AGRONOMIC PERFORMANCE OF SEVERAL CAVENDISH CULTIVARS (*Musa* spp. AAA) UNDER PLASTIC GREENHOUSE

PERFORMANȚELE AGRONOMICE ALE CÂTORVA CULTIVARE DE BANANE CAVENDISH (*Musa* spp. AAA) ÎN SERELE ACOPERİTE CU PLASTİC

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Abstract: *Banana is grown both in open-field and protected cultivation in Turkey. However, protected cultivation is very popular due to the high yield and quality. The present study was carried out to evaluate agronomic performance of four new banana cultivars under plastic greenhouse. Cultivars'Williams', 'MA 13', 'Jobo','CV 902' and 'Dwarf Cavendish' (control) were used as experimental material. Pseudostem circumference, pseudostem height, total number of leaves, days from shooting to harvest, bunch stalk circumference, hand and finger numbers, finger circumference and length and also bunch weight were determined according to cultivars. The lowest pseudostem circumference, pseudostem height and bunch stalk circumference were found in 'Dwarf Cavendish' and the highest in 'Williams'. Total number of leaves varied between 27 and 32. Number of days from shooting to harvest was the shortest (141 days)in 'Williams' and the longest (164 days) in 'MA 13'. The highest bunch weight (57 kg)wasobserved in'MA 13'and the lowest (42 kg) in 'Dwarf Cavendish'.In conclusion, we found that all tested cultivars were superior to 'Dwarf Cavendish' underunheated plastic greenhouse.*
Key words: *Banana, protected cultivation, cultivar, adaptation, yield, quality.*

Rezumat: *Bananele sunt cultivate atât în câmp deschis cât și în mod protejat, în Turcia. Cu toate acestea, cultivarea protejată este utilizată în mod frecvent datorită randamentului ridicat și calității ftuctelor obținute. Prezentul studiu a fost efectuat pentru a evalua performanțele agronomice a patru noi soiuri de banane, în sere tip tunel, din plastic. Cultivarele 'Williams',' MA 13',' Jobo',' CV 902 "și" Dwarf Cavendish"(martor) au fost utilizate ca material experimental. Circumferința și înălțimea, pseudotulpinii, numărul total de frunze, numărul de zile de la apariția florilor până la recoltare, circumferința mănunchiului de banane , numărul de banane intr-un mănunchi, circumferința și lungimea unei banane, dar și greutatea unui mănunchi fost determinate în funcție de soiuri. Cele mai mici valori ale circumferințe și înălțimii pseudotulpinii și a circumferinței mănunchiului de banane au fost găsite în cazul cultivarului "Dwarf Cavendish", iar cele mai mari în cazul cultivarului "Williams". Numărul total de frunze a variat între 27 și 32. Cel mai scurt număr de zile de la apariția florilor până la recoltare a fost de 141 zile, în cazul cultivarului "Williams" iar cel mai lung (164 zile), în cazul cultivarului "MA 13". Masa cea mai mare a mănunchiului (57 kg) a fost identificată în cazul 'MA 13' iar cea mai*

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mică (42 kg), în cazul cultivarului "Cavendish'. In concluzie, s-a constatat că toate soiurile testate au fost superioare cultivarului martor "Dwarf Cavendish" în sere tip tunel, de plastic, neîncălzite.
Cuvinte cheie: *Banana, cultivare protejată, cultivar, adaptare, recoltă, calitate.*

INTRODUCTION

Banana is grown mainly under tropical conditions. India, Philippines and Ecuador are the major banana producer in the world. However, banana is also grown in Egypt, South Africa, Spain, Morocco, Australia, Turkey and Israel under subtropical conditions.

Banana is the only tropical fruit grown economically in Turkey. It is grown in both open-field and protected cultivation. However, protected cultivation is more popular in Turkey as it results in high yield. Presently, banana production in Turkey is around 206.00 tonnes, whereas the total consumption is over 400.000 tonnes (FAO, 2012).

Subtropical conditions are characterized by low winter temperatures, a large difference between day and night temperatures, high and low temperature extremes in summer and winter, and low rainfall which is often poorly distributed (Smith, M.K. et. al., 1998). Therefore, protected cultivation can be recommended in subtropical conditions to prevent temperature fluctuation, to reduce frost and wind damage to banana. Besides temperature, cultivar used has a profound effect on yield and quality in banana production. The main cultivar grown in Turkey, like other subtropical regions in the world, is Dwarf Cavendish. However, bunch shape and short fingers limit potential production of this cultivar in subtropical areas. There are many studies on evaluation of cultivars for their performance in different subtropical conditions. Galan Sauco. et. al. (1998) evaluated five banana cultivars (Eylon, Zelig, Gal, 19-39, and Chinese Cavendish) in Canary Islands which foundZelig and Chinese Cavendish suitable for commercial cultivation in the Canary Islands. Ecksteinet al. (1998), examined the performance of different banana cultivars such as Williams, Chinese Cavendish and Grand Nain Israel, which are a subgroup of Cavendish grown in both open-field and greenhouse cultivation in South Africa. Grand Nain Israel and Williams were comparatively superior to Chinese Cavendish in terms of cultivar performance in both open-field and greenhouse cultivation. Ribeira, L.V.N.P. and Alcino de Silva, J. (1998) evaluated the adaptation of cultivars, Grand Nain, Williams, Zelig, Eylon and Chinese Cavendish in Madeira Island and found the cultivar Grand Nain with highest yield and pseudostem. A similar study on evaluation of performance of five banana cultivars (Valery, Lacatan, Giant Cavendish, Dwarf Cavendish, Green Red) in South Western Kenya found Valery and Giant Cavendish best suitable for cultivation due to the their high yield, good taste and strong pseudostems (Kwach, et. al., 2000). Previously, our group compared the performence of some Cavendishcultivars (AAA) under open-field and plastic greenhouse conditions in terms of yield and quality(Gubbuk et al. (2004), andwefound Williams and Grand Nainwere superior to Dwarf Cavendish for greenhouse cultivation in terms of

their yield and quality. All tested cultivars, except 'Poyo', were recommended for open field cultivation. Cabrera Cabrera and Galan Sauco (2012) compared the cultivars Gruesa and Grand Nain under protected cultivation showed that the Gruesa plants in comparison to Grand Nain plants resulting in a higher humber of leaves until bunch emerge, lower height, smaller width and a lower pseudostem height width ratio, and longer cycle producing shorter fingers.

The objective of the present study was to evaluate the agronomic performance of some of the newly introduced banana cultivars under plastic greenhouse condition.

MATERIAL AND METHOD

The study was carried out in between 2006 to 2008 in Kargıcak-Alanya (altitude 10 m, latitude 36°28' N) in the province of Antalya. Average mean yearly minimum/maximum temperatures under protected cultivation were 13.51- 27.37^{0}C and relative humidity 70-90%.

The greenhouse structure was consisted with iron structure covered with plastic and top height and height from the gutter were around 7.5 meters and 5 meters, respectively. The greenhouse was ventilated from all the sides and the top. The greenhouse was not heated during two cycles. The experimental materials were introduced from Vitropic (French Tissue Culture Company).

All plant materials propagated via meristem culture. Cultivar Williams, MA13, Jobo, CV 902 and Dwarf Cavendish (control) were used as experimental material. Plant spacing was 3 x 1.8 m (1850 plant/ha).

The soil condition consisted of pH 7.7, 1.7% lime content, loamy texture, with 2% organic matter. Irrigation and fertilization were uniformly applied as per normal recommended practices (Pekmezci et. al., 1998).

Pseudostem circumference (20 cm above the soil level), pseudostem height, total leaf number (at shooting stage), days from shooting to harvest, bunch stalk circumference (5 cm above the first hand), hand and finger numbers, finger circumference (at the center of first, middle and last hands of fingers), finger length (from end to end in a straight line) and bunch weight, were determined at harvest time according to Pekmezci et. al.(1998) and Mendez Hernandez (1998). Trials were laid out with three replications and 3 plants in each replicate in a completely randomized experimental design.

The experiment results were analyzed using analysis of variance (ANOVA). Means were separated using LSD multiple range test at 0.05 levels.

RESULT AND DISCUSSION

Pseudostem circumference and height, total leaf number and days from shooting to harvest are presented in tab. 1. The least pseudostem circumference and height (71 cm - 196 cm) was found in Dwarf Cavendish, whereas the greatest (92 cm - 314 cm) in Williams. Total leaf number was highly variable among cultivars and was on an average more than 27 per plant. Number of days from shooting to harvest differed among cultivars and was statistically significant (tab. 1). Shooting to harvest was longest in MA 13 and the shortest in Williams. The values obtained for all cultivar regarding pseudostem circumference, pseudostem height, total leaves number and shooting to harvest varied according to cultivars.

Similar results were also obtained in previousstudies (Galán Saúco et al., 1998; Eckstein et al., 1998; Kwach et al. 2000; Gubbuk et al., 2004). The outcome of the present studies clearly suggests that genotype affects morphological features and also shooting to harvest. Our results are concomitant with previous studies.

Table 1.

Pseudostem circumference, pseudostem height and total leaves number, shooting to harvest of different banana cultivar grown in plastic greenhouse in Alanya

Cultivars	Pseudostem circumference (cm)	Pseudostem height (cm)	Total leaves number (number/plant)	Shooting to harvest (day)
Williams	92.06 a	313.83 a	32.14 a	140.67 d
MA 13	88.58 b	310.16 a	29.16 b	164.00 a
Jobo	86.58 b	300.50 a	28.61bc	147.50 c
CV 902	85.07 c	282.83 b	32.00 a	159.33 b
DwarfCavendish	71.37 d	195.83 c	27.06 c	159.66 b
LSD %5	*3.12*	*14.86*	*2.27*	*1.61*

The cultivar, Williams showed the higher bunch stalk circumference including other features(tab. 2). Hand number per bunch varied among 11 (Dwarf Cavendish) and 13 (Williams) depending on the cultivars. Finger number was also statistically different and CV 902 had the highest mean finger number (258 per bunch) followed by MA 13 (255 per bunch). Our results showed that yield component such as hand and finger numbers per bunch varied within cultivars. Compared to Dwarf Cavendish, all cultivars showed the best result in yield parameters. Similar results have been obtained in other cultivars in previous works (Galán Saúco et al., 1998; Eckstein et. al., 1998; Kwach et al., 2000; Gubbuk et. al., 2004).

Table 2

Bunch stalk circumference, hand and finger numbers of different banana cultivars grown in plastic greenhouse in Alanya

Cultivars	Bunch stalk circumference (cm)	Hand number (number/bunch)	Finger number (number/bunch)
Williams	34.52 a	*13.33 a*	251.42 b
MA 13	29.75 bc	12.16 b	255.40 a
Jobo	27.83 c	11.83 b	251.70 b
CV 902	30.76 b	12.50 b	257.57 a
DwarfCavendish	24.90 d	10.67 c	224.76 c
LSD %5	***2.07***	***0.68***	***3.54***

Finger circumference and length differed significantly among the cultivars (tab. 3). Finger circumference was the highest (14) in Jobo and the lowest (12) in 'Dwarf Cavendish'. On the other hand, finger length was highest (25 cm) in MA 13 and the lowest in Dwarf Cavendish (21 cm). A significant (P <0.05) difference was also found in bunch weight among cultivars. The highest bunch weight was obtained in MA13 (57 kg) and the lowest in Dwarf Cavendish (42 kg). According to experimental results, yield parameters (finger circumference, finger length and

bunch weight) varied within cultivars. Dwarf Cavendish gave the lowest yield parameters. These results are in agreement with those obtained in our previous studies in other cultivars (Gubbuk et.al., 2004).

Table 3

Fingercircumference, fingerlengthandbunchweightof different banana cultivars grown in plastic greenhouse in Alanya

Cultivars	Fingercircumference (cm)	Finger length (cm)	Bunch weight (kg)
Williams	12.83 b	22.92 b	55.97 b
MA 13	13.41 a	24.58 a	57.42 a
Jobo	13.66 a	23.67 ab	45.92 d
CV 902	12.33 b	23.83 ab	52.00 c
Dwarfcavendish	11.00 c	21.00 c	41.78 e
LSD %5	*0.57*	*1.08*	*1.97*

CONCLUSIONS

Our studies on evaluation of the agronomic performance of the banana cultivars grown in plastic greenhouse showed the Cultivars MA 13 and Williams resulting in the best yield parameters and fruit quality, followed by CV. 902 and Jobo. Our results recommend, cultivation of all cultivars as a replacement to the main cultivar Dwarf Cavendish.

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