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THE EFFECTS OF GA3 ON SOME QUANTITATIVE AND QUALITATIVE CHARACTERISTICS OF *Pistacia vera* Var. Ohadi

[1]Saeid Kashanizadeh, [2]Asghar Mohammadbeigi, [3*]Valiollah Rasoli

[1]Scientific member, Horticulture Crops Research Department, Qazvin Agricultural and Natural Resources Research and Education Center, AREEO, Qazvin, Iran

[2]Assistant Professor, Plant Protection Research Department, Qazvin Agricultural and Natural Resources Research and Education Center, AREEO, Qazvin, Iran.

[3]Assistant Professor, Horticulture Crops Research Department, Qazvin Agricultural and Natural Resources Research and Education Center, AREEO, Qazvin, Iran.

ABSTRACT

The current study was conducted to identify the effect of gibberellic acid (GA3) on pistachio productivity, blank and split nuts. The experiments were arranged as Split plot design with five concentrations of GA3 repeated in four replications. The main plot was spray application times and subplot was GA3 concentrations applied on Ohadi cultivar. Significant differences were observed between treatments and control ($P<0.01$). There was significant difference ($P<0.01$) in quantity of crop between treatments and control. Most crop was obtained when 2500 mg/l of GA3 sprayed at 15th January. Lowest blank (10.07%) and highest split nuts (76.69%) were observed when GA3 was sprayed at 2500 mg/l concentration.

Keywords: pistachio, split nuts, blank nuts, GA3, Concentration

1. INTRODUCTION

Pistachio (*Pistacia vera* L.) is one of the most important tree crops in Iran. Currently, pistachios grow in over 360,000 ha of land in Iran. Kerman province as the most important pistachio production region with 270,000 ha pistachio cultivation, produces 77% of the total pistachio crops produced in Iran. Pistachio are also cultivated in other areas of the country such as Yazd, Khorasan, Fars, Semnan, Sistan and Baluchestan, Qazvin, Isfahan and Qom. The pistachio tree is dioecious belonging to Anacardiaceae family (the cashew or sumac family), Pistacia genus comprised of 11 species which all of them can exude turpentine or mastic. The female flower is

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apetalous (no petals) and has no nectarines, thus does not attract bees. The pollen is spread by wind so that the male trees must be planted sufficiently throughout the garden.

Phytohormones are chemical regulators produced and secreted within the plants, these substances are essential in plant physiology. Phytohormones are in fact the natural Plant Growth Regulators (PGRs) produced by plants. Plant Growth Regulators are also synthesized artificially. Five groups of Plant Growth Regulators have been known in the world which many of them are extensively used in agriculture and horticulture. For example, Gibberellins cause breaking seeds dormancy, blossom the long –day plants cultured in short- day condition and this is also able to prevent the plants from dwarfism caused by **plant viruses. From the point of chemical structures, the** Gibberellin**s are diterpenoid, so those are classed in chlorophyll and** carotene groups. Practically Gibberellins are the polymers of destructed isoprene. There are different types of Gibberellin defined by numbering such as GA1, GA2. From the standpoint of physiology and functional range, type of GA3 is the most important type between 70 types of Gibberellins which have been known in world.

Many studies have been done to show that Gibberellins are synthesized in roots and exported to the shoot in the xylem sap (Carr et al., 1964, Phillips and Jones, 1964, Reid et al., 1969, Reid and Crozier, 1971). The seeds embryo and fruits are also known as a Gibberellin production resources.

Considering that gibberellic acid (GA) has an important role in the elongation of plant organs, therefore spraying with appropriate concentration can be effective in elongation of stem and roots. However varying effects have been observed by different types of gibberellic acid.

Izzet et al (2010), studied the effects of boron and GA on pollen germination of pistachio, they found that GA had adverse effects on pollen germination of pistachio. Some studies showed that GA sprayed on pistachio was effective in generative growth and increasing of female flowers (Boyle et, al., 1994, Tzoutzoukou and Pontikis 1998). Gibberellic acid was effective in blooming, increasing of leaf area, decreasing of pistachio dried nuts weight, but it was not effective on loss of buds and fraction of pistachio nuts. Results showed that the efficacy of GA to increase the female trees blooming are depends on the doze of GA applied on the trees and the units of cold received by trees. (Tzoutzoukou and Pontikis 1998). Gibberellic acid sprayed on grape and apples increased the percent of crops significantly (Weeaver, 1960). Gibberellic acid anticipated the blooming times of pistachio 6-26 and 8-28 days in 1991 and 1992 respectively (Tzoutzoukou and Pontikis 1998). Abu-Qaoud (2007) showed that *Pistacia lentiscus* and *P. atlantica* seeds affected by scarified plus GA3 soak (1000 ppm GA3) had 34 and 39.9% germination respectively.

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It has also been demonstrated that GA are effective in flowering of many plants (Weeaver, 1960). Moldibowska (1960) showed that GA are effective in breaking the rest period of flower buds. It has also demonstrated that GA can be effective as cold period on breaking the rest period or young peach (Walker and Donoho, 1959). Lin and Crane (1984) reported the effect of GA on vegetative and in florescence buds of pistachio.

Studying of the effects of GA on florescence of peach and apple showed that GA3 sprayed on the trees in 15th January had the most effective in florescence (Paiava and Robitaille, 1987., Walker and Donoho, 1959). Tzoutzoukou and Pontikis (1998), demonstrated that the bloom advancement in female pistachio sprayed with GA3 depend on spraying concentration and time. They found that the most flowering occurred in treated pistachio trees sprayed by GA3 (20000 mg/l) in 15th December (Tzoutzoukou and Pontikis 1998).

Gibberellic acid can be recommended for females pistachio trees in warm regions, it is also recommended to coordinate the flowering of male and female pistachio trees. The low concentrations (1500 – 2000 mg/l) appear to be favourite doze because they increase blossom without any negative effect on fruit quality (Webster and Crowe 1969). Nabil and Ameen (2007), reported enhancement of germination and seedling growth of pistachio seeds soaked by GA and benzyladenine. (Nabil and Ameen, 2007). In the absence of pollination, GA applied on some variety of apples and pears stimulate the flowers to produce fruit. In some plants, spraying of GA using the appropriate dozes can perform the function of cold needed for flowering, consequently the crops will increase. Applying of GA in some plant species increase the length of the stem and root.

2. MATERIALS AND METHODS

The current study were done at Simorgh pistachio orchard, in the south of Ghazvin province, in Iran (Latitude**:** N 36° 2$'$ 29$''$, Longitude**:** E 50° 6$'$ 31$''$) for a period of 3.5 years between 2006 and 2010. The experiments were arranged as a completely randomized block design using split- plot experiment with four replicates for each treatment assayed on 25 years pistachio trees.

Spraying time was the main plot effects with three levels (a1 17 December, a2 16January, 15 February) and the doze of GA3 was subplot effect with five levels (b1= control, b2= 2500, b3= 5000, b4 = 10000 and b5= 20000 mg/l). The treatments were assayed on Ohadi pistachio cultivar. In each experimental unit 3 trees and totally 180 trees were assayed. Some traits including wet weight, dry weight, split and blank pistachio percentage were recorded after harvest. The average yield of three trees in each experimental unit was weighed. In order to evaluate the percentage of the split and blank pistachio, hundred pistachio selected from four

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bunches in four sides of a tree were assessed. Afterwards the obtained data were analyzed using MSTATC software and the means were compared using Duncan test.

3. RESULTS AND DISCUSSION

Significant differences ($P < 0.01$) were found between spraying times, concentrations of GA and their interaction for all traits (wet weight, dry weight, split and blank pistachio percentage) evaluated (Table 1).

Table 1. Compound variance analysis of characters

Source of variation	Free degree	Mean of squares			
		Dry weight	Unfilled (%)	Split nuts (%)	Wet weight
year	1	*0.182	*5.096	**0.38	** 3.274
Error	6	0.032	0.447	2.565	0.048
Spraying time	2	**1.027	**10.416	**38.929	**12.818
Year × spraying time	2	0.029	.254 ns0	*3.537	0.074
Error	12	0.033	0.185	1.104	0.163
Dosage	4	**1.619	**218.351	**41.941	**3.401
year × dosage	4	0.025	0.071	1.751	0.053
dosage × spraying time	8	*0.101	**4.871	**22.061	**0.847
year × dosage × spraying time	8	0.012	0.170	1.348	0.044
Error	72	0.044	0.618	1.432	0.119
Coefficient of variation (%)		8.43	5.40	1.69	4.58

*. Significant difference at level 0.05

**. Significant difference at 0.01

3.1 Crop dry and wet weight

Means comparison of different levels of the GA concentrations sprayed on pistachio (Ohadi cultivar) showed a significant difference in crop (dry weight). When GA was sprayed at concentration of 2500 mg/l, the mean dry weight of pistachio (1132 kg/ha) was significantly different with control. Significant difference in wet weight of pistachio was also observed between the crop obtained from the trees sprayed by GA (2500 mg/l) and control (Table 1). There was a significant difference between mean wet weight of the pistachio (8.84 kg / tree) treated by 2500 mg/l concentration of GA and control (7.41 kg/tree).

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Results showed that GA applied with 2500 mg/l was the best concentration for increasing the crop weight, while concentration of 20,000 mg/l compared to the control had no effect on crop increase (Table 1).

3.2. Split and blank percentage of pistachio

Gibberellic acid with dozes of 2500 and 5000 mg/l applied on pistachio (Ohadi cultivar) caused 76.69 and 74.46% split respectively. The aforementioned concentration were more effective than other concentrations. The lowest percentage of blank pistachio (10.07%) were also observed at the trees sprayed using 2500 mg/l concentration of GA, however the highest blank percentage (17.87%) was observed in control treatment (Table 2).

Table 2. Mean comparison in different levels of spraying times.

Time	Dry weight (kg)	Wet weight (kg)	Unfilled (%)	Split nuts (%)
A_1) 17 Dec(	^{b} 2.42	^{b} 7.37	^{b} 14.11	^{b} 71.27
A_2) 16 Jan(	^{a} 2.71	^{a} 8.38	^{b} 13.9	^{a} 71.97
A_3) 15 Feb(	^{b} 2.4	^{b} 7.33	^{a} 14.95	^{c} 69.53

Mean followed by the same letter are not significantly different at level 0.05.

Significant difference ($P < 0.01$) in quantity of crop was observed between control and lowest concentration (2500 mg/l) of GA applied on 16th January (Table 2). The interaction of different level of GA concentrations and spraying times have been shown in Table 3. As can be seen A2 B2 (concentration 2500 mg/l × spraying time 16th January) is the best compound.

Table 3. Interaction effect of the different levels mean in spraying time and dose of gibberellic acid

Interaction effect **A×B**	Dry weight **(kg)**	Wet weight **(kg)**	Unfilled (%)	Split nuts (%)
A_1B_1	2.28 ef	7.09 ef	18.15 a	66.85 g
A_1B_2	2.77 bc	8.41 bc	9.62 h	78.68 a
A_1B_3	2.67 cd	8.05 cd	12.93 efg	74.88 c
A_1B_4	2.2 f	6.78f	14.10 de	68.82 ef
A_1B_5	2.16 f	6.5f	15.77 bc	67.1 g
A_2B_1	2.48 de	7.61de	17.98 a	67.2 g
A_2B_2	3.1a	10.05 a	8.75 h	78.87 a
A_2B_3	2.88b	8.71 b	12.1 fg	76.5 b
A_2B_4	2.53 d	7.74 d	14.45 cde	68.62 f
A_2B_5	2.55 cd	7.77 cd	16.63 ab	67.67 fg
A_3B_1	2.48 de	7.52 de	17.5 a	66.8 g

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A_3B_2	2.62 cd	8.07 cd	11.85 g	72.52 d
A_3B_3	2.5 de	7.55 de	13.62 def	72.01d
A_3B_4	2.2 f	6.62 f	14.88 cd	68.03 fg
A_3B_5	2.24f	6.87 f	16.9 ab	68.27 efg

Mean followed by the same letter are not significantly different at level 0.05.

According to the results, GA sprayed at concentration of 2500 mg/l was more effective than other treatments. Mean pistachio crop (dry weight) has reached 2.83 kg per tree treated by 2500 mg/l concentration of GA which is significantly superior to the control treatment (Table 4).

Table 4. The mean comparisons in different levels of gibberellic acid's dose effect

Dose (Mg/L)	Dry weight (kg)	Wet weight (kg)	Unfilled (%)	Split nuts (%)
control	b 2.315	c 7.413	a 17.87	e 66.95
2500	a 2.833	a 8.846	e 10.07	a 76.69
5000	a 2.685	b 8.107	d 12.88	b 74.46
10000	b 2.313	d 7.052	c 14.48	c 68.82
20000	b 2.320	d 7.052	b 16.43	d 67.68

Mean followed by the same letter are not significantly different at level 0.05.

Results obtained from the current study are similar to the results of study done by Tzoutzoukou and Pontikis (1998). They found that 15th January is the most suitable time for applying GA to increase pistachio female flowers and crop. Webster and Crowe (1969) reported when GA with concentration of 2500 mg/l applied on pistachio caused an increase in crop and split pistachio percentage, this is similar to the results of the current study.

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