Research Article

ORGANIC NUTRIENT MANAGEMENT SYSTEM FOR CULTIVATION OF PINEAPPLE (*ANANAS COMOSUS* L.) CV KEW

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ABSTRACT

An investigation was carried out to standardize the organic production protocol for cultivation of pineapple cv. Kew. In this investigation pineapple suckers cv. Kew were planted at 64000 plants/ha and the different sources of organic manures (vermicompost at 43.2 kg/plot, farmyard manure at 60.48 kg/plot/year, poultry manure at 21.6 kg/plot/year, neem cake at 20.44 kg/plot/year) and biofertilizers (*azotobacter*, *azospirillum*, phosphorous solubilizers and potash mobilizers each at 100 g/plot/year) were compared alone and in combination. The rates of organic manures were decided based on the 50 per cent of the potassium requirement of the crop for the region. Biofertilizers in combination with different organic source of manures like farmyard manure, neem cake and vermicompost proved effective in increasing yield and improving fruit quality of pineapple. Considering the yield and quality of fruit, it may be suggested that for cultivation of pineapple cv. Kew organically, application of poultry manure at 21.6 kg/plot/year (857.14 kg/ha) + *azospirillum* + phosphorous solubilizers + potash mobilizers each at 100g/plot/year (T_{13}) in two splits (January and July) with a benefit: cost of 2.67 can be practiced under the alluvial plains of West Bengal conditions.

INTRODUCTION

Pineapple (*Ananas comosus*) is an important tropical fruit after bananas, contributing to over 20% of the world production of tropical fruits. Nearly 70% of the pineapple is consumed as fresh fruit in producing countries. Pineapple contains 81.2–86.2% moisture, 13–19% total soluble solids, of which sucrose, glucose and fructose are the main components and fibre makes up for 2–3%. It also contains a protease known as Bromelin having proteolytic activity. Fresh pineapple contains minerals such as Calcium, Chlorine, Potassium, Phosphorus and Sodium. Pineapple juice contains ascorbic acid which is an effective antioxidant. Thus pineapple can be used as supplementary nutritional fruit for good personal health. In India, it is cultivated in an area of 89'000 ha and total production is 1,415.00 thousand tons and contributes 7% share of the world production (Anonymous, 2018). But the present production of pineapple in the region as well as the country falls far short of the actual requirement and can hardly meet our demand for healthy and quality fruits. Extensive and continuous use of inorganic fertilizers and pesticides has lead to several detrimental effects on soil and environments. The soil, water and air got polluted by the use of agrochemicals. The residue of these chemicals entered into the food chain causing health problems to human as well as animals. The demand for organic food from the consumers showed a double digit growth in the last few years particularly from the developed countries like US, Japan, Canada, New Zealand and EU. To make organic farming successful, it is essential that eco-friendly technologies which can maintain or increase the productivity have to be developed. Organic farming system rely on large scale application of animal waste or farm yard manure, compost, crop rotation, crop residue, green manure, edible oil cakes, vermicompost and biofertilizers.

Horticultural crops play an important role in organic agriculture. Regarding consumer preference, fresh vegetables and fruit are among the most popular organic products. There is a great demand for organic pineapple. A lucrative niche market has emerged for organic pineapple at national and international levels. There even exists a sustained demand for processed organic pineapple (Murray and Manicom, 2009). The present study was conducted to develop an organic production protocol for cultivation of

pineapple cv. Kew in the alluvial plains of West Bengal, India.

MATERIALS AND METHODS

The experiment was carried out at the Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, West Bengal (22.43 ^{0}N latitude and 88.34 ^{0}E longitude), India during the years 2010–2012 on pineapple cv. Kew. The total number of experimental plants (16 plants/bed) was 816 planted at a spacing of 90 cm x 45 cm x 30 cm. The experiment was laid out in Randomized Block Design with seventeen treatments and three replications. In this experiment, various organic sources {farm yard manure (60.48 kg/bed/year), poultry manure (21.6 kg/bed/year), vermicompost (43.20 kg/bed/year) and neem cake (20.44 kg/bed/year)} along with various biofertilizers combinations (*azotobacter*, *azospirillum*, phosphorous solubilizers and potash mobilizers each at 100 g/tree/year) were tested. The different doses of organic manure were calculated based on the fifty percent of potash requirement of the recommended dose (600 g N: 400 g P_2O_5: 600 g K_2O) of pineapple for the region. The calculated dose along with biofertilizer was applied in two splits in January and August. The treatments employed were: T_1 = Vermicompost (VC) at 43.20 kg/bed/year, T_2 = Farmyard manure (FYM) at 60.48 kg/bed/year, T_3 = Poultry manure (PM) at 21.6 kg/bed/year, T_4 = Neem cake (NC) at 20.44 kg/bed/year, T_5 = Azotobacter (AZ) at 100 g/bed/year, T_6 = Azospirillum (AP) at 100 g/bed/year, T_7 = VC + AZ + Phosphorous solubilizers (PS) at 100 g/bed/year + Potash mobilizers (KM) at 100 g/bed /year, T_8 = FYM + AZ + PS + KM, T_9 = PM + AZ + PS +KM, T_{10} = NC + AZ + PS +KM, T_{11} =VC + AP + PS + KM, T_{12} = FYM + AP + PS + KM, T_{13} = PM + AP + PS + KM, T_{14} = NC + AP + PS + KM, T_{15} = AZ + PS + KM, T_{16} = AP + PS + KM and T_{17} = Control (without any nutrient treatment).

Table 1. Maturity and plant characters due to different organic sources and biofertilizer treatments on pineapple cv. Kew (pooled data for 2 years)

Treatment	Plant height (cm)	Number of leaves per plant at flowering	Days required from flowering to fruit maturity
T_1 = Vermicompost at 43.2 kg/bed (VC)	95.00	39.39	131± 7
T_2 =Farmyard manure at 60.48 kg/bed/year (FM)	73.67	36.28	125± 7
T_3 = Poultry manure at 21.6 kg/bed (PM)	101.92	42.47	126± 7
T_4 = Neem cake at 20.44 kg/bed (NC)	100.73	38.44	141± 7
T_5 = *Azotobacter* (AZ) at 100g/bed/year	91.89	33.87	138± 7
T_6= *Azospirillum* (AP) at 100g/bed/year	74.21	34.67	128± 7
T_7 = VC+ AZ + Phosphorous solubilizers(PS) + potash mobilizers (KM) each at 100g/bed/year	71.49	36.61	133± 7
T_8= FM + AZ + PS + KM	89.25	36.11	162± 7
T_9 = PM + AZ + PS +KM	97.42	43.83	123± 7
T_{10}= NC + AZ + PS +KM	75.78	36.22	139± 7
T_{11}=VC + AP + PS + KM	72.00	43.56	128± 7
T_{12}=FM + AP + PS + KM	74.60	30.34	123± 7
T_{13}= PM + AP + PS + KM	92.19	**44.38**	128± 7
T_{14}=NC + AP + PS + KM	107.08	35.06	133± 7
T_{15}= AZ + PS + KM	83.78	35.50	139± 7
T_{16}= AP + PS + KM	70.02	34.06	148± 7
T_{17} = Control	75.94	32.39	134± 7
S.Em (±)	5.83	2.85	1.74
C.D (5%)	16.81	8.20	5.02

Organic manures were placed around the rhizosphere and then properly covered with soil. Biofertilizers were applied by mixing with different organic sources used in this experiment. Observations on different fruit quality parameters were made by using randomly selected mature fruits from each replicated bed. The fruit quality parameters [total soluble solids (TSS), reducing sugar, total sugar, acidity and vitamin C content of fruit] were estimated following the standard procedures described by AOAC (1995) and benefit cost ratio was calculated.

Table 2. Quality of fruit due to different organic and biofertilizer treatments (pooled data for 2years)

Treatment	Fruit weight (kg)	TSS (^{0}Brix)	Fruit acidity (%)	Total sugar (%)	Non-reducing sugar (%)	Vitamin C (mg/100g)
T_1 = Vermicompost at 43.2 kg/bed (VC)	1.45	15.60	0.64	16.78	11.53	27.26
T_2 =Farmyard manure at 60.48 kg/bed/year (FM)	1.49	14.17	0.75	13.33	8.88	25.73
T_3 = Poultry manure at 21.6 kg/bed (PM)	1.50	13.67	0.76	11.42	8.49	40.22
T_4 = Neem cake at 20.44 kg/bed (NC)	1.51	15.73	0.70	12.91	9.09	33.58
T_5 = *Azotobacter* (AZ) at 100g/bed/year	1.72	12.87	0.52	12.95	9.45	41.16
T_6= *Azospirillum* (AP) 100g/bed/year	1.52	14.30	0.67	12.37	8.75	27.33
T_7 = VC + AZ + phosphorous solubilizers(PS) + potash mobilizers (KM) each at 100g/bed/year	1.55	16.00	0.74	14.29	10.78	24.37
T_8= FM + AZ + PS + KM	1.64	12.93	0.78	8.22	5.50	37.72
T_9 = PM + AZ + PS +KM	1.64	14.53	0.77	13.65	10.08	32.35
T_{10}= NC + AZ + PS +KM	1.62	11.25	0.62	12.44	8.16	35.70
T_{11}=VC + AP + PS + KM	1.57	14.97	0.64	12.27	8.56	26.48
T_{12}=FM + AP + PS + KM	1.58	13.67	0.68	13.99	8.50	38.28
T_{13}= PM + AP + PS + KM	**1.79**	**16.53**	0.72	**15.15**	**12.00**	**44.10**
T_{14}=NC + AP + PS + KM	1.60	12.63	**0.87**	12.55	8.34	36.75
T_{15}= AZ + PS + KM	1.58	14.20	0.58	10.32	7.26	34.15
T_{16}= AP + PS + KM	1.61	13.67	0.77	10.55	7.62	39.67
T_{17} = Control	1.50	12.00	0.38	11.31	8.40	31.50
S.Em (±)	0.05	0.97	0.08	1.02	0.96	3.66
C.D (@5%)	0.15	2.80	0.22	2.94	2.76	10.55

RESULTS AND DISCUSSION

The data presented in Table 1 revealed that days required from flowering to fruit maturity significantly varied due to different treatments. It appears that treatment T_9 (PM + AZ + PS + KM) caused earliest maturity (123±7 days) of fruit compared with 148±7 days required in T_{16} (AZ + PS + KM). Maximum plant height (107.08 cm) was recorded by application of Neem cake + *azospirillum* + P-solubilizers + K-Mobilizers (T_{14}), while application of Poultry manure + *azospirillum* + P-solubilizers + K-Mobilizers treatment showed the highest number of leaves (44.38/plant). The average fruit weight varies between 1.45 kg and 1.79 kg among the different treatments used in this investigation compared with 1.50 kg in control. Fruits from the plots receiving Poultry manure + *azospirillum* + P-solubilizers + K-mobilizers (T_{13}) at 21.6 kg /bed/year and 100 g each of *azospirillum*, P-solubilizers and K-mobilizers caused the maximum fruit weight of 1.79 kg (Table 2). Biofertilizers in combination with different organic source of manures like farmyard manure, neem cake and vermicompost proved effective in increasing yield and improving fruit quality of pineapple**.** Enhancement in yield and other attributes with poultry manure may be due to availability of more nutrients to the plants (Jaipaul *et al*., 2011). This increased vigour of plant and increased leaf area caused higher synthesis of assimilates due to enhanced rate of photosynthesis. Such effects might be attributed to increased rate of mobility of photosynthetic products from leaves to developing fruits, thereby increasing TSS and total sugars in fruit (Singh and Singh, 2006; Singh *et al*., 2010). However, the core weight of the fruit showed no significant variations due to different treatments.

The total soluble solids (TSS) content of fruit showed marked improvement due to different treatment compared with control. Poultry manure in combination with *azospirillum*, P- solubilizers and K- mobilizers (T_{13}) caused the highest TSS (16.53 ^{0}Brix) content of fruit compared with 12.00^0 Brix in control (Table 2). The fruit acidity varies between 0.38 and 0.87% due to different treatments. Treatment with neem cake + *azospirillum* + P-solubilizers + K-mobilizers caused the highest fruit acidity (0.87%). The total and non-reducing sugar content of fruit were also high in fruit under T_{13} treatment compared with other treatments used in this investigation including control. The highest total sugars (15.15%) and non-reducing sugars (12.00%) contents of fruit was observed in poultry manure + *azospirillum* + P-solubilizers + K- mobilizers treatment. Irrespective of the treatment the vitamin-C content of fruit increased compared with control and the increase was maximum in fruit from the plot receiving poultry manure +

azospirillum + P-solubilizers + K-Mobilizers (44.10 mg/100 g pulp) compared with control (31.5 mg/100 g pulp). Improvement in ascorbic acid content in pineapple with poultry manure may be because of slow but continuous supply of all major and micronutrients, which might have helped in the assimilation of carbohydrates and in turn synthesis of ascorbic acid. The role of biofertilizers in-combination with different organic source of manures like farm yard manure, neem cake and vermicompost in increasing yield and improving fruit quality of pineapple (Devdas and Kuriakose, 2005), mango (Patel *et al.,* 2005) and guava (Ram and Rajput, 2007) have been reported.

CONCLUSION

In the present investigation maximum average fruit weight of 1.77 kg, TSS (16.53 ^{0}Brix), and Vitamin-C content (44.10 mg/100 g pulp) and benefit: cost ratio (2.67) were recorded by application of poultry manure at 21.6 kg/plot/year + 100 g each of *azospirillum*, phosphorous solubilizers and potash mobilizers. Considering the yield and quality of fruit, it may be suggested that for cultivation of pineapple cv. Kew organically, application of poultry manure at 21.6 kg/plot/year (857.14 kg/ha) + *azospirillum* + phosphorous solubilizers + potash mobilizers each at 100g/plot/year (T_{13}) in two splits (January and July) which shows a benefit: cost of 2.67 can be practiced under the alluvial plains of West Bengal conditions.

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