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Research Article

Study the Effect of Number of Suckers Per Hill on Chlorophyll Content and Light Intensity of Malbhog (AAB) Banana in Ratoon Crop

Rupshree Borah[1]*, Dharindra Nath Hazarika[1], Ratna Kinkor Goswami[2] and Hemanga Das[1]

[1]Department of Horticulture, [2]Department of Crop Physiology,

B.N. College of Agriculture, Assam Agricultural University, Biswanath Chariali-784176, Assam, India

*Corresponding Author E-mail: borahrupshree@gmail.com

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ABSTRACT

An experiment was carried out at instructional cum experimental farm, Department of Horticulture, Biswanath College of Agriculture, Assam Agricultural University, Biswanath Chariali to "Study the effect of number of suckers per hill on chlorophyll content and light intensity of Malbhog (AAB) banana in ratoon crop". The treatments were T_1 (one sucker per hill), T_2 (two suckers per hill), T_3 (three suckers per hill), and T_4 (four suckers per hill). There were two spacing - S_1 (2.1 m x 2.1 m) and S_2 (2.5 m x 2.5 m) for all the treatments. One treatment with recommended package of practices (control-retention of one sucker during shooting of mother plant) was also included in the experiment. Nine treatment combinations were laid out in RBD with three replications. The highest CCI value was recorded in T_1 (one sucker per hill) at all the stages of observation i.e. 27.32 at vegetative stage, 37.65 at shooting and 55.10 at harvest. On the other hand, T_4 (four suckers per hill) recorded the lowest CCI values at all the stages. The highest light intensity was recorded 31.67 lux in T_1 (one sucker per hill) while T_4 (four suckers per hill) recorded the lowest light intensity (20.0 lux). The plants under control exhibited the highest chlorophyll content index and light intensity as compared to the other treatments.

Keywords: *Chlorophyll content, Light intensity, Ratoon crop, Yield, Desuckering.*

INTRODUCTION

Banana (*Musa* spp.) is one of the most important staple food and starchy fruit crops of the world and India ranks first in both area and production in world scenario. Banana is considered to be the most nutritious fruit available though out the year. Botanically, banana is a monocotyledonous, monocarpic, herbaceous plant belonging to the section *Eumusa* under the family Musaceae (Purseglove, 1976). Though area under banana production has been increasing in India but the total production, productivity and quality of the fruits have been found to be in reducing trend.

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This might be due to poor management of suckers, spacing, fertilization, irrigation, pests and diseases. In recent years, more emphasis is being given to higher productivity of banana per unit area with better quality by adopting various means. One of such methods is high density planting which depends on variety, method of cultivation, the height and spread of banana plant. Among the different cultural practices, desuckering is one of the important practices which influence the quality and bunch weight of banana. The commercial cultivation of banana in Assam has gained momentum since last one decade. But the growers in Assam rarely follow the practice of desuckering as per recommended package of practices. The majority of the farmers in Assam allow all the suckers to grow along with the mother plants. If all the suckers which arise from the stool are allowed to grow, bunches become smaller with poor quality and some plants may not bear fruit at all (Seifu, 2003). Stover (1984) observed that when the density of a commercial banana plantation is high, light transmitted to the understory is reduced to 10% of the above-canopy intensity which severely affected the growth and production of the plants. As per opinion of banana growers of Assam, if desuckering is practised it helps in better utilization of sunlight as well as soil moisture, nutrients availability and reduced disease and pest infection which ultimately affect on yield of crops. Therefore, the growers allow the suckers to grow along with the mother plants to get return earlier from the subsequent ratoon crops.

Chlorophyll content of the plant influences photosynthetic rate. Photosynthesis is the basic energy conversion processes, which makes possible the utilization of the energy of sunlight for living organisms. Generally, plant photosynthesis are only designed to function well over a rather a narrow range of temperatures. When heated, cytochromes, pigments, and membrane critical to phosphorylations; plant may open stomata and evaporate water which will lower the leaf temperature. In this case, stomatal density may increase or decrease in response to environmental variation in sunlight and water availability. The chlorophyll content of leaf tissue varies with cultivars, age of the crop, growth stages, light and temperature (kumar & singh, 1996). Crop productivity is governed by the photosynthetic rate which in term depends on efficient light interception by the crop canopy and the amount of photosynthetic pigments including chlorophyll. Both the parameters, *viz*., the light interception and chlorophyll content are affected by the number of suckers. Therefore, the present experiment is design to study the effect of number of suckers on leaf chlorophyll content and light intensity in side the crop canopy.

1.1 Aim and Objective of the study

1) Study on the effect of number of suckers per hill on Chlorophyll Content of first ratoon crop.
2) Study on the effect of number of suckers per hill on light intensity of first ratoon crop.

MATERIALS AND METHODS

The experiment was carried out at instructional cum experimental farm, Department of Horticulture, Biswanath College of Agriculture, Assam Agricultural University, Biswanath Chariali. The experimental site is situated at 26°15′ N and 27°45′ S latitude and 91°42′ E and 95°30′ W longitude having an altitude of 104 m above mean sea level. The prevailing climatic condition of Biswanath Chariali is subtropical with prominent summer and cold winter seasons. The nine treatments combination were S_1T_1 (2.1m x 2.1 m with one sucker /hill), S_1T_2 (2.1m x 2.1 m with two suckers/hill), S_1T_3 (2.1m x 2.1 m with three suckers/hill), S_1T_4 (2.1m x 2.1 m with four suckers/hill), S_2T_1 (2.5 m x 2.5 m with one sucker /hill), S_2T_2 (2.5m x 2.5 m with two suckers/hill), S_2T_3 (2.5m x 2.5 m with three suckers/hill), S_2T_4 (2.5m x 2.5 m with four suckers/hill) and One treatment with recommended package of practices (control-retention of one sucker during shooting of the mother plant). There were two spacing categaries - S_1 (2.1 m x 2.1 m) and S_2 (2.5 m x

2.5 m) for all the treatments. Nine treatment combinations were laid out in Randomized Block Design (1365 m^2) with three replications. Malbhog is a medium tall, most preferred indigenous table purpose hybrid variety that bears fruit in 18 months. Suckers were collected from Amlighat near Jagirod in Morigaon district, Assam. The CCI values were recorded in the morning hours at the third leaf from thre apex of the plant following the standard procedure at three stages of growth *viz.*, vegetative stage, at shooting and at harvest with the help of Chlorophyll Meter (Model: CCM-200, CID, Inc, USA) and the third leaf from the apex of the plant was taken for chlorophyll estimation. The data were collected from three different positions – at the apex, middle and at the base of the lamina and the average chlorophyll content index was calculated. Light intensity values were measured with the help of Lux Meter. The data were collected from inside the canopy the plant at the time of shooting of the plants. The average light intensity data was calculated out and expressed in Lux (Range: 2,00,000 lux).

RESULT AND DISCUSSION

3.1. Chlorophyll content and light intensity

Higher the content of chlorophyll in the leaves, higher is the rate of photosynthesis which leads to the production of higher photosynthates in plants. Therefore, chlorophyll is considered as a vital component of photosynthesis through which plant get their energy. In the present study, chlorophyll content index values were recorded in three stages of growth – at vegetative stage, at shooting and at harvest **(Table1).** There were no significant differences among the treatments in relation to chlorophyll content index at vegetative stage and at shooting but it varied significantly at harvest. The values of chlorophyll content index gradually decreased with the increase in number of suckers per plant recorded at all the stages of growth. The highest CCI value was recorded in T_1 (mother plant + one sucker) at all the stages of observation i.e. 27.32 at vegetative stage, 37.65 at shooting and 55.10 at harvest. On the other hand, T_4 (mother plant + four suckers) recorded the lowest CCI values at all the stages of observation. The leaves of the plants under control exhibited the highest chlorophyll content index values as compared to the treatments. CCI increased at harvest over vegetative phase and shooting in all the treatments of the experiment. The possible explanation could be that the young leaves were not mature and on the other hand adult leaves were fully mature (Siwach & Gill, 2014; & James et al., 1999). It is in conformity with the works of Surender et al. (2013) who reported that chlorophyll content of banana leaves increased with the increase in the age of the plant. It might also be due to larger leaf size and more interception of sunlight by the leaves. Similar result was also reported earlier by Kumar and Singh (1996). It was further proved by Kamble et al. (2015) who observed the qualitative difference of chlorophyll a and chlorophyll b content between young and adult leaves of ten different crops and recorded higher chlorophyll content in adult leaves as compared to young leaves.

In the present study, spacing did not have significant influence on chlorophyll content index at vegetative stage and at harvest. But it differed significantly at shooting due to effect of spacing. The average chlorophyll content index was significantly higher at recommended spacing (S_1) than at wider spacing (S_2).There was no significant variation in CCI due to the interaction effects between the spacing and the treatments at all the stages of observation. The CCI values ranged from 23.23 to 28.20 at vegetative stage, from 30.08 to 39.10 at shooting and from 39.57 to 56.12 at harvest in different treatment combinations.

Light intensity recorded at shooting is presented in **Table 2** and showed that the light intensity values were significantly influenced by the treatments, spacing and the interaction effect between the treatments and spacing. In the present study, light intensity gradually decreased with increase in number of suckers per plant. Among the treatments, the highest light intensity was recorded 31.67 lux in T_1

(mother plant + one sucker) and was followed by 30.17 in T_2 (mother plant + two suckers) and they were at par with each other. On the other hand, T_4 (mother plant + four suckers) recorded the lowest light intensity (20.0 lux) and was at par with 21.50 lux in T_3 (mother plant + three suckers).

There was significant difference in light intensity between two different spacing. Higher light intensity (28.83 lux) was measured in wider spacing (S_2) than that of 22.83 lux in recommended spacing (S_1). It might be due to low lighter penetration through the canopy of the plants due to higher number of suckers retained.

The interaction effects between the treatments and spacing significantly influenced the light intensity and the highest was recorded 35.00 lux in S_2T_1 (wider spacing with one sucker/plant) which was at par with 34.33 lux in S_2T_2 (wider spacing with two suckers/plant) and 28.33 lux in S_1T_1 (recommended spacing with one sucker/mother plant). The light intensity measured 17.67 lux in S_1T_4 (recommended spacing with four suckers/ mother plant), 19.33 lux in S_1T_3 (recommended spacing with three suckers/mother plant), 22.33 lux in S_2T_4 (wider spacing with four suckers/mother plant) and 23.67 lux in S_2T_3 (wider spacing with three suckers/mother plant) were at par with each other. The least light intensity (17.67 in the range of 2,00,000 lux) recorded in S_1T_4 (mother plant with four suckers spaced at 2.1 m x 2.1 m) might have resulted the lesser girth of pseudostem and LAI leading to smaller bunch production. It was observed that the maximum light intensity was recorded in control (66.67 lux) and differed significantly with all the treatments.

Purseglove (1972) stated that "Banana requires high light intensity", but very little quantitative information on the actual requirement is available. The term intensity is used to describe the rate at which light spreads over a surface of a given area some distance from a source. The intensity varies with the distance from the source and the power of the source.

Table 1: Chlorophyll Content Index (CCI) of leaves at different stages of growth

Treatments	Chlorophyll Content Index (CCI) of leaves								
	At vegetative stage			At shooting			At harvest		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
T_1 **:(**one sucker per hill**)**	28.20	26.43	27.32	36.20	39.10	37.65	54.08	56.12	55.10
T_2 :(two suckers per hill)	25.93	27.62	26.78	35.39	38.64	37.02	43.27	46.50	44.89
T_3 :(three suckers per hill)	24.09	27.62	25.85	31.43	37.01	34.22	41.12	45.31	43.22
T_4 :(four sucker per plant)	23.23	24.97	24.10	30.08	33.97	32.02	40.20	39.57	39.89
Mean	25.36	26.66	---	33.28	37.18	---	44.67	46.88	---
Control	---	---	40.68	---	---	39.18	---	---	57.35
CD (P=0.05)	**T: NS S: NS T x S: NS C vs T: NS**			**T: NS S: 2.86 T x S: NS C vs T: NS**			**T: 4.57 S: NS T x S:NS C vs T: 6.47**		

Table 2: Light intensity (Lux) of first ratoon crop

Treatments	**Light intensity** (Range = 2,00,000 Lux)		
	S_1	S_2	Mean
T_1 **:(**one sucker per hill**)**	28.33	35.00	31.67
T_2 :(two suckers per hill)	26.00	34.33	30.17
T_3 :(three suckers per hill)	19.33	23.67	21.50
T_4 :(four sucker per plant)	17.67	22.33	20.00
Mean	22.83	28.83	---
Control : (Recommended practice)	---	---	66.67
CD (P=0.05)	**T : 5.46 S : 3.86 T x S : 7.72 C vs T : 8.74**		

3.2. Bunch weight and yield of first ratoon crop

Number of hands and fingers per bunch produced by the plants are developed at very young stage of the plant before shooting in the soil level itself and depends on growth of the plant, nutrient status in soil, soil moisture and among the most important factors in the prevailing temperature (Chakrabarty, 1977).

The economic character of a banana plant is the bunch which is influenced by the number of hands and fingers per bunch, weight of fingers, length, girth and volume of fingers. The result of the present study revealed bunch weight and yield were significantly influenced by the different treatments in first ratoon crop **(Table 3)**. Among the different treatments, bunch weight per plant and corresponding yield per hectare were highest in plants with retention of only one sucker with mother plant (T_1) and bunch weight and yield gradually decreased with the increase in number of suckers per plant. It was interesting to note that though the bunch weight per plant was found to be higher in wider spacing but the total yield per hectare was reduced in wider spacing. It might be due more number of plants accommodated per unit area with closer spacing (S_1). Similar results were also obtained by Sarrwy, et al. (2012); Abdullah et al. (2010); Nalina et al. (2003); Kesavan et al. (2002). The plants cultivated as per recommended package of practices (control) produced the heaviest bunches which might be due to adequate spacing, plant population and nutrient supply resulting higher values of number of fingers, girth of fingers, length of finger, weight of second hand and peduncle.

The benefit-cost ratio is another most important factor that determines its usefulness and acceptance by the growers. The evaluation of relative merits of different treatments adopted in the present study in respect of economics of cultivation resulted that benefit-cost ratio was higher (5.19) in control which could very well be explained to higher yield. The benefit-cost ratio of S_1T_1 (mother plant + one sucker in 2.1 m x 2.1 m) and S_2T_1 (mother plant + one sucker in 2.5 m x 2.5 m) were 4.75 and 4.74, respectively and this might be due to higher return obtained from banana and sucker production. The lowest (2.92) benefit-cost ratio was recorded in the treatment four suckers per hill with a spacing of 2.5 m x 2.5 m. which might be due to higher cost of cultivation as compared to total yield of this treatment.

Table 3: Bunch weight (kg/plant) and yield (t/ha) of first ratoon crop

Treatments	Bunch weight (kg/plant) of first ratoon crop			Yield (t/ha) of first ratoon crop		
	S_1	S_2	Mean	S_1	S_2	Mean
T_1	8.71	9.41	9.06	19.73	15.05	17.39
T_2	6.28	8.24	7.26	14.67	13.18	13.93
T_3	6.22	7.49	6.85	14.09	11.97	13.03
T_4	6.16	6.33	6.24	14.33	10.12	12.23
Mean	6.84	7.87	---	15.71	12.58	---
Control	---	---	10.08	---	---	22.84
CD (P=0.05)	T: 0.29 S: 0.21 T x S: 0.41 C vs T: 0.35			T : 0.66 S : 0.46 T x S : 0.93 C vs T: 0.71		

CONCLUSION

The findings of the present investigation revealed that retention of suckers with mother plant influenced chlorophyll content index (CCI), light intensity and yield of banana. The highest CCI value was recorded in T_1 (mother plant + one sucker) at all the stages of observation *i.e.* 27.32 at vegetative stage, 37.65 at shooting and 55.10 at harvest whereas T_4 (mother plant + four suckers) recorded the lowest CCI value 24.10 at vegetative stage, 32.02 at shooting and 39.89 at harvest. Light intensity recorded at shooting showed significant variation in the values of light

intensity due to different treatments. Light intensity gradually decreased with increase in number of suckers per plant. Among the treatments, the highest light intensity (31.67 lux) was recorded in T_1 (mother plant + one sucker) and was followed by 30.17 in T_2 (mother plant + two suckers) and they were at par with each other. Significantly higher light intensity (28.83 lux) was measured in wider spacing (S_2) than that of 22.83 lux in recommended spacing (S_1). It was observed that the maximum light intensity was recorded in control (66.67 lux) and differed significantly from all the treatments.

In first ratoon crop, bunch weight (10.08 kg/bunch) and yield (22.84 t/ha) were significantly higher in control (Recommended desuckering practice) over all other treatments. The benefit-cost ratio was also higher (5.19) in control as compared to other treatments. Among the treatments, higher yield (19.73 t/ha) and benefit-cost ratio (4.75) were recorded in S_1T_1 (mother plant + one sucker/plant with spacing of 2.1 m x 2.1 m). Considering higher yield and benefit-cost ratio, the treatment (S_1T_1: mother plant + one sucker/plant with spacing of 2.1 m x 2.1 m) might be suggested for the farmers who grow banana organically.

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