

Short communication

Effects of GA₃ and IBA on germination of pistachio

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ABSTRACT

Germination rates were determined following GA₃ and IBA hormone application was studied in pistachio cvs. Ohadi, Uzun and Siirt under southeastern Anatolia region. For growth period, germination rate, germination speed, seedling length and stem diameter of Ohadi with GA₃ (250 ppm) and in Siirt with IBA (100 ppm) applications were higher. The lowest germination was observed in Siirt species with IBA control, germination with lowest time and rate was determined in the 12th day by 80% in Ohadi to which 250 ppm GA₃.

Key words: Pistachio, germination, gibberellic acid, indole-butyric acid.

Pistachio production in Southeastern Anatolia Region is one of the major horticultural practices. In recent years, although an increase in area was observed, there are difficulties in finding standard rootstock for the region (Abu-Qaoud, 1; Hartman and Kester, 4). The seedlings of cvs. Ohadi, Uzun and Siirt have shown promise in the semi-arid Southeastern Anatolia following application of indole butyric acid (IBA) and gibberellic acid (GA₃). Several studies have shown that hormonal application influence the germination and also affect the seedling growth rate (Kafkas and Kaşka, 6). Hormone applications eliminate germination preventing effects shells. Thus, quick germination is possible by reducing seed dormancy by hormone application (Khan *et al.*, 7). At the same time, seed shell restricts gas exchange for the developing embryo in the seed, thus delaying the seed germination. Hormonal application improves seed germination and also negates the effect of retardants (Lorenzo *et al.*, 8). Physical and metabolic conditions had to be improved for a proper seed germination to raise rootstocks. Hence, treatment with suitable growth regulators of seeds like kinetin that is the antagonist of ABA and other inhibitors like ABA and GA₃ from outside individually or as combination has significant effects on germination (Gonzalez-Garcia *et al.*, 3).

Ak *et al.* (2), Nikpeyma *et al.* (10) and Kafkas and Kaşka (6) tried various amounts of GA₃ and IBA on widely grown pistachio cultivars in Southeastern Turkey and suggested use of GA₃ for efficient germination. The above studies were undertaken at greenhouse and southern margins of Southeastern Anatolia in the Diyarbakir region.

The research was conducted in nursery garden working area of the Diyarbakir Provincial Department of Environment and Forestry. Experimental bags (2.75 l) were filled with a mixture of loam + loamy tundra soil and burned farm manure at the rate of (1:1:1). Seeds of cvs. Ohadi, Uzun and Siirt were used for the study. In each trial, 25 seeds were pre-treated with 50, 100, 250 ppm GA₃ and IBA, and a hormone-free control. Seeds were kept in hormonal solutions for 12 h and then planted to plastic bags individually. These bags were irrigated daily with 250 ml of water at in the evening hours. Germination rate, speed, sapling length and diameter along with shoot length were measured following standard procedures. The experiment was conducted following complete randomized block design with three replications. Variation analysis was applied following GLM (General Linear Model) of SAS program. 'Duncan Multiple Comparison Test' was used in determining significant variations.

The effect of GA₃ and IBA on seed treatment of some pistachio cultivars to be used as rootstock on germination and seedling growth was found to be significant with respect to germination, sapling height, sapling diameter and shoot length (Table 1). The best germination rate (80%) was achieved within 12 days in Ohadi with 250 ppm GA₃ application. For Uzun the highest germination (80%) was recorded at 14 days with 100 ppm GA₃ treatment (Figs. 1 & 2), while it was 70% in 14 days with 250 ppm GA₃ in Siirt. The lowest germination (50%) after 15 days was registered in Siirt with 100 ppm GA₃. With IBA treatments, highest germination (60%) was accomplished after 30 days with 100 ppm followed by 33 days, 60% germination at 50 ppm level in Ohadi (Fig. 2). The lowest germination (10%) was noted in Siirt cultivar after 33 days with 100 ppm IBA application. Amongst growth regulators, GA₃ was found most responsive compared to IBA treatment. Similar results were also observed by

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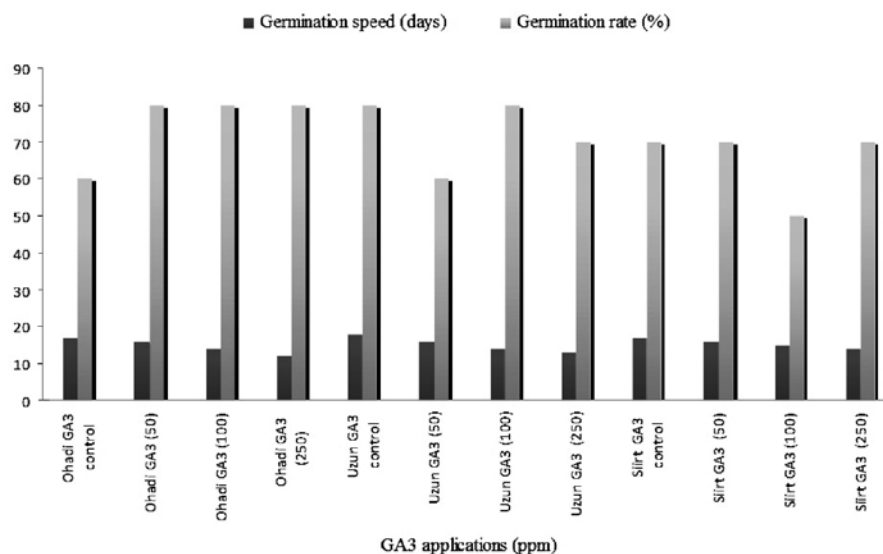


Fig. 1. Effect of GA₃ on germination speed (days) and rate in pistachio (%).

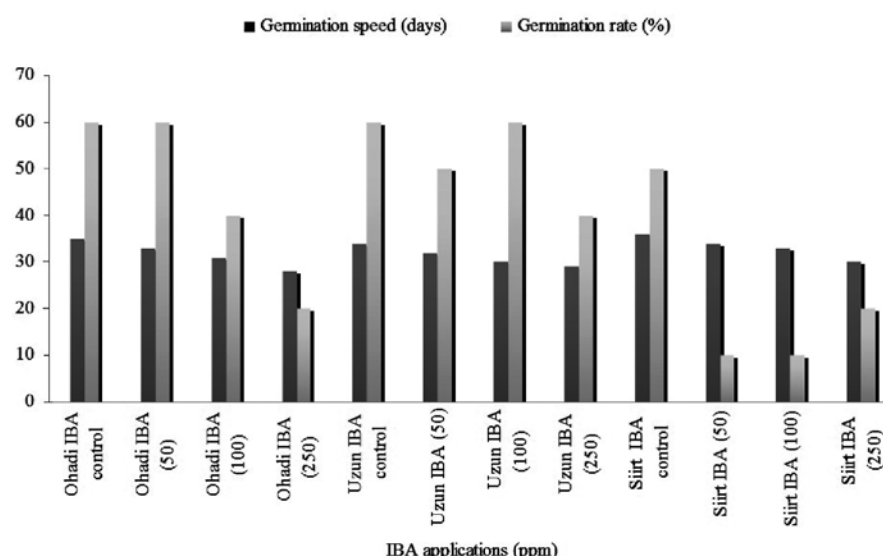


Fig. 2. Effect of IBA on germination speed (days) and rate (%) in pistachio.

several workers (Ak *et al.*, 2; Kafkas and Kaşka, 6; Nabil *et al.*, 9; Sa´nchez-Zamora *et al.*, 13).

The highest sapling height (32.25 cm) and longest shoot length (4.85 cm) were observed in cv. Ohadi, whereas the lowest sapling height (27.58 cm) and shortest shoot length (4.61 cm) were determined for Uzun (Table 1). Difference between hormone applications was statistically significant (Table 1). Although, the effect of hormone application was not significant for sapling diameter, GA₃ was effective on overall sapling height (32.12 cm), sapling diameter (0.72 cm) and shoot length (5.32 cm). Ohadi has the

highest sapling height (37.97cm) and diameter (6.32 cm) at GA₃ applied trials whereas IBA applications revealed relatively lower height (32.45 cm) and diameter (5.37 cm). In contrast, Siirt had the higher sapling length (32.89 cm), longer shoot (0.76 cm) and thicker stem diameter (5.52 cm) in IBA applied pots. It was shown that type of hormone is more important than dose level on sapling height, diameter and shoot length. Thus, GA₃ application revealed promising results for Ohadi and Uzun cultivars, IBA was more effective only for Siirt. Similarly, Nikpeyma *et al.* (10) found better grow rate at GA₃ trials particularly 250

Table 1. Effect of GA₃ and IBA treatment on seedling height, stem diameter and shoot length of some pistachio cultivars.

Particulars		Sapling height (cm)	Stem diameter (cm)	Shoot length (cm)
Cultivar (C)		*	NS	***
Ohadi	Control	35.25 ± 0.59a	0.72 ± 0.01	5.85 ± 0.13a
Siirt		29.58 ± 0.76b	0.71 ± 0.01	4.95 ± 0.13b
Uzun		27.58 ± 1.08c	0.72 ± 0.01	4.61 ± 0.14c
Hormone (H)		***	*	**
GA ₃		32.12 ± 0.70a	0.72 ± 0.01a	5.32 ± 0.13a
IBA		31.31 ± 0.78b	0.70 ± 0.01b	5.26 ± 0.12b
C × H		***	***	***
R ²		0.683	0.375	0.638
CV		1.149.036	1.041.014	1.285.523
Ohadi	GA ₃	37.97 ± 0.58a	6.32 ± 0.16a	0.75 ± 0.02a
	IBA	32.45 ± 0.76b	5.37 ± 0.15b	0.69 ± 0.02b
Siirt	GA ₃	27.20 ± 0.90b	4.54 ± 0.13b	0.68 ± 0.02b
	IBA	32.89 ± 0.83a	5.52 ± 0.18a	0.76 ± 0.01a
Uzun	GA ₃	29.62 ± 0.72a	4.82 ± 0.13a	0.74 ± 0.01a
	IBA	19.00 ± 2.12b	3.70 ± 0.22b	0.62 ± 0.02b

*P<0.05 **P<0.01 ***P<0.001

and 500 ppm doses significantly augments hairy root formation. Kafkas and Kaşka (6) also determined that Siirt and Ohadi seedlings developed better above ground parts following hormone applications.

Dry and hard nut shell of pistachio seeds blocks exchange of gases, which inhibits the germination rate. Thus, for increasing germination rate in stone fruits plant hormones of ABA, GA₃ and IBA (Weiss and Ori, 14). Harvesting time, nut drying and stratification are other factors affecting seed germination (Rouhi *et al.*, 12). The control groups did not reveal significant difference for germination. However, the quickest and highest germination (80%) was determined with 250 ppm hormone application. The best germination (80%) was achieved within 12 days in Ohadi with 250 ppm GA₃ application (Fig. 1).

Germination in IBA treated seeds was not as high as GA₃ irrespective of the cultivars. Without any stratification, germination in Ohadi with GA₃ application was 80% in 12 days. Results revealed a higher germination rate in less days with less hormone application. For sapling height, shoot length and stem diameter studied in different cultivars, Ohadi and Siirt cultivars had better height due to IBA, while in Uzun it was higher in GA₃ treatment. However, the three directional variance analyses manifested ineffectiveness of hormone doses to sapling height

irrespective of cultivar. Whereas, hormone interaction was found to be significantly effective on plant height. Overall, GA₃ was more effective than IBA for Ohadi and Uzun cultivars but for Siirt IBA hormone revealed better results. In contrast to our findings, Nikpeyma *et al.* (10) who studied rooting and germination in *P. vera*, *P. khinjuk*, *P. atlantica* and *P. terebinthus* and obtained dense hairy roots with 250 and 500 ppm GA₃. They also found better root development in Siirt and Ohadi cultivars than Kırmızı, *P. vera*, *P. khinjuk*, *P. atlantica* and *P. terebinthus* cultivars. GA₃ treatment exposed a positive effect on sapling growth.

In accordance with Nikpeyma *et al.* (10), GA₃ treatment induced better growth rate for seedlings of Ohadi and Uzun cultivars, which confirms our results. Hormone doses are not effective on shoot length and sapling height on the basis of cultivar type during the experiment period but hormone treatment enhanced all cultivars sapling and shoot growth rate. Stratification is required for better germination rate of stone fruits which needs time and labour cost. However, without stratification, the GA₃ and IBA hormone treatment in a relatively short duration (12 h) on widely grown Ohadi, Uzun and Siirt pistachio nut cultivars causing high germination.

Thus, we recommend GA₃ application to Ohadi and Uzun cultivars and IBA for Siirt pistachio nut

cultivars which can be grown in Diyarbakır in the northern margin of Turkey.

ACKNOWLEDGMENT

The authors thanks to Republic of Turkey Ministry of Environment and General Directorate of Forestry Directorate in Diyarbakır.

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Received : February, 2012; Revised : June, 2012;
Accepted : August, 2012