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Influence of Bunch Covers on Yield of Banana Cv. Jahaji (AAA) Under High Density Planting System

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ABSTRACT

Application of bunch covers is one of the most important intercultural practices to increase the yield and improve the quality of banana. Although use of bunch covers has been established as a standard practice in banana cultivation, but its performance in a high density planting is yet to be ascertained experimentally. The investigation was carried out in the Experimental Farm, Department of Horticulture, Jorhat during 2013-2014 in order to find out the best bunch cover material among white non-woven polypropylene bag, blue non-woven polypropylene bag, transparent polyethylene bag, leno bag, gunny bag, dry banana leaves and Control (no cover) in banana cv. Jahaji (AAA) under the high density planting system. Most of the yield parameters were significantly influenced by the application of bunch covers. The highest finger length, finger girth, finger weight and finger volume were recorded in white non-woven polypropylene bag, while the lowest values were recorded in the uncovered. The increase in finger weight increased the hand weight, bunch weight and ultimately the yield in white non-woven polypropylene bag (115.62 t/ha) which were lowest in control (93 t/ha). Similarly, highest harvest index (0.32) was obtained under white non-woven polypropylene cover and lowest (0.25) was obtained in the control. The variation in rise in the temperature within the bunch covers was considered as the main cause behind variation in yield.

Key words: *India; Musa; Yield improvement; Bunch cover, High density planting system*

INTRODUCTION

Banana is one of the most important fruits grown and consumed in Assam. It is true that banana production is increased by the successful application of high density plantation but the bunch weight and size of the individual finger and hands were reduced compared to normal plantation[1,18,27]. Under high density plantation the microclimate created within a high density planting system leads to lowering of temperature within the plantation.

Banana production also varies depending of the season[13]. Banana is available in large quantities throughout the year but the quality of the fruits that grow in the cool seasons are inferior in all aspects compared to fruit developing in other seasons[10].

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Growth of bunch under such season shows slow growth with improper finger filling and lower bunch weight[17,20,26]. Plants under high density plantation get more affected when the shooting time coincides with the low temperature periods of the season. The decrease in atmospheric temperature during the shooting, in addition with the closer spacing cumulatively affects the yield and quality of banana. These aspects have a scope of improvement by the use of bunch covers which might help to overcome these problems.

Regulation of fruit growth using synthetic materials has opened new vistas in plantation crop production and has helped in mitigating certain complicated problems regarding banana production round the year. Bunch covering with synthetic material may alter this situation by increasing the temperature up to 10^{o}C in a modified microclimatic condition around the bunch[23]. This microclimate helps in proper finger growth and development as well as reduction in shooting-harvest interval irrespective of season Patil *et al*.[22], Daniells and Lindsay[9], Rodrigues *et al*.[24], Gowen[12], Harhash and Al-Obeed , Jia *et al*.[16]. Bunch covers are also reported to reduce scarring beetle infestation on fruits[5], Shanmugasundaram and Manavalan[28]. Thus, it helps to reduce application of chemical pesticides and their pollution. Keeping in view, the advantages of bunch covers, the investigation was carried to select the best bunch cover material to overcome the yield problems in high density planting system.

MATERIALS AND METHODS

The field experiment was conducted at the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during the year 2013-2014. The experimental site was situated at 26°47'N latitude and 94°12'E longitude and at an elevation of 86.8 m above mean sea level. The climatic condition of Jorhat city is characterized by a subtropical environment with hot-humid summer and relatively dry and cool winter. The average rainfall is about 1875 mm to 2146 mm which is unevenly distributed throughout the year. The temperature reaches a maximum of 34-36°C during summer and the minimum of 7°C during winter. The experiment was laid out in Randomized Block Design (RBD) with three replication comprising seven treatments. There were twenty one plots each having twelve numbers of plants with the spacing of 1 m × 1.2 m × 2 m. Individual plot size was 8.8 m^2 and the total area of the experimental site was 313.2 m^2. Healthy three months old uniform sword suckers of cv. Jahaji weighing about 2 kg each were collected from healthy mother plants and used as planting materials. Seven treatments viz., bunch cover with white non-woven polypropylene bag(T_1), bunch cover with blue non-woven polypropylene bag(T_2), bunch cover with transparent polyethylene bag(T_3), bunch cover with leno bag(T_4), bunch cover with gunny bag(T_5), bunch cover with dry banana leaves(T_6), Control(T_7) were allotted randomly in each block. Bunches with uniform number of hands and almost same date of shooting were randomly selected. The bunch covers of size 1.5m x 0.8m were applied ten days after the full formation of the last hand. Uniform perforations of 0.05% were provided in the Polyethylene bags. The male buds were removed before bagging. Covers were slid up from the bottom of the stalk and securely tied to the peduncle above the first hand of the fruit. Covers were left on bunches until harvest. The fruits were considered to be physiologically matured and ready for harvest when the angular girth of fruit skin disappeared and the colour of fruits turned from dark green to light green. Finger length was measured from the base of the pedicel to the tip of the fruit along the dorsal curve and the mean length was expressed in cm. The finger girth was measured at the middle portion of the representative finger selected for finger length and expressed in cm. The volume of the representative finger was estimated by water displacement method and expressed in cc. The weight of the individual finger from the second hand was recorded and expressed in gram. The weight of the second hand was

recorded and expressed in kilogram. Yield per hectare was calculated by multiplying the average bunch weight with the total number of plants per hectare and expressed in tonnes. Harvest Index (on fresh weight basis) was calculated as per the method suggested by Donald[11]. The data obtained from different observations during field experimentation and laboratory determination were subjected to the analysis variance by Randomized block design. Significance and non-significance of variance due to treatment effects was determined by calculating 'F' values as described by Panse and Sukhatme[21].

RESULTS AND DISCUSSION

Yield is the ultimate aim of cropping. In banana, the number of finger and hands, finger length and girth, finger weight, hand weight and bunch weight are various factors of yield. As far as the yielding components were concerned, there was a significant difference among the effect of treatments in regard of the parameters recorded after the bunch covers application.

Length and girth of the finger contribute to the commercial worthiness of a banana fruit. In the present study, variations in finger length and finger girth were found to be significant among the treatments. It is evident from the Table 1, that all the bunch cover treatments significantly increased the finger length and finger girth. The highest finger length was recorded in the T_1 (17.65 cm) followed by T_2 (17.11 cm) and T_3 (16.23 cm) whereas the control treatment recorded the lowest finger length (15.26 cm). Similar trend was observed in the case of finger girth. The girth of the finger was found highest in the bunch covered with white non-woven polypropylene bags (11.71 cm). This might be due to better filling of finger under the bunch cover treatments which had more temperature than that of open air temperature particularly during cold season. The higher temperature inside the bunch covers triggered the nitrate reductase activity in the plants. Nitrate reductase is one of the most important enzymes in the assimilation of exogenous nitrate (the predominant form of nitrogen available to green plants growing in soil) which helped in better development of the fruits. These results were in conformity with the findings of Cuneen and Entyre[8], Anon[2], Anon[3] and Choudhury[7].

Likewise, the volume was also recorded higher 149.52 cc and 140.01 cc in case of white non-woven polypropylene and blue non-woven polypropylene cover respectively, whereas it was the lowest (114.36 cc) in control. The increased volume might be due increase in length and girth of the fruit.

In case of individual fruit weight, highest value was recorded in the bunch covered with white non-woven polypropylene bags (114.78 g) whereas the control fruits recorded the lowest finger weight of 100.89 g. The higher fruit weight inside the bunch cover treatments might be due to more supply of photosynthates to the developing fruits, faster conversion of carbohydrates and better assimilation of metabolites which were again triggered by warmer temperature inside the bunch covers.

Likewise, second hand weight was found higher in the bunch covered by white non-woven polypropylene bags (2.30 kg) followed by blue non-woven polypropylene cover (2.25 kg) and transparent polyethylene cover (2.20 kg). This was attributed to increase in weight of the individual fingers, which ultimately increased the weight of the hand. Lowest second hand weight of 1.75 kg was recorded in the control bunches.

In the present study, bunch weights differed significantly among the treatments. The highest bunch weight was recorded in the bunches covered by the white non-woven polypropylene bags (18.50 kg) which was closely followed by the blue non-woven polypropylene bags (17.61 kg) and transparent polyethylene bags (17.11 kg) while the same was lowest in the bunches which were left uncovered (14.88 kg). Similar trend was also recorded by Anon[3]. The reason behind this might be increased temperature within the bunch cover. There is a positive association of temperature during shooting to harvest which

is suggestive that temperature sets a limiting factor for bunch weight. Similarly, Singh[29] and Robinson and Nel[24] indicated that with rise in the temperature an increased trend in bunch weight occur. The larger size, volume and weight of individual finger had exerted influence in augmentation of bunch weight. This result agrees to the findings of Choudhury[7], Heenan[15], Mukharjee[20] and Reddy[23] who also found higher bunch weight in the covered bunches compared to the uncovered control bunch.

Similar trend was observed in case of yield. It is evident from the Table 2, that the highest yield was registered in white non-woven polypropylene bags (115.62 t ha^{-1}) which was followed by blue-non woven polypropylene bags (110.06 t ha^{-1}) while the uncovered bunch registered the lowest yield (93.00 t ha^{-1}). The increase in finger size and weight leading to increase in bunch weight increased overall yield per hectare under various bunch cover treatment. The increased yield was not due to increase in number of fingers but mainly due to mainly due to better fruit filling of individual fingers.

Harvest index (HI) generally serves as a good index for assessing the relative efficiency of different treatments. In the present study, the harvest index was found significantly influenced by the treatments. This view is in tune with that of Bhattacharyya and Madhava Rao[19] who had enunciated that the product of total dry weight at harvest and harvest index would determine the bunch production in banana. Higher harvest index is a measure of efficacy of a treatment and also gives an indication of economic yield in relation to total biomass production. A close observation of the harvest index revealed that, highest harvest index was observed in the T_1 (0.32) which might be due to efficient partitioning of assimilates leading to the development of healthy bunch production resulting in a heavy bunch.

Table 1: Influence of bunch cover treatments on Length, girth, weight and volume of finger

Treatments	Finger length (cm)	Finger girth (cm)	Fingers volume (cc)	Finger weight (g)
T_1	17.65^{a}	11.71^{a}	149.52^{a}	114.78^{a}
T_2	17.11^{ab}	11.51^{ab}	140.01^{ab}	110.00^{b}
T_3	16.23^{bc}	11.42^{ab}	131.03^{bc}	109.56^{bc}
T_4	15.50^{cd}	11.30^{bc}	122.39^{cd}	102.11^{d}
T_5	16.07^{cd}	11.38^{abc}	128.49^{bc}	106.56^{c}
T_6	15.97^{cd}	11.28^{bc}	125.56^{cd}	106.22^{c}
T_7	15.26^{d}	11.00^{c}	114.36^{d}	100.89^{d}
S.Ed. (±)	0.43	0.17	5.57	1.53
$C.D_{0.05}$	0.93	0.36	12.14	3.34

Table 2: Influence of bunch cover treatments on weight of the 2nd hand, bunch weight, yield and harvest index

Treatments	Weight of 2nd hand (kg)	Bunch weight (kg)	Yield (t ha^{-1})	Harvest index
T_1	2.30^{a}	18.50^{a}	115.62^{a}	0.32^{a}
T_2	2.25^{a}	17.61^{ab}	110.06^{ab}	0.31^{ab}
T_3	2.20^{ab}	17.11^{bc}	106.94^{bc}	0.29^{abc}
T_4	2.03^{b}	15.83^{d}	98.89^{de}	0.27^{cd}
T_5	2.10^{ab}	16.67^{bcd}	103.12^{cd}	0.29^{abc}
T_6	2.03^{b}	16.27^{cd}	101.73^{cd}	0.28^{bcd}
T_7	1.75^{c}	14.88^{e}	93.00^{e}	0.25^{d}
S.Ed. (±)	0.10	0.43	2.77	0.02
$C.D_{0.05}$	0.23	0.94	6.03	0.04

Means within column separated by Duncan's multiple range test P = 0.05

Means followed by the same letter shown in superscript(s) are not significantly different.

CONCLUSION

From the above results it can be concluded that all the bunch cover treatments resulted in increased yield characters such as finger length, finger girth, finger volume, finger weight, weight of second hand, bunch weight and ultimately yield. White non-woven Polypropylene bags were found to be the best with 19.56% increase in yield over control.

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