Effect of male bud flower removal on yield and quality of 'Dwarf Cavendish' banana

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Abstract

Banana is commercially grown in Turkey both in open-field and under protected cultivation. The cultural practices are very similar in both banana growing systems. The removal of male buds (debelling) after the completion of female flowers is a routine cultural practice in many banana growing countries. However, the farmers in Turkey have a divided opinion on this practice whether it improves the yield and quality of bananas. This study was conducted on 'Dwarf Cavendish' cultivar in the open-field conditions in the subtropical area. The objective of the study was to evaluate the effect of the male bud flowers removal in two different stages: firstly after completion of female flowers and secondly when hermaphrodite flowers were dried on fruit filling, yields and fruit quality features. The treatments were compared with control (no treatment). The experimental results showed that the number of days for fruit filling was reduced in both treatments as compared to the control. The highest bunch weight (27 kg bunch^{-1}) was recorded when the male flowers were removed after the female flowers got dried. Compared to the control, both treatments gave better results in terms of all the investigation parameters.

Keywords: banana, open-field condition, male bud removal, yield, fruit quality

INTRODUCTION

Cultural practices such as irrigation, nutrition, pruning, sucker management, debelling, leaf pruning, bunch trimming, pest and disease control, as well as weed control affect successfully banana cultivation. It is necessary to carefully plan and follow all cultural practices for profitable banana production.

Debelling is one of the cultural practices that prevents insect vector transmission, increases yield and fruit quality, and also reduces time from shooting to harvest (Daniells et al., 1994; Ebeed et al., 2008; Mwangi and Nakato, 2009). For instance, debelling is commonly done to increase bunch weight and to remove feeding sites for pests and insects in Australia (Anonymous, 2004). The bell is removed to within 100 mm of the lowest hand of fruit after the last hand has been set. However, there is still gap whether debelling affects yield and quality of banana in Turkey condition.

O'Farrel and Daniells (1988) investigated the effect of debelling on bunch weight and fruit grades in South Johnstone, Australia. Their result showed that bunch weight was increased by 9% by debelling soon after the bottom hand being exposed and by 4% by debelling three weeks later compared to leaving the bell on. Earlier debelling was recommended in order to provide high yield and also higher fruit length.

Daniells et al. (1994) examined the effect of bunch trimming and leaf removal at flowering on maturity bronzing, yield, and other aspects of fruit quality of bananas in North Queensland, Australia. They tested four levels of leaf removal (4, 7, 10, and 13 leaves retained) and four levels of bunch trimming (male bud retained, male bud removed, male bud and 2 hands removed, male bud and 4 hands removed) at the flowering time. The result showed that removal of the male bud, practicing no bunch trimming, and ensuring the retention of at least 9-10 leaves from flowering to harvest gave the best results in terms of

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maximum yield and high fruit quality.

Ebeed et al. (2008) investigated GA_3 spray twice (just after emergence of last hand and one month later) with concentrations of 100 and 200 ppm in presence or with male bud removed on 'Grand Nain' banana bunches. The results showed that removing male bud and spraying with GA_3 had positive effect on improving yield and fruit quality. However, removal of male bud followed by GA_3 and spray at 200 ppm twice after emergence of the last hand and one month later was recommended as the promising treatment.

Mwangi and Nakato (2009) stated that *Xanthomonas* wilt of banana is a serious threat for sustainable banana production in East and Central Africa. According to their experience, the susceptibility of cultivar, environment for insect vectors, long-distance trade in bananas, lack of knowledge on disease diagnosis and management, and cultural practices are the key factors for disease spread. Harvesting of green leaf, using the clean planting materials, removal of male buds could reduce the transmission of the insects' vector.

The objective of the study was to evaluate the effect of the male bud flowers removal in two different stages on the time from shooting to harvest and some physical and chemical fruit features.

MATERIALS AND METHODS

The study was conducted in the open-field conditions in the period from 2013 to 2014 in Gazipasa (latitude 36°33'N), the province of Antalya, Turkey. Average monthly minimum mean temperature was below 14°C (around 12-13°C) only in December, January and March, whereas they were over 15°C in the other months. Annual optimum temperature was around 25°C between May and October. Average yearly relative humidity was around 60%.

'Dwarf Cavendish' cultivar was used as experimental material. The population density was about 1600 plants ha^{-1}. The soil had loamy texture, consisting of 1.3% organic matters and with pH of 7.8. A double line drip irrigation system was installed for each row. Nitrogen (NH_4SO_4) 200 g $plant^{-1}$, phosphorous (TSP) 250 g $plant^{-1}$ and potassium (KNO_3) 1000 g $plant^{-1}$ were applied to each plant during the ratoon crop. Except for the control, male bud flowers were removed in two different stages: firstly after completion of female flowers (Treatment 1: after 10-15 days from shooting) and secondly when hermaphrodite flowers are dried (Treatment 2: after 25-30 days from shooting). Fruits were harvested at the green peel stage when the fruit shape was three quarters round (75% mature). Fruits were ripened with 1000 ppm ethylene at 16°C temperature and 90% relative humidity. Finger weight, peel thickness, peels and pulp weight, peel/pulp ratio and soluble solids content were determined at stage 6 according to banana ripeness chart (Kader, 2005).

Trials were carried out in a completely randomized experimental design in three replications per 10 fruits in each replicate. The data were analyzed using analysis of variance (ANOVA). Means were separated using LSD multiple range test at 0.05 levels.

RESULTS AND DISCUSSION

The effect of male bud flowers removal at two different stages on the time from shooting to harvest, bunch weight and some fruit physical features are presented in Table 1. All the investigated parameters were statistically significant in the applied treatments comparing to the control. The time from shooting to harvest was the shortest in Treatment 1 and the longest in the control treatment. Bunch weight was found the lowest (20.68 kg) in control and the highest in Treatment 2 (27.00 kg). All the fruit physical features in both treatments were better than those in control treatment. Finger weight, finger circumference and finger length varied between 92.29-106.28 g, 10.89-11.22 cm and 19.04-20.51 cm, respectively.

According to Daniells et al. (1994), debelling can cause shortened period from the flowering to harvest and increased the yield. Our results are in agreement with the previous study in terms of period from shooting to harvest. O'Farrel and Daniells (1988) recommended earlier debelling to obtain high yield and also higher fruit length. However, according to our results, the highest bunch and finger weight were obtained in Treatment 2 (removal of male bud after hermaphrodite flowers were dried). The differences found

between the debelling times may be also result of various ecological conditions.

Table 1. The effect of different male bud removal stage on the time from shooting to harvest, bunch weight and some physical fruit features.

Treatments	Time from shooting to harvest (day)	Bunch weight (kg)	Finger weight (g)	Finger circumference (cm)	Finger length (cm)
Control	154.66 a[1]	20.68 c	92.29 c	10.89 c	19.04 b
Treatment 1	143.33 c	24.23 b	101.07 b	11.22 a	20.51 a
Treatment 2	150.00 b	27.00 a	106.28 a	11.01 b	20.47 a
LSD $_{\%5}$	1.793	2.136	2.218	0.032	0.066

[1]Means within a column followed by different letters were significantly different according to LSD test ($P \leq 0.05$).

All fruit quality features were found statistically significant in the applied treatments comparing to the control (Table 2). Finger weight was found higher at the ripening stage 6 in the Treatment 2 as before ripening time. Peel thickness and fruit pulp firmness were found higher in the control treatment. However, pulp ratio was found higher in Treatment 1. Both treatments were found in the same statistical group in terms of soluble solids content. There is no comparative study of the effect of debelling on fruit physical features after ripening.

Table 2. The effect of different male bud removal stage on some physical fruit features after ripening.

Treatments	Finger weight (g)	Peel thickness (mm)	Fruit pulp firmness (kg cm^{-2})	Peel ratio (%)	Pulp ratio (%)	Soluble solids (%)
Control	84.81 c[1]	2.81 a	0.80 a	39.35 a	60.64 c	18.20 b
Treatment 1	97.41 b	2.20 c	1.67 b	31.91 c	68.08 a	21.03 a
Treatment 2	102.97 a	2.52 b	1.68 b	35.96 b	64.02 b	21.00 a
LSD $_{\%5}$	1.384	0.045	0.016	1.798	1.798	1.053

[1]Means within a column followed by different letters were significantly different according to LSD test ($P \leq 0.05$).

CONCLUSIONS

Our experimental results showed that the earlier debelling (removal of male flower bud just after completion of female flowers) reduced the time from shooting to harvest. However, Treatment 2 (removal of male flower bud after hermaphrodite flowers were dried) gave the best results in terms of the highest bunch and finger weight, and higher soluble solids content compared to the control treatment.

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