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The effect of pruning, organic and inorganic nutrition on quality characters of mango cv. Amrapali

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Abstract
The present investigation was conducted with the objective to know the effect of different pruning intensity and nutrition on biochemical/quality characters *viz.*, total soluble solids, acidity, ascorbic acid content, reducing sugar, non-reducing sugar and total sugars. The experiments were conducted in Randomized Block Design with seven treatments i.e. T_1=5 cm pruning+FYM@ 20 kg per plant, T_2=5 cm pruning+ Vermicompost @ 10kg per plant, T_3=5 cm pruning+ ZnSO4 @ 1.0 % + Borax @ 0.4%, T_4=10 cm pruning+ FYM@ 20kg+ Zinc Sulphate@ 1.0% per plant, T_5=10 cm pruning+ Vermicompost @10kg+ Borax @0.4% per plant, T_6=10 cm pruning+PSB 250g+ MgSO4 @0.5% per plant, T_7=15 cm pruning+FYM @20kg+ Zinc Sulphate @1.0% per plant, T_8=15 cm pruning+ Vermicompost @10kg+ Borax@0.4% per plant, T_9=15 cm pruning+ PSB 250g+ MgSO4 @0.5% per plant, T_{10}= Control (no pruning+ water spray). The quality attributes viz., T.S.S, acidity (%), ascorbic acid (mg/100g), reducing sugars (%), non-reducing sugars (%) and total sugars (%) influenced significantly due to different levels of pruning and application of organic and inorganic fertilizers during both the years. The maximum reducing, non-reducing sugars, total sugars and ascorbic acid content were noted in treatment T_8 during both the years.

Keywords: Pruning intensity, organic, inorganic and quality characters

Introduction
Mango (*Mangifera indica* L.) is the fifth most important fruit of the world after apple, citrus, banana and grape. It is cultivated in more than 100 countries because of its delicious taste, excellent flavour, attractive fragrance and excellent source of vitamin A and C. The total annual production of mango in India is 18.43 million tonnes, cultivated in 2.52 million hectare with productivity (7.30 Mt/ ha), (Anonymous, 2014). The major mango producing states in India are Uttar Pradesh (4.30 million tonne) followed by Andhra Pradesh (2.74 million tonnes), and Karnataka (1.75 million tonnes) (Anonymous, 2014).

Considering the importance of mango there is dire need to initiate the nutrient management and pruning intensity programme to increase vegetative growth, fruit size, uniform ripening, fruit yield and quality of mango. In addition to nutrient intensity and pruning has also been reported to manage plant canopy and enhance the flowering, fruiting, yield and quality of many fruit crops (Ali *et al*., 2001) [1].

Chemical composition of mango differs with the variety and stage of maturity. It is a rich source of carbohydrate of well as vitamin A and C. A comprehensive report has been made on the chemical composition after analysis of more than 5 varieties of mango (Anonymous, 1966). According to this report chemical constituents in mango are moisture 73.0-86.7 per cent, carbohydrate 11.6-24.3 per cent, protein 0.3-1.0 per cent, fat 0.1-0.8 per cent, mineral 0.3-0.7 per cent, vitamin A 650-259 Yo T.U. and vitamin C 3-83 mg/100 g fruit.

In most of the Horticultural, Medicinal and Vegetable crops, FYM is the most common organic manure used for supplement the initial requirement of nutrients for better establishment such as animal, plant wastage i.e. Nitrogen, Phosphorus, Potash and micronutrients. The continuous applications of huge amount of chemical fertilizers hamper the fruit quality, soil health and generate pollution. The combination of organic and in-organic nutrients paves away to overcome of these problems.

Plant nutrient can be supplied from different sources viz., organic manures and chemical fertilizers for better utilization of resources and to produce crop with less expenditure. Organic manures enhance nutrient availability in order to improve the soil health, soil structure and provide conducive environment for the treatment of soil micro flora. Potentially of using organic manures along with balanced fertilizers are well established in increasing crop yield and sustained crop production (Nambiar and Abrol, 1992) [11].

The micro-nutrients play vital role in growth, development, retention and quality of fruits. The foliar feeding of micro-nutrients has gained much importance in recent years and comparatively more effective for rapid recovery of plants, as under high soil pH conditions, most of macro and micro-nutrients are unavailable. Various trials have been conducted on foliar feeding of micro-nutrients in different fruit crops and found effective in improving the vegetative growth, yield and quality of fruits (Sindhu *et al.,* 1994; Banik *et al.,* 1997 and Babu and Singh, 1998) [14, 4, 3].

Materials and Methods

The experiment was carried out on 25 year old mango orchard planted under sodic soil condition and site is located at Main Experiment Station, Horticulture, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad on the Raibarelly road at the distance of 42 km away from Faizabad district head quarter. Geographically it is situated at 26^0-47^0N latitude, 82.12^0E longitude of 113 meter away from mean sea level. This site is located in typical saline-alkaline belt of indigenous plains of eastern Uttar Pradesh.

The values were corrected at 20^0 C and expressed as (^{0}Brix) TSS of the fruit juice (Ranganna, 1978). Sugars were estimated by Fehlings 'A' and 'B' solution method given by Lane and Eynon (1943).

Results and Discussion

The quality characters *viz.,* total soluble solids, acidity, ascorbic acid content, reducing sugar, non-reducing sugar and total sugars were significantly influenced due to different treatments of pruning intensity, organic and inorganic nutrients during both the years except reducing sugars.

Maximum accumulation of total soluble solids (T.S.S.) content in mango fruits was recorded with T_5 (10 cm pruning + Vermicompost @10kg+ Borax @ 0.4 %) followed by T_8 (15 cm pruning + Vermicompost @10kg+ Borax @ 0.4 %) while, minimum total soluble solids (T.S.S.) was obtained with the control (no pruning + water spray) during both the years shown in Table 4.19. Total Soluble Solids content of fruit may be due to fact that nutrients have played important role in photosynthesis which ultimately lead to the accumulation of carbohydrates and attributed to increase T.S.S. of mango fruit. Increase in the total soluble solids may be because of more carbon assimilation promoted by application of boric acid. The results are in closed conformity with the finding of Kundu *et al.* (1995) [9] reported significant effect of pruning on TSS in ber, Shirole *et al.* (2003) [13] noted that 5 kg Vermicompost + 25 Kg FYM per plant per year resulted highest TSS in sapota and Yadav (2006) [16] reported that application of Vermicompost with 100% NPK recorded maximum TSS, Total sugar and reduction in acidity of papaya fruit.

It is evident from the data that the application the treatment T_8 (15 cm pruning + Vermicompost @10kg+ Borax @ 0.4 %) accumulated highest reducing, non-reducing and total sugars followed by T_5 (10 cm pruning + Vermicompost @10kg+ Borax @ 0.4 %) during both the years of investigation (2015-16 & 2016-17). While, minimum reducing, non-reducing and total sugars in treatment T_{10} (control) during both the years of experimentation. Increased in sugar per cent over control (unpruned tree + water spray) may be due to involve in the translocation of more sugar to the fruits. It has been reported that there is greater conversion of starch into sugar (source to sink. The results are conformed with findings of Khan *et al.* (2006) [6] noted that sugars significantly increased by pruning in Flordasum peach and Bohane and Tiwari (2014) [5], while Arvind *et al.* (2012) [2] observed that foliar application of Borax 0.5%, K_2SO_4 0.5% at marvel stage of mango fruit cv. Dashehari significantly increased maximum total sugar over control.

The effect of different pruning intensity, application of organic nutrients and spray of inorganic nutrients on ascorbic acid content have been portrayed in Table 5 clearly indicated that the maximum amount of ascorbic acid was found with the foliar spray of T_8 (15 cm pruning + Vermicompost @10kg+ Borax @ 0.4 %) whereas, minimum was recorded with control (T_{10}). The increased ascorbic acid content of fruit juice was due to increase synthesis of catalistic activity by enzyme and coenzyme, which are represented ascorbic acid synthesized. The adequate amounts of zinc improve the auxin content and it also acted as catalyst in oxidation process. These findings is closely confirmed with the results of a significant improvement in ascorbic acid content which noticed by Singh *et al.* (2001) [15] with the application of 0.5 % $ZnSO_4$, 0.2 % Borax and 0.4 % $CuSO_4$ in aonla cultivar fransis. Kumar *et al.* (2012) [7] reported the highest ascorbic acid using 50% NPK + 15 kg vermicompost + 5 kg neem cake treatment in lemon.

The use of different treatments significantly influence the acidity percentage in mango fruits. The minimum acidity percentage was noted T_8 (15 cm pruning + Vermicompost @10kg+ Borax @ 0.4 %), whereas, maximum was noted in control treatment (T_{10}) during both the years of experimentation. Acidity content of fruit decrease with the pruning intensity and application of organic and inorganic nutrients, might be due to increase in translocation of carbohydrates and increase metabolic conversion from acidity to sugar by the reaction involving reversal of glycolytic path way by used in respiration or both similarly. Acidity per cent was reduced with nutrients treated fruits, which might be due to early ripening induced by the nutrient spray during which degradation of acid might have occurred. The similar results were reported by Kundu and Mitra (1999) [8] observed that foliar spray of 0.3 per cent copper, 0.1% Borax and 0.3% Zn reduced acid content in guava fruits.

Table 1: Effect of pruning, organic and inorganic nutrition on TSS of mango cv. Amrapali.

Treatments		TSS (^{0}Brix)	
		2015-16	2016-17
T_1	5 cm pruning+FYM@ 20 kg per plant	18.18	18.23
T_2	5 cm pruning+ Vermicompost @ 10kg per plant	18.54	18.59
T_3	5 cm pruning+ ZnSO4 @ 1.0 % + Borax @ 0.4%	17.60	17.33
T_4	10 cm pruning+ FYM@ 20kg+ Zinc Sulphate@ 1.0% per plant	18.69	18.63

T_5	10 cm pruning+ Vermicompost @10kg+ Borax @0.4% per plant	19.06	19.00
T_6	10 cm pruning+PSB 250g+ MgSO4 @0.5% per plant	17.76	17.71
T_7	15 cm pruning+FYM @20kg+ Zinc Sulphate @1.0% per plant	18.53	18.43
T_8	15 cm pruning+ Vermicompost @10kg+ Borax@0.4% per plant	18.90	18.80
T_9	15 cm pruning+ PSB 250g+ MgSO4 @0.5% per plant	17.62	17.52
T_{10}	Control (no pruning+ water spray)	17.28	17.05
SEm±		0.50	0.50
CD at 5%		1.49	1.48

Table 2: Effect of pruning, organic and inorganic nutrition on reducing sugar per cent in mango cv. Amrapali.

Treatments		Reducing sugar (%)	
		2015-16	2016-17
T_1	5 cm pruning+FYM@ 20 kg per plant	4.20	4.15
T_2	5 cm pruning+ Vermicompost @ 10kg per plant	4.27	4.25
T_3	5 cm pruning+ ZnSO4 @ 1.0 % + Borax @ 0.4%	4.03	4.05
T_4	10 cm pruning+ FYM@ 20kg+ Zinc Sulphate@ 1.0% per plant	4.30	4.24
T_5	10 cm pruning+ Vermicompost @10kg+ Borax @0.4% per plant	4.38	4.32
T_6	10 cm pruning+PSB 250g+ MgSO4 @0.5% per plant	4.10	4.03
T_7	15 cm pruning+FYM @20kg+ Zinc Sulphate @1.0% per plant	4.34	4.28
T_8	15 cm pruning+ Vermicompost @10kg+ Borax@0.4% per plant	4.43	4.36
T_9	15 cm pruning+ PSB 250g+ MgSO4 @0.5% per plant	4.12	4.07
T_{10}	Control (no pruning+ water spray)	3.98	3.95
SEm±		0.19	0.20
CD at 5%		NS	NS

Table 3: Effect of pruning, organic and inorganic nutrition on non reducing sugar in mango cv. Amrapali.

Treatments		Non-reducing sugar (%)	
		2015-16	2016-17
T_1	5 cm pruning+FYM@ 20 kg per plant	10.75	10.70
T_2	5 cm pruning+ Vermicompost @ 10kg per plant	10.98	10.90
T_3	5 cm pruning+ ZnSO4 @ 1.0 % + Borax @ 0.4%	10.23	10.15
T_4	10 cm pruning+ FYM@ 20kg+ Zinc Sulphate@ 1.0% per plant	11.05	10.91
T_5	10 cm pruning+ Vermicompost @10kg+ Borax @0.4% per plant	11.28	11.11
T_6	10 cm pruning+PSB 250g+ MgSO4 @0.5% per plant	10.50	10.37
T_7	15 cm pruning+FYM @20kg+ Zinc Sulphate @1.0% per plant	11.16	11.00
T_8	15 cm pruning+ Vermicompost @10kg+ Borax@0.4% per plant	11.37	11.22
T_9	15 cm pruning+ PSB 250g+ MgSO4 @0.5% per plant	10.63	10.45
T_{10}	Control (no pruning+ water spray) per plant	9.37	9.45
SEm±		0.29	0.29
CD at 5%		0.85	0.86

Table 4: Effect of pruning, organic and inorganic nutrition on total sugar in mango cv. Amrapali.

Treatments		Total sugars (%)	
		2015-16	2016-17
T_1	5 cm pruning+FYM@ 20 kg per plant	14.95	14.85
T_2	5 cm pruning+ Vermicompost @ 10kg per plant	15.25	15.15
T_3	5 cm pruning+ ZnSO4 @ 1.0 % + Borax @ 0.4%	14.21	14.10
T_4	10 cm pruning+ FYM@ 20kg+ Zinc Sulphate@ 1.0% per plant	15.35	15.15
T_5	10 cm pruning+ Vermicompost @10kg+ Borax @0.4% per plant	15.66	15.43
T_6	10 cm pruning+PSB 250g+ MgSO4 @0.5% per plant	14.60	14.40
T_7	15 cm pruning+FYM @20kg+ Zinc Sulphate @1.0% per plant	15.50	15.28
T_8	15 cm pruning+ Vermicompost @10kg+ Borax@0.4% per plant	15.80	15.58
T_9	15 cm pruning+ PSB 250g+ MgSO4 @0.5% per plant	14.75	14.52
T_{10}	Control (no pruning+ water spray)	13.35	13.40
SEm±		0.41	0.46
CD at 5%		1.22	1.38

Table 5: Effect of pruning, organic and inorganic nutrition on ascorbic acid (mg/100g pulp) in mango cv. Amrapali.

Treatments		Ascorbic acid (mg/100g pulp)	
		2015-16	2016-17
T_1	5 cm pruning+FYM@ 20 kg per plant	32.77	32.99
T_2	5 cm pruning+ Vermicompost @ 10kg per plant	33.42	33.64
T_3	5 cm pruning+ ZnSO4 @ 1.0 % + Borax @ 0.4%	31.15	31.35
T_4	10 cm pruning+ FYM@ 20kg+ Zinc Sulphate@ 1.0% per plant	32.42	32.53
T_5	10 cm pruning+ Vermicompost @10kg+ Borax @0.4% per plant	33.06	33.18
T_6	10 cm pruning+PSB 250g+ MgSO4 @0.5% per plant	31.49	31.63
T_7	15 cm pruning+FYM @20kg+ Zinc Sulphate @1.0% per plant	33.13	33.28

T_8	15 cm pruning+ Vermicompost @10kg+ Borax@0.4% per plant	34.00	34.10
T_9	15 cm pruning+ PSB 250g+ MgSO4 @0.5% per plant	33.78	33.94
T_{10}	Control (no pruning+ water spray)	30.82	30.92
SEm±		0.88	0.86
CD at 5%		2.60	2.55

Table 6: Effect of pruning, organic and inorganic nutrition on acidity per cent in mango cv. Amrapali.

Treatments		Acidity (%)	
		2015-16	2016-17
T_1	5 cm pruning+FYM@ 20 kg per plant	0.28	0.26
T_2	5 cm pruning+ Vermicompost @ 10kg per plant	0.29	0.27
T_3	5 cm pruning+ ZnSO4 @ 1.0 % + Borax @ 0.4%	0.27	0.28
T_4	10 cm pruning+ FYM@ 20kg+ Zinc Sulphate@ 1.0% per plant	0.26	0.28
T_5	10 cm pruning+ Vermicompost @10kg+ Borax @0.4% per plant	0.27	0.29
T_6	10 cm pruning+PSB 250g+ MgSO4 @0.5% per plant	0.30	0.27
T_7	15 cm pruning+FYM @20kg+ Zinc Sulphate @1.0% per plant	0.29	0.27
T_8	15 cm pruning+ Vermicompost @10kg+ Borax@0.4% per plant	0.25	0.25
T_9	15 cm pruning+ PSB 250g+ MgSO4 @0.5% per plant	0.28	0.26
T_{10}	Control (no pruning+ water spray)	0.32	0.30
SEm±		0.01	0.009
CD at 5%		0.02	0.026

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