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# Effect of Integrated Nutrient Management on Growth and Soil Properties in *Ailanthus excelsa* Nursery

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**An experiment was conducted to study the effect of integrated nutrient management on the growth of *Ailanthus excelsa* and soil properties. The results revealed that the integration of 150 mg of N, 200 mg of $P_2O_5$ and 100 mg of $K_2O$ kg$^{-1}$ soil along with vermicompost 40 g bag$^{-1}$ enhanced the various growth parameters like shoot length and dry matter production at all stages of seedling growth *viz*., 30, 60 and 90 days after transplanting. In addition, the INM treatment also enhanced the volume index and quality index used for the evaluation of seedling quality characteristics. The analysis of soil samples for the physico-chemical characters *viz*., pH and EC and the nutrient status of the soil through available N, P and K and organic carbon both initially and at 90 DAT revealed that there was no profound influence of INM on soil pH and EC but, the organic carbon (4.8 g kg$^{-1}$), available nitrogen (261 kg ha$^{-1}$), phosphorus (14.9 kg ha$^{-1}$), and potash (208 kg ha$^{-1}$) status in the soil was appreciably increased with the application of 150 mg of N, 200 mg of $P_2O_5$ and 100 mg of $K_2O$ kg$^{-1}$ soil supplemented with vermicompost 40 g bag$^{-1}$.**

**Key words:** *Ailanthus excelsa*, INM, growth parameters and soil properties

*Ailanthus excelsa* Roxb is commonly known as 'perumaram' in Tamil. The genus *Ailanthus* belongs to the family Simaroubaceae and order Rutales contains about 6-10 species. It is indigenous to India found throughout the tropical and subtropical parts up to 1000 m altitude. It occurs in mixed deciduous, semi-evergreen forests and also in Sal forests (Champion and Seth, 1968) and is found in the states of Gujarat, Rajasthan, Haryana, Punjab, Uttar Pradesh, Bihar, Odisha, Tamil Nadu and the Deccan plateau. It is a large deciduous tree, attaining a height of 18-24 m. It is light-demander; drought hardy and moderately frost-tender; coppices well and produces root suckers. It is fast growing softwood cum fodder tree, which thrives better on porous loamy soil. It grows well in the semi moist regions (Bhimaya *et al.,* 1963). Flowers appear from February- March in Central India, fruits start ripening between March to May and riped pods are collected from the trees before these are blown away by wind. Wings are removed either by hand (or) by beating the seeds then cleaned by winnowing. The samara fruits are copper red in colour winged with prominent veins and enclose one compressed seed at the centre. Fruit dimension is 7.24 cm length and 1.85 cm width (Ram Parkash, 1998). It is mainly propagated through seeds. It is a suitable plantation tree for social forestry, farm forestry, agroforestry, Industrial plantations and wasteland Afforestation. It is planted as an avenue tree for its deep shade and soil erosion control.

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The earlier concept is less input and less output. But the latest concept is high input and high output that to meet the ever-increasing demand of propagating material. Supply of quality planting stock for higher survival, establishment, and growth with short rotation is the pre requisite by the growers and consumers. In the nursery, several factors such as a seed, type of container, type of nursery, potting mixture, integrated nutrient management (INM) and the maintenance of nursery, plays a major role in the production of healthy planting stock in a shorter duration. Neeta Srivastava and Behl (2002) also stressed the importance of nursery planting medium with sufficient nutrients for better adaptability. Several researchers opined that nutrient management in nursery is important for production of quality seedlings. Application of small quantities of inorganic fertilizers in nursery increases the seedlings growth tremendously (Sundarlingam, 1983). It is now recognized as a significant technology in producing quality seedlings of a tree species in a short nursery period. As the INM treated seedlings will show more survival and growth under wider edapho climatic conditions.

The present concept of INM plays a major role in eliminating the above problem. Viewing the importance of integrated nutrient management with incorporation of organic, inorganic and biofertilizers in the production of quality planting material, the present study was undertaken with *Ailanthus* *excelsa,* to find out the best integrated nutrient (INM) management technique for the production of quality seedlings by evaluating the biometric and growth indices of the seedlings and nutrient status of the potting mixture at various stages of growth.

## Materials and Methods

The experiment was carried out at Forest College and Research Institute, Mettupalayam during the year 2006-07. The soil used was red non-calcareous (*Typic ustropept*) sandy loam in texture. For this study well decomposed vermicompost was used as organic manure. Urea, diammonium phosphate and muriate of potash were used as inorganic sources of N, $P_2O_5$ and $K_2O$, respectively. Inorganic fertilizers were applied to each seedling in the form of aqueous solution at seven days after the application of biofertilizers. The microbial inoculants *viz*., *Azospirillum* and Phosphobacteria were used as biofertilizers and vermicompost as organic manure. The polythene bags of size 15 x 25 cm were filled with two kg of soil mixture (2:1:1). The pre treated seeds (3 days leaching in 24 h interval) were sown in mother bed. At 30th day healthy and uniform height seedlings were pricked out and transplanted @ one seedling bag-1. The seedlings were arranged in a Completely Randomized Bock Design with three replications @ 20 seedlings per replication. Intercultural operation *viz*., watering, weeding and plant protection were given as per general recommendation. A shade panthal was erected to protect the transplanted seedlings from the sunshine. The calculated quantity of biofertilizers, individually and in combinations (vermicompost 40 g bag-1, *Azospirillum* 20 g bag-1 and Phospho bacteria 20 g bag-1) were added in the pot mixture while the inorganic fertilizers were added as aqueous solution to each poly bag. The treatment details of the experiment are furnished as below.

### Treatment details

| Treatment | Treatment (kg-1 of pot mixture) |
|---|---|
| $T_1$ | Control |
| $T_2$ | Vermicompost 20 g kg-1 of soil |
| $T_3$ | *Azospirillum* 10 g kg-1 of soil |
| $T_4$ | Phosphobacteria10 g kg-1 of soil |
| $T_5$ | 75:100: 50 mg NPK kg-1 of soil |
| $T_6$ | 150:200:100 mg NPK kg-1 of soil |
| $T_7$ | Vermicompost 20 g + 75:100:50 mg NPK kg-1 of soil |
| $T_8$ | *Azospirillum* 10 g + 75:100:50 mg NPK kg-1 of soil |
| $T_9$ | Phosphobacteria10 g +75:100:50 mg NPK kg-1 of soil |
| $T_{10}$ | Vermicompost 20 g +150:200:100 mg NPK kg-1 of soil |
| $T_{11}$ | *Azospirillum* 10 g + 150:200:100 mg NPK kg-1 of soil |
| $T_{12}$ | Phosphobacteria 10 g + 150:200:100 mg NPK kg-1 of soil |

The initial soil sample (pot mixture prior to imposing treatments) as well as soil samples collected at the end of the experiment (90 days after transplanting) were processed and analyzed for physico-chemical properties (Jackson (1973), organic carbon (Walkley and Black (1934), NPK status following the standard procedures of Subbiah and Asija (1956), Olsen *et al.* (1954) and Stanford and English (1949).

## Results and Discussion

All the INM treatments had a profound influence in enhancing the growth parameters and quality parameters of the seedlings. However, integration of 150 mg of N, 200 mg of $P_2O_5$ and 100 mg of $K_2O$ $kg^{-1}$ soil coupled with 20 g $kg^{-1}$ vermicompost ($T_{10}$) recorded the highest shoot length (30.5, 33.8 and 35.6 cm) and shoot dry matter (4.72, 7.37 and 8.83 g) (Table 1) at all the growth stages *viz*., 30, 60 and 90 days after transplanting. Nitrogen is the key element for increasing the dry matter production and obviously the N availability in the soil has unique importance. The results of Pankaj Tiwari and Saxena (2003) who found that application of 100 mg of urea and 25 mg of SSP seedling-1 for one year old *Dalbergia sissoo* produced vigorous seedlings with high survival and maximum dry matter production is concomitant to the present results. Vogel *et al*. (2001) have also reported that the dry weight of the above ground; root and total biomasses of *Hovenia dulcis* seedlings was positively influenced by the application of vermicompost.

**Table 1. Effect of INM treatments on shoot length (cm) and shoot dry weight (g) of *Ailanthus excelsa* at various periods of nursery**

| Treatment | Shoot length (cm) | | | Shoot dry weight (g) | | |
|---|---|---|---|---|---|---|
| | 30 DAP | 60 DAP | 90 DAP | 30 DAP | 60 DAP | 90 DAP |
| $T_1$ | 15.9 | 17.3 | 19.0 | 1.21 | 1.80 | 3.67 |
| $T_2$ | 21.6 | 24.6 | 26.7 | 2.41 | 3.48 | 4.51 |
| $T_3$ | 21.8 | 23.5 | 25.0 | 1.84 | 3.17 | 4.11 |
| $T_4$ | 23.2 | 25.0 | 26.0 | 2.06 | 2.53 | 3.44 |
| $T_5$ | 18.3 | 25.5 | 27.6 | 2.71 | 4.09 | 5.14 |
| $T_6$ | 20.1 | 24.8 | 28.0 | 2.33 | 4.70 | 5.57 |
| $T_7$ | 26.9 | 29.4 | 32.2 | 3.58 | 5.79 | 6.67 |
| $T_8$ | 25.6 | 28.3 | 30.3 | 3.18 | 4.33 | 5.17 |
| $T_9$ | 27.7 | 31.2 | 34.0 | 3.24 | 6.47 | 7.39 |
| $T_{10}$ | 30.5 | 33.8 | 35.6 | 4.72 | 7.37 | 8.83 |
| $T_{11}$ | 25.7 | 28.9 | 30.9 | 3.01 | 4.52 | 6.03 |
| $T_{12}$ | 25.3 | 28.5 | 30.0 | 2.96 | 4.80 | 5.40 |
| SEd | 0.9 | 0.9 | 0.6 | 0.40 | 0.60 | 0.60 |
| CD | 1.8 | 1.8 | 1.2 | 0.80 | 1.20 | 1.30 |

In addition to the accepted growth parameters, these indices were also utilized to assess the quality of *Ailanthus excelsa* seedlings on application of various INM treatments. The highest volume index (1136.2, 2785.9 and 3482.3) and quality index (0.113,0.284 and 0.411) (Table 2) was noticed in the seedling grown in 150 mg of N, 200 mg of $P_2O_5$ and 100 mg of $K_2O$ associated with vermicompost @ 20g kg-1 of soil. It is supported with Hidalgo and Harkess (2002), who reported that growth index (Volume index and Quality index), foliar and bract area and dry weight were greater in Poinsettia (*Euphorbia pulcherrima*) grown in substrates with vermicast.

**Table 2. Effect of INM treatments on volume index and quality index of *Ailanthus excelsa* at various periods of nursery**

| Treatment | Volume index | | | Quality index | | |
|---|---|---|---|---|---|---|
| | 30 DAP | 60 DAP | 90 DAP | 30 DAP | 60 DAP | 90 DAP |
| $T_1$ | 146.8 | 321.9 | 521.8 | 0.029 | 0.077 | 0.153 |
| $T_2$ | 353.6 | 962.3 | 1372.4 | 0.056 | 0.149 | 0.224 |
| $T_3$ | 312.9 | 837.2 | 1076.7 | 0.040 | 0.123 | 0.195 |
| $T_4$ | 333.4 | 839.3 | 1340.6 | 0.043 | 0.106 | 0.157 |
| $T_5$ | 242.0 | 1291.9 | 1934.9 | 0.060 | 0.182 | 0.265 |
| $T_6$ | 312.2 | 1152.0 | 2163.6 | 0.057 | 0.193 | 0.272 |
| $T_7$ | 556.1 | 1920.8 | 2263.9 | 0.069 | 0.237 | 0.272 |
| $T_8$ | 333.3 | 1349.1 | 1992.1 | 0.053 | 0.160 | 0.220 |
| $T_9$ | 734.7 | 2039.3 | 2886.7 | 0.077 | 0.202 | 0.328 |
| $T_{10}$ | 1136.2 | 2785.9 | 3482.3 | 0.113 | 0.284 | 0.411 |
| $T_{11}$ | 347.7 | 1300.6 | 1561.2 | 0.052 | 0.160 | 0.204 |
| $T_{12}$ | 367.9 | 1392.5 | 1598.7 | 0.053 | 0.177 | 0.224 |
| SEd | 82.8 | 151.3 | 242.8 | 0.01 | 0.019 | 0.024 |
| CD | 170.8 | 312.3 | 501.0 | 0.020 | 0.040 | 0.050 |

***Soil physico-chemical properties***

Before imposing INM treatment, the soil had a pH of 8.45 and electrical conductivity (EC) of 0.15 dS $m^{-1}$. After imposing the INM treatment, the pH of the soil was not altered by the treatments. It was observed that there was a decline in soil pH as compared to the initial pH (7.86) (Table 3). The probable reason would be the release of organic acids from the potting media and also from the organic sources of nutrients during the growing period. The decrease in soil pH upon organic manure addition was also reported by Sukhmal Chand *et al*. (2002). The EC also varied within narrow limits among the treatments. When compared to initial EC value (0.12), control and biofertilizers alone treatments recorded relatively lower values which might be due to the presence of relatively lesser concentration of soluble salts.

**Table 3. Effect of INM treatments on the physico-chemical properties and available nutrient status of soil at 90 DAT of *Ailanthus excelsa*.**

| Treatment | pH | Electrical conductivity (dS $m^{-1}$) | Organic carbon g $kg^{-1}$ | Available N (kg $ha^{-1}$) | Available P (kg $ha^{-1}$) | Available K (kg $ha^{-1}$) |
|---|---|---|---|---|---|---|
| $T_1$ | 7.86 | 0.12 | 2.7 | 197 | 11.4 | 158 |
| $T_2$ | 7.55 | 0.13 | 3.3 | 217 | 13.5 | 213 |
| $T_3$ | 7.82 | 0.13 | 3.9 | 209 | 12.5 | 153 |
| $T_4$ | 7.48 | 0.13 | 3.4 | 193 | 11.6 | 175 |
| $T_5$ | 7.98 | 0.17 | 3.2 | 229 | 12.0 | 189 |
| $T_6$ | 7.36 | 0.13 | 3.7 | 230 | 14.1 | 215 |
| $T_7$ | 7.51 | 0.17 | 4.1 | 258 | 14.2 | 197 |
| $T_8$ | 7.56 | 0.16 | 3.9 | 196 | 12.7 | 201 |
| $T_9$ | 7.27 | 0.12 | 3.7 | 222 | 12.8 | 208 |
| $T_{10}$ | 7.49 | 0.17 | 4.8 | 261 | 14.9 | 221 |
| $T_{11}$ | 7.56 | 0.16 | 3.2 | 196 | 13.2 | 204 |
| $T_{12}$ | 7.38 | 0.19 | 2.1 | 229 | 12.1 | 200 |
| SEd | 0.28 | 0.02 | 0.1 | 13 | 0.6 | 32 |
| CD(P=0.05) | NS | NS | NS | 27 | 1.2 | NS |

***Effect of INM on the available nutrient status of soil***

Before imposing INM treatments, the soil was low in available N (230 kg $ha^{-1}$), medium in available P (11.2 kg $ha^{-1}$), low in available K (188 kg $ha^{-1}$) and also low in organic carbon (0.36 %). The application of 150 mg of N, 200 mg of $P_2O_5$ and 100 mg of $K_2O$ $kg^{-1}$ soil along with vermicompost ($T_{10}$) was associated with relatively higher organic carbon (4.8 g $kg^{-1}$) content (Table 3). This might be due to the integrated effect of various sources of nutrients with vermicompost. The present finding is in corroboration with the findings of Saravanapandian (1990). The same treatment ($T_{10}$) had recorded the highest soil available N status (261 kg $ha^{-1}$). This clearly indicates the beneficial effect of integration of vermicompost with inorganic fertilizers by virtue of more favorable environment to the crop. Increase in available N and P was obtained by fertilization with FYM and the same was also reported by Singh e*t al*. (1968). The beneficial effect of inorganic fertilizers on soil available N status was also reported by Thiyagarajan *et al*. (1986) and Muthuswamy *et al.* (1990). The soil available Phosphorus was also higher (14.9 kg $ha^{-1}$) than all the other treatments. This above said treatment paved the way for better nutrition to the soil by the contribution of P from applied source of inorganic fertilizer and P supplemented with the effect of vermicompost which mineralize the unavailable soil P into available form. The positive influence of integrated supply of nutrients was also reported by Santhy (1995) and Karikalan (2005). Similarly higher potassium was also recorded (221 kg $ha^{-1}$) in $T_{10}$. It was further observed in the present study that addition of inorganic K appreciably increased the available K status of the soil indicating, the beneficial effects of INM in increasing the available K status. This finding is in accordance with the observation of Aravind (1987) and Santhy (1995).

## Conclusion

The Integrated nutrient management indicated that the integration of 150 mg of N, 200 mg of $P_2O_5$ and 100 mg of $K_2O$ $kg^{-1}$ of soil along with vermicompost enhanced the various growth parameters like shoot length, root length and collar diameter, the quality index values of Ailanthus excelsa**.** The above scored treatment also recorded higher amount of organic carbon, available nitrogen, phosphorus, and potash status of the potting mixture evaluated at 90 days after transplanting. But there was no change in the physico chemical properties of the soil *viz*., pH and EC.

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