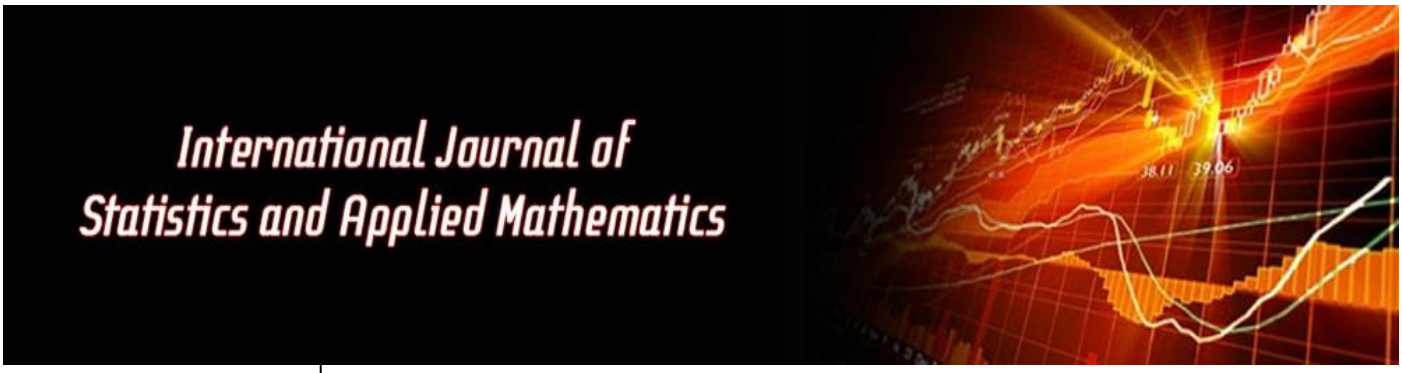

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Horticultural techniques to improve growth, yield and quality of major fruit crops

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Abstract
In mango an application of paclobutrazol @ 5g a.i. per tree at 15th July, pruning third order branches 30cm from origin improved growth, yield and quality. In banana desuckering stage (300 mm), bunch cover with white non-woven polypropylene bag, silver-black polyethylene mulch, removal of male bud and feeding of bunch with urea (7.5 g) + sulphate of potash (7.5 g) + cow dung (500 g) + 100ml water and planting two suckers per pit spaced at 1.8X3.6 m improved growth, yield and quality parameters of banana. In guava crop regulation by water stress, light pruning at 20cm + borax 0.2%, 250 gauge black polythene, high density planting at 2X1.5m and branch bending improved growth, yield and quality parameters. In pomegranate 50% RDF through fertigation, pragmen paper bag, 30cm pruning + 30 fruit retain per plant, 100 µ silver polythene mulch improved growth, yield and quality. Citrus responded well to girdling + 2% KNO_3, GA_3 50 ppm in June + cycocel 1000 ppm in September+ KNO_3 2%, black polythene mulch; fertigation with 120% of RDF improved growth, yield and quality. Papaya performed better with 100% RDF (28.29 kg) + plastic mulch + vermiwash + neem seed extract (87.31 MT) improved growth, yield and quality. In ber pruning on 16th May + keeping 60cm length of branch improved growth, yield and quality of ber.

Keywords: Mulching, DE suckering, training, pruning, denavelling, girdling

Introduction
Cultivation of fruit crops plays an important role in the prosperity of nation. It is generally stated that the standard of living of the people can be judged by per capita production and consumption of fruits. Fruits crops are capable of giving higher tonnage of yield per unit area than other field crops. Fruits are major source of vitamins and minerals like calcium, phosphorus and iron from major fruits like Mango, Banana, Guava, Papaya, Citrus etc. Need of horticultural techniques are higher yield from unit area, production of quality fruit for valuable market return, proper maintenance of orchard, utilization of farm and natural resources, control of biotic and a biotic factor by proper supervision of orchard. In mango, different techniques like, Canopy management, training, pruning, mulching, fertigation, use of paclobutrazol, use of KNO_3, smudging, girdling, bagging, rejuvenation are used. In banana, high density planting, mulching, fertigation, earthing up, DE suckering, propping, denavelling, pduncle wrapping, bunch covering, bunch feeding, mattoking practices are done. In Guava**,** meadow orchard, mulching, fertigation, crop regulation, cultural practices, to expose roots, deblossoming**,** bending, pruning, chemical methods are used. In Pomegranate, High density planting, Training & pruning, Mulching, Fertigation, Bahar treatment, Bagging etc. are done. In citrus done different practice like, high density planting, mulching, fertigation, crop regulation, girdling. In Papaya**,** mulching, fertigation, bagging are done. In ber Pruning is done. (Malam *et al.*, 2022) [11]

Mango
Reported that treatment heading back up to tertiary branches gave maximum flowering (58.40%) and fruit weight (210.15 g) and it was at par with treatment heading back up to secondary branches and thinning out of central leader branch was considered as T_3 in fruit weight (g). Highest TSS (25.10º Brix) observed under treatment thinning out of central leader branch was considered as T_3 followed by treatment Heading back up to secondary branches.

Dalvi *et al.* (2010) [4] showed that the spacing 5 m X 5 m in Alphanso mango significantly increased the number of fruits/tree (89), average fruit yield (18.4 kg/tree), average yield (6.400 tree/hectare) and fruit weight (297 g). Reddy and Kurian (2011) [19] concluded that significantly maximum numbers of fruits per plant (400.4), fruit yield (82.4 kg/plant) and minimum acidity (0.201%) were observed in the treatment of pruning third order branches 30 cm from origin in mango cv. Alphonso and it was at par with treatment pruning third order branches 45 cm from origin in numbers of fruits per plant (356.9) and fruit yield (72.5 kg/plant).

Patel and Tandel (2011) [14] reported that soil application of paclobutrazol @ 5 g a.i. per tree during 15th July gave significantly maximum yield in Alphanso (11310 kg/tree), Rajapuri (25181 kg/tree) and Kesar (11826 kg/tree) varieties of mango and it was at par with 15th August, paclobutrazol at 5g a.i. per tree in Kesar and Rajapuri mango. Highest average weight of fruit reported in Kesar reported with drenching at 15th July, paclobutrazol at 5g a.i. per tree in Kesar mango and followed by all the treatment in kesar varieties except control whereas in Alphanso control gave the best result. While drenching at 15th Sep. paclobutrazol at 5g a.i. per tree gave maximum TSS (20.63º Brix) in variety Alphanso mango and which was at par with drenching at 15th July, paclobutrazol at 5g a.i. per tree and 15th August, paclobutrazol at 5g a.i. per tree.

Kulkarni *et al.* (2012) [7] revealed that significantly maximum weight of fruit (275g), yield/tree (150.62 kg) and TSS (20.97 ºBrix) under mulching + $Ca(NO_3)_2$ (4%) followed by treatments mulching + $CaCl_2$, $6H_2O$ (4%), mulching + $CaCl_2$, $6H_2O$ (2%) and mulching + K_2SO_4 (1%). However maximum number of fruit per tree recorded in mulching (100 micron black plastic) and minimum acidity (0.22) noted in mulching + $CaCl_2$, $6H_2O$ (4%). Sarker and Rahim (2013) [20] suggested that treatment urea at 4% gave maximum fruit weight (202.83 g), TSS (25.53 %), vitamin c (31.97 mg/100 g pulp) and minimum acidity (0.19 %). While significant maximum no. of fruits per plant (136.67) gave treatment KNO_3 at 4% in mango. Nagaharhitha *et al.* (2014) recorded that bagging of mango fruit at harvest stage with plastic bag gave maximum ascorbic acid (79.43 mg/100 g) which was superior to all other treatments. While highest reducing sugar was noticed in treatment control (1.80%) at harvest stage and it was at par with bagging with scurting bag, muslin bag and plastic bag. Non reducing sugar (1.21%) was the highest in treatment scurting bag at harvest stage followed by treatment muslin bag, control and plastic bag.

Makhmale (2017) [10] reported that fertigation of mango tree with 180:120:150 g NPK/plant gave maximum plant height (3.82 m), stem girth (26.73 cm), noumber of fruit/tree (94.50), yield (29.53 kg/tree) and TSS (22.79 ºBrix). It was at par with treatment 120:75:100 g NPK/plant. Ghadage *et al.* (2017) [6] concluded that significantly maximum fruit weight (301.66 g), volume of pulp (190.55 ml), number of fruits/shoot (2.06) and fruit yield (97.42 kg/plant) was obtained with girdling width @1.50 cm. Girdling during 15th July gave significantly maximum fruit weight (293.49 g), volume of pulp (184.73 ml), number of fruit/shoot (1.99) and fruit yield (94.20 kg/plant).

Banana

Odeke *et al.* (1999) [12] recorded that desuckering stage (300 mm) gave significantly maximum plant height (223.3 cm), girth at 50 cm (51.9), girth at 100 cm (42.5) and bunch weight (17.9 kg) followed by desuckering stage (500 mm) in banana cv. Kibuzi. Weerasinghe and Ruwanpathirana (2002) [26] reported that banana bunch cover with blue bag gave maximum bunch weight (18.26 kg) and hand weight (1.72 kg) which was at pat with all other treatment except control. While maximum fruit weight (117.2 g) was observed with bagging with colorless bag which was also at par with all other treatment except control. Bhalerao *et al.* (2009) concluded that fertigation 100% RDF (200:200 g/NK/plant) of banana plant gave maximum hand/bunch (8.7), finger/ bunch (151), bunch weight (20.6 kg) and yield (91.4 t/ha) and which was at par with fertigation @ 75% RDF NK. Fertigation 100% RDF (200:200 g/NK/plant) remains at par with all treatment in case maximum hand/bunch.

Chaudhari and baruah (2010) [3] suggested that planting of two suckers per pit spaced at 1.8m X 3.6 m gave maximum number of hands/bunch (9.87), number of fingers/bunch (169.25), finger weight (119.00 cm) and yield (45.08 t/ha) followed by all treatment. Normal plating 1.5m x 1.5m reported maximum bunch weight (18.50). Sharma *et al.* (2014) [23] revealed that significantly maximum length of fingers (14.00 cm), girth of fingers (13.19 cm) and weight of bunch (20.66 kg) were recorded with the removal of male bud and feeding of bunch with urea (7.5 g) + sulphate of potash (7.5 g) + cow dung (500 g) + 100ml water in banana cv. Borjahaji.

Rao and Swami (2017) [18] observed that bunch feeding of nutrient to banana bunch with treatment 7.5 g banana special + 500g cow dung + 200 ml water gave maximum finger weight (236.15 g) which was at par with treatment 5 g urea + 5 g SOP+ 5g banana special + 500 g cow dung + 200 ml water, 10g urea + 10 g SOP + 500 g cow dung + 200 ml water, 5 g banana special + 500 g cow dung + 200 ml water and 10 g urea + 10 g SOP+ 7.5g banana special + 500 g cow dung + 200 ml water. While treatment 5 g urea + 5 g SOP+ 5 g banana special + 500 g cow dung + 200 ml water gave maximum bunch weight (36.90 kg) which was at par with treatment 10 g urea + 10g SOP + 500 g cow dung + 200ml water. Shaikh *et al.* (2017) [21] opinted that silver black polythene mulch gave maximum number of hands/bunch (12.2), bunch weight (23.5 kg), yield (104.4 MT) and TSS (20.8º Brix) and it was at par with treatment black polythene mulch. Highest pulp: peel ratio (2.2) reported in mulching with banana plants part, silver-black polyethylene mulch and black polyethylene mulch in banana cv. Grand naine.

Guava

Singh *et al.* (1997) [24] observed that significantly maximum fruit weight (143.50 & 246.87 g), fruit length (6.93 & 7.3 cm) and fruit diameter (6.36 & 7.77 cm) were found in the treatment of water stress in Allahabad Safeda and Sardar guava. Bagchi *et al.* (2008) [2] suggested that significantly maximum number of fruits retained/branch (12.99 up to harvest), number of fruit retained/plant (195.5 up to harvest), yield/plant (48.6 kg) and maximum fruit weight (242g) were found in the treatment bending of lateral branches and partial removal of old leaves of guava. Treatment 20 cm pruning with complete removal of old leaves was at par with treatment bending of lateral branches and partial removal of old leaves in respect to mean fruit weight.

Das *et al.* (2010) [5] concluded that soil cover with black polythene mulch gave significantly maximum number of fruits/plant (347.95) and maximum yield (47.05 kg/plant) which was at par with treatment paddy straw (10 cm thickness) and white polythene (250 guage) in respect to yield (kg/plant). Mulching with paddy straw (10 cm thickness) gave

significant higher TSS (8.53ºBrix) and it was at par with dry leaves (guava leaves- 10 cm thickness) mulching. Treatment white polythene (250 guage) mulching gave minimum acidity (0.32%) in guava cv. L-49. Ramdasi (2013) [17] reported that treatment 20 cm light pruning gave significantly higher number of flower/shoot (4.99), fruit weight (121.75 g), yield fruit/plant (64.30 kg), maximum TSS (12.39º Brix) and minimum acidity (0.48 %). Treatment 40 cm medium pruning is at par with 20 cm light pruning in respect to TSS (ºBrix). While borax 0.2% chemical spray gave significantly higher no. of flower/shoot (4.70), TSS (1.90 ºBrix), significantly minimum acidity (0.48%) and maximum yield fruit/plant (64.72 kg). Spraying of borax 0.2% at par with borax 0.4%, GA_3 50 ppm and GA_3 100 ppm in respect to yield fruit/plant (kg). while treatment GA_3 50 ppm gave maximum fruit weight (122.30 g) in guava cv. L-49.

Pal *et al.* (2017) [13] concluded that in high density planting with spacing 2 X 1.5 m gave significantly higher fruit diameter (6.53 cm), maximum fruit length (5.78 cm) and fruit volume (193.50) which was treatment of spacing 2 X 1.5 m was at par with spacing 2 X 1 m and spacing 1.5 X 1.5 m in respect to fruit length (cm) and fruit volume in guava cv. Pant Prabhat. Mahadevan *et al.* (2017) [9] resulted that 30 cm pruning + drip fertigation of 125% RDF (1250: 1250: 1250 g NPK/ plant/year) gave significant minimum acidity (0.44%), maximum TSS (11.78ºBrix), ascorbic acid (220.75 mg/100 g pulp) an total sugar (8.64%) which was at par with treatment 30 cm pruning + drip fertigation of 100 % RDF (1000: 1000: 1000 g NPK/ plant/year) in respect to TSS (ºBrix), ascorbic acid (mg/100 g pulp) and total sugar (%) in guava cv. Sardar.

Pomegranate

Shanmugasundaram and Balakrishnamurthy (2013) [22] concluded that significantly maximum no. of fruit/tree (54.10), average fruit weight (241.35 g), fruit volume (249.75 cc) and peel weight (74.60 gm) was reported with 50% RDF (250:62.5:62.5 g/plant/year) through fertigation in pomegranate cv. Mridula under ultra high density planting. Abou (2014) reported that significantly maximum fruit weight (354.8 g) and fruit yield/tree (21.29 kg) found in bagging with prgmen paper bag. Significantly maximum TSS (16 ºBrix) and minimum acidity (1.26%) noticed with control in pomegranate fruit suggested that 30 cm pruning + 30 fruit retain per plant in pomegranate gave maximum fruit weight (417.50g), TSS (17.93^{0}Brix) and juice (80.63%) and it was at par with treatments 15 cm pruning + 30 fruit retain per plant and 30 cm pruning + 40 fruit retain per plant. While treatment 15 cm pruning + 40 fruit retain per plant recorded maximum plant height (3.64m). Maximum yield (17.71 kg/plant) was noted in treatment 30 cm pruning + 50 fruit retain per plant which was at par with all treatment. Yograj *et al.* (2017) [27] concluded that mulching with black polythene mulch (100 µ) gave maximum fruit weight (299.42 g), fruit length (81.44 mm), fruit width (82.13 mm) and total aril weight of fruit (193.78 g) which was at par with treatment silver polythene mulch (100 µ) in respect to all characters.

Citrus

Mostafa and Saleh (2006) observed that girdling + 2% KNO_3 seen significantly maximum yield/tree (65.0 kg), number of fruits per tree (412) and fruit weight (157 g) in Balady mandarin trees. Thirugnanavel *et al.* (2007) [25] reported that GA_3 50 ppm in June + cycocel 1000 ppm in September + KNO_3 2% gave significantly maximum number of flowers/shoot (7.01), initial fruit set (4.49), number of fruit/tree (224) and yield/tree (11.15 kg) in acid lime suggested that treatment mulching with black polythene mulch recorded significantly higher plant height (210.00 cm), plant spread (East-West) (142 cm) and plant spread (North-South) (147 cm). While treatment mulching with black polythene mulch at par in respect to plant spread (East-west) and plant spread (North-South) with mulching with FYM is at par in respect to in Kinnow. Kunchanwar *et al.* (2017) [8] recorded that maximum fruit weight (138.15g) and fruit diameter (6.83cm) were found in treatment soil application with RDF which was at par with fertigation with 160% and fertigation with 140% RDF in respect to weight of fruit (g). While application of fertigation with 120% RDF gave maximum juice content (52.32%) and TSS (11.06ºBrix) which was at par with all other treatments in respect to juice content (%) in mandarin.

Papaya

Prajapati *et al.* (2017) [16] reported that maximum plant height (179.56 cm) after 270 DAT, stem girth (40.89 cm) after 270 DAT, petiole length (72.64 cm) after 270 DAT, initiation of flowering (98.68 days), number of fruits/plant (28.11), fruit weight (1.010 kg/plant) and fruit yield (28.29 kg/plant) found in the treatment of 100% RDF (28.29 kg) + plastic mulch + vermi wash, neem seed extract (87.31MT). Treatment of 100% RDF (28.29 kg) + plastic mulch + vermiwash, neem seed extract (87.31MT) at par with treatments 80% RDF + plastic mulch + Vermiwash + Neem seed extract, 100% RDF + plastic mulch, 80% RDF + plastic mulch and 100% RDF + organic mulch in respect to plant height (cm) after 270 DAT, stem girth (cm) after 270 DAT, petiole length (cm) after 270 DAT, number of fruits/plant, fruit weight kg/plant and fruit yield kg/plant in papaya.

Ber

Patel (1985) concluded that significantly maximum fruit set (17.18%), fruit weight (22.33g), yield (25.323 kg/tree), maximum TSS (22.45ºBrix) and minimum acidity (0.292%) were found with pruning on 16th May which was at par with treatment 1th May time of pruning in respect to TSS (ºBrix) and acidity (%). While in pruning intensity keeping 90cm stem length gave significantly maximum fruit set (17.71%), yield (26.06 kg/tree), TSS (23.38ºBrix), maximum fruit weight (23.06g) and minimum acidity (0.292%) which was at par with treatment keeping 30 cm length of branch in respect to fruit weight (g) and acidity (%) in ber.

Conclusion

In conclusion, the cultivation of fruit crops emerges as a crucial contributor to a nation's prosperity, offering a yardstick for the standard of living through per capita fruit production and consumption. Fruit crops, exemplified by Mango, Banana, Guava, Papaya, Citrus, and Pomegranate, not only yield significantly higher tonnage per unit area compared to other field crops but also serve as rich sources of essential vitamins and minerals, including calcium, phosphorus, and iron. The adoption of horticultural techniques proves indispensable for maximizing yield, ensuring top-quality fruit for valuable market returns, maintaining orchard health, and judiciously utilizing farm and natural resources. Techniques such as canopy management, training, pruning, mulching, fertigation, and the use of specific substances like paclobutrazol and KNO_3 play pivotal roles in enhancing productivity across various fruit crops.

Specifically focusing on Mango cultivation, practices like spacing adjustments, pruning of third-order branches, and soil application of paclobutrazol showcase significant impacts on flowering, fruit weight, and overall yield. Similarly, in Banana cultivation, desuckering, high-density planting, and various fertigation practices exhibit positive effects on plant height, bunch weight, and overall yield.

Guava cultivation benefits from meadow orchards, mulching, fertigation, and other cultural practices, leading to increased fruit yield and superior quality. Pomegranate, under techniques like high-density planting and careful pruning, achieves notable improvements in fruit weight, volume, and overall yield.

Citrus cultivation, employing practices such as high-density planting, mulching, fertigation, and girdling, witnesses positive outcomes in terms of yield and fruit quality. In Papaya, the implementation of mulching and fertigation practices contributes to improved fruit characteristics. Finally, Ber cultivation experiences enhanced fruit set, yield, and quality through prudent pruning techniques.

In the pursuit of sustainable and efficient fruit cultivation, continuous research and adoption of innovative practices remain imperative. The findings presented in this paper underscore the significance of informed agricultural practices in harnessing the full potential of fruit crops, contributing not only to agricultural prosperity but also to the nutritional well-being of the populace.

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