Original Research Article

Influence of interaction between fertilizer and micronutrient spray on growth, yieldand quality of guava under ultra high density orcharding system.

Abstract

A field experiment was conducted for two consecutive years (2012-2013 and 2013-2014) on 5-year-old guava orchard of cv. Sardar was planted at a spacing of 1.0 m x 2.0 m in Ranchi. The objective of this investigation was to know the influence of interaction between the basal and foliar application of fertilizers of guava cv. Sardar under ultra-high-density planting system in eastern plateau and hill conditions. The experiments were set up in a split-plot design with four fertilizer doses 100%NPK i.e.580 g N, 270 g P, 400g K/plant; 60%NPK i.e. 348gN, 162gP, 240g K/plant; 40%NPK i.e. 232gN,180gP 160g K/plant; 20%NPK i.e.116gN 54gP 80g K/plant as main plots and four different foliar sprays as boric acid(0.4%), zinc sulphate (0.2%),boric acid(0.4%)+ zinc sulphate(0.2%) and water spray as subplots with four replications. The NPK fertilizer dose was applied at an interval of every two months from June 12 to April 14 (Total of twelve times/ two year) in a 1m radius around the tree trunk (drip line of trees). The foliar application of micronutrients was sprayed at the rate 750 ml/ tree at flowering and fruit set stage during June 12 and August 14 (Total of Four times/ two years).In our two year study, the experimental results clearly indicated that 60% NPK fertilizer dose resulted in maximum trunk girth (55.33mm) and girth of primary branches (43.77mm), while, maximum per cent increase in trunk girth(15.81%) and girth of primary branches(18.62%) were recorded in 100% NPK fertilizer dose. However the maximum number of flower per plant (18.66), number of fruit per plant (17.10) and fruit weight/ plant (3.65kg/plant) recorded in 100%NPK fertilizer dose, which was at par with 60% NPK Fertilizer dose.

Keywords:- Interaction between fertilizer doses and micronutrients spray, growth, yield and quality.

Introduction

Guava (*Psidium guajava* Linn.*)*, the most common fruit of tropical and sub-tropical areas originated from tropical America belongs to family Myrtaceae, also known as "apple of tropics". It is considered as poor man's apple due to cheapness and high nutritive value in addition to its availability in the market. This is a properly diagnosed reality that will prolong in productiveness of fruit receives uproot of large parts of essential minerals from the soil. Without tolerable management,regular fruit production shortens nutrient reserves in the soil. Another difficulty of greatest notch challenge is the sustainability of soil productivity, as land started out to be intensively exhausted to produce extended yields. Overtime, aggregate reduction decreases fruit production, yield and soil fertility and lead to soil degradation.

Standardization of nutrient management strategy refers to maintenance of soil fertility and plant nutrient supply to optimum level for sustaining the desired crop productivity through optimization of the benefits from all possible sources of plant nutrients. Practices that enhance fertilizer utilization efficiency include appropriate timing of fertilizer application, formulation of fertilizer material, amount and rate of fertilizer applied, and methods used to apply fertilizers. The nutrient requirement of guava differs from region to region due to soil support system, which imparts desired changes in growth and flushing in a set of climatic condition. The amount of fertilizer, method of application and timing are all important. Guava crop is very responsive to the application of inorganic fertilizers,(Shanker,1966). Singh and Singh (1970) reported that fertilization of guava plants not only increased the fruit yield but also improved the fruit quality. Singh and Singh (2007) emphasized the importance of nutrition in guava for better fruit production. The critical examination of these trial and examination of growth curve indicated that 583g of N/plant, 271g of P/plant and 400g of K/plant are optimum for guava. Jose et al. (2007) conducted a trial to assess the different fertilizer amounts on four year -old guava variety Paluma under micro irrigation system with 6m x 5m spacing, under tropical semi-arid climate in Brazil. Application of 600g of nitrogen and 300g of potassium resulted in 7.5 tonnes / ha yield of crop and average fruit weight of 200g. Increasing the fertilizer amount resulted in reduced fruit weight and increase in number of fruits per plant. Due to deficiency of single element Phosphorus, plant can not their life cycle hence phosphorus is called " Key to life" or life of plant and acts as energy currency due to being a constituents of ATP and ADP. Phosphorus stimulates root formation particularly lateral roots. Potassium (K) regulates several enzyme functions, plant water relations, electrochemical equilibrium of cells, and carbohydrate transport of vascular plants (Marschner, 1995). In addition, K plays an important role in maintenance of cell turgor and extensibility that affects fruit size. Since K is highly mobile in plants, it is found in high concentrations in growing parts including leaves, flowers and fruits. Potassium is highly mobile in plants at all levels, that is from individual cell to xylem and phloem transport. This cation plays a major role in enzyme activation, protein synthesis, stomatal function, stabilization of internal pH, photosynthesis, turgor related processes and transport of metabolites (A.K . Alva et al.,2006).*Depending* on the enzyme, Fe, Mn, Zn, Cu, Ni, Mo, and Cl all take part in the functioning of one of a kind enzymes, along with DNA/RNA polymerases, N-metabolizing enzymes, superoxide dismutases, catalases, dehydrogenases, oxidases, ATPases and several other enzymes concerned *with* redox procedures (Broadley et al., 2012). Micro-nutrients such as boron, zinc are essential for different biological functions that attributed to tree yield and fruit quality (Shoeib, 2003). Soil applications are not very effective because the roots of fruit crops occupy deep soil layers and zinc does not easily move in the soil, therefore, foliar sprays are more effective (Chandler et al., 1931). Boron is a necessary *micronutrient* required for accurate great and high yield of plant Produce (Dale and Krystyna, 1998, Mahmoud M. Shaaban 2010).

Present study was under taken to see the standardization of basal and foliar application of nutrients in guava under UHDP system. Plants impose differential nutrient demand depending upon the sink strength, in form of fruits and newly emerging vegetative growth, which eventually dictate the nutrient requirement. Knowing the required nutrients for all stages of growth, and understanding the soil's ability to supply those needed nutrients are critical for profitable crop production. Such studies are particularly significant in Eastern plateau region of Jharkhand having predominantly acidic andpoor soil fertility coupled with low water holding capacity of soil of guava orchards.Therefore, the present investigation was undertaken during 2012-2014.

Materials and methods

In order to enhance the growth and yield of ultra high density guava orchard, an investigation was undertaken at ICAR, Research Complex for Eastern Region, Research Centre Complex for Eastern Region, Research Centre, Ranchi during 2012-2013 and 2013-2014. The average rainfall is around 1400 mm occurring in the months of June to October. The place is situated between $23^0 19'$ North latitude and $85^0 19'$ East longitude and located at a height of 625 m above the mean sea level. It falls in sub-humid, sub-tropical climate zone. In the present investigation, five year old guava orchard of cultivar 'Sardar' planted at distance of 1m x 2m. Data were recorded on trunk girth, girth of primary branches, percent increases in trunk girth and girth of primary branches, number of flower and fruit, fruit yield per plant in different season at two months intervals. Trunk girth and girth of primary branches was observed of veneers capillaries at two months intervals during both the years of experimentation. The value of trunk girth and girth of primary branches was expressed in mm. Fruit yield per plant was measured with the help of physical balance at the time of harvesting. Five fruits per experimental plant were taken randomly and their quality parameters (total soluble solids, acidity, ascorbic acid). The fruit quality parameters were calculated as fresh weight basis of fruits. Total soluble solids (TSS) of ripe fruits was estimated by Digital model pocket refractometer of 0 to 53% range at 20 ^{0}c. Titratable acidity was determined for the composite consisting of 5ml fruit juice and 20ml distilled water by titrating to an end point of pH 8.1 with 0.1N NaOH and using phenolphthalein indicator. The titratable acidity results represented citric acid content expressed as a percentage. (A.O.A.C.,1990). The ascorbic acid of guava fruit was determined by diluting the known volume of juice with 3% metaphosphoric acid and titrating with 2,6 dichlorophenol indophenols dye solution. The result was expressed as mg of ascorbic acid per 100g of fruit juice (A.O.A.C.,1990). Irrigation water use efficiency was calculated as the ratio between total produced yield and total supplied water volume.

The experiment was laid out in split plot design (SPD) with four replications, considering twelve plants as treatment unit, four fertilizer doses 100%NPK i.e.580 g N, 270 g P, 400g K/plant; 60%NPK i.e. 348gN, 162gP, 240g K/plant; 40%NPK i.e. 232gN,180gP 160g K/plant; 20%NPK

i.e.116gN 54gP 80g K/plant as main plots and four different foliar sprays as boric acid(0.4%), zinc sulphate (0.2%),boric acid(0.4%)+ zinc sulphate(0.2%) and water spray as sub plots . Total treatment combinations were sixteen viz. T_1-(100%NPK+ boric acid(0.4%)) , T_2-(100% NPK+ zinc sulphate (0.2%)), T_3-(100% NPK+ boric acid(0.4) + zinc sulphate (0.2%)), T_4-(100% NPK+ water sprays), T_5-(60%NPK+ boric acid(0.4%)) , T_6-(60% NPK+ zinc sulphate (0.2%)), T_7-(60% NPK+ boric acid(0.4) + zinc sulphate (0.2%)), T_8-(60% NPK+ water sprays), T_9-(40%NPK+ boric acid(0.4%)) , T_{10}-(40% NPK+ zinc sulphate (0.2%)), T_{11}-(40% NPK+ boric acid(0.4) + zinc sulphate (0.2%)), T_{12}-(40% NPK+ water sprays), T_{13}-(20%NPK+ boric acid(0.4%)) , T_{14}-(20% NPK+ zinc sulphate (0.2%)), T_{15}-(20% NPK+ boric acid(0.4) + zinc sulphate (0.2%)), T_{16}-(20% NPK+ water sprays). Data were subjected to analysis of variance.

Results

Trunk girth(mm) of plant:

During August, 2012, the treatments did not differ significantly with respect to their effects on trunk girth (Table- 1, fig.1a). Among the interaction effects, the maximum trunk girth was recorded with F2M2 (57.24 mm) whereas, the minimum value was recorded in case of F4M3 (45.36 mm). During December, 2013, interaction between fertilizer doses and foliar application resulted in significant variation in the trunk girth while, individual effects of fertilizer doses and foliar applications were non-significant. The treatment F2M2 resulted in the maximum trunk girth (58.15 mm) whereas, the minimum trunk girth was recorded in case of F4M3 (46.87 mm). During February and April, 2014, significant effects of the treatments could not be observed on trunk girth.

Girth of primary branches of guava plant:

Data pertaining to girth of primary branches of guava as influenced by fertilizers and foliar spray are presented in the Table 2 and (Fig.2a). The treatmental effects remained non-significant till February 2013. During April, 2013, the interaction effect between fertilizer doses and foliar application was found to be significant. The maximum girth of primary branches was recorded in case of F2M2 (39.79 mm) which was at par with F4M1, F3M2 and F1M3. During June, 2013 also, the interaction effect between fertilizer doses and foliar application was found to be significant and the maximum girth of primary branches was recorded in case of F2M2 (40.85 mm) which was at par with F3M2 and F1M3. Similarly, during August, 2013, the maximum girth of primary branch was recorded in case of F2M2 (42.12 mm) which was at par with F3M2 and F1M3. During October, 2013, the maximum value was found in F2M2 also (43.41mm) which was at par with F3M2 and F1M3. During December,2013, the maximum value was recorded in case of F2M2 (44.97 mm) which was at par with F3M2 and F1M3. During February, 2014, the maximum value as also recorded in case of F2M2 (46.14 mm) which was at par with F3M2 and F1M3.During April 2014, the maximum girth of primary branch was recorded in case of F2M2 (47.37 mm) which was at par with F3M2 and F1M3.

Per cent increase in trunk girth of guava plant:

Data on per cent increase in trunk girth of guava plant is presented in Table 3(fig.3a). As evident from table, the different treatments did not show any marked variation in per cent increase in trunk girth. During the whole experimentation period non- significant effects of interaction between fertilizer and micronutrient spray**.**

Percent increase in girth of primary branches of guava plant:

Data presented in Table- 4 (fig.4a). Showed that the different foliar sprays and interaction effects did not differ significantly for per cent increase in girth of primary branches during experimental period.

Number of flowers per plant:

Data pertaining to number of flowers per plant during the experimentation as influenced by fertilizer doses and foliar spray are presented in the Table 5(Fig.5a)The interaction effect was also not significant except during the May-2013 and December-2013. In the month of May, 2013, interaction of 100% NPK + foliar spray of boric acid (0.4%) + zinc sulphate (0.2%) produced maximum number of flower (32.80) followed by 100% NPK + foliar spray of boric acid (0.4%). During the December, 2013 the combination of 100% NPK + foliar spray of boric acid (0.4%) + zinc sulphate (0.2%) also produced maximum number of flower (22.60) but found at par with 60% NPK + foliar spray of boric acid (0.4%).

Number of fruit per plant:

A perusal of data presented in Table -6 revealed that the number of fruits per plant. The interaction effect was also significant during August, 2013 and February, 2014 only The application of 100% NPK dose along with the foliar spray of boric acid (0.4%) + zinc sulphate (0.2%) showed significantly maximum number of fruits per plant (30.84) during August, 2013 and remained at par with the application of 100% NPK dose along with the foliar spray of boric acid (0.4%) (30.74) followed by 60% NPK dose along with the foliar spray of zinc sulphate (0.2%) treatment combination. However, during February, 2014 also, the treatment combination comprising of 100% NPK dose along with the foliar spray of boric acid (0.4%) + zinc sulphate (0.2%) showed significantly maximum number of fruits per plant (21.04), which was at par with 60% NPK dose along with the foliar spray of boric acid (0.4%) + zinc sulphate (0.2%) (18.62). The average Number of fruits per plant during *mrig*and *hast bahar*(2013-14) were found significantly higher (86.40) with the application of 100% NPK dose along with the foliar spray of boric acid (0.4%) and was statistically similar with the application of 100% NPK dose along with the foliar spray of boric acid (0.4%) + zinc sulphate (0.2%) *i.e.* (83.27).

Fruit yield (kg/plant):

Data on fruit yield per plant are presented in Table- 7 and illustrated in Fig. 7a. With respect to theinteraction effect was also not significant except during the August-2013 and February-2014. In the month of August - 2013, interaction of 100% NPK + foliar spray of boric acid (0.4%) + zinc sulphate (0.2%) produced maximum yield of fruit (3.48 kg/plant) followed by 100% NPK + foliar spray of boric acid @0.4%

(3.22 kg/plant). During the February, 2014 the combination of 100% NPK + foliar spray of boric acid (0.4%) + zinc sulphate (0.2%) was also produced maximum yield of fruit (4.52 kg/ plant) but was found to be at par with 60% NPK + foliar spray of boric acid (0.4%)+ zinc sulphate (0.2%) (3.97kg/plant).

Total soluble solids (ºBrix)

The interaction effect was not significant throughout the experimental period except during the October-2013 Table- 8 and illustrated in Fig. 8a. In the month of October - 2013, interaction of 100% NPK + foliar spray of boric acid (0.4%) + zinc sulphate (0.2%) resulted in maximum TSS content of fruit (12.45 ^{0}Brix) which was at par with 100% NPK + foliar spray of boric acid @0.4% (12.43^{0}Brix) followed by 100% NPK + foliar spray of zinc sulphate @ 0.2% (10.90^{0}Brix).

Titratable acidity (%)

The data on acidity content in guava cv. Lucknow - 49 have been presented in Table- 9 and illustrated in Fig. 9a. The titratable acidity of guava fruit was not significantly influenced by different fertilizer doses during both the years of experimentation.

Ascorbic acid (mg/100g fruit pulp)

The data with respect to acidity presented in Table -10 and Fig-10a. The interaction effect was also not significant except during October-2013. In the month of October-2013, application of 60% NPK+ foliar spray of boric acid (0.4%) recorded maximum ascorbic acid content of guava fruit (99.36 mg/100g) followed by 100% NPK+ foliar spray of boric acid (0.4%) + zinc sulphate (0.2%).

Discussion

Trunk girth(mm) of plant:

As évident from data individual effects of fertilizer and foliar spray on individual trunk girth of plant were non significant, whereas the interaction between fertilizer and foliar spray was non- significant during First year of experimentation.Among the interaction effects, during October-2013 maximum trunkgirthwasrecordedwith F2M3(57.24mm) however the minimum value wasrecorded in the case of F4M3(45.36mm). During December-2013 the treatment F2M2 resulted in the maximum trunk girth (58.15 mm) whereas, the minimum trunk girth was recorded in

case of F4M3 (46.87 mm).These results corroborated to the findings of Kumar, D. *et al.*(2009) who also reported that application of 600g N, 300g P and 600gK per plant per year resulted maximum stem diameter . Similar findings were also observed by Baksh, H.*et al.* (2008) in guava.Ghosh*et al*.(2012) in pomegranate. Joshi *et al*.(2012)in litichi.

Per cent increase in trunk girth

During both years of experimentation, the treatments did not differ significantly with respect to their effects on percent increased trunk girth. The interaction between fertilizer and foliar spray was also found non-significant except during December 2013.While interaction betweenfertilizer x foliar spray weresignificantlyeffect on girth of primarybarnches. Maximum girth of primary branches was recorded in case of M2S2 resulted in 40.85mm, 42.10mm, 43.41mm, 44.97mm and 47.37mm during Jun-2013, Aug-2013, Oct.-2013, Dec.-2013, Feb-2013 and April-2014 respectively. Result of the present study are in accordance with findings of Shukla et at. (2009) who have also observed the maximum increase in girth of primary branches (9.45cm) with the application of 100% NPK 500:200:500+ Zn (0.5%)+B(0.2%) + Mn (0.1%)as foliar spray twice (August and October) and organic mulching 10 cm thick in guava. Similar patterns were also observed by Goswami *et al.*(2012) and Ramniwas*et al*. (2012) in guava. Joshi *et al*.(2012)in litichi.

Per cent increase in girth of primary branches

Data showed that the different foliar sprays and interaction effects did not differ significantly for per cent increase in girth of primary branches during experimental period.

Number of flowers per plant:

With respect to number of flower significantly influenced by interaction between fertilizer dose and foliar spray. Significant differences could be recorded with foliar spray and interaction between media x foliar spray during the May-2013 and December-2013. During May 2013, interaction of 100% NPK + foliar spray of boric acid (0.4%) + zinc sulphate (0.2%) produced maximum Number of flower (32.80) followed by 100% NPK + foliar spray of boric acid (0.4%). During the December, 2013 the combination of 100% NPK + foliar spray of boric acid (0.4%) + zinc sulphate (0.2%) also produced maximum Number of flower (22.60) but found at par with 60% NPK + foliar spray of boric acid (0.4%). The results of the present investigations are in accordance with the findings of Bagali*et al*.(1993) who have reported that number of flower buds per shoot (9.18) in guava with the foliar application of borax(0.3%) + zinc sulphate (0.3%).

Number of fruit per plant:

With respect to interaction between fertilizer dose and foliar spray, the interaction effect was also significant during August 2013 and February 2014 only. The application of 100% NPK dose along with the foliar spray of boric acid (0.4%) + zinc sulphate (0.2%) showed significantly

maximum Number of fruits per plant (30.84) during August 2013 and remained at par with the application of 100% NPK dose along with the foliar spray of boric acid (0.4%) (30.74) followed by 60% NPK dose along with the foliar spray of zinc sulphate (0.2%) treatment combination. However, during February 2014 also the treatment combination comprising of 100% NPK dose along with the foliar spray of boric acid (0.4%) + zinc sulphate (0.2%) showed significantly maximum Number of fruits per plant (21.04) which was at par with 60% NPK dose along with the foliar spray of boric acid (0.4%) + zinc sulphate (0.2%) (18.62). The results of the present investigations are in accordance with the findings of Marathe and Bharambe (2007) who reported that application of FYM (to supply 50% N) + 50% RDF of inorganic fertilizers showed the maximum number of fruits per plant in sweet orange cv. Mosambi. Similar results were observed by Yadav *et al*.(2011) in mango cv. Amrapali.

Fruit yield (kg/plant):

With respect to interaction between fertilizer dose and foliar spray, the interaction effect was also not significant except during the August-2013 and February-2014. Maximum fruit yield was recorded in case of interaction of 100% NPK + foliar spray of boric acid (0.4%) + zinc sulphate (0.2%),which was at par with 100% NPK + foliar spray of boric acid (0.4%), during August-2013. Whereas during the February- 2014 the combination of 100% NPK + foliar spray of boric acid (0.4%) + zinc sulphate (0.2%) was also produced maximum yield of fruit (4.52 kg/ plant) but found at par with 60% NPK + foliar spray of boric acid (0.4%) + zinc sulphate (0.2%) (3.97 kg/plant). Result of the present study are in accordance with findings of Shukla et al. (2009) who have found that the application of 50% NPK of RDF +5o kg FYM 250g Azotobacter resulted in highest fruit yield 28 kg/plant in guava fruits. Similar results were obtained by Sharma *et al*.(2013), Goswami *et al*.(2012)in guava. Pathak *et al*. (2012) and Dutta *et al.* (2010) in litchi cv. BomBai. Marathe *et al*.(2007) in sweet orange cv. Mosambi. Yadav *et al*.(2011)in mango cv. Amrapali under high density orchard. Yadav *et al*.(2013) in low –chill peach cv-Sharbati.Kumar, D.,*et al*.(2008) in Banana. Kashyap, P.,*et al*.(2012) in pomegranate cv.Ganesh.

Total soluble solids (ºBrix):

Among the interaction between fertilizer dose x foliar spray, significantly highest T.S.S. content was recorded in the month of October - 2013, interaction of 100% NPK + foliar spray of boric acid (0.4%) + zinc sulphate (0.2%) resulted in maximum TSS content of fruit (12.45 ^{0}Brix) which was at par with 100% NPK + foliar spray of boric acid @0.4% (12.43^{0}Brix) followed by 100% NPK + foliar spray of zinc sulphate @ 0.2% (10.90^{0}Brix). These results further get support from the findings of Sharma et al.(2013) who also reported that the application of Azotobacter + 50%of N per Tree through FYM+ 50% of N per Tree through inorganic fertilizer showed highest T.S.S.(12.95 ^{0}Brix) Similar results were observed by Yashin Ashraf *et al*.(2010) in Kinnow. Kashyap, P., *et al*. (2012) in Pomegranate cv. Ganesh. Ghosh *et al*.(2012) in pomegranate cv.Ruby and Lal and Dayal (2014) in Acid lime.

Titratable acidity (%):

With respect to acidity, significant effects of different treatments could not be recorded in case of fertilizer doses and interaction between fertilizer dose and foliar spray.

Ascorbic acid (mg/100g fruit pulp)

Among the interaction between fertilizer dose x foliar spray, in the month of October- 2013, application of 60% NPK+ foliar spray of boric acid (0.4%) recorded maximum ascorbic acid content of guava fruit (99.36 mg/100g) followed by 100% NPK+ foliar spray of boric acid (0.4%) + zinc sulphate (0.2%). The results of the present investigations are in accordance with the findings of Shukla *et al.*(2009), who have reported that Ascorbic acid content of 198.30 mg/100g in guava with the application of 50% NPK with inorganic fertilizer + 50 FYM + 250 g Azotobacter .Similar patterns were also observed by Kumar, D. *et al.* (2009) who reported that the application of 900g N, 600g P and 900g K/ tree/ Year resulted the in highest Ascorbic acid of guava Fruits. Similar results have also been reported by Goswami *et al*.(2012) in guava and Gautam *et al*. (2012) in mango cv. Sunderja . Yadav *et al*.(2011) in mango cv. Amrapali and Yadav *et al*.(2013) in low –chill peach cv-Sharbati.

Table:-1 Interaction between fertilizer doses and micronutrients spray on Trunk girth of guava fruit cv. Lucknow-49.

Treatments	**Trunk girth**											
	June-	August-	October-	December-	February-	April-	June-	August-	October-	December-	February-	April-

	2012	2012	2012	2012	2013	2013	2013	2013	2013	2013	2014	2014
M1X S1	39.05	40.37	41.20	42.55	44.17	44.92	46.26	47.53	53.10	50.57	52.68	53.98
M1XS2	40.00	41.50	42.85	44.15	45.15	45.94	46.92	48.18	52.45	50.98	52.50	53.35
M1XS3	41.00	42.23	43.46	45.17	46.24	47.40	48.20	49.46	51.92	52.82	54.74	55.72
M1XS4	38.10	38.91	40.49	41.95	43.23	44.16	45.09	46.23	49.34	49.45	51.10	52.05
M2XS1	41.25	42.47	43.53	44.52	45.26	46.49	47.40	48.77	50.33	51.24	53.59	54.30
M2XS2	45.75	47.19	48.55	49.80	51.02	52.28	53.57	54.86	57.24	58.15	59.80	60.66
M2XS3	40.65	42.15	43.30	44.38	45.43	46.33	47.31	48.53	49.90	51.64	52.93	53.53
M2XS4	39.60	40.99	42.15	42.79	43.65	44.42	45.42	46.72	48.74	49.74	52.13	52.85
M3XS1	39.80	40.81	41.94	42.82	43.83	44.56	45.53	46.80	47.29	49.31	50.95	51.60
M3XS2	45.30	46.34	47.30	48.37	49.46	50.32	51.24	52.14	55.18	54.59	56.23	56.95
M3XS3	40.35	41.53	42.63	43.99	45.51	46.54	47.70	49.13	51.35	52.77	54.26	55.08
M3XS4	42.15	43.33	44.27	45.39	46.43	47.30	48.24	49.71	50.10	52.55	53.70	54.55
M4XS1	41.70	42.89	43.90	45.13	46.44	47.47	48.78	49.92	52.45	52.55	54.16	55.20
M4XS2	41.60	42.93	43.72	44.84	45.88	46.82	47.90	49.04	50.16	50.97	52.28	53.08
M4XS3	36.85	38.12	39.09	39.96	40.83	41.98	43.10	44.37	45.36	46.87	48.33	49.20
M4XS4	42.60	43.75	44.70	46.18	47.67	48.56	49.63	50.64	51.27	53.22	54.45	55.26
SEm±	1.88	1.90	1.89	1.88	1.85	1.80	1.75	1.75	1.57	1.75	1.83	1.88
CDat 5%	NS	NS	NS	NS	NS	NS	NS	NS	4.50	5.02	NS	NS

Table:- 2 Interaction between fertilizer doses and micronutrients spray on Girth of primary branches of guava fruit cv. Lucknow-49.

Treatments	**Girth of primary branches**											
	June-2012	August-2012	October-2012	December-2012	February-2013	April-2013	June-2013	August-2013	October-2013	December-2013	February-2014	April-2014
M1X S1	28.68	29.88	30.95	31.84	33.13	34.10	35.14	36.26	37.32	38.68	40.12	41.32
M1XS2	28.52	29.98	31.17	32.49	33.70	34.64	35.49	36.93	38.11	39.45	40.80	42.12
M1XS3	29.78	31.08	32.27	33.31	35.37	37.01	38.20	39.40	40.83	42.58	44.00	45.19
M1XS4	27.90	29.25	30.45	31.52	32.71	33.78	34.83	36.13	37.52	38.92	40.29	41.69
M2XS1	29.51	31.04	32.04	33.10	34.29	35.31	36.44	37.44	38.72	40.05	41.26	42.46
M2XS2	33.41	34.56	35.77	37.37	38.50	39.79	40.85	42.10	43.41	44.97	46.14	47.37
M2XS3	29.05	30.21	31.33	32.34	33.58	34.74	36.02	37.04	38.21	39.68	41.03	42.24
M2XS4	28.68	29.79	30.94	32.04	33.33	34.45	35.65	37.24	38.62	40.08	41.72	43.03
M3XS1	29.15	37.60	31.33	32.22	33.55	34.54	35.62	36.68	37.94	39.19	40.43	41.57
M3XS2	31.77	32.90	33.98	35.01	36.35	37.55	38.47	39.47	40.90	42.03	43.14	44.16
M3XS3	28.74	30.61	31.39	32.81	33.88	34.29	36.03	37.27	38.37	39.57	40.73	41.76
M3XS4	31.07	32.10	33.14	34.19	35.36	36.22	37.15	38.24	39.33	40.39	41.62	42.66
M4XS1	30.98	32.25	33.49	34.44	35.32	36.18	36.93	37.84	38.82	39.89	41.00	41.86
M4XS2	29.57	30.73	31.73	32.72	33.70	34.48	35.36	36.36	37.38	38.33	39.27	40.17
M4XS3	25.61	26.81	27.69	28.43	29.30	30.77	31.78	32.76	33.67	34.56	35.62	36.56
M4XS4	29.89	31.28	32.11	33.10	34.12	35.08	36.12	37.83	38.77	39.72	40.62	41.67
SEm±	1.39	2.53	1.39	1.34	1.33	1.27	1.25	1.28	1.27	1.29	1.31	1.30
CDat 5%	NS	NS	NS	NS	NS	3.65	3.59	3.67	3.65	3.69	3.75	3.72

Table:-3 Interaction between effect of fertilizer doses and micronutrients spray on percent increase in trunk girth of guava fruit cv. Lucknow-49.

Treatments	**Percent increase in trunk girth**											
	June-2012	August-2012	October-2012	December-2012	February-2013	April-2013	June-2013	August-2013	October-2013	December-2013	February-2014	April-2014
M1X S1	2.93	5.68	9.66	14.42	17.37	2.93	4.49	8.58	11.82	16.48	20.13	4.49
M1XS2	2.67	5.10	8.52	11.86	13.65	2.67	5.32	9.81	14.69	19.15	22.64	5.32
M1XS3	2.56	6.02	9.81	14.06	16.15	2.56	4.50	8.62	12.30	17.29	20.69	4.50
M1XS4	2.51	6.18	10.04	13.91	16.06	2.51	5.14	9.47	13.48	18.02	22.30	5.14
M2XS1	2.87	5.55	8.07	13.11	14.66	2.87	4.70	9.42	13.47	17.92	21.77	4.70
M2XS2	2.43	5.52	9.19	12.91	14.62	2.43	3.82	7.71	13.02	16.81	20.66	3.82
M2XS3	2.59	6.11	9.19	11.99	13.31	2.59	4.67	8.84	12.69	16.31	20.42	4.67
M2XS4	2.95	5.62	9.81	15.16	16.79	2.95	3.92	8.02	11.50	15.78	19.52	3.92
M3XS1	2.75	5.30	8.21	11.87	13.34	2.75	3.78	8.37	11.39	14.28	17.12	3.78
M3XS2	1.85	4.45	6.86	10.16	11.64	1.85	4.00	7.74	10.94	15.69	17.76	4.00
M3XS3	3.09	7.34	10.94	13.86	15.45	3.09	4.21	8.60	15.01	18.59	20.56	4.21
M3XS4	3.42	6.03	9.92	12.44	14.66	3.42	3.25	6.96	10.83	15.06	17.92	3.25
M4XS1	2.48	5.08	8.05	11.43	13.57	2.48	4.29	8.51	11.16	13.72	16.19	4.29
M4XS2	2.42	4.43	6.46	9.24	10.97	2.42	3.92	7.47	10.91	13.92	16.22	3.92
M4XS3	3.01	5.83	8.82	12.16	14.22	3.01	5.29	8.80	12.34	16.90	20.03	5.29
M4XS4	2.05	4.65	7.33	9.92	11.60	2.05	5.38	8.20	11.04	14.69	17.51	5.38
SEm±	0.46	0.71	0.91	1.14	1.28	0.46	0.49	0.64	1.15	1.51	1.81	0.49
CDat 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table:- 4Interaction between fertilizer doses and micronutrients spray on Percent increase in Girth of primary branches of guava fruit cv. Lucknow-49.

Treatments	**Percent increase in Girth of primary branches**											
	June-2012	August-2012	October-2012	December-2012	February-2013	April-2013	June-2013	August-2013	October-2013	December-2013	February-2014	April-2014
M1X S1	4.49	8.58	11.82	16.48	20.13	4.49	3.46	6.72	10.59	14.87	18.39	3.46
M1XS2	5.32	9.81	14.69	19.15	22.64	5.32	3.33	6.88	10.53	14.30	17.36	3.33
M1XS3	4.50	8.62	12.30	17.29	20.69	4.50	3.22	7.11	11.85	15.66	18.90	3.22
M1XS4	5.14	9.47	13.48	18.02	22.30	5.14	3.22	7.20	11.38	15.57	19.84	3.22
M2XS1	4.70	9.42	13.47	17.92	21.77	4.70	2.66	6.26	10.04	13.43	16.86	2.66
M2XS2	3.82	7.71	13.02	16.81	20.66	3.82	3.17	6.51	10.36	13.45	16.59	3.17
M2XS3	4.67	8.84	12.69	16.31	20.42	4.67	3.78	7.37	11.73	15.73	18.89	3.78
M2XS4	3.92	8.02	11.50	15.78	19.52	3.92	3.89	7.78	11.96	16.66	20.10	3.89
M3XS1	3.78	8.37	11.39	14.28	17.12	3.78	3.07	6.55	10.38	13.95	17.32	3.07
M3XS2	4.00	7.74	10.94	15.69	17.76	4.00	2.87	6.75	9.72	12.78	15.57	2.87
M3XS3	4.21	8.60	15.01	18.59	20.56	4.21	3.65	6.63	9.99	13.63	16.59	3.65
M3XS4	3.25	6.96	10.83	15.06	17.92	3.25	3.18	6.66	9.11	12.56	15.52	3.18
M4XS1	4.29	8.51	11.16	13.72	16.19	4.29	2.66	5.41	8.38	11.52	14.06	2.66
M4XS2	3.92	7.47	10.91	13.92	16.22	3.92	2.94	6.05	8.86	11.74	14.36	2.94
M4XS3	5.29	8.80	12.34	16.90	20.03	5.29	3.18	6.12	9.04	12.47	15.52	3.18
M4XS4	5.38	8.20	11.04	14.69	17.51	5.38	2.45	5.01	7.52	10.13	12.98	2.45
SEm±	0.49	0.64	1.15	1.51	1.81	0.49	0.35	0.60	0.78	1.02	1.27	0.35
CDat 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table:-5 Interaction between fertilizer doses and micronutrients spray on number of flower in guava fruit cv. Lucknow-49.

Treatments	**Flowers/ plant**							
	May-2012	July ,2012	October-2012	December-2012	May-2013	July ,2013	October-2013	December-2013
M1X S1	28.55	19.50	10.80	22.35	32.20	27.40	13.35	19.65
M1XS2	24.95	19.45	9.50	18.65	25.40	19.45	10.70	15.95
M1XS3	27.05	21.10	10.90	19.25	32.80	21.90	12.60	22.60
M1XS4	25.35	16.10	9.60	17.25	21.65	14.50	9.15	16.45
M2XS1	24.85	16.90	10.20	17.55	24.65	15.80	9.50	17.75
M2XS2	31.10	18.70	11.50	17.15	27.80	16.50	11.40	17.10
M2XS3	24.55	20.40	12.30	18.35	24.20	18.70	11.35	19.85
M2XS4	24.25	19.95	8.60	16.95	22.55	16.75	10.85	17.75
M3XS1	25.40	19.70	7.90	16.40	19.85	14.70	7.80	17.00
M3XS2	23.00	19.05	7.50	16.55	23.50	15.15	7.40	17.80
M3XS3	22.85	14.80	9.20	16.10	18.75	16.85	10.45	17.10
M3XS4	23.75	15.30	8.00	17.40	23.15	14.45	6.70	16.60
M4XS1	22.20	14.80	10.35	14.20	17.20	13.35	6.85	13.55
M4XS2	22.55	17.55	7.35	10.45	14.90	15.10	6.90	15.00
M4XS3	20.85	20.05	7.70	11.50	17.85	14.25	8.10	13.05
M4XS4	20.50	14.15	6.80	12.00	21.55	15.05	6.45	12.40
SEm±	2.02	1.89	1.02	1.37	1.89	2.76	0.92	1.01
CDat 5%	NS	NS	NS	NS	5.43	NS	NS	2.89

Table:-6 Interaction between fertilizer doses and micronutrients spray on number of fruit in guava fruit cv. Lucknow-49

Treatments	**Fruits/ plant**							
	August-2012	October-2012	December-2012	February-2013	August-2013	October-2013	December-2013	February-2014
M1X S1	26.33	17.96	10.08	20.09	30.73	25.25	12.30	18.13
M1XS2	23.26	17.91	8.25	17.19	24.13	18.52	9.38	14.81
M1XS3	25.69	20.20	10.25	18.46	30.84	20.11	11.29	21.04
M1XS4	23.45	14.28	8.35	16.17	20.03	13.43	7.98	14.43
M2XS1	23.42	15.81	9.45	16.65	23.32	14.85	8.60	16.53
M2XS2	29.43	17.67	10.50	16.08	26.31	15.29	10.51	16.17
M2XS3	23.42	19.43	11.48	17.29	23.83	17.81	10.43	18.62
M2XS4	23.03	18.76	7.89	15.58	21.34	15.55	9.75	16.62
M3XS1	24.01	18.34	7.08	15.59	18.46	13.34	6.90	16.02
M3XS2	21.88	17.89	6.67	15.43	22.12	14.36	6.75	16.85
M3XS3	22.08	13.94	8.20	15.25	17.74	16.05	9.62	16.20
M3XS4	22.18	14.27	7.50	16.45	22.01	13.58	6.23	15.61
M4XS1	21.01	13.89	9.55	13.36	16.19	12.55	6.13	12.60
M4XS2	21.48	16.85	6.78	9.68	14.23	14.31	6.47	14.13
M4XS3	19.79	19.12	6.96	10.75	16.63	13.43	7.38	12.15
M4XS4	19.13	13.24	6.05	11.20	20.38	13.72	6.04	11.55
SEm±	1.941	1.924	0.984	1.23	1.84	2.58	0.917	1.00
CDat 5%	NS	NS	NS	NS	5.27	NS	NS	2.88

Table:- 7 Interaction between fertilizer doses and micronutrients spray on fruit yield of guava fruit cv. Lucknow-49.

Treatments	**Fruit weight-kg/plant**							
	August-2012	October-2012	December-2012	February-2013	August-2013	October-2013	December-2013	February-2014
M1X S1	2.86	2.44	2.07	4.00	3.22	3.06	2.58	3.74
M1XS2	2.50	2.43	1.81	3.73	2.67	2.50	2.14	3.04
M1XS3	3.19	3.00	2.18	3.85	3.48	2.82	2.52	4.52
M1XS4	2.70	2.01	1.72	3.30	2.40	2.24	1.83	3.29
M2XS1	2.65	2.11	1.95	3.51	2.80	2.23	1.90	3.55
M2XS2	3.11	2.40	2.30	3.43	2.78	2.11	2.28	3.42
M2XS3	2.63	2.55	2.46	3.67	2.63	2.44	2.27	3.97
M2XS4	2.43	2.49	1.72	3.39	2.26	2.09	2.17	3.55
M3XS1	2.54	2.46	1.58	3.14	2.10	1.91	1.56	3.40
M3XS2	2.30	2.23	1.44	3.31	2.35	1.89	1.48	3.56
M3XS3	2.55	2.00	1.84	3.22	1.97	2.11	2.09	3.42
M3XS4	2.38	1.91	1.60	3.20	2.44	1.90	1.34	3.32
M4XS1	2.01	1.61	1.58	2.45	2.04	1.92	1.37	2.71
M4XS2	2.40	2.12	1.47	2.09	1.66	1.99	1.38	2.87
M4XS3	2.41	2.10	1.54	2.30	1.97	2.05	1.62	2.61
M4XS4	2.05	1.82	1.36	2.40	2.27	1.85	1.29	2.31
SEm±	0.21	0.21	0.12	0.22	0.19	0.25	0.19	0.20
CDat 5%	NS	NS	NS	NS	0.55	NS	NS	0.56

Table:-8 Interaction between fertilizer doses and micronutrients spray on Annual fruit yield of guava fruit cv. Lucknow-49.

Treatments	**Annual Fruit yield-kg/plant**		**Annual Fruit yield-ton/ha**	
	2012-2013	2013-2014	2012-2013	2013-2014
M1X S1	11.36	12.60	62.62	69.45
M1XS2	10.47	10.35	57.71	57.06
M1XS3	12.22	13.34	67.37	73.53
M1XS4	10.01	9.76	55.16	53.82
M2XS1	10.23	10.48	56.37	57.75
M2XS2	11.24	10.59	61.98	58.37
M2XS3	11.31	11.32	62.33	62.38
M2XS4	10.03	10.07	55.29	55.51
M3XS1	9.72	8.98	53.61	49.49
M3XS2	9.27	9.28	51.12	51.18
M3XS3	9.61	9.59	52.97	52.85
M3XS4	9.09	8.99	50.11	49.58
M4XS1	7.65	8.03	42.20	44.28
M4XS2	8.08	7.90	44.55	43.56
M4XS3	8.35	8.25	46.03	45.49
M4XS4	7.63	7.73	42.07	42.59
SEm±	0.44	0.37	2.41	2.06
CDat 5%	NS	1.07	NS	5.91

Table:-9Interaction between fertilizer doses and micronutrients spray on total soluble solids of guava fruit cv. Lucknow-49.

Treatments	**Total soluble solids**							
	August-2012	October-2012	December-2012	February-2013	August-2013	October-2013	December-2013	February-2014
M1X S1	8.88	10.55	11.23	12.10	10.40	12.43	11.30	10.80

M1XS2	8.90	10.43	11.75	9.83	9.98	10.90	12.03	10.75
M1XS3	9.05	10.78	12.10	9.20	10.58	12.45	12.60	11.98
M1XS4	9.13	9.78	10.18	7.68	8.68	8.65	8.93	8.75
M2XS1	8.35	10.00	10.25	11.33	10.30	11.08	11.13	10.78
M2XS2	9.10	10.48	9.60	9.08	9.75	10.69	10.73	10.20
M2XS3	10.38	10.88	10.60	9.68	10.15	12.29	12.05	10.74
M2XS4	9.20	9.63	8.90	8.68	8.48	8.38	9.45	8.95
M3XS1	8.48	10.78	9.80	9.85	9.55	10.90	11.20	10.65
M3XS2	8.30	9.78	10.03	9.95	9.55	10.78	10.68	10.73
M3XS3	8.75	10.38	11.98	10.00	10.43	11.68	11.63	12.08
M3XS4	9.03	10.03	8.73	8.90	7.95	8.65	9.13	9.35
M4XS1	8.73	10.40	10.88	10.50	9.78	10.33	10.10	10.93
M4XS2	8.03	11.48	9.00	10.23	9.48	11.36	10.78	10.78
M4XS3	8.40	11.73	10.58	11.18	10.38	11.81	11.00	12.13
M4XS4	8.23	9.73	9.48	9.10	7.73	8.25	8.55	8.58
SEm±	0.44	0.41	0.56	0.63	0.44	0.26	0.42	0.29
CDat 5%	NS	NS	NS	NS	NS	0.75	NS	NS

Table:-10Interaction between fertilizer doses and micronutrients spray on Acidity (%) of guava fruit cv. Lucknow-49.

Treatments	**Acidity (%)**							
	August-2012	October-2012	December-2012	February-2013	August-2013	October-2013	December-2013	February-2014
M1X S1	0.19	0.32	0.27	0.25	0.24	0.28	0.25	0.31

M1XS2	0.24	0.29	0.26	0.21	0.22	0.27	0.25	0.30
M1XS3	0.22	0.29	0.28	0.26	0.22	0.26	0.28	0.33
M1XS4	0.23	0.30	0.27	0.25	0.21	0.22	0.27	0.35
M2XS1	0.21	0.30	0.25	0.25	0.21	0.26	0.26	0.33
M2XS2	0.22	0.30	0.28	0.25	0.21	0.26	0.30	0.29
M2XS3	0.19	0.26	0.24	0.29	0.24	0.26	0.29	0.31
M2XS4	0.20	0.28	0.26	0.30	0.20	0.24	0.26	0.28
M3XS1	0.21	0.29	0.28	0.28	0.22	0.27	0.28	0.33
M3XS2	0.20	0.28	0.26	0.29	0.19	0.26	0.32	0.29
M3XS3	0.20	0.29	0.27	0.29	0.21	0.26	0.31	0.34
M3XS4	0.21	0.28	0.27	0.26	0.19	0.24	0.27	0.30
M4XS1	0.18	0.28	0.26	0.26	0.23	0.21	0.31	0.32
M4XS2	0.18	0.28	0.28	0.24	0.22	0.27	0.29	0.30
M4XS3	0.18	0.30	0.26	0.27	0.22	0.25	0.30	0.34
M4XS4	0.19	0.29	0.28	0.30	0.26	0.22	0.25	0.29
SEm±	0.01	0.02	0.02	0.02	0.02	0.01	0.02	0.02
CDat 5%	NS	NS	NS	NS	NS	NS	NS	NS

Table:-11Interaction between fertilizer doses and micronutrients spray on Ascorbic acid (mg / 100g) of guava fruit cv. Lucknow-49.

Treatments	**Ascorbic acid (mg / 100g)**							
	August-2012	October-2012	December-2012	February-2013	August-2013	October-2013	December-2013	February-2014
M1X S1	64.94	94.73	87.52	67.28	62.83	86.95	74.31	93.84
M1XS2	61.36	93.42	85.30	62.06	67.84	86.36	81.77	98.20
M1XS3	61.70	97.67	80.58	63.55	60.38	92.52	91.78	95.14
M1XS4	62.00	89.75	78.86	65.56	64.59	78.83	76.25	94.41
M2XS1	58.16	88.94	75.50	65.80	55.91	99.36	78.06	96.05
M2XS2	72.09	88.52	82.86	70.66	61.45	89.72	79.06	95.22
M2XS3	53.19	94.03	84.92	62.09	63.34	84.78	79.98	97.38
M2XS4	53.20	90.72	85.11	63.86	64.11	85.69	81.91	86.20
M3XS1	54.05	91.95	80.53	63.73	65.34	88.97	82.53	88.20
M3XS2	54.98	94.02	82.70	64.53	73.50	96.44	79.17	93.42
M3XS3	54.72	94.38	79.91	60.38	74.83	83.20	79.05	96.17
M3XS4	52.20	91.19	80.44	65.03	71.13	81.75	66.72	95.73
M4XS1	53.89	86.09	81.94	58.20	69.08	85.63	71.56	92.91
M4XS2	53.80	84.48	78.64	61.36	68.81	83.63	77.50	92.72
M4XS3	53.03	85.14	78.61	58.91	62.77	88.81	73.86	97.39
M4XS4	52.92	85.59	82.75	59.33	64.56	83.53	73.83	86.75
SEm±	3.55	3.25	3.25	1.97	3.72	1.71	4.23	4.13
CDat 5%	NS	NS	NS	NS	NS	4.90	NS	NS

Conclusions

Ultra-high density orcharding (UHD) in guava is an effective technology for improving the profitability of guava orcharding under Jharkhand conditions. Recommendations on nutrient and water requirement in UHD under Jharkhand conditions was not available. There was a need for rationalization of fertilizer dose which has been developed for traditional orcharding systems. Again, maintaining the fruit quality under UHD in long term is a challenge under micronutrient deficient acid soils of Jharkhand. Keeping in view the above facts, the trial was conducted to standardize nutrient and water requirement for improving the yield and fruit quality of ultra-high density guava. Although the interaction effects of fertilizer dose and foliar application was not significant during the economically important stages. While application of 60% of recommended dose of fertilizer was found to be at par with that of 100% with respect to maximizing yield per tree. Foliar application of Zinc sulphate (0.2%) + Boric acid (0.4%) resulted in maximum yield during the economically important stages of crop. Although fertilizer dose did not have any effect of fruit quality, foliar application of Zinc sulphate (0.2%) + Boric acid (0.4%) was found to increase the TSS over the control.

According to the results of the present study, from the Sixteeninteraction treatment, we conclude that Interaction between fertilizer doses and micronutrients spray.Hence, it is recommended that application of 60% of recommended dose of NPK in soil and foliar application of Zinc sulphate (0.2%) + Boric acid (0.4%) can maximize the yield and fruit quality under ultra-high density guava orchard.

References

1. A O A C .1990. Official Methods of Analysis. Association of Agricultural Chemists, Washington D.C.
2. Alva, A. K., Jr.D. Mattors., Paramasivam S., Patil. B., Dou. H. and Sajwan, K.S. 2006. Potassium management for high yield and Quality of Citrus in sandy Soils. *International Journal of fruit Science.* 6:2-43.

3. Bagali, A.N., Hulamani , N.C. and Sulikeri, G.S.1993. Effect of foliar application zinc, magnesium and boron on growth and yield of Guava (Psidium guajava L.) cv. Lucknow 49. *Karnataka J. Agric. Sci.*6: 137-141.

4. Baksh, H., Yadav, R. and Dwivedi, R. 2008. Effect INM on growth, yield, yield attributing characters and quality of guava (P.guajava L.) cv. Sardar *Prog. Agric.* 8 : 141-144.
5. Broadley, M.; Brown, P.; Cakmak, I.; Rengel, Z. and Zhao, F. 2012. Functions of nutrient: micronutrients. In: Marschner P (ed) Marschner's mineral nutrition of higher plants, 3rd edn. Elsevier, Oxford, pp 243–248.

6. Chaitanya, C.G., Kumar, G., Rana, B.L. and Muthoo, A.K. 1997. Effect of foliar application of zinc and boron on yield and quality of guava cv. L. 49. *Haryana J. Hort. Sci*. 26: 78-80.
7. Chandler,W.H., Hoagland, D.R. and Hibbard, P.L. 1931. Little leaf or rosette of fruit trees. *Proc. Amer. Soc. Hoti.Sci.* 28:556-560.

8. Dale, G.B. and Krystyna, M. L. 1998. Boron in plant structure and function. Annu. Rev. Plant Physiol. *Plant Mol. Biol*. 49: 481-500.

9. Dutta,P., Kundu, S. and Biswas ,S. 2010. Integrated nutrient management in litchi cv Bombai in new alluvial zone of West Bengal. *Indian J. Hort.* 67181-184.

10. Gautam, U.S., Singh, Rajesh.,Tiwari, Neelam., Gurjar, P.S. and Kumar, Ashish. 2012. Effect of integrated nutrient management in mango cv. Sunderja. *Indian J.Hort*. 69:151-155

11. Ghosh, S.N., Bera, B., Royand, S. and Kundu, A. 2012. Integrated nutrient management in pomegranate grown in laterite soil. *Indian J. Hort.* 69: 333-337.

12. Gomez, K.A., Gomez, A.A. 1984. Statistical procedure for Agricultural Research. John Wiley and Sons, New York.
13. Goswami, Amit. Kumar., Lal, Shant. and Misra, K.K. 2012. Integrated nutrient management improves growth and leaf nutrient status of guava cv. Pant Prabhat . *Indian J. Hort.* 69: 168-172.

14. Jose, L.M.,D.Jose, P. Neto, and D. Fernandes. 2007. Response function of guava to water depth and nitrogen fertilization. Brazilian magazine of fruit culture. 29: 323-328.
15. Joshi, Ganga., Singh, P. K., Srivastava, P. C. and Singh, S. K. 2012. Effect of mulching, drip irrigation scheduling and fertilizer levels on plant growth, fruit yield and quality of litchi (*Litchi chinensis* Sonn.). *Ind. J. Soil Cons.* 40:46-51.

16. Kashyap, P., Pramanick, K.K., Meena, K.K. and Meena, V. 2012. Effect of N and K application on yield and quality of pomegranate cv. Ganesh under rainfed conditions. *Indian J. Hort.* 69: 322-327.

17. Kumar, Dinesh., Pandey,V., Anjaneyulu,K. And Nath,Vishal. 2009. Optimization of major nutrients for guava yield and quality under east coastal conditions. *Indian J. Hort.* 66: 18-21.

18. Kumar,D., Pandey,V. And Anjaneyulu,K. 2008. Effect of planting density and nutrient management on growth ,yield and quality of micro-propagated banana RasthaliPathkapoora(AAB). *Indian J. Hort.* 65: 272-276.

19. Lal,G. and Dayal, H. 2014. Effect of integrated nutrient management on yield and quality of acid lime (*Citrus aurantifolia Swingle). Afr.J.Agric.Res*. vol.9, pp.2985-2991.

20. Mahmoud M. Shaaban. 2010. Role of boron in plant nutrition and human health. *American journal of plant physiology*, 5(5): 224-240.

21. Marathe, R.A. and Bharambe, P.R. 2007. growth, yield and quality of sweet orange cv.Mosambi in response to INM in vertisols of central India. *Indian J. Horti.* 64: 274-277.
22. Pathak, P.K., Majumder, K. and Mitra, S.K. 2012. Levels and time of potassium fertilization influence soil and leaf nutrient composition and its relation with yield of litchi. *Indian J. Hort.* 69 : 33-38.

23. Ramniwas, R. A., Kaushik, D. K., Sarolia, Pareek, Sunil. and Singh, V. 2012. Effect of irrigation and fertigation scheduling on growth and yield of guava (*Psidium guajava*L.) under meadow orcharding . *African Journal of Agricultural Research*.47: 6350-6356.

24. Shanker, G. 1966. Fertilizer your guava plants for higher yields .*Fertilizers News*, 11: 27-28.

25. Sharma, A., Wali,V.K., Bakshi, P. and Jasrotia, A. 2013. Effect of integrated nutrient management strategies on nutrient status, yield and quality of guava. *Indian J. Hort.* 70: 333-339.
26. Shoeib, M.M. and El sayed, A. 2003. Response of "Thompson Seedless" grape vines to the spray of some nutrients and citric acid. *Minia J. Agric. Res. Dev.* 23: 681–698.

27. Shukla, A.K., Sarolia, D.K., K, Bhavana., Kaushik, R.A., Mahawer, L.N. and Bairwa, H.L. 2009. Evaluation of substrate dynamics for integrated nutrient management under high density planting of guava cv. Sardar. *Indian J. Hort.* 66:461-464 .

28. Singh, H.P. and Singh, G. 2007. Nutrient and water management in guava proc. 1st Interna. Guava sym., CISH, Lucknow, *Acta Horti.*, 735: 389-397.

29. Singh, J. And Singh, M.P.1970. Effect of foliar application of trace elements and nitrogen on quality of guava. Fertilizers News, 15: 45.

30. Yadav, A.K., Singh, J.K.andsingh, H.K. 2011.Studies on integrated nutrient management in flowering, fruiting, yield and quality of mango cv. Amrapali under high density orcharding. *Indian J. Hort.* 68: 453-460.

31. Yadav, V., Singh, P.N. and Yadav, P. 2013. Effect of foliar fertilization of boron, zinc and iron on fruit growth and yield of low –chill peach cv-Sharbati. *International journal of Scientific and Research Publications* 3: 2250-3153.

32. Yasin, A, M., Gul, Attiya., Ashraf, Muhammad., Hussain, F. and Ebert, G. 2010. Improve ment in yield and quality of kinnow (Citrus deliciosa X Citrus nobilis) by Potassium fertilization. *Journal of plant Nutrition.* 33: 1625-1637.