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# Growth and Fruit Yield Response of Banana (Mussa acuminate) to Sucker Management

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**Abstract**
Banana plants begin to produce suckers few months after planting, and these suckers compete with the main plant for water and nutrients and reduce productivity. Field experiment was conducted during 2004-2008 cropping seasons on clay loam textured soil of Chano-mille to determine the optimum sucker for banana yield. Treatments were six sucker managements (mother plant + one sucker, mother plant +two suckers, mother plant +three suckers, mother plant +four suckers, mother plant +five suckers and suckers left un-removed) to maintain the required suckers. Removal of suckers was done when the suckers reach 30 cm height and in month interval from its emergence using machete. There was a highly significant ($P<0.01$) growth and bunch weight difference observed due to sucker management. Mother +one sucker per hill yielded highest (42.7 t $ha^{-1}$) but not significantly highest than the mother +two suckers per hill management (35.4 t $ha^{-1}$). The sucker un-managed plant yielded the least (26.3 t $ha^{-1}$). The marginal rate of return revealed the same trend. The overall result showed that farmers growing banana can use one, two and three suckers to get highest yield and significantly highest net benefit.
**Keywords**: Bunch weight, fingers, hands, sucker, management

## 1. Introduction

Banana is widely cultivated in varying agro climatic regions under different systems of production (Mustaffa, 2011). With the increasing demand and vast export potential coupled with the farmers desire to grow banana on a large area, it is necessary that systematic and sustained sucker management practices as a planting material should be adopted. Banana plants begin to produce suckers few months after planting, and these suckers compete with the main plant for water and nutrients and reduce productivity (Oluwafemi, 2013). In East Africa banana provides the staple food for around 70 million people, and this region alone produces nearly 15million tones annually. It is in this region that banana reach their greatest importance as a staple food crop (Picq *et al.*, 1999). In Ethiopia, banana is the second major fruit crop next to citrus (Seifu, 1999). Banana is produced throughout the country wherever there is adequate rainfall or irrigation. It has great potential or export commodity besides its use as a chief source of carbohydrate, minerals, and vitamins as well as shade tree for coffee plants in coffee producing regions.

Banana plantation is wide spreading in the area, while fruit size, bunch weight and fruit quality is going down from time to time. This might be due to failure to use appropriate technologies such as better varieties and improved agronomic practices in spacing, sucker management, fertilization, irrigation, disease and pest control, and time of harvest. Sucker management was not practiced. Many suckers are allowed to grow per hill. None of these suckers produces desired bunch and fingers. If all of the suckers which arise from the stool are allowed to grow, bunches will be small and of poor quality and some may not bear fruits at all (Seifu, 2003). According to Martney (1987) yield was found highest in the plants left with one sucker followed by those with two and three suckers and the lowest is in plants without removal of suckers. The crop suffers severely from root competition. The present study was initiated to determine optimum number of suckers that improve growth and fruit yield of banana.

## 2. Materials and methods

### 2.1. Description of the study area

The study was conducted during 2004-2008 cropping season at Chanomille research site of Arbaminch Agricultural Research Centre. The site is located at an altitude of 1200 masl with bimodal erratic rain fall of 700 mm per annum and it may fall below this figure some years. The soil is black vertisols and clay loam in texture with pH value of 7.5, total N of 0.155 and 2.3% of organic carbon.

### 2.2. Treatments and design of the experiment

The experiment was laid out in a randomized complete block design within three replications. A clone named Giant Cavendish was planted in a spacing of 2.5 m x 2.5 m between plants and rows. The treatments included in the study were , mother plant + one sucker, mother plant +two suckers, mother plant +three suckers, mother plant +four suckers, mother plant +five suckers and sucker not-removed was the control. The suckers were removed at 30 cm height within a month interval from its emergence using local instrument (machete) to maintain the required suckers.

### 2.3. Agronomic data collection

The data were collected on plant height which is from the base of above ground to the base of bunch during maturity; pseudo stem circumference, which is measured at the height of one meter from the base of above ground; number of effective leaves, number of hands, number of fingers (only marketable fingers), fruit length, fruit diameter and bunch weight.

### 2.4. Statistical analysis

All collected data were subjected to analysis of variance using SAS computer software version 9.3 ( (SAS, 2008). Mean separation was done using Least Significant Difference (LSD) test at 5% level.

## 3. Results and Discussions

**Effect of sucker management on growth of Banana:** Plant height and number of effective leaves were not significantly affected (Table 1). The lack of influence of sucker management on plant height and number of effective leaves could be attributed to mother plants of the plant crop cycle having no competition as the plants were exposed to sunlight for a greater part of their growth cycle and also minimum competition for nutrients assimilates and moisture. There is highly significant ($P< 0.01$) banana pseudo stem circumference differences observed due to sucker management. The highest pseudostem circumference of 59.6cm and 58.1 cm were obtained due to sucker management of one and two suckers left with mother plant, respectively. This result indicates that suckers allowed to grow together with planted banana suffer from root competition for moisture and nutrients; that is why the circumferences of banana pseudo stem is significantly reduced when suckers were not removed (Table 1). This result agrees to the report of Odeke et al., 1999, they found out that sucker management improved growth parameters including pseudo stem girth. Similar effects of intra-mat competition on growth and yield of banana have been reported by Robinson and Nel (1990) and Stover and Simmonds (1987).

Table 1. Effect of sucker management on growth of banana

| Sucker management | Plant height (cm) | Pseudo stem circumference (cm) | Effective leave (number) |
|---|---|---|---|
| Mother plant +one sucker | 286.4 | 59.6a | 11.3 |
| Mother plant + two suckers | 285.1 | 58.1ab | 10.2 |
| Mother plant +three suckers | 287.0 | 55.3bc | 10.3 |
| Mother plant +four suckers | 281.6 | 54.9bc | 10.3 |
| Mother plant +Five suckers | 276.8 | 53.8cd | 10.7 |
| Sucker not removed | 274.4 | 50.6d | 10.0 |
| CV (%) | 6.46 | 6.23 | 9.77 |
| LSD 5% | NS | 4.9 | NS |

NS=not significant.

**Effect of sucker management on yield and yield components of banana:** All yield parameters namely, hands/bunch, fingers per bunch, finger length and finger diameters were significantly varied due to sucker management (Table 2). The highest number 9 and 8.6 hands per bunch were obtained due to one and two suckers managed with mother plant, respectively; However, this values were not significantly different from three and four sucker left with mother plant; whereas five suckers with mother plant and sucker unmanaged plants give the least (7.8 and 7.7), respectively. The same result observed on number of fruits per bunch. The highest 141 and 129 fruits obtained due to mother +one sucker and mother +two suckers. Similarly, fruit length and fruit diameter were also highly significantly varied due to sucker management. In both cases one and two suckers with mother plant out yielded the other sucker management practices. Banana bunch yield was highly significantly ($P<0.01$) varied due to sucker management. The highest 42.7 and 35.4 tons per hectare were obtained from one and two sucker maintained with mother banana plant, respectively; whereas 26.3 tons of suckers not removed was the least. This was attributed to more intra-mat competition for photosynthates and nutrients in plots of more suckers left with mother plant. This result is in line with the finding of Martney (1987) who found out that yield was highest in the plants left with one sucker followed by those with two and three suckers and the lowest is in plants without removal of suckers. Similarly, Mahdi *et al*. (2014) also reported that yield attributes of crop generally decreased significantly as the number of suckers per mat increased. Moreover, the increase in bunch weight and yield components had been attained by removing the suckers (Robinson and Nel, 1990; Sarrwy, 2012).

Table 2. Effect of sucker management on banana hands per bunch, fruits per bunch, fruit length (cm), fruit diameter(cm) and bunch yield(ton/ha) over years (2004-2008).

| Sucker management | Hands/bunch | Fingers/ bunch | Fruit length (cm) | Fruit diameter (cm) | Bunch yield(t/ha) |
|---|---|---|---|---|---|
| Mother +one sucker | 9.0a | 141.4a | 21.1a | 3.44a | **42.7a** |
| Mother + two suckers | 8.6ab | 127.9ab | 20.4ab | 3.22a | **35.4ab** |
| Mother +three suckers | 8.3ab | 120.4ab | 20.2ab | 3.11ab | 32.7bc |
| Mother +four suckers | 8.1ab | 116.9b | 19.3b | 2.89ab | 28.4bc |
| Mother +Five suckers | 7.8b | 110.7b | 19.6b | 2.89ab | 26.8c |
| Sucker not removed | 7.7b | 108.6b | 20.3ab | 2.78b | 26.3c |
| CV (%) | 10.37 | 13.38 | 5.61 | 15.08 | 18.59 |
| LSD 5% | 1.22 | 23.03 | 1.61 | 0.66 | 8.5 |

**Association of characters.** As indicate in Table 3 , fruit yield $ha^{-1}$ correlated positively and highly significantly with pseudo stem circumference, number of effective leaves, number of hands, and number of fruits per bunch and fruit diameter with r value of 0.80, 0.67, 0.89, 0.85 and 0.63, respectively. This shows that growth parameters directly influenced fruit yield of banana except the height. Fruits per bunch and number of effective leaves with plant height, again number of effective leaves with number of hands were negatively correlated. This implies that some of growth parameters had no influence or inverse effect on the other growth or yield parameters.

Table 3. Linear correlations of growth, yield, yield components (N=54).

| X | Ssc | L | Hds | Fpb | Flth | Fdm | Fyld |
|---|---|---|---|---|---|---|---|
| Ph | - 0.37** | -0.30* | 0.15 | -0.06 | 0.18 | 0.04 | 0.16 |
| Ssc | | - 0.57** | 0.82** | 0.77** | 0.32* | 0.48** | 0.80** |
| L | | | - 0.73** | 0.86** | 0.16 | 0.56** | 0.67** |
| Hds | | | | - 0.91** | 0.26 | 0.54** | 0.89** |
| Fpb | | | | | - 0.15 | 0.51** | 0.85** |
| Flth | | | | | | - 0.29* | 0.44** |
| Fdm | | | | | | | 0.63** |

Ph=plant height, Ssc= pseudo stem circumference, L = number of effective leave, Hds= number of hands, Fpb= number of fruits per bunch, Flth= fruit length, Fdm= fruit diameter, Bw/p =bunch weight per plant, Fyld= fruit yield per hectar. * Significant (5%). ** Highly significant (1%).

**Net benefit**: Partial budget analysis showed that the net benefit of the experiment which was obtained by subtracting total cost that vary to the treatments from gross field benefit of the treatments indicated mother plant left with one sucker, two suckers and three suckers provided highest net benefit as compared to the rest of the sucker managements (Table 4).

Table 4. Partial budget analysis of the effect of sucker management on growth and fruit yield.

| Treatments | Fruit yield (t ha-1) | Field price $Kg^{-1}$ | Gross field benefit | Cost of planting materials | Labor cost for planting | Labor cost to manage sucker | Cost that vary | Net benefit |
|---|---|---|---|---|---|---|---|---|
| Mother +one sucker | 42.7 | 2 | 85400 | 8000 | 4800 | 19200 | 32000 | 53400 |
| Mother + two suckers | 35.4 | 2 | 70800 | 8000 | 4800 | 9600 | 22400 | 48400 |
| Mother +three suckers | 32.7 | 2 | 65400 | 8000 | 4800 | 6400 | 19200 | 46200 |
| Mother +four suckers | 26.5 | 1.5 | 39750 | 8000 | 4800 | 4800 | 17600 | 22150 |
| Mother +Five suckers | 26.8 | 1.5 | 40200 | 8000 | 4800 | 3200 | 16000 | 24200 |
| Sucker not removed | 26.3 | 1.25 | 32875 | 8000 | 4800 | - | 12800 | 20075 |

**Marginal Analysis:** Marginal analysis (Table 5) showed that sucker management of one sucker left with mother plant to that of two suckers with mother plant resulted in 53% of marginal rate of return. This indicated that for every one Ethiopian bir invested to manage one sucker with mother plant than allowing two suckers with mother plant, farmers can expect to recover the one bir, and obtain additional 0.53 Ethiopian bir. Similarly, investing in managing two suckers left with mother plant would give a marginal rate of return of 69% when compared to that of three suckers left with mother plant. That is, investing one Ethiopian bir in sucker management of two suckers with mother plant when compared to three suckers with mother plant; farmers recover that one bir and obtain additional 0.69 bir (Table 5). The marginal rate of return advantage of 36% of three suckers with mother plant over sucker unmanaged also encourages farmers to manage sucker for significant net benefit (Table 5).

Table 5. Marginal Analysis for growth and yield response of banana to sucker management

| Treatments | Total cost that vary | Marginal cost | Net benefit | Marginal net benefit | Marginal rate of return |
|---|---|---|---|---|---|
| Mother +one sucker | 32000 | | 53400 | | 0.52 |
| Mother + two suckers | 22400 | 9600 | 48400 | 5000 | 0.69 |
| Mother +three suckers | 19200 | 3200 | 46200 | 2200 | 0.36 |
| Mother +four suckers | 17600 | 1600 | 22150 | 24050 | |
| Sucker not removed | 12800 | 5800 | 20075 | 2075 | |

## 4. Conclusion

From the findings of the present investigation, it can be concluded that sucker management are indispensable for higher yields and highest net benefit of banana. In general, plants with suckers removed performed better than leaving them attached to the mother plants as in conventional farmer's practice. Therefore, proper sucker management practices must be adhered the farmers to obtain significantly highest fruit yield and net benefit.

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