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Effects of Hydrogen Cyanamide on Bloom Advancement in Female Pistachio (*P. vera* L.)

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Abstract

Inadequate pollination in pistachio trees is usually due to the unstable period (delayed and/or prolonged) of blooming of the female trees, especially in areas with mild winters, as well as to the absence of the middle and late flowering *Pistacia vera* pollinators. Spraying female trees with hydrogen cyanamide during the their rest period advanced bloom by about 19 days. This advance was sufficient to allow overlap with both *P. vera* 'B' and 'C' in areas with mild winters and *P. terebinthus* and *P. vera* 'A' in cold region orchards where the middle and late flowering pollinators are usually absent. Using hydrogen cyanamide as a dormancy breaking agent the female trees produce commercial yields.

Introduction

The pistachio is dioecious, that is the staminate and pistilate flowers are on separate trees. Therefore pistachio must always be cross-pollinated. Since pollen is carried from male to female trees by light winds, male trees must be interspersed in the orchard. The standard recommendation is for one male to 7 or 8 female trees. For successful pollination the blooming of female and male trees must coincide. Male trees of the species *P. terebinthus* and *P. vera* are used as pollinators in Greece, but pollen of *P. vera* is preferred because it increases shell splitting, a characteristic highly desirable for commercially purposes. Pollen of *P. terebinthus* is shed too early to be useful in pollinating pistachio cultivars. The male *P. vera* cultivars used as pollinators in Greece are 'A' (early flowering), 'B' (middle flowering) and 'C' (late flowering).

In many pistachio orchards inadequate pollination occurs and consequently the yield is poor. This is usu-

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ally due to the unstable bloom period (delayed and/or prolonged) of the female trees, especially in areas with mild winters (Crete, Rhodos, Kos, Santorini), as well as to the absence of middle and late flowering male *P. vera* cultivars.

Hydrogen cyanamide has been found to break the dormancy effectively on grapevines (3), peaches, plum and apples (1), raspberries (5, 6) and cherries (7).

In order to overcome the problem of the inadequate pollination the dormancy breaking chemical hydrogen cyanamide was used to advance the blooming of female trees and in this way to synchronize the blooming of male and female pistachio trees.

Materials and Methods

40 year-old pistachio trees of the cultivar 'Aegenes' were selected in the pistachio orchard of the Agricultural University of Athens. The trees had moderate vigor. Three concentrations, 2%, 5% and 8% of hydrogen cyanamide (H_2CN_2) or 'Dormex' (containing 49% active ingredient, SKW Co., W. Germany) were applied on November 10, 1985, January 8, 1986, January 30, 1987 and January 8, 1988 to individual scaffold branches or single trees. The solutions were applied to run-off with a 15 L hand sprayer. The wetting agent Triton X-100 was added to the solutions at a concentration of 0.02%. Each treatment included 4 replications in a complete randomized experimental design. The dates of full bloom of treated and untreated scaffold branches or trees were recorded. The full bloom date was recorded, when 80% of flower buds were open, as well as the yield.

Figure 1. Bud opening of female pistachio trees. Left: Trees sprayed on January 8, 1986, with hydrogen cyanamide 8%.

The data were analyzed for statistical significance by analysis of variance with mean separation by Duncan's Multiple Range test.

Results and Discussion

Hydrogen cyanamide advanced blooming in the female trees by about 2-19 days depending both on the concentrations of hydrogen cyanamide and on the date of application (Table 1). Therefore blooming of the female trees was synchronized either with the blooming of the pollinators *P. terebinthus* and *P. vera* cv. A. In orchards where *P. vera* cvs. B and C. were absent or with the blooming of the pollinators *P. vera* cvs. B and C in areas with mild winters where the female trees flower later than either pollinator (Table 1). Thus the chance of pollination was improved and led to an economic yield (Table 1).

The 8% concentration was more effective than the 2 or 5% concentrations in advancing blooming of female trees (Fig. 1). Hydrogen cyanamide at 5% was significantly more effective than 2% for the January applications and at 2% was significantly more effective than the control except of the January 30 application (Table 1). None of these concentrations were phytotoxic.

The results clearly show that the hydrogen cyanamide advances bloom-

Table 1. Effects of hydrogen cyanamide (H_2CN_2) treatments on the development of flower bud and on the yield in female pistachio.

Cultivar	Concentration (%)	Application dates and days° from treatment to achieve 80% open flower buds				Application dates and time of bloom				Application dates and average of yield/tree° (Kg of dry nuts)			
		1985 Nov. 10	1986 Jan. 8	1987 Jan. 30	1988 Jan. 8	1985 Nov. 10	1986 Jan. 8	1987 Jan. 30	1988 Jan. 8	1985 Nov. 10	1986 Jan. 8	1987 Jan. 30	1988 Jan. 8
Female trees													
P. vera	2	129b°°	75b	59a	74b	13-20/3	18-26/3	22-30/3	17-25/3	12.5a°°	12.5a	11.9a	12.0a
P. vera	5	128b	68c	57b	67c	12-20/3	11-19/3	20-28/3	10-18/3	11.8a	12.5a	12.5a	11.7a
P. vera	8	127b	64d	52c	63d	11-19/3	7-15/3	15-22/3	7-14/3	12.2a	12.0a	12.2a	11.5a
P. vera+	control	140a	83a	61a	81a	24/3-1/4	26/3-3/4	24/3-1/4	24-31/3	4.0b	4.6b	6.5b	5.0b
Male trees													
P. vera cv. A	Untreated					15-27/3	16-29/3	17-29/3	16-28/3				
P. terebinthus	"					10-21/3	8-21/3	11-23/3	8-22/3				
P. vera cv. B	"					21-31/3	20-31/3	22/3-1/4	21-31/3				
P. vera cv. C	"					25/3-6/4	26/3-6/4	26/3-6/4	25/3-6/4				

°All values are means of 4 replications.
°°Mean separation in columns by Duncan's Multiple Range Test, 1% level.
+The bloom of the female *P. vera* in areas with mild winters is delayed and/or prolonged about 7-14 days in comparison with cold regions.

Table 2. Accumulative chilling and heat units from October to April at Botanikos (Athens, Greece) in the years 1985/86, 1986/87 and 1987/88, and bloom advancement in female pistachio with hydrogen cyanamide treatments. Data from the Meteorological Station at the Agricultural University of Athens.

Year (Period October-April)	Chilling units	Heat units ≥ 10°C	Application dates	Chilling units up to the treatments	Concentrations and bloom advancement in comparison to the control (days)		
					2%	5%	8%
1985/86	428	4275	Nov. 10, 1985	21	11	12	13
			Jan. 8, 1986	132	8	15	19
1986/87	1135	3051	Jan. 30, 1987	553	2	4	9
1987/88	449	3628	Jan. 8, 1988	146	7	14	17

ing in pistachio trees that have received little chilling at the application date (Tables 1, 2). The strongest effect of hydrogen cyanamide usually occurred after the accumulations about 132 chilling units according to the Utah model (2) (Tables 1, 2). Similar results have been obtained in grapevines (3, 4). No significant advancing effect of hydrogen cyanamide at 2% could be achieved in pistachio with chilling accumulation of about 553 units (Tables 1, 2). In this test period the activity of the higher concentrations has started to decrease.

Moreover, a considerable increase in leaf development was observed in the treated trees. Shell splitting was not affected by any treatment.

In conclusion, the study shows the usefulness of hydrogen cyanamide for advancing bloom in female pistachio and therefore a potential for successful pollination and commercial yields.

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