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EFFECT OF DIFFERENT GROWING MEDIA AND PLANTING DATES ON GERMINATION AND SEEDLING GROWTH OF PECAN NUT (*CARIYA ILLIONENSIS* L.)

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ABSTRACT

Suitable growing media and optimum time are considered the basic requirements to get the maximum yield and high profit for their direct and significant impact on seedlings quality and productivity of trees later. This experiment was carried out to explore the effect of different growing media (GM): sandy soil 100% (GM1); sandy soil: cocopeat: vermicompost (2:1:1) (GM2) by volume; sandy soil: cocopeat: vermicompost (1:2:1) (GM3); loamy soil: sandy soil: vermicompost (2:1: 1) (GM4); loamy soil: sandy soil: vermicompost (1:2:1) (GM5); loamy soil: cocopeat: vermicompost (2:1:1) (GM6) and loamy soil: cocopeat: vermicompost (1:2:1) (GM7). Pecan nut seeds were planted on three different dates *viz*., 10th December, 20th December and 1st February at 20 days interval in polythene bags (60 × 25 cm) after soaking in water for 48 hours. The results obtained from this study showed that the maximum germination percentage, number of leaves/seedling, leaf area, stem diameter, stem fresh and dry weight, root length and root fresh and dry weight were recorded when the pecan nut seed was planted on 10th December in the growing media combination (GM3) contained sandy soil: cocopeat: vermicompost (1:2:1).

Key words : Pecan nut, Growing media, Dates, Seed germination, Seedling growth.

Introduction

The Pecan (*Carya illinoinensis* L.) is the most important species that belongs to the Carya genus. It is cultivated mainly for its nut, which is rich in oils and proteins and for its good quality wood. Pecan is conventionally propagated by budding or grafting onto rootstocks obtained by open pollination (Casales *et al*., 2018). However, the poor seedling growth of rootstocks ready for budding/grafting takes 3-4 years of time under poor soil depth and texture (George, 1995). The convenient sowing time of each type of crop is considered basic requirements to yield. A number of experiments have been conducted on sowing seeds and transplanting time, which showed that the total crop yield is significantly affected by sowing times (Snoek, 1981). As the pecan nut plants are multiplied through asexually and each plant is made up of the rootstock which provides root system and the scion forming the tree canopy. Both of these parts play an equally vital role in the life of a tree. The rootstock has great influence on the vigour, longevity and productivity of the scion variety (Manthri and Bharad, 2017).

One of many decisions to make when planning to grow pecan seedling rootstocks is what medium to use. Media for growing pecan rootstocks are often composed of shredded pine bark, sphagnum peat moss, sand, and soil mixed in various combinations and proportions (Sloan and Overcash, 1980). Whatever the composition, a growing medium should conform to certain bulk density, porosity and water and nutrient retention specifications (Waters *et al*., 1970). Moreover, the use of suitable growing media or substrates for sowing seeds directly

affects the germination, development and functional rooting system (Meena *et al.*, 2017). A good growing media provides adequate anchors or support to the plant, a reservoir for nutrients and water allows the release of oxygen to the roots and gas exchange between the roots and the atmosphere outside the roots substrate (Abad *et al.*, 2002). The growing medium vermicompost+ pond soil + sand (1:1:1) with 2 cm cocopeat was considered the best media as the germination, seedling growth and development parameters of papaya seedlings were higher as compared to other media (Bhardwaj, 2012). Gebregiorgs *et al*. (2021) reported that the mango seed germination, seedling growth and establishment with soil potting media combinations of top soil: FYM: sand in the ratio of 3:2:1 for improving productivity and food security. The composition of the medium influences the quality of the seedlings (Wilson *et al.*, 2001). The quality of seedlings is greatly affected by the growth media under nursery (Agbo and Omaliko, 2006). The quality of the seedlings obtained from a nursery affects the re-establishment in the field and the final productivity of the orchard (Baiyeri and Mbah, 2006). Soil, peat moss and vermiculite are generally used as a basic medium for sowing seeds in nurseries because it is cheap and easy to procure supplementing the soil to make media more porous and adequate source to the nutrients for the seedlings.

Cocopeat a byproduct of cutting and shifting of coconuts for fiber production. It is becoming very popular propagating and growing medium because it has an excellent pore space (25-30 per cent) and fine structure required for proper growth and development of seedlings. It is a rich source of nutrients and can easily be mixed with other growing media. Cocopeat is considered as a growing medium component with acceptable pH, EC and other chemical attributes (Abad *et al.*, 2002). Cocopeat has good physical properties, high total pore space, high water content, low shrinkage, low bulk density and slow biodegradation (Prasad, 1997 and Evans *et al.*, 1996). Vermicompost represents a very suitable medium for plant growth showing improved growth for many plant species (Ebrahimi *et al.*, 2021). Parkhe *et al*. (2018) claimed that from different potting mixtures; garden soil, cocopeat, farm yard manure (FYM), vermicompost and sand with different combinations, 100% hardening success was conducted to banana plantlets of cv. Grand Naine when garden soil and FYM (3:1) were used. This combination gave maximum height and survival of plantlets and shows outstanding performances in field condition. The objective of this study was to test the growing media combinations on different dates to produce seedling rootstocks of at an early stage for production of quality planting material of improved pecan nut varieties.

Materials and Methods

Pecan nut seeds were obtained from local pecan nut orchard in Poonch district of Jammu & Kashmir, North India. The experiments were conducted in a fruit plant nursery at Poonch station, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, J&K, India during two growth seasons (2022 and 2023) and data was represented as the average of two seasons. Different growing media (GM) combinations: sandy soil 100% (GM1); sandy soil: cocopeat: vermicompost (2:1:1) (GM2) by volume; sandy soil: cocopeat: vermicompost (1:2:1) (GM3); loamy soil: sandy soil: vermicompost (2:1:1) (GM4); loamy soil: sandy soil: vermicompost (1:2:1) (GM5); loamy soil: cocopeat: vermicompost (2:1:1) (GM6); and loamy soil: cocopeat: vermicompost (1:2:1) (GM7). Physical and chemical properties of these growing media are shown in Table 1. Pecan nut seeds were planted on three different dates *viz*, 10th December, 20th December and 1st February at 20 days interval in polythene bags (60 × 25 cm) after soaking in water for 48 hours. Each growth medium was represented by 50 polythene bags per replicate and replicated three times. One seed was sown per bag after disinfected by a fungicide and irrigation with water daily. In addition to this, all other cultural practices were completed according to the requirements of nursery. Seed germination percentage of pecan nut was measured as number of seeds that produced a seedling from each seeds group and expressed as percentage, the stem length, number of leaves/seedling, leaf area, stem diameter of 5 cm above the soil surface, root length, leaf fresh weight, leaf dry weight, stem fresh weight, stem dry weight, root fresh weight and root dry weight were measured for all plants. Data were statistically analyzed using completely randomized design with two factors with three replicates (50 seeds per replicate). Analysis of variance and Duncan's multiple range tests were used.

Results and Discussion

Seed germination percentage

The germination percentage of pecan nut seed was significantly affected by the planting date and growing medium (Table 1). The maximum germination (88.15%) of pecan nut seeds were observed under the treatment (GM3), which including sandy soil: cocopeat: vermicompost (1:2:1), when the sowing was done in 10 December. However, the minimum germination (45.33%) was recorded under the treatment (GM1) contained sandy soil, when sowing was done in 1st February. The maximum germination percentage was recorded when

Table 1 : Effect of different growing media and dates of sowing on germination percentage of pecan nut seedlings.

Treatments	Seed germination %		
	10th December	20th December	1st February
GM1	52.12[d]	50.18[d]	45.33[d]
GM2	70.20[c]	64.10c	61.30[c]
GM3	88.15[a]	76.10[a]	70.40[a]
GM4	65.03[c]	60.13c	55.21[c]
GM5	67.08[c]	64.10[c]	61.03[c]
GM6	80.22[b]	67.35[b]	66.41[b]
GM7	84.33[b]	70.66[b]	68.32[b]

The same letter with row indicates that there is no significant difference ($p < 0.05$)

Table 2 : Effect of different growing media and dates of sowing on stem length (cm) of pecan nut seedlings.

Treatments	Stem length (cm)		
	10th December	20th December	1st February
GM1	37.12[d]	35.42[d]	33.85[d]
GM2	41.15[c]	38.14[c]	36.86[c]
GM3	47.45[a]	45.16[a]	43.52[a]
GM4	39.10[d]	37.34[d]	35.44[d]
GM5	40.33[c]	38.45[c]	36.21[c]
GM6	43.21[b]	41.16[b]	39.48[b]
GM7	45.36[b]	43.13[b]	41.98[b]

The same letter with row indicates that there is no significant difference ($p < 0.05$)

Table 3 : Effect of different growing media and dates of sowing on number of leaves of pecan nut seedlings.

Treatments	Number of leaves/seedling		
	10th December	20th December	1st February
GM1	5.66[d]	4.36[d]	3.85[d]
GM2	6.66[cd]	5.52[cd]	4.40$_{cd}$
GM3	10.66[a]	9.33[a]	8.10[a]
GM4	6.32[cd]	5.14[cd]	4.85[cd]
GM5	7.35[bc]	6.48[bc]	5.76[bc]
GM6	8.13[b]	7.45[b]	6.20[b]
GM7	8.65[b]	7.58[b]	6.92[b]

The same letter with row indicates that there is no significant difference ($p < 0.05$)

the pecan nut seed was planted on 10 December and seedlings growing in the (GM3) contained sandy soil: cocopeat: vermicompost (1:2:1). It might be due to good water holding capacity and moisture supply as well as sufficient porosity which permit adequate moisture and gaseous exchange between media and seeds. Similar findings were reported by Parasana *et al*. (2013), where a combination of Soil: FYM: Sand (2:1:1) with Master royal local cultivar of mango, which resulted in early days to germination. Similar results were also obtained by Nagar *et al*. (2016) and Arvind *et al* (2015) in papaya.

Seedling growth characteristics

Seedling growth characteristics *viz.*, stem length, number of leaves per seedling, leaf area, stem diameter and stem fresh and dry weight were significantly affected by various growing media at different dates (Tables 2-5). Data presented in Table 2, revealed that the maximum of seedling stem length (47.45 cm) was recorded with sowing on 10th December; however, the minimum of seedling stem length (33.85 cm) was noted when seeds were sown on 1st February. Growing media (GM3) sandy soil: cocopeat: vermicompost (1:2:1), when the sowing was done in 10 December. However, the minimum stem length (33.85 cm) was recorded under the treatment (GM1) contained sandy soil, when sowing was done in 1st February. Number of leaves per seedling was significantly affected by various treatment combinations. It is clear from Table 3 that higher number of leaves/ seedling (10.66) was noted under the growing media (GM3) sandy soil: cocopeat: vermicompost (1:2:1), when planted pecan nut seeds on 10 December. The late sowing (1 February) of pecan nut seeds had lower number leaves/ seedling (3.85) in the growing media (GM1) contained sandy soil only. A perusal of data given in Table 4 revealed that leaf area per plant was also significantly influenced by use of different growing media and date of sowing of pecan nut seedlings. The maximum leaf area (130.42 cm^2) was recorded in the treatment combination (GM3) sandy soil: cocopeat: vermicompost (1:2:1), when pecan seeds were sown on 10th December. Whereas, the minimum leaf area (106.18 cm^2) was recorded in the seeds sown on 1st February under the treatment (GM1) contained sandy soils only. The greater stem diameter (3.73 mm) was recorded under the treatment combination (GM3) sandy soil: cocopeat: vermicompost (1:2:1), when pecan seeds were planted on 10th December (Table 5). The late sowing (1 February) recorded a minimum stem diameter (2.86 mm) under the treatment (GM1) contained sand soils only. Stem fresh and dry weight were also significantly affected by different growing media on date of sowing. Results in Table 6 indicated maximum stem fresh and dry weight were recorded with sowing on 10th December in (GM3) sandy soil: cocopeat: vermicompost (1:2:1) (11.23 and 4.10 gm); however, the minimum stem fresh and dry weight (4.61 and 1.42 gm) were noted when seeds were sown on 1 February in (GM1) sandy soil, respectively. The increase in overall growth

Table 4 : Effect of different growing media and dates of sowing on leaf area of pecan nut seedlings.

Treatments	(Leaf area cm^2)		
	10th December	20th December	1st February
GM1	110.22^{d}	108.10^{d}	106.18^{d}
GM2	116.10^{cd}	114.14^{cd}	112.36^{cd}
GM3	130.42^{a}	128.30^{a}	126.33^{a}
GM4	117.13^{cd}	116.15^{cd}	114.45^{cd}
GM5	119.40^{bc}	117.24^{bc}	115.60^{bc}
GM6	121.15^{b}	119.13^{b}	117.75^{b}
GM7	123.45^{b}	121.46^{b}	119.30^{b}

The same letter with row indicates that there is no significant difference ($p < 0.05$).

Table 5 : Effect of different growing media and dates of sowing on stem diameter of pecan nut seedlings.

Treatments	Stem diameter (mm)		
	10th December	20th December	1st February
GM1	3.10^{d}	3.01^{d}	2.86^{d}
GM2	3.41^{cd}	3.20^{cd}	3.10^{cd}
GM3	3.73^{a}	3.64^{a}	3.40^{a}
GM4	3.52^{cd}	3.45^{cd}	3.26^{cd}
GM5	3.57^{bc}	3.48^{bc}	3.35^{bc}
GM6	3.60^{b}	3.55^{b}	3.42^{b}
GM7	3.64^{b}	3.57^{b}	3.49^{b}

The same letter with row indicates that there is no significant difference ($p < 0.05$)

Table 6 : Effect of different growing media and dates of sowing on stem fresh weight of pecan nut seedlings.

Treatments	Stem fresh weight (gm)		
	10th December	20th December	1st February
GM1	5.60^{e}	5.10^{e}	4.61^{e}
GM2	8.12^{cb}	7.30^{cb}	6.92^{cb}
GM3	11.23^{a}	10.33^{a}	9.10^{a}
GM4	6.31^{de}	5.52^{de}	4.95^{de}
GM5	7.14^{d}	6.45^{d}	5.65^{d}
GM6	8.19^{bc}	7.23^{bc}	6.45^{bc}
GM7	9.20^{b}	8.44^{b}	7.36^{b}
Stem dry weight (gm)			
GM1	1.55^{e}	1.50^{e}	1.42^{e}
GM2	2.71^{cb}	2.62^{cb}	2.54^{cb}
GM3	4.10^{a}	3.85^{a}	3.76^{a}
GM4	1.72^{e}	1.65^{e}	1.58^{e}
GM5	2.25^{d}	2.15^{d}	2.01^{d}
GM6	2.85^{bc}	2.65^{bc}	2.53^{bc}
GM7	3.35^{b}	3.20^{b}	3.05b

The same letter with row indicates that there is no significant difference ($p < 0.05$)

parameters might be due to cocopeat and vermicompost provides adequate nutrients and enhances both the physical and biological properties and the water holding capacity of soil (Soegiman, 1982). A similar result was also reported by Bhardwaj (2014). These results are in conformity with Sahni *et al*. (2008), who reported that the combined application of vermicompost and cocopeat showed significant effect on seedling growth parameters and plant biomass probably due to the synergistic combinations of these factors improving the physical conditions of the media and nutritional factors. It may be due to better nutrient availability leading to higher production of photosynthetically functional leaves in these treatments finally resulting in better girth of seedling (Borah *et al*., 2008). Similar results were also obtained by Gebregiorgs *et al*. (2021), Parasana *et al*. (2014) in mango and Meena *et al*. (2017) in papaya.

Root characteristics

Root parameters like root length, root fresh and dry weight were significantly affected by different growing media and date of sowing. Data presented in Table 7 shows that maximum root length (20.52 cm) was noticed under the treatment (GM3) sandy soil: cocopeat: vermicompost (1:2:1), when pecan nut seeds were planted on 10th December. However, the minimum root length (10.01 cm) was recorded under growing media (GM1) sandy soil only, when sown on 1st February. Whereas, the root fresh and dry weight results in Table 8 indicated the maximum root fresh and dry weight were recorded with sowing on 10th December in (GM3) sandy soil: cocopeat: vermicompost (1:2:1) (10.13 and 4.09 gm); however, the minimum root fresh and dry weight (4.02 and 1.20 gm) were noted when seeds were sown on 1 February in (GM1) sandy soil, respectively. It might be due to good physical and biological conditions in cocopeat and vermicompost had positive effect on root development, which is helpful in increased survival percentage of seedling in main field after transplanting. These results are in conformity with Acock and Overcash (1983), who reported that container-grown rootstocks of pecan nut partitioned more dry matter into the roots when grown in a 4 pinebark: 1 sand (v/v) growing medium. Beneficial effect of cocopeat on root system was also observed on nutmeg seedling by Abirami *et al*. (2010). This may be also due to this favorable media has suitable physical properties and good water holding capacity that supports the vigorous growth of seedlings, better growth of the seedling, particularly for good development of a root system. These results are in close agreement with Shamet *et al*. (1994). Similar results were also reported by Hartmann and Kester (1997).

Table 7 : Effect of different growing media and dates of sowing on root length of pecan nut seedlings.

Treatments	Root length (cm)		
	10th December	20th December	1st February
GM1	11.45^{d}	10.16^{d}	10.01^{d}
GM2	15.20^{cd}	14.15^{cd}	13.85^{cd}
GM3	20.52^{a}	18.13^{a}	17.18^{a}
GM4	13.15^{cd}	12.21^{cd}	13.32^{cd}
GM5	14.52^{bc}	13.22^{bc}	12.45^{bc}
GM6	16.21^{b}	15.30^{b}	14.25^{b}
GM7	18.45^{b}	17.20^{b}	16.33^{b}

The same letter with row indicates that there is no significant difference ($p < 0.05$)

Table 8 : Effect of different growing media and dates of sowing on root fresh weight of pecan nut seedlings.

Treatments	Root fresh weight (gm)		
	10th December	20th December	1st February
GM1	4.42^{e}	4.12^{e}	4.02^{e}
GM2	7.16^{b}	6.55^{b}	6.10^{b}
GM3	10.13^{a}	9.25^{a}	8.64^{a}
GM4	5.35d^{e}	5.15^{e}	5.03^{e}
GM5	6.15^{c}	5.85^{c}	5.16^{c}
GM6	7.19^{bc}	6.72^{bc}	5.95^{bc}
GM7	8.33^{b}	7.65^{b}	6.74^{b}
Root dry weight (gm)			
GM1	1.45^{d}	1.30^{d}	1.20^{d}
GM2	2.65^{c}	2.10^{c}	2.05^{c}
GM3	4.09^{a}	3.75^{a}	3.56^{a}
GM4	1.62^{d}	1.55^{d}	1.36^{d}
GM5	2.15^{c}	2.10^{c}	2.05^{c}
GM6	2.75^{c}	2.55^{c}	2.43^{c}
GM7	3.25^{b}	3.13^{b}	3.04^{b}

The same letter with row indicates that there is no significant difference ($p < 0.05$)

Conclusion

Pecan nut is a potential nut crop contributing greatly to the improvement of nutritional and health of the Indian society. In the study area, the nut crop is contributing significantly to the livelihoods and food security of the local growers. Despite its potential for food and nutrition security its productivity is very low. However, suitable growing media for early root stock generation play a great lot in improving its productivity. Generation of early stage pecan nut rootstocks suitable for production of quality planting material under growing media combination (GM3) sandy soil: cocopeat: vermicompost (1:2:1)at the optimum date (10th December) of sowing gave better pecan nut seed germination and seedling growth in the study area. Accordingly, the treatment is recommended for improving productivity of pecan nut in the study area.

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