

# Original Research Article

## Effect of Pruning and Micronutrient Sprays on Physico-chemical Properties of Ber

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### ABSTRACT

An investigation was undertaken to study the effect of pruning height and micronutrients on physicochemical properties of ber. The experiment was laid out in the farmers field at Manikpur area of Bongaigaon district, Assam (26°26'51" North latitude and 90°46'47" East longitude) for two consecutive years. Two types of Thailand ber were exposed to two different pruning heights and eight different types of micronutrient spray combinations. Results depicted that Roundish ovate reddish type variety performed better. The highest total sugar content (14.91%), TSS/acid ratio (44.07) and ash content (2.66%) were observed in pruning height of 75 cm. Among micronutrients, borax at 0.5% and zinc sulphate at 0.5% in combination proved to be better in terms of total sugar (14.83%) and ash content (2.64%). So, the experiment proved that pruning height of 75 cm from the ground level and spraying of borax 0.5% and zinc sulphate 0.5% in combination, were better compared to the other treatments.

*Keywords: Ash content; Ber; Sugar; Titratable acidity; TSS*

### 1. INTRODUCTION

*Ziziphus mauritiana* Lamk., the Indian ber of Rhamnaceae family occupies an important place among minor fruits of India. India produces around 513 thousand metric tons of ber annually from an area of around 50 thousand hectares [1]. This fruit crop is in cultivation in India from very ancient times. The sage Vedavyasa was also popular as 'Badrayan' (the person residing in ber forest) as he created his cottage in the forest where plenty of ber plants were there [2]. The nutritious fruit ber is superior to apple in terms of vitamin C, calcium, phosphorus and protein [3].

Annual pruning is mandatory in ber as it bears fruits on the current season growth [3]. Again, it is noticed that micronutrients play vital role in fruit set, fruit retention, fruit development and quality of ber. Boron proved its efficiency in increasing the blooming and retention of flowers along with development of seed and fruit [4]. The stimulation of carbohydrates and proteins in plant cells as well as formation of DNA are regulated by the micronutrient zinc, besides its role in biosynthesis of indole-3-butyric acid [5]. Therefore, an experiment was laid out to assess the role of pruning and micronutrients in the physico-chemical properties of two types of Thailand ber variety under Assam condition.

### 2. MATERIAL AND METHODS

The experiment was conducted for two years during 2020-21 and 2021-22 in a farmers field located at Manikpur area of Bongaigaon district, Assam, India (26°26'51" North latitude and

90°46'47" East longitude). The soil was strongly acidic (pH 5.1) with high organic carbon content (1.03%).

Two types of Thailadbers were selected as study material, viz., V<sub>1</sub>: Round green type, V<sub>2</sub>: Roundish ovate reddish type. Heading back system of pruning was followed and two different height of pruning were considered for the experiment (P<sub>1</sub>: 50 cm from the ground level and P<sub>2</sub>: 75 cm from the ground level). Pruning was performed just after harvest during March. Borax (11% B) and zinc sulphate (33% Zn) were the two micronutrient sources taken for the study with various levels as N<sub>0</sub>: No micronutrient, N<sub>1</sub>: Borax 0.4%, N<sub>2</sub>: Borax 0.5%, N<sub>3</sub>: ZnSO<sub>4</sub> 0.4%, N<sub>4</sub>: ZnSO<sub>4</sub> 0.5%, N<sub>5</sub>: Borax 0.4% + ZnSO<sub>4</sub> 0.4%, N<sub>6</sub>: Borax 0.4% + ZnSO<sub>4</sub> 0.5%, N<sub>7</sub>: Borax 0.5% + ZnSO<sub>4</sub> 0.4%, N<sub>8</sub>: Borax 0.5% + ZnSO<sub>4</sub> 0.5%. Spraying of micronutrients were done twice, first at fruit set and the next one is 30 days after the first spray.

### 2.1. Moisture content (%)

The moisture content was determined by following standard procedure with the help of following formula –

$$\text{Moisture content (\%)} = \frac{\text{Fresh weight (g)} - \text{Dry weight (g)}}{\text{Fresh weight (g)}} \times 100$$

### 2.2. TSS (°Brix)

The fresh fruit was after removal of seed. To make homogenous mixture, the cut pieces were ground. Then juice was extracted and filtered with a muslin cloth. A drop of juice was placed in the digital hand refractometer to find the TSS (°Brix) at room temperature.

### 2.3. Reducing sugar (%)

Lane-Eynon method was used for determining the reducing sugar.

$$\text{Reducing sugar (\%)} = \frac{\text{mg of invert sugar} \times \text{dilution} \times 100}{\text{titre value} \times \text{weight of sample}}$$

Where, mg of invert sugar = Factor 0.05

### 2.4. Total sugar (%)

To determine the total sugar, the Lane-Eynon method was executed.

$$\text{Total invert sugar (\%)} = \frac{\text{mg of invert sugar} \times \text{dilution} \times \text{second volume make up} \times 100}{\text{titre value} \times \text{weight of sample} \times \text{sample kept overnight}}$$

Where, mg of invert sugar = Factor 0.05

$$\text{Sucrose (\%)} = \{\text{Total invert sugar (\%)} - \text{Reducing sugar (\%)}\} \times 0.95$$

$$\text{Total sugar (\%)} = \text{Sucrose (\%)} + \text{Reducing sugar (\%)}$$

### 2.5. Non-reducing sugar (%)

The value of non-reducing sugar was directly calculated by using following formula –

Non-reducing sugar (%) = Total sugar (%) – Reducing sugar (%)

## 2.6. Titratable acidity (%)

Determination of titratable acidity in percentage was done following the procedure prescribed by AOAC [6]. Titratable acidity was calculated in terms of percentage anhydrous citric acid.

$$\text{Titratable acidity (\%)} = \frac{\text{Titre value} \times N \times V \times \text{equivalent weight of citric acid} \times 100}{\text{weight of sample} \times \text{aliquot} \times 1000}$$

Where, N = Normality of alkali and V = Volume made up

## 2.7. TSS/acid ratio

The ratio of TSS and acid is important aspect in relation to consumer preference. It was calculated out by dividing the value of TSS by the value of titratable acidity.

## 2.8. Ash content (%)

The ash content was determined by burning out all the organic material present in the sample in a temperature of 600°C in a muffle furnace [6]. The following calculation was used to find out the ash content –

$$\text{Ash (\%)} = \frac{W_1 - W}{W_2 - W} \times 100$$

Where, W = Weight of the crucible

$W_1$  = Weight of sample heated at 600°C

$W_2$  = Weight of crucible + sample

The relevant parameters of the study were subjected to standard statistical procedures [7].

## 3. RESULTS AND DISCUSSION

For different physico-chemical parameters records were taken as per standard protocol as mentioned in the materials and methods and are presented and discussed hereunder.

### 3.1. Moisture content (%)

It is evident from Table 1 that only variety influenced the fruit moisture content significantly, whereas the pruning height as well as micronutrient sprays had no significant effect on fruit moisture. The maximum moisture of 79.36 per cent was recorded for variety  $V_1$ . The result is in conformity with the works of other research workers [8].

**Table 1. Moisture and TSS content as influenced by variety, pruning height and micronutrient sprays**

Treatments	Moisture (%)	TSS (°Brix)
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	2020 – 21	2021 – 22	Pooled	2020 – 21	2021 – 22	Pooled
V <sub>1</sub>	79.73	78.98	79.36	13.53	13.46	13.49
V <sub>2</sub>	78.29	78.76	78.52	14.91	15.09	15.00
<b>CD<sub>P=0.05</sub></b>	<b>1.18</b>	<b>1.00</b>	<b>0.70</b>	<b>0.07</b>	<b>0.05</b>	<b>0.04</b>
P <sub>1</sub>	79.23	78.59	78.91	13.86	13.92	13.89
P <sub>2</sub>	78.79	79.15	78.97	14.58	14.63	14.61
<b>CD<sub>P=0.05</sub></b>	<b>NS</b>	<b>NS</b>	<b>NS</b>	<b>0.07</b>	<b>0.05</b>	<b>0.04</b>
N <sub>0</sub>	79.46	79.35	79.41	13.91	13.99	13.95
N <sub>1</sub>	78.88	79.25	79.07	14.01	14.07	14.04
N <sub>2</sub>	79.49	77.96	78.73	14.09	14.12	14.10
N <sub>3</sub>	78.91	79.38	79.15	14.16	14.18	14.17
N <sub>4</sub>	78.68	80.00	79.34	14.20	14.22	14.21
N <sub>5</sub>	79.56	78.10	78.83	14.27	14.32	14.29
N <sub>6</sub>	77.10	79.45	78.28	14.35	14.43	14.39
N <sub>7</sub>	79.88	79.09	79.49	14.46	14.53	14.49
N <sub>8</sub>	79.13	77.23	78.18	14.53	14.63	14.58
<b>CD<sub>P=0.05</sub></b>	<b>NS</b>	<b>NS</b>	<b>NS</b>	<b>0.15</b>	<b>0.10</b>	<b>0.09</b>

### 3.2. TSS (°Brix)

All the three factors viz., variety, pruning height and application of micronutrients significantly affected the total soluble solid content in fruits (Table 1). A TSS value of 15.00 °Brix in the variety V<sub>2</sub> was the highest and 4.61 °Brix was noticed in pruning height P<sub>2</sub>. This resulted in higher accumulation of photosynthates and minerals in pruned trees led to the highest content of TSS in medium pruned trees [9]. Medium pruning (P<sub>2</sub>) performed better in terms the TSS content of peach cv. Flordaking[10]. Among the micronutrients, the highest TSS was found in N<sub>8</sub> (14.58 °Brix) and the lowest in N<sub>0</sub> (13.95 °Brix). Researchers also observed significant difference among various ber varieties [11]. Open plant canopy allows more sunlight penetration. Boron alone, or in association with Zn had positive influence on fruit TSS content. Boron mediated transport of higher assimilates might be the reason behind this [12].

### 3.3. Total sugar (%)

As depicted by the Table 2, amount of total sugar in fruit was significantly influenced by variety, pruning and micronutrient treatments. Among varieties, V<sub>2</sub> showed significantly higher amount of total sugar content (15.14%) compared to V<sub>1</sub> (13.54%). The significant deviation in total sugar content of fruits due to variety tallies the experimental finding of [11]. Pruning height of 75 cm from the ground level (P<sub>2</sub>) found to be significantly superior to pruning height of 50 cm from the ground level (P<sub>1</sub>) in terms of total sugar content with values of 14.91 and 13.77 per cent, respectively. Similarly, higher amount of total sugar was achieved in 50 per cent pruning intensity due to accumulation of more photosynthates and nutrients in pruned shoots [13]. Among micronutrient levels, N<sub>8</sub> showed significantly higher content of total sugar (14.83%) compared to all other levels, whereas N<sub>0</sub> exhibited the lowest quantity of total sugar (13.86%). The effect of boron can be attributed to its vital role in translocation of sugar by formation of 'sugar-borate complex' with sugar in higher plants [14].

Zinc mediated metabolism of starch and nucleic acid might be the cause for positive effect of this micronutrient in increasing the total sugar content [15].

**Table 2. Total and reducing sugar content as influenced by variety, pruning height and micronutrient sprays**

Treatments	Total sugar (%)			Reducing sugar (%)		
	2020 – 21	2021 – 22	Pooled	2020 – 21	2021 – 22	Pooled
V <sub>1</sub>	13.58	13.49	13.54	7.41	7.32	7.37
V <sub>2</sub>	15.26	15.03	15.14	8.13	8.03	8.08
<b>CD<sub>P=0.05</sub></b>	<b>0.06</b>	<b>0.05</b>	<b>0.04</b>	<b>0.03</b>	<b>0.03</b>	<b>0.02</b>
P <sub>1</sub>	13.84	13.69	13.77	7.51	7.40	7.45
P <sub>2</sub>	15.00	14.83	14.91	8.04	7.94	7.99
<b>CD<sub>P=0.05</sub></b>	<b>0.06</b>	<b>0.05</b>	<b>0.04</b>	<b>0.03</b>	<b>0.03</b>	<b>0.02</b>
N <sub>0</sub>	13.92	13.80	13.86	7.54	7.47	7.50
N <sub>1</sub>	14.05	13.92	13.99	7.60	7.52	7.56
N <sub>2</sub>	14.17	14.03	14.10	7.65	7.57	7.61
N <sub>3</sub>	14.31	14.17	14.24	7.72	7.63	7.67
N <sub>4</sub>	14.44	14.26	14.35	7.78	7.67	7.72
N <sub>5</sub>	14.57	14.35	14.46	7.83	7.70	7.77
N <sub>6</sub>	14.67	14.47	14.57	7.89	7.76	7.83
N <sub>7</sub>	14.76	14.58	14.67	7.95	7.81	7.88
N <sub>8</sub>	14.89	14.77	14.83	8.00	7.90	7.95
<b>CD<sub>P=0.05</sub></b>	<b>0.13</b>	<b>0.11</b>	<b>0.08</b>	<b>0.07</b>	<b>0.07</b>	<b>0.05</b>

### 3.4. Reducing sugar (%)

The data pertaining to reducing sugar content in fruits also followed the same trend as total sugar content. Table 2 illustrated that reducing sugar content was significantly influenced by variety, level of pruning and micronutrient treatments. Among varieties, V<sub>2</sub> showed significantly higher level of reducing sugar content (8.08%) compared to V<sub>1</sub> (7.37%). Significant difference as a result of variety was also obtained by [8]. Pruning level P<sub>2</sub> (7.99%) performed better than P<sub>1</sub> (7.45%) in terms of reducing sugar content. More synthesis of photosynthates in moderately pruned apple trees as illustrated by [16] might be the probable cause of significant variation achieved due to pruning. As in case of total sugar content, N<sub>8</sub> exhibited significantly higher content of reducing sugar (7.95%) compared to all other levels. Again, N<sub>0</sub> exhibited the lowest content reducing sugar (7.50%). Besides aiding in sugar transport, source to sink movement of growth regulators is also regulated by boron [17]. Conversion of starch to sugar through hydrolysis is promoted by zinc. As a result, significantly higher amount of reducing sugar in zinc treated fruits were obtained [18].

### 3.5. Non-reducing sugar (%)

Table 3 depicted that all the factors *i.e.* variety, pruning level and micronutrient sprays had significant effect on non-reducing sugar content of Thailand ber fruit. The variety V<sub>2</sub> (7.07%) was significantly superior to V<sub>1</sub> (6.17%) in terms of non-reducing sugar content. This variation occurred because of significant diversity in total sugar and reducing sugar content among varieties. In case of pruning, P<sub>2</sub> (6.92%) performed significantly better than P<sub>1</sub> (6.31%) in regards to non-reducing sugar content of fruits. More assimilation of food material increased the non-reducing sugar content in medium pruned ber trees [9]. Similar observations in ber were also reported earlier [19]. Non-reducing sugar content of N<sub>8</sub> was significantly higher (6.88%) compared to all other micronutrient treatments, while, N<sub>0</sub> exhibited the lowest content non reducing sugar (6.36%). As a result of significant impact of boron and zinc on total sugar and reducing sugar, significant effect of these micronutrients were also noticed in case of non-reducing sugar content.

**Table 3. Non reducing sugar and titratable acidity content as influenced by variety, pruning height and micronutrient sprays**

Treatments	Non reducing sugar (%)			Titratable acidity (%)		
	2020 – 21	2021 – 22	Pooled	2020 – 21	2021 – 22	Pooled
V <sub>1</sub>	6.17	6.18	6.17	0.32	0.31	0.32
V <sub>2</sub>	7.13	7.00	7.07	0.53	0.53	0.53
<b>CD<sub>P=0.05</sub></b>	<b>0.040</b>	<b>0.031</b>	<b>0.023</b>	<b>0.008</b>	<b>0.008</b>	<b>0.006</b>
P <sub>1</sub>	6.33	6.30	6.31	0.49	0.48	0.48
P <sub>2</sub>	6.96	6.88	6.92	0.37	0.36	0.36
<b>CD<sub>P=0.05</sub></b>	<b>0.040</b>	<b>0.031</b>	<b>0.023</b>	<b>0.008</b>	<b>0.008</b>	<b>0.006</b>
N <sub>0</sub>	6.39	6.33	6.36	0.48	0.48	0.48
N <sub>1</sub>	6.45	6.41	6.43	0.47	0.46	0.46
N <sub>2</sub>	6.52	6.47	6.49	0.45	0.44	0.45
N <sub>3</sub>	6.59	6.55	6.57	0.44	0.42	0.43
N <sub>4</sub>	6.67	6.59	6.63	0.43	0.42	0.42
N <sub>5</sub>	6.74	6.64	6.69	0.41	0.40	0.41
N <sub>6</sub>	6.77	6.71	6.74	0.40	0.40	0.40
N <sub>7</sub>	6.81	6.77	6.79	0.38	0.37	0.37
N <sub>8</sub>	6.89	6.86	6.88	0.38	0.38	0.38
<b>CD<sub>P=0.05</sub></b>	<b>0.086</b>	<b>0.065</b>	<b>0.049</b>	<b>0.016</b>	<b>0.017</b>	<b>0.012</b>

### 3.6. Titratable acidity (%)

Significant variations were noted in case of titratable acidity of fruits in regards to variety, pruning and micronutrient level (Table 3). Variety V<sub>1</sub> recorded significantly lower titratable acidity of 0.32 per cent, while compared with V<sub>2</sub> (0.53%). As found in the current study Ghosh and Mathew (2002) also saw significant effect of variety on titratable acidity of fruits. In case of pruning, P<sub>2</sub> exhibited the lowest titratable acidity of 0.36 per cent compared to P<sub>1</sub> (0.48%). Reduction in pruning intensity significantly reduced the titratable acidity in the present investigation, which is in conformity with the illustration of [20], which could be attributed to either conversion of acid to sugar or utilization of acids in the process of metabolism. Among different level of micronutrients, N<sub>7</sub> recorded the lowest level of titratable

acidity with value of 0.37 per cent, which was at par with 0.38 per cent recorded in N<sub>8</sub>. Further, the highest titratable acidity was found in N<sub>0</sub> (0.48%). The probable cause for the phenomenon might be because of conversion of acids to sugar due to reversal of glycolytic pathway or acids had been utilized in respiration as a substrate or both [21].

### 3.7. TSS/acid ratio

The ratio of total soluble solid and acid differed significantly *w.r.t.* variety, pruning level and micronutrient levels (Table 4). Significantly higher value of 45.33 was observed in V<sub>1</sub>, while V<sub>2</sub> recorded a value of 29.07. In regards to pruning height, P<sub>2</sub> exhibited significantly higher TSS/acid ratio of 44.07 than P<sub>1</sub> (30.33). The ratio of TSS/acid was the maximum in N<sub>7</sub> (43.04) closely followed by N<sub>8</sub> (42.94). The lowest TSS/acid ratio was found in N<sub>0</sub> (31.24) closely followed by N<sub>1</sub> (32.32). Interaction studies revealed significant difference of TSS/acid ratio among various interaction (Table 4.). More TSS and less titratable acidity tends to higher TSS/acid ratio and vice versa. The probable reasons already discussed which led to variation in TSS and titratable acidity. The significant variation in TSS and titratable acidity led to significant changes in TSS/acid ratios.

**Table 4. TSS/acid ratio and ash content as influenced by variety, pruning height and micronutrient sprays**

Treatments	TSS : acid			Ash (%)		
	2020 – 21	2021 – 22	Pooled	2020 – 21	2021 – 22	Pooled
V <sub>1</sub>	44.08	46.57	45.33	2.37	2.38	2.37
V <sub>2</sub>	28.90	29.25	29.07	2.65	2.66	2.65
<b>CD<sub>P=0.05</sub></b>	<b>0.861</b>	<b>1.016</b>	<b>0.655</b>	<b>0.015</b>	<b>0.013</b>	<b>0.010</b>
P <sub>1</sub>	30.02	30.63	30.33	2.35	2.39	2.37
P <sub>2</sub>	42.96	45.19	44.07	2.66	2.65	2.66
<b>CD<sub>P=0.05</sub></b>	<b>0.861</b>	<b>1.016</b>	<b>0.655</b>	<b>0.015</b>	<b>0.013</b>	<b>0.010</b>
N <sub>0</sub>	31.14	31.34	31.24	2.39	2.41	2.40
N <sub>1</sub>	31.40	33.25	32.32	2.43	2.44	2.44
N <sub>2</sub>	33.74	34.89	34.32	2.45	2.46	2.46
N <sub>3</sub>	34.02	36.96	35.49	2.48	2.48	2.48
N <sub>4</sub>	35.30	38.32	36.81	2.51	2.52	2.51
N <sub>5</sub>	38.34	39.26	38.80	2.53	2.54	2.53
N <sub>6</sub>	39.06	40.61	39.83	2.56	2.57	2.57
N <sub>7</sub>	43.09	42.98	43.04	2.60	2.62	2.61
N <sub>8</sub>	42.33	43.56	42.94	2.63	2.64	2.64
<b>CD<sub>P=0.05</sub></b>	<b>1.827</b>	<b>2.155</b>	<b>1.389</b>	<b>0.031</b>	<b>0.028</b>	<b>0.020</b>

### 3.8. Ash content (%)

A view of Table 4 enlightened that all the factors *i.e.* variety, pruning height and micronutrient levels had significant influence on ash content of Thailand ber fruits under study. The ash content of V<sub>2</sub> was 2.65 per cent, which was significantly superior to V<sub>1</sub> (2.37%). As observed in the current investigation, significant varietal differences among Thai apple ber accessions were also observed [8]. Significantly higher ash content was witnessed in P<sub>2</sub> (2.66%) compared to P<sub>1</sub> (2.37%). Moderate pruning provides more open canopy of ber plants, which aids in penetration of more sun rays leading to more production of photosynthates [2], which in turn triggered changes in ash content. The micronutrient treatment N<sub>8</sub> was found to be the best in terms of ash content and the value of 2.64 per cent was significantly higher than all other micronutrient treatments. The lowest ash content was detected in N<sub>0</sub> with a value of 2.40 per cent. Application of micronutrient boron enhances the uptake and transport of other nutrients, *viz.*, N, P, K, Cu, Zn and Fe from soil [22] which instigated increase in ash content of fruits. Zinc influenced ash content positively being a constituent of the enzyme carbonic anhydrase, which is a mandatory enzyme for photosynthesis [23].

#### 4. CONCLUSION

In the present study, it was revealed that Roundish ovate reddish type variety (V<sub>2</sub>) was superior to the Round green type variety (V<sub>1</sub>) in terms of physico-chemical parameters. In regards to those parameters pruning height of 75 cm (P<sub>2</sub>) was better and micronutrient sprays with Borax 0.5% and Zinc Sulphate 0.5% (N<sub>8</sub>) performed the best. On the basis of results, the best pruning height and micronutrient sprays can be advocated for adoption.

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