Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(5): 1339-1342
Received: 19-07-2018
Accepted: 20-08-2018

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Influence of integrated nutrient management on yield and bio-chemical parameters of pineapple (cv. Kew)

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Abstract
The present investigation entitled "Effect of Integrated Nutrient Management on Yield and bio-chemical parameters of Pineapple (cv. Kew)" was conducted with the objective to understand the better utilization of nutrients for yield and quality at Horticulture farm under Department of Horticulture and Post Harvest Technology, Institute of Agriculture, Visva Bharati, Sriniketan during 2014-2016 which consisted of nine treatment combinations viz., T1= Control; T2= 20t/ha FYM + 100% of recommended dose of fertiliezer (RDF) of NPK; T3= 30t/ha FYM + 75% of RDF of NPK; T4= 5 t/ha Vermicompost + 100% of RDF of NPK; T5= 7.5 t/ha Vermicompost + 75% of RDF of NPK; T6= 20t/ha FYM + 100% of RDF of NPK + biofertilizer (Azotobactor + phosphate solubalizing bacteria or PSB); T7= 30t/ha FYM + 75% of RDF of NPK + biofertilizer; T8= 5 t/ha Vermicompost + 100% of RDF of NPK + biofertilizer; T9= 7.5 t/ha Vermicompost + 75%NPK + biofertilizer. On the basis of result findings it may be concluded that the use of vermicompost along with the combination of NPK and biofertilizer has found to be the best and beneficial for obtaining higher yield in pineapple (cv. Kew). The studies emphasize the application of 30t/ha FYM + 75% RDF of NPK + biofertilizer as best treatment in terms of maintaining fruit bio-chemical parameters of pineapple.

Keywords: Pineapple, FYM, NPK, biofertilizer, yield, quality

Introduction
Pineapple [*Ananas comosus* (L.) Merr.] Is an important tropical fruit of world under Bromeliaceae family. Due to presence of crown at top pineapple is also called 'king of fruits' in some countries. It is one of the choicest fruit all over the world because of its pleasant taste and flavor. Pineapple being a heavy feeder it requires large quantities of inorganic and organic nutrient inputs but requires less fertilizer in the first 5 months after planting. Late application of N had a positive effect on fruit yield but decreased TSS. Phosphorus and Calcium are usually banded in the plant line during bed preparation while potassium is usually applied to the soil before planting and later by side dressing. Deficiency in K can be balanced out by the use of wood ash (combined with compost). Most farmers for a long time have been using inorganic fertilizers to grow pineapple, but in spite of the effect on size, yield and quality of pineapple, the requirement by international regulations to practice environmentally sound, sustainable agriculture is forcing many farmers to shift from conventional farming to organic farming. Pineapple can grow well in low soil fertility areas, but the best production is obtained with high fertile soils. High soil organic matter is also desirable. Pineapple has high requirement for nitrogen (N), potassium (K) and iron (Fe) and relatively low requirement for phosphorus (P) and calcium (Ca) and high soil organic matter and potassium status is also desirable. Nitrogen is required second after potassium and is important in determining the growth and productivity of the plant. The absence of Nitrogen in either organic or inorganic form, always results in compromised development and/or productivity of the plant, with the appearance of typical symptoms of nitrogen deficiency. Increase in nitrogen rates increased yield, fruit size and juice content and decreased Total soluble solids (TSS), Titratable Acidity (TA) and vitamin C. Similarly, an increase in potassium rates increased pineapple yield, fruit size, TSS, TA and vitamin C content.

Material and methods
The experiment was conducted at Horticulture farm under Department of Horticulture and Post Harvest Technology, Institute of Agriculture, Visva Bharati, Sriniketan and departmental laboratory. Uniform suckers of Kew pineapple variety were planted in double hedge row system with the spacing of 25cm x 35cm x 90cm and bed size was 3m x 0.7m = 2.1m^2. The whole experiment was conducted using Randomized Block Design with three replications. The experiment was consisting of 9 treatment comprising:

T_1	Control
T_2	20t/ha FYM + 100% of Recommended Dose of Fertiliezer (RDF) of NPK
T_3	30t/ha FYM + 75% of RDF of NPK
T_4	5 t/ha Vermicompost + 100% of RDF of NPK
T_5	7.5 t/ha Vermicompost + 75% of RDF of NPK
T_6	20t/ha FYM + 100% of RDF of NPK + biofertilizer (Azotobactor + Phosphate Solubalizing Bacteria or PSB)
T_7	30t/ha FYM + 75% of RDF of NPK + biofertilizer
T_8	5 t/ha Vermicompost + 100% of RDF of NPK + biofertilizer
T_9	7.5 t/ha Vermicompost + 75% RDF of NPK + biofertilizer

N and K were given at 4 split doses. Half dose of N and K along with entire P was given as basal at the time of planting and rest amount of N and K was given three times at after every two months of interval. 10 g each of Azotobactor and Phosphate Solubalizing Bacteria with 500g FYM applied half during planting and rest half 8 months after planting.
Observation was recorded on yield and quality attributes on fruit length without crown (cm), crown length (cm), fruit weight without crown (g), crown weight (g), estimated yield without crown (t/ha), fruit juice content (g), TSS(° brix), acidity (%), TSS: acidity ratio, reducing sugar (%) and total sugar (%). All yield parameters and quality parameters of fruits were analyzed as per standards methods given in (A.O.A.C.).

Result and discussion
Data presented in [table 1] showed significant difference among the various treatments. It is clear from the result that treatment T_9 (7.5 t/ha Vermicompost + 75% RDF of NPK + biofertilizer) recorded significantly maximum in fruit length without crown (21.92cm) which was followed by T_8 (20.21 cm). Crown length was found best in T_6 (14.85 cm) which was statistically at par with T_9 (14.91cm) and maximum was recorded in T_2 (15.73cm) and poor and unhealthy length was observed in control. It is evident from two year pooled mean data [table 1] that maximum fruit weight without crown (1379.0g) was recorded with treatment 30t/ha FYM + 75% RDF of NPK + biofertilizer (T_7) and minimum was recorded with control. 20t/ha FYM + 100% of RDF of NPK (T_2) was found to be responsible for increasing maximum crown weight (373.7g). Result depicted from the [table 1] showed that the estimated yield without crown was found highest with the application of T_9 (67.26 t/ha) and lowest with control (28.95 t/ha). The significance response of FYM/ vermicompost, NPK and biofertilizer had positively and significantly influenced the yield attributes. Firstly this may be attributed due to the improved fertilizer use efficiency with the application of organic sources of nutrients and bio-fertilizers and also helps in increasing fruit volume, diameter and weight ultimately the fruit yield per tree was obtain maximum. Deshmukh *et al.* (2014) [1], Dheware and Waghmare (2009) [2]. Secondly, it is well known that efficiency of bioagent can be well exploited with the use of organic manure with inorganic fertilizers (Suther, 2009) [8]. which might have improved the yield parameters by better availability and uptake of nutrient by plant roots and enhancing the source – sink relationship by increasing the movement of carbohydrates from the leaves to the fruits. Similar findings have been reported by Srivastava (2008) [6]. and Sha and Karuppaiah (2010) [3]. Significant difference was observed between the treatments with respect to quality parameters [Table 2]. Among all the treatments T_7 (30t/ha FYM + 75% of RDF of NPK + biofertilizer) has showed best result in obtaining maximum TSS (13.93 °Brix) and TSS:acidity ratio (20.18) and minimum was recorded in T_1. All the different treatment was recorded non-significant in terms of acidity. It is clear from the pooled mean two year data that total sugar was observed maximum with T_7(12.56%) and reducing sugar has found to be the highest with T_9 (5.77%) which was statistically at par with T_7(5.75%) and lowest with T_1(3.15%). The increase in TSS, Total sugar, reducing sugar and TSS:acidity content of fruits could be attributed to the conversion of reserved starch and other insoluble carbohydrates into soluble sugars. Improvement in fruit quality might be due to increased continuous supply of nutrients, higher concentration of soil enzymes, soil microorganism, rapid mineralization and transformation of plant nutrient in soil and also growth promoting substances produced by microorganism. The results of present study are in accordance with the finding of Shivakumar, (2010) [4], Yadav *et al*. (2011) [9]. It is very known fact that integrated nutrient management stimulated the function of number of enzymes in physiological process. The acids have either been converted into sugar and their derivatives by the reaction evolving reversal of glycolytic pathway or might be used into transpiration or both. The above findings are in agreement with the work of Suresh and Hasan (2001) [7].

Conclusion
On the basis of above findings it may be concluded that use of vermicompost along with the combination of NPK and biofertilizer found to be the best and beneficial for obtaining higher yield in pineapple (cv. Kew). The studies emphasize the application of 30t/ha FYM + 75% RDF of NPK + biofertilizer as best treatment in terms of maintaining fruit bio-chemical parameters of pineapple. Over all T9 and T7 which is a combination of organic manure, inorganic fertilizer and biofertilizer was found to be best with best fruit length without crown, fruit weight without crown, total estimated yield of medium high quality fruits.

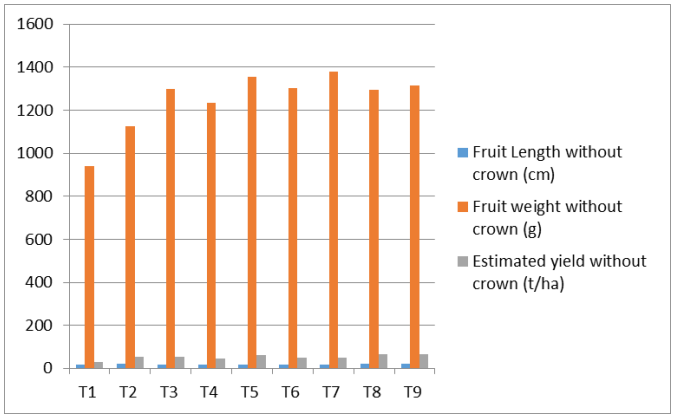

Fig 1: Effect of INM on fruit length without crown (cm), fruit yield without crown (t/ha)

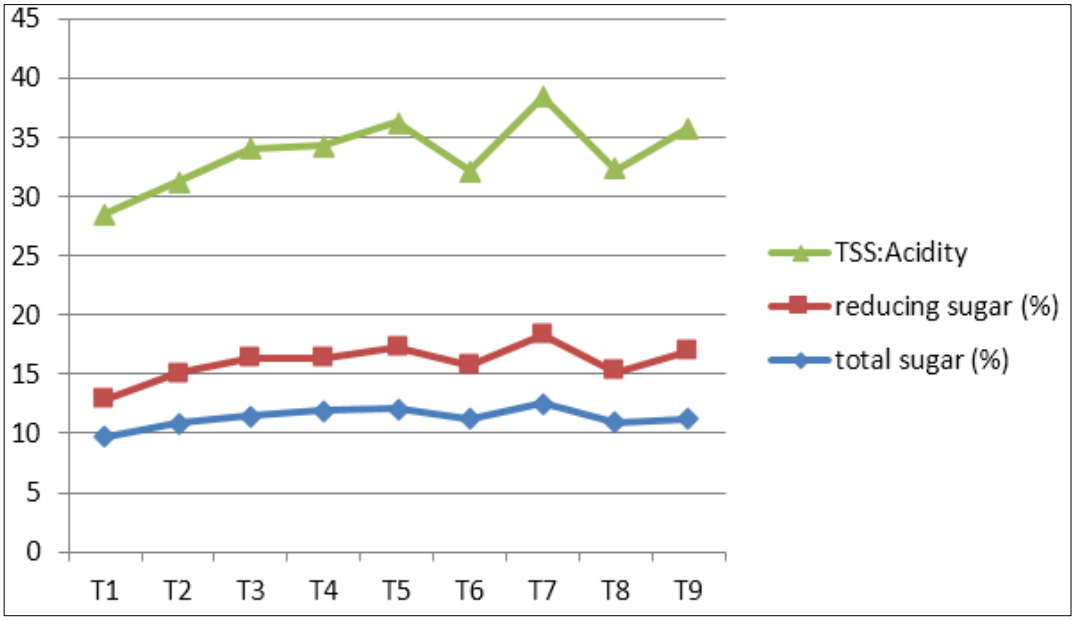

Fig 2: Effect of INM on TSS: acidity ratio, total sugar and reducing sugar

Table.no. 1. Effect of INM on fruit length without crown (cm), crown length (cm), fruit weight without crown (g), crown weight (g), estimated yield without crown (t/ha)and fruit juice content (g)

Treatment	Fruit Length without crown (cm)			Crown length (cm)			Fruit weight without crown (g)			Crown weight (g)			Estimated yield without crown (t/ha)		Fruit juice content (g)			
	1st yr	2ndyr	mean	1st yr	2ndyr	mean	1st yr	2nd yr	mean	1st yr	2nd yr	mean	1st yr	2nd yr	mean	1st yr	2nd yr	mean
T1	17.76	15.54	16.60	9.77	9.5	9.135	1022.7	853.1	0937.9	219.4	242.1	230.8	32.81	25.09	28.95	0846.2	0797.3	0821.8
T2	21.88	18.24	20.15	15.56	15.91	15.73	1236.2	1015.4	1125.8	349.2	398.2	373.7	62.62	48.25	55.43	0995.3	0825.8	0910.6
T3	19.95	18.13	19.01	16.71	13.21	14.96	1407.3	1192.3	1299.8	224.3	218.7	221.5	62.03	46.65	54.34	1027.1	0945.2	0986.2
T4	18.18	17.97	17.95	15.93	14.93	15.43	1325.4	1143.2	1234.3	258.8	210.6	234.7	51.68	39.63	45.65	0925.4	0871.6	0898.5
T5	20.87	17.82	19.12	14.76	15.44	15.05	1452.1	1258.6	1355.4	285.6	235.5	260.6	66.51	55.44	60.97	1047.0	0976.2	1011.6
T6	19.65	18.74	18.74	14.67	15.65	14.85	1381.3	1221.4	1301.5	311.2	261.2	286.2	56.01	45.31	50.66	1018.2	0963.4	0990.8
T7	18.77	17.89	18.13	16.57	13.88	15.06	1444.7	1313.4	1379.0	274.7	222.8	248.3	55.65	45.63	50.64	1059.3	0975.7	1017.5
T8	20.65	19.88	20.21	17.13	13.31	15.28	1379.6	1207.5	1293.5	291.9	220.7	256.3	71.11	58.07	64.59	0975.8	0883.9	0929.9
T9	22.88	20.96	21.92	15.16	14.28	14.91	1343.2	1256.7	1314.9	150.5	190.8	170.7	71.12	63.41	67.26	0898.1	0811.5	0854.8
CD (0.05%)	1.57	1.68	1.72	0.76	0.77	0.80	21.2	19.2	18.3	12.2	11.3	10.5	3.02	3.11	3.24	16.7	15.6	18.4
SEm±	0.36	0.41	0.45	0.21	0.21	0.25	7.06	6.41	6.09	4.06	3.78	3.51	1.00	1.02	1.06	5.5	5.2	6.5

T1: Control; T2: 20t/ha FYM + 100% of RDF of NPK T3: 30t/ha FYM + 75% of RDF of NPK; T4: 5t/ha Vermicompost + 100% of RDF of NPK; T5: 7.5 t/ha Vermicompost +75% of RDF of NPK; T6: 20t/ha FYM + 100% of RDF of NPK + Biofertiliser; T7: 30t/ha FYM + 75% RDF of NPK + Biofertiliser; T8: 5T/ha Vermicompost + 100% of RDF of NPK + biofertilizer; T9: 7.5 t/ha Vermicompost + 75% RDF of NPK + Biofertilize

Table.no. 2. Effect of INM on TSS (° brix), acidity (%), TSS:acidity ratio, total sugar (%) and reducing sugar (%)

Treatment	TSS (°Brix)			Acidity (%)			TSS: Acidity		Total sugar (%)			Reducing sugar (%)			
	1st yr	2nd yr	mean	1st yr	2nd yr	mean	1st yr	2nd yr	mean	1st yr	2nd yr	mean	1st yr	2nd yr	mean
T1	12.13	11.46	11.75	0.73	0.78	0.75	16.61	14.69	15.66	10.63	8.96	9.75	3.53	2.85	3.15
T2	12.84	11.34	11.94	0.72	0.76	0.74	17.83	14.92	16.13	11.81	9.91	10.85	4.47	4.88	4.26
T3	13.26	11.14	12.15	0.69	0.77	0.69	19.21	14.46	17.60	12.57	10.37	11.46	5.15	4.75	4.94
T4	13.54	11.36	12.46	0.68	0.74	0.69	19.91	15.35	18.05	13.65	10.86	11.93	4.76	4.13	4.42
T5	13.85	11.75	12.75	0.65	0.76	0.67	21.30	15.46	19.02	12.83	11.56	12.15	5.46	4.96	5.15
T6	13.66	11.73	12.65	0.75	0.78	0.76	18.21	15.03	16.44	12.27	10.16	11.15	4.71	4.36	4.58
T7	14.84	13.67	13.93	0.68	0.77	0.69	21.82	17.75	20.18	12.95	11.13	12.56	5.92	5.65	5.75
T8	13.22	11.54	12.12	0.73	0.72	0.71	18.10	15.90	17.07	11.84	10.91	10.92	4.57	3.92	4.26
T9	14.25	12.82	13.56	0.72	0.75	0.72	19.79	17.09	18.83	12.23	10.46	11.18	5.94	5.52	5.77
CD (0.05%)	0.46	0.47	0.52	NS	NS	NS	0.52	0.41	0.50	0.35	0.30	0.32	0.16	0.18	0.17
SEm±	0.16	0.15	0.16	NS	NS	NS	0.17	0.13	0.17	0.11	0.10	0.10	0.05	0.06	0.06

T1: Control; T2: 20t/ha FYM + 100% of RDF of NPK T3: 30t/ha FYM + 75% of RDF of NPK; T4: 5t/ha Vermicompost + 100% of RDF of NPK; T5: 7.5 t/ha Vermicompost +75% of RDF of NPK; T6: 20t/ha FYM + 100% of RDF of NPK + Biofertiliser; T7: 30t/ha FYM + 75% RDF of NPK + Biofertiliser; T8: 5T/ha Vermicompost + 100% of RDF of NPK + biofertilizer; T9: 7.5 t/ha Vermicompost + 75% RDF of NPK + Biofertilizer

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