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Impact of plant growth regulator (ga₃) treatment on germination percentage and growth attributes of Persian walnut (*Juglans regia* L.) at Dehradun valley

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Abstract

A field experiment was planned and conducted during the winter season of 2018-19 at Horticulture Research Block of School of Agricultural Sciences, SGRR University, Dehradun, Uttarakhand to investigate the impact of GA₃ treatment on germination percentage and growth attributes of walnut. The experiment was laid out in randomized block design with three replications and twelve treatments. The treatments comprised following levels of GA₃ concentrations viz. 500ppm, 1000ppm, 1500ppm and control in three different replications of Horticultural Research Block viz., polybag, polyhouse beds and nursery beds. Observations on germination percentage and growth attributes were recorded using standard method of measurements. The results revealed that treatment of GA₃ 1500ppm of polybag application found to be most effective treatment for increasing plant height, leaf length, total number of branches, number of leaves, shoot length and shoot diameter. Also the 1500ppm GA₃ treatment in polyhouse was found to be profitable as compared to rest of treatments in terms of number of days taken for germination. Apart from this leaf width and survival percentage of 1000ppm in polybag was found effective and germination percentage of 500ppm was totally best in efforts.

Keywords: Walnut, germination percentage, growth attributes, survival percentage, polyhouse

Introduction

Persian walnut (*Juglans regia* L.) is one of the most commercially valuable trees of temperate regions which belongs to family Juglandaceae and having chromosome number 2n=32. Walnuts having a wide range of origin from Eastern Europe, Asia Minor and points towards east to the Himalayan Mountains. The native habitat of the walnuts ranges from the Carpathian Mountains to Europe across Turkey, Iraq, Afghanistan, South Russia and further towards the eastern foot hills of Himalayas. In India, walnuts are usually grown in the mid hills of Jammu and Kashmir, Himachal Pradesh and the Upper hills of Uttarakhand and Arunachal Pradesh as well. According to National Horticultural Board (2017-2018) the total production of walnuts in India is 299.11 metric tonnes of which Jammu and Kashmir produce 275.45 metric tonnes which is 91.91%, Uttarakhand produces 7.06%, while Himachal Pradesh produces 0.82% and of Arunachal Pradesh 0.21%. Seed Dormancy has always been a major problem in germination of seeds. Studies related to the mechanism of seed dormancy have a little different approach. Some seeds are dormant because of the impermeability of the testa to oxygen and water. Stokes (1964) ^[9] reported that many seeds of temperate species show dormancy which is overcome by chilling like in the case of apple, pears, peach, plum etc. In case of walnut the seed dormancy has been correlated with physiological dormancy that is controlled by seed coat and embryo dormancy. Seed germination is a complex process that started with the absorption of water and after a short pause; the enzyme is activated (Matilla and Matilla-Vazquez, 2008) ^[5].

There are many ways to be followed to break the dormancy in walnut seeds to improve the seed germination. The main aim of this study was to test different pre-sowing treatments of GA₃ in an attempt to improve over all germination percentage and other growth attributes of walnut seeds in three different replications conditions i.e., in Polyhouse, Polybags and Nursery beds under Dehradun region.

Materials and Methods

The present investigation was conducted during 2018-19 at the Horticulture Research Block of School of Agricultural Sciences, Shri Guru Ram Rai University, Dehradun, Uttarakhand, India. The experiment was laid out in Randomized Block Design (RBD) with three replications. The fully matured seeds of walnut cultivar 'Chandler' were brought from Jammu and Kashmir. There were twelve different treatments including four gibberellic acid concentrations (500 ppm, 1000 ppm, 1500 ppm and control) with a combination of three replications of sowing location i.e. Polyhouse, Polybag and Nursery. The selected seeds were participated with the different pre-sowing treatments of stratification for 30 days at 5 °C, scarification with combination of hot water (60 °C) for 6 hours and cold water for 6 hours and finally gibberellic acid treatment for 24 hours in the three different concentrations (500 ppm, 1000 ppm, 1500 ppm) and treated seeds are sown in a Randomized Block Design with three replications at a spacing of (30×15) cm² in Polyhouse bed, Polybag and Nursery bed. The variety Chandler was sown on December 22, 2018 and observations of different germination and growth parameters were starts recorded from first week of February, 2019 onwards. All the intercultural operations were followed timely in the experimental plots as per the requirement of the crop. From each plot randomly selected five plants and used for taking observations for growth and germination attributes.

Results and Discussion

The findings that were obtained from the execution of the experiment were recorded and are thoroughly discussed below:

Seed Germination Percentage

The best seed germination percentage was showed up by the treatment of 500ppm GA₃ in Polyhouse beds having (86%) followed up by 1000ppm GA₃ of Polyhouse beds having (75%) as mentioned in Table 2 & Figure 1. The least count of germination percentage was found in control of polybags having (8%) and 500ppm polybag (13%) was recorded with a combination of pre-sowing treatments of scarification + stratification for 30 days. The higher germination with GA₃ is due to diffusion of endogenous auxins and gibberellins like substances or might have antagonized the effects of inhibitors present in the seed (Mathur et al., 1971 and Sastry and Muir, 1963) [4, 8]. The maximum germination might also be due to the fact that GA₃ involved in the activation of cytological enzymes which stimulates α-amylase enzyme that converts insoluble starch into soluble sugars (Babu et al., 2010) [2].

Survival percentage

The survival percent of walnuts seedlings was found to be maximum in 1000ppm conc. of GA₃ with polybag having

(89%) of the survival rate followed up by the 1500ppm conc. of GA₃ with polybag having (88.23%) and 500ppm conc. GA₃ with Polyhouse beds having (72%) of the survival rate with a combination of scarification and stratification for 30 days as mentioned in Table 2 & Figure 2. The least survival percentage was recorded in the control of nursery (35%) followed by control of polybag (45%). The readings recorded during the work were approximately nearer to the findings of the Wani (2014) [10] who also observed the increases in the survival percentage with an application of gibberellic acid @ 500ppm for 40 hours. Though the perfect reasons are not known but, various factors may affect the survivability percentage of the plant like biotic and abiotic stresses, salt stresses, high temperature stresses and etc.

Total Number of Branches

The total number of branches was found to be recorded highest in (T₇) 1500 ppm of GA₃ in polybags, having total number of 39 branches followed by 1500ppm conc. GA₃ of polyhouse having (38) branches and 1000ppm of polyhouse beds recorded 23 branches. The least number of branches was calculated in control of polyhouse with 9 branches.

Total Number of Leaves

As the highest number of leaves was calculated in 1500 ppm conc. GA₃ of polybag having (77 leaves) followed by 1500 ppm conc. GA₃ of polyhouse beds having (69 leaves) and (58 leaves) in 1000ppm conc. GA₃ of polyhouse beds. The total number of leaves were least counted in 500ppm conc. GA₃ of Nursery bed walnuts which having (28 leaves) followed by control of Nursery beds walnut with (29 leaves). The main reasons are GA₃ increases the rapidity of the plant height there will be an increase in the total number of leaves and branches. Similar results were also reported by Negi *et al.*, 2008 in pistachio nut treated with various concentrations of GA₃ and thiourea for various aspects including number of leaves and total number of branches per plant.

Plant Height

The highest increase in plant height was found recorded in 1500ppm conc. GA₃ of polybags measured (60 cm) followed by 1000ppm conc. GA₃ of polybag measured (56cm) and 1500ppm conc. GA₃ of Nursery bed (41cm) as mentioned in Table 3 & Figure 3. However, treatment control of polyhouse was found to be least effective to increase in plant height and recorded (5cm) plant height. The might be due to the process of rapid leaf expansion which results in increase in the photosynthetic area which subsequently heightens the plant. The similar approximate results were recorded in the research of average seedling development (height and number of leaves) increased with GA₃ at 250 ppm + stratification for 3 weeks at 5 °C treatment (Dahshan *et al.*, 1987) [3].

Table 1: Details of treatments

S. No.	Symbol	Treatments
1.	T ₁	GA ₃ @500ppm +Scarification+ Stratification+ Polyhouse bed
2.	T ₂	GA ₃ @1000ppm +Scarification+ Stratification+ Polyhouse bed
3.	T ₃	GA ₃ @1500ppm +Scarification+ Stratification+ Polyhouse bed
4.	T ₄	Control + Polyhouse
5.	T ₅	GA ₃ @500ppm +Scarification+ Stratification+ Polybag
6.	T ₆	GA ₃ @1000ppm +Scarification+ Stratification+ Polybag
7.	T ₇	GA ₃ @1500ppm +Scarification+ Stratification+ Polybag
8.	T ₈	Control + Polybag
9.	T ₉	GA ₃ @500ppm +Scarification+ Stratification+ Nursery bed

10.	T ₁₀	GA ₃ @1000ppm +Scarification+ Stratification+ Nursery bed
11.	T ₁₁	GA ₃ @1500ppm +Scarification+ Stratification+ Nursery bed
12.	T ₁₂	Control + Nursery bed

Table 2: Effect of GA₃ concentrations on germination and growth attributes of walnut

Treatments	Germination Percentage	Survival Percentage	Total Number of Branches	Total Number of Leaf	Plant Height (cm)
T ₁	86%	72%	11	21	17
T ₂	75%	65%	27	52	25
T ₃	71%	54%	38	69	37
T ₄	55%	67%	9	22	5
T ₅	13%	66%	23	47	37
T ₆	28%	89%	21	58	56
T ₇	53%	88%	39	77	60
T ₈	8%	45%	16	30	24
T ₉	60%	65%	12	28	29
T ₁₀	50%	59%	15	38	26
T ₁₁	45%	66%	13	33	41
T ₁₂	39%	35%	17	29	21
±SE(m)			7.035	13.634	11.439
CD _{0.05}			N/A	N/A	N/A

Fig 1: Representation of the germination percentage of walnut due to influence of GA₃ **Fig 2:** Representation of the survival percentage of walnut due to influence of GA₃

Fig 3: Representation of the effect of GA₃ treatment on Plant height of walnut

Conclusion

The conclusion obtained from the results recorded in the present studies showed that among the following different pre-sowing treatments, the best results in terms of total number of branches, total number of leaves, plant height and survival percentage were obtained with stratification for 30 days + gibberellic acid @ 500 ppm, 1000ppm, 1500 ppm amongst three different location. The best germination percentage was recorded with scarification + stratification for 30 days + GA₃ @ 500ppm concentration in polyhouse beds while, the maximum survival percentage was recorded in scarification + stratification for 30 days + GA₃ @ 1000ppm concentration in polybags sown walnut was found to be very effective. Although in terms of growth attributes such as total number of branches, total number of leaves and plant height the most effective result was recorded in scarification + stratification for 30 days + GA₃ @ 1500ppm of Polybags was measured perfect overall growth of walnut seedlings.

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