients on the establishment of papaya (*Carica papaya* L.) cv. Red lady "was carried out at Department of horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology of Sciences (SHUATS), Prayagraj (U.P), Latitude 25.4137 N and Longitude 81.8491 E. during the summer season of the year 2023-24. The cuttings were gathered from the Allopibagh, Uttar Pradesh, India. For the research purpose, 60 days seedlings are brought and transplanted. In a well-prepared field, pits of 45 x 45 x 45 cm sizes are to be made within the required distance. The pits are filled with topsoil along with 20 kg of FYM and 1 kg of cocopeat. The treatment combinations are as follows: T_0(control), T_1 Zn(60 mg/l) + FYM +cocopeat (2:1:1) + GA3(100 ppm),T_2 Zn(90 ml/l) + FYM +cocopeat (2:1:1) + GA3(100 ppm), T_3 Zn(120 ml/l) + FYM +cocopeat (2:1:1) + GA3(100 ppm), T_4 Zn(150 ml/l) + FYM +cocopeat (2:1:1) + GA3(100 ppm), T_5 Mg(3 mg/l) + FYM +cocopeat (2:1:1) + GA3(100 ppm), T_6 Mg(6 mg/l) + FYM +cocopeat (2:1:1) + GA3(100 ppm), T_7 Mg(9 mg/l) + FYM +cocopeat (2:1:1) + GA3(100 ppm) The data were recorded at 30 days after planting, 60 days after planting, 90 days after planting and 30 days after transplanting. With 3 replications in Randomized Block Design (RBD).

Results and Discussion

Shoot parameters: Zinc concentration and Magnesium concentration had a significant influence on the shoot parameters per cuttings in Pomegranate at 30 DAP, 60 DAP, 90 DAP. The data presented here indicated that micronutrients had a significant effect on the days to new leaf initiation, shoot length, no. of leaves, leaf area, leaf area index.

Days to first leaf initiation: The Papaya seedlings with control recorded least no. of days for the first leaf initiation (4.11) and maximum were recorded in treatment Zn (150 mg/l) + FYM + cocopeat (2:1:1). This might be because zinc is an essential component of several enzymes that control various metabolic processes in plants. And also, it helps plants resist biotic and abiotic stresses.

Shoot length: The seedlings treated with Zn(150 ml/l) + FYM +cocopeat (2:1:1) + GA3(100 ppm) produced maximum shoot length (26.83, 42.38, 52.68) and minimum was recorded in control (17.68, 33.06, 42.82) in the time period of 1 MAP, 2MAP, 3MAP.This conductive effect of growth hormones combination on water holding capacity, porosity, soil aeration and delivering ample amount of nutrient particularly nitrogen and micro nutrient for protein synthesis, cell reproduction, good root and shoot growth over soil alone Chopde *et al*. (1999) [15] in custard apple. Metabolism cannot be neglected due to its physiological importance.

No. of leaves: The seedlings treated with Zn(150 ml/l) + FYM +cocopeat (2:1:1) + GA3(100 ppm) produced maximum no. of leaves (4.6,8.0,11.75) and minimum was recorded in control (3.0,3.8,5.58) in the time period of 1 MAP, 2 MAP, 3 MAP. Increased in number of leaves might be mainly due to corresponding increase in plant height (Govind and Chandra, 1993 in Khasi mandarin), Bhat *et al*. (2004) [17] in pomegranate, Navjot and Kahlon (2007) [18] in pomegranate, Sharma *et al*. (2009) [19] in pomegranate and Rathwa *et al*. (2017) [20] in pomegranate.

Survival percentage on transplanting: The effect of different hormones on Survivability % of Papaya seedling is very obvious and consistent. There was significant difference among the impact of the different treatment combinations on Survivability % during the course of the experiment after transplanting with maximum Survivability % in T_4 Zn(150 ml/l) + FYM +cocopeat (2:1:1) + GA3(100 ppm) with (91.66) and T_5 Mg(3 mg/l) + FYM +cocopeat (2:1:1) + GA3(100 ppm) with (91.66), respectively, followed by T_1 Zn(60 mg/l) + FYM +cocopeat (2:1:1) + GA3(100 ppm) with (83.33) and T_6 Mg(6 mg/l) + FYM +cocopeat (2:1:1) + GA3(100 ppm) with (83.33) which were significantly superior over T_2 Zn(90 ml/l) + FYM +cocopeat (2:1:1) + GA3(100 ppm) and T_3 Zn(120 ml/l) + FYM +cocopeat (2:1:1) + GA3(100 ppm) with (75.00) and minimum was recorded in T_0 (control) with (50.00). This could be because Zinc and magnesium plays crucial roles in enzyme synthesis, protein production, root growth, and hormone regulation, ultimately promoting healthy growth and development, good growth hormones combinations that increased nutrient uptake and further develop plant structure which increased overall plant development and maintain the cell turgidity, cell elongation and increased respiration at optimum level, resulting in favorable growth. A good soil environment cause soil aggregation, which may increase organic matter availability as well as phosphorus absorption, permeability and air flow in the rhizosphere. The evaluation of different hormones on the seedlings of papaya treated with different treatment combinations for survivability percentage is critical to ascertain their adaptability and resilience to various environmental conditions. By subjecting the seedlings to rigorous field trials and stress tests, growers can determine their ability to withstand factors such as drought, pests, diseases, and extreme temperatures. The seedlings exhibiting higher survivability percentages indicate greater vigor, robustness, and potential for long-term orchard establishment. Understanding survivability percentages also aids in selecting hormones suitable for specific agro-climatic zones, optimizing resource allocation, and mitigating risks associated with crop failure. Ultimately, prioritizing the hormone treatments with superior survivability enhances the sustainability and success of Papaya cultivation endeavors.

Table 1: Effect of zinc and magnesium on papaya saplings.

Notion	Treatment combination	Number of leaf	Leaf area	Leaf area Index	Shoot Length	Shoot Diameter	Survivability
T_0	Control	4.110	522	22.573	14.170	2.167	50.00
T_1	Zn (60 mg/l)+FYM +cocopeat (2:1:1)+ GA3(100 ppm)	5.163	39.267	39.267	18.477	2.550	83.33
T_2	Zn (90 mg/l)+FYM +cocopeat (2:1:1)+ GA3(100 ppm)	6.163	46.037	46.037	21.203	2.650	75.00
T_3	Zn (120 mg/l)+FYM +cocopeat(2:1:1)+ GA3(100 ppm)	5.857	47.793	47.793	21.107	2.820	75.00
T_4	Zn (1500 mg/l) + FYM +cocopeat (2:1:1)+ GA3(100 ppm)	6.533	69.263	69.263	29.053	2.867	91.66
T_5	Mg (3 mg/l)+FYM +cocopeat (2:1:1)+ GA3(100 ppm)	5.277	28.390	28.390	19.347	2.780	58.33
T_6	Mg (6 mg/l)+FYM +cocopeat (2:1:1)+ GA3(100 ppm)	5.360	33.857	33.857	19.403	2.827	83.33
T_7	Mg (9 mg/l)+FYM +cocopeat (2:1:1)+ GA3(100 ppm)	5.273	37.703	37.703	20.803	2.917	75.00
	F-test	S	S	S	SS	S	S
	S.ED	0.409	2.746	0.049S	1.438	0.311	11.18
	CD	1.252	8.409	0.149	3.114	0.951	0.58
	C.V	12.952	11.711	3.121	8.613	16.444	23.14

Conclusion

On the basis of our experimental findings, it is concluded that the T_4 Zn(150 ml/l) + FYM +cocopeat (2:1:1) + GA3(100 ppm) was found to be best in the terms of days to days to leaf initiation, shoot lengths, number of leaves, leaf area, leaf area index. The survivability or establishment percentage found to be the highest in T_4 Zn(150 ml/l) + FYM +cocopeat (2:1:1) + GA3(100 ppm). It is also concluded that the best treatment of T_4 Zn(150 ml/l) + FYM +cocopeat (2:1:1) + GA3(100 ppm) papaya seedlings for Prayagraj agro-climatic conditions was found to be T_4 Zn(150 ml/l) + FYM +cocopeat (2:1:1) + GA3(100 ppm) for establishment.

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