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Effect of different levels of pruning and plant nutrients on vegetative growth and yield of apple Ber (*Zizyphus mauritiana*)

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Abstract
The present research entitled "Effect of different levels of pruning and plant nutrients on vegetative growth and yield of Apple Ber (*Zizyphus mauritiana*)" was carried out during May, 2019 to January, 2020 at Horticulture Research Station (HRS), Konda Mallepally, Nalgonda District, Telangana. The experiment was laid in factorial randomized block design with 21 treatments 3 replications. Among the treatments of pruning (20, 30 cm and un pruned trees) in apple ber trees. The maximum shoot length (76.07 cm) was recorded with the 30 cm pruning. The maximum number of shoots per branch (26.64) were noticed in 20 cm pruning. Among the treatments of pruning, the maximum fruit weight (95.42 g), fruit diameter (4.60 cm), fruit firmness (11.84 kg cm^{-2}), fruit volume (22.83 ml) and fruit length, (5.49 cm), yield per tree (128.71 kg) and yield per hectare (53.98 t) were noticed in 30 cm pruning. Among different level of nutrients, Potassium Nitrate (1.0%), Potassium Nitrate (1.5%), Urea (0.5%), Urea (1.0%), Calcium Chloride (0.25%), Calcium Chloride (0.50%) and control in apple ber crop, the maximum shoot length (76.07 cm), number of shoots for branch (26.64) were noticed with the Urea 1.0%. The maximum fruit weight (97.60 g), fruit diameter (4.66 cm), fruit firmness (12.07 kg cm^{-2}), fruit volume (23.44 ml) and fruit length, (5.93 cm), specific gravity (4.62 (g cm^{-3}), yield per tree (28.55 kg) and yield per hectare (5.83 t) were noticed with the 1.5% Potassium Nitrate. The interaction between pruning and foliar sprays of nutrients has shown significant results, maximum shoot length (90.50 cm), number of shoots for branch (29.83) was recorded in 30 cm pruning in combination with urea (1%). fruit weight (110.46 g), fruit diameter (5.26 cm), fruit firmness (12.50 kg cm^{-2}), fruit length (7.00 cm), fruit volume (24.50 ml), specific gravity (5.26 g cm^{-3}), yield per tree (38.66 kg) and yield per hectare (8.0 t) was recorded in 30 cm pruning in combination with Potassium Nitrate (1.5%).

Keywords: Apple Ber, 20 cm and 30 cm pruning, potassium nitrate, calcium chloride, urea and water spray

Introduction
Apple ber (*Ziziphus mauritiana*) is a Thailand variety ber and hardy minor tropical fruit, belongs to the family Rhamnaceae. Apple ber is developed by grafting Thailand green apple with Thai local ber. This fruit resembles green apple in its appearance and tastes like ber, hence the name Apple ber. It is also called as Apple plum or Jujube berry. The genus *Ziziphus* comprises about 40 species distributed throughout the tropical and subtropical regions of the world. Among various species, *mauritiana* is commercially cultivated for its nutritive and edible fruits. It is popularly known as poor man's fruit of tropics.

In India apple ber cultivation first started in Maharashtra, later extended to other states like Gujarat and Telangana. In Telangana it is cultivated commercially in Hyderabad, Mahbubnagar, Medak, Warangal and Khammam districts. It is also popularly known as "Telangana Apple" in Telangana state. The weight of each fruit is 60-150g. It is very attractive, sweet, crispy and juicy. In recent years farmers are showing interest in cultivation of apple ber when compared to ber due to its unique traits like thorn less nature, high yielding, early crop, ease of cultivation in terms of harvesting and wider adaptability to grow in any type of soil with less consumption of water. It has ability to withstand extreme summer, heavy rains, heavy winds and extreme winter. Ber fruits are highly nutritious, rich in ascorbic acid and contain fairly good amount of minerals like calcium, phosphorus and iron. Ber fruits are also higher in ascorbic acid content than the orange (Jawanda and Bal, 1978) [14].

Material and Methods

The experiment was conducted at existing 4 years aged apple ber orchard at Department of Horticulture, Horticulture Research Station, SKLTSHU, Konda Mallepally, Nalgonda District, Telangana State during 2019-2020. The materials used, techniques adopted and observation recorded during the course of investigation.

The pruning was carried out on main shoot and also subsequent secondary and tertiary shoots on whole plant, with different levels up to 20, 30 cm from shoot tip and control (without pruning) from top end.

Observations recorded

T_1-(P_1N_1)-Medium pruning (20cm)+ Potassium Nitrate (1.0%), T_2-(P_1N_2)-Medium pruning (20cm) + Potassium Nitrate (1.5%), T_3-(P_1N_3)-Medium pruning (20cm) + Urea (0.5%), T_4-(P_1N_4)-Medium pruning (20cm) + Urea (1.0%), T_5-(P_1N_5)-Medium pruning (20cm) + Calcium Chloride (0.25%), T_6-(P_1N_6)-Medium pruning (20cm) + Calcium Chloride (0.50%), T_7-(P_1N_7)-Medium pruning (20cm) + Water spray, T_8-(P_2N_1)-Heavy pruning (30cm) + Potassium Nitrate (1%), T_9-(P_2N_2)-Heavy pruning (30cm) + Potassium Nitrate (1.5%), T_{10}-(P_2N_3)-Heavy pruning (30cm) + Urea (0.5%), T_{11}-(P_2N_4)-Heavy pruning (30cm) + Urea (1.0%), T_{12}-(P_2N_5)-Heavy pruning (30 cm) + Calcium Chloride (0.25%), T_{13}-(P_2N_6)-Heavy pruning (30 cm) + Calcium Chloride (0.50%), T_{14}-(P_2N_7)-Heavy pruning (30 cm) + Water spray, T_{15}-(P_3N_1)-Control (Un pruned) + Potassium Nitrate (1.0%), T_{16}- (P_3N_2)-Control (Un pruned) + Potassium Nitrate (1.5%), T_{17}- (P_3N_3)-Control (Un pruned) + Urea (0.5%), T_{18}- (P_3N_4)-Control (Un pruned) + Urea (1.0%), T_{19}- (P_3N_5)-Control (Un pruned) + Calcium Chloride (0.25%), T_{20}- (P_3N_6)-Control (Un pruned) + Calcium Chloride (0.50%), T_{21}-(P_3N_7)-Control (Un pruned) + Water spray.

Number of shoots emerged per branch: The number of main branches present in Apple ber tree was counted as primary branches. The number of secondary branches on each primary branch was counted and average was computed to express as number of secondary branches.

Shoot length (cm): It was recorded from the base to the apex of the shoot with the help of a meter scale and expressed in cm.

Fruit weight (g): The individual five fruits from each treatment were taken randomly after the harvest. The weight was measured on digital analytical balance and average weight was expressed in grams.

Fruit diameter (cm): Five fruits from each treatment were taken randomly and the diameter was measured with the help of digital vernier callipers at widest middle point where maximum diameter was noticed. The average value was expressed in centimetres.

Fruit firmness (kg cm^{-2}): Five fruits from each treatment were taken randomly and the diameter was measured with the help of penetrometer. The average value was expressed in terms of kg cm^{-2}.

Specific gravity (g/cm^{-3}): Specific gravity was calculated by dividing fruit weight with its volume of displaced water. The average value was expressed in g/cm^{-3}.

Fruit volume (ml): Five fruits from each treatment were taken randomly and volume of the fruits was recorded by water displacement method and mean was calculated.

Yield per tree (kg/$tree^{-1}$): Fully matured fruits were harvested and the total yield was calculated by adding the values obtained in different harvesting periods and it is expressed in kilograms per tree.

Yield per hectare (t/ha^{-1}): The yield per hectare was computed by multiplying the yield per tree with the number of trees accommodated in one hectare and was expressed in tons per hectare.

Statistical analysis: The experimental data on all yield parameters were tabulated and subjected to analysis of variance (ANOVA) using module of ICAR CCARI WASP for Factorial Randomized Block Design (FRBD).

Results and Discussion

1. Shoot length (cm): The data on shoot length of apple ber as affected by different levels of pruning and plant nutrients and its interactions were presented in the Table 1.

The collective data revealed that significant variation was recorded in foliar spray of plant nutrients. The highest shoot length (78.83 cm) was noticed with 1% Urea followed by 0.25% Calcium Chloride (77.17 cm) and 0.5% Calcium chloride whereas, minimum shoot length (63.77 cm) was noticed in water spray.

The data regarding the shoot length of apple ber significantly affected by different levels of pruning. The treatment, heavy pruning at 30 cm recorded maximum shoot length (76.07 cm) followed by medium pruning 20 cm with (70.05 cm). However, minimum shoot length (69.57 cm) was observed in control.

The interaction between different levels of pruning and plant nutrients was found to be significant on shoot length. However, maximum shoot length (90.50 cm) was recorded in 1% Urea spray in combination with pruning at 30 cm and followed by minimum shoot length (85.50 cm) was observed in 0.25% Calcium Chloride in combination with heavy pruning 30 cm. The lowest shoot length (61.50 cm) was noticed in water spray in combination with control.

Pruning has its physiological effects basically due to changes in the partitioning of the reserves. It changes sink preference for allocation of photosynthates. Depending upon the time of the year, the extent and frequency of pruning, some sites of accumulation will disappear and others will be created. As a result, changes in seasonal fluctuations of reserves can appear as well and effect on shoot length in fruit crops (Clair *et al*., 1999) [6].

Pruning is the removal of reduction of certain plant parts that are not required, that are no longer effective or that are of no use to the plant. It improves the shape of the plant, influences the vegetative parameters, flowering and fruiting behaviour and also improving the quality of fruits. Besides giving structural strength, it also has dwarfing effect (Sneha *et al*., 2017) [28]. Calcium attributed to the stabilization of membrane systems and the formation of calcium pectate and cell wall which increase rigidity of the middle portion of the cell wall (Hoda *et al.* 2013) [11].

2. Number of shoots emerged per branch: The data on number of shoots emerged per branch of apple ber as affected

by different levels of pruning, plant nutrients and its interactions are presented in the Table 2.

The collective data revealed that significant variation was recorded in different foliar spray of plant nutrients. The highest number of shoots emerged per branch (26.94) was noticed with 1% Urea closely followed by 0.25% Calcium Chloride (26.94) and minimum number of shoots emerged per branch (25.88) was noticed in water spray.

The data regarding the number of shoots emerged per branch of apple ber significantly affected by different levels of pruning. The treatment, medium pruning at 20 cm recorded maximum number of shoots emerged per branch (26.64) followed by pruning at 30 cm with (25.88). However, minimum number of shoots emerged per branch (24.81) was observed in control. The interaction between different levels of pruning and plant nutrients was found to be significant on number of shoots emerged per branch. However, maximum number of shoots emerged per branch (29.50) was recorded in 1% Urea in combination with pruning at 30 cm and followed by observed in 0.25% Calcium Chloride in combination with pruning at 30 cm (28.50). The lowest number of shoots emerged per branch (23.16) was noticed and found 0.5% Calcium chloride significantly lowest than in combination with pruning at 30 cm.

3. Fruit weight (g): The data on fruit weight of apple ber as affected by different levels of pruning, plant nutrients and its interactions are presented in the Table 3.

The collective data revealed that significant variation was recorded in different foliar sprays of plant nutrients. However, the highest fruit weight (97.60 g) was noticed with 1.5% Potassium Nitrate spray followed by 0.5% Urea (92.00 g) and minimum fruit weight (81.68 g) was noticed in water spray.

The data regarding the fruit weight of apple ber significantly affected by different levels of pruning. The treatment, pruning at 30 cm recorded maximum fruit weight (95.42 g) followed by pruning at 20 cm with (86.82 g). However, minimum fruit weight (84.59 g) was observed in control.

The interaction between different levels of pruning and plant nutrients was found to be significant on fruit weight. However, maximum fruit weight (110.46g) was recorded in 1.5% Potassium Nitrate in combination with pruning at 30 cm and minimum fruit weight (73.00 g) was observed in water spray in combination with control (Unpruned).

Increase in fruit weight might be due to utilization of whole photosynthates among fewer fruit in severe pruned trees. Similar results were reported by Choudhary and Dhakare (2018) [5] in custard apple.

Because of heavy pruning the tree canopy was reduced and thereby increasing the availability of photosynthates and lesser nutritional competition among the developing fruits, thus improved the fruit weight (Javaid *et al*. 2016) [13].

Prakash *et al*. (2012) [21] opined that guava fruit size has direct correlation with high leaf to fruit ratio and availability of more photosynthesis due to removal of current season' s growth, the fruits gained larger size and weight compared to those from unpruned trees.

4. Fruit diameter (cm): Data pertaining to fruit diameter of apple ber was significantly influenced by different levels of pruning and plant nutrients are presented in Table 4.

There was significant variation was noted however, the highest fruit diameter (4.66 cm) was noted with 1.5% Potassium Nitrate followed by 0.25% Calcium Chloride (4.53 cm) and minimum fruit diameter (4.26 cm) was noticed in 0.5% Calcium chloride.

Significant difference was noted among the treatments for fruit diameter. Among different treatments of pruning, pruning at 30 cm observed maximum fruit diameter (4.60 cm) and followed by treatment of pruning at 20 cm (4.37 cm). However, minimum fruit diameter (4.29 cm) was observed in control.

The interaction of different levels of pruning and foliar spray of plant nutrients showed significant effect on fruit diameter. However, maximum fruit diameter (5.26 cm) was recorded in 1.5% Potassium Nitrate in combination with pruning at 30 cm and minimum fruit diameter (3.50 cm) was observed in 0.5% Calcium chloride in combination (Unpruned) control.

Regarding foliar spray of plant nutrients maximum fruit diameter was recorded with 1.5% Potassium Nitrate and it might be due to application of plant nutrients increases the levels of carbohydrates, thereby improving the distribution of assimilates between fruits, producing fruit with greater mass and diameter (Byers, 2003) [3].

The increase in diameter may be due to the pruning and foliar spray of plant nutrients. This in turn diverted more nutrients to the remaining fruits, thereby improving the size of fruits. These results are in line with Sheikh and Rao (2002) [25] and Bhuva *et al*. (2018) [2] in pomegranate, Singh and Dhaliwal (2004) [29] and Prabhugouda *et al*. (2017) [20] in guava and Racsko (2006) [22] in apple.

The increase in fruit diameter by the foliar application of plant nutrients might be due to optimum supply of plant nutrients and growth hormones in right amount during the entire crop growth period causing vigorous vegetative development of the plants and ultimately production of more photosynthates (Sachs and Hackett, 1972) [24].

5. Fruit length (cm): Data pertaining to fruit diameter of apple ber was significantly influenced by different levels of pruning and foliar sprays of plant nutrients are presented in Table 5.

There was significant variation among different nutrient sprays however, the highest fruit diameter (5.93 cm) was noted with 1.5% Potassium Nitrate followed by 1.0% Urea (5.52 cm) and minimum fruit diameter (4.84 cm) was noticed in calcium chloride @0.5% which was on par with water spray (4.93 cm).

Significant difference was noted among the treatments with regarding to pruning levels for fruit diameter. The treatment, pruning at 30 cm observed maximum fruit diameter (5.49 cm) and followed by treatment of pruning at 20 cm (5.36 cm). However, minimum fruit diameter (5.15 cm) was observed in control.

The interaction of different levels of pruning and foliar sprays of plant nutrients showed significant effect on fruit diameter. However, maximum fruit diameter (7.00 cm) was recorded in 1.5% Potassium Nitrate in combination with pruning at 30 cm and minimum fruit length (4.50 cm) was observed with pruning at 20 cm and water spray control treatment.

Regarding pruning levels, the maximum fruit length was recorded with 30 cm pruning it might be due to reduction in vegetative growth reduces initial competition for carbohydrates, thereby improving the distribution of assimilates between fruits, producing fruit with greater mass and length (Byers, 2003) [3]. The increase in diameter may be endorsed to the reduction in growth. This in turn diverted more nutrients to the remaining fruits, thereby improving the

size of fruits. These results are in line with Kumar *et al.* (2014) [16] in ber and Sheik and Rao (2012) [25] in pomegranate, Shrivastava and Jain (2006) [27], Yeshitela *et al.* (2005) [32] in mango and Chaturjeet and Bal (2006) [4] in ber.
The increase in fruit length by the foliar application of nutrients might be due to optimum supply of plant nutrients and growth hormones in right amount during the entire crop growth period causing vigorous vegetative development of the plants and ultimately production of more photosynthates (Sachs and Hackett, 1972) [24] and the other possible reason for enhancement of fruit diameter with foliar sprays of nutrients might be due to their involvement in hormonal metabolism, increased cell division, elongation and expansion of cells. The increment in diameter with micronutrient sprays might be due to important component for fruit growth and development which have been influenced via potassium by potassium nitrate sprays (Ramesh *et al.,* 2016) [23].

6. Fruit firmness (kg/cm^{-2}): The data with respect to fruit firmness as influenced by different levels of pruning and plant nutrients and its interactions are presented in Table 6.
There was significant variation among different foliar sprays of nutrients, however, the highest fruit firmness (12.07 kg cm^{-2}) was noted with 1.5% Potassium Nitrate closely followed by 0.5% Urea (11.99 cm), Calcium chloride @0.25% (11.77 kg cm^{-2}) and found non significant. Minimum fruit firmness (11.25 kg cm^{-2}) was noticed in water spray.
Results revealed that the different levels of pruning showed significant effect on fruit firmness. The treatment pruning at 30 cm resulted in the maximum fruit firmness (11.84 kg cm^{-2}) which is on par with pruning at 20 cm (11.77 kg cm^{-2}). Minimum fruit firmness (11.35 kg cm^{-2}) was recorded with control.
The interaction of different levels of pruning and foliar sprays of plant nutrients shown significant variation (Table 6). Significantly high firmness (12.50 kg cm^{-2}) reading was recorded in 30 cm pruning in combination with 1.5% Potassium Nitrate which was on par with 30 cm pruning in combination with 0.5% Calcium Chloride (12.22 kg cm^{-2}). The treatment 20 cm pruning in combination with 0.5% Urea (12.15 kg cm^{-2}) and 20 cm pruning in combination with control (11.34 cm^{-2}) was on par to 20 cm pruning in combination with control (11.50 kg cm^{-2}). Un pruned trees in combination with 1.5% Potassium Nitrate (12.07 kg cm^{-2}) and 30 cm pruning in combination with control (11.50 kg cm^{-2}) was on par to 30 cm pruning in combination with 0.5% Urea (11.99 kg cm^{-2}). Minimum fruit firmness (10.91 kg cm^{-2}) was noticed in un pruned trees in combination with control.
The above results are in agreement with Jens *et al.* (2005) [15], Racsko (2006) [22] in apple and Ihsan and Abdur (2012) [12] in litchi.

7. Fruit volume (ml): The influence of different levels of pruning and plant nutrient sprays on fruit volume differed significantly and is presented in Table 7.
The data regarding the fruit volume of apple ber significantly affected by pruning. The maximum fruit volume (22.83 ml) was noticed in 30 cm pruning followed by 20 cm pruning fruits per tree (22.24 ml). However. minimum fruit volume (21.28 ml) was noticed in un pruned trees.
The different levels of plant nutrient sprays had significant effect on fruit volume. The treatment 1.5% Potassium Nitrate recorded maximum fruit volume (23.44 ml) followed by 0.5% Urea (22.50 ml). However, minimum fruit volume (21.45 ml) was observed in control (without sprays of nutrients).
The interaction effect of pruning and plant nutrients was shown significant variation (Table 7). Significantly maximum fruit volume (24.50 ml) was recorded in 30 cm pruning in combination with 1.5% Potassium Nitrate followed by 30 cm pruning in combination with 0.5% Urea (23.50 ml). The treatment, 30 cm pruning in combination with control (22.50 ml) was 30 cm pruning in combination with 0.5% Calcium Chloride (21.36 ml). The treatment 20 cm pruning in combination with 0.25% Calcium Chloride (23.50 ml) was on par to 20 cm pruning in combination with 0.5% Urea (23.48 ml). Minimum fruit volume (19.50 ml) was noticed in un pruned trees in combination with control (without sprays of nutrients).
More nutrients were available to the fruits as competition among fruits was less. This may have induced an increase in cell division and helps in production of higher fruit mass. These factors lead to an increase in fruit size, weight and fruit volume. The results are in accordance with the findings reported by Gill and Bal (2010) [9] in ber, Lal *et al.* (2016) [18] in Acid Lime and Cronje *et al.* (2009) [7] in Litchi and Kumar *et al.* (2014) [17] in guava.
The above results are in agreement with that of Kumar *et al.* (2014) [16] in ber and Choudhary and Dhakare (2018) [5] and Dahapute *et al.* (2018) [8] in custard apple, Agnihotri *et al.* (2016) [1] and Shivpoojan *et al.* (2018) [26] in guava. The increase in fruit volume by the foliar sprays of nutrients might be due to optimum supply of nutrients in right amount during the entire crop growth period causing vigorous vegetative development of the plants and ultimately production of more photosynthates (Sachs and Hackett, 1972) [24]. The other possible reason for enhancement of fruit volume with different nutrients might be due to their involvement in hormonal metabolism, increased cell division, elongation and expansion of cells.

8. Specific gravity (g cm^{-3}): The data pertaining to specific gravity as influenced by different levels of pruning and plant nutrients foliar sprays in apple ber was presented in Table 8.
The data on the specific gravity was significantly affected by foliar sprays plant nutrients. However, the maximum specific gravity (4.62 g cm^{-3}) was noticed in 1.5% Potassium Nitrate and minimum specific gravity (4.23 g cm^{-3}) was observed in water spray.
The data on the specific gravity was significantly affected by different levels of pruning. However, the maximum specific gravity (4.57 g cm^{-3}) was noticed in pruning at 30 cm followed by pruning at 20 cm (4.29 g cm^{-3}) and minimum specific gravity (4.25 g cm^{-3}) was observed in control.
The interaction between different levels of pruning and plant nutrients was found to be significant on specific gravity. However, the maximum specific gravity (5.26 g cm^{-3}) was recorded in 1.5% Potassium Nitrate in combination with pruning at 30 cm and minimum specific gravity (3.60 g cm^{-3}) was observed in water spray in combination with control. The above results are in agreement with Sheikh and Rao (2002) [25], Hazel *et al.* (2011) [10] in pomegranate, Jens *et al.* (2005) [15] and Racsko (2006) [22] in apple.

9. Yield per tree (kg tree^{-1}): It is evident from the Table 9 that significant variation existed with respect to yield per tree among the different levels of pruning and foliar sprays of plant nutrients.
The highest yield per tree (28.55 kg) was obtained in

treatment 1.5% Potassium Nitrate followed 1.0% Potassium Nitrate (26.50 kg). While the minimum fruit yield per tree (106.50 kg) was obtained in water spray.

The different levels of pruning had significant effect on yield per tree. The treatment, pruning at 30 cm recorded maximum yield per tree (27.33 kg) followed by pruning at 20 cm (26.26 kg). However, minimum yield per tree (21.61 kg) was observed in control.

The interaction between different levels of pruning and foliar sprays of plant nutrients was found to be significant on yield per tree. However, highest yield per tree (38.66 kg) was observed in 1.5% Potassium Nitrate in combination with pruning at 30 cm and followed by 1% Potassium Nitrate (30.50 kg) was recorded in combination of with pruning at 20 cm and minimum yield per tree (19.16 kg) was obtained in water spray in combination with control.

With respect to foliar sprays of plant nutrients, the maximum yield per tree was recorded in 1.5% Potassium Nitrate and it might be due to nutrients spray in combination of pruning which in turn increased carbohydrates, thereby improving the distribution of assimilates between fruits, producing fruits with greater mass and diameter. Thus, increases yield of tree (Byers, 2003) [3]. Similar results were reported by Sheikh and Rao (2002) [25] in pomegranate Javaid *et al*. (2016) [13] in apple and Prabhugouda *et al.* (2017) [20] in guava.

The increase in yield might be due to additional dose of plant nutrients supplied through foliar sprays of plant nutrients and pruned which was utilized for cell elongation, cell division, RNA, DNA synthesis in the plants which are in active growing stage.

Increase in yield might be due to the availability of more metabolites and retention of sufficient length of bearing shoot after pruning at 30 cm. Similar results were reported by Prakash *et al.* (2012) [21] in guava, Dahapute *et al.* (2018) [8] in custard apple and Bhuva *et al*. (2018) [2] in pomegranate.

10. Yield per hectare (t ha^{-1}): It is evident from the Table 10 that significant variation existed with respect to yield per hectare among the different levels of pruning and foliar sprays of plant nutrients.

The highest yield per hectare was obtained in treatment 1.5% Potassium Nitrate (5.83 t ha^{-1}) which was on par with 1.0% Potassium Nitrate (5.46 t ha^{-1}). While the minimum fruit yield per tree (3.94 t ha^{-1}) was obtained in water spray.

The highest yield per hectare was obtained in treatment pruning at 30 cm (5.64 t ha^{-1}) which was followed by pruning at 20 cm (5.09 t ha^{-1}). While the minimum fruit yield per hectare (3.98 t ha^{-1}) was obtained in control.

The interaction between different levels of pruning and foliar sprays of plant nutrients was found to be significant on yield per hectare. However, highest yield per hectare (8.00 t ha^{-1}) was recorded in 1.5% Potassium Nitrate in combination with pruning at 30 cm and minimum yield per hectare (3.33 t ha^{-1}) was recorded in water spray in combination with control.

Regarding plant nutrients spray, the maximum yield per hectare was recorded in 1.5% Potassium Nitrate and it might be due to improving the distribution of assimilates between fruits, producing fruits with greater mass and diameter. Thus, increases the yield of tree (Byers, 2003) [3]. The increased in yield might be due to additional dose of plant nutrients sprayed which was utilized for cell elongation, cell division, RNA, DNA synthesis in these plants. The similar results were reported by Sutanu *et al*. (2017) [30] and Tanuja *et al*. (2016) [31] in pomegranate, Lal *et al.* (2016) [18] and Cronje *et al*. (2009) [7] and Pathak and Mitra (2008) [19] in Litchi and Kumar *et al*. (2014) [17] in guava.

Table 1: Effect of different levels of pruning and foliar sprays of nutrients on shoot length (cm) of Apple ber (*Zizyphus mauritiana*)

Treatments	**Nutrients spray (B)**							
Pruning (A)	N_1	N_2	N_3	N_4	N_5	N_6	N_7	Mean
P_1- Medium pruning (20 cm) on previous season growth	80.33	60.50	65.50	75.50	70.50	73.50	65.33	70.05^{b}
P_2- Heavy pruning (30 cm) on previous season growth	72.50	62.50	74.50	90.50	85.50	83.50	63.50	76.07^{a}
P_3- Control (Un pruned)	61.50	70.16	72.50	70.50	75.50	74.35	62.50	69.57^{c}
Mean	71.44^{C}	64.38^{E}	70.83^{D}	78.83^{A}	77.17^{B}	77.16^{B}	63.77^{F}	
	"F" Test			SE(m)±		CD at 5%		
Factor (A)	*			0.040		0.114		
Factor(B)	*			0.061		0.175		
A×B	*			0.106		0.303		

Table 2: Effect of different levels of pruning and foliar sprays of nutrients on number of shoots for branch of Apple ber (*Zizyphus mauritiana*)

Treatments	**Nutrients spray (B)**							
Pruning (A)	N_1	N_2	N_3	N_4	N_5	N_6	N_7	Mean
P_1- Medium pruning (20 cm) on previous season growth	24.50	25.50	26.50	27.50	27.66	28.50	26.33	26.64^{a}
P_2- Heavy pruning (30 cm) on previous season growth	25.50	23.83	24.50	29.50	28.50	23.16	25.88	25.88^{b}
P_3- Control (Un pruned)	25.16	24.16	26.50	23.50	24.50	24.33	25.50	24.81^{c}
Mean	25.05^{F}	24.50^{G}	25.83^{C}	26.94^{A}	26.88^{B}	25.33^{D}	25.88^{E}	
	"F" Test			SE(m)±		CD at 5%		
Factor (A)	*			0.078		0.223		
Factor(B)	*			0.119		0.340		
A×B	*			0.206		0.596		

Table 3: Effect of different levels of pruning and foliar sprays of nutrients on fruit weight (g) of Apple ber (*Zizyphus mauritiana*)

Treatments	**Nutrients spray (B)**							
Pruning (A)	N_1	N_2	N_3	N_4	N_5	N_6	N_7	Mean
P_1- Medium pruning (20 cm) on previous season growth	80.36	89.33	95.00	82.00	92.50	84.80	84.56	86.82^{b}
P_2- Heavy pruning (30 cm) on previous season growth	90.03	110.46	96.50	98.83	99.83	84.83	87.50	95.42^{a}
P_3- Control (Un pruned)	89.83	92.50	84.50	86.50	82.50	85.50	73.00	84.59^{c}
Mean	86.74^{E}	97.60^{A}	92.00^{B}	89.11^{D}	91.61^{C}	85.04^{F}	81.68^{G}	

	"F" Test	SE(m)±	CD at 5%
Factor (A)	*	0.094	0.268
Factor(B)	*	0.143	0.410
A×B	*	0.248	0.711

Table 4: Effect of different levels of pruning and foliar sprays of nutrients on fruit diameter (cm) of Apple ber (*Zizyphus mauritiana*)

Treatments	**Nutrients spray (B)**							
Pruning (A)	N_1	N_2	N_3	N_4	N_5	N_6	N_7	Mean
P_1- Medium pruning (20 cm) on previous season growth	4.33	4.36	4.06	4.35	4.46	4.56	4.43	4.37^b
P_2- Heavy pruning (30 cm) on previous season growth	4.36	5.26	4.61	4.50	4.80	4.46	4.66	4.60^a
P_3- Control (Un pruned)	4.46	4.36	4.46	4.30	4.33	3.50	3.90	4.29^c
Mean	4.38^D	4.66^A	4.35^C	4.36^C	4.53^B	4.26^F	4.33^E	
	"F" Test			SE(m)±		CD at 5%		
Factor (A)	*			0.014		0.042		
Factor(B)	*			0.022		0.065		
A×B	*			0.039		0.113		

Table 5: Effect of different levels of pruning and foliar sprays of nutrients on fruit length (cm) of Apple ber (*Zizyphus mauritiana*)

Treatments	**Nutrients spray (B)**							
Pruning (A)	N_1	N_2	N_3	N_4	N_5	N_6	N_7	Mean
P_1- Medium pruning (20 cm) on previous season growth	5.53	5.23	5.53	6.00	5.63	5.10	4.50	5.36^b
P_2- Heavy pruning (30 cm) on previous season growth	5.60	7.00	5.40	5.53	5.10	4.66	5.16	5.49^a
P_3- Control (Un pruned)	4.53	5.56	5.83	5.03	5.11	4.76	5.15	5.02^c
Mean	5.22^E	5.93^A	5.32^C	5.52^B	5.27^D	4.84^G	4.93^F	
	"F" Test			SE(m)±		CD at 5%		
Factor (A)	*			0.041		0.117		
Factor(B)	*			0.062		0.179		
A×B	*			0.104		0.311		

Table 6: Effect of different levels of pruning and foliar sprays of nutrients on fruit firmness ((kg cm-2) of Apple ber (*Zizyphus mauritiana*)

Treatments	**Nutrients spray (B)**							
Pruning (A)	N_1	N_2	N_3	N_4	N_5	N_6	N_7	Mean
P_1- Medium pruning (20 cm) on previous season growth	12.12	12.02	12.15	11.78	12.01	11.69	11.34	11.77^b
P_2- Heavy pruning (30 cm) on previous season growth	11.63	12.50	12.00	10.96	11.80	12.22	11.50	11.84^a
P_3- Control (Un pruned)	11.06	11.71	11.82	11.30	11.51	11.16	10.91	11.35^c
Mean	11.60^E	12.07^A	11.99^B	11.35^F	11.77^D	11.94^C	11.25^G	
	"F" Test			SE(m)±		CD at 5%		
Factor (A)	*			0.073		0.211		
Factor(B)	*			0.112		0.322		
A×B	*			0.195		0.559		

Table 7: Effect of different levels of pruning and foliar sprays of nutrients on fruit volume (ml) of Apple ber (*Zizyphus mauritiana*)

Treatments	**Nutrients spray (B)**							
Pruning (A)	N_1	N_2	N_3	N_4	N_5	N_6	N_7	Mean
P_1- Medium pruning (20 cm) on previous season growth	20.50	22.50	23.48	21.50	23.50	21.50	21.50	22.24^b
P_2- Heavy pruning (30 cm) on previous season growth	22.50	24.50	23.50	23.16	23.16	22.50	22.49	22.83^a
P_3- Control (Un pruned)	22.36	23..33	21.40	23.43	21.50	21.36	19.50	21.28^c
Mean	21.78^E	23.44^A	22.78^B	22.70^D	22.72^C	21.50^F	21.04^G	
	"F" Test			SE(m)±		CD at 5%		
Factor (A)	*			0.045		0.130		
Factor(B)	*			0.069		0.199		
A×B	*			0.120		0.345		

Table 8: Effect of different levels of pruning and foliar sprays of nutrients on specific gravity (g cm-3) of Apple ber (*Zizyphus mauritiana*)

Treatments	**Nutrients spray (B)**							
Pruning (A)	N_1	N_2	N_3	N_4	N_5	N_6	N_7	Mean
P_1- Medium pruning (20 cm) on previous season growth	4.17	4.23	4.04	4.23	4.30	4.50	4.43	4.29^b
P_2- Heavy pruning (30 cm) on previous season growth	4.36	5.26	4.63	4.50	4.35	4.46	4.46	4.57^a
P_3- Control (Un pruned)	4.46	4.36	4.35	4.30	4.80	3.90	3.60	4.25^c
Mean	4.33^D	4.62^A	4.34^C	4.34^C	4.48^B	4.28^E	4.23^F	
	"F" Test			SE(m)±		CD at 5%		
Factor (A)	*			0.031		0.090		
Factor(B)	*			0.068		0.138		
A×B	*			0.083		0.240		

Table 9: Effect of different levels of pruning and foliar sprays of nutrients on yield per tree (kg tree-1) of Apple ber (*Zizyphus mauritiana*)

Treatments	Nutrients spray (B)							
Pruning (A)	N_1	N_2	N_3	N_4	N_5	N_6	N_7	Mean
P_1- Medium pruning (20 cm) on previous season growth	25.50	26.00	23.66	35.66	26.50	27.00	24.50	26.26^b
P_2- Heavy pruning (30 cm) on previous season growth	30.50	38.66	26.50	26.83	24.50	24.83	22.50	27.33^a
P_3- Control (Un pruned)	23.50	24.00	21.83	20.50	22.50	19.83	19.16	21.61^c
Mean	26.50^B	28.55^A	24.00^E	26.00^C	24.50^D	23.88^F	22.05^G	
	"F" Test			SE(m)±		CD at 5%		
Factor (A)	*			0.10		0.37		
Factor(B)	*			0.16		0.46		
A×B	*			0.27		0.79		

Table 10: Effect of different levels of pruning and foliar sprays of nutrients on yield per hectare (t ha^{-1}) of Apple ber (*Zizyphus mauritiana*)

Treatments	Nutrients spray (B)							
Pruning (A)	N_1	N_2	N_3	N_4	N_5	N_6	N_7	Mean
P_1- Medium pruning (20 cm) on previous season growth	5.50	4.50	6.50	5.60	4.50	5.00	4.00	5.09b
P_2- Heavy pruning (30 cm) on previous season growth	6.00	8.00	5.50	5.00	5.50	5.00	4.50	5.64^a
P_3- Control (Un pruned)	4.00	5.00	4.40	3.83	4.00	3.33	3.33	3.98^c
Mean	5.16^C	5.83^A	5.46^B	4.83^D	4.66^E	4.44^F	3.94^G	
	"F" Test			SE(m)±		CD at 5%		
Factor (A)	*			0.09		0.27		
Factor(B)	*			0.14		0.42		
A×B	*			0.23		0.72		

Significant at (0.05 –p LOS), NS- Non- Significant
Means with similar alphabets did not differe significantly.
Values are compared with respective C.D values.
P_1- Medium pruning (20 cm) on previous season growth
N_1 - Potassium Nitrate @1.0% N_2 - Potassium Nitrate @ 1.5%
N_3- Urea @ 0.5% N_4 - Urea @ 1.0%
N_5 - Calcium Chloride @ 0.25% N_6 - Calcium Chloride @ 0.50%
N_7 - Water spraying

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