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Dormancy, flowering and sex expression in 20 olive cultivars (Olea europea L.) under Giza conditions

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Abstract

Olive cultivars differed significantly concerning the number of buds per shoot, percentage of burst buds, and floral buds borne on one-year-old shoot. Time of flowering varied in the cultivars studied differently in two successive years of investigation. It is uncertain whether chilling hours or the number of heat units influenced this phenomenon more. Sex expression depended as well on cultivar as on climatic conditions of the year.

INTRODUCTION

Olive tree was found to be a day neutral plant with an obligated low temperature requirements (H a c k e t and H a r t m a n n, 1963, 1964). Bud initiation and differentiation is greatly affected by chilling. B r o w n et al. (1962) found that the yield of olive trees was low in years with relatively high temperature at period of flower bud differentiation. It was aimed by this study to investigate the general behaviour of newly imported olive cultivars especially concerning dormancy, flowering and sex expression in relation to climatic conditions.

MATERIAL AND METHODS

A collection of 20 mediterranean olive cultivars newly imported to Egypt was chosen for this study. The trees have been grown in the experimental station of the Faculty of Agriculture Cairo University at Giza, Egypt, since 1966. This study was conducted in two successive seasons 1971 and 1972. Three trees (6 years old) were chosen of each cultivar. On each tree 40 one-year-old shoots were tagged for collecting the following data:

(1) The average number of buds borne on one-year-old shoot.

(2) Percentage of burst buds.
(3) Percentage of floral buds to the total number of buds per shoot.
(4) Blooming dates: begining, full bloom and petal fall.
(5) Percentage of perfect flowers to the total number of flowers.

Heat units calculation: Detailed information regarding the temperature changes during the whole period of investigation at Giza were obtained from the General Organization of Meteorology. The lowest temperature enabling growth in olives was considered 15°C (Azzig, 1935; cit. Morettini, 1950). Accumulated heat units (Table 4) were calculated as sum of daily mean temperature, degress below 15°C were considered 15°C (El-Azzouni et al., 1961).

Chilling hours: The accumulated chilling hours below 7.2°C were calculated during the seasons of study.

Statistical analysis: The experiment was set up in randomized blocks. The method of analysis of variance was used (Steel and Torrie, 1960). The significance of mean differences between cultivars was determined by Duncan's (1955) multiple range test. The per cent values were transformed according to Bliss.

RESULTS AND DISCUSSION

Table 1 represents number of buds per shoot in different cultivars studied. It is obvious that 'Changlot' real cv. has the lowest number of buds per shoot (28.2), while 'Picual' bears the highest number (36.8), other cultivars range in between. Per cent of buds which were completely burst on the shoot differ according to cultivar (Table 2). It is evident that these cultivars could be arranged in groups related to the percentage of buds which were completely burst during the season. 'Gordal', 'Sevillano', 'Chemlali 1', and 'Meski' could be classified in the group that has less than 40 per cent of burst buds. 'Villa longa', 'Changlot real' and 'Blanquetta' represent the second group with more than 40 to less than 50 per cent, 'Serrana', 'Mossolati', and 'Picual' represent the third with more than 50 to less than 60, 'Coratina 2', 'Chemlali 2', 'Coratina 1', 'Enduri', 'Frantoio', 'Chemlali T', 'Ouslati' and 'Arbequin' are belonging to the the fourth group which has more than 60 to 70, while the fifth group includes 'Chemlali 3' and 'Negral' with percentage of burst buds more than 70.

If we consider the percentage of buds that burst in relation to the total number of buds per shoot, one can notice that a cultivar like Gordal which bore in the average 29.5 buds, burst only 33.0 per cent of these buds. On the other hand, 'Negral' which have 33.2 buds (in average) burst more than 92.1 per cent of these buds. However, 'Picual' which was noticed to have the highest number of buds per shoot burst only 34.0 per cent of them. This leads us to a conclusion that this

Table 1

Average number of buds per shoot for different cultivars (1971)

Cultivar	No. of buds	Cultivar	No. of buds
'Changlot real'	28.2^{i}	'Chemlali T'	33.6^{bcd}
'Gordal'	29.5^{i}	'Chemlali 3'	34.2^{cde}
'Villa longa'	31.5^{a}	'Sevillano'	34.2^{cde}
'Mossolati'	32.6^{ab}	'Arbequin'	34.4^{cdef}
'Coratina 1'	33.0^{bc}	'Frantoio'	34.8^{defg}
'Enduri'	33.1^{bc}	'Ouslati'	35.0^{efg}
'Negral'	33.2^{bc}	'Coratina 2'	35.5^{efg}
'Blanquetta'	33.3^{bc}	'Chemlali 2'	35.7^{fgh}
'Meski'	33.4^{bc}	'Chemlali 1'	36.0^{gh}
'Serrana'	33.5^{bcd}	'Picual'	36.8^{h}

Table 2

Percentage of bud burst on shoots of different cultivars (1971)

Cultivar	Bud burst		Cultivar	Bud burst	
	%	angle		%	angle
'Gordal'	33.0	35.06^{a}	'Coratina 2'	62.6	52.35^{fgh}
'Sevillano'	33.1	35.12^{a}	'Chemlali 2'	62.7	52.40^{fgh}
'Chemlali 1'	35.1	36.35^{ab}	'Coratina 1'	62.8	52.42^{fgh}
'Meski'	36.1	36.94^{ab}	'Enduri'	64.6	53.51^{gh}
'Villa longa'	40.6	39.50^{abc}	'Frantoio'	65.8	54.25^{h}
'Changlot real'	41.6	40.20^{abc}	'Chemlali T'	66.1	54.41^{h}
'Blanquetta'	48.4	44.11^{cde}	'Ouslati'	66.4	54.57^{h}
'Serrana'	52.4	45.24^{de}	'Arbequin'	69.4	56.45^{h}
'Mossolati'	53.4	46.97^{efg}	'Chemlali 3'	71.0	57.95^{h}
'Picual'	54.7	47.74^{efg}	'Negral'	92.1	74.03^{i}

phenomenon might be caused by internal factors affected by chilling requirements of trees of each cultivar.

It is known that olive trees bear their flower buds laterally as mixed (C h a n d l e r, 1958) or simple (H e g a z i, 1970) in the axil of the leaves on one-year-old shoots. Flower buds were progressively more advanced in development from proximal to distal nodes which indicates that initiation had proceeded acropetally. The uppermost nodes bore vegetative buds (H e g a z i, 1970). The percentage of buds which give flowers in relation to the total number of buds on a

shoot are presented in Table 3. It could be noticed that 'Negral' had 81.5 per cent of its total buds that had been differentiated as flower buds. It is worth noticing that this cultivar developed shoots with 33.2 (in average) buds of which 92.1 per cent burst. 'Sevillano' had the lowest percentage of flower buds (33.9) carrying 34.2 buds per shoot of which only 33.1 had burst.

Table 3

Percentage of floral buds on shoots of different cultivars (1971)

Cultivar	Floral buds		Cultivar	Floral buds	
	%	angle		%	angle
'Sevillano'	23.9	29.27^{a}	'Coratina 1'	54.7	47.71^{ef}
'Chemlali 1'	28.9	32.55^{ab}	'Coratina 2'	55.8	48.35^{ef}
'Meski'	29.1	32.66^{ab}	'Chemlali 3'	57.0	49.06^{ef}
'Changlot real'	29.8	33.10^{ab}	'Chemlali 2'	57.9	49.56^{ef}
'Villa longa'	32.4	34.59^{ab}	'Frantoio'	58.3	49.81^{ef}
'Gordal'	32.8	34.81^{ab}	'Enduri'	58.3	49.81^{ef}
'Blanquetta'	35.1	36.24^{bc}	'Chemlali T'	58.9	50.12^{f}
'Mossolati'	43.9	41.52^{cd}	'Ouslati'	59.7	50.61^{f}
'Picual'	47.7	43.67^{de}	'Arbequin'	62.9	52.51^{f}
'Serrana'	50.1	44.89^{def}	'Negral'	81.5	64.59^{g}

Studies of Bosco and Michele (1970) showed that higher winter temperature (20°C) during the period preceding flower bud differentiation prevented the formation of flowers. Hartmann and Whisler (1975) found that optimum inflorescence production occurred after exposing olive trees to 80 days of low temperature (2-15°C). The range of low temperature required for inflorescence production in olives differs according to cultivar (Porlings, 1972, Hartmann and Whisler, 1975).

Blooming dates differed in the studied cultivars in the two seasons of study. Blooming started earlier in most cultivars in the second season than in the first season. There were more winter chilling hours in the second season than in the first season, whereas in general there was more heat units in the first season (Table 4). Varietal differences regarding flowering dates were not highly evident. However, 'Negral', 'Coratina 2', 'Frantoio' cvs started earlier than others (13th of April) in the first season. Blooming periods extended from 22 days in 'Negral' where it was only 12 days in 'Arbequin'. In the second season, the 'Villa longa', 'Sevillano', 'Chemlali 1' and 'Meski' which had not flowered in the first season bloomed in this season. The earliest cultivars were 'Sevillano', 'Arbequin', 'Mossolati' and 'Chemlali 3' (15th of April). The flowering period extended from 22 days in 'Changlot real', 'Blanquetta', 'Villa longa' to only 9 days in 'Enduri' cv.

Table 4

Total numbers of accumulated chilling hours and heat units corresponding to blooming dates of the studied cultivars during the two successive seasons (1971 and 1972)

Cultivar	1971			1972		
	Chilling h	Heat units		Chilling h	Heat units	
		starting	ending		starting	ending
'Gordal'		190.5	327.8		144.8	329.0
'Changlot real'		190.5	327.8		144.8	329.0
'Serrana'		181.7	301.5		126.9	281.1
'Negral		174.1	301.5		113.6	259.5
'Blanquetta'		190.5	301.5		120.8	296.8
'Villa longa'		–	–		120.8	296.8
'Sevillano'		–	–		88.8	231.5
'Picual'		186.1	301.5		136.8	296.8
'Arbequin'		198.6	301.5		88.8	220.7
'Coratina 1'	162	195.6	301.5	228	144.8	296.8
'Coratina 2'		173.5	249.0		153.6	307.5
'Mossolati'		182.0	289.6		88.8	246.2
'Enduri'		181.0	239.5		174.3	259.5
'Frantoio'		188.4	239.5		158.0	307.5
'Chemlali 1'		–	–		144.8	307.5
'Chemlali 2'		181.0	301.5		126.9	287.1
'Chemlali 3'		181.7	289.6		88.8	231.5
'Chemlali T'		181.0	239.5		144.8	307.5
'Ouslati'		181.0	239.5		158.0	287.1
'Meski'		–	–		158.0	307.5

Table 5

Percentage of perfect flowers on inflorescences of olive cultivars (1971)

Cultivar	Perfect flowers		Cultivar	Perfect flowers	
	%	angle		%	angle
'Blanquetta'	41.3	39.81^{a}	'Coratina 1'	95.6	79.10^{c}
'Picual'	51.7	46.09^{a}	'Enduri'	96.3	80.46^{c}
'Coratina 2'	66.3	56.42^{ab}	'Changlot real'	97.3	80.61^{c}
'Arbequin'	85.1	67.49^{bc}	'Chemlali 2'	97.8	81.39^{c}
'Mossolati'	85.6	69.88^{bc}	'Frantoio'	97.9	81.77^{c}
'Gordal'	86.4	70.71^{bc}	'Ouslati'	98.0	81.90^{c}
'Negral'	87.2	73.03^{bc}	'Chemlali 3'	98.5	83.16^{c}
'Serrana'	94.5	77.07^{c}	'Chemlali T'	99.6	87.14^{c}

Sex ratio in olives was considered to be related to genetical factors (M o r e t t i n i, 1951). According to the present study different cultivars were classified in groups according to their sex expression. This classification was not identical for the two seasons. In the first season, 'Blanquetta', 'Picual', and 'Coratina 2', produced less than 70 per cent perfect flowers. 'Arbequin', 'Mossolati', 'Gordal' and 'Negral' had more than 70 to 80 per cent, 'Serrana', 'Coratina 1', 'Enduri', 'Changlot real', 'Chemlali 2', 'Frantoio', 'Ouslati', 'Chemlali 3' and 'Chemlali T' had more than 90 per cent (Table 5). In the second season (Table 6), 'Negral', 'Picual' and 'Blanquetta' were lower in this percentage (less than 40). While 'Enduri' and 'Chemlali 3' produced more than 80 to 90 and other cultivars from more than 90 to less than 100 per cent perfect flowers. 'Serrana' cv. which produced 94.5 per cent perfect flowers in the first season gave less than one per cent in the second season. This extreme seasonal variation in 'Serrana' was related to the evident tendency of this cultivar towards alternate bearing which mainly was accomplished by the abortion of pistils (H e g a z i, 1973).

T a b l e 6

Percentage of perfect flowers on inflorescences of olive cultivars (1972)

Cultivar	Perfect flowers		Cultivar	Perfect flowers	
	%	angle		%	angles
'Serrana'	0.8	4.11^{f}	'Villa longa'	96.1	80.70^{bcde}
'Negral'	11.3	18.76^{a}	'Mossolati'	97.4	81.05^{bcde}
'Picual'	11.5	19.51^{a}	'Gordal'	98.2	82.79^{cde}
'Blanquetta'	39.0	38.47^{g}	'Frantoio'	98.4	84.22^{cde}
'Enduri'	89.2	70.68^{b}	'Ouslati'	98.5	84.27^{cde}
'Chemlali 3'	89.9	71.50^{b}	'Coratina 1'	99.2	85.13^{cde}
'Chemlali 1'	91.9	74.81^{bc}	'Sevillano'	99.4	85.87^{de}
'Arbequin'	94.2	76.12^{bcd}	'Chemlali 2'	99.8	88.29^{e}
'Changlot real'	95.1	78.18^{cde}			

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Spoczynek, kwitnienie i determinacja płci u 20 odmian uprawnych oliwek (*Olea europea* L.) w warunkach rejonu Giza

Streszczenie

Badane odmiany uprawne oliwek różniły się istotnie co do liczby pąków na jednorocznym pędzie, jak również co do procentowego udziału pąków pękających oraz pąków kwiatowych. Okres kwitnienia badanych odmian w dwóch kolejnych latach różnił się znacznie. Nie ma pewności czy na to zjawisko ma większy wpływ ilość dni chłodnych, czy suma temperatur. Determinacja płci uzależniona była zarówno od odmiany uprawianej, jak i warunków atmosferycznych w danym roku.