Growth Behavior of Pineapple cv. Mauritius under Integrated Nutrient Management in Northern part of West Bengal, India

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A B S T R A C T

Pineapple is an important fruit crop and West Bengal is the leader in pineapple production in India. In West Bengal the commercial cultivars is Kew under Smooth Cayenne group which suitable for processing purpose. Table purpose cultivars like Queen is being grown as home stead condition in some pockets of West Bengal. Mauritius cultivar (Queen Group) of pineapple was introduced first time in West Bengal from the south India and its growth performance under the integrated nutrient management practices was assessed in this present experiment. The experiment was conducted at farmers field near Bidhannagar area of Siliguri under the Darjeeling district from 2014-16. The experiment was conducted with Factorial Randomized block design having three factors- Chemical fertilizer (Factor A), organic manure (Factor B) and bio-fertilizer (Factor C) and eighteen treatment combination with three replication. It is found from the present experiment that the treatment combinations having chemical fertilizer, organic manure and bio-fertilizers shows better performance than the other treatment combinations. The plant height, canopy spread, number of leaves, D-leaf length, D-leaf breadth, and leaf area was recorded highest in T12 (Chemical 75% RDF + Vermicompost + Bio-fertilizer).

Keywords: Growth, Behavior, Pineapple, Nutrient, West Bengal.

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Introduction

Pineapple (Ananas comosus L. Merr.) is an important tropical fruit of world under the Bromeliaceae family. Pineapple is one of the most internationalized fruit traded globally; it is third only to bananas and citrus in this respect. The major pineapple products are canned slices, chunks, crush, juice and fresh fruit. Processed pineapple products, such as juices, largely dominate this market, accounting for 80 percent of the trade (Jacob and Soman, 2006). India ranks 6th (7.4%) in terms of world pineapple production (National Horticulture Database-2014) but productivity is quite low (15.8t/ha) compare to leading countries like Indonesia (124.5t/ha), Costa Rica (59.2t/ha), Brazil (40.9t/ha). West Bengal is leader in pineapple production in India (316 thousand metric
tonnes). Pineapple is an important commercial fruit crop of West Bengal and it is intensively cultivated in Siliguri sub-division of Darjeeling district, Sadar sub-division of Jalpaiguri district, Islampur sub-division of Uttar Dinajpur district and parts of Cooch Behar district.

In West Bengal the commercial cultivars is Kew since long back. The Kew comes under Smooth Cayenne group suitable for processing purpose.

Table purpose cultivars like Queen is being grown as home stead condition in some pockets of West Bengal. Whereas, pineapple cv. Mauritius under the Queen group is very popular in southern parts of India (Kerala, Karnataka region) due to its taste, sweetness, flavor (Annon, 2017).

Considering the fact the Mauritius cultivar of pineapple was introduced first time in West Bengal from the south India and its performance under the integrated nutrient management practices was assessed in this present experiment.

Materials and Methods

The experiment was conducted at farmer’s field near Bidhannagar area of Siliguri under the Darjeeling from 2014-16 with Spacing: 90cm×35cm×25cm having individual bed size of: 3×0.7 m=2.1m² with 25 number of plants per plot. The experiment was conducted with Asymmetrical Factorial Randomized Block design having three factors- Chemical fertilizer (Factor A), organic manure (Factor B) and bio-fertilizer (Factor C) and eighteen treatment combination with three replication. Chemical fertilizers were applied in 3 levels (A₀-zero, A₁-75 percent and A₂- 100 percent recommended dose), organic manure were applied also in 3 levels (B₀-zero, B₁-FYM, B₂-Vermicompost), bio-fertilizer were applied in 2 levels (C₀-zero and C₁- Azotobactor + Phosphate Solublising Bacteria). The doses for integrated nutrient management was as follows: Regular Dosages of Fertilizer (RDF)= 12:4:12 g/plant, Farm Yard Manure (FYM) = 500g/ plant, Vermicompost = 300g/Plant, Azotobactor = 10g, Phosphate Solublising Bacteria (PSB) = 10g was applied. It was reported that of 12g/ plants of nitrogen and potash has been found to be optimum and no effect of phosphorus was observed, however, 4g of P₂O₅ increased fruit weight and yield in pineapple (Reddy and Prakash, 1982).

| Treatment combinations | T₁ | T₁₀ | T₂ | T₁₀ | T₃ | T₁₀ | T₄ | T₁₀ | T₅ | T₁₀ | T₆ | T₁₀ | T₇ | T₁₀ | T₈ | T₁₀ | T₉ |
|------------------------|----|-----|----|-----|----|-----|----|-----|----|-----|----|-----|----|-----|----|-----|----|
| A₀B₀C₀                 |    |     | A₀B₀C₀ |     | A₀B₀C₀ |     | A₀B₁C₀ |     | A₀B₁C₀ |     | A₀B₂C₀ |     | A₀B₂C₀ |     | A₀B₂C₀ |     | A₀B₂C₀ |     |
| A₁B₁C₁                 |    |     | A₁B₁C₁ |     | A₁B₁C₁ |     | A₁B₁C₁ |     | A₁B₁C₁ |     | A₁B₁C₁ |     | A₁B₁C₁ |     | A₁B₁C₁ |     | A₁B₁C₁ |     |
| A₁B₂C₀                 |    |     | A₁B₂C₀ |     | A₁B₂C₀ |     | A₁B₂C₀ |     | A₁B₂C₀ |     | A₁B₂C₀ |     | A₁B₂C₀ |     | A₁B₂C₀ |     | A₁B₂C₀ |     |
| A₁B₂C₁                 |    |     | A₁B₂C₁ |     | A₁B₂C₁ |     | A₁B₂C₁ |     | A₁B₂C₁ |     | A₁B₂C₁ |     | A₁B₂C₁ |     | A₁B₂C₁ |     | A₁B₂C₁ |     |
| A₁B₂C₀                 |    |     | A₁B₂C₀ |     | A₁B₂C₀ |     | A₁B₂C₀ |     | A₁B₂C₀ |     | A₁B₂C₀ |     | A₁B₂C₀ |     | A₁B₂C₀ |     | A₁B₂C₀ |     |
| A₁B₂C₁                 |    |     | A₁B₂C₁ |     | A₁B₂C₁ |     | A₁B₂C₁ |     | A₁B₂C₁ |     | A₁B₂C₁ |     | A₁B₂C₁ |     | A₁B₂C₁ |     | A₁B₂C₁ |     |

Regarding the growth behaviour the height of the plant (cm), plant spread in North-South and East-West direction (cm), number of leaves, D-leaf length (cm), leaf length (cm), leaf breadth (cm), and leaf area (cm²) were recorded 3 months after planting and continue upto 18 months with 3 months interval for 2015 and 2016. Analysis of variance for each parameter was performed using ProcGlm of Statistical Analysis System (SAS) software (version 9.3). Mean separation for different treatment under different parameter were performed using Least Significant Different (LSD) test (P≤ 0.05). Normality of residuals under the assumption of ANOVA was tested using Kolmogrov-Smirnov procedure using Proc-Univariate procedure of SAS (version 9.3).
Results and Discussion

Plant height (cm)

The plant height of pineapple cv. Mauritius was varied significant among different treatments and it was found highest in T_{10} and T_{12} for 2015 and 2016 at 3 months after planting. From 9 months after planting to 18 months after planting the maximum plant height was recorded in T_{12} for 2015, 2016 and for pooled values. The height of pineapple plant was 83.71cm (pooled) and 90.76cm (pooled) for 15 and 18 months after planting in T_{12} followed by 79.96cm (pooled) and 87.53 cm (pooled) in T_{10}, respectively. The result from table 1 show clearly there is significant role of nutrient management for increasing the height of pineapple plants. Comparing the T_{11} and T_{12} it is clear that there is a great role of bio-fertilizer for the growth of pineapple plants.

Plant canopy spread (cm)

Observation revealed (Tables 2 and 3) that the plant canopy on North-South and East-West direction was increased in all the treatments from 3 months after planting up to the 18 months after planting. Significant variation between the main factor and treatments combination with respect to canopy spread was observed among several nutrient treatments.

Treatments combination T_{10}, T_{11}, T_{12}, T_{18} shows the better performance compare with other treatment combinations. For all observation months the lowest canopy spread was recorded with T_{1} (no nutrient). The performance of canopy spread was better in treatments where chemical, organic and bio-fertilizers were applied combined compared with sole application of bio-fertilizers, or organic or only chemical fertilizers. The rate of increase of canopy was higher from 3 months to 6 months and 12 months to 15 months after planting for both north-south and east-west direction. Maximum canopy spread in north-south and east-west direction was observed with T_{12} for 2015, 2016 and pooled values. The spread was 117.64cm and 124.20cm respectively for north-south and east-west direction at 18 months after planting.

Number of leaves

The number of leaves of pineapple increased from three months to eighteen months and it varied significantly mostly among all the treatments. Flower induction is an important practice in pineapple normally done during 11-12 months after planting and for effectiveness the number of leaves in pineapple has an important factor and 30-40 leaves are required for flowering of pineapple. At 12 months after planting, the number of leaves was 49.47 and 49.27, respectively with T_{12}. Lowest number (pooled mean) of leaves (36.14 and 39.27) was observed with T_{1} (no nutrient) and maximum number (pooled mean) of leaves (55.75 and 58.87) were recorded with T_{12} which was statistically at par with T_{9}, T_{10}, T_{11}, T_{14}, T_{16}, T_{18}, respectively at 15 and 18 months after planting, respectively. The rate of increase of number of leaves was higher from 9 to 12 months after planting. Treatments with having all the chemicals, organic and bio-fertilizers combinations showed better performance compare with individual effect of organic, chemical and bio-fertilizers.

D-leaf length, breadth and area

D-leaf is the most physiological active leaves of pineapple and it is highly co-related to growth behaviour, nutrient content of pineapple leaves. Leaf size is an important parameter for most of the crop regarding the flowering, fruiting and subsequent yield.
Table.1 Effect of Nutrient management on plant height (cm)

| Treatments       | 3 MAP   |                     | 6 MAP   |                     | 9 MAP   |                     |
|------------------|---------|---------------------|---------|---------------------|---------|---------------------|
|                  | 2015    | 2016                | Mean    | 2015                | 2016                | Mean    | 2015                | 2016                | Mean    | 2015                | 2016                | Mean    | 2015                | 2016                | Mean    |
| A0               | 23.95c  | 23.97c              | 23.96c  | 30.1c               | 32.36c  | 31.23a              | 37.96b  | 38.16b              | 38.06b              |         |                     | 2015                | 2016                | Mean    |
| A1               | 32.64a  | 33.13a              | 32.89a  | 40.08a              | 42.40a  | 41.24a              | 53.85a  | 54.8a               | 54.33a              |         |                     | 2015                | 2016                | Mean    |
| A2               | 31.29b  | 31.88b              | 31.59b  | 39.16b              | 41.28b  | 40.22b              | 50.61a  | 50.73a              | 50.67b              |         |                     | 2015                | 2016                | Mean    |
| S.Em. (±)        | 0.28    | 0.29                | 0.26    | 0.24                | 0.27    | 0.23                | 1.67    | 1.69                | 1.68                |         |                     | 2015                | 2016                | Mean    |
| L.S.D.(P≤0.05)   | 0.81    | 0.85                | 0.76    | 0.70                | 0.76    | 0.67                | 4.80    | 4.85                | 4.82                |         |                     | 2015                | 2016                | Mean    |
| B0               | 28.49b  | 28.72b              | 28.61b  | 34.68b              | 36.81b  | 35.75b              | 43.52b  | 44.30b              | 43.91b              |         |                     | 2015                | 2016                | Mean    |
| B1               | 29.64a  | 29.92a              | 29.78a  | 37.07a              | 39.30a  | 38.19a              | 48.84a  | 49.02ab             | 48.93a              |         |                     | 2015                | 2016                | Mean    |
| B2               | 25.75a  | 30.34a              | 30.05a  | 37.59a              | 39.92a  | 38.76a              | 50.06a  | 50.37a              | 50.22a              |         |                     | 2015                | 2016                | Mean    |
| S.Em. (±)        | 0.28    | 0.29                | 0.26    | 0.24                | 0.27    | 0.23                | 1.67    | 1.69                | 1.68                |         |                     | 2015                | 2016                | Mean    |
| L.S.D.(P≤0.05)   | 0.81    | 0.85                | 0.76    | 0.70                | 0.76    | 0.67                | 4.80    | 4.85                | 4.82                |         |                     | 2015                | 2016                | Mean    |
| C0               | 30.50a  | 31.06a              | 30.78a  | 38.24a              | 40.46a  | 38.36a              | 50.36a  | 50.80a              | 50.58a              |         |                     | 2015                | 2016                | Mean    |
| S.Em. (±)        | 0.23    | 0.24                | 0.21    | 0.22                | 0.19    | 0.19                | 1.36    | 1.38                | 1.37                |         |                     | 2015                | 2016                | Mean    |
| L.S.D.(P≤0.05)   | 0.66    | 0.69                | 0.62    | 0.57                | 0.62    | 0.54                | 3.92    | 3.96                | 3.93                |         |                     | 2015                | 2016                | Mean    |

Treatments/ Combination: 2015 2016 Mean 2015 2016 Mean 2015 2016 Mean

MAP-Month after planting. **Means with the same letter are not significantly different
**Table 1** Effect of Nutrient management on plant height (cm) (contd….)

| Treatments/ Combination | 12 MAP |  | 15 MAP |  | 18 MAP |  |
|-------------------------|--------|-----------------|--------|-----------------|--------|-----------------|
|                         | 2015   | 2016 Mean       | 2015   | 2016 Mean       | 2015   | 2016 Mean       |
| A0                      | 52.45b | 54.39b          | 53.39b | 60.64b          | 63.95b | 62.30b          |
| A1                      | 66.37a | 66.59a          | 66.49a | 76.10a          | 74.69a | 75.40a          |
| A2                      | 65.81a | 63.78a          | 64.80a | 72.89a          | 72.04a | 72.47a          |
| S.Em. (±)               | 1.78   | 2.01            | 1.77   | 1.68            | 2.09   | 1.85            |
| L.S.D.(P≤0.05)           | 5.12   | 5.78            | 5.09   | 4.84            | 6.00   | 5.32            |
| B0                      | 58.93a | 57.32b          | 58.12b | 66.19b          | 66.71b | 66.45b          |
| B1                      | 61.85a | 62.74b          | 62.30ab| 70.93b          | 70.83b | 70.88ab         |
| B2                      | 63.85a | 64.65a          | 64.25a | 72.51a          | 73.16a | 72.84a          |
| S.Em. (±)               | 1.78   | 2.01            | 1.77   | 1.68            | 2.09   | 1.85            |
| L.S.D.(P≤0.05)           | 5.12   | 5.78            | 5.09   | 4.84            | 6.00   | 5.32            |
| C0                      | 59.17b | 58.89b          | 59.03b | 67.15b          | 67.31b | 67.23b          |
| C1                      | 63.91a | 62.45a          | 64.08a | 72.60a          | 73.15a | 72.88a          |
| S.Em. (±)               | 1.45   | 1.64            | 1.45   | 1.38            | 1.71   | 1.51            |
| L.S.D.(P≤0.05)           | 4.18   | 4.72            | 4.15   | 3.95            | 4.90   | 4.34            |

**Means with the same letter are not significantly different**

**MAP-Month after planting**

**Means with the same letter are not significantly different**

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### Table 2 Effect of Nutrient management on Canopy Spread (cm) on North-South Direction

| Treatments | 3 MAP  | 6 MAP  | 9 MAP  |
|------------|--------|--------|--------|
|            | 2015   | 2016   | Mean   | 2015   | 2016   | Mean   | 2015   | 2016   | Mean   |
| A0         | 21.84b | 22.09b | 21.97b | 30.74c | 33.29b | 32.02c | 44.16b | 44.70c | 44.43c |
| A1         | 25.88a | 26.48a | 26.18a | 40.90a | 44.42a | 42.66a | 55.75a | 57.58a | 56.67a |
| A2         | 25.34a | 25.84a | 25.93a | 40.20a | 43.16a | 41.59a | 55.23a | 55.27b | 55.25b |
| S. Em. (±) | 0.39   | 0.52   | 0.44   | 0.27   | 0.45   | 0.25   | 0.44   | 0.44   | 0.43   |
| L.S.D(P≤0.05) | 1.11  | 1.50   | 1.27   | 0.76   | 1.29   | 0.73   | 1.25   | 1.25   | 1.22   |
| B0         | 23.41b | 24.03b | 23.72b | 35.31b | 38.31b | 36.81b | 49.81b | 50.26b | 50.04b |
| B1         | 24.66a | 24.84b | 24.75ab | 37.80a | 40.99a | 39.40a | 52.52a | 53.32a | 52.92a |
| B2         | 25.00a | 25.54a | 25.27a | 38.55a | 41.57a | 40.06a | 52.81a | 53.97a | 53.99a |
| S. Em. (±) | 0.39   | 0.52   | 0.44   | 0.27   | 0.45   | 0.25   | 0.44   | 0.44   | 0.43   |
| L.S.D(P≤0.05) | 1.11  | 1.50   | 1.27   | 0.76   | 1.29   | 0.73   | 1.25   | 1.25   | 1.22   |
| C0         | 23.86b | 24.19a | 24.03b | 35.51b | 39.03b | 37.28b | 49.66b | 50.56b | 50.11b |
| C1         | 24.85a | 25.41a | 25.13a | 38.93a | 41.55a | 40.24a | 53.77a | 54.47a | 54.12a |
| S. Em. (±) | 0.32   | 0.43   | 0.36   | 0.22   | 0.37   | 0.21   | 0.36   | 0.36   | 0.35   |
| L.S.D(P≤0.05) | 0.91  | NS     | 1.03   | 0.62   | 1.05   | 0.59   | 1.02   | 1.02   | 1.00   |

**Means with the same letter are not significantly different**

### Table 3 Effect of Nutrient management on Canopy Spread (cm) on East-West Direction

| Treatments/Combination | 3 MAP  | 6 MAP  | 9 MAP  |
|------------------------|--------|--------|--------|
|                        | 2015   | 2016   | Mean   | 2015   | 2016   | Mean   | 2015   | 2016   | Mean   |
| T1         | 19.84 g | 19.67 e | 19.76 g | 27.39 g | 30.37 h | 28.88 i | 41.48 g | 40.59 j | 41.04 i |
| T2         | 23.29 cdef | 23.07 bcde | 23.18 cdef | 32.19 e | 33.73 g | 32.96 f | 47.08 f | 45.83 gh | 46.46 g |
| T1         | 21.24 fg | 21.63 de | 21.44 fg | 28.37 fg | 32.82 gh | 30.60 hi | 42.47 g | 43.60 hi | 43.04 hi |
| T4         | 22.09 efg | 22.24 cde | 22.17 efg | 32.87 e | 34.24 g | 33.56 f | 46.70 f | 46.34 gh | 46.52 g |
| T5         | 22.18 ef | 22.96 bcd | 22.57 defg | 29.98 f | 33.62 g | 31.80 gh | 42.99 g | 44.75 gh | 43.87 gh |
| T6         | 22.41 defg | 22.96 bcd | 22.69 defg | 33.66 e | 34.96 g | 34.31 f | 44.25 fg | 47.06 fg | 45.66 gh |
| T7         | 24.72 abcd | 25.72 abc | 25.22 abcd | 37.39 cd | 40.13 ef | 38.76 ef | 51.98 de | 53.23 ef | 52.66 ef |
| T8         | 24.55 bcde | 25.33 abc | 24.94 abcd | 38.73 bc | 42.88 bcde | 40.81 bc | 53.14 cde | 54.98 cde | 54.06 cde |
| T9         | 26.53 ab | 25.98 ab | 26.26 abc | 39.96 b | 44.64 abcde | 42.30 h | 54.77 cd | 56.74 cd | 55.76 bc |
| T10        | 26.45 ab | 27.24 a | 26.85 ab | 43.12 a | 46.54 a | 44.83 a | 59.35 a | 61.32 a | 60.34 a |
| T11        | 25.68 abc | 27.02 a | 26.35 ab | 42.55 a | 45.68 abc | 44.12 a | 55.81 bc | 57.78 bc | 56.80 bc |
| T12        | 27.35 a | 27.60 a | 27.48 a | 43.64 a | 46.64 a | 45.14 a | 59.44 a | 61.41 a | 60.43 a |
| T13        | 23.68 cdef | 24.68 abcd | 24.18 cdef | 36.32 d | 39.35 f | 37.84 e | 50.65 e | 51.45 f | 51.05 f |
| T14        | 24.35 bcde | 25.71 abc | 25.03 abcde | 39.82 b | 43.38 bcd | 41.60 bcd | 54.55 cd | 55.48 cde | 55.02 cde |
| T15        | 25.08 abcd | 24.84 abcd | 24.94 abcd | 39.34 b | 42.05 f | 40.70 bcd | 53.25 cde | 54.15 def | 53.70 def |
| T16        | 26.55 ab | 27.15 a | 26.85 ab | 43.16 a | 45.67 abc | 44.22 a | 58.55 ab | 57.75 bc | 58.15 ab |
| T17        | 25.81 abc | 25.31 abc | 25.56 abc | 38.32 bc | 42.64 cde | 40.48 cde | 53.52 cde | 52.74 ef | 53.13 def |
| T18        | 26.56 abc | 27.39 a | 26.98 ab | 43.15 a | 45.88 abc | 44.52 a | 60.85 a | 60.05 ab | 60.45 a |
| S. Em. (±) | 0.65   | 1.28   | 0.60   | 0.65   | 1.10   | 0.62   | 1.07   | 1.07   | 1.04   |
| L.S.D(P≤0.05) | 2.72  | 3.67   | 3.10   | 1.86   | 3.16   | 1.78   | 3.06   | 3.07   | 2.99   |

**Means with the same letter are not significantly different**

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Table 2 Effect of Nutrient management on Canopy Spread (cm) on North-South Direction (contd….)

| Treatments | 12 MAP Mean | 15 MAP Mean | 18 MAP Mean |
|------------|-------------|-------------|-------------|
|            | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 |
| A₀ | 58.64c | 59.11c | 58.88c | 73.10b | 76.06b | 74.58b | 81.86b | 84.13b | 83.00b |
| A₁ | 75.52a | 74.91a | 73.22a | 89.32a | 92.02a | 90.67a | 107.54a | 109.18a | 108.36a |
| A₂ | 72.71b | 73.08b | 72.90b | 85.59a | 88.26a | 86.93a | 104.96a | 106.78a | 105.87a |
| S.Em. (±) | 0.49 | 0.43 | 0.45 | 2.36 | 2.43 | 2.39 | 1.25 | 2.20 | 1.62 |
| L.S.D(P≤0.05) | 1.42 | 1.22 | 1.29 | 6.78 | 6.97 | 6.87 | 3.59 | 6.31 | 4.65 |
| B₀ | 66.05b | 66.07b | 66.06b | 78.09b | 81.18b | 79.64b | 93.57b | 94.79b | 94.18b |
| B₁ | 70.05a | 70.23a | 70.14a | 83.89b | 86.51ab | 85.20ab | 99.57a | 101.49a | 100.53a |
| B₂ | 70.77a | 70.08b | 72.90b | 85.03a | 88.65a | 87.34a | 101.24a | 103.81a | 102.52a |
| S.Em. (±) | 0.49 | 0.43 | 0.45 | 2.36 | 2.43 | 2.39 | 1.25 | 2.20 | 1.62 |
| L.S.D(P≤0.05) | 1.42 | 1.22 | 1.29 | 6.78 | 6.97 | 6.87 | 3.59 | 6.31 | 4.65 |
| C₀ | 65.82b | 65.57b | 65.70b | 78.88b | 81.69b | 80.29b | 92.99b | 94.35b | 93.67b |
| C₁ | 72.10a | 72.50a | 72.30a | 86.46a | 89.20a | 87.83a | 103.26a | 105.71a | 104.49a |
| S.Em. (±) | 0.40 | 0.34 | 0.37 | 1.92 | 1.98 | 1.95 | 1.02 | 1.79 | 1.32 |
| L.S.D(P≤0.05) | 1.16 | 1.00 | 1.05 | 5.53 | 5.69 | 5.61 | 2.93 | 5.15 | 3.80 |

**Means with the same letter are not significantly different**

MAP-Month after planting
### Table 3: Effect of Nutrient management on Canopy Spread (cm) on East-West Direction

| Treatments | 3 MAP  | 6 MAP  | 9 MAP  | 3 MAP  | 6 MAP  | 9 MAP  | 3 MAP  | 6 MAP  | 9 MAP  | 3 MAP  | 6 MAP  | 9 MAP  |
|------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
|            | 2015   | 2016   | Mean   | 2015   | 2016   | Mean   | 2015   | 2016   | Mean   | 2015   | 2016   | Mean   |
| A₀         |        |        |        |        |        |        |        |        |        |        |        |        |
| A₁         | 26.80b | 27.29b | 27.05b | 38.91b | 39.66b | 39.28b | 49.12c | 49.54c | 49.33c |        |        |        |
| A₂         | 30.34a | 31.66a | 31.28a | 52.18a | 52.39a | 52.29a | 61.93a | 63.28a | 62.60a |        |        |        |
| A₃         | 30.90a | 30.97a | 30.66a | 50.72a | 51.00a | 50.86a | 59.90b | 61.34b | 60.62b |        |        |        |
| S.Em. (±) | 0.44   | 0.53   | 0.48   | 0.62   | 0.61   | 0.61   | 0.36   | 0.38   | 0.31   |        |        |        |
| L.S.D(P<0.05) | 1.27 | 1.51 | 1.38 | 1.80 | 1.75 | 1.76 | 1.03 | 1.08 | 0.88 |        |        |        |
| B₀         | 28.67a | 29.22a | 28.95a | 45.99b | 46.20b | 46.10b | 55.38b | 56.02c | 55.70b |        |        |        |
| B₁         | 29.44a | 29.99a | 29.72a | 47.54ab | 48.11a | 47.83ab | 57.77a | 58.45b | 58.11a |        |        |        |
| B₂         | 29.92a | 30.70a | 30.31a | 48.27a | 48.74a | 48.51a | 57.77a | 59.68a | 58.74a |        |        |        |
| S.Em. (±) | 0.44   | 0.53   | 0.48   | 0.62   | 0.61   | 0.61   | 0.36   | 0.38   | 0.31   |        |        |        |
| L.S.D(P<0.05) | 1.27 | 1.51 | 1.38 | 1.80 | 1.75 | 1.76 | 1.03 | 1.08 | 0.88 |        |        |        |
| C₀         | 28.89a | 29.39a | 29.14a | 45.39b | 45.69b | 45.54b | 54.79b | 55.43b | 55.11b |        |        |        |
| C₁         | 29.80a | 30.55a | 30.18a | 49.15a | 49.68a | 49.41a | 59.17a | 60.67a | 59.92a |        |        |        |
| S.Em. (±) | 0.36   | 0.43   | 0.39   | 0.51   | 0.50   | 0.50   | 0.29   | 0.31   | 0.25   |        |        |        |
| L.S.D(P<0.05) | 3.42 | 3.65 | 3.49 | 3.62 | 3.61 | 3.61 | 3.61 | 3.61 | 3.61 |        |        |        |

**Means with the same letter are not significantly different**

MAP-Month after planting
Table 3 Effect of Nutrient management on Canopy Spread (cm) on East- West Direction (contd….)

| Treatments/Combination | 12 MAP 2015 | 12 MAP 2016 | Mean 2015 | 15 MAP 2015 | 15 MAP 2016 | Mean 2015 | 18 MAP 2015 | 18 MAP 2016 | Mean 2015 |
|------------------------|-------------|-------------|-----------|-------------|-------------|-----------|-------------|-------------|-----------|
| A₀                    | 59.71b      | 61.35c      | 60.53c    | 68.76b      | 74.62b      | 71.69b    | 86.14b      | 85.87b      | 86.01b    |
| A₁                    | 78.56a      | 77.78a      | 78.17a    | 91.23a      | 92.69a      | 91.96a    | 112.82a     | 112.68a     | 112.75a   |
| A₂                    | 77.12a      | 75.95b      | 76.54b    | 86.85a      | 87.87a      | 87.36a    | 107.53a     | 107.82a     | 107.67a   |
| S.Em. (±)             | 0.53        | 0.43        | 0.43      | 2.97        | 3.02        | 2.96      | 2.57        | 2.39        | 2.33      |
| L.S.D(P<0.05)         | 1.52        | 1.22        | 1.23      | 8.53        | 8.68        | 8.52      | 6.53        | 6.87        | 6.69      |
| B₀                    | 68.91b      | 68.73b      | 68.82b    | 76.99b      | 79.87a      | 78.43b    | 98.27b      | 98.06a      | 98.17b    |
| B₁                    | 72.76a      | 72.89a      | 72.82a    | 83.70b      | 87.10a      | 85.40b    | 102.67b     | 103.57a     | 103.12a   |
| B₂                    | 73.72a      | 73.47a      | 73.60a    | 86.14a      | 88.22a      | 87.18a    | 105.55a     | 104.73a     | 105.14a   |
| S.Em. (±)             | 0.53        | 0.43        | 0.43      | 2.97        | 3.02        | 2.96      | 2.27        | 2.39        | 2.33      |
| L.S.D(P<0.05)         | 1.52        | 1.22        | 1.23      | 8.53        | NS          | 8.52      | 6.53        | NS          | 6.69      |
| C₀                    | 68.45b      | 67.81b      | 68.13b    | 79.13a      | 80.56b      | 79.85b    | 97.48b      | 97.85b      | 97.67b    |
| C₁                    | 75.14a      | 75.58a      | 75.36a    | 85.42a      | 89.56a      | 87.49a    | 106.85a     | 106.39a     | 106.12a   |
| S.Em. (±)             | 0.43        | 0.35        | 0.35      | 2.42        | 2.47        | 2.42      | 1.86        | 1.95        | 1.90      |
| L.S.D(P<0.05)         | 1.24        | 1.00        | 1.00      | NS          | 7.09        | 6.95      | 5.34        | 5.61        | 5.46      |

MAP-Month after planting

**Means with the same letter are not significantly different**
### Table 4 Effect of Nutrient management on Number of leaves

| Treatments | 3 MAP (Mean) | 6 MAP (Mean) | 9 MAP (Mean) | L.S.D.(P<0.05) |
|------------|--------------|--------------|--------------|----------------|
|            | 2015         | 2016         | 2015         | 2016           | 2015           | 2016           |              |
| A<sub>0</sub> | 12.06b       | 11.17b       | 11.61b       | 20.00b         | 20.23b         | 20.11b         | 27.87b       | 28.36b       | 28.12b       |
| A<sub>1</sub> | 15.77a       | 16.46a       | 16.11a       | 25.84a         | 26.84a         | 26.34a         | 34.69a       | 35.46a       | 35.08a       |
| A<sub>2</sub> | 15.55a       | 15.58a       | 15.56a       | 25.52a         | 26.22a         | 25.87a         | 33.83a       | 34.90a       | 34.37a       |
| S.Em. (±)   | 0.28         | 0.35         | 0.29         | 0.48           | 0.57           | 0.51           | 0.43         | 0.53         | 0.44         |
| L.S.D.(P<0.05) | 0.80     | 0.99         | 0.85         | 1.39           | 1.63           | 1.47           | 1.23         | 1.52         | 1.27         |
| B<sub>0</sub> | 13.73b       | 13.92a       | 13.83b       | 22.71b         | 23.75a         | 23.23a         | 31.09b       | 32.26a       | 31.67b       |
| B<sub>1</sub> | 14.93a       | 14.52a       | 14.73a       | 24.13a         | 24.72a         | 24.42a         | 32.44a       | 33.11a       | 32.78a       |
| B<sub>2</sub> | 14.71a       | 14.77a       | 14.74a       | 24.52a         | 24.82a         | 24.67a         | 32.86a       | 33.36a       | 33.11a       |
| S.Em. (±)   | 0.28         | 0.35         | 0.29         | 0.48           | 0.57           | 0.57           | 0.43         | 0.53         | 0.44         |
| L.S.D.(P<0.05) | 0.80     | NS           | 0.85         | 1.39           | NS             | 1.39           | 1.23         | NS           | 1.27         |
| C<sub>0</sub> | 13.66b       | 13.82b       | 13.74b       | 23.10b         | 23.84a         | 23.51b         | 31.36        | 32.27b       | 31.81b       |
| C<sub>1</sub> | 15.26a       | 14.98a       | 15.12a       | 24.47a         | 25.02a         | 24.74a         | 32.90a       | 33.55a       | 33.22a       |
| S.Em. (±)   | 0.23         | 0.28         | 0.24         | 0.40           | 0.46           | 0.42           | 0.35         | 0.43         | 0.36         |
| L.S.D.(P<0.05) | 0.65     | 0.82         | 0.69         | 1.14           | NS             | 1.20           | 1.00         | 1.24         | 1.04         |

**Means with the same letter are not significantly different**

MAP-Month after planting

2480
**Table 4** Effect of Nutrient management on Number of leaves (contd….)

| Treatments/ Combination | Mean | Mean | Mean | Mean | Mean |
|-------------------------|------|------|------|------|------|
|                         | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 |
| L.S.D (P≤0.05)           | 2.45 | 3.61 | 2.90 | 4.29 | 5.04 | 4.59 |
| B₃                      | 36.13b | 36.72b | 36.43b | 40.76a | 42.39a | 41.58a |
|                         | 45.26a | 45.72a | 45.49a |
| S.Em. (±)               | 0.85 | 1.26 | 1.01 | 1.49 | 1.75 | 1.60 |
| L.S.D (P≤0.05)           | 2.45 | 3.61 | 2.90 | 4.29 | 5.04 | 4.59 |
| S.Em. (±)               | 0.85 | 1.26 | 1.01 | 1.49 | 1.75 | 1.60 |
| L.S.D (P≤0.05)           | 2.45 | 3.61 | 2.90 | 4.29 | 5.04 | 4.59 |
| C₉                      | 36.63b | 36.68b | 36.65b | 41.26b | 42.67b | 41.97b |
|                         | 45.18b | 45.78b | 45.48b |
| S.Em. (±)               | 0.70 | 1.03 | 0.82 | 1.22 | 1.43 | 1.30 |
| L.S.D (P≤0.05)           | 2.00 | 2.95 | 2.36 | 3.50 | 4.11 | 3.75 |

**Means with the same letter are not significantly different**

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**Table 4** Effect of Nutrient management on Number of leaves (contd….)

| Treatments | 12 MAP | 18 MAP |
|------------|--------|--------|
|            | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 |
| L.S.D (P≤0.05) | 5.99 | 8.55 | 7.10 | 10.51 | 12.34 | 11.24 | 10.13 | 11.54 | 3.78 | 3.78 | 3.78 |

**Mean**

**MAP-Month after planting**

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2481
### Table 5: Effect of Nutrient management on D-leaf length (cm)

| Treatments  | 3 MAP          | 6 MAP          | 9 MAP          |
|-------------|----------------|----------------|----------------|
|             | 2015 | 2016 | Mean | 2015 | 2016 | Mean | 2015 | 2016 | Mean |
| A₀          | 20.02b| 19.71b| 19.86b| 24.62b| 25.24b| 24.93b| 29.79c| 32.85b| 31.32c|
| A₁          | 22.54a| 22.47a| 22.64a| 27.80a| 28.04a| 27.92a| 34.68a| 36.01a| 35.35a|
| A₂          | 22.51a| 22.40a| 22.47a| 27.31a| 27.69a| 27.50a| 34.03b| 35.045a| 34.74b|
| S.Em. (±)   | 0.33  | 0.27  | 0.29  | 0.31  | 0.27  | 0.28  | 0.21  | 0.26  | 0.20  |
| L.S.D.(P≤0.05) | 0.94 | 0.78  | 0.84  | 0.90  | 0.78  | 0.81  | 0.60  | 0.75  | 0.58  |
| B₀          | 21.42ab| 21.15a| 21.29a| 26.45a| 26.46b| 26.45a| 32.22b| 34.07b| 33.14b|
| B₁          | 21.29ab| 21.82a| 21.56a| 26.52a| 27.20ab| 26.86a| 33.01a| 35.00a| 34.01a|
| B₂          | 22.36a| 21.87a| 22.12a| 26.78a| 27.31a| 27.05a| 33.27a| 35.24a| 34.26a|
| S.Em. (±)   | 0.33  | 0.27  | 0.29  | 0.31  | 0.27  | 0.28  | 0.21  | 0.26  | 0.20  |
| L.S.D.(P≤0.05) | 0.94 | 0.78  | 0.84  | 0.90  | 0.78  | 0.81  | 0.60  | 0.75  | 0.58  |
| C₀          | 21.21b| 21.22b| 21.22b| 26.21b| 26.63b| 26.42b| 32.18b| 34.11b| 33.15b|
| C₁          | 22.16a| 22.01a| 22.09a| 26.95a| 27.35a| 27.15a| 32.49a| 35.43a| 34.46a|
| S.Em. (±)   | 0.27  | 0.22  | 0.24  | 0.26  | 0.22  | 0.23  | 0.17  | 0.21  | 0.17  |
| L.S.D.(P≤0.05) | 0.77 | 0.64  | 0.69  | 0.73  | 0.63  | 0.66  | 0.49  | 0.62  | 0.48  |

**Means with the same letter are not significantly different**

MAP-Month after planting
Table 5: Effect of Nutrient management on D-leaf length (cm) (contd….)

| Treatments | 12 MAP | 15 MAP | 18 MAP |
|------------|--------|--------|--------|
|            | 2015   | 2016   | Mean   | 2015   | 2016   | Mean   | 2015   | 2016   | Mean   |
| A0         | 37.64b | 41.48b | 39.56b | 46.11b | 48.31b | 47.21b | 54.44b | 55.25b | 54.85b |
| A1         | 44.90a | 45.39a | 45.15a | 51.56a | 51.86a | 51.71a | 59.18a | 60.35a | 59.77a |
| A2         | 43.77a | 44.40a | 44.09a | 50.77a | 51.42a | 51.10a | 58.22a | 59.34a | 58.78a |
| S.Em. (±)  | 0.77   | 0.79   | 0.65   | 0.71   | 0.61   | 0.62   | 0.42   | 0.45   | 0.39   |
| L.S.D.(P≤0.05) | 2.20  | 2.28   | 1.87   | 2.04   | 1.76   | 1.79   | 1.22   | 1.28   | 1.11   |
| B          | 40.80b | 42.63a | 41.71b | 48.58a | 49.40b | 48.99b | 55.91b | 56.73b | 56.32b |
| S.Em. (±)  | 0.77   | 0.79   | 0.65   | 0.71   | 0.61   | 0.62   | 0.42   | 0.45   | 0.39   |
| L.S.D.(P≤0.05) | 2.20  | NS     | 1.87   | 1.76   | 1.79   | 1.22   | 1.28   | 1.11   |
| C          | 40.98b | 42.76b | 41.87b | 48.73a | 49.55b | 49.15b | 55.88b | 56.99b | 56.44b |
| S.Em. (±)  | 0.63   | 0.64   | 0.53   | 0.58   | 0.50   | 0.51   | 0.35   | 0.36   | 0.31   |
| L.S.D.(P≤0.05) | 1.80  | 1.86   | 1.53   | NS     | 1.43   | 1.46   | 1.00   | 1.05   | 0.90   |

**Means with the same letter are not significantly different**

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### Table 6 Effect of Nutrient management on D-leaf breadth (cm)

| Treatments | 3 MAP | 6 MAP | 9 MAP |
|------------|-------|-------|-------|
|            | 2015  | 2016  | Mean  | 2015  | 2016  | Mean  | 2015  | 2016  | Mean  |
| A₀         | 3.08c | 3.18b | 3.13c | 3.18c | 3.24b | 3.21c | 3.33b | 3.41b | 3.37b |
| A₁         | 3.76a | 4.02a | 3.89a | 3.92a | 4.21a | 4.06a | 4.12a | 4.29a | 4.21a |
| A₂         | 3.35a | 3.89a | 3.62b | 3.49b | 4.06a | 3.78b | 3.73ab| 4.16a | 3.95a |
| S.Em. (±)  | 0.07  | 0.10  | 0.07  | 0.07  | 0.13  | 0.08  | 0.14  | 0.15  | 0.15  |
| L.S.D.(P≤0.05) | 0.19  | 0.28  | 0.21  | 0.19  | 0.36  | 0.24  | 0.41  | 0.44  | 0.42  |
| B₀         | 3.38a | 3.58a | 3.48a | 3.42b | 3.74a | 3.58a | 3.62a | 3.75a | 3.69a |
| B₁         | 3.38a | 3.72a | 3.55a | 3.52ab| 3.88a | 3.70a | 3.73a | 4.03a | 3.88a |
| B₂         | 3.43a | 3.78a | 3.61a | 3.90a | 3.78a | 3.84a | 3.84a | 4.08a | 3.96a |
| S.Em. (±)  | 0.07  | 0.10  | 0.07  | 0.07  | 0.13  | 0.08  | 0.14  | 0.15  | 0.15  |
| L.S.D.(P≤0.05) | 0.19  | 0.28  | 0.21  | 0.19  | 0.36  | 0.24  | 0.41  | 0.44  | 0.42  |
| C₀         | 3.28b | 3.58a | 3.43b | 3.43b | 3.75b | 3.59a | 3.60a | 3.81a | 3.71a |
| C₁         | 3.51a | 3.81a | 3.66a | 3.63a | 3.93a | 3.78a | 3.85a | 4.09a | 3.98a |
| S.Em. (±)  | 0.05  | 0.08  | 0.06  | 0.05  | 0.10  | 0.07  | 0.12  | 0.12  | 0.12  |
| L.S.D.(P≤0.05) | 0.15  | NS    | 0.17  | 0.15  | 0.29  | NS    | NS    | NS    | NS    |

**Means with the same letter are not significantly different.**

MAP-Month after planting
Table 6 Effect of Nutrient management on D-leaf breadth (cm) (contd….)

| Treatments | 12 MAP | 15 MAP | 18 MAP |
|------------|--------|--------|--------|
|            | 2015   | 2016   | Mean   | 2015   | 2016   | Mean   | 2015   | 2016   | Mean   |
| A₀         | 3.54b  | 3.81b  | 3.68b  | 3.76b  | 3.84b  | 3.80b  | 3.97b  | 4.06b  | 4.02b  |
| A₁         | 4.50a  | 4.54a  | 4.52a  | 4.54a  | 4.63a  | 4.58a  | 4.73a  | 4.85a  | 4.79a  |
| A₂         | 4.32a  | 4.34a  | 4.32a  | 4.38a  | 4.52a  | 4.45a  | 4.58a  | 4.72a  | 4.65a  |
| S.E.m. (±) | 0.09   | 0.11   | 0.09   | 0.09   | 0.09   | 0.09   | 0.09   | 0.10   | 0.10   |
| L.S.D.(P≤0.05) | 0.25   | 0.32   | 0.27   | 0.27   | 0.27   | 0.27   | 0.27   | 0.29   | 0.28   |
| B₀         | 3.98b  | 4.07b  | 4.02b  | 4.12a  | 4.32a  | 4.18a  | 4.28b  | 4.41a  | 4.35a  |
| B₁         | 4.13ab | 4.19b  | 4.16ab | 4.19a  | 4.32a  | 4.26a  | 4.43ab | 4.55a  | 4.49a  |
| B₂         | 4.26a  | 4.42a  | 4.33a  | 4.35a  | 4.45a  | 4.40a  | 4.56a  | 4.67a  | 4.12a  |
| S.E.m. (±) | 0.09   | 0.11   | 0.09   | 0.09   | 0.09   | 0.09   | 0.09   | 0.10   | 0.10   |
| L.S.D.(P≤0.05) | 0.25   | 0.32   | 0.27   | NS     | NS     | 0.27   | NS     | NS     | 0.27   |
| C₀         | 3.98b  | 4.02b  | 4.00b  | 4.09b  | 4.22a  | 4.16b  | 4.28b  | 4.40b  | 4.34b  |
| C₁         | 4.27a  | 4.44a  | 4.35a  | 4.39a  | 4.44a  | 4.40a  | 4.57a  | 4.69a  | 4.63a  |
| S.E.m. (±) | 0.07   | 0.09   | 0.08   | 0.08   | 0.08   | 0.08   | 0.08   | 0.08   | 0.08   |
| L.S.D.(P≤0.05) | 0.20   | 0.26   | 0.22   | NS     | 0.22   | 0.22   | 0.24   | 0.23   | 0.23   |

| Treatments/Combination | 12 MAP | 15 MAP | 18 MAP |
|-------------------------|--------|--------|--------|
|                         | 2015   | 2016   | Mean   |
| T₁                      | 3.40f  | 3.44f  | 3.42g  |
| T₂                      | 3.58ef | 3.88cdef | 3.73efg |
| T₃                      | 3.51ef | 3.53f  | 3.52fg |
| T₄                      | 3.52ef | 3.85de  | 3.91def |
| T₅                      | 3.56ef | 3.71ef  | 3.64fg |
| T₆                      | 3.70ef | 4.44abde | 4.07def |
| T₇                      | 4.11bde  | 4.14abcde | 4.13bced |
| T₈                      | 4.40abcd | 4.42abcde | 4.45ab |
| T₉                      | 4.50abcde | 4.48abcde | 4.41abcde |
| T₁₀                     | 4.68ab | 4.78ab  | 4.73ab |
| T₁₁                     | 4.44abcd | 4.51abcd | 4.48ab |
| T₁2                     | 4.85a  | 4.88a  | 4.87a  |
| T₁₃                     | 3.97def | 4.06bde | 4.02defg |
| T₁₄                     | 4.41abcd | 4.48abcde | 4.45abcde |
| T₁₅                     | 3.97def | 3.96cdef | 3.97def |
| T₁₆                     | 4.58abcde | 4.55abcde | 4.57abcde |
| T₁₇                     | 4.34abcd | 4.32abcd | 4.33abcd |
| T₁₈                     | 4.66abc | 4.64abc | 4.65abc |
| S.E.m. (±)              | 0.21   | 0.27   | 0.23   |
| L.S.D.(P≤0.05)          | 0.61   | 0.78   | 0.65   |

MAP-Month after planting **Means with the same letter are not significantly different
Table 7 Effect of Nutrient management on D-leaf area (cm²)

| Treatments | 3 MAP (cm²) | 6 MAP (cm²) | 9 MAP (cm²) |
|------------|-------------|-------------|-------------|
|            | 2015 | 2016 | Mean | 2015 | 2016 | Mean | 2015 | 2016 | Mean |
| A₀         | 61.70c | 62.72b | 62.21c | 78.31c | 81.84c | 99.19c | 111.79b | 105.49b |
| A₁         | 84.73a | 91.62a | 88.17a | 109.15a | 118.24a | 113.69a | 143.12a | 154.65a | 148.90a |
| A₂         | 75.25b | 87.30a | 81.27b | 95.43b | 112.71a | 104.07b | 127.19b | 147.52a | 137.36a |
| S.Em. (±)  | 1.76  | 2.63  | 1.99  | 2.21  | 3.79  | 2.66  | 4.74  | 5.35  | 4.97  |
| L.S.D.(P≤0.05) | 5.07 | 7.55 | 5.72 | 6.35 | 10.89 | 7.66 | 13.62 | 15.37 | 14.28 |
| T₀         | 72.61a | 76.28a | 74.44a | 90.77b | 99.48a | 95.13a | 116.99a | 128.16b | 122.57a |
| T₁         | 72.25a | 82.05a | 77.15a | 93.87b | 106.05a | 99.96a | 124.12a | 141.60b | 132.86a |
| T₂         | 76.82a | 83.31a | 80.06a | 98.24a | 107.25a | 92.74a | 128.42a | 144.20a | 136.31a |
| S.Em. (±)  | 1.76  | 2.63  | 1.99  | 2.21  | 3.79  | 2.66  | 4.74  | 5.35  | 4.97  |
| L.S.D.(P≤0.05) | NS   | NS   | NS   | 6.35 | NS   | NS   | NS   | 15.37 | NS   |
| C₀         | 69.81b | 76.67b | 73.24b | 90.03b | 100.54a | 95.29b | 116.45b | 130.59b | 123.52b |
| C₁         | 77.97a | 84.42a | 81.20a | 98.55a | 107.98a | 103.27a | 129.90a | 145.38a | 137.64a |
| S.Em. (±)  | 1.44  | 2.14  | 1.63  | 1.80  | 3.09  | 2.17  | 3.87  | 4.37  | 4.06  |
| L.S.D.(P≤0.05) | 4.14 | 6.16 | 4.67 | 5.18 | NS   | 6.25 | 11.12 | 12.55 | 11.06 |

**Means with the same letter are not significantly different**

MAP-Month after planting
**Table 7** Effect of Nutrient management on D-leaf area (cm²) (contd….)

| Treatments | 12 MAP | 15 MAP | 18 MAP |
|------------|--------|--------|--------|
| A₀         | 133.29c| 158.56b| 145.93b|
| A₁         | 202.30a| 206.51a| 204.4a |
| A₂         | 189.23b| 192.45a| 190.84a|
| S.E.m. (+) | 4.36   | 6.23   | 4.80   |
| L.S.D(P≤0.05) | 12.53  | 17.92  | 13.79  |
| B₀         | 163.02b| 173.65b| 168.33b|
| B₁         | 176.14a| 186.26b| 181.2ab |
| B₂         | 185.67a| 197.61a| 191.64a|
| S.E.m. (+) | 4.36   | 6.23   | 4.80   |
| L.S.D(P≤0.05) | 12.53  | 17.92  | 13.79  |
| C₀         | 163.70b| 172.36b| 168.03b|
| C₁         | 186.18a| 199.32a| 192.75a|
| S.E.m. (+) | 3.56   | 5.09   | 3.91   |
| L.S.D(P≤0.05) | 10.23  | 14.63  | 11.26  |

**Means with the same letter are not significantly different**

**Table 7** Effect of Nutrient management on D-leaf area (cm²) (contd….)

| Treatments/ Combination | 12 MAP | 15 MAP | 18 MAP |
|-------------------------|--------|--------|--------|
| A₀⁺B₀⁺C₀               | 124.68b| 136.19g| 130.44b|
| A₀⁺B₁⁺C₀               | 135.23g| 163.23defg| 149.23gh|
| A₀⁺B₂⁺C₀               | 130.35g| 145.81f| 138.08gh|
| A₀⁺B₃⁺C₀               | 134.87gh| 163.37defg| 149.12fgh|
| A₀⁺B₄⁺C₀               | 133.96gh| 154.37efg| 144.17fgh|
| A₀⁺B₅⁺C₀               | 140.67gh| 188.37bedefg| 164.52fgh|
| A₀⁺B₆⁺C₀               | 175.66def| 176.96defefg| 192.75a|
| A₁⁺B₀⁺C₀               | 191.82bcde| 196.03abcde| 193.93bede|
| A₁⁺B₁⁺C₀               | 192.53bcde| 201.31abcde| 196.92bcde|
| A₁⁺B₂⁺C₀               | 221.83ab| 227.08abcde| 250.82abcde|
| A₁⁺B₃⁺C₀               | 197.95bcde| 202.34abcd| 200.15bced|
| A₁⁺B₄⁺C₀               | 233.99a| 235.34a| 234.67a|
| A₁⁺B₅⁺C₀               | 157.68f| 171.3defg| 164.49efgh|
| A₁⁺B₆⁺C₀               | 193.02bcde| 198.19abcde| 195.61bcde|
| A₅⁺B₀⁺C₀               | 171.47ef| 173.99abedf| 172.73def|
| A₅⁺B₁⁺C₀               | 205.77abcd| 205.98abcd| 205.88abcd|
| A₅⁺B₂⁺C₀               | 188.98cde| 188.94cdfed| 188.96cde|
| S.E.m. (+)             | 10.68   | 15.27   | 11.75   |
| L.S.D.(P≤0.05)         | 30.68   | 43.89   | 33.77   |

MAP-Month after planting

**Means with the same letter are not significantly different**

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It is clear from the tables 5, 6 and 7 that the D-leaf length, breadth and area has increased continuously from 3 months after planting to eighteen months after planting in both 2015, 2016 and significantly varied among the most of the treatments for both the years and for pooled mean values which suggest there is a role of integrated nutrient management for growth behaviour of pineapple. It is also noticed that organic manure as main factor has non-significant role for D-leaf length, breadth and area for some observation time. The rate of increase of length was higher from 9 to 12 and 12 to 15 months after planting. At 18 months after planting the D-leaf length (pooled) was highest (63.35 cm) with T_{12} which was statistically at par with T_{10} and T_{18}. Almost similar observation was recorded (pooled) for D-leaf breadth which was recorded maximum (5.17cm) with T_{12}. It is also observed from the pooled means of table 7 that the highest D-leaf area (327.54 cm\(^2\)) was recorded with T_{12} which was statistically at par with T_{10} (305.82cm\(^2\)), T_{18} (299.71cm\(^2\)), and T_{16} (287.85cm\(^2\)). Several scientist had reported regarding the nutritive management which confirms the result of present experiment. Omotoso and Akinrinde (2013) and (Bhugaloo, 1998). Reported the effect of N fertilizer application on growth and behavior in pineapple. Singh et al., (2010), to study the response of integrated nutrient management on growth, yield and quality of papaya cv. Surya. Organic manure, urea and their combination have also important role in growth behavior like D-leaf length, number of leaves, root length and leaf area (Omotoso and Akinrinde, 2012).

The different parameters for growth behaviour study of pineapple cv. Mauritius under the integrated nutrient management showed significant variation for 2015, 2016 and pooled means among most of the treatments. It is also found from the present experiment that the treatment combinations having chemical fertilizer, organic manure and bio-fertilizers shows better performance than the other treatment combinations. The plant height, canopy spread, number of leaves, D-leaf length, D-leaf breadth, and leaf area was recorded highest in T_{12} (A_1B_3C_1).

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