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# Selection and evaluation of superior planting materials of *Ailanthus triphysa* (Dennst.) in Thrissur district, Kerala

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**Abstract**
An experiment was carried out to test the seedling characters and early field growth performance of candidate plus trees of *Ailanthus triphysa* from Thrissur district, Kerala. This species is one of the most widely cultivated agroforestry tree species in Kerala. Its major uses are for making match splints, furniture manufacturing, and aromatic resin called Halmaddi, used for making incense sticks. Twelve candidate plus trees were selected based on the comparison tree method from three distinct agro ecological zones of Thrissur District, Kerala. The germination and biometric characters of the progenies showed significant difference at nursery and at field level. Highest germination percentage of 83.50 was recorded by CPT-11 and lowest of 67 percentage by CPT-1. The CPT-11 showed significantly higher height of 88.67 cm at nursery and attained maximum height of 99 cm and girth of 21.04 mm from the field performance (180 DAP). Other promising progenies at the field level were CPT-10 and CPT-09.

**Keywords:** Candidate plus tree, comparison tree method, nursery evaluation, field performance, single tree selection

## Introduction
Kerala farmers prefer timber trees such as ailanthus and teak besides fruit trees such as mango, jack and cashew. Tree planting efforts in India has been largely limited to free and indiscriminate distribution of a large number of seedlings without due consideration of the needs, priorities and attitudes of the intended target group. As in the case of agriculture, the interest shown by a farmer for raising tree crops in his land are influenced by sociological, economic, demographic and environmental factors. These factors influence the choice of farmer for the adoption of a new technology. Is called subsistence farming system, which is the typical farm scenario in Kerala (Nair and Sreedharan, 1986) [19]. In this context, *Ailanthus triphysa* is a promising tree species used for various end uses. This tree attains a merchantable volume at the age of 6 – 8 years. The tree is propagated through seed. Because of its fast growing nature, *Ailanthus triphysa* is a good source of income for farmers. The resin present in this species reduces the necessity for dipping the splints in wax, therefore the species has been counted as one of the best matchwood species (Indira, 1996) [12].The farmers are interested in cultivation of *A.triphysa*, because of its fast growth, minimal space utilization, ready market and generous revenue. The demand of this wood increased exponentially but the area of ailanthus plantations is very less as compared to other commercial timbers. The state of Kerala have 144 match factories, they can meet only 10 per cent of total market demand from the state (Nair and Sreedharan, 1986) [19]. Expanding yield of plantations by genetic improvement techniques is a possible option to meet the rising raw material requirement of the industry. In this back ground, the present study is undertaken for selection and evaluation of superior planting materials of *Ailanthus triphysa* and also to assess the nursery and field performance of the selected progenies. A successful tree improvement has been achieved through plus tree selection as reported in many tree species *viz. Ailanthus excelsa* (Daneva *et al*, 2018) [7], *Pongamia pinnata* (Kaushik *et al*, 2011) [14] and in *Azadirachta indica* (Gera *et al*. 2004) [8]. People are more interested in cultivating forest trees not only for conservation aspects but as a major part of their income. Hence this study mainly focused on selecting plus trees for propagation and production of superior quality seedlings by selecting seeds from phenotypically superior trees. The assessment of initial field performance will also throw light in to the advantages of early stand development and reduction of rotation planned for *Ailanthus triphysa*.

## Material and Methods

A detailed survey was conducted through the agro-ecological zones of Thrissur district for identify candidate plus trees (CPTs) of *Ailanthus triphysa*. Twelve phenotypically superior trees were selected as candidate plus tree. The CPTs were selected from the three distinct agro-ecological zones (KAU, 2002) [15] *viz*. Malayoram, Central midland, and Coastal sandy region of Thrissur district for giving due representation of these zones in the selection. Nursery experiments were carried out at College of Forestry Vellanikkara, and field trial was established at Instructional Farm, College of Horticulture, Kerala Agricultural University, Vellanikkara. Four plus trees were selected from each of the agro-ecological zones by comparison tree method. These plus trees were selected according to the growth rate, timber form, free from diseases and insects, yield, individual-tree height, stem diameter.

The collected seeds were dried uniformly under the sun, de-winged and were subjected to 12 hrs of overnight water soaking and sown uniformly by broadcasting over the prepared nursery bed of size 12m × 1.2m. The germinated seeds, at two-leaf stage, were transplanted to the poly bags and kept in shade house. The potting mixture consisted of soil, cow dung and coir pith in the ratio of 2:1:1. Three best seedlings were selected from each of the candidate plus trees and recorded the growth parameters at 30 days of interval for a period of 180 days. Completely Randomized Design (CRD) was used for the analysis of nursery growth data.

For the germination trial, there were four replications from each of the candidate plus trees and each replication consisted of 100 healthy seeds. The seeds were sown on a seed bed of size 12m × 1.2 m × 0.3 m. The bed was mulched with leaves till the start of germination. The observations were taken for a period of four weeks from initiation to completion of the germination. The germinated seeds were counted daily and calculated the germination parameters such as germination per cent (GP), peak value of germination (PV), mean daily germination (MDG), and germination value (GV) using the following formulae.

$$\text{Germination percent (GP)} = \frac{\text{Number of seeds germinated}}{\text{Number of seeds sown}} \times 100$$

$$\text{Peak value of germination (PV)} = \frac{\text{Total germination per cent}}{\text{Total number of days}}$$

$$\text{Mean Daily Germination} = \frac{\text{Final germination per cent}}{\text{The number of days that took to reach peak germination}}$$

$$\text{Germination Value} = \text{Final Mean Daily Germination (MDG)} \times \text{Peak Value of Germination (PV)}$$

The biometric observations were taken by destructive sampling method. Three randomly selected seedlings were uprooted for each of the candidate plus trees and observed various biometric observations at 30 days of intervals up to a period of 180 days at the nursery bed.

For evaluating the initial growth performance of plus tree progenies, three best seedlings were selected from each of the candidate trees. A total of 108 seedlings were planted in blocks with spacing of 3 m × 3m. The experimental plot was laid out in a Randomised Block Design. An additional row of bulk seedlings of *Ailanthus triphysa* were also planted all along the borders to eliminate the border effect. For the field planting, area was prepared manually and aligning and staking was done. The observations were taken at 30 days interval from 30 DAP to 180 DAP.

**Table 1:** Details of the *Ailanthus triphysa* candidate plus trees selected for the study.

| Tree No. | Tree Height (m) | Girth at breast height (cm) | Representative Agro-ecological zones* |
|---|---|---|---|
| CPT-1 | 21 | 135 | Malayoram |
| CPT-2 | 22 | 136 | |
| CPT-3 | 21 | 128 | |
| CPT-4 | 22 | 136 | |
| CPT-5 | 23 | 126 | Central midland |
| CPT-6 | 19 | 136 | |
| CPT-7 | 24 | 138 | |
| CPT-8 | 24 | 136 | |
| CPT-9 | 20 | 120 | Coastal sandy |
| CPT-10 | 23 | 140 | |
| CPT-11 | 23 | 136 | |
| CPT-12 | 21 | 143 | |

*Selections were made from the all the three distinct zones

## Results and Discussion

The progenies of selected CPTs shows a significant difference in the observed traits after six month at nursery. From the germination trial, we found that CPT-11 shows better performance in all the traits, followed by CPT-10 and CPT-9 (Figure 1). The germination percentage varied from 67.0 to 83.50 per cent. Similar significant differences in seed germination was also found by Paul (2017) [20] and Indira (1996) [13] in *Ailanthus triphysa*. Chauhan *et al*., 2010[5] reported that highest germination percentage of 85.50% in *Pongamia pinnata* was achieved through candidate plus tree selection. The germination value (GV) was also varied significantly among the selections and there was no significant variation in Peak value of germination. A significant relation was found between the seed sources and elevationa1 range of seed sources of *Ailanthus excelsa* selections (Chhaganbhai (2014) [6] and in *Grewia oppositifolia* (Uniyal *et al*., 2003) [23]. Causes of such variability might be generally attributed either to the genetic characters of source population (Bewley and Black 1994) [4], or the impact of mother plant environment (Andersson and Milberg 1998) [3]. It shows that seed source and individual trees have more influence on seed germination. Seed sources with higher germination also had higher germination value.

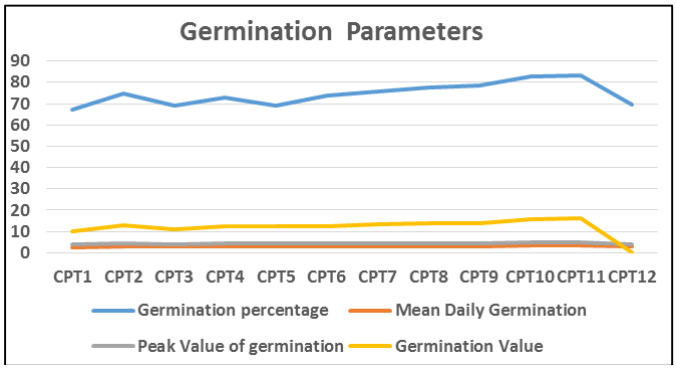


**Fig 1:** Variation in seed germination parameters of *Ailanthus triphysa* selections

After 180 days of nursery evaluation, CPT-11 showed the superiority (88.67cm) in height over all the CPTs immediately followed by CPT-6, CPT-9, and CPT-10 (Table 2). CPT-5 attains lowest seedling height of 76.33 cm. The collar diameter of CPT-3 was (7.44mm) and for CPT-12 (4.90mm). The CPT-11, CPT-10, CPT-9 were also produced better collar diameter. In view of the high heritability of germination percentage and its significant relationship with early height

and collar diameter growth which is maintained up to sixth month. There was a good indication that the candidate plus tree, which are superior in seed quality are also superior in subsequent growth and development. The progenies with superior growth rates maintain their superiority until a later developmental stage. That is, the seed germination characteristics can be under strong genetic control. From this point of view this parameter can be included in the criteria for the selection of superior plus trees in *Ailanthus triphysa*. Wani and Ahmed (2013) [25] supports this hypothesis with a significant difference in the field performance of *Madhuca indica*.There was a significant difference in taproot length, number of primary and secondary roots, number of leaves and leaflets were also noticed, among these all traits CPT-11 shows superiority followed by CPT-10, CPT-9 and CPT- 7 (Table 2). A significant difference in number of leaves in *Simarouba glauca* influenced by seed source (Chhaganbhai, 2014) [6].

**Table 2:** Biometric observations of selections after 6 month at nursery.

| Code | Seedling height (cm) | Collar diameter (mm) | Taproot length (cm) | Number of leaflets | Number of leaves | Number of secondary roots | Number of tertiary roots |
|---|---|---|---|---|---|---|---|
| CPT-1 | 81.33$^{d}$ | 6.38$^{b}$ | 32.60$^{ef}$ | 94.66$^{e}$ | 26.00$^{g}$ | 75.00$^{e}$ | 173.00$^{f}$ |
| CPT-2 | 78.33$^{efg}$ | 5.26$^{de}$ | 33.33$^{ef}$ | 88.00$^{f}$ | 35.66$^{f}$ | 78.00$^{e}$ | 175.00$^{ef}$ |
| CPT-3 | 85.33$^{bc}$ | 7.44$^{a}$ | 29.76$^{f}$ | 103.33$^{cd}$ | 36.66$^{def}$ | 86.66$^{d}$ | 189.00$^{bc}$ |
| CPT-4 | 77.00$^{g}$ | 5.35$^{d}$ | 35.66$^{e}$ | 103.66$^{cd}$ | 40.00$^{cde}$ | 91.00$^{cd}$ | 195.66$^{ab}$ |
| CPT-5 | 76.33$^{g}$ | 5.60$^{cd}$ | 22.56$^{g}$ | 104.00$^{cd}$ | 35.66$^{f}$ | 78.33$^{e}$ | 184.33$^{cd}$ |
| CPT-6 | 85.67$^{bc}$ | 6.44$^{b}$ | 53.43$^{ab}$ | 99.33$^{de}$ | 36.00$^{ef}$ | 91.00$^{cd}$ | 184.66$^{cd}$ |
| CPT-7 | 77.67$^{fg}$ | 6.73$^{b}$ | 48.36$^{bcd}$ | 115.33$^{b}$ | 40.33$^{cd}$ | 88.00$^{cd}$ | 181.00$^{de}$ |
| CPT-8 | 80.67$^{de}$ | 6.48$^{b}$ | 47.10$^{cd}$ | 106.00$^{c}$ | 43.66$^{abc}$ | 92.33$^{bc}$ | 187.33$^{cd}$ |
| CPT-9 | 84.67$^{c}$ | 5.79$^{c}$ | 45.83$^{d}$ | 107.00$^{c}$ | 44.66$^{ab}$ | 97.00$^{b}$ | 196.66$^{ab}$ |
| CPT-10 | 87.33$^{ab}$ | 6.55$^{b}$ | 57.00$^{a}$ | 114.66$^{b}$ | 47.66$^{a}$ | 105.00$^{a}$ | 196.66$^{ab}$ |
| CPT-11 | 88.67$^{a}$ | 6.40$^{b}$ | 55.33$^{a}$ | 123.66$^{a}$ | 47.00$^{a}$ | 105.66$^{a}$ | 197.33$^{a}$ |
| CPT-12 | 79.67$^{def}$ | 4.90$^{e}$ | 51.66$^{abc}$ | 96.33$^{e}$ | 41.00$^{bc}$ | 96.33$^{b}$ | 186.00$^{cd}$ |
| F value | 22.994** | 34.23** | 38.099** | 23.354** | 17.017** | 36.756** | 9.257** |
| C.D. | 2.605 | 0.366 | 5.429 | 5.967 | 4.303 | 4.811 | 8.031 |

Analysis of biomass of shoots and roots evidence the superior growth of CPT-11 over the remaining selections (Table 3). CPT-10 and CPT-9 are the other dominant selections followed by CPT-11. Significant variations reported for all morphological and biomass traits. Similar variations was found by Kumar *et al.* (2007) [16] in *Pongamia pinnata*, Liu (2002) [17] in *Camptotheca acuminate.*

**Table 3:** Biomass observations of selections after 6 month at nursery.

| Code | Fresh weight of shoot (g) | Dry weight of shoot (g) | Fresh weight of root (g) | Dry weight of root (g) | Root - Shoot length ratio | Root – shoot biomass ratio |
|---|---|---|---|---|---|---|
| CPT-1 | 15.08$^{h}$ | 12.28$^{f}$ | 17.51$^{g}$ | 10.23$^{f}$ | 0.39$^{ef}$ | 1.16$^{a}$ |
| CPT-2 | 20.40$^{fg}$ | 12.83$^{def}$ | 18.63$^{efg}$ | 12.55$^{ef}$ | 0.42$^{ef}$ | 0.91$^{bcd}$ |
| CPT-3 | 20.21$^{g}$ | 13.64$^{bc}$ | 19.34$^{cde}$ | 13.77$^{bcd}$ | 0.29$^{g}$ | 0.96$^{b}$ |
| CPT-4 | 20.64$^{efg}$ | 13.33$^{bcd}$ | 18.77$^{def}$ | 13.82$^{bc}$ | 0.37$^{f}$ | 0.91$^{bcd}$ |
| CPT-5 | 21.85cde | 13.18$^{bcde}$ | 19.38$^{cde}$ | 14.10$^{abc}$ | 0.26$^{g}$ | 0.89$^{bcd}$ |
| CPT-6 | 22.85$^{bcd}$ | 13.82$^{bc}$ | 19.88$^{abcd}$ | 14.36$^{ab}$ | 0.50$^{bc}$ | 0.87$^{cd}$ |
| CPT-7 | 22.01$^{bcde}$ | 13.11$^{cde}$ | 20.73$^{ab}$ | 14.32$^{ab}$ | 0.49$^{cd}$ | 0.94$^{bc}$ |
| CPT-8 | 21.75$^{def}$ | 12.56$^{ef}$ | 19.58$^{bcde}$ | 13.08$^{cde}$ | 0.53$^{bc}$ | 0.90$^{bcd}$ |
| CPT-9 | 23.27$^{abc}$ | 13.93$^{ab}$ | 20.52$^{abc}$ | 14.17$^{abc}$ | 0.44$^{de}$ | 0.88$^{bcd}$ |
| CPT-10 | 23.08$^{bcd}$ | 13.52$^{bcd}$ | 20.38$^{abc}$ | 14.84$^{ab}$ | 0.55$^{ab}$ | 0.88$^{bcd}$ |
| CPT-11 | 24.57$^{a}$ | 14.64$^{a}$ | 20.97$^{a}$ | 15.13$^{a}$ | 0.50$^{bc}$ | 0.85$^{de}$ |
| CPT-12 | 23.36$^{ab}$ | 13.71$^{bc}$ | 18.02$^{fg}$ | 12.63$^{def}$ | 0.60$^{a}$ | 0.77$^{e}$ |
| F value | 24.841** | 6.125** | 7.168** | 2.807** | 30.903** | 9.714** |
| C.D. | 1.438 | 0.765 | 1.194 | 3.189 | 0.054 | 0.086 |

The field evaluation of the progenies shows a significant difference in almost all the growth attributes (Table. 4). After 180 days after planting (DAP) the superior plant height (99.00cm), collar diameter (21.04mm), number of branches, number of leaves was observed from CPT-11 followed by CPT-9, CPT-10, CPT-2 and CPT-7. Survival percentage in the field was 98.14 per cent. The phenomenon of forking of the main stem was not prominent in the seedlings of the *Ailanthus triphysa.* The maximum forking observed was only 4 (CPT-6) and the minimum of 1(CPT5).

**Table 4:** Field Performance of selections of *Ailanthus triphysa after* 180 DAP

| Code | Plant height (cm) | Collar diameter (mm) | Number of leaves | Number of leaflets |
|---|---|---|---|---|
| CPT1 | 82.00$^{b}$ | 17.60$^{b}$ | 18.77$^{e}$ | 212.66$^{d}$ |
| CPT2 | 85.66$^{b}$ | 18.05$^{b}$ | 23.55$^{a}$ | 334.55$^{a}$ |
| CPT3 | 83.11$^{b}$ | 18.53$^{b}$ | 22.33$^{abc}$ | 321.22$^{abc}$ |
| CPT4 | 84.00$^{b}$ | 17.65$^{b}$ | 20.55$^{bcde}$ | 259.66$^{cd}$ |
| CPT5 | 85.66$^{b}$ | 18.35$^{b}$ | 23.22$^{a}$ | 325.88$^{ab}$ |
| CPT6 | 84.44$^{b}$ | 14.60$^{c}$ | 19.11$^{de}$ | 264.11$^{bcd}$ |
| CPT7 | 86.22$^{b}$ | 19.15$^{ab}$ | 22.66$^{ab}$ | 310.33$^{abc}$ |
| CPT8 | 85.00$^{b}$ | 18.59$^{b}$ | 23.33$^{a}$ | 339.88$^{a}$ |
| CPT9 | 95.00$^{a}$ | 18.29$^{b}$ | 21.55$^{abcd}$ | 369.77$^{a}$ |
| CPT10 | 93.66$^{a}$ | 18.15$^{b}$ | 20.22$^{bcde}$ | 344.88$^{a}$ |
| CPT11 | 99.00$^{a}$ | 21.04$^{a}$ | 23.22$^{a}$ | 370.00$^{a}$ |
| CPT12 | 85.00$^{b}$ | 18.52$^{b}$ | 20.11$^{cde}$ | 346.66$^{a}$ |
| F value | 7.228** | 4.352** | 4.3** | 4.97** |
| C.D. | 5.932 | 2.047 | 2.47 | 63.369 |

Present study revealed significant variations in germination and seedling growth characters of candidate plus trees of *Ailanthus triphysa*. Variation in germination and seedling growth traits of the progenies of trees growing at different localities with different environmental conditions have also been reported by various workers earlier in different species, *e.g.* Jaswal (1992) [13] in *Grewia optiva*, Goel *et al*. (1997) [10] in *Prosopis juliflora*, Manga and Sen (1998) [18] in *Prosopis cineraria*, Ginwal *et al*. (1995) [9] in *Acacia nilotica*, Thakur and Thakur (2015) [22] in *Melia azedarach*, Gunaga *et al*. (2010)[11] in *Tectona grandis*, Srivastava (1995) [21], Anand (2003) [2], Wani and Wani (2014) [24] in *Bauhinia variegata*. Variation in germination and seedling growth traits can also be attributed to the genetic makeup of parent trees and thereby their progenies as these trees are of seedling origin and are expected to show heterozygosity. The seeds which germinates rapidly and vigorously under favourable conditions are likely to be capable of producing vigorous seedlings in field conditions also, whereas weak or delayed germination is often fatal (Aldhous 1972) [1]. Results of the present study strongly support this hypothesis as the selection (CPT-11) having higher seed germination also had better field performance.

## Conclusion

The identification and selection of superior quality planting materials of *Ailanthus triphysa* has a greater role in the tree improvement. The single tree selection is one of the best methods for the production of superior progenies. From the present study after considering the important attributes of initial growth *viz*. germination parameters, plant height, collar diameter, root-shoot ratio, number of branches and seedling biomass. the three progenies out performed and emerged successful are CPT-11, CPT-10 and CPT-9 and hence are recommended for immediate and short term use for planting to utilise the possible "genetic gain" obtained from the selection and for further long term tree improvement studies of this important commercially cultivated tree *Ailanthus triphysa.*

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