The effects of paclobutrazol (PP-333) applications on inflorescence in male pistachio trees

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SUMMARY - In this experiment, the effects of paclobutrazol (PP-333) applications on inflorescence in male pistachio trees were investigated. Zero (Control), 125, 250, 500 1000, 2000 and 4000 ppm doses of paclobutrazol were used in this work. According to the outcome of this experiment the time and period of flowering increased parallel to the increase in the doses starting from 500 ppm. In addition, the germination of pollen and shoot growths were determined.

Key words: Pistachio, inflorescence, paclobutrazol, synchronization, pollen, male tree.

RESUME - *"Les effets de l'application de paclobutrazol (PP-333) sur l'inflorescence chez les arbres mâles de pistachier". Dans cette expérience, on a étudié les effets des applications de paclobutrazol (PP-333) sur l'inflorescence chez les arbres mâles de pistachier. Des doses de zéro (témoin), 125, 250, 500, 1000, 2000 et 4000 ppm de paclobutrazol ont été utilisées dans cet essai. D'après les résultats de l'expérience, le temps et la période de floraison ont augmenté parallèlement à l'augmentation des doses à partir de 500 ppm. En outre, la germination du pollen et la croissance des pousses ont été déterminées.*

Mots-clés : *Pistache, inflorescence, paclobutrazol, synchronisation, pollen, arbre mâle.*

Introduction

Pistachio nut tree is dioecious. That means male and female flowers on separate trees (Kaşka, 1990). Pollination and fertilization are necessary to obtain seeded fruit. To provide sufficient pollination ratio of male trees should be 1/8 or 1/11 female trees. But in fact this is not enough solution for pollination. In addition, some features should be for good male pistachio trees (Ak, 1992) as below:

(i) Growth must be strong and upright.
(ii) The flowering period must be synchronize.
(iii) Flowering period of the male should be long enough to overlap with the flowering period of females.
(iv) The number of clusters must be high.
(v) Flower clusters must be big size.
(vi) The amount of pollen production (each cluster) must be high.
(vii) Yield potential must be high.
(viii) The germination rate of pollen must be high.
(ix) The pollen's viability *in vivo* must be long.
(x) It must not show alternate bearing.

As it is well known in this fruit trees protandry is common. Male flowers spreads their pollen before female flowers become receptive. However flowering period of male trees shorter than female's (Ak and Kaşka, 1993). In order to produce good yield it is necessary to the flowering time of male and female flowers synchronize.

Porlingis and Voyiatzis (1986), made a research using paclobutrazol on the male pistachio trees. Paclobutrazol sprays on male pistachio trees of cv. B delayed their flowering the following spring

without reducing to any considerable extent pollen production and formation of the flower buds in the new vegetation, or affecting pollen germination capacity.

Some chemicals used for male and female pistachio trees with mineral oil to advance their flowering period (Procopiou, 1973). Procopiou (1973) explained that late flowering of the female trees is probably due to lack of sufficient winter chilling. Spraying female trees with mineral oil-DNOC during their rest period advanced their flowering date by about 3 weeks, sufficient to overlap that of both cultivated and wild male pistachio trees, and led to an economic increase in fruit set.

Pontikis (1989) used hydrogen syanamide on bloom advancement at female pistachio. It is found that spraying female trees with hydrogen cyanamide during the their rest period advanced bloom by about 19 days. Using hydrogen cyanamide as a dormancy breaking agent the female trees produce commercial yields.

The aim of this experiment to find out effect of different paclobutrazol (PP-333) solutions on: (i) extension of pollen shedding period; (ii) germination rate of pollen and (iii) vegetative growth of shoots.

Materials and methods

Material: Three pistachio male trees which are same to each other were marked. In addition to this Siirt female variety was chosen for comparison. At Ceylanpınar state Farm in Şanlıurfa.

Methods: Paclobutrazol (PP-333) solutions were applied on each of 3 male trees 7 branches were selected and 1 per treatment was used as foliar sprays using a hand sprayer. The solutions of paclobutrazol were; 0 (zero) as control, 125, 250, 500, 1000, 2000, 4000 ppm. Plus with 1-2 drop Agral 90.

Application time: When the current shoot growth is completed (25 June 1989).

Phenological observations: In 1990 spring phenological observations were made in each applied branch. The dates at which 5-10% and 90% of anthers had dehisced in the inflorescence of each branch was recorded (Hadj-Hassan, 1985).

Rate of pollen germination (%): Pollen germination tests were performed at 25ºC using "Saturated Petri Dish" method with 15% sucrose solution (Eti, 1991).

Determination of vegetative growth (cm): In 1990 The shoot growth determined as length when the shoots growth are stopped or end of the season. That means when the apical bud was occurred.

Results and discussions

Flowering periods

As it is well known, flowering period in pistachio was late if compared other fruit trees. In Turkey flowering period occurs end of March or first week of April. Male trees spreads their pollen before unreceptive period of female pistachios. It is change some factors as well. Synchronization is very important for male and female pistachio varieties. To provide this period some chemicals can be used for this purpose (Porlingis and Voyiatzis, 1986; Pontikis, 1989). At this experiment paclobutrazol have been used for male trees to delay or extend flowering period of male pistachio trees.

The obtained results were given in Fig. 1. The pollen spreading have been occurred between 24 March - 3 April at control branches. Flowering period was between 28 March - 11 April at the female pistachios. As it is seen selected control tree was suitable for Siirt varieties. However flowering period of male control trees was shorter than 500 ppm paclobutrazol applied branches. According to observations at this year 500 ppm paclobutrazol, application suitable to synchronize Siirt female

pistachio varieties. Additionally, Beginning of flowering or pollen spreading extended increasing with doses of paclobutrazol.

Similar experiment had been done by Porlingis and Voyiatzis (1986). According to their results beginning of flowering period almost same in all of the paclobutrazol application doses. But in this experiment according to result flowering time was extended and beginning of flowering delayed related with increasing paclobutrazol doses.

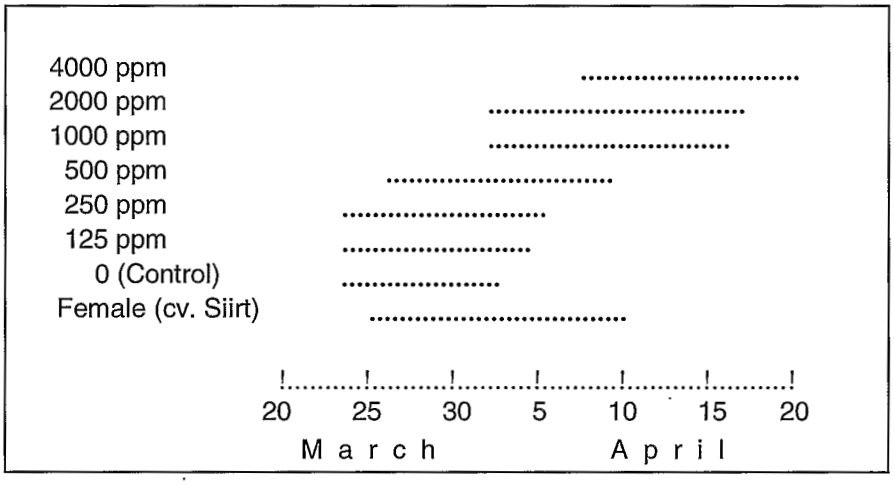

Fig. 1. Flowering time of male trees which are paclobutrazol (PP-333) applied and female (cv. Siirt) pistachio trees.

The rate of pollen germination

The effect of paclobutrazol on the pollen germination rate was observed. The obtained results presented Table 1. The best germination rate (85%) was obtained from control. The lowest germination (50%) was obtained from 250 ppm application. Similar result was obtained by Porlingis and Voyiatzis (1986).

Table 1. Germination rate of pollen obtained from paclobutrazol (PP-333) applied pistachio male trees

Doses (ppm)	Germination rate (%)
0 (Control)	85
125	54
250	50
500	65
1000	75
2000	80
4000	70

Shoot growth

Some of the Researchers were mentioned that paclobutrazol is reducing vegetative growth and increasing the generative development of different fruit trees (Miller and Swietlik, 1986; Kaşka *et al.,* 1990; Kara and Kaşka, 1991; Kaşka *et al.,* 1991). At this experiment paclobutrazol was found effective on vegetative growth of male pistachio trees When the control growth (10.16 cm) accepted %, growth

rate were changed between 83.66%-9.84% applied shoots. Pistachio grows unirrigated conditions in Turkey. Because of this reason shoot growth is limited either. This effect is undesirable. As it is seen clearly in Table 2 shoot length was decreased by increasing paclobutrazol doses. Porlingis and Voyietzis (1986) have obtained similar results their paclobutrazol applications on the male pistachio trees.

Table 2. Effect of paclobutrazol (PP-333) on vegetative growth at male pistachio trees

Application dose (ppm)	Average shoot length (cm)†	Reduction at growth (%, Comp. control)
0 (Control)	10.16	100.00
125	8.50	83.66
250	8.00	78.74
500	7.80	76.77
100	7.20	70.86
2000	4.50	44.29
4000	1.00	9.84

†Each value is average of three shoots

If the results were summarized; Pollen shedding time delayed with paclobutrazol applications. That means: (i) it can be solved protandry problem; (ii) it can be applied male and female trees to take the flowering time extension the areas where the spring frost damages occur; (iii) it can be used for breeding programs and (iv) it is harmful for pistachio orchards where it is grown under unirrigated conditions because of preventing growth of shoots.

In fact, delaying flowering period in male pistachio trees can be provide using paclobutrazol to solve protandry problem. Another solution of this problem; flowering advancement in female varieties may be provide using hydrogen cyanamide. Both of them are temporary solution for this problem. The main and permanent solution is to find suitable male trees, which some features have been mentioned in introduction, for female pistachio varieties. For this purpose suitable male selection studies have been started in Turkey and other some countries (Martínez-Palle and Herrero, 1993; Atlı *et al.,* 1995; Köroğlu and Köksal, 1995; Vargas *et al.,* 1995).

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