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Studies on the effect of various dormancy breaking treatments on pistachio (*Pistacia vera* L.) seed germination and seedling growth

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Abstract

The present study was conducted to investigate the effect of various dormancy breaking treatments on seed germination and subsequent seedling growth of pistachio nut at Mountain Agricultural Research and Extension Centre (MAREC) of CSK Himachal Pradesh Krishi Vishvavidyalaya at Sangla, district Kinnaur during 2009-2010. For this, fully matured seeds/kernals were stratified for 60 days and then subjected to soaking in GA_3 and thiourea at different concentrations and combinations for 90 minutes before sowing in the nursery beds in polyhouse. The observations on seed germination percentage, number of leaves per seedling, seedling length, number of branches and roots were recorded. Among various treatments GA_3 @ 200 ppm + thiourea @ 10,000 ppm gave maximum seed germination percentage and seedling growth and root length as compared to other treatments and seeds which were only stratified.

Key words: Pistachio, GA_3, thiourea, polyhouse, stratified seeds, root length.

Introduction

Pistachio nut is one of the most expansive among other nut crops being grown in various parts of the world; it belongs to the family Anacardiaceae of which other commercially grown fruits are mango and cashewnut. The total area under its cultivation in world is 5, 86, 224 ha with annual production of 6, 33, 582 MT (FAO, 2009) and Iran is the leading pistachio nut producing country in the world with annual production of 2, 55, 000 MT contributing about 40.25 % of the total production (FAO, 2009).

In India attempts of its cultivation was made as early as 1985 at the Regional Horticultural Reaserch Station, Sharbo in Kinnaur district of Himachal Pradesh (Thakur, 2010) as this area has congenial climatic conditions to cultivate it. It requires about 600 to 1500 chilling hours to break dormancy and cannot tolerate excessive humidity and rainfall in summer. The areas having long hot and dry summer are best suited for its cultivation, but frost during flowering hampers the fruit set and kills newly emerging buds (Khan *et al.*, 1999).

Its cultivation in India is at nascent stage and we don't have wild relatives of this species to use as rootstocks, though some wild species of *Pistacia* are found growing in district Kinnaur particularly in areas characterized by no or occurrence of very less rainfall during summers and heavy snowfall in winters, these are Spillow, Jangi, Kanam and Pooh. Until now studies on their compatibility and feasibility as rootstocks has not been carried out. Most of the pistachio growing

countries are using *P. atlantica, P. terebinthus* and *P. integerimma* as rootstocks; generally it is propagated by budding or grafting scions onto these rootstocks. These rootstock species are used because of their vigour and resistance to nematodes and soil borne fungi. There are reports that pistachio shows difficulty in seed germination under ordinary conditions that might be due to their hard seed coat or other physiological barriers. But dehulling or splitting, soaking in water, acid scarification, treating with gibberellic acid and stratification increased germination rate of pistachio seeds (Crane and Ford, 1974; Kaka *et al.*, 1992). Therefore, an attempt was made to see the effects gibberellic acid and thiourea on seed germination and subsequent growth of pistachio seedlings at CSKHPKV Mountain Agricultural Research and Extension Centre Sangla, Kinnaur Himachal Pradesh, India during 2009-10.

Materials and Methods

The CSKHPKV Mountain Agricultural Research and Extension Centre, Sangla district Kinnaur is situated at an elevation of 2590 m above mean sea level which represents typical dry temperate zone of Himachal Pradesh. The area is characterized by very low to moderate rainfall in summer and in winters there is occurrence of heavy snowfall with very low temperature, particularly from the month of December to March. The soil is predominantly sandy loam in texture and neutral to slight alkaline in reaction.

For this study, seeds/kernals of pistachio (*Pistacia vera*) were collected from the Research Sub-Station Leo Kinnaur HP in October 2009 and kept as such in the Laboratory at CSKHPKV Mountain Agricultural Research and Extension Centre Sangla at room temperature. Then these seeds were transferred in pots filled with sand + soil + FYM in equal proportion and were kept in refrigerator for 60 days at temperature of 6-7 ^{0}C. After that these seeds were removed from pots and were soaked in solutions of GA_3 and thiourea singly or in different combinations for 90 minutes prior to sowing in nursery beds in polyhouse. The treatments comprised of GA_3 at 100 and 200 ppm, thiourea at 10, 000 and 20, 000 ppm, GA_3 + thiourea (100 ppm+ 20, 000 ppm and 200 +10, 000 ppm), stratified and soaked in ordinary water and no treatment, sown directly from pot (control). The treatments were replicated thrice and experiment was laid in Randomized Block Design. The observations on germination of seeds, number of leaves per seedling, seedling height and root length were recorded and analysed accordingly. The data thus obtained was analysed for LSD at 0.5 % as per procedure described by Gomez and Gomez (1984).

Results and Discussions

Seed germination

It is clear from the data presented in Table 1 that none of the treatments could exert any significant effect on number of days taken to germination of seeds

whereas; the per cent seed germination was significantly affected by the treatments. The stratified seeds along with application of GA_3 and thiourea alone or in different combinations caused more seeds to germinate as compared to seeds which were either stratified for 60 days or stratified + soaked in water for 90 minutes before sowing. The maximum seed germination percentage (30.95%) was observed in those seeds which were treated with combined solution of GA_3 + thiourea (200 ppm + 10,000 ppm,), whereas, the seeds which were only stratified or soaked in water registered minimum (11.40% and 14.41% respectively) percentage of germination. In this study, it was observed that the overall seed germination was very poor, it might be due to blankness of the seeds, although only those seeds were selected which were appearing healthy and did not float in water when they were submerged. In a study conducted by Khan *et al.* (1999) reported that application of KNO_3 at 1 % significantly increased seed germination of three species of pistachio cv. wild. However, GA_3 gave slight less percentage of seed germination but it was significantly higher than control. In contrary to this, AK *et al.* (1995) reported improvement in seed germination of pistachio when treated with GA_3 at different concentrations similarly, the best results were obtained when seeds of *P. khinjuk* and *P. atlantica* were removed from their green hulls and soaked in 100 ppm GA_3 for 7 days before sowing (Kuru and Aksu 1995). Ak (1990), reported positive correlation between stratification period and germination percentage in two pistachio species (*P. vera* and *P. Khinjuk*) and postulated the significant effects of pre treatments on germination percentages might be due to scarification of all the seeds. Cetinbas and Koyuncu (2006) also observed increased seed germination in cherry when they were treated with GA_3, KNO_3 and thiourea. Similarly, Bhan and Sharma (2011) also observed higher percentage of wild apricot kernel germination when they were stratified and given GA_3, thiourea and KNO_3 in different concentrations as compared to seeds which were only stratified and not given any chemical treatments.

Seedling growth

Both gibberellic acid and thiourea significantly influenced the growth of pistachio seedlings (Table 1). The combined treatment of gibberellic acid at 200 ppm and thoiurea at 10, 000 ppm produced tallest seedlings (56.15 cm), whereas, the seedling growth was minimum (18.23 cm) when seeds were either stratified or stratified and soaked in water for 90 minutes before sowing. Similarly, the intermodal length and seedling diameter was also more in those seedlings which were treated with these chemicals. All seedlings which were

treated with either gibberellic acid alone or in combination with thiourea recorded better growth and attained graftable size in one year; it might be due to the fact that both GA_3 and thiourea may have reactivated the metabolic activity of the seeds and further helped in elongation of seedlings. Similarly, thiourea might have supplemented additional nitrogen to the plants which resulted more growth and GA_3 might have increased intermodal length of seedlings. These findings are in line with Khan *et al.* (1999) who also reported application of KNO_3 to pistachio seeds significantly increased their growth and postulated that KNO_3 might have triggered metabolic activities which helped seedlings to synthesize more auxins. Similarly, Ak *et al.* (1995) also observed more seedling growth in pistachio when the seeds were treated with GA_3 at 500 ppm for 48 hours before sowing.

Number of leaves and root growth

It was observed that seedlings having maximum height produced more number of leaves (Table 1 & 2) and treatments of gibberellic acid and thiourea applied singly or in different combinations significantly influenced the number of leaves per seedlings. The maximum number of leaves (22.13/seedling) were observed when seeds were treated with reports of Khattak *et al* (1991); Westwood, (1993) and Khan *et al.* (1999). Isfendiyaroglu *et al.* (1999) postulated that the amount of certain flavonoid and phenlpropane substances played a significant role during the seed germination GA_3 and thiourea (200 + 10,000 ppm), closely followed by same combination at 100 + 20, 000 ppm respectively (17.15/seedling). The other treatments also produced more number of leaves as compared to seeds which were either stratified or treated with water (4.86 and 5.25/seedling). Similarly, the root length and number of roots per seedling were also significantly affected by these treatments. The maximum root length (20.86 cm) was observed with same treatment i.e. GA_3 + thiourea at 200 ppm + 10, 000 ppm, followed by GA_3 + thiourea at 100 ppm + 20,000 ppm respectively. The shortest roots were observed in seedlings which were either soaked in water or only stratified. The maximum number (19.33) of roots per seedling was found in seedlings which were subjected to GA_3 + thiourea at 200 +10,000 ppm and least (3.60) number of roots in seedlings whose seeds were only stratified for 60 days. However, the seeds which were soaked in water for 90 minutes also produced seedlings with lesser number of roots as compared to other treatments. The seedlings having better shoot and root growth by GA_3 + thiourea might be due to their positive effect on biosynthesis of other growth promoters such as auxins that ultimately triggered the growth of embryo. These findings are in line with the earlier of pistachio. They also reported that application of GA_3 to the stratified seeds of pistachio improved seed germination and better shoot and root growth when compared with the seeds which were only stratified.

Table 1. Effect of gibberellic acid, thiourea and their combinations on seed germination and seedling growth of pistachio nut

Treatments	Number of days taken to germination	Germination per cent	Seedling length (cm)	Internodal length (cm)	Seedling diameter (mm)
GA_3 100 ppm	44.00	14.27(22.15)*	40.50	2.10	0.59
GA_3 200 ppm	43.67	18.91(25.74)	48.32	2.45	0.64
GA_3 100 + thiourea 20,000 ppm	44.67	19.97(26.52)	50.40	2.33	0.67
GA_3 200 ppm + thiourea 10,000 ppm	44.33	26.52(30.95)	56.15	2.55	0.80
Thiourea 10,000 ppm	43.00	12.26 (20.46)	30.19	1.30	0.46
Thiourea 20,000 ppm	43.33	14.23 (22.15)	35.01	1.52	0.41
Water	44.00	6.26 (14.41)	20.03	1.25	0.31
Control (stratified)	43.33	4.05 (11.40)	18.23	1.55	0.30
CD (P=0.05)	NS	3.19 (2.85)	4.15	0.98	0.05
SE		1.5 (1.26)	2.49	0.35	0.03

*The values in parenthesis are arcsine transformation

Table 2. Effect of gibberellic acid, thiourea and their combinations on number of leaves, root length and number of roots per seedling

Treatments	No. of leaves per seedlings	Root length (cm)	No. of roots per seedlings
GA_3 100 ppm	12.61	13.66	8.22
GA_3 200 ppm	16.64	16.09	11.76
GA_3 100 + thiourea 20, 000 ppm	17.15	17.43	14.45
GA_3 200 ppm + thiourea 10000 ppm	22.13	20.86	19.33
Thiourea 10, 000 ppm	7.18	10.17	8.32
Thiourea 20, 000 ppm	9.38	11.92	9.33
Water	4.86	8.99	4.67
Control (stratified)	5.25	7.78	3.60
CD (P=0.05)	2.75	1.69	1.60
SE	1.36	0.98	0.76

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