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Chemical regulation of sex expression in certain olive cultivars

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Abstract

The modifying effect of growth regulators on bud burst, flower bud formation and sex expression in olives varies greatly according to cultivar, concentration and time of application. Cycocel 200, 500 mg/l. ethephon 200 mg/l and SADH 2000 mg/l stimulated bud burst and flower bud formation in the 'Blanquetta' cv. A noticeable increase in the percentage of perfect flowers was obtained by 100 mg/l of kinetin*, and 200 mg/l of Cycocel in the cv. 'Picual', Ethephon 200/l, Cycocel 200 mg/l and SADH 2000 mg/l considerably increased the percentage of perfect flowers in the cvs 'Blanquetta', 'Serrana' and 'Picual'. Treatments at green cluster stage were not effective.

INTRODUCTION

Recent reports have given strong evidence for the possibility of modifying sex expression of some plants by certain growth regulators. It was reported that auxins modified sex expression in *Cucurbitaceae* plants ⟨Wittwer and Hilyer, 1954; Galun, 1958; Kaushik and Arora, 1969⟩. Cytokinin is also of significance in modifying the male flowers to hermaphrodite in ceratin vitis hybrids ⟨Gargiola, 1958; Negi and Olmo; 1966⟩ and in *Luffa acutangula* ⟨Bose and Nitsch, 1970⟩. Trials concerning this phenomenon have been recently shifted towards the use of ethephon, an ethylene producing agent. Sex expression of monoecious cultivars of *Cucurbitaceae* was highly influenced by treatment with this chemical ⟨ McMurray and Miller, 1969; Goerge, 1970⟩. Certain growth suppressing compounds mainly Cycocel ⟨Bose and Nitsch, 1970; Ghosh and Bose, 1970⟩ and SADH ⟨Halevy and Rudich, 1967; Bose and Nitsch, 1970⟩ were also reported as agents modifying sex expression in certain plant species.

*Abbreviations: kinetin ⟨6-furfurylaminopurine⟩, ethephon ⟨2-chloroethylene-phosphonic acid⟩, SADH ⟨succinic acid 2.2-dimethylhydrazide⟩, Cycocel ⟨2-chloroethyl ammonium chloride⟩.

In olives ⟨*Olea europea* L.⟩, the ratio of perfect to staminate flowers is a characteristic feature of each cultivar ⟨Morettini, 1951⟩. The staminate flowers are in fact a hermaphrodite in which the female organ is aborted ⟨Hegazi, 1973⟩. This phenomenon, however, as related to cultivar, is much affected by a number of environmental and endogenous factors.

The following experiments were aimed at investigation, of the possibility of modifying sex expression in certain olive cultivars by growth substances treatment in favour of differentiating a higher percentage of perfect flowers.

MATERIALS AND METHODS

The flowering behaviour and sex expression in 20 olive cultivars grown in the orchard of the Faculty of Agriculture Cairo University were previously investigated ⟨Hegazi, 1973⟩. Three cultivars characterized by a low percentage of perfect flowers were studied in two successive seasons 1972 and 1973. In the first season, three growth regulators, ethephon, Cycocel and kinetin were applied in various concentrations at two different times, January 15 ⟨prior to flower initiation⟩ and March 20 ⟨at green cluster stage⟩. Three trees ⟨7 years old⟩ were chosen from each cultivar. Each growth regulator was applied to a separate tree. Three separate limbs were chosen for various concentrations or control. Aqueous solutions of ethephon and Cycocel were applied till the drip stage. Polyethylene curtains were used to avoid drift of spraying solutions to adjacent limbs. Kinetin solutions were applied by immersing individual shoots in them for one minute. Triton b-1956 ⟨Rohm Haas Philadelphia 5, PA⟩ was applied in 0.02% to all used solutions to facilitate absorption.

In the second season, different experiments were designed, taking into consideration the results of the first season. Three growth regulators were used, ethephon, Cycocel, and SADH. Only one concentration of each regulator was used and applied to an individual tree ⟨3 replicates⟩. Spraying was conducted on January 1, prior to flower initiation. Forty shoots per treatment were tagged for collecting data concerning the percentage of burst buds in reference to the total number of buds per shoot, the percentage of flower buds, and percentage of perfect flowers in reference to the total number of flowers produced.

The recorded data was subjected to analysis of complete randomized blocks. The significance of mean differences between treatments was determined by the multiple range test ⟨Duncan, 1955⟩.

RESULTS

The data obtained in the first season indicate that different treatments with Cycocel, ethephon and kinetin dit not significantly increase the percentage of bud burst or flower buds in the cv. 'Picual'. Kinetin in a concentration of 100 mg/l and

Cycocel 200 mg/l significantly increased the percentage of perfect flowers, while the latter considerably reduced this percentage at a concentration of 1000 mg/l. In the second season Cycocel 200 and SADH 2000 mg/l increased the percentage of bud burst and floral buds. The percentage of perfect flowers was considerably higher in treatments with Cycocel 200 mg/l ethephon 200 mg/l and SADH 2000 mg/l as compared with the control ⟨Table 1⟩.

Table 1

Effect of growth substances applied prior to floral initiation on percentage of bud burst, floral buds and perfect flowers in cv. 'Picual'

Treatments mg/l	Bud burst %	Floral buds %	Perfect flowers %
	1972		
Cycocel 200	59.1 N.S	–	32.6 a
Cycocel 500	65.0 "	61.2 N.S	10.5 bcd
Cycocel 1000	61.3 "	63.3 "	18.6 ab
Ethephon 200	69.2 "	61.4 "	2.3 ae
Ethephon 400	68.1 "	61.5 "	6.4 cd
Kinetin 100	62.1 "	68.8 "	33.0 a
Kinetin 500	71.1 "	61.3 "	5.8 cde
Kinetin 1000	67.2 "	65.6 "	0.1 e
Control	63.9 "	58.4 "	10.0 bc
	1973		
Cycocel 200	35.1	26.9	79.6
Ethephon 200	19.6	16.1	74.2
SADH 2000	31.4	28.3	66.7
Control	16.4	15.2	47.8

Table 2

Effect of growth substances applied prior to floral initiation on percentage of bud burst, floral buds and perfect flowers in cv. 'Blanquetta'

Treatments mg/l	Bud burst %	Floral buds %	Perfect flowers %
	1972		
Cycocel 200	67.9 ab	60.9 a	6.7 b
Cycocel 500	69.4 ab	61.6 a	5.4 b
Cycocel 1000	59.3 bc	53.0 ab	6.7 b
Ethephon 200	70.2 a	62.4 a	49.7 a
Ethephon 400	55.6 c	45.8 b	50.3 a
Control	56.4 c	44.9 b	23.7 b
	1973		
Cycocel 200	41.2	39.7	71.3
Ethephon 200	54.8	48.5	73.8
SADH 2000	53.5	51.4	77.5
Control	30.6	35.1	42.4

In the cv.'Blanquetta', ethephon at 200 mg/l and Cycocel at 200 and 500 mg/l increased the percentage of bud burst and floral buds. The percentage of perfect flowers increased by ethephon at 200 and 400 mg/l. In the second season the percentage of burst buds and floral buds was higher in shoots treated with Cycocel 200 mg/l, ethephon 200 mg/l and SADH 2000 mg/l than in the control. The percentage of perfect flowers was increased by treatment with Cycocel 200 mg/l, ethephon 200 mg/l and SADH 2000 mg/l ⟨Table 2⟩.

The cv. 'Serrana' was subjected to treatment with Cycocel 200 mg/l, ethephon 200 mg/l and SADH 2000 mg/l in the second season. None of these treatments affected the percentage of bud burst or floral buds, while the percentage of perfect flowers was considerably higher in treated shoots in comparison with the control ⟨Table 3⟩.

Table 3

Effect of growth substances applied prior to floral initiation on percentage of bud burst, floral buds and perfect flowers in cv. 'Serrana'

Treatments mg/l	Bud burst %	Floral buds %	Perfect flowers %
	1973		
Cycocel 200	35.7	34.5	90.3
Ethephon 200	32.8	31.1	80.6
SADH 2000	41.3	27.6	99.3
Control	36.9	35.7	27.3

DISCUSSION

Trials on the effect of growth regulators on flowering behaviour and sex expression in olive cultivars comprised treatments conducted either at the time of flower initiation or at the green cluster stage. The obtained results have a preliminary character and open the way for detailed studies in the future. Some effects of growth regulators on bud burst and flower bud formation were observed and this effect was different according to the cultivar and growth regulator used. 'Blanquetta' cv. showed a higher percentage of burst and flower buds after treatments than other cultivars. The percentage of perfect flowers was clearly increased by treatments with kinetin, ethephon, Cycocel and SADH in the cultivars 'Picual', 'Serrana' and 'Blanquetta'. 'Serrana' cv. is a cultivar with an evident tendency to alternate bearing and extremely seasonal variation in the number of perfect flowers ⟨Hegazi, 1973⟩. The general response of cultivars to the treatments was characterized by varietal and seasonal variations. The percentage of perfect flowers was generally higher in the second season with all cultivars than in the first season. The two seasons were considerably different in number of chilling hours as more chilling hours were accumulated in the second

season during January and February. The average temperature in this period is critical for flower bud differentiation in olives ⟨Brown et al., 1962⟩.

The time of application is a critical factor determining the ability of growth regulators for modifying the structure of flowers. Earlier treatments prior to flower initiation were more effective while late treatments at green cluster stage showed no response.

The role of growth regulators in determining sex and their internal action in plant tissues are largely unresolved. It is known that the internal action of ethephon is confined to ethylene production. Sex expression may be regulated by the hormonal balance of ethylene and other endogenous hormones especially gibberellin which has a contrary effect, as it favours the differentiation of male flowers ⟨Wittwer and Bukovac, 1962⟩. It was found that ethephon treatment increased peroxidase and decreased IAA oxidase activity in monoecious cucumber plants. The function of peroxidase and IAA oxidase in cucumber tissues could be explained in relation to growth hormones which determine sex.

There are some indications that Cycocel increases the production of cytokinin by roots ⟨Skene, 1968⟩. This might explain the effect of Cycocel increasing femaleness through its action on the level of cytokinin which is reported as the most powerful agent in producing female flowers ⟨Bose and Nitsch, 1970⟩.

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Chemiczna regulacja ujawniania się płci u niektórych odmian oliwek

Streszczenie

Modyfikujący efekt regulatorów wzrostu na pękanie pąków, tworzenie pąków kwiatowych i ujawnianie się płci u oliwek zmienia się bardzo w zależności od odmiany rośliny oraz stężenia i czasu podania regulatora. Cycocel 200, 500 mg/l, etefon 200 mg/l i SADH 2000 mg/l stymulowały pękanie pąków i formowanie się pąków kwiatowych u odmiany 'Blanquetta'. Otrzymano znaczny procentowy wzrost liczby doskonałych kwiatów po zastosowaniu 100 mg/l kinetyny i 200 mg/l Cycocelu u odmiany 'Picual'. Etefon 200 mg/l, Cycocel 200 mg/l i SADH 2000 mg/l spowodowały wyraźny wzrost liczby kwiatów ⟨w %⟩ u odmian 'Blanquetta', 'Serrana' i 'Picual'. Zabiegi doświadczalne w stadium zielonych liści nie dały wyniku.