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Studies on Soluble Carbohydrates Role on Floral Bud Abscission in Pistachio Trees

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ABSTRACT

An experiment was conducted at Kerman Pistachio Research Station on pistachio cv. 'Ohadi'. The objective of this investigation was to determine the role of soluble carbohydrates concentration on flower bud abscission. The results showed that interaction of time and alternate bearing trees and time on soluble carbohydrates of inflorescence buds were significant but effect of alternate bearing on soluble carbohydrates concentration was not significant. Effect of interaction of time and alternate bearing trees, time and alternate bearing trees on soluble carbohydrates concentration of leaves of pistachio trees were not significant. Soluble carbohydrate of On trees declined from June to August and caused flower bud abscission. But it increased from July to August in Off trees.

Key Words: Pistachio; Floral bud; Abscission; Carbohydrates

INTRODUCTION

The pistachio tree, native to western Asia and Asia minor. Iran is the first largest producer of pistachio nuts in the world. Biennial, or irregular bearing occurs in many fruit trees. In most deciduous fruit species, few floral buds are produced in the year of heavy fruits. Alternate bearing in apples may be due to substances produced by the seed that inhibit pistillate flower formation (Chan & Cain, 1967) . Biennial bearing in pistachio result from the excessive abscission of floral buds during summer of heavy fruit nuts, causing a small fruit nuts the following year (Crane & Iwakiri, 1981) . Most pistachio floral buds abscission coincides with rapid seed growth (Crane & Nelson, 1972; Crane *et al*., 1973) , suggesting competition between floral buds and developing nuts for carbohydrates and other resources (Crane & Al-shalan, 1977; Porlingis, 1974; Takeda *et al*., 1980) .There is no report about role of carbohydrates on inflorescence bud abscission of cultivars of Iran and biennial bearing has an impact on the economic survival of pistachio producer. This experiment was designed to determine the role of soluble carbohydrates on floral bud abscission on pistachio trees.

MATERIALS AND METHODS

Experiments were conducted on pistachio 'Ohadi' trees growing at Kerman Pistachio Research Station, Dept. of Horticulture, Faculty of Agriculture, University of Tehran, Iran, during 2000-2002. Twelve 20-year-old *Pistacia vera* cv."Ohadi" trees were selected for uniform size, and canopy size. Six trees were On and six of them in their natural Off cycle. Standard commercial practices for weed control, fertilization, and irrigation of the trees were followed during the experiment. The split-plot in time as completely randomized block experiment design consisted of two On and Off trees with three replications. Ten shoots sampled on first of June, July and August and placed in an oven at 50°C until dry weight stabilized and grind. soluble carbohydrates was measured by sulfuric acid–phenol methods (Nzima *et al*., 1997) . Data were analyzed by SAS 8.2 program.

RESULTS AND DISCUSSION

The analyzed data indicated that interaction of alternate bearing trees and time on soluble carbohydrates concentration of inflorescence buds were significant $P \leq 0.05$ (Table I) .Main effect of time on soluble carbohydrate concentration of floral buds also were significant $P \leq 0.05$ (Table II) . Main effect of alternate bearing trees on soluble carbohydrates concentration of flower buds was not

Fig. 1. Effect of alternate bearing trees and time interaction on soluble carbohydrates of inflorescence buds of pistachio trees in 2000

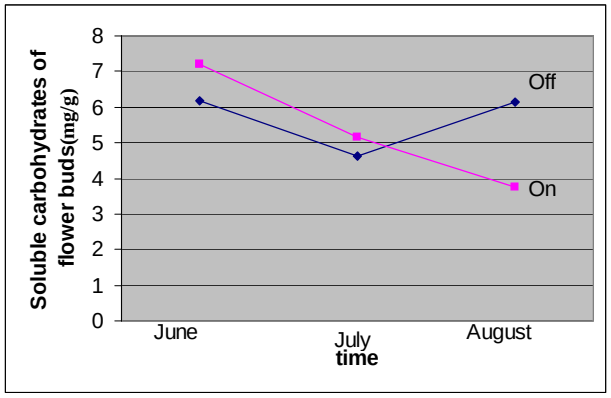


Table I. Effect of alternate bearing trees and time interaction on soluble carbohydrates of inflorescence buds and leaves of pistachio trees

Year	Time	Soluble carbohydrate Concentration of leaves (mg/g)		Soluble carbohydrate concentration of inflorescence buds (mg/g)	
		On	Off	On	Off
	June	10.78 a[z]	9.28a		7.2 a[y] 6.1ab
2000	July	7.7 a	11.9a		5.1 abc 4.6bc
	August	8.73 a	10.4a		3.7 c 6.15ab
	% Coefficient of variability		23.36		14.07
	June	15.7 a	10.8a	6.8 a	4.3bc
2002	July	9.3 a	12.3a	3.8 bc	3.5bc
	August	9.7a	11.3a	3.1c	4.8abc
	% Coefficient of variability		25.83		18.6

[z, y]Values followed with same letters within a column are not significantly different according to DMR test(P≤0.05)

significant. Main effect of alternate bearing trees, time and interaction of time and alternate bearing trees on soluble carbohydrates concentration of leaves of alternate bearing pistachio trees were not significant. Inflorescence buds of On trees had concentration of soluble sugars that were greater than those of Off trees on first of June (Table I; Fig. 1). After this time soluble carbohydrates declined in inflorescence buds of On trees (Table I; Fig. 1).

Table II. Effect of time on concentration of soluble carbohydrates of inflorescence buds and leaves of pistachio trees

Year	Time	Soluble carbohydrate of leaves (mg/g)	Soluble carbohydrate of inflorescence buds (mg/g)
	June	9.28 a[z]	6.69 a[y]
2000	July	11.19 a	4.88 ab
	August	10.41 a	4.94 b
	%Coefficient of variability	23.36	14.07
	June	10.03 a	5.77 a
2002	July	11.86 a	4.23 ab
	August	10.05 a	4.89 ab
	% Coefficient of variability	25.83	18.6

[z, y]Values followed with same letters within a column are not significantly different according to DMR test(P≤0.05).

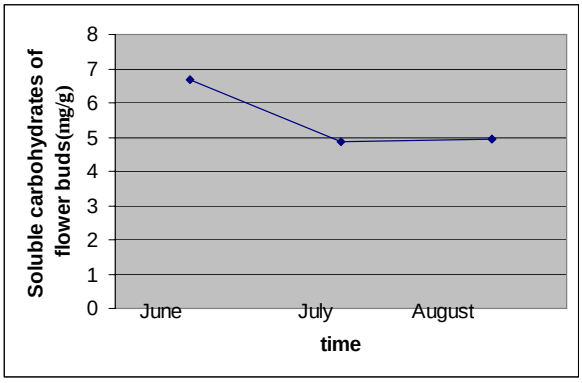
Table III. Effect of alternate bearing trees on concentration of soluble carbohydrates of inflorescence buds and leaves of pistachio trees

Year	Alternate bearing trees	Soluble carbohydrate of leaves (mg/g)	Soluble carbohydrate of inflorescence buds (mg/g)
	On	9.07 a[z]	5.36 a[y]
2000	Off	10.29 a	5.65 a
	% Coefficient of variability	23.36	14.07
	On	11.61 a	5.68 a
2002	Off	11.41 a	4.2 a
	% Coefficient of variability	25.83	18.6

[z, y]Values followed with same letters within a column are not significantly different according to DMR test(P≤0.05)

Concentration of soluble carbohydrates increased during flower bud abscission among inflorescence buds of Off trees (Table I). By the last sampling dates, inflorescence buds of Off trees had greater soluble carbohydrates concentration than those of On trees on first of August 2000 and 2002. Soluble carbohydrates of leaves of On trees on first of June was greater than Off trees and after this time soluble carbohydrates of leaves of Off trees increased compared to On trees but it was not significant. There is evidence that initial growth and development of reproductive and vegetative organs of deciduous tree species derive considerable proportion of the carbohydrate requirement from stored reserves (Ferree & Palmer, 1982; Dickson, 1989; Kozlowski, 1992; Loescher *et al*., 1985, 1990) because anthesis and fruit set precede the development of a competent photosynthetic system. The use of stored reserves by alternate bearing pistachio is unique because this involves vegetative growth during the Off year and also includes the growth of fruit, nuts and the initiation and development of inflorescence buds in the On year. Kernel development and flower buds abscission have been associated with competition for resources among fruitlets and between reproductive and vegetative organs (Lioyd, 1980; Farrington & Pate, 1981; Stephenson, 1983; Newell,

Fig. 2. Main effect of time on concentration of soluble carbohydrates of inflorescence buds pistachio trees in 2000



1987; Byer *et al*., 1991). Carbohydrate levels in heavily bearing trees or branches were implicated as a cause for bud loss (Crane *et al*., 1976; Crane & Al-shalan, 1997). At sampling date of first June each year On trees had higher concentration of soluble carbohydrates than Off trees in inflorescence buds. Carbohydrate concentration in inflorescence buds of On trees decreased until nut maturity because the buds were either weak sinks (Takeda *et al*., 1980) or inefficient in using imported photosynthates. Our results for soluble carbohydrate concentration of floral buds in the On trees are similar to those reported by Nzima *et al*. (1997). Main effect of time on soluble carbohydrates of floral buds showed that soluble carbohydrates of flower buds decreased from June to August (Fig. 2). A study of the effect of developing nuts on translocation and distribution of photosynthates from leaves revealed that most of the c14-photosynthate transported from leaves accumulated in developing nuts. Inflorescence buds competed poorly against the developing nuts for photosynthate, as those on bearing branches had about half as mach as those on non bearing branches and led to the suggestion that developing fruits induce a change in photosynthate partitioning, depleting bud carbohydrates and resulting in bud abscission (Takeda *et al.,* 1980). Irregular bearing in pecan was proposed to be related to carbohydrate whether a tree is On or Off depends on the levels of carbohydrate that accumulates during the previous season (Sparks, 1974). Thus carbohydrate deficiency in the buds may be responsible for the inflorescence buds abscission phenomenon and subsequent alternate bearing. In conclusion we submit the following.

1. On pistachio trees enter the growing season with a higher concentration of reserve soluble sugar than do Off trees.
2. Off tree inflorescence buds contained greater concentration of soluble sugar than On buds by the end of growing season

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