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Preliminary Study on the Vegetative and Reproductive Growth of Six Common Fig (*Ficus carica* L.) Cultivars in Jordan

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ABSTRACT

This research was conducted to study the vegetative and reproductive growth of six local common fig cultivars (Ajlouni, Byadi, Khartamani, Khdari, Mwazi, and Zraki). Annual growth of all six cultivars took place in two growth flushes. The major growth flush started at the beginning of April, and the minor started in the middle of May. Most of the new shoots grew at the distal nodes of the previous season's growth. Khartamani cultivar produced significantly more shoots than the cultivars Khdari and Zraki. Shoots of the cultivar Khartamani were significantly longer than shoots of all other cultivars except Byadi. There were no significant differences among Ajlouni, Khartamani, Mwazi and Zraki cultivars with respect to the number of nodes. The second crop was the major crop. The average fruiting percentage of this crop for Khartamani cultivar was significantly higher than that for the other cultivars except Mwazi and Zraki cultivars. Fruit drop started two weeks before harvest for Khartamani, Mwazi and Zraki cultivars, four weeks for Ajlouni and Byadi cultivars and six weeks for Khdari cultivar. The fruit weight of Zraki cultivar was significantly higher than the other cultivars.

KEYWORDS: breba; fig cultivars; fruiting; growth flushes; second crop.

1. INTRODUCTION

The common cultivated fig originated in Western Asia (Jackson and Looney, 1999). Most of the world's production occurs in the Mediterranean Basin, the total area planted with figs in Jordan was 567 ha (FAO, 2003), which represents about 0.64% of the total area planted with fruit trees and the production was 2600 Mt. The above figures indicate a sharp decrease in the area compared to 1991 which was 1085 ha, thus reflecting the low interest on fig tree in Jordan. This development encouraged us to give this tree, which has been grown in Jordan for a long time, more effort and interest.

Condit (1938) has classified figs into four different groups: The caprifig, the Smyrna, the white san pedro and the common fig type. The common fig is the main type grown in Jordan that includes figs, which are completely parthenocarpic under the environmental conditions best suited to their culture.

The fig carries two crops a year. The first crop, called the breba crop (locally called dafoor), is produced from fruiting buds initiated in the preceding summer. The second or main crop is produced from fruiting buds on the current season growth (Crane and Brown, 1950; Petrucci and Crane, 1950).

It is very important to understand the reproductive and vegetative growth of the fig tree properly to manage the cultural practices like pruning, training, irrigation, fertilization and application of growth regulators; this finally will lead to production improvement. Growth of fruit tree branches takes place in distinctive vegetative flushes throughout the year, which generally occur two times like in avocado (Scholefield et al., 1985), macadamia (Stephenson and Cull, 1986), apple (Lauri and Terouanne, 1998) and walnut (Sabatier and Barthelemy, 2001) or three times like in loquat (Ateyyeh

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and Qrunfleh, 1997) and citrus (Jackson and Davies, 1999) or more than three times like in mango (Willis and Marler, 1993).

In addition, understanding the bearing habits of fruit tree species concerning where the particular species produce flowers and fruits is very important in order to know how a tree responds to pruning cuts. In figs, fruiting buds occur laterally in the axils of the current or past season leaves, removing the terminal bud stimulates lateral fruit and branch buds into activity, leaf development is suppressed and the rapid development of fruit encouraged (Condit, 1926).

Therefore, this research aims to investigate the vegetative and reproductive growth of six common fig cultivars (Mwazi, Khartamani, Khdari, Zraki, Byadi and Ajlouni) which are among the most important common fig cultivars in Jordan.

2. MATERIALS AND METHODS

The field work was carried out at the experimental fig orchard at Al Mushaqar in Madaba district, which belongs to The National Center for Agricultural Research and Technology Transfer, during 2002/2003 season. The station situated at about 1000 m above sea level, the area is characterized by cold winter and hot dry summer. The average annual precipitation and temperature are 325 mm and 17.1 ^{o}C, respectively . The laboratory work was conducted in the Department of Horticulture and Crop Science, University of Jordan.

The six cultivars (Ajlouni, Byadi, Khartamani, Khdari, Mwazi, and Zraki cultivars) were replicated four times in a randomized complete-block design. Each replicate represented by a tree that is 4 years old. The trees were spaced 4 x 4 m and were uniform in size.

2.1. Vegetative Growth

Five shoots of the previous season growth distributed well around each tree were selected to study the vegetative growth, the number and position (basal, medium or distal) of new shoots growing on shoots of previous season growth were recorded. In addition to that, five new shoots distributed well around each tree were selected to measure their length and count the number of nodes.

2.2. Reproductive Growth

Five shoots of the previous season growth and another five shoots of the current growth distributed well around each tree were selected to study the reproductive growth. To investigate the first crop, the number of fruiting buds and fruits on the shoots of previous season growth were counted every 2 weeks on every node after fruiting bud initiation until fruit maturity. The same procedure was followed to study the second crop. Fruiting percentage for each cultivar was calculated as the ratio of the number of fruits to the number of fruiting buds. A representative sample of twenty fruits per tree was taken to measure fruit weight. Productivity potential of one year old shoot was estimated by using the following equation (shoot number of the 1st flush * fruit number per shoot * fruit weight).

2.3. Data Analysis

To analyze the results, the statistical program (Statistical Analysis System) from SAS Institute Corporation (SAS Institute Inc.,1999) was used. The values were analyzed by one way analysis of variance. The comparisons among the treatments were carried out by LSD test.

3. RESULTS

3.1. Vegetative Growth

There were significant differences among the cultivars with respect to the of production of new shoots, although all of cultivars had the same growth pattern. The new shoots grew in two flushes, the first growth flush, which is the major one, started at the beginning of April. It was the strongest in Khartamani cultivar and the weakest in Zraki cultivar. The other cultivars were intermediate. The second growth flush, which is the minor flush, started at the middle of May, it was significantly stronger in Khartamani and Mwazi cultivars than the other cultivars except Byadi and Khdari (Table 1). Most of the new shoots (92.8%, 81.3%, 78.3%, 86.2%, 82.2%, and 100% for Ajlouni, Byadi, Khartamani, Khdari, Mwazi and Zraki cultivars, respectively) in all studied cultivars which grew at the distal nodes of the previous season growth. There were no new shoots growing at the basal node of any of the studied cultivars**.**

Table (1): Vegetative growth of the six common fig cultivars.

Cultivars	Average no. of shoots 1st flush		Average no. of shoots 2nd flush		Total number of shoots		Average shoot length (cm)		Average number of nodes	
Khartamani	4.6	a	1.7	a	6.3	a	73.5	a	17.5	a
Zraki	1.45	c	0.4	c	1.9	c	53.8	c	15.9	ab
Byadi	3.5	ab	1.7	ab	5.2	ab	67.0	ab	14.9	bc
Khdari	2.6	bc	1.0	abc	3.6	bc	48.0	c	13.0	c
Mwazi	3.5	ab	1.8	a	5.4	ab	59.0	bc	16.0	ab
Ajlouni	4.3	ab	0.6	bc	4.8	ab	52.0	c	15.8	ab

*Means in one column followed by the same letter are not significantly different at P≥0.05.

Khartamani cultivar gave significantly more shoots than Zraki and Khdari cultivars but not than Ajlouni, Byadi and Mwazi cultivars. Shoots in Khartamani cultivar were significantly longer than those of other cultivars except Byadi, but this did not reflect on the node number since there were no significant differences between Ajlouni, Khartamani, Mwazi and Zraki cultivars (Table 1). In all cultivars, each node had two buds, in most cases, one bud differentiated to fruiting bud and the other remained vegetative, rarely the two buds remained vegetative or both of them differentiated to fruiting buds. The fruiting bud developed to multiple fruit type called syconium and the vegetative bud which remained dormant, rarely developed into new growth.

3.2. Reproductive Growth

*First Crop***.** Fruiting buds, which developed to fruits and gave the first crop, were borne on the previous season's growth. The number of these buds was very low in all cultivars. The highest fruit number was in Khdari cultivar but all fruits dropped before maturation. Fruiting percentage was zero in all cultivars except Zraki (1.88%) and Ajlouni (12.5) cultivars (Table 2).

Second Crop. Fruiting buds of the second crop, which developed on the current season's growth, started to grow two months after beginning of the first flush. Each node on the shoots of the first flush had two buds; one of them (rarely both) differentiated to floral bud, the other remained dormant until the next season. It was observed that fruiting buds differentiated firstly at the basal nodes where the shoot started firstly to mature then extended to the distal nodes.

Table (2): Reproductive growth of the six common fig cultivars.

Cultivars	Average no. of fruiting buds 2nd crop		Average no. of fruit 2nd crop		Average fruiting (%) 1st crop		Average fruiting (%) 2nd crop		Average fruit weight (g)		Productivity potential of one year old shoot (g)	
Khartamani	12.6	ab	11.5	a	0.0	b	91.2	a	21.7	b	1119.6	a
Zraki	8.6	cd	7.0	bc	1.9	b	81.4	ab	28.1	a	265.0	c
Byadi	13.1	a	1.8	d	0.0	b	13.7	d	19.9	b	120.2	d
Khdari	6.7	d	1.9	d	0.0	b	28.6	c	11.4	c	59.4	d
Mwazi	12.0	ab	9.8	ab	0.0	b	81.7	ab	23.1	b	770.7	b
Ajlouni	9.9	bc	6.7	c	12.5	a	68.1	b	11.0	c	304.9	c

*Means in one column followed by the same letter are not significantly different at P≥0.05.

The average number of fruiting buds per shoot in Byadi cultivar (13.1) was significantly higher than the others except Khartamani and Mwazi cultivars (12.55 and 12, respectively). On the other hand, the average fruit number per shoot in Khartamani cultivar (11.45) was significantly higher than that for the other cultivars except Mwazi (9.8). The average fruiting percentage of Khartamani cultivar (91.24%) was significantly higher than in the other cultivars except Mwazi and Zraki (81.67% and 81.4%, respectively) (Table 2). The number of fruits for each cultivar increased then some fruits started to drop. The date of fruit drop varied among cultivars, it started two weeks before the harvest began for Khartamani, Mwazi and Zraki cultivars, and before four weeks for Ajlouni and Byadi cultivars, and six weeks for Khdari cultivar (Figure 1).

The average fruit weight of Zraki cultivar was significantly higher than the other cultivars, and the fruit weight of Byadi, Khartamani and Mwazi cultivars was significantly higher than Ajlouni and Khdari cultivars. Productivity potential of one year old shoot of the cultivar Khartamani (1119.6) was significantly higher than in all other cultivars, the cultivars Byadi (120.2) and Khdari (59.4) had the lowest productivity potential of one year old shoot without being significantly different from each other.

4. DISCUSSION

4.1. Vegetative Growth

All studied common fig cultivars showed two vegetative growth flushes (the April growth flush, which is the major flush and the May growth flush, which is the minor flush) like in avocado (Scholefield et al., 1985), macadamia (Stephenson and Cull, 1986), apple (Lauri and Terouanne, 1998) and walnut (Sabatier and Barthelemy, 2001). The April flush was very important for the second crop, because many buds on the shoots of this flush were differentiated to fruiting buds at the same season and few of them remained dormant till the next season. The May flush was very important for first crop, because the buds on the shoots of this flush were initiated to fruiting buds for the next season's first crop, but there was no value for this crop.

To improve the first crop, it is advised to investigate heading back one year old shoots in late spring to encourage the second growth flush. Maimon (1998) pruned one year old fig trees to a height of 50 cm during summer to produce new growth for a breba crop (first crop) for the next year. However, to improve the second crop, it could be advised to investigate heading back the previous season growth in winter to encourage the first growth flush, especially for cultivars producing low shoot numbers (Khdari and Zraki cultivars). Kawamata *et al.* (2002) classified the endodormancy of the fig bud into three phases, i.e. (1) introductory (early October to early November), (2) deepest (late November) and (3) awaking phases (middle December to late January). The fig shoot can be heated or headed back at any season to get fruit-bearing shoots for double cropping or year-round production.

All studied cultivars gave high node numbers per shoot, and the lowest number of nodes per shoot was 13 for Khdari cultivar. However, not all buds on the nodes differentiated to fruiting buds, and that could be seen in the next section.

4.2. Reproductive Growth

First Crop. The average fruiting percentage was zero for all cultivars except Zraki (1.8%) and Ajlouni (12.5%) cultivars. This is an indication that these cultivars had low tendency to produce breba crop. The use of some growth regulators could improve the production of breba crop. Application of Dormex, a dormancy breaking agent, was found essential for inducing a synchronized development of figs syconia of the breba fig cultivar Nazareth (Yablowitz *et a*., 1998).

Second Crop. In all the studied cultivars, it was observed that the fruiting buds differentiated firstly at the basal nodes (except the first one) where the shoot started firstly to mature then extended to the distal nodes. The most productive part of the shoot in 'Mission' was found to be the portion consisting of the third to the fifth node from the base. Buds on the basal and distal portions of the shoots were reported to be the least productive (Petrucci and Crane, 1950). The low productivity in Zraki cultivar was due to the low number of shoots which could be improved by heading back the terminal buds during winter, while low productivity of the

Byadi and Ajlouni cultivars was due to low fruiting percentage and to the low fruit weight, respectively. The lowest productivity of the Khdari cultivar was due to low fruiting percentage and low fruit weight.

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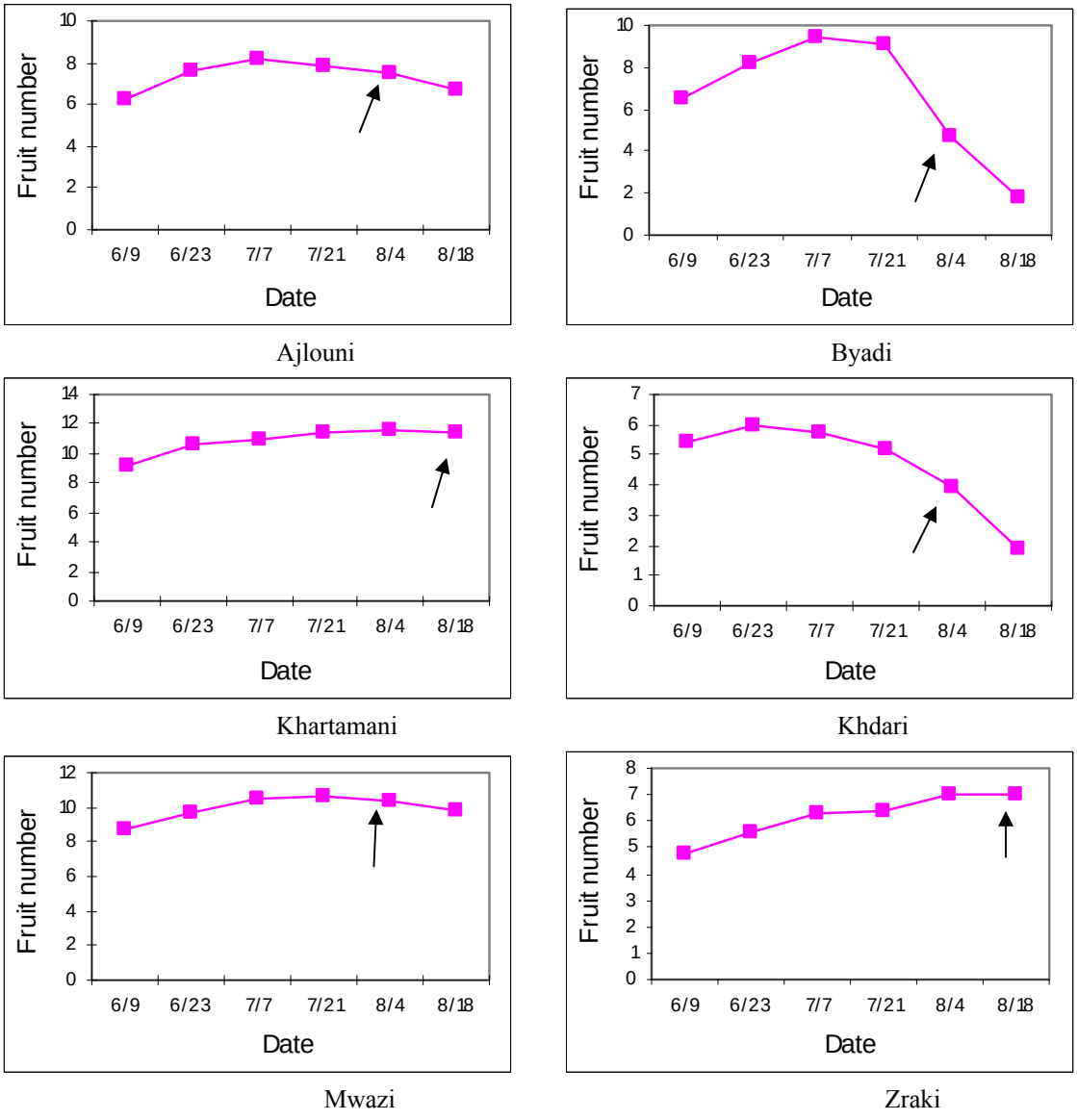

Fig. 1 Variation in the number of fruits per shoot in the second crop for six common fig cultivars (the beginning of harvesting date indicated by arrow).

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دراسة أولية للنمو الخضـري والاثمـاري لستة أصنـاف من التين العـادي في الأردن

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ملخـص

تناول هذا البحث دراسة كل من النمو الخضري والاثماري لستة أصناف من التين العادي، وهي عجلوني وبياضي وخرطماني وخضاري وموازي وزراقي. أظهرت الدراسة وجود دفعتي نمو، بدأت الرئيسة في أوائل شهر نيسان بينما بدأت الثانوية حوالي منتصف شهر أيار، وتبين أن معظم النموات الحديثة نمت على العقد القمية لنموات الموسم السابق، ونما اكبر عدد من الأفرع على أشجار الصنف خرطماني بالمقارنة مع بقية الأصناف، ومع ذلك لم يكن الفرق معنويا مع كل من الأصناف التالية: بياضي وموازي وعجلوني. تميز معدل نمو هذه الأفرع بفرق معنوي اكبر في حالة الصنف خرطماني بالمقارنة مع بقية الأصناف ما عدا الصنف بياضي. ولم يكن لهذه النتيجة أي اثر في عدد العقد؛ إذ لم يتحقق أي فرق معنوي بين الأصناف التالية: عجلوني وخرطماني وموازي وزراقي.
اعتبر المحصول الثاني هو المحصول الرئيس، وكان معدل نسبة الاثمار في المحصول الثاني للصنف خرطماني (91.24%) أعلى من بقية الأصناف، إلا أن هذه الزيادة لم تكن معنوية بالمقارنة مع الصنفين موازي وزراقي (81.67% و 81.4%, على التوالي). بدأ تساقط الثمار قبل موعد الحصاد باسبوعين لكل من الأصناف خرطماني وموازي وزراقي، وقبل أربعة أسابيع للصنفين عجلوني وبياضي وقبل ستة أسابيع في حالة الصنف خضاري. وكان متوسط وزن ثمرة الصنف زراقي اكبر معنويا من بقية الأصناف.

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