AJH
eISSN- 0976-724X

THE ASIAN JOURNAL OF HORTICULTURE
Volume **11** | Issue 2 | December, 2016 | 411-419
Visit us -*www.researchjournal.co.in*

A REVIEW

DOI : 10.15740/HAS/TAJH/11.2/411-419

Article history :
Received : 28.09.2016
Accepted : 29.11.2016

Effect of fertigation, splitting and mulching on different fruit crops

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KEY WORDS : Fertigation, Splitting, Mulching, Fruit crops

HOW TO CITE THIS ARTICLE : Jadhav, P.B., Padhiar, B.V. and Dekhane, S.S. (2016). Effect of fertigation, splitting and mulching on different fruit crops. *Asian J. Hort.*, **11**(2) : 411-419, **DOI : 10.15740/HAS/TAJH/11.2/411-419.**

Fertigation, splitting and mulching are an essential tools in precision farming and that effectively affected in physiological, growth attributes, yield and quality parameters as well as nutrients content in leaves. Joint use of fertigation and mulch resulted in comparable growth and yield as unmulched condition and saved in fertilizers and irrigation water. Mulches maintain the soil temperature, retard the loss of soil moisture, suppress of wood growth, conservation of soil from erosion, reduction of soil salinity, improvement of soil structures, improve water infiltration rate by creating hindrance in flow of water, control of pest and diseases and enhance microbial activity in the field. The total dry matter (TDM) production and leaf area index were significantly higher in drip irrigation. Water-soluble fertilizer (WSF) fertigation recorded significantly higher total dry matter and LAI over drip irrigation. Chlorophyll concentration was significantly higher in fertigation treatments over soil applied treatments. The fruit yield in fruit crop was higher in drip irrigation over furrow irrigation. Fertigation with 100 per cent WSF increased the fruit yield significantly over furrow-irrigated control and drip irrigation. Fertigation resulted in lesser leaching of NO_3-N and K to deeper layer of soil. Subsurface drip fertigation caused higher assimilable P in deeper layer.

Effect of fertigation and mulching on growth parameters :

Papaya :

Biswas *et al.* (1989) reported that maximum plant height (176.5 cm), girth (38.1 cm) and number of leaves (96.3) were in the treatment combination of 350 g N and 600 g P_2O_5 per plant in papaya.

Scheduling the nutrient application under drip fertigation system at weekly intervals six splits were found to be good, while recommended twelve splits to get higher yield and quality of fruits in CO-2 papaya (Irulappan *et al*., 1984; Sulladmath *et al*., 1984; Jeyakumar *et al*., 2001 and Ravichandrane *et al*., 2002)

Singh *et al.* (2004) studied on N, P and K @ 400 g N + 350 g P_2O_5 and 600 g K_2O per plant, which gave maximum plant height, girth, number of leaves, number of fruits per plant, fruit size (cm), yield per plant and yield ha^{-1}, also quality parameters like total soluble solids,

total sugar and ascorbic acid in papaya cv. RANCHI.

Agrawal *et al.* (2010) revealed that water-soluble fertilizer for fertigation was quite effective on plant vigour, flowering, fruit set, yield and quality of papaya cv. RED LADY. Plant height, stem girth, number of functional leaves, earlier flowering and early fruit set were higher under 100 per cent fertigation treatment.

Jeyakumar *et al.* (2010) reported that application of N and K_2O through drip resulted in flowering at the lowest height, maximum stem girth and higher number of leaves in 100 per cent recommended dose of fertilizers in papaya cv. CO 7.

Singhkirad *et al.* (2010) observed that maximum number of leaves, trunk girth, shelf-life of fruit were recorded with 75% RDF + 25% vermicompost + rhizosphere bacteria culture, while maximum plant height and petiole length were associated with 100% RDF alone in papaya cv. SURYA.

The result of Ray *et al.* (1999) in papaya was to be important with respect the treatment RDF + organic manure combination, similarly Prasad *et al.* (2010) concluded that the maximum plant height, early flower initiation and maximum average fruit weight (1298.88 g) were noted under the $N_3P_2K_2$ and minimum days (246.11) taken to flower initiation as well as average number of fruits (44.66), in treatment $N_2P_2K_2$. FYM 10 kg + neem cake 2 kg, cake-o-meal 1 kg with 200 g N, 200 g P_2O_5 and 200 g K_2O gave highest stem circumference (33.4 cm) and minimum days to fruit setting (154.8 days) in papaya cv. PUSA DELICIOUS.

Anonymous (2011) reported that the drip and mulching shown positive response in term of growth parameters *i.e.,* plant height (1.82 m), stem girth (45.43 cm), number of leaves per plant (31.74), leaf length (86.99 cm), leaf width (87.12 cm) and petiole length (85.24 cm) were maximum in the fruits of papaya cv.TAIWAN RED LADY (786) plants receiving combination with treatments of drip fertigation with black polythene mulch.

Yadav *et al.* (2011) observed that under combination of 30 kg FYM + 100 % NPK + 25 g *Azotobacter* was recorded with maximum enhanced the yield attributes such as days taken to first flowering, days taken to maturity, fruit weight, number of fruits per plant, yield kg $plant^{-1}$ and q ha^{-1} in papaya cv. PUSA DWARF.

Banana :

Srinivas (1997) studied the growth and yield response of banana to nitrogen fertilization through drip irrigation (fertigation) and direct soil application. Plant height, stem girth and leaf number increased with N soil application and with N fertigation although the increase was not significant beyond 100 g N/plant applied through drip irrigation compared to direct soil application. Fruit yields were highest with 300 g N $plant^{-1}$ fertigation, but the differences were not significant above 100 g N. However, yield increased with soil applied N up to 200 g both in the plant and the ratoon crop.

According to Suganthi (2002) the planting of one plant / pit along with 100 per cent of RDF (110:35:300 g NPK) through fertigation resulted in higher bunch weight (22.55 kg), number of fingers (98.92) and finger weight (255.36 g) in banana cv. RED BANANA.

Guava :

Plants in respect of canopy spread, number of fruits per plant, fruit yield plant and per hectare, minimum days to 50 per cent flowering and minimum days to fruit maturity were found under 80 per cent water through drip with plastic mulch in guava cv. L 49 (National variety -Sardar- Selection from seedling Allahabad Safeda) (Dikshit *et al.,* 2010).

Effect of fertigation and mulching on physiological attributes :

Papaya :

The influence of temperature and increased photosynthesis might have influenced to the initiation of first flowering, 50 per cent flowering, number of flowers per plant, fruit set percentage due to different levels of drip irrigation and mulching (Dikshit *et al.,* 2010).

Banana :

As reported by Turner (1970) in banana, the increased production of leaves might have helped to produce more photosynthetic and to induce flowering stimulus and plants commence flowering and fruit set about 15-25 days earlier due to the efficient and timely utilization of nutrients applied through fertigation.

Agrawal *et al.* (1997) reported splitting of N, P and K helps in accumulation of photo-assimilates and also helps in better availability of nutrients during crop period and thus, favours the yield and quality improvement in banana.

Guava :

Patil and Patil (2001) noticed that greater influence

of temperature and increased photosynthesis might have influenced to the initiation of first flowering, 50% flowering, number of flowers per plant, fruit set percentage due to different levels of drip irrigation and mulching. Similar results were corroborated with the findings of Patra *et al.* (2003) in guava and Turner (1970) in banana.

Effect of fertigation and mulching on yield and yield attributes :

Papaya :

Purohit (1977) studied response of papaya to dose of 250 g N + 110 g P + 415 g K per plant per year gave maximum number of fruits, fruit weight and ultimately maximum yield.

In Solo variety of papaya, 250 g N, 250 g P_20_5 and 200 g K_20 plant^{-1} year^{-1} applied in 6 split doses were the best when spaced at 2 x 2 m (Sulladmath *et al.,* 1984 and Irulappan *et al.,* 1984).

Biswas *et al*. (1989) revealed that maximum number of fruit (46) and yield (1267.1 q/ha) with treatment combination of 350 g N and 600 g P_2O_5 per plant in papaya.

Marinho *et al.* (2001) observed that two sources of N (ammonium sulfate and ammonium nitrate were applied at 10, 20 and 30 g plant^{-1} month $^{-1}$, respectively). The treatments with ammonium nitrate significantly produced higher fruit yield, as well as increased ascorbic acid concentration in papaya cv. IMPROVED SUNRISE SOLO LINE- 72/12 fruits.

Oliveira and Caldas (2004) reported that good yields and quality of fruits are directly linked to a balanced nutrition of determining the nitrogen (N), phosphorus (P) and potassium (K) doses of maximum physical efficiency for the papaya. At the same way, a plant appropriately well nourished, is able to resist illnesses and has a better potential for reaching high yields. A dose of 350 g N, 250 g P_2O_5 and 200 g K_2O/plant/ year applied in 6 split doses was the best for Solo variety under Bangalore conditions (http://*www. pnbkrishi.com/papayatech.htm, 2010*).

Agrawal *et al.* (2010) carried out the experiment of study the effect of fertigation through water-soluble fertilizers on growth, yield and quality of papaya cv. RED LADY. Fruit length (32.12 cm), circumference (68.72 cm), fruit number (56.32), fruit weight (1748.33 g), pericarp (epicarp + mesocarp) thickness (3.21 cm) and per cent TSS (12.38^{o}B) and fruit yield (140.80 t/ha) were higher under the treatment *i.e.* application of 100 per cent fertilizers of recommended dose through drip irrigation. Further it was reported also reported that number of fruits per plant (56.32), fruit weight (1748.33 g) and maximum yield of 144.80 t/ha were obtained in F_1 treatment *i.e.* 100 per cent fertilizer of recommended dose applied.

Jeyakumar *et al*. (2010) concluded that more number of fruits, fruit weight and TSS with 100 per cent recommended dose of N and K_2O (50 g N and 50 g K_2O) through drip irrigation, in addition to soil application of 50 g P_2O_5. The increase in number of fruits and fruit weight is attributed for higher fruit yield per tree (73.97 kg) and the resultant total fruit yield per hectare (184.9 tonnes) with high B:C ratio (1:1.97) in plants with above treatment, treated with 100 per cent recommended dose of N and K_2O (50 g N and 50 g K_2O) through drip irrigation, in addition to soil application of 50 g P_2O_5.

According to Kumar *et al.* (2010), application of N 300, P_2O_5 300 and K_2O 300 kg/ha/year was beneficial for papaya to get maximum single fruit weight and fruit yield in content in yellow and red fleshed varieties of papaya in cvs. CO 2 and CO 7, respectively.

Sadarunnisa *et al.* (2010) reported that 75 per cent N and K, when applied through drip recorded a yield of 100.42 kg/plant which was on par with the yield of plants supplied with 100 per cent RDF (102.60 kg/plant).

The experiment in papaya cv. MADHU BINDU was carried out by Tank *et al*. (2011) and they concluded that number of fruits/plant (28.29), average fruit weight (1.248 kg), fruit yield (35.31 kg/plant) and fruit yield (79.46 t/ha) were maximum in the fruits of papaya cv. MADHU BINDU plants receiving combination with treatments of drip irrigation @ 0.8 PEF + BPM + N and K_2O @ 100% RDF through fertigation.

Anonymous (2011) reported that number of fruits per plant (50.69) and fruit yield (66.70 t/ha) were found the maximum in papaya cv. TAIWAN RED LADY (786) plants receiving combination with treatments of drip @ 0.6 PEF + black polythene mulch @ 20 % area coverage (50 micron) + fertigation than drip and control alone.

Banana :

Pandit *et al.* (1992) found that Dwarf Cavendish banana along with 80 g N, 50 g P_2O_5 and 120 g K_2O produced significantly highest yield (35 t ha^{-1}) and number of hands per bunch.

Berad *et al.* (1998) observed that 100:40:200 N,

P_2O_5 and K_2O g/plant in solid form and N applied through the drip irrigation treatments performed well in respect of all yield attributes and registered 15 per cent higher yield (68.5 t/ha) and 7 per cent higher net return in banana cv. BASRAI.

The highest number of fruits and yield plant^{-1} were significantly obtained in treatment combination applied *i.e.*, 200 g N + 50 g P_2O_5 + 200 g K_2O to the banana cv. NEY POOVAN (Lavania and Jain, 1998).

Mahalakshmi (2000) revealed that under both the normal and high density system of planting, fertigation was effective in improving the yield in cv. ROBUSTA (AAA).

Arumugam and Manivannan (2001) reported that the application of N and K at 200 g and 400 g per plant, respectively and recorded as the highest bunch weight of 33.71 kg, which was at par with 200 g and 300 g N and K per plant, respectively. The yield attributes like number of fingers per bunch, number of finger per hand, weight, length and girth of fingers were favourably influenced by the application of nutrients.

Chandrakumar *et al*. (2001) revealed that the increase in the N and K fertigation levels improved the growth parameters of plants. However, differences beyond 100 g were not significant. Furthermore, both levels and ratios of N and K fertigation influenced the yield and yield parameters. The positive response of banana to higher potassium application after flowering was also observed. The highest profit per rupee invested was recorded with 150 g of N and K fertigation at 1:2 ratio.

Deolankar and Firake (2001) studied the effect of water soluble fertilizer rates (40, 60, 80 and 100 g/plant) and grades (20:10:20, 18:9:18, 10:20:20, 15:15:15, 34:0:0, 0:0:60 and 0:0:50) as well as that of irrigation methods (surface and drip irrigation) on the growth and yield of banana. The number of fingers per bunch was higher with premium-grade fertilizers over regular-grade fertilizers. NPK at 100 and 80 per cent were equally effective in improving the yield and yield attributes, except the number of fingers per bunch.

Tumbare and Bhoite (2001) studied the optimization of liquid fertilizer under drip irrigation with different levels of recommended dose (50, 75, 100 and 125 % of RDF) in banana. The banana crop responded to 125 per cent of recommended dose of liquid fertilizers for achieving optimum fruit yield. The quadratic function predicted the yield to the highest degree of accuracy, indicating that the quadratic function fits well to yield of banana.

The increase in yield with increasing fertigation levels and highest at 2000g N and K as reported by Reddy *et al*. (2002). They further stated that soil application resulted in the lowest yield, while drip application showed the highest yield in banana cv. ROBUSTA (AAA).

Amilton *et al*. (2004) studied four fertilizer application models monthly fertigation promoted bunch weight and yield as well as reducing 50 per cent RDF did not affect yield and quality of the banana cv. PRATA-ANA BANANA (*Musa* sp. AAB).

The maximum yield of 620.4 q/ha was obtained with 1.8 x 1.8 m spacing followed by 2.0 x 2.0 m spacing with recommended dose of fertilizers 200:40-50:300 g NPK (Pathak *et al.,* 2010).

Guava :

Dikshit *et al*. (2010) reported that maximum number of leaves, twigs and yield were observed with the treatment 60 per cent of water through drip irrigation than rest treatments.

Citrus :

Shirgure *et al*. (2001) found that fertigating Nagpur Mandarin with 50:140:70 NPK kg ha^{-1} is good in improving the tree vigour, yield and quality of fruits. Application of 75 per cent recommended amount of N and K through drip irrigation was found ideal for sweet oranges under Maharastra, Andhra Pradesh and Punjab conditions.

Mango:

Various parameters like fruit weight (465.32 g), number of fruits per tree (160.00) and yield per tree (50.89 kg tree^{-1}) were observed the highest by balanced application of 100 per cent recommended dose of nutrients 800:400:800 g NPK plant^{-1} year^{-1} through fertigation in mango cv. RATNA planted under high density planting (Sivakumar, 2007).

Effect of fertigation and mulching on quality parameters :

Papaya :

Jeyakumar *et al*. (2001) found graded doses of K (0, 150, 300 and 450 kg K_2O ha^{-1}) were applied with two cultivars (CO 2 and CO 7) at four locations of Tamil Nadu and found that potassium nutrition significantly influenced fruit weight, fruit yield plant^{-1} and the quality of fruits.

Two sources of N, 1) ammonium sulfate and 2) ammonium nitrate (10, 20 and 30 g plant^{-1} month^{-1}) were studied by Marinho *et al.* (2001) and it was stated that total soluble solids contents decreased, when ammonium sulfate application increased. The treatment with ammonium nitrate resulted in higher fruit production, as well as increased ascorbic acid concentration in papaya cv. IMPROVED SUNRISE SOLO LINE- 72/12.

Ravichandrane *et al.* (2002) were recommended twelve splits instead of six as it resulted application of 400 g each of NPK plant^{-1} year^{-1} gave higher yield and number of fruits, TSS 14.40 (%), carotene enzyme 3.64 mg 100g^{-1} pulp and fruits weight 2.11 kg in papaya cv. CO 2.

Agrawal *et al.* (2010) observed that TSS (12.38°B) higher under the treatment *i.e.* application of 100 per cent fertilizers of recommended dose through drip irrigation in papaya cv. RED LADY.

Kumar *et al.* (2010) recommended the application of balanced fertilization with N 300, P_2O_5 300 and K_2O 300 kg/ha/year for papaya to get maximum pulp thickness in papaya in content in yellow and red fleshed varieties.

The quality characters of fruits like fruit length, circumference, volume and TSS etc. in fertigated treatments were found superior by Sadarunnisa *et al.* (2010). Since there was no significant difference between 100 and 75 per cent N and K treatments through drip regarding yield and yield attributes.

Maximum number of number of fruits per plant (46), average fruit weight (0.85 kg), pulp thickness (3.5 cm), shelf life of fruit (12 days), vitamin A (2280 IU/100 g pulp) and TSS (15.8°Brix) were recorded with 75% RDF + 25% vermicompost + rhizosphere bacteria culture treatment in papaya cv. SURYA (Singhkirad *et al.*, 2010).

Tank *et al.* (2011) reported that maximum fruit TSS (11.10 ^{0}Brix), total sugar (9.89%), reducing sugar (8.43%), ascorbic acid content (35.31 mg/100 g pulp) and minimum non-reducing sugar (1.46%) of fruits in papaya cv. MADHU BINDU harvested from the plants were received the treatment of application of drip irrigation @ 0.8 PEF + N and K_2O @ 100 RDF.

Litchi :

The maximum fruit weight was observed in cv. BOMBAI and lowest in cv. SHAHI (RED), while TSS (9.0-13.0%) and total sugar (6.96-10.50%) were observed in cv. BOMBAI and cv. SHAHI, respectively (Zaman *et al.*, 2006).

Banana :

Upadhyay (1988) applied N as ammonium sulphate at 0.09 or 0.18 kg/plant, P as superphosphate at 0.13 or 0.26 kg/plant and K as MOP at 0.26 or 0.52 kg/plant in four equal split doses *viz*., in July, September, February and June months and observed that the highest yield was obtained with N + P at higher rate, whereas fruit quality was best with N, P_2O_5 and K_2O each at the lower rate.

Natesh *et al.* (1993) observed that application of the recommended fertilizer rates (190 g N, 115 g P_20_5 and 300 g K_20, per plant per year) in 4 splits (2, 4, 6 and 8 months after planting) increased banana cv. NENDRAN yield compared with the same rates applied in 2 splits (2 and 4 months after planting).

Agrawal *et al.* (1997) studied the effect of NPK on qualitative characters of *in vitro* banana cv. ROBUSTA. Fruit quality in terms of TSS, reducing sugar and total sugar were proven to be the best with 450 g per plant each of N and K applied in 5 splits.

Srinivas (1997) indicated that the application of 100 per cent fertilizers of recommended dose through drip system were found the maximum yield without affecting the fruit quality, similar results was reported in Ney Poovan and Robusta banana (AAA) under drip irrigation by Mahalakshmi *et al.* (2001).

The normal and high density system of planting was studied by Mahalakshmi (2000) and revealed that fertigation was effective in improving the quality in cv. ROBUSTA (AAA).

Deolankar and Firake (2001) studied the effect of water soluble fertilizer rates (40, 60, 80 and 100 g/plant) and graded doses (20:10:20, 18:9:18, 10:20:20, 15:15:15, 34:0:0 and 0:0:50) as well as that of irrigation methods (surface and drip irrigation) on the growth and yield of banana. The quality parameters (pulp: peel ratio and total soluble solids) were highest with 100 per cent recommended dose of NPK.

Raskar (2003) reported that banana yield was significantly higher where water-soluble fertilizer used in fertigation compared to straight fertilizer. The yield, pulp: peel ratio and total soluble solids (TSS) were increased significantly by application of 100 per cent recommended dose of fertilizer. The returns and benefit: cost ratio were significantly higher in normal planting in straight fertilizer with N through drip and application of 100 per cent recommended dose of fertilizer.

Guava :

Khoreiby and Salem (1989) reported that white polythene mulch improved fruit quality of guava over control and black polythene was superior over Jaishakti in improving fruit quality. These results are in close conformity with Tang *et al*. (1985) and Naygtal *et al.* (1985).

The scheduling of irrigation adopted in orchard influences the availability of soil moisture to the plant as well as its distribution in the soil profile and thus, improves yield and quality in bearing trees. The advantageous effects of drip irrigation have been proved by many workers *viz.,* Sen and Deshmukh (2000); Pathak *et al.* (2002) and Nath and Pathak (2006) in guava and aonla, but the actual requirement of water varies in different agro-climatic conditions. The beneficial effect of plastic mulch in guava production has been widely discussed by several workers such as Bhattacharya and Bortharkar (1992); Debnath *et al.* (2004) and Maji and Das (2008).

Dikshit *et al.* (2010) reported that the treatment having 60 per cent water through drip with plastic mulch was found effective for maximum fruit diameter (7.56 cm), weight of pulp (182.34 g), reducing sugar (3.82 %), total sugar (10.83 %) and minimum acidity (0.32 %) of guava cv. L-49 (Sardar).

Mango :

Sivakumar (2007) showed that significantly higher TSS (24.93 ^{0}B), ascorbic acid content (48.92 mg 100 g pulp^{-1}) and carotenoides content (5.82 mg 100 g pulp^{-1}) were found in balanced application of 100 per cent recommended dose of nutrients 800:400:800 g NPK plant^{-1} year^{-1} through fertigation in mango cv. RATNA planted under HDP.

Effect of fertigation and mulching on nutrient contents in leaf :

Papaya :

Veerannah and Selvaraj (1984) found that uptake of N, P, K, Ca and Mg on papaya cv. CO 1 were higher between flowering (53.37, 15.41, 203.36, 4.10 and 2.30 kg ha^{-1}, respectively) and harvesting stages (305.58, 103.68, 524.02, 327.40, and 183.34 kg ha^{-1}, respectively), but uptake is specifically higher between fruit development and harvest stages more so with potassium.

Extent of the various nutrients removed from soil by whole papaya plant at different phases of growth *viz.*, seedling, vegetative, pre-flowering, flowering, fruit development and harvest. Significant uptake of the nutrients is observed after flowering. The nutrients removed by whole plant at harvest were 305, 103, 524, 327 and 183 kg per hectare N, P, K, Ca and Mg, respectively. Thus, the ratios of N, P, K removed are 1:0.34:1.71 (*www.http://ikisan.com. 2000*).

The CO 1 papaya plant revealed significant uptake of nutrients like N, P, K, Ca and Mg at the flowering and the nutrients were removed by the whole plant at harvest were 305, 103, 524, 327 and 183 kg of N, P, K, Ca and Mg/ha, respectively. Thus, the ratio of N:P:K removed was 1:0.33:1.71. Field trials showed that 140-350 g N, 200-300 g P_2O_5 and 200-300 g K_2O/plant/year are optimum, depending on the cultivars and soil-climatic conditions. Inorganic fertilizers @ 200-250 g each of N, P_2O_5 and K_2O/plant are generally recommended for obtaining high yield in papaya. The N @ 200 g/plant was found optimum for fruit yield at Pusa (Bihar), papain yield increased with level of doses up to 300 g/plant at Coimbatore (*http://www.pnbkrishi.com/papayatech.htm, 2010*).

Jeyakumar *et al*. (2010) reported that 100 per cent recommended dose of N and K_2O (50 g N and 50 g K_2O) through drip irrigation significantly influenced the leaf N and K content while, P revealed no variations among the treatments in papaya cv. CO 7.

Banana :

Scanning of literature showed that critical levels of N (%), P (%) and K (%) varied from for banana 2.85, 0.20 and 4.69 (Kohli *et al*., 1981), 2.80, 0.52 and 3.80, respectively (Ray *et al*., 1981), 2.09, 0.10 and 4.48, respectively (Nalina, 1999), 2.98, 0.32 and 2.53 (Mahalakshmi, 2000) and 3.01, 0.36 and 2.28, respectively (Kavino, 2001).

Srinivas *et al.* (2001) observed that the plant height, stem girth and number of functional leaves increased with ontogeny of the crop and with increase in N and K fertigation upto 200 g/plant. Leaf area index increased significantly with the application of 150 g N and K fertigation. However, leaf area duration increased gradually upto harvesting date with 150 g N and K fertigation. The fruit yield and yield components increased markedly upto 150 g N and K fertigation. The N uptake was highest with leaves followed by fruits and stem. The P uptake was highest in fruit followed by stem and leaves, where K uptake was highest in fruits followed by leaves and stem.

Citrus :

Thirty tonnes of citrus fruits removed 270 kg N, 60 kg P_2O_5 and 350 kg K_2O from the soil (Tandon and Kemmler, 1986).

Guava :

Lal *et al*. (2000) noticed that the application of N at 600 g/plant/year significantly enhanced N and Mn content of leaves, while it reduced the P, K and Zn content of leaves.

Pineapple :

Cowie (1951) was reported that for pineapple yield 100 tonne ha^{-1} production requirement of uptake of N, P, K @ 123, 34, 308 kg ha^{-1}, respectively.

Stewart (1956) reported that requirement of uptake N, P, K @ 574, 126, 631 kg ha^{-1}, respectively for 81 tonne ha^{-1} yield of pineapple.

Martin and Prevel (1961) reported requirement uptake for pineapple yield 81 tonne ha^{-1} of N, P, K, Ca and Mg @ 205, 58, 393, 121 and 42 kg ha^{-1}, respectively.

Sapota:

Avilan *et al.* (1980) reported that 8 to 10 year old sapota tree were required 1.69 kg K_20, 1.16 kg N, 1.12 kg Ca, 0.17 kg P_2O_5 and 0.14 kg MgO to produce 1000 kg of fruits.

Conclusion :

Soil moisture under fertigation remained greater in the upper 0–30 cm of soil, whereas under conventional surface irrigation, deeper layers registered greater values. Mulch application resulted in greater moisture and raised the minimum but lowered the maximum soil temperatures, especially during later growth periods. Available nitrogen (N) and potassium (K) contents under fertigation closely followed the moisture distribution pattern. Irrespective of treatments, available phosphorus (P) remained confined within upper layer soil depth. Fertigation resulted in greater growth and yield over conventional fertilization with irrigations besides saving about 30 per cent in irrigation water.

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