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Influence of hand trimming and bunch feeding of nutrient on yield and yield attributes of banana cv. Grand Naine

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ABSTRACT

A field experiment was conducted during the year 2018-19 and 2019-20 at Instructional Farm, ACH, and Soil and Water Management Research Unit Navsari Agricultural University, Navsari (Gujarat) to assess the effect of hand trimming and bunch feeding on yield and yield attributes parameters of banana cv. Grand Naine. The investigation comprised of ten treatments and each treatment was repeated thrice in CRD. The treatments viz. Control (T_1), KNO_3 1% without trimming (T_2), KNO_3 2% without trimming (T_3), SOP 1.5% without trimming (T_4), SOP 2.0% without trimming (T_5), KNO_3 1% with trimming of one apical hand (T_6), KNO_3 2.0% with trimming of one apical hand (T_7), SOP 1.5% with trimming of one apical hand (T_8), SOP 2.0% with trimming of one apical hand (T_9) and 300g cowdung slurry + 10g SOP +20g ammonium sulphate (T_{10}) were imposed on banana plants of cultivar 'Grand Naine'. Banana bunch feeding with 300g cow dung slurry + 10g SOP + 20g ammonium sulphate recorded the maximum bunch weight, fruit yield, weight of 3rd hand, finger length, finger girth and finger weight in the pooled study.

Key words: *Banana, Hand trimming, Bunch feeding, Cowdung and Fruit yield.*

Introduction

Banana (*Musa spp*.) is considered as a "Queen of tropical fruits" cultivated by humans since prehistoric times. Banana (*Musa paradisiaca* L.), which belongs to the family Musaceae in the order Scitamineae has been associated with mankind for centuries and is now one of the most important fruit crops in the world. It is a premier fruit having great socio-economic significance in India. Indeed many consider banana to be mankind's first food. Banana provides nutrition and well balanced diet to millions of people around the globe and also contributes to livelihood through crop production, processing and marketing (Singh, 2002). It grows well in humid tropical low lands and is predominantly distributed between 30^0 N and 30^0 S of equator.

Banana is at the forefront in the fight against malnutrition because of its year round availability and affordability to all sections of the society. It contains about 71.3 g moisture, 26.56 g carbohydrate, 1.08 g protein, 0.11 g fibres, 5 mg calcium, 0.49 mg iron, 18 mg phosphorous, 494 mg potassium, 5.1 mg ascorbic acid, 0.044 mg thiamin, 0.045 mg riboflavin and 88 IU vitamin A per 100 g edible portion (Milik *et al*., 2018). It is also used as dessert fruit for millions of people and can be used as staple food due to its rich and easily digestible carbohydrates. Owing to its multifaceted uses from underground stem up to the male flower, it is referred as *Kalpatharu*.

In India, Andhra Pradesh, Gujarat, Maharashtra, Tamil Nadu and Karnataka are the leading banana producing states. In India, it is cultivated over an estimated area of 0.883 million hectares with 30.80 million tonne of production and a productivity of 34.9 MT/ha. Total export of banana is 101.31 thousand MT valued at Rs. 34877.39 lakh (Anon. 2018). Gujarat is the second leading producer of banana next to Andhra Pradesh in the country contributing 14.51 percent of total banana production. The state accounts for about 4627.52 thousand MT of the total production from an area of 69.54 thousand hectares with a productivity of 66.54 MT/ha in the country (Anon., 2020).

Nutrient play a significant role in the production of high yield of good quality fruits. Providing appropriate quantities of nutrients at the right proportion when needed most is the essence of management of nutrients in successful banana cultivation. Banana takes up major nutrients in great quantities during peak growth phase and after shooting the rate of nutrient uptake slows down. Nutrients at the shooting stage affects bunch size and quality of banana. Among the several factors affecting fruit quality, adequate nutrients specially nitrogen and potassium application is considered to be of major importance in banana cultivation (Tandon and Sekhon, 1988).

Manipulation of fruit size in a banana bunch to meet market demands is very important for realizing maximum profitability which is done by hand trimming of bunch. Hand trimming is the removal of the distal one or two hands on banana bunches soon after fruit setting for the purpose of increasing the length of fingers on the remaining hands and to obtain better prices of the fruit. Sometimes hand trimming is done by farmers to increase fruit size and advanced fruit maturity, albeit at a small loss in bunch weight (Mustaffa and Kumar, 2012). However, without resorting to such drastic measures, enhanced bunch weight, with concomitant improvement in growth of fruits at the stalk end of the bunch besides improved fruit nutrient content by direct nutrient feeding at the de-navelled distal end of the rachis or stalk.

Therefore, it is proposed to investigate the potential impact of Cow dung, KNO_3, SOP and ammonium sulphate placement at the cut stalk end on growth and yield attributes in banana cv. Grand Naine.

Materials and Methods

About the Location

The present investigation was carried out during 2018-19 at Instructional Farm, ASPEE College of Horticulture, Navsari Agricultural University, Navsari and Soil and Water Management Research Unit during the year 2019-20. Which is situated on the coast of Arabian Sea at 20º572 N latitude and 72º542 E longitude at an altitude of about 11.83m above the mean sea level.

Treatment details

The experiment was laid out in Completely Randomized Design with 10 treatments and 3 repetitions. The treatments comprised Control (T_1), KNO_3 1% without trimming (T_2), KNO_3 2% without trimming (T_3), SOP 1.5% without trimming (T_4), SOP 2.0% without trimming (T_5), KNO_3 1% with trimming of one apical hand (T_6), KNO_3 2.0% with trimming of one apical hand (T_7), SOP 1.5% with trimming of one apical hand (T_8), SOP 2.0% with trimming of one apical hand (T_9) and 300g cowdung slurry + 10g SOP +20g ammonium sulphate (T_{10}).

Methodology of bunch feeding

The methodology involved de-navelling the stalk of the distal/lower hand of the banana bunch after bunch formation by cutting the stalk with a sharp knife keeping about 15 cm long stalk. Plastic bag of 200 guage and 15 cm × 25 cm was used for bunch feeding. The plastic bag was tied to the stalk with a strong thread in such a way that 8 to 10 cm of the denavelled end remained immersed in the solution.

Data recording and statistical analysis

Banana bunches harvested from the six tagged plants were utilized for recording fruit yield attributing characters. For bunch weight (kg) bunches were harvested when peel colour changed from green to light green and ridges on the fruits disappeared. The bunches were weighed immediately after harvest by using weighing balance and expressed in kilograms. Fruit yield per hectare was calculated by multiplying the average yield of fruit per plant with the total number of plants per hectare and divided by 1000. The third hand from each harvested bunch was separated from the bunch and weighed or weight of third hand. Length and girth of fingers from third hand was measured with help

Fully opened bunch | De-navelling of bunch with slant cut | Bunch with fertilizer solution | Staking of bunch

Fig. 1. Methodology of bunch feeding in banana

of measuring tape. The average finger length and girth was calculated and expressed in centimeter. Finger weight was measured from the middle finger selected from 3rd hand and weighed on electronic balance immediately after harvest; the average value was worked out and expressed in gram.

The data were analysed using appropriate method of analysis of variance technique described by Panse and Sukhatme (1985) and the treatment differences were tested by 'F' test at 5% level of significance.

Results and Discussion

The changes in yield parameters like bunch weight, fruit yield, weight of third hand, finger weight, finger length and finger girth due to the imposition of treatments were estimated at harvesting stage and are presented in this section. Bunch feeding treatments and hand trimming has a significant influence on all the above mentioned parameters. For the sake of brevity, only pooled data is presented and discussed in this paper.

Fruit Yield and Yield Parameters

Table 1 shows weight of bunch, fruit yield and weight of third hand. Hand trimming and bunch feeding of nutrient showed marked effects on the yield attributing parameters of fruit in comparison to control. The highest bunch weight (29.17 kg) was obtained by feeding the bunch with 300 g cow dung + 10g SOP + 20g Ammonium sulphate (T_{10}). Increase in bunch weight was significant over control which recorded only 23.34 kg. The maximum increase in bunch weight was 24.97% over control. It might be due to the sulphur present in sulphate of potash might be responsible for the formation of ferridoxin (iron-sulphur protein) in plants which may have a direct impact in activating the catalase and peroxidase enzymes. Sulphur application increased the bunch weight since it is a constituent of amino acid and protein production (Soumya *et al*., 2018). These result are in tune with Kotur and Keshavamurthy (2010), Kotur and Murty (2010), Shira *et al*. (2012), Sharma *et al*. (2014), Kotur *et al*. (2014), Kotur (2015), Adinarayana *et al*. (2016), Kumar (2016), Rao and Swamy (2017), Milik *et al*. (2018), Devraj *et al*. (2019) and Sahu (2019). In this investigation, trimming of one apical hand also increased the bunch weight which is in consonance with the findings of Baiyeri *et al*. (2016).

Fruit yield was recorded to be maximum (101.26 t/ha) by treatment T_{10} (300g cow dung + 10g SOP + 20 g ammonium sulphate) as compared to control which recorded only (81.03 t/ha). It was at par with T_5 (100.66 t/ha) and T_9 (98.81 t/ha) treatments. The

maximum increase in fruit yield was 24.96% over control. The increase in fruit yield might be due to sulphur helps in transformation and activation of enzymes in carbohydrate metabolism and subsequently greater partitioning of photosynthates. Sulphur application may have increased yield since it is a constituent of amino acid and is involved in protein production (Devraj *et al*. (2019). With regards to the effect of bunch feeding on fruit yield the results of present experiment is in consonance with the findings of Shira *et al*. (2012), Sharma *et al*. (2014), Kumar (2016), Adinarayana *et al*. (2016), Milik *et al*. (2018), Devraj *et al*. (2019) and Sahu (2019). The positive impact of trimming of one apical hand on fruit yield was earlier noticed by Jones (1996), Kurien *et al.* (2000) and Baiyeri *et al*. (2010).

It was observed that maximum weight of 3rd hand (3.05 kg) was recorded with T_{10} (300g cow dung + 10g SOP + 20g Ammonium sulphate) treatments. It was at par with treatment T_5 (3.03 kg), T_9 (3.01 kg) and T_8 (2.93 kg). The maximum increase in weight of third hand was 40.55% over control. The increase in weight of third hand might be attributed to the application of potassium which indirectly

Table 1. Effect of hand trimming and bunch feeding on bunch weight, fruit yield and weight of third hand in banana cv. Grand Naine (Pooled mean of 2 years)

Treatments	Bunch weight (kg) Mean	increase over control(%)	Fruit yield (t/ha) Mean	increase over control(%)	Weight of third hand(kg) Mean	increase over control (%)
T_1: Control	23.34		81.03		2.17	
T_2: KNO_3 1% without trimming	25.38	8.74	88.10	8.72	2.53	16.58
T_3: KNO_3 2% without trimming	25.59	9.64	88.85	9.65	2.61	20.27
T_4: SOP 1.5% without trimming	26.31	12.72	91.35	12.73	2.73	25.80
T_5: SOP 2.0% without trimming	28.91	23.86	100.66	24.22	3.03	39.63
T_6: KNO_3 1% with trimming of one apical hand	25.11	7.58	87.20	7.61	2.72	25.34
T_7: KNO_3 2% with trimming of one apical hand	26.80	14.82	93.07	14.85	2.77	27.64
T_8: SOP 1.5% with trimming of one apical hand	26.29	12.63	91.28	12.64	2.93	35.02
T_9: SOP 2.0% with trimming of one apical hand	28.45	21.89	98.81	21.94	3.01	38.70
T_{10}: 300g cowdung+10g SOP+ 20g Ammonium sulphate	29.17	24.97	101.26	24.96	3.05	40.55
SEm (±)	0.59		2.09		0.07	
$CD_{0.05}$	1.69		5.93		0.20	
CV (%)	5.40		5.39		6.66	

Table 2. Effect of hand trimming and bunch feeding on finger length, finger girth and finger weight in banana cv. Grand Naine (Pooled mean of 2 years)

Treatments	Finger length (cm) Mean	increase over control(%)	Finger girth (cm) Mean	increase over control(%)	Finger weight (g) Mean	increase over control (%)
T_1: Control	19.19		11.51		140.66	
T_2: KNO_3 1% without trimming	21.05	9.69	11.86	3.04	152.75	8.59
T_3: KNO_3 2% without trimming	21.03	9.58	11.63	1.04	152.85	8.66
T_4: SOP 1.5% without trimming	21.94	14.33	12.19	5.90	152.82	8.64
T_5: SOP 2.0% without trimming	24.02	25.16	12.61	9.55	175.34	24.65
T_6: KNO_3 1% with trimming of one apical hand	22.78	18.70	12.16	5.64	158.08	12.38
T_7: KNO_3 2% with trimming of one apical hand	22.01	14.69	12.12	5.29	169.53	20.52
T_8: SOP 1.5% with trimming of one apical hand	23.05	20.11	12.36	7.38	166.04	18.04
T_9: SOP 2.0% with trimming of one apical hand	24.09	25.53	12.58	9.29	174.06	23.74
T_{10}: 300g cowdung+10g SOP+ 20g Ammonium sulphate	24.31	26.68	12.71	10.42	176.61	25.55
SEm (±)	0.36		0.15		3.40	
$CD_{0.05}$	1.03		0.42		9.68	
CV (%)	4.03		2.90		4.88	

improves utilization of nitrogen and protein formation in terms of size, weight *etc (*Milik *et al*. (2018). Higher weight of 3rd hand with bunch feeding is in accordance with earlier findings by Shira *et al*. (24), Sharma *et al*. (2014), Adinarayana *et al*. (2016), Soumya *et al*. (2018), Devraj *et al*. (2019) and Sahu (2019). In this study, trimming of one apical hand also increased weight of 3rd hand which is supported by the findings of Hasan *et al*. (2007) and Donato *et al*. (2020). Further, control recorded the least value for weight of 3rd hand (2.17 kg) in pooled study.

The data summarized in Table 2 reveals the length of finger, girth of finger and weight of finger of third hand. Treatment T_{10}, *i.e.* 300g cow dung + 10g SOP + 20g Ammonium sulphate recorded maximum finger length 24.31 cm. It was at par with treatment T_9 (24.09 cm) and T_5 (24.02 cm). The maximum increase in finger length was 26.68% over control. It can be inferred that the nutrients were utilized more for cell elongation of the fruit rather than cell multiplication and the cell enlargement resulted in more cell elongation. Further, nutrients supplied externally in the form of cow dung slurry may have induced cell elongation in fruits which resulted in more fruit length (Kurien and Ancy, 2000). Higher finger length with bunch feeding is in close agreement with the observations of Sharma *et al*. (2014), Kumar (2016), Milik *et al*. (2018), Soumya *et al*. (2018), Devraj *et al.* (2019) and Sahu (2019). An increase in finger length on trimming of one apical hand has been reported by Jones (1996), Kurien *et al*. (2000), Hasan *et al*. (2007), Vargas (2014), Sarkar (2015) and El-Kholy (2017). The minimum finger length (19.19 cm) were noted with control.

Banana bunch feeding with 300g cow dung + 10g SOP + 20g Ammonium sulphate (T_{10}) produced higher finger girth (12.71 cm). It was statistically at par with treatment T_5 (12.61 cm), T_9 (12.58 cm) and T_8 (12.36 cm). The maximum increase in girth of finger was 10.42% over control. The increase in finger girth might be due to the exogenous potassium supply, which acted as an activator of several enzymes. Potassium also has a role in synthesizing the precursor of chlorophyll pigments. Presence of sulphur in sulphate of potash has a synergistic effect with zinc, which is essential for carbon dioxide absorption and utilization, synthesis of RNA and auxin which increased the girth of fruit (Milik *et al*. (2018). Sharma *et al*. (2014), Milik *et al*. (2018), Soumya *et al*. (2018), Devraj *et al*. (2019) and Sahu (2019) also noticed higher finger girth with bunch feeding. In this experiment, trimming of one apical hand also increased the finger girth. This is in confirmation to the earlier report by Kurien *et al*. (2000). Whereas, lowest values of finger girth (11.51 cm) were reported with control.

Treatment T_{10} (300g cow dung +10g SOP +20 ammonium sulphate) recorded significantly maximum finger weight (176.61 g) of banana. This treatment was statistically on same bar with T_5 (175.34 g), T_9 (174.06 g) and T_7 (169.53 g). Whereas lowest recorded in treatment T_1 (control). The maximum increase in finger weight was 25.55% over control. The increase in fruit weight may be attributed to the removal of flower bud after formation of the bunch which helped in conservation and utilization of photosynthates in a more efficient way (Milik *et al*., 2018). That bunch feeding promotes finger weight is supported by the findings of Kothur and Murthy (2010), Shira *et al*. (2012), Sharma *et al*. (2014), Kotur

Table 3. Effect of hand trimming and bunch feeding of nutrient on economics in banana cv. Grand Naine

Treatments	Yield (t ha^{-1})	Gross realization (Rs/ha) A	Fixed cost (Rs/ha) B	Variable Cost (Rs/ha) C	Total cost of cultivation (Rs/ha) D= B + C	Net realization (Rs/ha) E= A –D	BCR E/D
T_1	81.03	891330	243257	0	243257	648073	2.66
T_2	88.10	969100	243257	633.6	243890.6	725209.4	2.97
T_3	88.85	977350	243257	1249.92	244506.92	732843.08	2.99
T_4	91.35	1004850	243257	1041.6	244298.6	760551.4	3.11
T_5	100.66	1107260	243257	1388.8	244645.8	862614.2	3.52
T_6	87.20	959200	243257	633.6	243890.6	715309.4	2.93
T_7	93.07	1023770	243257	1249.92	244506.92	779263.08	3.18
T_8	91.28	1004080	243257	1041.6	244298.6	759781.4	3.11
T_9	98.81	1086910	243257	1388.8	244645.8	842264.2	3.44
T_{10}	101.26	1113860	243257	10150.52	253407.52	860452.48	3.39

et al. (2014), Adinarayana *et al*. (2016), Kumar (2016), Rao and Swamy (2017), Milik *et al*. (2018), Soumya *et al*. (2018), Devraj *et al*. (2019) and Sahu (2019). Trimming of one apical hand also increased finger weight which is in accordance with the observations of Daniells *et al*. (1994), Jones (1996), Kurein *et al*. (2000), Wanichkal and Boonma (2009), Sarkar (2015), El-Kholy (2017) and Donato *et al*. (2020).

Interaction effect between year and treatments did not have a significant influence on all the yield attributing parameters of banana in pooled data.

Economics

Economics was worked out for different sources and various treatments of bunch feeding with and without trimming of one apical hand, which is given in Table 3.

Taking into account economics of both the years, the maximum net realization (862614.2 Rs./ha) was obtained with treatment T_5 (SOP 2.0 % without trimming)

Conclusion

From the two years study it can be inferred that after complete opening of the bunch feeding with cow dung slurry (300g) + SOP (10g) + ammonium sulphate (20g) was found as the best treatment for fruit yield and yield attributing traits. However, from the economic point of view, bunch feeding with SOP (2.0 %) without trimming of one apical hand was found better. This treatment also recorded significantly higher fruit yield, bunch weight, finger length, finger girth and was at par with the best treatment (cow dung slurry (300 g) + SOP (10 g) + ammonium sulphate (20g)).

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