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Studies on different grades and times of application of micronutrient mixture on vegetative growth and reproductive growth parameters of Custard apple *(Annona squamosa* L.) Cv. Balanagar

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Abstract
The experiment was laid out in factorial randomized block design with two factors i.e. factor A- micronutrient mixture grade (G) and factor B- time of application (T). These factors consist of four and three levels respectively, twelve treatment combinations with three replications. Among the different treatment combination the treatment G_4T_1 (Grade-4 chelated by foliar application monthly) noted the highest vegetative growth, reproductive growth in respect to, plant height (52.25 cm), plant spread east-west (50.08 cm) and north-south (49.68 cm), stem girth (6.47 cm), plant volume (13.23 m^3),days required for flowering (150.17 days), days required for fruit set (10.67 days), days required for fruit maturity (101.00 days), number of flowers/m^3 (24.67), number of fruits/m^3 (20.33), fruit set (82.47%). In this experiment the treatment G_4T_1 (Grade-4 chelated by foliar application monthly) also performed well in respect of growth and yield which showed results viz. reduction in days required for flowering (150.17 days) and fruit set (10.67 days and number of flowers per m^3 (24.67).

Keywords: Chelate, micronutrients, grade, FRBD, growth, Balanagar

1. Introduction
Custard apple (*Annona squamosa L.*) is the most anciently land fruit crop in India. It is originated from tropical region of America and widely distributed throughout the tropics and subtropics. Annonaceous fruits form an important part of diet of the people in the South India. It comprises of 40 genera and 120 species of which only five of them produce edible fruits. Among the annonas, custard apple (*Annona squamosa* L.*)* is valued more than *Annona reticulata* L. (Ramphal), *Annona glabra* L., *Annona atemoya* (Hanumanphal) and *Annona cherimola* (Laxmanphal). The origin of different species of annona is reported to be at different regions. *Annona squamosa* is originated in Central America from there; it was distributed to Mexico and Tropical America (Popenoe, 1974) [9]. The annonas are distributed in the entire globe, due to their suitability to different climatic conditions.

The fruits are medium in size (250-250 g), globular, green skin, conspicuous reticulation on fruit surface, non-acidic, having good quality and sweet pulp. Edible portion or pulp of fruit is creamy, granular with good blend of sweetness and acidity which vary with the species. Fruit pulp contains proteins, fatty acids, fibre, carbohydrates, minerals and vitamins (Rajput *et al*., 1991, Babu *et al*., 2005, Rawat *et al*., 2010 etc) [12, 1, 11]. The pleasant flavour and mild aroma have universal liking. The fruit contains vitamin C and minerals such as calcium, phosphorus and potassium.

Custard apple has slightly granular, creamy, yellow or white, sweet pulp with good flavour and low acidity, thus it is consided the sweetest fruit of the other annonas (FAO, 1990) [2]. Fruit contains sugar 16-20 per cent and lipids 0.35 per cent of edible part of fruit (Leal, 1990) [5].

It has many health and nutritional benefits. It is a rich source of dietary fibre, which helps in digestion. It contains magnesium, which plays a vital role in relaxing muscles and protecting heart against diseases. Flesh of the fruit is used for the preparation of milk shakes and ice-cream. Delicious sauce for cake and puddings can be made by blending the seeded flesh with mashed banana and with a little cream. The seeds of the fruits have insecticidal and abortifacient properties.

Similarly, seed oil is suitable for soap making and seed cake can be used as manure (Naidu and Saetor, 1954) [8]. Custard apple has many alkaloids, such as aporohine, romerine, norocoydine, squamoninecorydine, norisocroriydine, glaucine and anononaine in different parts of the plant (Kowlska and Putt, 1990) [4].

Table 1: Nutritional composition of custard apple (per 100 g of pulp)

S. No	Constituents	Values
1.	Carbohydrates	20-25.2 g
2.	Protein	1.17-2.47 g
3.	Fat	0.5-0.6 g
4.	Crude fibre	0.9-6.6 g
5.	Calcium	17.6-27 mg
6.	Phosphorus	14.7-32.1 mg
7.	Iron	0.42-1.14 mg
8.	Thiamine	0.075-0.018 mg
9.	Riboflavin	0.086-0.175 mg
10.	Niacin	0.528-1.190 mg
11.	Ascorbic acid	15.0-44.4 mg

(Navaneetha and Nattar, 2011) [7].

One of the main reasons for low custard apple orchard productivity of Marathwada region is nutrient deficiencies. The soils of this region are mostly derived from basaltic parent material and are commonly deficient in multiple nutrients, including N, P, Fe, Mn and Zn that is why the conventional nutrient management strategy based mainly on macronutrient application in custard apple orchards has not been very successful in raising the productivity level (Srivastava *et al.*, 2009) [13]. Relatively, small amount of micronutrients are required as compared to those of primary nutrients, but these are equally important for plant metabolism (Katyal, 2004) [3]. Even though micronutrients are present in soil, their absorption may be hindered by other nutrients by interaction between nutrients. For instant, zinc deficiency often occurs due to heavy phosphate application. Manganese deficiency occurs especially due to over liming, heavy phosphate application and excess of iron, copper and zinc in the soil. Copper deficiency is induced by heavy liming and excessive application of nitrogen and phosphate. The yield of crops could be improved with little quantities of micronutrients applied either singly or in mixtures through soil or foliar feeding (Malewar, 2005) [6].

Micronutrient plays many complex roles in plant nutrition and plant production, while most of micronutrients participate in the functioning of number of enzyme systems. There is a considerable variation in the specific function of the micronutrients in plant and microbial growth processes, for example, copper, iron and molybdenum are capable of acting as electron carriers in the enzyme system that bring about oxidation reduction reactions in plants. Such reactions are essential steps in photosynthesis and many other metabolic processes. Zinc and manganese functions in many enzyme systems as bridges to connect the enzyme with the substrate upon which it is meant to act (Raja *et al.*, 2009) [10]. Boron is required for cell division and extension. The sixteen elements have been established to be essential for plant growth and development, in the complete absence of any of which the plant cannot function properly.

Micronutrients play important role in crop production due to their essentiality in plant metabolism and adverse effects that manifest due to their deficiency. Besides affecting plant growth, micronutrients also play a major role in disease resistance in cultivated crop species. Micronutrients can tremendously boost horticultural crop yield and improve quality and post-harvest life of horticultural produce (Raja, 2009) [10]. Foliar spray of micronutrients is the common practice to overcome the micronutrients deficiency in order to improve the fruit quality.

2. Material and Methods

The details of the material used and methods adopted during the course of the present investigation are described in this chapter under appropriate headings and sub headings.

- **Source of micronutrients and inorganic fertilizers**

Micronutrient mixture like Grade-1 and Grade-2 were purchased from market. Inorganic fertilizers like Urea, DAP and Muriate of potash were obtained from the Custard apple Research Station Ambejogai, Dist.-Beed.

Table 2: Source of micronutrients

S. No	Trade/Common Name	Content
1	Green nutria (Grade-1 sulphate)	Fe-2%, Zn-5%, Mn-1%, Cu-0.5%, B-1%
2	Chelmixcombi (Grade-1 Chelated)	Fe-2.5%, Zn-3%, Mn-1%, Cu-1%, Mo- 0.1%, B-0.5%
3	Micnelf MS 32 (Grade-2 sulphate)	Fe-2.5%, Zn-3%, Mn-1%, Cu-1%, Mo- 0.1%, B-0.5%
4	Chelmixcombi (Grade-2 Chelated)	Fe-2.5%, Zn-3%, Mn-1%, Cu-1%, Mo- 0.1%, B-0.5%

Treatment details: The details of treatments are given in Table No. 3

Table 3: Treatment details

Factor	Symbol	Treatment
Factor: A Micronutrient mixture (G)	G_1	Soil application of Grade-1 sulphate @ 250 g/tree
	G_2	Soil application of Grade-1 chelated @ 25 g/tree
	G_3	Foliar application of Grade-2 sulphate @ 30 g/tree
	G_4	Foliar application of Grade-2 chelated @ 7 g/tree
Factor: B Time of application (T)	T_1	Monthly application
	T_2	Bimonthly application
	T_3	Trimonthly application

Table 4: Chemical composition of fertilizers

Organic Manures / Fertilizers	Nutrient contents		
	N (%)	P_2O_5 (%)	K_2O (%)
Urea	46	-	-
Single Super Phosphate	-	16	-

Muriate of Potash	-	-	60
Farm Yard Manure	0.75	0.20	0.50

3. Results and Discussion

The data on various parameters were recorded during the investigation and statistically analysed and results are presented in this chapter under appropriate headings and subheadings.

3.1. Vegetative Growth Parameter

3.1.1. Height of Plant (cm)

The data related to the different treatments of micronutrient mixture and time of application increased the height of plant and data is presented in Table-5 and graphically represented in figure number 2.The average height of plant recorded was 41.03 cm.

Micronutrient Mixture Grade (G)

The application of micronutrient mixture significantly increased the height of plant. The treatment G_4 (Grade4-chelate by foliar application) recorded highest height of plant i.e. 44.58 cm, followed by G_3 (Grade-3 sulphate by foliar application) i.e. 42.89 cm. The lowest height of plant recorded was in G_2 (Grade-2chelate by soil application) i.e. 37.46 cm.

Time of Application (T)

The time of application significantly increased the height of plant. The treatment T_1 (monthly application) recorded maximum height of plant i.e. 46.02 cm followed by T_2 (bimonthly application) i.e. 41.99 m. The treatment T_3 (tri monthly application) recorded lowest height of plant i.e. 35.06 cm.

Interaction (G x T)

The data pertaining to the interaction of micronutrient mixture and time of application significantly increased the height of plant. The data presented in Table-5. The treatment combination G_4T_1 (Grade-4 chelate monthly foliar application, monthly) recorded highest plant height i.e. 52.25 cm, followed by treatment combination G_4T_2 (Grade-4 chelate by foliar application, bimonthly) i.e. 48.70 cm. The lowest height of plant was recorded in treatment combination G_2T_3 (Grade-2 chelate by soil application, tri monthly) i.e. 30.65 cm.

3.1.2 Plant spread (cm)

The different treatments of micronutrient mixture and time of application increased the plant spread and data is presented in Table-5.The average increase in plant spread was recorded east-west 38.85 cm and north-south 37.91 cm.

Micronutrient mixture Grade (G)

The application of micronutrient mixture significantly increased the plant spread. The treatment G_4 (Grade4-chelate by foliar application) recorded highest increase in plant spread i.e. east-west 42.78 cm and north-south 41.02 cm followed by G_3 (Grade-3 sulphate by foliar application) i.e. east-west 40.47 cm and north-south 39.99 cm. The lowest plant spread recorded in G_2 (Grade-2 chelate by soil application) was east-west 35.41 cm and north-south 35.75 cm.

Time of Application (T)

The time of application significantly increased the plant spread. The treatment T_1(monthly application) recorded maximum plant spread i.e. east-west 43.47 cm and north south 44.01 cm followed by T_2 (bimonthly application) i.e. east-west 40.31 cm and north-south 39.94 cm. The treatment T_3 (tri monthly application) recorded lowest plant spread i.e. east-west 32.76 cm and 29.76 cm.

Interaction (G x T)

The data pertaining to the interaction of micronutrient mixture and time of application significantly increased the plant spread. The data is presented in Table-5. The treatment combination G_4T_1 (Grade-4chelate monthly foliar application, monthly) recorded highest plant spread i.e. east-west 50.08 cm and north-south 49.68 cm, followed by treatment combination G_4T_2 (Grade-4chelate monthly foliar application, bimonthly) i.e. east-west 47.80 cm and north-south 47.73 cm. The lowest increase in the plant spread was recorded in treatment combination G_2T_3 (Grade-2 chelate by soil application, tri monthly) i.e. east-west 28.65 cm and north-south 22.45 cm.

Table 5: Effect of different grades of micronutrients mixture, time of application and their interaction on plant height and plant spread.

Factor/Treatment	Increase in plant height (cm)	Increase in plant spread	
		East-West (cm)	North-South (cm)
Factor A : Micronutrient mixture Grade (G)			
G_1	39.16	36.79	36.85
G_2	37.46	35.41	33.75
G_3	42.89	40.47	39.99
G_4	44.58	42.72	41.02
SE+	0.25	0.58	0.53
CD at 5%	0.75	1.70	1.54
Factor B : Times of Application (T)			
T_1	46.02	43.47	44.01
T_2	41.99	40.31	39.94
T_3	35.06	32.76	29.76
SE+	0.22	0.50	0.46
CD at 5%	0.65	1.47	1.33
Interaction (G x T)			
G_1T_1	39.64	36.85	37.56
G_1T_2	35.66	33.67	32.17
G_1T_3	42.18	39.85	40.85
G_2T_1	44.08	41.42	43.32

G_2T_2	37.67	36.15	35.50
G_2T_3	30.65	28.65	22.45
G_3T_1	48.12	45.53	45.52
G_3T_2	45.93	43.62	44.38
G_3T_3	34.63	32.26	30.10
G_4T_1	52.25	50.08	49.68
G_4T_2	48.70	47.80	47.73
G_4T_3	32.81	30.26	25.67
Mean	41.03	38.85	37.91
SE+	0.44	1.00	0.91
CD at 5%	1.30	2.94	2.67
Micronutrient Mixture Grades (G) G_1- Grade-1 Sulphate (Soil) G_2- Grade-2 Chelated (Soil) G_3- Grade-3 Sulphate (Foliar) G_4- Grade-4 Chelated (Foliar)		Times of Application (T) T_1- Monthly T_2- Bimonthly T_3- Tri monthly	

3.1.3 Stem girth (cm)

The data related to the different treatments of micronutrient mixture and time of application increased the stem girth and data is presented in Table-6. The average increase in stem girth was recorded 5.25 cm.

Micronutrient Mixture Grade (G)

The application of micronutrient mixture significantly increased the stem girth. The treatment G_4 (Grade4-chelate by foliar application) recorded highest increase in stem girth i.e. 5.58 cm followed by G_3 (Grade-3 sulphate by foliar application) i.e. 5.45 cm. The lowest plant spread recorded in G_2 (Grade-2chelate by soil application) was 4.97 cm.

Time of Application (T)

The time of application significantly increased the stem girth. The treatment T_1 (monthly application) recorded maximum stem girth i.e. 5.74 cm followed by T_2 (bimonthly application) i.e. 5.54 cm. The treatment T_3 (tri monthly application) recorded lowest stem girth 4.46 cm.

Interaction (G x T)

The data pertaining to the interaction of micronutrient mixture and time of application significantly increased the stem girth. The data is presented in Table-6. The treatment combination G_4T_1 (Grade-4chelate monthly foliar application) recorded highest stem girth i.e. 6.47 cm, followed by treatment combination (Grade-3sulphate foliar application, bimonthly) G_3T_2 i.e. 6.17 cm. The lowest increase in the plant spread was recorded in treatment combination G_4T_3 (Grade-4 chelate by foliar application, tri monthly) i.e. 4.13 cm.

3.1.4 Plant volume (m^3)

The data related to the different treatments of micronutrient mixture and time of application increased the plant volume and data is presented in Table-6.The average increase in plant volume was recorded 11.60 cm.

Micronutrient mixture Grade (G)

The application of micronutrient mixture significantly increased the plant volume. The treatment G_4 (Grade4-chelate by foliar application) recorded highest increase in plant volume i.e. 12.21 cm followed by G_3 (Grade-3 sulphate by foliar application) i.e. 11.96 cm. The lowest plant volume recorded in G_2 (Grade-2chelate by soil application) was 10.76 cm.

Time of application (T)

The time of application significantly increased the plant volume. The treatment T_1 (monthly application) recorded maximum plant volume i.e. 12.22 cm followed by T_2 (bimonthly application) i.e. 11.81 cm. The treatment T_3 (tri monthly application) recorded lowest plant spread i.e. 10.76 cm.

Interaction (G x T)

The data pertaining to the interaction of micronutrient mixture and time of application significantly increased the plant volume. The data is presented in Table-6. The treatment combination G_4T_1 (Grade-4chelate foliar application, monthly) recorded highest plant volume i.e. 13.23 cm, followed by treatment combination G_4T_2 (Grade-4chelate foliar application, bimonthly) i.e. 13.13 cm. The lowest increase in the plant volume was recorded in treatment combination G_2T_3 (Grade-2 chelate by soil application, tri monthly) i.e. 9.50 cm.

Table 6: Effect of different grades of micronutrients mixture, time of application and their interaction on stem girth and plant volume.

Factor/Treatment	Increase in stem girth (cm)	Increase in plant volume (m^3)
Factor A : Micronutrient mixture Grade (G)		
G_1	4.98	11.44
G_2	4.97	10.76
G_3	5.45	11.96
G_4	5.58	12.21
SE+	0.13	0.27
CD at 5%	0.39	0.82
Factor B : Times of Application (T)		
T_1	5.74	12.22
T_2	5.54	11.81
T_3	4.46	10.76
SE+	0.11	0.24
CD at 5%	0.33	0.70
Interaction (G x T)		

G_1T_1	4.98	11.55
G_1T_2	4.63	10.78
G_1T_3	5.33	12.00
G_2T_1	5.50	11.65
G_2T_2	5.23	11.13
G_2T_3	4.18	9.50
G_3T_1	6.00	12.45
G_3T_2	6.17	12.17
G_3T_3	4.17	11.27
G_4T_1	6.47	13.23
G_4T_2	6.13	13.13
G_4T_3	4.13	10.27
Mean	5.25	11.60
SE±	0.22	0.48
CD at 5%	0.66	1.41
Micronutrient Mixture Grades (G) G_1- Grade-1 Sulphate (Soil) G_2- Grade-2 Chelated (Soil) G_3- Grade-3 Sulphate (Foliar) G_4- Grade-4 Chelated (Foliar)		Times of Application (T) T_1- Monthly T_2- Bimonthly T_3- Tri monthly

3.2 Reproductive Growth Parameter

3.2.1 Days required for flowering

The different treatments of micronutrient mixture and time of application greatly influenced the days required for flowering. The data pertaining to days required for flowering are presented in Table-7. The average days required to flowering recorded were 159.94 days.

Micronutrient Mixture Grade (G)

The application of micronutrient mixture significantly affected the days for flowering. The treatment G_3 (Grade-3 sulphate by foliar application) recorded minimum days for flowering i.e. 157.17 days, followed by G_4 (Grade-4 chelate by foliar application) i.e. 158.00 days. The highest days for flowering were recorded in G_2 (Grade-2 chelate by soil application) i.e.162.94 days.

Time of Application (T)

The time of application significantly influenced the days for flowering. The treatment T_1 (monthly application) recorded minimum days for flowering i.e. 154.33 days, followed by T_2 (bimonthly application) i.e. 159.04 days. The treatment T_3 (tri monthly application) has recorded highest days for flowering i.e. 166.46 days.

Interaction (G x T)

The interaction of micronutrient mixture and time of application significantly influenced the days for flowering. The data is presented in Table-7. The treatment combination G_4T_1 (Grade-4 chelated by foliar application, monthly) recorded lowest days for flowering i.e. 150.17 days, followed by G_4T_2 (Grade-4 chelated by foliar application, bimonthly) i.e. 152.67 days. The highest days for flowering recorded were 171.50 days in treatment combination G_2T_3 (Grade-2 sulphate by foliar application, tri monthly).

3.2.2 Days required for fruit set

The different treatments of micronutrient mixture and time of application greatly influenced the days required for fruit set. The data pertaining to days required for fruit set are presented in Table-7. The average days required to fruit set recorded were 13.09.

Micronutrient Mixture Grade (G)

The application of micronutrient mixture significantly affected the days for fruit set. The treatment G_4 (Grade-4 chelate by foliar application) recorded minimum days for fruit set i.e. 11.17, followed by G_3 (Grade-3sulphate by foliar application) i.e. 13.65 days. The highest days for fruit set were recorded in G_2 (Grade-2 chelate by soil application) i.e. 13.82.

Time of Application (T)

The time of application significantly influenced the days for fruit set. The treatment T_1 (monthly application) recorded minimum days for fruit set i.e. 12.49 d, followed by T_2 (bimonthly application) i.e. 12.89. The treatment T_3 (tri monthly application) has recorded highest days for fruit set i.e. 13.88.

Interaction (G x T)

The interaction of micronutrient mixture and time of application non-significantly influenced the days for fruit set. The data is presented in Table-7. The treatment combination G_4T_1 (Grade-4 chelated by foliar application, monthly) recorded lowest days for fruit set i.e. 10.67, followed by G_4T_2 (Grade-4 chelated by foliar application, bimonthly) i.e. 11.00. The highest days for fruit set recorded were 14.93 in treatment combination G_3T_3 (Grade-3 sulphate by foliar application, tri monthly).

3.2.3 Days required for fruit maturity

The different treatments of micronutrient mixture and time of application greatly influenced the days required for fruit maturity. The data pertaining to days required for fruit maturity are presented in Table-7. The average days required to fruit maturity recorded were 116.08.

Micronutrient Mixture Grade (G)

The application of micronutrient mixture significantly affected the days for fruit maturity. The treatment G_4 (Grade-4 chelate by foliar application) recorded minimum days for fruit maturity i.e. 108.11, followed by G_3 (Grade-3 sulphate by foliar application) i.e. 115.44. The highest days for fruit maturity were recorded in G_2 (Grade-2 chelate by soil application) i.e. 120.67.

Time of Application (T)

The time of application significantly influenced the days for fruit maturity. The treatment T_1 (monthly application) recorded minimum days for fruit maturity i.e. 110.42, followed by T_2 (bimonthly application) i.e. 114.83. The

treatment T_3 (tri monthly application) has recorded highest days for fruit maturity i.e. 123.00.

Interaction (G x T)

The interaction of micronutrient mixture and time of application significantly influenced the days for fruit maturity. The data is presented in Table-7. The treatment combination G_4T_1 (Grade-4 chelated by foliar application, monthly) recorded lowest days for fruit maturity i.e. 101.00, followed by G_4T_2 (Grade-4 chelated by foliar application, bimonthly) i.e. 104.00 days. The highest days for fruit maturity recorded were 128.67 in treatment combination G_2T_3 (Grade-2 chelate by soil application, tri monthly).

Table 7: Effect of different grades of micronutrients mixture, time of application and their interaction on days required for flowering, days required for fruit set and days required for fruit maturity.

Factor/Treatment	Days required for flowering	Days required for fruit set	Days required for fruit maturity
Factor A : Micronutrient mixture Grade (G)			
G_1	161.67	13.71	120.11
G_2	162.94	13.82	120.67
G_3	157.17	13.65	115.44
G_4	158.00	11.17	108.11
SE+	1.10	0.30	0.89
CD at 5%	3.20	0.88	2.62
Factor B : Times of Application (T)			
T_1	154.33	12.49	110.42
T_2	159.04	12.89	114.83
T_3	166.46	13.88	123.00
SE+	0.95	0.26	0.78
CD at 5%	2.77	0.76	2.27
Interaction (G x T)			
G_1T_1	160.67	13.33	120.00
G_1T_2	165.67	13.90	122.00
G_1T_3	158.67	13.90	118.33
G_2T_1	153.50	13.13	113.00
G_2T_2	163.83	13.50	120.33
G_2T_3	171.50	14.83	128.67
G_3T_1	153.00	12.83	107.67
G_3T_2	154.00	13.17	113.00
G_3T_3	164.50	14.93	125.67
G_4T_1	150.17	10.67	101.00
G_4T_2	152.67	11.00	104.00
G_4T_3	171.17	11.83	119.33
Mean	159.94	13.09	116.08
SE+	1.89	0.52	1.55
CD at 5%	5.54	1.52	4.53
Micronutrient Mixture Grades (G) G_1- Grade-1 Sulphate (Soil) G_2- Grade-2 Chelated (Soil) G_3- Grade-3 Sulphate (Foliar) G_4- Grade-4 Chelated (Foliar)		Times of Application (T) T_1- Monthly T_2- Bimonthly T_3- Tri monthly	

3.2.4 Number of flowers/m^3

The different treatments of micronutrient mixture and time of application non-significantly increased number of flowers per meter cube. The data related to number of flowers per meter cube are presented in Table-8. The average number of flowers per meter cube was 16.36.

Micronutrient Mixture Grade (G)

The effect of application of micronutrient mixture was significant in respect of number of flowers per meter cube. The treatment G_4 (Grade-4 chelated by foliar application) recorded maximum number of flowers per meter cube i.e.19.11, followed by G_3 (Grade-3 sulphate by foliar application) i.e.18.00. The minimum number of flowers per meter cube were recorded in G_2 (Grade-2 chelate by soil application) i.e.13.33.

Time of Application (T)

The time of application has significantly increased the number of flowers per meter cube. The treatment T_1 (monthly application) recorded maximum number of flowers per meter cube i.e.19.50 followed by T_2 (monthly application) i.e. 16.83. The treatment T_3 (tri monthly application) recorded minimum number of flowers per meter cube i.e. 12.75.

Interaction (G x T)

The result about interaction of micronutrient mixture and time of application significantly influenced the number of flowers per meter cube are presented in Table-8. The treatment combination G_4T_1 (Grade-4 chelated by foliar application, monthly) recorded maximum number of flowers per meter cube i.e. 24.67 followed by G_3T_1 (Grade-3sulphated by foliar application, monthly) i.e. 21.33. The minimum number of flowers per meter cube were recorded in treatment combination G_2T_3 (Grade-2 chelate by soil application, tri monthly) i.e. 10.00.

3.2.5 Number of fruits/m^3

The different treatments of micronutrient mixture and time of application non-significantly increased number of fruits per meter cube. The data related to number of fruits per meter

cube are presented in Table-8. The average number of fruits per meter cube was 12.22.

Micronutrient mixture Grade (G)
The effect of application of micronutrient mixture was significant in respect to number of fruits per meter cube. The treatment G_4 (Grade-4 chelated by foliar application) recorded maximum number of fruits per meter cube i.e.14.77, followed by G_3 (Grade-3 sulphate by foliar application) i.e.13.44. The minimum number of fruits per meter cube were recorded in G_2 (Grade-2 chelate by soil application) i.e.9.5.

Time of Application (T)
The time of application has significant increased the number of fruits/m^3. The treatment T_1 (monthly application) recorded maximum number of fruits per meter cube i.e.15.16 followed by T_2 (bimonthly application) i.e. 12.83. The treatment T_3 (trimonthly application) recorded minimum number of fruits per meter cube i.e. 8.66.

Interaction (G x T)
The result about interaction of micronutrient mixture and time of application significantly influenced the number of fruits per meter cube are presented in Table-8. The treatment combination G_4T_1 (Grade-4 chelated by foliar application, monthly) recorded maximum number of fruits per meter cube i.e. 20.33 followed by G_4T_2 (Grade-4 chelated by foliar application, bimonthly) i.e. 17. The minimum number of fruits per meter cube were recorded in treatment combination G_4T_3 (Grade-4 chelate by foliar application, tri monthly) i.e.7.00.

3.2.6 Fruit set (%)
The data related to the different treatments of micronutrient mixture and time of application significantly influenced the fruit set percentage and it is presented in Table-8. The average final fruit set percentage recorded was 73.17%.

Micronutrient Mixture Grade (G)
The micronutrient mixture application non-significantly increased the final fruit set percentage. The treatment G_1 (Grade-1 sulphate by soil application) and G_4 (Grade-4 chelated by foliar application) recorded maximum final fruit set i.e. 74.55% each, followed by G_3 (Grade-3 sulphate by foliar application) i.e. 73.44%. The minimum fruit set was recorded in G_2 (Grade-2 chelated by soil application) i.e. 70.11%.

Time of Application (T)
The time of application has significantly increased the final fruit set percentage. The treatment T_1 (monthly application) recorded maximum final fruit set i.e. 77.33%, followed by T_2 (bimonthly application) i.e.75.05%. The treatment T_3 (tri-monthly application) recorded lowest final fruit set percentage i.e. 67.11%.

Interaction (G x T)
The interaction of micronutrient mixture and time of application significantly influenced the fruit set per cent are presented in Table-8. The treatment combination G_4T_1 (Grade-4 chelate by foliar application, monthly) recorded maximum final fruit set i.e. 82.47%. The treatment combinations G_4T_1 was followed by treatment combination G_4T_2 (Grade-4 chelate by foliar application, bimonthly) i.e. 80.92%. The minimum fruit set percentage was recorded with treatment combination G_4T_3 (Grade-2 chelate by foliar application, tri monthly) i.e. 60.26%.

Table 8: Effect of different grades of micronutrients mixture, time of application and their interaction on number of flowers/m^3, number of fruits/m^3 and fruit set (%)

Factor/Treatment	Number of flowers/m^3	Number of fruits/m^3	Fruit set (%)
Factor A : Micronutrient mixture Grade (G)			
G_1	15.00	11.22	74.55
G_2	13.33	9.5	70.11
G_3	18.00	13.44	73.44
G_4	19.11	14.77	74.55
SE±	0.90	0.71	1.89
CD at 5%	2.64	2.10	5.52
Factor B : Times of Application (T)			
T_1	19.50	15.16	77.33
T_2	16.83	12.83	75.05
T_3	12.75	8.66	67.11
SE±	0.78	0.62	1.63
CD at 5%	2.29	1.82	4.78
Interaction (G x T)			
G_1T_1	15.67	12.00	76.53
G_1T_2	12.67	9.00	71.15
G_1T_3	16.67	12.67	75.98
G_2T_1	16.33	12.00	73.94
G_2T_2	13.67	9.67	69.72
G_2T_3	10.00	6.67	66.67
G_3T_1	21.33	16.33	76.39
G_3T_2	20.00	15.67	78.40
G_3T_3	12.67	8.33	65.54
G_4T_1	24.67	20.33	82.47
G_4T_2	21.00	17.00	80.92
G_4T_3	11.67	7.00	60.26
Mean	16.36	12.22	73.17
SE±	1.56	1.24	3.27
CD at 5%	4.57	3.65	9.57
Micronutrient Mixture Grades (G)		Times of Application (T)	

G_1- Grade-1 Sulphate (Soil) G_2- Grade-2 Chelated (Soil) G_3- Grade-3 Sulphate (Foliar) G_4- Grade-4 Chelated (Foliar)	T_1- Monthly T_2- Bimonthly T_3- Tri monthly

4. References

1. Babu KD, Yadav DS. Foliar spray of micronutrients for yield and quality improvement in Khasi mandarin (Citrus reticulate Blanco.). Indian Hort. J. 2005; 62:280-281.
2. FAO. Utilization of tropical fruits and leaves. FAO, Food and Nutrition Paper. 1990; 47(7):10-14.
3. Katyal JC. Role of micronutrients in ensuring optimum use of macronutrients. IFA International Symposium on Micronutrients, New Delhi, India. 2004, 3-17.
4. Kowlska MT, Putt D. Potential Biomedical application for tropical fruit product, tropical garden fruit world. 1990; 1(4):126-127.
5. Leal F. Sugar apple in: fruits of tropical and subtropical origin, composition, properties and uses. Edited by S. Nagy, Shaw, P. E. and Worpowasi, W. F., Florida Science., inc. Lake, alfede Fla., 1990, 149-158.
6. Malewar GU. Micronutrient stresses in soil and crops: Serious sickness and clinical approaches for sustainable agriculture. J Indian Soc. Soil Sci. 2005; 53(4):484-489.
7. Navaneethakrishnan K, Nattar S. Custard apple. Kisan world, 2011, 15-19.
8. Naidu. Sactor, Fruit culture in India, I.O.A.R., New Delhi. 1954, 225-259.
9. Papenoe W. Manual of tropical and sub-tropical fruits. MacMillan Pub. Co. Inc. New York, 1974, 334-352.
10. Raja EM. Importance of Micro-nutrients in the changing horticultural sceinario. Indian Journal of Hort Sci. 2009; 4:1-27.
11. Rawat V, Tomar YK, Rawat JMS. Influence of foliar application of micronutrients on the fruit quality of guava cv. Lucknow-49. Journal of Hill Agriculture. 2010; I(I):63-66.
12. Rajput RS, Shigh AR, Pande NC. Role of potas and zinc on the biochemical parameters of Kagzi lime. JI Hort. Sci. 1991; 18:41-50.
13. Srivastava AK, Shyam S, Diware VS, Hamandeep S. Site-specific nutri-11, 2009.