Journal of Crop and Weed, 13(2): 144-156 (2017)

Effect of integrated nutrient management on flowering and fruiting characteristics of pineapple cv. Mauritius

N. BHOWMICK, S. K. GHOSH, [1]P. S. MUNSI, [1]P. DEB AND [2]A. GHOSH

Dept. of Pomology and Post Harvest Technology, [2]Dept. of Agril Statistics, Uttar Banga Krishi Viswavidyalaya, Pundibari-736165, Cooch Behar, West Bengal

[1] Dept.of Horticulture and Post Harvest Technology, Institute of Agriculture, Visva-Bharati, Sriniketan-731235 , West Bengal

Received : 04-09-2017 ; Revised : 10-09-2017 ; Accepted : 12-09-2017

ABSTRACT

West Bengal is the leader of pineapple production in India and Kew is the commercial cultivar which is suitable for processing purpose. Table purpose Mauritius cultivar (Queen group) of pineapple was introduced first time in West Bengal from South India and its flowering and fruiting characteristics under the integrated nutrient management practices was assessed. The experiment was conducted with Factorial Randomized Block Design with three factors- chemical fertilizer, Organic manure and Bio-fertilizer having eighteen treatment combinations with three replication. Flowering percentage, estimated fruit yield was highest in T_{12} (Chemical 75% RDF + Vermicompost + Bio-fertilizer), which was statistically at par with T_{18} (Chemical 100% RDF + Vermicompost + Bio-fertilizer). Most of the bio-chemical properties were recorded highest with T_{18} which was statistically at par with T_{12}.

***Keywords*:** Flowering, fruiting integrated, management, nutrient, pineapple

Pineapple (*Ananas comosus* L. Merr.) is an important tropical fruit of world under the Bromeliaceae family and one of the most internationalized fruit traded globally after bananas and citrus (Jacob and Soman, 2006). India ranks 6th (7.4%) in terms of world pineapple production (National Horticulture Database-2014) and West Bengal is leader for pineapple production in India. In West Bengal 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. The commercial cultivar of West Bengal is Kew which issuitable 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., 2016). 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 90×35×25cm spacing. 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 replications. Chemical fertilizers were applied in 3 levels (A_0-zero, A_1-75 percent and A_2- 100 percent recommended dose), organic manure were applied also in 3 levels (B_0-zero, B_1-FYM, B_2-Vermicompost), bio-fertilizer were applied in 2 levels (C_0-zero and C_1-*Azotobacter* + Phosphate Solublising Bacteria). The doses for integrated nutrient management was as follows: Recommended dosages of fertilizer (RDF)= 12:4:12 g plant^{-1}, farm yard manure (FYM) =500g plant^{-1}, vermicompost= 300g plant^{-1}, *Azotobactor* = 10g, phosphate solublising bacteria (PSB) = 10g. It was reported that of 12g plant^{-1} of nitrogen and potash has been found to be optimum and no effect of phosphorus was observed, however, 4g of P_2O_5 increased fruit weight and yield in pineapple (Reddy and Prakash, 1982). For determination of leaf nutrient content (NPK), the middle one third of the basal portion of "D leaf" was collected during 10 month after planting and during harvesting time.

Treatment combinations			
T_1 -	$A_0B_0C_0$	T_{10} -	$A_1B_1C_1$
T_2 -	$A_0B_0C_1$	T_{11} -	$A_1B_2C_0$
T_3 -	$A_0B_1C_0$	T_{12} -	$A_1B_2C_1$
T_4 -	$A_0B_1C_1$	T_{13} -	$A_2B_0C_0$
T_5 -	$A_0B_2C_0$	T_{14} -	$A_2B_0C_1$
T_6 -	$A_0B_2C_1$	T_{15} -	$A_2B_1C_0$
T_7 -	$A_1B_0C_0$	T_{16} -	$A_2B_1C_1$
T_8 -	$A_1B_0C_1$	T_{17} -	$A_2B_2C_0$
T_9 -	$A_1B_1C_0$	T_{18} -	$A_2B_2C_1$

Email: nileshbhowmick@gmail.com

Parameters like flowering percentage, fruit yield, fruit physical parameters like fruit length, crown length, fruit circumferences, fruit weight, crown weight, fruit weight without crown, pulp, peel and core content, bio-chemical properties like total soluble solids, total sugar percentage, reducing sugar percentage, titrable acidity, TSS: acidity ratio and ascorbic acid content was recorded for plant crop yield of 2015 and 2016. The fruits (average 10 fruits per replication) were weighed, with the help of electronic (digital) balance and expressed in gram(g). Fruit length (average 10 fruits per replication) was measured with the help of digital slide caliper and expressed in centimeters (cm).Total soluble solids (TSS), total sugar and reducing sugar, acidity of the fruit juice, ascorbic acid content was recorded by the standard method (Ranganna, 1977). For leaf nutrient analysis, 'D' leaves were collected (D-leaf is the youngest physiologically 4^{th} to 5^{th} leaves from mature whorl, Singh *et al.,* 1978) and central 20 cm of the leaf were taken for sampling. The leaves were placed in a drier and kept at 65^{o}C for 96 hours (Maeda *et al.,* 2011). Estimation of total nitrogen of plant sample was carried out by modified Kjeldhal method as described by Jackson (1967). Estimation of phosphorous was carried out by Vanadomolybdo-phosphoric yellow colour method in nitric acid system and intensity of colour (red) was measured in Spectrophotometer (Perkin Elmer, Lambda 25) at 420nm as described by Jackson (1967) and total potassium in plant sample was estimated by flame photometer (Systronics Model No. 128) as proposed by Jackson (1973).

For statistical interpretation, 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 (Pd" 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

Flowering and fruiting characteristics

The flowering percentage of pineapple cv. Mauritius was varied significant among different treatments and it was found highest in T_{12} (97.33, 98.67, 98.00) and lowest in T_1 (76.00, 80.00, 78.00) for 2015, 2016 and pooled means, respectively. The integrated nutrient management has significant role for flowering response. The lower flowering response in T_1 is due to no nutrient application in any form, whereas, higher responses was found in T_{12}, T_{10}, T_9, T_{16} and T_{17} may be due proper and balanced nutrition of plant. Estimated fruit yield with crown ($61.10 tha^{-1}$) was recorded with T_{12} which was statistically *at par* with T_{18}, T_{16}, and T_{10} (Table 1). Similar observation was also noticed for the estimated fruit yield without crown which was also recorded highest with T_{12}($58.26t ha^{-1}$). The combination effect of chemical, organic and bio-fertilizer provided best results regarding the estimated yield due to proper balanced nutrition.

Fruit physical properties

The fruit length (18.15cm) and circumference (37.55cm) was recorded highest with T_{12}. It is observed from pooled mean of the table 3 that, significant variation also present among various nutrient combinations for the parameter of fruit weight and recorded maximum (1118.81g) with T_{12} which was statistically *at par* with T_9(1103.69g), T_{18} (1092.63g), T_{16} (1068.53g), and T_{11}(1052.30g). The combination effect of chemical, organic and bio-fertilizer have a great role for improving the fruit weight of pineapple. The lowest fruit weight observed with T_1 is due to no nutrient application, followed by sole bio-fertilizer ($A_0B_0C_1$, $A_0B_0C_2$) and sole organic manure ($A_0B_1C_0$, $A_0B_2C_0$) and their interaction combination ($A_0B_1C_1$, $A_0B_2C_1$, $A_0B_2C_1$, $A_0B_2C_2$) treatments. The crown weight and fruit weight without crown was smaller in T_1 as the fruit size was also smaller in control and was highest in T_{12} treatment (189.21g and 929.61g respectively).From the pooled means of table 4, it is revealed that the pulp weight was maximum (644.10g) in T_{12} which is statistically *at par* with T_{18} ($A_2B_2C_1$), T_{10} ($A_1B_1C_1$) and T_{16} ($A_2B_1C_1$), however, the peel percentage was highest (58.53%) in T_{18} followed by T_{10}. It is clear from the result that the nutrient management through integrated manner comprising chemical, organic and bio-fertilizers provided the best results in terms of pulp weight. Lowest pulp weight was obtained with control. Higher peel weight in T_9, T_{10}, T_{11}, and T_{12} may contribute due to the higher fruit weight and peel weight was lower in control, as the size of fruit was very small. Lower percentage of peel was recorded with T_{16}, T_{18}, T_{17}, T_{14}, and T_{15}. The interaction effect of chemical, organic andchemical, organic, bio-fertilizer results lower peel percentage. It was higher in control (T_1) due to imbalance nutrition as no nutrition was provided in T_1. Similar trends were observed for the crown percentage. It was highest in T_1, may be due to development of small fruit and lower percentage was recorded with treatments having interaction effect of chemical, organic andchemical, organic, bio-fertilizer. Lower core percentage was recorded with T_{11}, followed by T_{10}, T_{12}, T_{18}. Balanced nutrition also has contribution of lower core weight of pineapple.

Bio-chemical properties

From the pooled means of table 6 it is revealed that the, maximum total soluble solids (18.51^{o}brix), total sugar percentage (12.58%), and reducing sugar (2.99%)

Table 1: Effect of integrated nutrient management on flowering and yield of pineapple cv. Mauritius

Treatments		Flowering percentage			Estimated fruit yield with crown (t ha^{-1})			Estimated fruit yield without crown (t ha^{-1})		
		2015	2016	Mean	2015	2016	Mean	2015	2016	Mean
A_0		80.22b	81.56b	80.89b	38.92b	44.69b	41.81b	35.69b	36.73b	36.21b
A_1		94.00a	96.22a	95.11a	48.69a	65.56a	57.12a	52.72a	54.42a	53.57a
A_2		93.78a	95.11a	94.44a	47.69a	63.59a	55.64a	51.52a	52.98a	52.25a
SEm(±)		**0.67**	**0.70**	**0.64**	**0.38**	**1.06**	**0.66**	**0.53**	**0.88**	**0.66**
LSD (0.05)		**1.92**	**2.01**	**1.85**	**1.09**	**3.06**	**1.91**	**1.53**	**2.54**	**1.89**
B_0		87.56b	89.56b	88.56b	41.91b	53.41b	47.66b	42.54b	44.15b	43.45b
B_1		89.78a	90.89ab	90.33ab	46.22a	59.27a	52.75a	47.94a	49.21a	48.58a
B_2		90.67a	92.44a	91.56a	47.16a	61.16a	54.16a	49.45a	50.78a	50.11a
SEm(±)		**0.67**	**0.70**	**0.64**	**0.38**	**1.06**	**0.66**	**0.53**	**0.88**	**0.66**
LSD (0.05)		**1.92**	**2.01**	**1.85**	**1.09**	**3.06**	**1.91**	**1.53**	**2.54**	**1.89**
C_0		87.56b	89.33b	88.44b	43.10b	54.60b	48.85b	43.60b	44.99b	44.29b
C_1		91.11a	92.59a	91.85a	47.10a	61.30a	54.20a	49.69a	51.11a	50.40a
SEm(±)		**0.54**	**0.57**	**0.53**	**0.31**	**0.87**	**0.54**	**0.43**	**0.72**	**0.54**
LSD (0.05)		**1.56**	**1.64**	**1.51**	**0.89**	**2.50**	**1.56**	**1.25**	**2.08**	**1.54**
T_1	$A_0B_0C_0$	76.00e	80.00e	78.00e	24.95k	28.95g	26.95i	20.36j	22.43h	21.40i
T_2	$A_0B_0C_1$	78.67e	80.00de	79.34e	39.52j	44.29f	41.91h	35.66i	36.92g	36.29h
T_3	$A_0B_1C_0$	77.33e	78.67e	78.00e	39.77j	43.77f	41.77h	34.93i	35.92g	35.43h
T_4	$A_0B_1C_1$	84.00d	84.00d	84.00d	43.51hi	50.67ef	47.09fg	41.80h	42.04fg	41.92g
T_5	$A_0B_2C_0$	77.33e	78.67e	78.00e	41.26ij	45.35f	43.31gh	36.39i	37.15g	36.77h
T_6	$A_0B_2C_1$	88.00cd	89.33c	88.67c	44.48gh	55.14de	49.81ef	45.00gh	45.93ef	45.47fg
T_7	$A_1B_0C_0$	92.00bc	94.67ab	93.34b	46.05efgh	61.28cd	53.67cde	48.58efg	50.49de	49.54def
T_8	$A_1B_0C_1$	92.00bc	96.00ab	94.00ab	47.70cdef	63.49abc	55.60bd	50.50def	52.95abcd	51.73de
T_9	$A_1B_1C_0$	93.33ab	96.00ab	94.67ab	47.96cdef	64.67abc	56.32bcd	51.57cdef	53.56abcd	52.57bcde
T_{10}	$A_1B_1C_1$	96.00ab	97.33ab	96.67ab	50.68ab	69.15ab	59.92ab	56.22ab	57.83abc	57.03ab
T_{11}	$A_1B_2C_0$	93.33ab	94.67ab	94.00ab	48.31bcde	64.00abc	56.16bcd	51.81cdef	52.79abcd	52.30cde
T_{12}	$A_1B_2C_1$	97.33a	98.67a	98.00a	51.44a	70.76a	61.10a	57.62a	58.89a	58.26a
T_{13}	$A_2B_0C_0$	92.00bc	93.33bc	92.67bc	45.60fgh	59.04cd	52.32de	48.19fg	49.05de	48.62ef
T_{14}	$A_2B_0C_1$	94.67ab	94.67ab	94.67ab	47.66cdef	63.43abc	55.55bcd	51.98cde	53.03abcd	52.51bcde
T_{15}	$A_2B_1C_0$	93.33ab	94.67ab	94.00ab	46.51defg	62.13bcd	54.32cde	49.64ef	51.62cde	50.63de
T_{16}	$A_2B_1C_1$	94.67ab	94.67ab	94.67ab	48.88abcd	65.26abc	57.07abc	53.46bcd	54.31abcd	53.89abcd
T_{17}	$A_2B_2C_0$	93.33ab	94.67ab	94.00ab	47.47cdef	62.20bcd	54.84cd	50.90def	51.84bcde	51.37de
T_{18}	$A_2B_2C_1$	94.67ab	98.67a	96.67ab	50.02abc	69.50ab	59.76ab	54.98abc	58.05ab	56.52abc
SEm(±)		**1.63**	**1.71**	**1.58**	**0.93**	**2.61**	**1.63**	**1.30**	**2.17**	**1.61**
LSD (0.05)		**4.69**	**4.93**	**4.54**	**2.68**	**7.49**	**4.68**	**3.75**	**6.23**	**4.63**

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

Table 2: Effect of integrated nutrient management on fruit length, crown length and fruit circumference of pineapple cv. Mauritius

Treatments		Fruit length (cm)			Crown length (cm)			Fruit circumference (cm)		
		2015	2016	Mean	2015	2016	Mean	2015	2016	Mean
A_0		12.30c	12.31c	12.31c	12.53c	12.47c	12.50c	26.34b	26.73c	26.54c
A_1		16.38a	16.48a	16.43a	16.58a	16.61a	16.60a	31.70a	32.87a	32.29a
A_2		15.63b	15.43b	15.53b	15.76b	15.59b	15.67b	31.31a	31.38b	31.35b
SEm(±)		**0.12**	**0.11**	**0.10**	**0.11**	**0.03**	**0.06**	**0.19**	**0.12**	**0.13**
LSD (0.05)		**0.35**	**0.32**	**0.29**	**0.30**	**0.10**	**0.17**	**0.57**	**0.35**	**0.39**
B_0		13.94b	14.00b	13.97b	14.28c	14.09c	14.19c	28.04c	28.58c	28.31c
B_1		15.16a	15.02a	15.09a	15.02b	15.09b	15.06b	30.27b	30.96b	30.62b
B_2		15.21a	15.20a	15.21a	15.57a	15.49a	15.53a	31.04a	31.44a	31.24a
SEm(±)		**0.12**	**0.11**	**0.1**	**0.11**	**0.03**	**0.06**	**0.19**	**0.12**	**0.13**
LSD (0.05)		**0.35**	**0.32**	**0.29**	**0.30**	**0.10**	**0.17**	**0.57**	**0.35**	**0.39**
C_0		14.09b	13.92b	14.00b	14.12b	13.99b	14.06b	28.03b	28.35b	28.19b
C_1		15.45a	15.56a	15.51a	15.79a	15.79a	15.79a	31.53a	32.30a	31.92a
SEm(±)		**0.10**	**0.09**	**0.08**	**0.09**	**0.03**	**0.05**	**0.16**	**0.09**	**0.11**
LSD (0.05)		**0.28**	**0.26**	**0.24**	**0.25**	**0.08**	**0.14**	**0.47**	**0.29**	**0.32**
T_1	$A_0B_0C_0$	11.64f	11.5j	11.57k	11.03j	10.96p	11.00l	22.87 h	24.33 m	23.60i
T_2	$A_0B_0C_1$	12.39ef	12.56hi	12.48ij	13.06h	12.73m	12.90j	27.53fg	27.67 k	27.60g
T_3	$A_0B_1C_0$	12.04f	11.9ij	11.97jk	11.94i	11.95o	11.95k	24.24 h	24.64 m	24.44j
T_4	$A_0B_1C_1$	13.00e	12.93gh	12.97i	13.14h	13.25l	13.20j	28.73def	28.47jk	28.60f
T_5	$A_0B_2C_0$	12.38ef	12.24hij	12.31ij	12.11i	12.20n	12.16k	26.42 g	26.32 l	26.37h
T_6	$A_0B_2C_1$	12.35ef	12.73h	12.54ij	13.89g	13.72k	13.81i	28.24ef	28.96ij	28.60f
T_7	$A_1B_0C_0$	14.44b	14.59e	14.52gh	15.22de	15.12hi	15.17fg	28.81def	29.67ghi	29.24ef
T_8	$A_1B_0C_1$	14.88d	15.71d	15.30f	15.38de	15.57g	15.48ef	29.39 de	30.26fgh	29.83e
T_9	$A_1B_1C_0$	16.44c	16.17cd	16.31de	16.42c	16.40e	16.41de	29.69 d	30.66 f	30.18e
T_{10}	$A_1B_1C_1$	17.95a	17.9a	17.93ab	17.52b	17.62c	17.57c	34.03 b	36.78 b	35.41b
T_{11}	$A_1B_2C_0$	16.41c	16.34bcd	16.38de	16.23c	16.09f	16.16d	31.35 c	31.66 e	31.51d
T_{12}	$A_1B_2C_1$	18.15a	18.14a	18.15a	18.74a	18.87a	18.81a	36.90 a	38.20 a	37.55a
T_{13}	$A_2B_0C_0$	14.17d	13.58fg	13.88h	15.08e	14.90i	14.99gh	29.77 d	29.18ij	29.48ef
T_{14}	$A_2B_0C_1$	16.11c	16.08d	16.10e	15.91cd	15.28h	15.60a	29.85 d	fg30.36	30.11e
T_{15}	$A_2B_1C_0$	14.67d	14.3ef	14.49gh	14.91ef	14.41j	14.66h	29.32 de	29.48 hi	29.40ef
T_{16}	$A_2B_1C_1$	16.86bc	16.9bc	16.88cd	16.19c	16.91d	16.55d	35.63 a	35.75 c	35.69b
T_{17}	$A_2B_2C_0$	14.59d	14.63e	14.61fg	14.18fg	13.92k	14.05i	29.80 d	29.19ij	29.50ef
T_{18}	$A_2B_2C_1$	17.36ab	17.11b	17.24bc	18.25ab	18.13b	18.19b	33.50 b	34.28 d	33.89c
SEm(±)		**0.30**	**0.27**	**0.25**	**0.26**	**0.09**	**0.14**	**0.49**	**0.29**	**0.33**
LSD (0.05)		**0.85**	**0.78**	**0.71**	**0.74**	**0.24**	**0.41**	**1.40**	**0.85**	**0.95**

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

Table 3: Effect of integrated nutrient management on fruit weight, crown weight and fruit weight without crown of pineapple cv. Mauritius

Treatments		Fruit weight (g)			Crown weight (g)			Fruit weight without crown (g)		
		2015	2016	Mean	2015	2016	Mean	2015	2016	Mean
A_0		844.55b	853.05b	848.80b	153.63c	152.29b	152.96c	690.92b	700.75b	695.84b
A_1		1056.6a	1063.4a	1060.00a	181.02a	180.72a	180.87a	875.57a	882.67a	879.13a
A_2		1034.94a	1044.02a	1039.48a	176.98b	174.17a	175.58b	857.96a	869.85a	863.91a
SEm(±)		**8.26**	**14.88**	**10.53**	**1.35**	**2.70**	**1.75**	**7.07**	**12.42**	**8.89**
LSD (0.05)		**23.73**	**42.77**	**30.28**	**3.87**	**7.75**	**5.02**	**20.33**	**35.69**	**25.54**
B_0		909.57b	919.93b	914.76b	161.90b	160.25b	161.08b	747.68b	759.68b	753.68b
B_1		1003.02a	1012.02a	1007.42a	173.95a	172.04a	173.00a	829.07a	839.98a	834.53a
B_2		1023.48a	1028.51a	1026.00a	175.78a	174.89a	175.34a	847.70a	853.62a	850.66a
SEm(±)		**8.26**	**14.88**	**10.53**	**1.35**	**2.70**	**1.75**	**7.07**	**12.42**	**8.89**
LSD (0.05)		**23.73**	**42.77**	**30.28**	**3.87**	**7.75**	**5.02**	**20.33**	**35.69**	**25.54**
C_0		935.27b	945.09b	940.18b	166.76b	167.08b	166.92b	768.51b	778.01b	773.26b
C_1		1022.19a	1028.56a	1025.34a	174.33a	171.05a	172.69a	847.79a	857.51a	852.65a
SEm(±)		**6.74**	**12.15**	**8.60**	**1.10**	**2.20**	**1.43**	**5.78**	**10.14**	**7.26**
LSD (0.05)		**19.38**	**34.92**	**24.72**	**3.16**	**6.33**	**4.10**	**16.60**	**29.14**	**20.86**
T_1	$A_0B_0C_0$	541.56k	574.25h	557.90j	123.08 i	129.25 g	126.17i	418.48 j	445.00 i	431.74j
T_2	$A_0B_0C_1$	857.60j	866.3g	861.95i	148.98 h	144.04fg	146.51h	708.63 i	722.26gh	715.44i
T_3	$A_0B_1C_0$	863.05j	869.66g	866.36i	156.95gh	155.88ef	156.42gh	706.10 i	713.78 h	709.94i
T_4	$A_0B_1C_1$	944.33hi	942.21efg	943.27gh	166.54ef	160.63def	163.59efg	777.78gh	781.57efgh	779.68gh
T_5	$A_0B_2C_0$	895.38ij	900.97fg	898.18hi	159.86fg	162.88cdef	161.37fg	735.52 hi	738.08fgh	736.80hi
T_6	$A_0B_2C_1$	965.36gh	964.89defg	965.12fgh	166.36efg	161.06def	163.71defg	799.00fg	803.83defg	801.41fg
T_7	$A_1B_0C_0$	999.30efgh	1011.85bcde	1005.58defg	174.23cde	178.12abcd	176.18bc	825.07efg	833.73bcde	829.40defg
T_8	$A_1B_0C_1$	1035.12cdef	1032.03abcde	1033.58bcdef	177.22bcd	171.24abcde	174.23bcde	857.90cde	860.79abcde	859.35bcdef
T_9	$A_1B_1C_0$	1040.79cdef	1051.25abcd	1046.02abcde	177.86bcd	180.64abc	179.25abc	862.92cde	870.62abcd	866.77bcde
T_{10}	$A_1B_1C_1$	1099.77ab	1107.62ab	1103.69ab	185.15ab	181.29abc	183.22ab	914.62ab	926.33 a	920.48ab
T_{11}	$A_1B_2C_0$	1048.38bcde	1056.22abcd	1052.30abcde	181.34abc	184.97ab	183.16ab	867.04bcde	871.25abcd	869.15abcde
T_{12}	$A_1B_2C_1$	1116.22a	1121.40a	1118.81a	190.34 a	188.08 a	189.21a	925.88 a	933.33 a	929.61aefg
T_{13}	$A_2B_0C_0$	989.48fgh	988.65cdef	989.07efg	171.04 de	167.31bcde	169.18cdef	818.44efg	821.34cdef	819.89bcde
T_{14}	$A_2B_0C_1$	1034.38cdef	1046.52abcde	1040.45bcde	176.84bcd	171.56abcde	174.20bcde	857.55cde	874.96abcd	866.25defg
T_{15}	$A_2B_1C_0$	1009.42defg	1025.1abcde	1017.26defg	178.5bcd	173.42abcde	175.96bcd	830.92ef	851.68abcde	841.30abcd
T_{16}	$A_2B_1C_1$	1060.78abcd	1076.27abc	1068.53abcd	178.70bcd	180.39abc	179.55abc	882.09abcd	895.88abc	888.98cdef
T_{17}	$A_2B_2C_0$	1030.07cdef	1027.82abcde	1028.95cdef	177.93bcd	171.22abcde	174.58bcde	852.14 de	856.60abcde	854.37abc
T_{18}	$A_2B_2C_1$	1085.50abc	1099.77ab	1092.63abc	178.86bcd	181.14abc	180.00abc	906.63abc	918.63ab	912.63abc
SEm(±)		**20.23**	**36.45**	**25.81**	**3.30**	**6.61**	**4.28**	**17.33**	**30.42**	**21.77**
LSD (0.05)		**58.13**	**104.76**	**74.17**	**9.48**	**18.99**	**12.30**	**49.80**	**87.41**	**62.57**

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

were found maximuminT$_{18}$ ($A_2B_2C_1$). Total soluble solids (TSS), total sugar and reducing sugar were also recorded higher with treatments having balanced nutrition with chemical, organic and bio-fertilizer in 2015, 2016 and pooled mean value. The acidity percentage was non-significant among all treatments in 2015, 2016 and for the pooled mean values. Significant variation between the main factor and treatments combination with respect to the TSS and acidity ratio was observed among several nutrient treatments and it was found maximum (27.895) in T_{18} ($A_2B_2C_1$). The pooled means of table 8 shows significant variation is present among the most of the treatments for both the years and for pooled mean values for the ascorbic acid content and it was recorded highest (40.56 mg/100g of edible portion) with $T_{18,}$ it suggest there is a role of integrated nutrient management for ascorbic acid content.

Leaf nutrient content

From the table 8 and 9 it is clear that the leaf phosphorus content was non-significant for main effect on 2015, 2016 and pooled means for both 10thmonths after planting (MAP) and during harvesting, suggesting the role of phosphorus is less important in the nutrition of pineapple compare to nitrogen and potash. The nutrient content was lower in harvesting period compare to 10th MAP, suggesting the utilization of plant nutrient for production of pineapple fruit. The leaf nutrient content was lowest for T_1 ($A_0B_0C_0$), as it was not received any form of nutrient applied to plant. Leaf nitrogen content was highest (1.972%) in T_{15} (high dose of nitrogen fertilizer) which was statistically at par with T_{14} (high dose of nitrogen and bio-fertilizer) and T_{18} (balanced with fertilizer, organic and bio-fertilizer). Similar trends of leaf nitrogen content were observed during the harvesting stage of pineapple with highest (1.880%) in T_{15}. Leaf potash content was highest (3.461%) in T_{15} followed by T_{14}, T_{18}, T_{17}, and T_{16} during 10th MAP, similar trends of leaf potash content were also recorded during the harvesting period of pineapple. Most of the cases the higher nutrient content was recorded with treatments having balanced nutrition with chemical, organic and bio-fertilizer.

Several scientists had reported regarding the nutritive management which confirms the result of present experiment. Nitrogen supply increased yield, fruit size and the percentage of large fruits and potassium had a positive influence on pineapple yield and fruit size. High yield and fruit size were closely related to nitrogen and potash concentrations of pineapple leaves (Spironello *et al.*, 2004). The effect of nitrogen application on leaf nutrient content of pineapple was also assessed by Rao *et al.* (1977). Effects of potassium fertilization on plant growth showed strong relation with fruit yield (Teixeria *et al.*, 2011). Omotoso and Akinrinde (2013) and (Bhugaloo, 1998) reported the effect of N fertilizer application on growth and behavior in pineapple. The increase in yield due to application of nitrogen as pineapple showed the high requirement of nitrogen (De Geus, 1973; Asoegwu, 1987). The highest average fruit weight of 1.88 kg was obtained with 200 N and 200 or 400 kg K_2O. The total soluble solids (TSS), which ranged from 11-18°Brix, were also highest at those levels of N and K_2O (Hartinee and Zabedah, 2011). Andre and Jose (2011) reported that the fruit quality was reduced with application of N, but increased with the addition of P and K. Combination of urea and chicken manure resulted in maximum accumulation of bioactive compounds of pineapple (Danatas *et al.*, 2015). Bhowmick *et al.*, (2011) reported that maximum fruit length of pineapple cv. Kew without crown (17.37cm) and breadth (36.67 cm) with ethrel at 25 ppm. Kumar *et al.* (2017) worked on the nutrient management in papaya and also find the similar responses of fertilizer interaction.

Chhuria *et al*. (2016) reported that the organic carbon of soil has been increased in RDF+biofertilizer treatment due to the presence of organic sources which led to stabilized C:N ratio and increasing the organic carbon content of the soil (Parr and Papendick, 1978). The highest weight of banana bunch recorded in 50 per cent RDF + FYM + *Azotobacter* (50 g plant^{-1}) + PSB (50 g plant^{-1}) + VAM (250 g plant^{-1}) due to the vigorous plant growth character. Increased number of leaves might have increased the photosynthetic activity resulting in higher accumulation of carbohydrates. Relatively higher amount of carbohydrate could have promoted the growth rate and in turn increased the weight of bunch. This was in accordance with the result of Hazarika and Ansari (2010). The applied N, P, K and biofertilizers were utilized efficiently by the plant, which resulted in producing maximum photosynthates in terms of high biomass and translocating the assimilated material to the developing sink resulting in heavier weight of bunch. N is the chief constituent of chlorophyll. Protein and amino acids, the synthesis of which is accelerated through increased supply of N (Pafli, 1965; Mahadevan, 1988).

The flowering and fruiting characteristics of pineapple cv. Mauritius under the integrated nutrient management showed significant variation for 2015, 2016 and pooled means among most of the treatments indicating there is significant role of nutrient management for flowering and fruiting of pineapple plants. It is also found that the treatment having combinations of chemical fertilizer, organic manure and bio-fertilizers shows better performance compared with sole application of bio-fertilizers, or organic or only chemical fertilizers. Flowering percentage, estimated fruit yield was highest in T_{12}, which was statistically at

Table 4: Effect of integrated nutrient management on pulp weight, peel weight and core weight of pineapple cv. Mauritius

Treatments		Pulp weight (g)			Peel weight (g)			Core weight (g)		
		2015	2016	Mean	2015	2016	Mean	2015	2016	Mean
A_0		460.10c	473.04b	466.57b	167.23c	165.93c	166.59c	63.59b	61.78c	62.69c
A_1		598.51a	599.64a	599.08a	211.12a	206.65a	208.88a	65.95b	76.39a	71.17b
A_2		584.17b	600.32a	592.25a	191.25b	196.47b	193.87b	82.54a	73.06b	77.80a
SEm(±)		**4.69**	**8.55**	**6.01**	**1.59**	**3.04**	**2.10**	**1.44**	**1.01**	**1.06**
LSD (0.05)		**13.49**	**24.57**	**17.27**	**4.56**	**8.74**	**6.03**	**4.15**	**2.91**	**3.05**
B_0		498.99c	516.71b	507.85b	177.53c	177.24b	177.39b	71.16a	65.73b	68.45b
B_1		564.96b	573.60a	569.29a	192.52b	191.10a	193.31a	71.59a	72.27a	71.94a
B_2		578.82a	582.69a	580.76a	199.56a	197.71a	198.64a	69.33a	73.32a	71.23ab
SEm(±)		**4.69**	**8.55**	**6.01**	**1.59**	**3.04**	**2.10**	**1.44**	**1.01**	**1.06**
LSD (0.05)		**13.49**	**24.57**	**17.27**	**4.56**	**8.74**	**6.03**	**NS**	**2.91**	**3.05**
C_0		517.96b	520.25b	519.11b	183.88b	187.62a	185.75b	66.67b	70.15a	68.41b
C_1		577.22a	595.09a	586.15a	195.86a	191.75a	193.81a	74.71a	70.67a	72.69a
SEm(±)		**3.83**	**6.98**	**4.90**	**1.30**	**2.48**	**1.71**	**1.18**	**0.83**	**0.87**
LSD (0.05)		**11.02**	**20.26**	**14.10**	**3.73**	**NS**	**4.92**	**3.39**	**NS**	**2.49**
T_1	$A_0B_0C_0$	265.34i	283.32j	274.33i	111.49k	118.68f	115.08g	41.65i	43.00g	42.33i
T_2	$A_0B_0C_1$	474.99h	500.62ghi	487.81gh	169.36ij	161.56e	165.46f	64.27gh	60.08f	62.18h
T_3	$A_0B_1C_0$	475.76h	472.29i	474.02h	164.19j	174.71de	169.45f	66.15efgh	66.78def	66.47gh
T_4	$A_0B_1C_1$	518.41fg	540.21fgh	529.31fg	182.57gh	176.32de	179.44ef	76.81bcd	65.04ef	70.93cdefg
T_5	$A_0B_2C_0$	491.22gh	487.86hi	489.54gh	176.99hi	182.84cde	179.92def	67.31defg	67.38cde	67.35efgh
T_6	$A_0B_2C_1$	534.87ef	553.94efg	544.41ef	198.80cde	181.49cde	190.15cde	65.32fgh	68.39cde	66.86fgh
T_7	$A_1B_0C_0$	566.10cde	550.93efg	558.52cdef	182.92gh	206.73ab	194.83c	76.05bcde	76.07ab	76.06abc
T_8	$A_1B_0C_1$	567.88cde	596.65a-f	582.27bcde	206.51bc	193.25abcd	199.88bc	83.50ab	70.89bcde	77.20abc
T_9	$A_1B_1C_0$	586.39bc	580.00cdef	583.19bcde	219.65a	211.66a	215.66a	56.89h	78.96a	67.92defgh
T_{10}	$A_1B_1C_1$	633.52a	642.42ab	637.97a	217.18ab	207.20ab	212.19ab	63.93gh	76.71ab	70.32cdefg
T_{11}	$A_1B_2C_0$	598.29bc	578.52def	588.41bcd	225.50a	213.09a	219.30a	43.24i	79.65a	61.44h
T_{12}	$A_1B_2C_1$	638.85a	649.34a	644.10a	214.93ab	207.94ab	211.44ab	72.10cdefg	76.04ab	74.07bcdef
T_{13}	$A_2B_0C_0$	540.34def	559.43efg	549.89def	200.40cd	188.83bcd	194.62cd	77.69bc	73.08abcd	75.39bcd
T_{14}	$A_2B_0C_1$	579.28bc	609.30a-e	594.29bc	194.47def	194.39abcd	194.43cd	83.80ab	71.27bcde	77.54abc
T_{15}	$A_2B_1C_0$	568.34cd	582.55bcdef	575.45bcde	184.98fgh	196.07abcd	190.53cde	77.60bc	73.06abcd	75.33bcd
T_{16}	$A_2B_1C_1$	607.38ab	624.14abcd	615.76ab	186.55fgh	198.64abc	192.59cde	88.16a	73.10abcd	80.63ab
T_{17}	$A_2B_2C_0$	569.89cd	587.33bcdef	578.61bcde	188.76efg	195.93abcd	192.35cde	93.48a	73.34abcd	83.41a
T_{18}	$A_2B_2C_1$	639.76a	639.17abc	639.47a	192.35defg	204.97ab	198.66bc	74.52bcdef	74.49abc	74.50bcde
SEm(±)		**11.50**	**20.94**	**14.71**	**3.89**	**7.44**	**5.13**	**3.54**	**2.48**	**2.60**
LSD (0.05)		**33.05**	**60.19**	**42.30**	**11.18**	**21.40**	**14.76**	**10.17**	**7.12**	**7.47**

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

Table 5: Effect of integrated nutrient management on pulp , peel, crown and core percentage of pineapple cv. Mauritius

Treatments		Pulp (%)			Peel (%)			Crown (%)			Core (%)		
		2015	2016	Mean	2015	2016	Mean	2015	2016	Mean	2015	2016	Mean
A_0		54.11c	55.02c	54.57c	19.84b	19.53a	19.69a	18.50a	18.18a	18.34a	7.54b	7.27a	7.41a
A_1		56.63a	56.36b	56.49b	19.98a	19.45a	19.71a	17.14b	17.00b	17.07b	6.25c	7.19a	6.72b
A_2		56.41b	57.49a	56.95a	18.50c	18.83b	18.67b	17.11b	16.67b	16.90b	7.98a	7.01b	7.49a
SEm(±)		**0.06**	**0.18**	**0.10**	**0.04**	**0.07**	**0.04**	**0.06**	**0.15**	**0.08**	**0.12**	**0.04**	**0.06**
LSD (0.05)		**0.18**	**0.52**	**0.28**	**0.11**	**0.21**	**0.12**	**0.18**	**0.44**	**0.23**	**0.34**	**0.14**	**0.19**
B_0		54.42c	55.67b	55.05b	19.61a	19.35a	19.48a	18.17a	17.80a	17.99a	7.80a	7.18a	7.49a
B_1		56.25b	56.61a	56.43a	19.19b	19.26a	19.19b	17.38b	17.03b	17.21b	7.18b	7.15a	7.17b
B_2		56.47a	56.58a	56.53a	19.53a	19.20a	19.39a	17.20c	17.02b	17.11b	6.80c	7.14a	6.97c
SEm(±)		**0.06**	**0.18**	**0.10**	**0.04**	**0.07**	**0.04**	**0.06**	**0.15**	**0.08**	**0.12**	**0.05**	**0.06**
LSD (0.05)		**0.18**	**0.52**	**0.28**	**0.11**	**0.21**	**0.12**	**0.18**	**0.44**	**0.23**	**0.34**	**NS**	**0.19**
C_0		55.03b	54.74b	54.89b	19.69a	19.89a	19.79a	18.09a	17.93a	18.01a	7.19a	7.44a	7.31a
C_1		56.40a	57.84a	57.12a	19.19b	18.65b	18.92b	17.08b	16.64b	16.86b	7.33a	6.88b	7.10b
SEm(±)		**0.05**	**0.15**	**0.08**	**0.03**	**0.06**	**0.03**	**0.05**	**0.12**	**0.07**	**0.10**	**0.04**	**0.05**
LSD (0.05)		**0.15**	**0.42**	**0.22**	**0.09**	**0.17**	**0.10**	**0.14**	**0.36**	**0.19**	**NS**	**0.11**	**0.15**
T_1	$A_0B_0C_0$	49.00k	49.18e	49.09j	20.59c	20.64a	20.61a	22.73a	22.66a	22.70a	7.69b	7.53a	7.61b
T_2	$A_0B_0C_1$	55.38g	57.78abc	56.58de	19.75e	18.64cde	19.20efg	17.37def	16.64def	17.01defghi	7.49bcd	6.93def	7.21bc
T_3	$A_0B_1C_0$	55.13ghi	54.32d	54.72i	19.02gh	20.08b	19.55cd	18.19b	17.93bc	18.06b	7.66bc	7.67a	7.67ab
T_4	$A_0B_1C_1$	54.90hij	57.33abc	56.11efgh	19.33f	18.71cde	19.02fgh	17.64cde	17.05bcdef	17.34def	8.13b	6.90def	7.52bc
T_5	$A_0B_2C_0$	54.86ij	54.15d	54.51i	19.77e	20.29ab	20.03b	17.85bc	18.08b	17.97bc	7.52bcd	7.48ab	7.50b
T_6	$A_0B_2C_1$	55.41g	57.40abc	56.40ef	20.59c	18.81cde	19.70c	17.23efgh	16.70def	16.97defghi	6.77de	7.09cdef	6.93cd
T_7	$A_1B_0C_0$	56.65de	54.46d	55.55h	18.30i	20.43ab	19.37de	17.44cdef	17.59bcd	17.52bcd	7.61bc	7.52a	7.56b
T_8	$A_1B_0C_1$	54.86ij	57.82abc	56.34ef	19.95e	18.71cde	19.33de	17.12fgh	16.60def	16.86efghi	8.06b	6.87def	7.47b
T_9	$A_1B_1C_0$	56.34ef	55.20d	55.77fgh	21.10b	20.11b	20.61a	17.09fgh	17.18bcdef	17.14defgh	5.47g	7.51a	6.49de
T_{10}	$A_1B_1C_1$	57.60b	58.01ab	57.81b	19.75e	18.70cde	19.23ef	16.83hi	16.37f	16.60hi	5.82fg	6.92def	6.37e
T_{11}	$A_1B_2C_0$	57.07cd	54.77d	55.92efgh	21.51a	20.18ab	20.85a	17.30def	17.51bcde	17.40cde	4.13h	7.54a	5.83f
T_{12}	$A_1B_2C_1$	57.24bc	57.91ab	57.57bc	19.26fg	18.54e	18.90ghi	17.06fgh	16.77def	16.92efghi	6.44ef	6.78f	6.61de
T_{13}	$A_2B_0C_0$	54.61j	56.58c	55.60gh	20.25d	19.10c	19.68c	17.29def	16.92cdef	17.10defgh	7.85b	7.39abc	7.62b
T_{14}	$A_2B_0C_1$	56.00f	58.22a	57.11cd	18.80h	18.57de	18.69i	17.10fgh	16.39f	16.74ghi	8.10b	6.81ef	7.46b
T_{15}	$A_2B_1C_0$	56.31ef	56.83bc	56.57de	18.33i	19.13c	18.73hi	17.69cd	16.92cdef	17.30defg	7.67bc	7.13cde	7.40b
T_{16}	$A_2B_1C_1$	57.25bc	58.00ab	57.63bc	17.59j	18.46e	18.02j	16.85ghi	16.74def	16.79fghi	8.32ab	6.79ef	7.56b
T_{17}	$A_2B_2C_0$	55.33gh	57.17abc	56.25efg	18.33i	19.07cd	18.70i	17.27defg	16.60def	16.94ghi	9.07a	7.16bcd	8.12a
T_{18}	$A_2B_2C_1$	58.94a	58.11a	58.53a	17.72j	18.65cde	18.18j	16.49i	16.47ef	16.48i	6.85cde	6.77f	6.81cde
SEm(±)		**0.16**	**0.44**	**0.23**	**0.10**	**0.18**	**0.1**	**0.15**	**0.37**	**0.20**	**0.29**	**0.12**	**0.16**
LSD (0.05)		**0.45**	**1.27**	**0.67**	**0.28**	**0.52**	**0.3**	**0.43**	**1.07**	**0.57**	**0.83**	**0.34**	**0.46**

**Means with the same letter are not significantly different

Table 6: Effect of integrated nutrient management on TSS, total sugar and reducing sugar contents of pineapple cv. Mauritius

Treatments		Total soluble solids (^{o}brix)			Total sugar (%)			Reducing sugar (%)		
		2015	2016	Mean	2015	2016	Mean	2015	2016	Mean
A_0		16.52b	16.44b	16.48b	10.66b	10.57b	10.61b	2.14c	2.12b	2.13c
A_1		17.41b	17.51a	17.46a	11.12b	11.87a	11.49a	2.28b	2.47a	2.38b
A_2		17.42a	17.71a	17.57a	11.86a	11.93a	11.89a	2.68a	2.54a	2.61a
SEm(±)		**0.20**	**0.20**	**0.20**	**0.24**	**0.29**	**0.20**	**0.02**	**0.06**	**0.03**
LSD (0.05)		**0.58**	**0.58**	**0.57**	**0.70**	**0.84**	**0.56**	**0.06**	**0.16**	**0.09**
B_0		16.60b	16.67b	16.64b	11.03a	10.85b	10.94b	2.27c	2.19b	2.23b
B_1		17.21a	17.41a	17.31a	11.10a	11.72a	11.41ab	2.37b	2.44a	2.40a
B_2		17.53a	17.58a	17.56a	11.50a	11.80a	11.65a	2.46a	2.51a	2.48a
SEm(±)		**0.20**	**0.20**	**0.20**	**0.24**	**0.29**	**0.20**	**0.02**	**0.06**	**0.03**
LSD (0.05)		**0.58**	**0.58**	**0.57**	**NS**	**0.84**	**0.56**	**0.06**	**0.16**	**0.09**
C_0		16.71b	16.80b	16.76b	11.18a	11.03b	11.10a	2.35a	2.25b	2.30b
C_1		17.52a	17.64a	17.58a	11.24a	11.88a	11.56a	2.38a	2.51a	2.44a
SEm(±)		**0.17**	**0.17**	**0.16**	**0.20**	**0.24**	**0.16**	**0.02**	**0.04**	**0.02**
LSD (0.05)		**0.48**	**0.48**	**0.47**	**0.57**	**0.68**	**NS**	**NS**	**0.13**	**0.07**
T_1	$A_0B_0C_0$	15.89f	15.79g	15.84e	9.93 e	10.06d	10.00d	2.09gh	2.08e	2.09h
T_2	$A_0B_0C_1$	16.61cdef	16.44defg	16.53cde	10.04de	10.62cd	10.33cd	2.13fgh	2.14de	2.14h
T_3	$A_0B_1C_0$	16.09ef	15.95fg	16.02de	10.38cde	10.09d	10.24d	2.11gh	2.11e	2.11h
T_4	$A_0B_1C_1$	16.98abcdef	17.27abcdef	17.13abcde	10.77abcde	11.16abcd	10.97bcd	2.21efgh	2.17de	2.19gh
T_5	$A_0B_2C_0$	16.08ef	16.01efg	16.05de	11.25abcde	10.35d	10.80bcd	2.07h	2.10e	2.09h
T_6	$A_0B_2C_1$	17.49abcde	17.21abcdef	17.35abcd	11.56abcde	11.10abcd	11.33abcd	2.22efgh	2.16 de	2.19gh
T_7	$A_1B_0C_0$	16.80bcdef	16.84cdefg	16.82cde	10.75abcde	10.82bcd	10.79bcd	2.17efgh	2.24 de	2.21gh
T_8	$A_1B_0C_1$	17.37abcde	17.15bcdefg	17.26abcd	11.86 abc	11.50abcd	11.68abc	2.28def	2.27de	2.28fgh
T_9	$A_1B_1C_0$	17.11abcdef	17.27abcdef	17.19abcde	11.76 abcd	11.63abcd	11.70abc	2.49c	2.29 de	2.39efg
T_{10}	$A_1B_1C_1$	17.62abcd	18.00abc	17.81abc	10.60bcde	12.63abc	11.62abc	2.14fgh	2.78abc	2.46def
T_{11}	$A_1B_2C_0$	17.31abcdef	17.44abcde	17.38abcd	10.98abcde	11.75abcd	11.37abcd	2.17efgh	2.33de	2.25fgh
T_{12}	$A_1B_2C_1$	18.22ab	18.35ab	18.29ab	10.79abcde	12.88a	11.84ab	2.42cd	2.91ab	2.67bcd
T_{13}	$A_2B_0C_0$	16.29def	16.64cdefg	16.47cde	11.18abcde	10.79bcd	10.99bcd	2.23efg	2.18de	2.21gh
T_{14}	$A_2B_0C_1$	16.66cdef	17.19bcdefg	16.93bcde	12.41a	11.28abcd	11.85ab	2.74b	2.25de	2.50cde
T_{15}	$A_2B_1C_0$	17.11abcdef	17.47abcd	17.29abcd	12.16ab	12.03abcd	12.10ab	2.95a	2.41cde	2.68bc
T_{16}	$A_2B_1C_1$	18.36a	18.52ab	18.44a	10.96abcde	12.76ab	11.86ab	2.31de	2.87ab	2.59bcde
T_{17}	$A_2B_2C_0$	17.73abc	17.83abcd	17.78abc	12.24ab	11.73abcd	11.99ab	2.90a	2.53bcd	2.72b
T_{18}	$A_2B_2C_1$	18.37a	18.64a	18.51a	12.19ab	12.97a	12.58a	2.96a	3.02a	2.99a
SEm(±)		**0.50**	**0.49**	**0.49**	**0.60**	**0.71**	**0.48**	**0.05**	**0.14**	**0.07**
LSD (0.05)		**1.43**	**1.43**	**1.40**	**1.71**	**2.05**	**1.38**	**0.15**	**0.40**	**0.21**

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

Table 7: Effect of integrated nutrient management on acidity, TSS: acidity ratio and ascorbic acid content of pineapple cv. Mauritius

Treatments	Acidity Percentage			TSS: Acidity			Ascorbic acid (mg $100g^{-1}$of edible portion)		
	2015	2016	Mean	2015	2016	Mean	2015	2016	Mean
A_0	0.678a	0.676a	0.675a	24.41b	24.43b	24.42b	32.06b	33.34b	32.70b
A_1	0.679a	0.672a	0.676a	25.68a	26.08a	25.88a	38.12a	37.59a	37.86a
A_2	0.684a	0.666a	0.677a	25.51ab	26.69a	26.10a	36.97a	38.21a	37.59a
SEm(±)	**0.006**	**0.009**	**0.005**	**0.39**	**0.44**	**0.36**	**1.20**	**1.22**	**0.93**
LSD (0.05)	**NS**	**NS**	**NS**	**1.11**	**1.27**	**1.04**	**3.45**	**3.52**	**2.67**
B_0	0.679a	0.679a	0.680a	24.45b	24.59b	24.52b	34.36a	34.01b	34.19b
B_1	0.686a	0.669a	0.678a	25.14ab	26.09a	25.62a	36.06a	37.78a	36.92a
B	0.677a	0.665a	0.670a	26.01a	26.52a	26.26a	36.73a	37.35ab	37.04a
SEm(±)	**0.006**	**0.009**	**0.005**	**0.39**	**0.44**	**0.36**	**1.20**	**1.22**	**0.93**
LSD (0.05)	**NS**	**NS**	**NS**	**1.11**	**1.27**	**1.04**	**NS**	**3.52**	**2.67**
C_0	0.680a	0.676a	0.678a	24.65b	24.92b	24.78b	34.51a	34.98a	34.74b
C_1	0.681a	0.667a	0.673a	25.75a	26.55a	26.15a	36.93a	37.78a	37.35a
SEm(±)	**0.005**	**0.008**	**0.004**	**0.32**	**0.36**	**0.29**	**0.98**	**1.00**	**0.76**
LSD (0.05)	**NS**	**NS**	**NS**	**0.91**	**1.04**	**0.85**	**NS**	**NS**	**2.18**
T_1 $A_0B_0C_0$	0.665a	0.681a	0.673a	23.94cde	23.20e	23.570e	29.82d	30.37 d	30.10c
T_2 $A_0B_0C_1$	0.677a	0.679a	0.678a	24.56bcde	24.32cde	24.440cde	32.73abcd	32.96 bcde	32.85bc
T_3 $A_0B_1C_0$	0.681a	0.674a	0.678a	23.64de	23.63de	23.635e	30.91cd	33.33 abcd	32.12bc
T_4 $A_0B_1C_1$	0.693a	0.674a	0.684a	24.50bcde	25.68bcde	25.090bcde	33.09abcd	36.67 abcd	34.88abc
T_5 $A_0B_2C_0$	0.684a	0.674a	0.679a	23.55e	23.87de	23.710de	32.36bcd	31.48 cd	31.92bc
T_6 $A_0B_2C_1$	0.665a	0.665a	0.665a	26.29abcd	25.90abcde	26.095abcde	33.45abcd	35.19 abcd	34.32abc
T_7 $A_1B_0C_0$	0.698a	0.686a	0.692a	24.10cde	24.61cde	24.355cde	35.27abcd	34.07 abcd	34.67abc
T_8 $A_1B_0C_1$	0.684a	0.677a	0.681a	25.41abcde	25.34bcde	25.375abcde	36.73abcd	37.04 abcd	36.89ab
T_9 $A_1B_1C_0$	0.686a	0.677a	0.682a	24.92abcde	25.52bcde	25.220bcde	37.45abcd	37.41 abcd	37.43ab
T_{10} $A_1B_1C_1$	0.679a	0.660a	0.670a	26.09abcde	27.31abc	26.700abc	40.36ab	40.00abc	40.18a
T_{11} $A_1B_2C_0$	0.663a	0.674a	0.669a	26.25abcde	25.86abcde	26.055abcde	37.82abcd	37.78 abcd	37.80ab
T_{12} $A_1B_2C_1$	0.667a	0.660a	0.664a	27.31a	27.85ab	27.580ab	41.09a	39.26 abc	40.18a
T_{13} $A_2B_0C_0$	0.663a	0.677a	0.670a	24.57bcde	24.67cde	24.620cde	34.55abcd	33.70 abcd	34.13abc
T_{14} $A_2B_0C_1$	0.691a	0.679a	0.685a	24.12cde	25.42bcde	24.770cde	37.09abcd	35.93 abcd	36.51abc
T_{15} $A_2B_1C_0$	0.681a	0.670a	0.676a	25.12abcde	26.15abcde	25.635abcde	36.00abcd	38.15 abcd	37.08ab
T_{16} $A_2B_1C_1$	0.691a	0.656a	0.674a	26.59abc	28.25ab	27.420ab	38.55abc	41.11 ab	39.83a
T_{17} $A_2B_2C_0$	0.688a	0.667a	0.678a	25.77abcde	26.73abcd	26.250abcd	36.36abcd	38.52 abcd	37.44sb
T_{18} $A_2B_2C_1$	0.684a	0.646a	0.665a	26.88ab	28.91a	27.895a	39.27abc	41.85 a	40.56a
SEm(±)	**0.014**	**0.021**	**0.012**	**0.95**	**1.09**	**0.88**	**2.94**	**2.99**	**2.28**
LSD (0.05)	**NS**	**NS**	**NS**	**2.73**	**3.12**	**2.54**	**8.46**	**8.62**	**6.54**

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

Table 8: Nutrient content on D-leaf at 10 MAP

Treatments		Nitrogen (%)			Phosphorus(%)			Potash(%)		
		2015	2016	Mean	2015	2016	Mean	2015	2016	Mean
A_0		1.565c	1.618c	1.594c	0.376b	0.371b	0.373b	2.218c	2.537c	2.379c
A_1		1.672b	1.733b	1.705b	0.390b	0.381b	0.386b	2.901a	3.131b	3.019b
A_2		1.828a	1.861a	1.848a	0.424a	0.409a	0.417a	3.153a	3.492a	3.321a
SEm(±)		**0.017**	**0.016**	**0.015**	**0.011**	**0.007**	**0.009**	**0.039**	**0.032**	**0.030**
LSD (0.05)		**0.049**	**0.047**	**0.044**	**0.031**	**0.020**	**0.025**	**0.111**	**0.091**	**0.085**
B_0		1.589c	1.637c	1.616c	0.378a	0.372b	0.375b	2.404c	2.707c	2.556c
B_1		1.701b	1.751b	1.729b	0.404a	0.389ab	0.397ab	2.792b	3.068b	2.931b
B_2		1.775a	1.823a	1.802a	0.408a	0.400a	0.404a	3.081a	3.385a	3.233a
SEm(±)		**0.017**	**0.016**	**0.015**	**0.011**	**0.007**	**0.009**	**0.039**	**0.032**	**0.030**
LSD (0.05)		**0.049**	**0.047**	**0.044**	**NS**	**0.020**	**0.025**	**0.111**	**0.091**	**0.085**
C_0		1.659b	1.713b	1.689b	0.399a	0.387a	0.393a	2.671b	2.966b	2.818b
C_1		1.718a	1.761a	1.743a	0.394a	0.387a	0.391a	2.847a	3.141a	2.994a
SEm(±)		**0.014**	**0.013**	**0.013**	**0.008**	**0.006**	**0.007**	**0.027**	**0.026**	**0.024**
LSD (0.05)		**0.040**	**0.039**	**0.036**	**NS**	**NS**	**NS**	**0.091**	**0.074**	**0.070**
T_1	$A_0B_0C_0$	1.190i	1.247j	1.219h	0.338c	0.336e	0.337d	1.159i	1.441i	1.300l
T_2	$A_0B_0C_1$	1.473h	1.493i	1.483g	0.355bc	0.341de	0.348cd	1.462h	1.747h	1.604k
T_3	$A_0B_1C_0$	1.523h	1.587hi	1.555g	0.367bc	0.362cde	0.365bcd	1.900g	2.127g	2.013j
T_4	$A_0B_1C_1$	1.660efg	1.713fg	1.687ef	0.378bc	0.373bcde	0.375bcd	2.717ef	3.061ef	2.889hi
T_5	$A_0B_2C_0$	1.767cdef	1.860abcd	1.813bcd	0.411bc	0.406abc	0.409bc	3.005bcd	3.417abc	3.211bcdef
T_6	$A_0B_2C_1$	1.777cdef	1.807cdef	1.792ede	0.412b	0.405abc	0.408b	3.075abcd	3.427ab	3.251abcde
T_7	$A_1B_0C_0$	1.560gh	1.620gh	1.590fg	0.381bc	0.377bcde	0.379bcd	2.614f	2.905f	2.760i
T_8	$A_1B_0C_1$	1.693def	1.767def	1.730de	0.395bc	0.388bcd	0.392bcd	3.024bcd	3.149de	3.087efgh
T_9	$A_1B_1C_0$	1.690def	1.743ef	1.717de	0.393bc	0.383bcde	0.388bcd	2.900cde	3.128def	3.014fgh
T_{10}	$A_1B_1C_1$	1.657fg	1.727efg	1.692ef	0.382bc	0.372bcde	0.377bcd	2.870def	3.096def	2.983gh
T_{11}	$A_1B_2C_0$	1.713def	1.777def	1.745de	0.395bc	0.388bcd	0.391bcd	3.017bcd	3.200cde	3.108defg
T_{12}	$A_1B_2C_1$	1.717def	1.763def	1.740de	0.397bc	0.382bcde	0.390bcd	3.009bcd	3.308bcd	3.158cdefg
T_{13}	$A_2B_0C_0$	1.710def	1.770def	1.740de	0.394bc	0.380bcde	0.387bcd	2.967bcde	3.393abc	3.180cdefg
T_{14}	$A_2B_0C_1$	1.910ab	1.923ab	1.917a	0.409bc	0.413ab	0.411b	3.205ab	3.605a	3.405ab
T_{15}	$A_2B_1C_0$	1.973a	1.970a	1.972a	0.503a	0.446a	0.475a	3.316a	3.607a	3.461a
T_{16}	$A_2B_1C_1$	1.700def	1.767def	1.734de	0.406bc	0.399abc	0.402bc	3.050abcd	3.395abc	3.222abcde
T_{17}	$A_2B_2C_0$	1.800bcd	1.840bcde	1.820bcd	0.414b	0.407abc	0.411b	3.162abc	3.472ab	3.317abcd
T_{18}	$A_2B_2C_1$	1.877abc	1.893abc	1.885abc	0.416b	0.409ab	0.412b	3.217ab	3.480ab	3.349abc
SEm(±)		**0.041**	**0.040**	**0.038**	**0.027**	**0.017**	**0.022**	**0.094**	**0.094**	**0.073**
LSD (0.05)		**0.119**	**0.116**	**0.108**	**0.076**	**0.048**	**0.062**	**0.272**	**0.223**	**0.209**

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

Table 9 : Nutrient content on D-leaf (during fruiting)

Treatments		Nitrogen (%)			Phosphorus(%)			Potash(%)		
		2015	2016	Mean	2015	2016	Mean	2015	2016	Mean
A_0		1.486c	1.533c	1.509c	0.373b	0.369b	0.370b	2.259c	2.387c	2.324c
A_1		1.593b	1.647b	1.620b	0.387b	0.381b	0.383b	2.675b	2.987b	2.832b
A_2		1.735a	1.774a	1.755a	0.419a	0.401a	0.409a	3.036a	3.290a	3.163a
SEm(±)		**0.022**	**0.017**	**0.019**	**0.008**	**0.005**	**0.006**	**0.035**	**0.029**	**0.024**
LSD (0.05)		**0.064**	**0.048**	**0.053**	**0.023**	**0.013**	**0.018**	**0.101**	**0.085**	**0.069**
B_0		1.531c	1.571c	1.551c	0.376b	0.369c	0.372b	2.207c	2.537c	2.373c
B_1		1.597b	1.652b	1.626b	0.399a	0.383b	0.391a	2.806b	2.908b	2.856b
B_2		1.686a	1.731a	1.707a	0.404a	0.397a	0.399a	2.957a	3.219a	3.088a
SEm(±)		**0.022**	**0.017**	**0.019**	**0.008**	**0.005**	**0.006**	**0.035**	**0.029**	**0.024**
LSD (0.05)		**0.064**	**0.048**	**0.053**	**0.023**	**0.013**	**0.018**	**0.101**	**0.085**	**0.069**
C_0		1.590a	1.631b	1.611a	0.395a	0.383a	0.389a	2.569b	2.804b	2.687b
C_1		1.619a	1.671a	1.646a	0.391a	0.384a	0.386a	2.744a	2.972a	2.859a
SEm(±)		**0.018**	**0.014**	**0.015**	**0.006**	**0.004**	**0.005**	**0.029**	**0.024**	**0.020**
LSD (0.05)		**NS**	**0.039**	**0.043**	**NS**	**NS**	**NS**	**0.083**	**0.069**	**0.057**
T_1	$A_0B_0C_0$	1.139g	1.202h	1.170j	0.333d	0.333e	0.333d	1.166h	1.237h	1.203k
T_2	$A_0B_0C_1$	1.400f	1.440g	1.420l	0.354cd	0.339e	0.346cd	1.407h	1.563g	1.487j
T_3	$A_0B_1C_0$	1.484ef	1.493fg	1.489i	0.372bcd	0.361de	0.367bcd	2.532f	2.000f	2.267i
T_4	$A_0B_1C_1$	1.512ef	1.600ef	1.556gh	0.377bcd	0.379bcd	0.378bcd	2.571ef	2.953de	2.763h
T_5	$A_0B_2C_0$	1.680bcd	1.727bcd	1.703cdef	0.401bc	0.399ab	0.400b	2.919bcd	3.323ab	3.123bcde
T_6	$A_0B_2C_1$	1.699bcd	1.733bcd	1.716bcde	0.403bc	0.401ab	0.402b	2.961abcd	3.247abc	3.103cdef
T_7	$A_1B_0C_0$	1.605de	1.630de	1.618defgh	0.374bcd	0.377bcd	0.376bcd	1.735g	2.753e	2.243i
T_8	$A_1B_0C_1$	1.605de	1.620de	1.613defgh	0.392bc	0.384bcd	0.388bc	2.969abcd	3.087cd	3.027defg
T_9	$A_1B_1C_0$	1.577de	1.637de	1.607efgh	0.394bc	0.387abcd	0.390b	2.882cd	2.970d	2.927gh
T_{10}	$A_1B_1C_1$	1.521ef	1.630de	1.576fgh	0.373bcd	0.367cde	0.370bcd	2.773def	3.000d	2.887gh
T_{11}	$A_1B_2C_0$	1.605de	1.673bcde	1.639defg	0.391bc	0.387abcd	0.389b	2.869cd	3.043cd	2.957efg
T_{12}	$A_1B_2C_1$	1.643cde	1.690bcde	1.666cdefg	0.397bc	0.384abcd	0.391b	2.828cd	3.073cd	2.950fg
T_{13}	$A_2B_0C_0$	1.624cde	1.660cde	1.642cdefg	0.392bc	0.380bcd	0.386b	2.789cde	3.210abc	3.000defg
T_{14}	$A_2B_0C_1$	1.811ab	1.873a	1.842ab	0.406bc	0.403ab	0.404ab	3.177a	3.373a	3.277ab
T_{15}	$A_2B_1C_0$	1.876a	1.883a	1.880a	0.479a	0.415a	0.447a	3.202a	3.400a	3.300a
T_{16}	$A_2B_1C_1$	1.615cde	1.670bcde	1.642cdefg	0.403bc	0.393abc	0.398b	2.873cd	3.130bcd	3.003defg
T_{17}	$A_2B_2C_0$	1.717abcd	1.773abc	1.745bcd	0.412b	0.401ab	0.407ab	3.031abc	3.303ab	3.163abcd
T_{18}	$A_2B_2C_1$	1.764abc	1.787ab	1.775abc	0.411b	0.402ab	0.407ab	3.145ab	3.323ab	3.233abc
SEm(±)		**0.055**	**0.041**	**0.045**	**0.020**	**0.011**	**0.015**	**0.086**	**0.072**	**0.059**
LSD (0.05)		**0.157**	**0.118**	**0.130**	**0.056**	**0.033**	**0.044**	**0.248**	**0.208**	**0.170**

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

par with T_{18}. Pulp weight was highest in T_{12}, whereas, T_{18} recorded highest pulp percentage, crown percentage, lower peel percentage. Most of the bio-chemical properties were recorded highest with T_{18} which was statistically *at par* with T_{12}. It is concluded from the experiment, that the T_{12} is the best nutrient combination of pineapple cv. Mauritius for flowering, fruiting characteristics (Chemical 75% RDF + Vermicompost + Bio-fertilizer).

REFERENCES

Andre, G. M., and Jose, A, V. 2011.Nitrogen, P and K fertilization and the development, yield and fruit quality of pineapple 'Gold' (MD-2). *R. Bras. Ci. Solo*, **35**:1367-76

Annonymous. 2016. Accessed from on http:// prsvkm.kau.in/ sites/default/files/documents/ pineapple on 12.6.2016

Asoegwu, S. N. 1987. Effect of irrigation and nitrogen on the growth and yield of pineapple (*Ananas comosus*) cv. Smooth Cayenne. *Fruits*, **42**:505-09

Bhowmick, N., Suresh, C. P., Paul, P. K., and Pal, R. K. 2011. Effect of ethrel on fruiting characteristics of pineapple under Cooch Behar district of West Bengal. *J Crop Weed*, **7**(2):210

Bhugaloo, R. A. 1998. Effect of different levels of nitrogen on yield and quality of pineapple variety Queen Victoris. *Food Agric. Res.Council*, Reduit, Mauritius.

Chhuria, S., Biswal, H., Thriveni., V. and Mandal., P. 2016. Impact of integrated nutrient management on soil fertility status of tissue culture banana cv. Grand Naine. *Int J Agric Sci. Res* , **6**(3):283-86

Danatas, A. L., Silva, S. M., Danatas, R L, Pereira, W, E,, Renato, Lima, R P, Mendonca, R. M. N., and Santos, D. 2015. Influence of combined sources of nitrogen fertilization on quality of cv. Victória pineapple. *African J Agric Res* , **10**(40): 3814-24

De Geus, J. G. 1973. *Fertilizer Guide for the Tropics and Sub-tropics*. Center d' Etude de I' Azote, Zurich, pp.631

Hartinee, A., and Zabedah, M. 2011. Effects of N and K on plant biomass, yield and quality of 'Maspine' pineapple fruit grown on Rasau Soil. *Acta Hort.*, **902**:269-74

Hazarika, B. N. and Ansari, S. 2010. Effect of integrated nutrient management on growth and yield of banana cv. Jahaji. *Indian J Hort.*, **67**(2):270-73.

Jackson, M. L. 1973. *Soil Chemical Analysis*, Prentice Hall of India, Pvt Ltd., New Delhi.

Jacob, C., and Soman, M. 2006. In: *Pineapples. Working Paper Series*. Institute for Financial Management and Research Centre for Development Finance.

Kumar, V., Singh , V. K. and Rani, T. 2017. Influence of nitrogen, potassium and their interaction on growth and phenology of papaya cv. Pusa Dwarf. *J.Crop Weed*, **13**(1) : 60-63

Maeda, A. S., Buzetti, S., and Boliani, A. C. 2011. Foliar fertilization on pineapple quality and yield. *Presquisa Agropecuaria Tropical* (*Agric. Res. in Trop.*), **41**(2):248-53

Mahadevan, V.C. 1988. *Effect of foliar nutrition of NPK on banana cv. Nendran (AAB). M.Sc. (Hort.) Thesis*, Tamil Nadu Agric. Uni., Coimbatore.

Omotoso, S.O. and Akinrinde, E. A.2013. Effect of nitrogen fertilizer on some growth, yield and fruit quality parameters in pineapple (*Ananas comosus*L. Merr.) plant at Ado-Ekiti South western, Nigeria. *Int. Res. J. Agric. Sci. Soil Sci.*, **3**(1): 11-16

Pafli., G. 1965. Relations between abundant N supply and amino acid concentration on leaves of rice plants. *Pl. Soil*, **23**:275-84.

Parr, J.F. and Papendick, R.I. 1978. Factor affecting decomposition of crop residues by micro organisms. In: *Crop Residue Management System* (Ed. Swchwald, W. R.). ASA, CSSSA, USA. pp.101-129.

Ranganna, S. 1977. *Handbook of Analysis and Quality control for Fruit and Vegetable Products.* Tata McGraw-Hill Publishing Company Limited., New Delhi

Rao, M. H., Subramanian, T. R., Murthy, H.K. S., Singh, H. P., Dass, H. C. and Ganapathy, K. M. 1977. Leaf nitrogen status as influenced by varying levels of nitrogen application and its relationship with yield in 'Kew' pineapple. *Scientia Hort.*, **7**: 137-42

Reddy, B. M. C, and Prakash, G. S. 1982. Standardization of optimum depth of trench of planting Kew Pineapple. In: *Annual Report. Indian Inst. of Hort. Res.*, p. 19.

Singh, H. P., Ganapathy, K. M., and Dass, H. C. 1978. Evaluation of physiological constant for estimation of leaf area in pineapple (*Ananas comosus* (L.) Merr.). *Sci. Cult.*, **44**:409-10

Spironello, A., Quaggio, J. A., Teixeria, L. A. J., Furlani, P. R., and Sigrist, J. M. M. 2004. Pineapple yield and fruit quality effected by NPK fertilization in a tropical soil. *Revista Brasileira de Fruticultura*, **26**(1):155-59

Teixeria, L. A. J., Quaggio, J. A., and Cantarella, H.Mellis, S. V. 2011. Potassium fertilization for pineapple: Effects on plant growth and fruit yield. *Revista Brasileira de Fruticultura*, **33**(2):618-26