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Effect of stratification and growth regulators on germination and seedling growth of pecan

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Abstract

The effect of different stratification periods followed by soaking of pecan nuts in varying concentrations of growth regulators on germination percentage and growth of pecan seedlings was studied. Treatment of pecan nuts with GA_3 after stratification for certain period increased germination percentage and seedling growth. Maximum value for germination percentage and seedling height was obtained in the nuts treated with GA_3 2000 ppm. Nuts stratified for 6 weeks recorded maximum germination percentage. Thus, maximum germination percentage was obtained in the nuts treated with GA_3 2000 ppm after 6 weeks stratification. Seedling diameter was maximum in GA_3 500 ppm + thiourea 1% treatment. Root length was maximum in nuts treated with GA_3 250 ppm. Longer periods of stratification gave higher values of growth parameters.

Keywords: Pecan nut, stratification, germination percentage, GA_3, thiourea.

Introduction

Pecan is a promising nut crop of northwestern Himalayan region. Most of the plantations of pecan are of seedling origin due to the non-availability of vegetatively propagated plants in sufficient numbers. Thus the seedlings are important not only for rootstock purpose but also for *in-situ* plantations. The low germination capacity, mortality due to rodents and high cost of nuts render the pecan nursery raising a less profitable proposition. The germination of pecan is low due to mechanical and chemical barriers. Non-stratified pecan nuts did not germinate quickly and uniformly. Pecan shell is freely permeable to water and gases but retards germination by mechanically restricting radical elongation (Staden and Dimalla, 1976). Stratification can substantially reduce the time of germination, improve the uniformity of germination and increase growth of the seedlings (Sparks *et al.*, 1974 and Madden *et al.*, 1977), but very little information is available on the pre-sowing treatments of pecan nuts with gibberellins (Knox and Smith, 1981). However, no such work on pecan has been done in India. Therefore, the present studies were carried out to find out the effect of stratification followed by treatments with gibberellins and thiourea on germination and seedling growth of pecan nuts.

Material and Methods

The experiment was carried out in the nursery of department of Horticulture, CSK HPKV, Palampur during 2006. Fresh and healthy nuts of uniform size were subjected to stratification on different dates for 2, 4, 6 and 8 weeks, such that the differential period of stratification could be completed on the same day. The coarse river sand was used as a medium for stratification. Stratified nuts were treated with 4 levels of GA_3 (250, 500, 1000 and 2000ppm); 2 levels of thiourea (1 and 3%) and 4 combinations of GA_3 + Thiourea (250ppm +1%, 250ppm + 3%, 500ppm + 1% and 500ppm + 3%). Control consisted of stratified and non-stratified nuts without chemical treatments. The nuts were sown after stratification in the nursery beds during first week of March, 2006 and the experiment was laid out in Randomized Block Factorial design. Twenty-five nuts were used per treatment and replicated 4 times.

The observations on germination were recorded during active growing season whereas, seedling height, diameter and root length were recorded in first week of November at the time of growth cessation.

Results and Discussion

Germination percentage

Perusal of the data given in table 1 revealed that the use of growth regulators, stratification period and their interaction

influenced the nut germination significantly. There was an increase in germination percentage with increased duration of stratification periods upto 6 weeks and thereafter non- significant decrease was observed. Maximum germination percentage (35.09) was recorded in the nuts stratified for 6 weeks, which was statistically at par with 8 weeks stratification period whereas, minimum germination was observed in non-stratified nuts. This increase in germination due to stratification may be because of the reason that it resulted in breaking of the physiological dormancy and increased endogenous GA levels.

Table 1. Effect of stratification periods and growth regulators on germination (%)

Growth regulators	Stratification period (weeks)					Mean
	0	2	4	6	8	
GA_3 250 ppm	22.0	24.0	26.0	28.0	26.0	25.20
GA_3 500 ppm	22.0	25.0	27.0	28.0	27.0	25.80
GA_3 1000 ppm	27.0	38.0	41.0	50.0	48.0	40.80
GA_3 2000 ppm	41.0	41.0	46.0	60.0	58.0	49.20
Thiourea 1 %	27.0	29.0	30.0	44.0	43.0	34.60
Thiourea 3 %	19.0	20.0	22.0	23.0	22.0	21.20
GA_3 250 ppm + Thiourea 1%	25.0	27.0	27.0	33.0	32.0	28.80
GA_3 250 ppm + Thiourea 3%	21.0	21.0	22.0	23.0	23.0	22.00
GA_3 500 ppm + Thiourea 1%	36.0	35.0	36.0	46.0	44.0	39.40
GA_3 500 ppm + Thiourea 3%	22.0	24.0	23.0	26.0	26.0	24.20
Control	22.0	23.0	24.0	25.0	27.0	24.20
Mean	25.81	27.91	29.45	35.09	34.18	-

CD (P=0.05)

Growth regulators = 1.79
Stratification = 1.21
Growth regulators X stratification = 4.00

Treatment of pecan nuts with higher levels of GA_3 resulted in higher germination. Nuts treated with GA_3 2000ppm had maximum germination percentage (49.20), whereas, minimum germination percentage (21.20) was obtained in the nuts treated with thiourea 3 per cent as compared to 24.2 per cent in control. Improvement in germination with GA was also recorded in walnut by Gaur (1980). These findings are also in agreement with the results of Chauhan *et al.* (1992) who observed improvement in germination of walnut by GA treatment and minimum germination was recorded under higher level of thiourea i.e. 3 per cent. In the present studies, treatment of nuts with GA_3 might be responsible for increase in endogenous GA level resulting in higher germination.

Among the interaction between stratification and growth regulators, nuts stratified for 6 weeks followed by GA_3 2000 ppm had maximum germination percentage (60.0) closely followed by 8 weeks stratification with same concentration of GA_3. Lowest germination percentage (19.0) was recorded in the non-stratified nuts followed by treatment with thiourea 3 per cent. These findings are in conformity with the results of Khalil *et al.* (1982) who obtained highest germination in pecan nuts stratified for 45 days followed by GA_3 treatment. Knox and Smith (1981) also found GA application with stratification favourable for pecan germination.

Seedling height and diameter

There was significant increase in seedling height and diameter with the increasing periods of stratification (Table 2 & 3). The maximum seedling height (26.30 cm) and diameter (4.94 mm) was recorded in the nuts stratified for 8 weeks while minimum values for seedling height (18.43 cm) and diameter (3.74 mm) were observed in the non-stratified nuts. This increase in growth characters may be due to the reason that nuts stratified for longer duration germinated earlier in comparison to others. Baqi *et al.* (1994) also observed increase in stem diameter and seedling height in the nuts stratified for longer duration.

Table 2. Effect of stratification periods and growth regulators on seedling height (cm)

Growth regulators	Stratification period (weeks)					Mean
	0	2	4	6	8	
GA_3 250 ppm	15.55	17.16	20.30	20.55	20.60	18.83
GA_3 500 ppm	19.10	19.48	20.38	20.75	24.25	20.79
GA_3 1000 ppm	18.61	22.52	34.15	35.45	37.23	29.59
GA_3 2000 ppm	31.22	33.80	35.81	36.00	39.91	35.35
Thiourea 1 %	14.20	21.90	23.14	25.95	28.35	22.71
Thiourea 3%	16.84	19.45	19.66	21.35	21.50	19.76
GA_3 250 ppm + Thiourea 1%	17.65	18.55	20.10	21.40	23.85	20.31
GA_3 250 ppm + Thiourea 3%	14.10	18.10	18.50	21.00	23.04	18.95
GA_3 500 ppm + Thiourea 1%	25.66	25.75	27.75	28.20	30.05	27.48
GA_3 500 ppm + Thiourea 3%	16.35	17.25	17.40	19.90	23.45	18.87
Control	13.52	14.02	15.76	16.96	17.05	15.46
Mean	18.43	20.72	22.99	24.32	26.30	-

CD (P=0.05)

Growth regulators	= 0.30
Stratification	= 0.20
Growth regulators X stratification	= 0.68

Table 3. Effect of stratification periods and growth regulators on seedling diameter (mm)

Growth regulators	Stratification period (weeks)					Mean
	0	2	4	6	8	
GA_3 250 ppm	3.32	4.08	4.16	4.31	4.57	4.09
GA_3 500 ppm	3.65	4.10	4.20	4.62	4.70	4.26
GA_3 1000 ppm	4.11	4.25	4.48	4.63	4.95	4.48
GA_3 2000 ppm	3.52	4.69	5.42	5.44	5.64	4.94
Thiourea 1 %	4.31	4.68	4.76	4.91	5.38	4.81
Thiourea 3%	3.67	3.74	4.04	4.48	4.83	4.15
GA_3 250 ppm + Thiourea 1%	3.67	4.29	4.39	4.43	4.51	4.26
GA_3 250 ppm + Thiourea 3%	3.84	4.06	4.50	4.70	5.35	4.49
GA_3 500 ppm + Thiourea 1%	4.41	4.87	5.27	5.38	5.59	5.11
GA_3 500 ppm + Thiourea 3%	3.35	3.65	3.86	4.14	4.68	3.94
Control	3.30	3.60	3.70	4.00	4.10	3.74
Mean	3.74	4.18	4.44	4.64	4.94	-

CD (P=0.05)

Growth regulators	= 0.20
Stratification	= 0.10
Growth regulators X stratification	= 0.40

Among the growth regulators treatments, nuts treated with GA_3 2000 ppm registered maximum seedling height (35.35 cm). Seedling diameter was maximum (5.11mm) under GA_3 500ppm + thiourea 1 per cent treatment, which was statistically at par with GA_3 2000 ppm treatment (4.94 mm), whereas, minimum values for seedling height (15.46cm) and diameter (3.74mm) were recorded under control.

The interaction between growth regulators and stratification periods gave highest values for seedling height (39.91cm) and diameter (5.64 mm) in the nuts stratified for 8 weeks followed by soaking in GA_3 2000 ppm. It may be attributed either to longer growth period due to early bud break with GA_3 treatment and stratification or the direct effect of GA_3 on seedling growth.

Root length

The root length of pecan seedlings was significantly increased with longer durations of stratification (Table 4). The maximum root length (33.76cm) was recorded in the nuts stratified for 8 weeks and minimum root length (24.99cm) was obtained in the non-stratified nuts.

Among the growth regulators, GA_3 250 ppm treatment recorded maximum root length

Table 4. Effect of stratification periods and growth regulators on root length (cm)

Growth regulators	Stratification period (weeks)					Mean
	0	2	4	6	8	
GA_3 250 ppm	32.00	32.00	32.32	32.50	35.32	32.83
GA_3 500 ppm	28.00	30.00	31.00	32.32	33.00	30.86
GA_3 1000 ppm	23.00	26.32	28.00	31.00	38.75	29.42
GA_3 2000 ppm	22.00	25.00	28.33	30.01	36.66	28.40
Thiourea 1 %	25.00	27.67	30.00	31.32	35.50	29.90
Thiourea 3%	22.32	24.66	28.67	29.67	30.67	27.20
GA_3 250 ppm + Thiourea 1%	29.67	30.00	32.67	33.00	34.33	31.93
GA_3 250 ppm + Thiourea 3%	30.00	31.32	33.67	34.00	34.00	32.60
GA_3 500 ppm + Thiourea 1%	25.25	25.32	25.67	30.82	35.67	28.55
GA_3 500 ppm + Thiourea 3%	20.67	27.31	27.32	32.32	33.00	28.13
Control	17.02	17.00	21.72	27.00	24.50	21.45
Mean	24.99	26.96	29.03	31.27	33.76	-

CD (P=0.05)

Growth regulators = 2.04
Stratification = 1.38
Growth regulators X stratification = 4.60

(32.83cm), which was statistically at par with GA_3 250 ppm + thiourea 1 %, GA_3 250 ppm + thiourea 3% and GA_3 500 ppm treatments. The lowest root length (21.45cm) was obtained in the control.

The nuts stratified for 8 weeks followed by soaking in GA_3 1000 ppm gave maximum root length (38.75cm), which was closely followed by 8 weeks stratification with GA_3 2000 ppm. Similar findings have also been reported in walnuts by Chauhan *et al.* (1992). This increase in root length may be due to the reason that nuts stratified for longer duration and application of growth regulators provided longer period for growth of roots due to early germination.

It may be concluded from the present studies that stratification for 6 weeks followed by soaking in GA_3 2000ppm are optimum for securing improved germination and seedling growth in pecan nut.

References

Baqi Abdul, Hussain SA, Muhammad Wazir and Khan Sharafat 1994. Effect of different stratification periods on germination and vigour of pecan cultivars. Sarhad J. Agri. **10** (1): 67-72.

Chauhan PS, Awasthi RP, Rana HS, Dwivedi MP and Ananda SA 1992. Effect of seed size, sowing depth and pre-sowing treatments on germination and seedling growth of walnut (*Juglans regia* L.). In: *Proc. Golden Jubilee National Seminar on Emerging Trends in Temperate Fruit Production in India* (No.1), eds Chadha KL,Uppal DK, Pal RN, Awasthi RP and Ananda SA, NHB, Gurgaon, pp 89-92.

Gaur NVS 1980. Effect of gibberllin, sulphuric acid and hand cracking on germination and growth of seedling in walnut. Indian J. Hort. **37** (1):16-19.

Khalil FA, Hamouda AM, El-Din ES, and El-Said ME 1982. Some methods to enhance seed germination of some pecan cultivars. Agric. Res. Rev. **60** (3): 111-24.

Knox CA and Smith RH 1981. A method for rapid seed germination of pecan. Pecan Quarterly **15** (3):23-24.

Madden G, Roberts D and Campbell D 1977. Further studies on the effects of chilling and stratification on nut germination and seedling growth of northern and southern pecan varieties. Pecan Quarterly **11**(2): 9-10.

Sparks D, Chapman JW and Lockwood DW 1974. Stratification promotes germination. Pecan Quarterly **8** (1): 13.

Staden J Van, and Dimalla GG 1976. Regulation of germination in pecan, *Carya illinoensis*. Z. Pflanzenphysiol **78**:66-75