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EFFECT OF DOSAGE AND FREQUENCY OF FERTIGATION ON PRODUCTION AND PRODUCTIVITY OF MANGO (*MANGIFERA INDICA* L.) CV. BANGANPALLI.

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ABSTRACT

A field experiment was carried out at Fruit Research Station, Sangareddy, Telangana State to study the effect of dosage (T_1 – NK @ 100% RDF, T_2 - NK @ 80% RDF, T_3 - NK @ 60% RDF, T_4 - NK @ 50% RDF) and frequency of fertigation (F_1 - One time at marble stage, F_2 - Daily fertigation) on production and productivity of mango (*Mangifera indica* L.) cv. Banganpalli. The experiment results revealed that application of daily fertigation with 100% RD of NK + micronutrient mixture (D_1F_2) recorded the maximum number of fruits per panicle at the time of fruit set (9.96), maximum number of fruits per tree at the time of harvest (223.81), maximum fruit weight (540.31 g), maximum yield per tree (120.95 kg), per unit (m^3) canopy volume (1.50 kg) and per ha. (18.87 t) due to increase in the soil and leaf macro (N (kg/ha), K (kg/ha)) nutrient levels. The same treatment has resulted in highest fertilizer use efficiency (120.95 kg/kg) and was found more economical with a net return of 304393.32 Rs/ha. and BC ratio of 4.17. However, the treatment daily fertigation with 80% RDF (D_2F_2) resulted in optimum value of net returns of 242030.89 Rs/ha. and BC ratio of 3.34 compared to other levels of fertigation.

Keywords **:** Mango (*Mangifera indica* L.), fertigation, productivity.

Introduction

Mango (*Mangifera indica* L.) belongs to the family Anacardiaceae considered as one of the most important fruits of the tropical and subtropical countries. India occupies the top position among mango growing countries of the world and produces 40.1% of the total world production. It is the premier and choicest fruit of India and undoubtedly one of the best fruits of the world. It is known as 'King of Fruits' due to its captivating flavour, irresistible taste and sweetness. Very aptly, Indians designated this fruit as the 'National Fruit' of the country. Mango is a highly nutritive fruit. It plays an important role in balancing the human diet by providing about 64-86 calories per 100 grams of ripe fruits (Rathore *et al.* 2007). It is a good source of vital protective nutrients like vitamins A, B, and C, niacin and is also rich in minerals including calcium, potassium and iron.

In general fertilizers are applied in two split doses for mango, one at the time of onset of monsoons and another dose at the time of flower initiation or during the fruit set stage. The second dose of fertilizer application plays key role in mango fruit production because it coincides with fruit growth and development. To improve fertilizer-use efficiency the available advance method is drip irrigation *i.e.,* fertigation. Fertigation refers to the application of solid or liquid mineral fertilizers via pressurized irrigation systems, thus forming irrigation water containing nutrients (Magen, 1995). Fertigation improves the nutrient uptake efficiency to an extent of 30-40 per cent, prevents soil degradation, and reduces the cost of fertilizer and application besides improving the productivity and quality of the fruits. Water coupled with nutrient management is particularly important for improving input-use efficiency (Melgar*et al.,* 2008; Panigrahi *et al.,* 2010). Further, fertigation ensures substantial saving in fertilizer usage and reduces leaching losses (Kumar *et al.,* 2007).

Material and Methods

Ten years old bearing trees of mango cv. Banganpalli, having uniform vigor and health were selected. Trees were spaced 8×8 m and received uniform pruning and cultural operations. Forty-eight selected trees were subjected to eight pre-harvest treatments viz. F_1T_1 - One time at marble stage + N_2 and K_2O @100% of RDF; F_1T_2 - One time at marble stage + N_2 and K_2O @80% of RDF; F_1T_3 - One time at marble stage + $N_2$and K_2O @60% of RDF; F_1T_4 - One time at marble stage + N_2 and K_2O @ 50 % of RDF; F_2T_1 - Daily fertigation+ $N_2$and K_2O @100% of RDF; F_2T_2 - Daily fertigation+ $N_2$and K_2O @80% of RDF; F_2T_3 - Daily fertigation+ $N_2$and K_2O @60% of RDF; F_2T_4 - Daily fertigation +N_2 and K_2O @ 50 % of RDF with three replications. The experiment was laid out in Factorial RBD with three replications.

Soil and leaf sampling

The soil and leaf samples were collected at two stages viz. before flowering (in October) and after harvesting (in August). Twenty healthy leaves from four sides of each selected tree were collected from the middle of the whorl, considering the fifth leaf in the whorl as the representative leaf, as described by Samra *et al.* (1978).

Table 1 : Methods used for soil analysis
Various soil parameters were analyzed by adopting the below-mentioned procedures

Sr. No	Parameters	Name of method	As suggested by
1	pH	Potentiometry	Jackson (1973)
2	EC (dsm^{-1})	Conductometry	Jackson (1973)
3	Available N Kg/ha	Alkaline permanganate method	Subbaiah and Asija (1956)
4	Available P kg/ha	Calorimetric method	Jackson (1973)
5	Available K kg/ha	Flame photometry method	Jackson (1973)
6	Zn (ppm)	Atomic absorption spectrophotometer	Lindsay & Norvell 1969
7	Fe (ppm)		
8	Mg (%)	Mg NH_4 $P0_4$ corresponds to the amount of magnesium present in the soil	Ishwaran 1980

Table 2 : Methods used for leaf analysis
Various leaf parameters were analyzed by adopting the below-mentioned procedures

Sr. No	Parameters	Name of method	As suggested by
3	Available N (%)	Kjeldahl method	Modified Kjeldahl's digestion method (Jackson, 2005)
4	Available P (%)	Vanadomolybdate method	Jackson 1973
5	Available K (%)	Atomic absorption spectrophotometer	Chapman and Pratt, 1961
6	Zn (ppm)		
7	Fe (ppm)		
8	Mg (%)		

Fruit physical and quality parameters were measured by selecting 20 healthy panicles per plant. Percentage of fruit set was calculated by taking into account the number of fruits at the initial fruit set and the number of fruits at the peanut stage in the panicles (Ram *et al.,* 2020). BBCH scale was used to record the fruit development stages which was developed by Rajan *et al.* (2011). Number of fruits $tree^{-1}$ (at the time of harvest), Yield (kg $tree^{-1}$) and Days taken for fruit maturity (From fruit set to harvest) (Vijay Krishna, 2019). The Canopy volume (m^3) (from the root base of a tree to maximum spreading) was measured using tape (fastened on a bamboo stick) and calculated by the formula suggested by Samaddar and Chakrabarti (1988).

$$\text{Canopy volume } (m^3) = 4/3\ \pi\ (r^2h)$$

Where r = diameter/2, h= height of the plant. The canopy diameter was measured in both the direction (NS and EW) of the canopy. Plant height (m) was measured from graft union to the top of the tree by measuring tape (fixed on a bamboo stick).

The gross realization in terms of rupees per hectare was worked out basis on of total yield for each treatment and prevailing market prices of mango. The benefit-cost ratio for respective treatments was obtained by dividing the net income by the total cost of that treatment.

Results and Discussion

Soil and leaf nutrient status

The perusal of data revealed that different doses and frequency of fertigation schedules have shown significant differences in NK levels in the soil and leaf whereas, P and micronutrient levels were found non-significant during both seasons *i.e.,* after the first season (before the second season) and after the second season of the investigation.

The individual effect of both fertigation dosages (D) and fertigation frequencies (F) recorded maximum N and K was recorded with the application of 100% RDF + micronutrient mixture (D_1) whereas the minimum N and K was recorded with the application of 50 % RDF + micronutrient mixture (D_4) after the first season (before the second season) and after the second season of the investigation, respectively.

Regarding the interaction effect of different fertigation dosages and frequencies (D x F) on soil nutrient status, maximum N (260.33 kg/ha and 260.68 kg/ha) and K (358.25 kg/ha and 353.81 kg/ha) was recorded with the application of daily fertigation with 100% RDF + micronutrient mixture (D_1F_2) whereas the minimum N (180.28 kg/ha and 200.62 kg/ha) and K (290.89 kg/ha and 296.92 kg/ha) was recorded with the application of one-time fertigation at marble stage with 50 % RDF + micronutrient mixture (D_4 F_1) after the first season (before the second season) and after the second season of the investigation, respectively. Further, the daily fertigation with 100% RDF + micronutrient mixture (D_1F_2) has resulted in a 35.41 % and 35.55 % increase in available soil N and 23.16 % and 21.64 % increase in K after the first season and after the second season of the investigation, respectively to the actual available soil N and K before investigation (Table 3 and 4). These results can be attributed to the fact that fertigation enables the uniform and efficient application of fertilizers (Patel and Rajput, 2000). As a fertigation system aids in the application of water and nutrients directly in the root zone, it results in an increased level of soil nutrient status (Fares and Alva, 2000; Subramanian *et al.*, 2012). Further, the application of fertilizers in split doses through drip irrigation minimizes the leaching losses in the soil and thus resulted in increased NK and micronutrients levels in soil (Basavaraju*et al.*, 2014) in the present treatment. These results are in agreement with the findings of Tank and Patel (2013) in papaya cv. Madhu Bindhu, Bandyopadhyay *et al.* (2019) in coconut and Kavino*et al.* (2002) in banana.

The interaction effect of different fertigation dosages and frequencies (D x F) on leaf nutrient status recorded maximum N (1.61% and 1.65%) and K (1.17% and 1.56%) D_1F_2 whereas the minimum N (0.65% and 0.66%) and K (0.64% and 0.64%) was recorded with D_4 F_1 after the first season (before the second season) and after the second season of the investigation, respectively. Further, with the application of daily fertigation with 100% RDF + micronutrient mixture (D_1F_2), the increase in leaf N was 1.84 times and 2.26 times and the increase in leaf K was 1.80 times and 2.40 times after the first season and after the second season of the investigation, respectively to the actual available leaf N and K before investigation (Table 5 and 6). The higher leaf nutrient (N, K, Fe, Zn and Mg) content in daily fertigated trees might be attributed to the fact that fertigation helps in better uptake of nutrients due to frequent and timely application of fertilizers directly in the feeder root zone (Devi *et al.*, 2019). These results are in close conformity with the findings of Kuchanwar*et al.* (2017) in Nagpur mandarin, Naik *et al.* (2016) in banana cv. Grand Naine, Pramanik*et al.* (2013) in banana cv. Martaman, Tank and Patel (2013) in papaya cv.

Madhu Bindu, Jeyakumar*et al.* (2010) in papaya cv. Co.7, Haneef *et al.* (2014) in pomegranate cv. Bhagwa and Srinivas *et al.* (2010) in passion fruit.

Number of fruitlets per panicle at the time of fruit set

Regarding the interaction effect of different fertigation dosages and frequencies (D x F), the maximum number of fruitlets per panicle at the time of fruit set (9.96) was recorded with the application of daily fertigation with 100% RDF + micronutrient mixture (D_1F_2) whereas the minimum number of fruitlets per panicle (5.96) was recorded with the application of one-time fertigation at marble stage with 50 % RDF + micronutrient mixture ($D_4 F_1$).

This increase in the number of fruitlets per panicle with D_1 andF_2 and their interaction can be attributed to the fact that the application of frequent fertigation with a higher quantity of fertilizers might have provided consistent moisture regimes and nutrient pool in the soil especially N and K (Table 7). The proper and continuous moisture in the soil with fertigation increases the availability of nutrients and translocation of food materials (Wuertz*et al.,* 2000). As plants receive optimum amount of water and nutrients, it directly improves cell permeability which enhances the phot osynthetic process and results in more number of leaves and flowers (Shah *et al.*, 2018). These results are in close conformity with the findings of Panwar *et al.*, (2007) who reported an increased fruit set and more number of fruits retained per panicle in fertigation with 100% RDF. Haneef *et al.*, (2014) in pomegranate.

Per cent fruit drop

Per cent fruit drop recorded at 703, 705 and 709 stage of BBCH Scale the results revealed that the individual and interaction effect of fertigation dosages and frequency found non-significant at all stages. The individual effect of different fertigation dosages and frequency on per cent fruit drop at 703 stage of BBCH Scale significantly recorded minimum per cent fruit drop (87.23) with D1 whereas the maximum per cent fruit drop (95.34) was observed with D4 (Table 7). These results are in close conformity with the findings of Panwar *et al.*, (2007) in mango cv. Dashehari reported maximum fruit retention per panicle with 100% dose of fertilizer application through fertigation.

Fruit development based on phenological stage

Number of days in 701, 703, 705 and 709 stage of BBCH Scale was recorded and results revealed that the individual effect of fertigation dosage D_1 and frequency F_2 found significantly less number of days when compare to other treatments. But the interaction effect of fertigation dosage and frequency found non-significant. From the above results, it is evident that the individual effect of application of daily fertigation (F_2) and fertigation with 100% RDF (D_1) have recorded the minimum number of days for fruit development in all recorded phenological stages of fruit development *i.e.,* early maturity of fruits compared to other treatments (Table 8). These results conform to the findings of Shree *et al.* (2018) who reported that the application of 100% RDF might have provided balanced nutrition and brought better growth, development and promoted early picking in cucumber.

Number of days taken from fruit set to maturity

The data obtained for the effect of different fertigation dosages and frequency on the number of days taken from fruit set to maturity in mango cv. Banganpalli was presented in Table 9. The analysis of pooled data revealed that individual factors *i.e.,* different levels of fertigation dosage (D) and frequency (F) have recorded significant difference in the number of days taken from fruit set to maturity in mango cv. Banganpalli.

Regarding the effect of different fertigation dosages (D), application of 100% RDF + micronutrient mixture (D_1) recorded the minimum number of days from fruit set to maturity (97.57 days) whereas the maximum number of days for fruit maturity (115.91 days) was recorded with the application of 50 % RDF + micronutrient mixture (D_4).

Regarding the effect of fertigation frequencies (F), daily fertigation (F_2) recorded the minimum number of days from fruit set to maturity (105.07 days) whereas the maximum number of days (110.07 days) was recorded with one-time fertigation at the marble stage (F_1).

In the present study, the individual effect of application of daily fertigation (F_2) and fertigation with 100% RDF (D_1) have recorded the minimum number of days taken from fruit set to maturity. This is due to the early development of fruits with the increased soil and leaf nutrient content (N&K) (Table 3 and 4) recording the minimum number of days in all phenological stages of fruit development (Table 8). Application of daily fertigation with 100% RDF might have improved plant metabolism by these elements being an essential constituent of diverse types of metabolically active compounds like amino acids, proteins, nucleic acids, prophytins, nucleotide and co-enzymes (Kaur *et al.*, 2019) which might have resulted in early maturity of fruits recording the minimum number of days taken from fruit set to maturity. These results conform to the findings of Shree *et al.* (2018) who reported that application of 100% RDF might have provided balanced nutrition and brought better growth, development and promoted early picking in cucumber.

However, the interaction effect of different fertigation frequencies and dosages (D x F) was found not significant on the number of days from fruit set to maturity among the treatments in mango cv. Banganpalli.

Fruit length (cm) and fruit breadth (cm) at the time of harvest

The data for the effect of different fertigation dosages and frequency on fruit length (cm) and fruit breadth (cm) at the time of harvest was presented in Tables 9. From the analysis of pooled data, it was found that individual factors (D and F) have significantly affected the fruit length and fruit breadth recorded at the time of harvest among the treatments in mango cv. Banganpalli.

Regarding the effect of different fertigation dosages (D), maximum fruit length and fruit breadth (12.85 and 10.87 cm, respectively) was recorded with the application of 100% RDF + micronutrient mixture (D_1) whereas the minimum fruit length and fruit breadth (11.22 and 9.40 cm, respectively) was recorded with the application of 50 % RDF + micronutrient mixture (D_4).

Regarding the effect of different fertigation frequencies (F), maximum fruit length and fruit breadth (12.33 and 10.40 cm, respectively) was recorded with the application of daily fertigation (F_2) whereas one-time fertigation at the marble stage (F_1) has resulted in minimum fruit length and fruit breadth (9.40 and 10.00 cm, respectively).

The results revealed that the individual effect of application of daily fertigation (F_2) and fertigation with 100% RDF (D_1) have significantly increased the fruit size (fruit length and breadth). This might be due to the increase in yield traits which helped to increase the synthesis of carbohydrates that are utilized for the development of fruits (Godi*et al.*, 2020). The constant and continuous supply of water and more nutrients in soluble form to the wetted area of the root zone ensured better availability of nutrients (Mahalakshmi *et al.*, 2001 b and Kavino *et al.*, 2004) and this increased the nutrient availability in soil and leaf (N&K) (Table 3 and 5). The regular supply of nutrients by daily fertigation especially nitrogen to the plants might have increased yield attributing characters because it is directly related to the synthesis of protein through amino acids (Hussain, 1970). This continuous supply of primary nutrients through daily fertigation till fruit maturity stage might have resulted in maintenance of high nutrient availability throughout the crop growth hence, promoting better fruit size (Tanari *et al.*, 2019). The increase in fruit size with the increasing quantity of N, P, K fertilizers through fertigation was also reported by Shirgure *et al.* (2001), Mahalakshmi *et al.* (2001) and Thakur & Singh (2004).

However, the interaction effect of different fertigation dosages and frequencies (DxF) has shown no significant difference in fruit length and fruit breadth recorded at the time of harvest among the treatments in mango cv. Banganpalli.

Fruit weight (g) at the time of harvest

The data obtained for the effect of different fertigation dosages and frequency on fruit weight (g) at the time of harvest was presented in Table 9. The analysis of pooled data revealed that different levels of fertigation frequency and dosage and their interaction effect have shown significant effect on fruit weight (g) recorded at the time of harvest in mango cv. Banganpalli.

Regarding the effect of different fertigation dosages (D), maximum fruit weight at the time of harvest (515.49 g) was recorded with the application of 100% RDF + micronutrient mixture (D_1) whereas minimum fruit weight (379.00 g) was recorded with the application of 50 % RDF + micronutrient mixture (D_4).

Regarding the effect of different fertigation frequencies (F), maximum fruit weight at the time of harvest (472.06) was recorded with the application of daily fertigation (F_2) whereas application of one-time fertigation at the marble stage (F_1) resulted in minimum fruit weight (434.84 g).

Regarding the interaction effect of different fertigation frequencies and dosages (D x F), maximum fruit weight at the time of harvest (540.31 g) was recorded with the application of daily fertigation with 100% RDF + micronutrient mixture (D_1F_2) whereas minimum fruit weight (366.60 g) was recorded with the application of one-time fertigation at marble stage with 50 % RDF + micronutrient mixture (D_4 F_1) (Fig 13).

A regular supply of higher doses of fertilizers especially nitrogen to the plants increased yield and yield attributing characters because it is directly related to the synthesis of protein through amino acids (Hussain, 1970). This increased fruit weight with D_1, F_2 and their interaction in the present study may be ascribed to the increased synthesis of metabolites and more uptake of nutrients and their translocation to the fruits (Kachwaya and Chandel, 2015). These results are in accordance with the findings of Thakur and Singh (2004) in mango cv. Amrapali and Mahalakshmi *et al.* (2001) observed a significant increase in fruit size in bananas, with increasing levels of NPK fertilizers. It could be due to the uniform distribution of nutrients, coupled with its confinement in the root zone under fertigation and might have led to the increased nutrient uptake which is reflected in better physiological activities of plants resulting in increased dry matter accumulation (Godara *et al.*, 2013). Similarly, Raina *et al.* (2011) also recorded higher fruit size and weight of apricot fruits with 100% recommended dose of fertilizers applied through fertigation.

Number of fruits per tree at the time of harvest

The results obtained for the effect of different fertigation dosages and frequency on the number of fruits at the time of harvest was presented in Table 10. The perusal of pooled data revealed that different levels of fertigation frequency and dosage have shown a significant effect on the number of fruits per tree at the time of harvest in mango cv. Banganpalli.

Regarding the effect of different fertigation dosages (D), the maximum number of fruits per tree at the time of harvest (208.33) was recorded with the application of 100% RDF + micronutrient mixture (D_1) whereas the minimum number (134.16) was recorded with the application of 50 % RDF + micronutrient mixture (D_4).

Regarding the effect of different fertigation frequencies (F), the maximum number of fruits per tree at the time of harvest (183.35) was recorded with the application of daily fertigation (F_2) whereas the minimum (163.01) was recorded with one-time fertigation at marble stage (F_1).

Regarding the interaction effect of different fertigation frequencies and dosages (D x F), the maximum number of fruits per tree at the time of harvest (223.81) was recorded with the application of daily fertigation with 100% RDF + micronutrient mixture (D_1F_2) whereas the minimum number of fruits per tree (124.05) was recorded with the application of one-time fertigation at marble stage with 50 % RDF + micronutrient mixture (D_4 F_1).

The increase in the number of fruits per tree is mainly due to an increase in the number of fruitlets per panicle at the time of fruit set (Table 4.2.5) and reduced fruit drop at the early stage of fruit growth (Table 4.2.6) with the application of daily fertigation with 100% RDF. Fertigation provided an adequate amount of water and nutrients to the plants which increases the availability of major nutrients in soil and leaf (N and K) (Table 4.2.1 and 3) as well as other essential nutrients. The highest number of fruits might be due to the constant and adequate availability of moisture in the plant rhizosphere during fruit developmental stages that eventually enhanced the fruit retention capacity of the plant (Hendre *et al.*, 2020). These results are in conformity with those of Panigrahi*et al.* (2012) in Nagpur mandarin and Kumar *et al.* (2013) in sweet orange. Similarly, Hendre *et al.* (2020) also recorded the highest number of fruits by application of

fertigation with 100% RDF who reported that increase in the number of fruits might be due to optimum level of nutrient absorption because of maintenance of field capacity conditions in the root zone with fertigation which led to maximum fruit number.

Fruit yield (kg) per tree and Fruit yield (t ha^{-1})

The data obtained for the effect of different fertigation dosages and frequency on fruit yield per tree (kg) and fruit yield (t ha^{-1}) was presented in Table 10. The analysis of pooled data revealed that different levels of fertigation frequency and dosage and their interaction effect have recorded significant differences in fruit yield per tree (kg) and fruit yield (t ha^{-1}) in mango cv. Banganpalli.

Regarding the effect of different fertigation dosages (D), maximum yield per tree (107.79 kg) and fruit yield (16.82 t ha^{-1}) was recorded with the application of 100% RDF + micronutrient mixture (D_1) whereas minimum fruit yield per tree (50.97 kg) and fruit yield (7.95 t ha-1) was recorded with the application of 50 % RDF + micronutrient mixture (D_4).

Regarding the effect of different fertigation frequencies (F), maximum yield per tree (88.26 kg) and fruit yield (13.77 t ha^{-1}) was recorded with the application of daily fertigation (F_2) whereas application of one-time fertigation at the marble stage (F_1) resulted in minimum fruit yield (72.16 kg) and fruit yield (11.26 t ha^{-1}).

Regarding the interaction effect of different fertigation frequencies and dosages (D x F), maximum fruit yield per tree (120.95 kg) and fruit yield (18.87 t ha^{-1}) was recorded with the application of daily fertigation with 100% RDF + micronutrient mixture (D_1F_2) (Plate 7)whereas minimum fruit yield per tree (45.46 kg) and fruit yield (7.09 t ha^{-1}) was recorded with the application of one-time fertigation at marble stage with 50 % RDF + micronutrient mixture (D_4 F_1) (Plate 8) (Fig 14 and 15).

The increase in yield per tree in D_1 and F_2 treatments and their interaction was large as a consequence of increased soil and leaf nutrient status (N and K) (Table 3 and 5) and its positive influence on yield attributing characteristics i.e., the highest number of fruits per plant (Table 10), more yield per m^3 canopy volume of the tree, increased size (length and breadth) and weight of individual fruits in the present study which ultimately contributed to more fruit yield per tree. The highest number of fruits per plant, maximum weight of fruit, length and breadth of fruit which was maybe due to enhanced supply of nutrients through increased fertigation level in the root vicinity of plant maintain optimum nutrient concentration in the root zone throughout the crop growth period, which increased the uptake of moisture and nutrients resulted in increasing all the growth attributes which increases the photosynthetic rate and absorption of photosynthetically active radiation (APAR) resulted in more translocation of photosynthates towards reproductive organ (sink) which ultimately increases the yield attributes (Kaur *et al.*, 2019) of mango. Present findings are in accordance with Raina *et al.* (2011) who reported higher fruit yield under 100% RDF applied through fertigation in apricot.

Canopy volume (m^3)

The data obtained for the canopy volume was presented in Table 10. The pooled data on canopy volume revealed that there was no significant difference among the treatments was found with the application of different fertigation dosages (D) and fertigation frequencies (F) and their interaction effect (DxF).

Fruit yield (kg) per m^3 canopy volume of tree

The data obtained for the effect of different fertigation dosages and frequency on canopy volume (m^3) oftree and fruit yield (kg) per m^3 canopy volume of mango cv. Banganpalli was presented in Tables 11. The perusal of pooled data revealed that different levels of fertigation frequency (F) and dosage (D) and their interaction effect (FxD) have shown no significant difference on canopy volume of the tree but fruit yield (kg) per m^3 canopy volume varied significantly in mango cv. Banganpalli.

Regarding the effect of different fertigation dosages (D), maximum yield per m^3 canopy volume (1.34 kg) was recorded with the application of 100% RDF + micronutrient mixture (D_1) whereas minimum fruit yield per m^3 canopy volume(0.65 kg) was recorded with the application of 50 % RDF + micronutrient mixture (D_4).

Regarding the effect of different fertigation frequencies (F), maximum yield per m^3 canopy volume (1.11 kg) was recorded with the application of daily fertigation (F_2) whereas application of one-time fertigation at marble stage (F_1) resulted in minimum fruit yield (0.90 kg) per m^3 canopy volume.

Regarding the interaction effect of different fertigation frequencies and dosages (D x F), maximum fruit yield per m^3 canopy volume (1.50 kg) was recorded with the application of daily fertigation with 100% RDF + micronutrient mixture (D_1F_2)whereas minimum fruit yield per m^3 canopy volume(0.59 kg) was recorded with the application of one-time fertigation at marble stage with 50 % RDF + micronutrient mixture (D_4 F_1).

The increase in yield per m^3 canopy volume with the application of daily fertigation with 100% RDF might be due to frequent and increased application of fertilizers directly in the vicinity of the root zone that increases the soil and leaf nutrient content (N and K) (Table 3 and 5) which leads to increase the cell size and cell elongation (Kaur *et al.*, 2019) resulting in better plant growth with a greater number of fruits per unit volume of the canopy. Furthermore, in the present treatment D_1F_2, fertilizers were applied daily in equal split applications and such fractionated supplies might have met the nutrients requirement of different growth stages of fruits thus leading to higher fruit yield (Kachwaya and Chandel, 2015). The better fruit size and weight of fruits under these fertigation treatments in the present study might have accounted for a higher yield. Further, fertigation with a higher level of nitrogen content produces extra protein by conversion of synthesized carbohydrates into amino acids in the leaf to enable them to grow larger to have a larger surface area for carbon assimilation and thus, probably have resulted in better plant growth and better fruit growth (Borthakur and Bhattacharyya, 1992) recording more fruit yield per unit volume of the canopy. These results are in conformity with those of Panigrahi*et al.* (2012) in Nagpur mandarin and Kumar *et al.* (2013) in sweet orange.

Fertilizer use efficiency (FUE)

The data was obtained for the effect of different fertigation dosages and frequency on the FUE of mango cv. Banganpalli was presented in Table 12. The perusal of pooled data revealed

that different fertigation dosages (D), frequency (F) and their interaction effect (DxF) have recorded significant differences among the treatments in FUE of mango cv. Banganpalli.

Regarding the effect of different fertigation dosages (D), maximum FUE (107.79) was recorded with the application of 100% RDF + micronutrient mixture (D_1) whereas minimum FUE (59.51) was recorded with the application of 50 % RDF + micronutrient mixture (D_4).

Regarding the effect of different fertigation frequencies (F), maximum FUE (94.27) was recorded with the application of daily fertigation (F_2) whereas application of one-time fertigation at marble stage (F_1) resulted in minimum FUE (77.31).

Regarding the interaction effect of different fertigation frequencies and dosages (D x F), maximum FUE (120.95) was recorded with the application of daily fertigation with 100% RDF + micronutrient mixture (D_1F_2)whereas minimum FUE (53.11) was recorded with the application of one-time fertigation at marble stage with 50 % RDF + micronutrient mixture (D_4 F_1) (Fig 16).

The results revealed that the highest fertilizer use efficiency (120.95 kg fruits/kg F) was observed in plants fertigated daily with 100% RDF. This increased fertilizer use efficiency may be attributed to the increase in yield in this treatment. Although the quantity of fertilizers used was higher in this treatment but yield, fruit size and quality were significantly higher in comparison to lower levels of fertigation. Daily fertigation with 80% RDF resulted in optimum fertilizer use efficiency without any adverse effect on yield and fruit quality. This may be the result of higher nutrient availability in soil (N&K) (Table 3) thereby causing higher uptake resulting in increased leaf nutrient content (N&K) (Table 5) and lower losses through leaching and mineralization. Thus, it may be concluded that application of daily fertigation with 100% RDF (D_1F_2) in equal split doses from fruit set to 30 days before harvest resulted in better quality fruits and gave around 22% higher yield as compared to one time fertigation with 100% RDF at marble stage (D_1F_1) and 12% higher yield as compared to daily fertigation with 80% RDF (D_2F_2). In drip and fertigation treatments, the soil remains moist because of regular and sufficient irrigation based on evapotranspiration demand of the crop and also right quantity of water and nutrient is applied in the vicinity of root zone which helps in maintaining optimum water potential in plant system favouring photosynthesis (Kachwaya and Chandel, 2015), which consequently resulted in better nutrient use efficiency of mango. Present findings are in accordance with Janapriya*et al.* (2010) and Haneef *et al.* (2014) in pomegranate who reported higher fruit yield under increased fertigation levels.

Cost economics

The data obtained for the effect of different fertigation dosages and frequency on cost economics in mango cv. Banganpalli was presented in Table 12.

Regarding the cost economics of different fertigation dosage and frequency treatments, application of daily fertigation with 100% RDF + micronutrient mixture (D_1F_2) was found more economical with the highest value of net returns of Rs 304393.32 / ha recording BC ratio as 4.17 whereas one-time fertigation at marble stage with 50% RDF + micronutrient mixture (D_4F_1) was found least economical with the lowest value of net returns of Rs 70362.44 / ha recording BC ratio as 0.98. This is due to the higher yield (Table 10) resulted from the timely availability of higher nutrients in soil and leaves (N&K) (Table 3 and 5) through daily fertigation with 100% RDF (D_1F_2) treatment, which favoured to produce the higher number of marketable fruits with good size and quality. Although more quantity of fertilizers was used in D_1F_2 treatment, the higher returns due to increased fruit yield compensated the extra cost incurred on fertilizers in this treatment with more BC ratio compared to the others (lower) levels of fertigation. These results conform with the findings of Haneef *et al.*, (2014) who reported maximum BC ratio through fertigation with 100% RDF in pomegranate. Further, the treatment daily fertigation with 80% RDF (D_2F_2) resulted in an optimum value of net returns of Rs 242030.89 / ha recording BC ratio as 3.34 without much compromise on yield of fruits compared to other lower levels of fertigation.

Conclusions

Daily fertigation of plants with 100% RD of NK + micronutrient mixture during fruit growth and development resulted in increased soil and leaf nutrient status and more fertilizer use efficiency of plants with enhanced yield and quality in terms of fruit set per panicle, number of fruits per tree, fruit weight, yield per tree and unit (m^3) canopy volume, TSS, specific gravity, reducing sugars, sugar-acid ratio, titratable acidity and shelf life with higher net returns.

Table 3 : Effect of dosage and frequency of fertigation on Nitrogen (kg/ha.), P (kg/ha.) and K (kg/ha.) levels in soil of mango cv. Banganpalli.

	N (kg/ha.)						P (kg/ha.)						K (kg/ha.)					
	After first season or before second season			After second season			After first season and before second season			After second season			After first season and before second season			After second season		
Treatments	**F_1**	**F_2**	**Mean of D**	**F_1**	**F_2**	**Mean of D**	**F_1**	**F_2**	**Mean of D**	**F_1**	**F_2**	**Mean of D**	**F_1**	**F_2**	**Mean of D**	**F_1**	**F_2**	**Mean of D**
D_1	239.65^{d}	260.33^{a}	**249.99^{a}**	243.52^{c}	260.68^{a}	**252.1^{a}**	18.12	18.92	**18.52**	18.42	20.25	**19.33**	331.73^{c}	358.25^{a}	**344.99^{a}**	338.94^{b}	353.81^{a}	**346.37^{a}**
D_2	229.31^{e}	249.99^{c}	**239.65^{b}**	234.94^{d}	252.1^{b}	**243.52^{b}**	17.73	18.53	**18.13**	18.5	19.66	**19.08**	324.89^{d}	342.1^{b}	**333.5^{b}**	329^{d}	335.54^{c}	**332.27^{b}**
D_3	208.62	266.49^{b}	**237.56^{c}**	217.78^{f}	226.36^{e}	**222.07^{c}**	16.94	17.35	**17.15**	17.34	17.92	**17.63**	307.89^{f}	318.06^{e}	**312.98^{c}**	313.79^{f}	320.73^{e}	**317.26^{c}**
D_4	180.28	198.28	**189.28^{d}**	200.62^{h}	209.2^{g}	**204.91^{d}**	16.16	16.57	**16.36**	16.17	16.75	**16.46**	290.89^{h}	304.39^{fg}	**297.64^{d}**	296.92^{h}	304.19^{g}	**300.55^{d}**
Mean of F	**214.46^{b}**	**243.77^{a}**	**229.12**	**224.22^{b}**	**237.08^{a}**	**230.65**	**17.24**	**17.84**	**17.54**	**17.61**	**18.65**	**18.13**	**313.85^{b}**	**330.7^{a}**	**322.28**	**319.66^{b}**	**328.57^{a}**	**324.11**
	S.Em±	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**	
Frequency (F)	0.31	0.93		0.34	1.02		0.5	NS		0.56	NS		1.13	3.42		0.11	0.33	
Dosage (D)	0.43	1.31		0.48	1.44		0.71	NS		0.79	NS		1.6	4.84		0.15	0.47	
FXT	0.61	1.86		0.67	2.04		1.01	NS		1.12	NS		2.26	6.85		0.22	0.66	

**Figures with same alphabet did not differ significantly*

F_1- One time at marble stage **D_1**– N_2 and K_2O @ 100% of RDF **D_3** - N_2 and K_2O @ 60 % of RDF

F_2- Daily fertigation (total dosage divided per day) **D_2**- N_2 and K_2O @80% of RDF **D_4** - N_2 and K_2O @ 50 % of RDF

Table 4 : Effect of dosage and frequency of fertigation on Mg (%), Zn (ppm) and Fe (ppm) levels in soil of mangocv. Banganpalli.

	Mg (%)						Zn (ppm)						Fe (ppm)					
	After first season and before second season			After second season			After first season and before second season			After second season			After first season and before second season			After second season		
Treatments	**F_1**	**F_2**	**Mean of D**	**F_1**	**F_2**	**Mean of D**	**F_1**	**F_2**	**Mean of D**	**F_1**	**F_2**	**Mean of D**	**F_1**	**F_2**	**Mean of D**	**F_1**	**F_2**	**Mean of D**
D_1	0.17	0.2	**0.18**	0.08	0.09	**0.09**	1.35	1.5	**1.43**	0.77	0.8	**0.79**	11.69	12	**11.85**	8.89	9.2	**9.04**
D_2	0.16	0.19	**0.17**	0.08	0.09	**0.08**	1.28	1.43	**1.35**	0.76	0.79	**0.77**	11.54	11.85	**11.69**	8.73	9.04	**8.89**
D_3	0.13	0.14	**0.14**	0.07	0.07	**0.07**	1.13	1.2	**1.17**	0.73	0.74	**0.74**	11.23	11.38	**11.31**	8.41	8.57	**8.49**
D_4	0.11	0.12	**0.11**	0.06	0.06	**0.06**	0.98	1.05	**1.02**	0.7	0.71	**0.71**	10.92	11.07	**11**	8.1	8.26	**8.18**
Mean of F	**0.14**	**0.16**	**0.15**	**0.07**	**0.08**	**0.08**	**1.18**	**1.3**	**1.24**	**0.74**	**0.76**	**0.75**	**11.34**	**11.58**	**11.46**	**8.53**	**8.77**	**8.65**
	S.Em±	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**	
Frequency (F)	0.01	NS		0	NS		0.1	NS		0.03	NS		0.43	NS		0.4	NS	
Dosage (D)	0.02	NS		0.01	NS		0.14	NS		0.04	NS		0.6	NS		0.57	NS	
FXT	0.03	NS		0.01	NS		0.2	NS		0.06	NS		0.85	NS		0.8	NS	

**Figures with same alphabet did not differ significantly*

F_1- One time at marble stage **D_1**– N_2 and K_2O @ 100% of RDF **D_3** - N_2 and K_2O @ 60 % of RDF

F_2- Daily fertigation (total dosage divided per day) **D_2**- N_2 and K_2O @80% of RDF **D_4** - N_2 and K_2O @ 50 % of RDF

Table 5 : Effect of dosage and frequency of fertigation on Nitrogen (%), P (%) and K (%) levels in leaves of mango cv. Banganpalli.

	N (%)						P (%)						K (%)					
	After first season and before second season			After second season			After first season and before second season			After second season			After first season and before second season			After second season		
Treatments	**F_1**	**F_2**	**Mean of D**	**F_1**	**F_2**	**Mean of D**	**F_1**	**F_2**	**Mean of D**	**F_1**	**F_2**	**Mean of D**	**F_1**	**F_2**	**Mean of D**	**F_1**	**F_2**	**Mean of D**
D_1	1.07^{b}	1.61^{a}	**1.34^{a}**	1.01^{b}	1.65^{a}	**1.33^{a}**	0.18	0.21	**0.2**	0.18	0.22	**0.2**	0.87^{b}	1.17^{a}	**1.02^{a}**	0.84	1.56	**1.2**
D_2	0.93^{c}	1.07^{b}	**1^{b}**	0.94^{b}	1.08^{b}	**1.01^{b}**	0.16	0.2	**0.18**	0.17	0.2	**0.18**	0.8^{bc}	1.07^{a}	**0.93^{a}**	0.8	0.89	**0.84**
D_3	0.79^{e}	0.86^{d}	**0.83^{c}**	0.8	0.87^{b}	**0.84^{c}**	0.13	0.15	**0.14**	0.13	0.15	**0.14**	0.72	0.76^{bcd}	**0.74^{b}**	0.72	0.76	**0.74**
D_4	0.65^{g}	0.72^{f}	**0.69^{c}**	0.66	0.73	**0.7^{c}**	0.1	0.12	**0.11**	0.1	0.12	**0.11**	0.64	0.68	**0.66^{b}**	0.64	0.68	**0.66**
Mean of F	**0.86^{b}**	**1.07^{a}**	**0.97**	**0.85^{b}**	**1.08^{a}**	**0.97**	**0.14**	**0.17**	**0.16**	**0.15**	**0.17**	**0.16**	**0.76^{b}**	**0.92^{a}**	**0.84**	**0.75^{b}**	**0.97^{a}**	**0.86**
	S.Em±	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**	
Frequency (F)	0.03	0.1		0.04	0.11		0.02	NS		0.02	NS		0.03	0.08		0.03	0.1	
Dosage (D)	0.05	0.14		0.05	0.15		0.03	NS		0.03	NS		0.04	0.12		0.04	0.14	
FXT	0.07	0.2		0.07	0.21		0.04	NS		0.04	NS		0.05	0.16		0.06	0.19	

**Figures with same alphabet did not differ significantly*

F_1- One time at marble stage **D_1**– N_2 and K_2O @ 100% of RDF **D_3** - N_2 and K_2O @ 60 % of RDF

F_2- Daily fertigation (total dosage divided per day) **D_2**- N_2 and K_2O @80% of RDF **D_4** - N_2 and K_2O @ 50 % of RDF

Table 6 : Effect of dosage and frequency of fertigation on Mg (%), Zn (ppm) and Fe (ppm) levels in leaves of mango cv. Banganpalli.

	Mg (%)						Zn (ppm)						Fe (ppm)					
	After first season and before second season			After second season			After first season and before second season			After second season			After first season and before second season			After second season		
Treatments	**F_1**	**F_2**	**Mean of D**	**F_1**	**F_2**	**Mean of D**	**F_1**	**F_2**	**Mean of D**	**F_1**	**F_2**	**Mean of D**	**F_1**	**F_2**	**Mean of D**	**F_1**	**F_2**	**Mean of D**
D_1	0.24	0.25	**0.24**	0.18	0.19	**0.19**	15.59	16.15	**15.87**	13.1	13.5	**13.3**	93.9	95.3	**94.6**	83.81	85.3	**84.56**
D_2	0.23	0.24	**0.24**	0.18	0.19	**0.18**	15.31	15.87	**15.59**	12.9	13.3	**13.1**	93.2	94.6	**93.9**	83.07	84.56	**83.81**
D_3	0.21	0.22	**0.22**	0.17	0.17	**0.17**	14.76	15.04	**14.9**	12.5	12.7	**12.6**	91.8	92.5	**92.15**	81.59	82.33	**81.96**
D_4	0.2	0.21	**0.2**	0.16	0.16	**0.16**	14.2	14.48	**14.34**	12.1	12.3	**12.2**	90.4	91.1	**90.75**	80.1	80.84	**80.47**
Mean of F	**0.22**	**0.23**	**0.23**	**0.17**	**0.18**	**0.18**	**14.97**	**15.38**	**15.17**	**12.65**	**12.95**	**12.8**	**92.32**	**93.37**	**92.85**	**82.14**	**83.26**	**82.7**
	S.Em±	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**	
Frequency (F)	0.01	NS		0.01	NS		0.51	NS		0.4	NS		0.9	NS		1	NS	
Dosage (D)	0.02	NS		0.02	NS		0.73	NS		0.56	NS		1.27	NS		1.42	NS	
FXT	0.02	NS		0.03	NS		1.03	NS		0.8	NS		1.79	NS		2.01	NS	

**Figures with same alphabet did not differ significantly*

F_1- One time at marble stage **D_1**– N_2 and K_2O @ 100% of RDF **D_3** - N_2 and K_2O @ 60 % of RDF

F_2- Daily fertigation (total dosage divided per day) **D_2**- N_2 and K_2O @80% of RDF **D_4** - N_2 and K_2O @ 50 % of RDF

Table 7 : Effect of dosage and frequency of fertigation on Number of fruitlets per panicle at the time of fruit set,Fruit drop (%) at 703, 705 and 709 stages of mango cv. Banganpalli.

Treatments	Number of fruitlets per panicle at the time of fruit set			Fruit drop (%) at 703 stage			fruit drop (%) at 705 stage			Fruit drop (%) at 709 stage		
	POOLED			POOLED			POOLED			POOLED		
	F_1	F_2	Mean of D	F_1	F_2	Mean of D	F_1	F_2	Mean of D	F_1	F_2	Mean of D
D_1	8.82^{c}	9.96^{a}	**9.39^{a}**	88.71	85.74	**87.23^{b}**	96.34	96.14	**96.24**	98.06	97.69	**97.88**
D_2	8.25^{d}	9.39^{b}	**8.82^{b}**	90.19	87.23	**88.71^{b}**	95.96	95.41	**95.68**	97.64	97.84	**97.74**
D_3	7.1	7.68	**7.39^{c}**	93.15	91.67	**92.41^{a}**	97.26	96.59	**96.93**	98.72	97.79	**98.25**
D_4	5.96	6.53	**6.25^{d}**	96.09	94.59	**95.34^{a}**	96.4	96.07	**96.23**	98.49	98.38	**98.44**
Mean of F	**7.53^{b}**	**8.39^{a}**	**7.96**	**92.03**	**89.81**	**90.92**	**96.49**	**96.05**	**96.27**	**98.23**	**97.93**	**98.08**
	S.Em±	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**	
Frequency (F)	0.06	0.19		1.18	NS		1.01	NS		0.5	NS	
Dosage (D)	0.09	0.26		1.67	4.86		1.43	NS		0.7	NS	
FXT	0.13	0.37		2.36	NS		2.02	NS		1	NS	

**Figures with same alphabet did not differ significantly*

F_1- One time at marble stage **D_1**– N_2 and K_2O @ 100% of RDF **D_3** - N_2 and K_2O @ 60 % of RDF

F_2- Daily fertigation (total dosage divided per day) **D_2**- N_2 and K_2O @80% of RDF **D_4** - N_2 and K_2O @ 50 % of RDF

Table 8 : Effect of dosage and frequency of fertigation on number of days in 701, 703, 705 and 709 stages of mango cv. Banganpalli.

Treatments	Number of days in 701 stage			Number of days in 703 stage			Number of days in 705 stage			Number of days in 709 stage		
	POOLED			POOLED			POOLED			POOLED		
	F_1	F_2	Mean of D	F_1	F_2	Mean of D	F_1	F_2	Mean of D	F_1	F_2	Mean of D
D_1	12.03	10.91	**11.47^{a}**	6.57	5.97	**6.27^{a}**	11.42	10.05	**10.73^{a}**	13.21	12.2	**12.70^{a}**
D_2	12.6	11.47	**12.03^{a}**	6.87	6.27	**6.57^{a}**	12.11	10.73	**11.42^{a}**	13.71	12.7	**13.21^{a}**
D_3	13.72	13.16	**13.44^{b}**	7.47	7.17	**7.32^{b}**	13.48	12.8	**13.14^{b}**	14.72	14.22	**14.47^{b}**
D_4	14.84	14.28	**14.56^{c}**	8.07	7.77	**7.92^{c}**	14.86	14.17	**14.52^{c}**	15.73	15.23	**15.48^{c}**
Mean of F	**13.30^{b}**	**12.45^{a}**	**12.88**	**7.25^{b}**	**6.79^{a}**	**7.02**	**12.97^{b}**	**11.94^{a}**	**12.45**	**14.34^{b}**	**13.59^{a}**	**13.96**
	S.Em±	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**	
Frequency (F)	0.22	0.65		0.11	0.31		**0.22**	**0.64**		0.25	0.72	
Dosage (D)	0.32	0.92		0.15	0.44		0.31	0.9		0.35	1.01	
FXT	0.45	NS		0.21	NS		0.44	NS		0.49	NS	

**Figures with same alphabet did not differ significantly*

F_1- One time at marble stage **D_1**– N_2 and K_2O @ 100% of RDF **D_3** - N_2 and K_2O @ 60 % of RDF

F_2- Daily fertigation (total dosage divided per day) **D_2**- N_2 and K_2O @80% of RDF **D_4** - N_2 and K_2O @ 50 % of RDF

Table 9 : Effect of dosage and frequency of fertigation on number of days taken from fruit set to maturity, fruit length (cm), breadth (cm) and fruit weight (g) at the time of harvest of mango cv. Banganpalli.

Treatments	Number of days taken from fruit set to maturity			Fruit Length (cm) at the time of harvest			Fruit Breadth (cm) at the time of harvesting			Fruit Weight (g) at the time of harvest		
	POOLED			POOLED			POOLED			POOLED		
	F_1	F_2	Mean of D	F_1	F_2	Mean of D	F_1	F_2	Mean of D	F_1	F_2	Mean of D
D_1	99.24	95.91	**97.57^{a}**	12.55	13.14	**12.85^{a}**	10.6	11.14	**10.87^{a}**	490.67^{c}	540.31^{a}	**515.49^{a}**
D_2	105.9	102.57	**104.24^{b}**	12.25	12.85	**12.55^{a}**	10.34	10.87	**10.60^{b}**	465.86^{d}	515.49^{b}	**490.67^{b}**
D_3	115.9	109.24	**112.57^{c}**	11.66	11.96	**11.81^{b}**	9.8	10.07	**9.93^{c}**	416.2	441.04^{e}	**428.63^{c}**
D_4	119.2	112.57	**115.91^{c}**	11.07	11.37	**11.22^{c}**	9.26	9.53	**9.40^{d}**	366.6	391.41	**379.00^{d}**
Mean of F	**110.07^{b}**	**105.07^{a}**	**107.57**	**11.88^{b}**	**12.33^{a}**	**12.11**	**10.00^{b}**	**10.40^{a}**	**10.2**	**434.84^{b}**	**472.06^{a}**	**453.45**
	S.Em±	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**	
Frequency (F)	0.99	2.89		0.08	0.23		0.06	0.19		2.87	8.39	
Dosage (D)	1.4	4.09		0.11	0.33		0.09	0.27		4.06	11.86	
FXT	1.98	NS		0.16	NS		0.13	NS		5.75	16.78	

**Figures with same alphabet did not differ significantly*

F_1- One time at marble stage **D_1**– N_2 and K_2O @ 100% of RDF **D_3** - N_2 and K_2O @ 60 % of RDF

F_2- Daily fertigation (total dosage divided per day) **D_2**- N_2 and K_2O @80% of RDF **D_4** - N_2 and K_2O @ 50 % of RDF

Table 10 : Effect of dosage and frequency of fertigation on number of fruits per tree at the time of harvest, yield per tree (kg) at the time of harvest, yield (t ha^{-1}) at the time of harvest and canopy volume (m^3)of mango cv. Banganpalli.

Treatments	Number of fruits per tree at the time of harvest			Yield per tree (kg) at the time of harvest			Yield (t ha^{-1}) at the time of harvest			Canopy Volume (m^3)		
	POOLED			POOLED			POOLED			POOLED		
	F_1	F_2	Mean of D	F_1	F_2	Mean of D	F_1	F_2	Mean of D	F1	F2	Mean of D
D_1	192.85^{b}	223.81^{a}	**208.33^{a}**	94.63^{c}	120.95^{a}	**107.79^{a}**	14.76^{c}	18.87^{a}	**16.82^{a}**	81.27	80.95	**81.11**
D_2	181.96^{c}	195.58^{b}	**188.77^{b}**	84.76^{d}	100.77^{b}	**92.76^{b}**	13.22^{d}	15.72^{b}	**14.47^{b}**	82.54	81.09	**81.82**
D_3	153.17^{e}	169.73^{d}	**161.45^{c}**	63.78	74.85^{e}	**69.32^{c}**	9.95	11.68^{e}	**10.81^{c}**	77.65	78.41	**78.03**
D_4	124.1	144.27	**134.16^{d}**	45.46	56.47	**50.97^{d}**	7.09	8.81	**7.95^{d}**	77.68	80	**78.84**
Mean of F	**163.01^{b}**	**183.35^{a}**	**173.18**	**72.16^{b}**	**88.26^{a}**	**80.21**	**11.26^{b}**	**13.77^{a}**	**12.51**	**79.79**	**80.11**	**79.95**
	S.Em±	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**	
Frequency (F)	1.08	3.14		0.76	2.22		0.12	0.35		1.24	NS	
Dosage (D)	1.52	4.44		1.07	3.13		0.17	0.49		1.76	NS	
FXT	2.15	6.28		1.52	4.43		0.24	0.69		2.49	NS	

**Figures with same alphabet did not differ significantly*

F_1- One time at marble stage **D_1**– N_2 and K_2O @ 100% of RDF **D_3** - N_2 and K_2O @ 60 % of RDF

F_2- Daily fertigation (total dosage divided per day) **D_2**- N_2 and K_2O @80% of RDF **D_4** - N_2 and K_2O @ 50 % of RDF

Table 11 : Effect of dosage and frequency of fertigation onfruit yield (kg) per m^3 canopy volume and FUE kg/kgof mango cv. Banganpalli.

Treatments	Fruit yield (kg) per m^3 canopy volume			FUE kg/kg		
	POOLED			POOLED		
	F_1	F_2	Mean of D	F_1	F_2	Mean of D
D_1	1.17[b]	1.50[a]	**1.34[a]**	94.63[c]	120.95[a]	**107.79[a]**
D_2	1.03[cb]	1.25[b]	**1.14[b]**	89.37[d]	106.16[b]	**97.77[b]**
D_3	0.82	0.96	**0.89[c]**	72.14	84.03[e]	**78.09[c]**
D_4	0.59	0.71	**0.65[d]**	53.11	65.91	**59.51[d]**
Mean of F	**0.90[b]**	**1.11[a]**	**1.01**	**77.31[b]**	**94.27[a]**	**85.79**
	S.Em±	**C.D. at 5%**		**S.Em±**	**C.D. at 5%**	
Frequency (F)	0.02	0.06		0.8	2.34	
Dosage (D)	0.03	0.08		1.13	3.31	
FXT	0.04	0.11		1.6	4.68	

**Figures with same alphabet did not differ significantly*

F_1- One time at marble stage
F_2- Daily fertigation (total dosage divided per day)
D_1– N_2 and K_2O @ 100% of RDF
D_2- N_2 and K_2O @80% of RDF
D_3 - N_2 and K_2O @ 60 % of RDF
D_4 - N_2 and K_2O @ 50 % of RDF

Table 12 : Effect of dosage and frequency of fertigation on Economics of mango cv. Banganpalli

Sr. No	Treatments	Economics					
		Yield per plant	Yield kg/ha	Gross realization Rs/ha	Total cost of cultivation Rs/ha	Net realization Rs/ha	BCR
1	F_1D_1	94.63	14762.28	295245.60	72970.68	222274.92	3.05
2	F_1D_2	84.76	13222.56	264451.20	72371.51	192079.69	2.65
3	F_1D_3	63.78	9949.68	198993.60	71772.34	127221.26	1.77
4	F_1D_4	45.46	7091.76	141835.20	71472.76	70362.44	0.98
5	**F_2D_1**	**120.95**	**18868.20**	**377364.00**	**72970.68**	**304393.32**	**4.17**
6	F_2D_2	100.77	15720.12	314402.40	72371.51	242030.89	3.34
7	F_2D_3	74.85	11676.60	233532.00	71772.34	161759.66	2.25
8	F_2D_4	56.47	8809.32	176186.40	71472.76	104713.64	1.47

**20 Rs. Cost Per kg fruits*

F_1- One time at marble stage
F_2- Daily fertigation (total dosage divided per day)
D_1– N_2 and K_2O @ 100% of RDF
D_2- N_2 and K_2O @ 80% of RDF
D_3 - N_2 and K_2O @ 60 % of RDF
D_4 - N_2 and K_2O @ 50 % of RDF

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