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STUDIES ON SEED YIELD IMPROVEMENT OF NEEM (*AZADIRACHTA INDICA* A.JUSS) THROUGH CANOPY MANAGEMENT (PRUNING) AT TIRUNELVELI DISTRICT OF TAMIL NADU

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ABSTRACT:

The pruning experiment was carried out in 12 year old neem plantation at Pathamadai village, Seranmadevi Taluk, Tirunelveli district, Tamil Nadu. The neem trees were imposed with three pruning intensities (15 % pruning, 25 % pruning and 45 % pruning) and control for enhancing the flowering and fruiting in neem. The total nitrogen (2.351 %), total phosphorus (0.349 %), total potassium (0.214 %), chlorophyll 'a' (0.437 mg g^{-1}), chlorophyll 'b' (0.677 mg g^{-1}) and total chlorophyll (1.108 mg g^{-1}) was found superior in T2 (25 % pruning) and the lowest leaf nutrient status in control. The maximum neem seed yield was exhibited in 25 percent pruning with the seed yield of 3.80 kg. and the minimum was recorded in control (1.58 kg.). To conclude the study, the moderate pruning in the neem tree enhanced the nutrient status in leaf and fruit yield.

KEYWORDS: *Neem, Pruning, Leaf nutrient, Chlorophyll content, Seed yield.*

INTRODUCTION:

Pruning is a common technique in horticulture crops to expose sunlight for induces vegetative and reproductive growth (Sarkka and Erikson, 2003). In general, pruning is to observe and control the plant growth to manipulate branch, flowers and fruits produced in the off-season or

through the year. Many researchers and their studies have underlined the outcome of pruning on flowering and its effects on the subsequent fruit growth and quantity as well as its quality (Calatayud *et al*., 2007). Periodic pruning of fruit trees always reduces yield but enhances fruit quality. Pruning increases fruit size because excess flower buds are removed and pruning encourages the growth of new shoots with high-quality flower buds (Dhillon and Anirudh, 2014; Prasath *et al.,* 2017).

Neem, a suitable species for wasteland and other afforestation programmes planted extensively in Tamil Nadu by the forest department, farmers and other agencies suffer from irregular bearing which results in poor seed yield.

It is documented by earlier workers that due to profuse flowering in *Azadirachta indica*, the fruit set was very poor, resulting in large scale abscission of flowers as well as fruits during various stages of development. Normally in neem, large plantation has failed in flowering and fruiting and by keeping this in mind, the pruning intensities were carried out to study the nutrient status and seed yield.

MATERIAL AND METHOD:

The study was carried out during 2017-2018 in the Pathamadai village, Seranmadevi Taluk, Tirunelveli district, Tamil Nadu, India (8°38'27.71"N, 77°35'57.52"E). 12 year old neem plantations were selected for productivity enhancement of Neem seed yield through the treatment of canopy management. The soil type is red sandy loam soil, slightly alkaline in nature and low in organic carbon status. Available nitrogen is low, whereas the available phosphorus was medium and highest available potassium content.

The experiment was initiated in September 2017. The trees were selected based on uniform vigor and development. The dormant pruning treatments were performed on the entire tree and consist of unpruned control and increasing levels of dormant pruning (removing 15 %, 25 %, or 45 % of the fruiting branches) and taken 25 trees per treatment with randomized block design. The leaf samples were taken for evaluation at different stages during new flush formation, flowering, fruit development and harvesting.

Nutritional status

The processed and ground leaf samples were analyzed for macronutrients using appropriate methodology as furnished in Table 1 and expressed in percentage.

Chlorophyll content

The concentrations of chlorophyll 'a', chlorophyll 'b' and total chlorophyll were estimated in the 34 progenies after three months interval period by adopting the method of Yoshida *et al.,* (1976) and expressed as mg per gram of fresh weight.

Matured young fresh leaf samples of 250 mg were collected, washed in distilled water and then ground with 10 ml of 80 percent acetone using pestle and mortar. The homogenate solution was centrifuged at 500 rpm for 10 minutes. The supernatant was collected and the volume was made up to 25 ml using 80 percent acetone. The optical density of the content was measured at 663 and 645nm (Tanee and Albert 2013). Then chlorophyll 'a', chlorophyll 'b' and total chlorophyll content were calculated using the following formulae:

$$\text{Chlorophyll a content (mg g}^{-1}) = \frac{12.7 \text{ x OD at 663 nm} - 2.69 \text{ x OD at 645 nm x V}}{1000 \text{ x W}}$$

$$\text{Chlorophyll b content (mg g}^{-1}) = \frac{22.7 \text{ x OD at 645 nm} - 4.68 \text{ x OD at 663 nm x V}}{1000 \text{ x W}}$$

$$\text{Total chlorophyll content (mg g}^{-1}) = (8.02 \text{ x OD at 663}) + (20.2 \text{ x OD at 645}) \text{ x Df}$$

Where,

V = Volume made (25ml),

W = Weight of fresh sample taken
Df = Dilute factor

Seed yield

The fruit has harvest and extracted seed from each tree was weighted and expressed in kg tree^{-1}.

Statistical analysis

The experimental data were subjected to statistical analysis by ANOVA for analysis of randomized block design as described by Panse and Sukhatme (1978).

RESULTS AND DISCUSSION:

Effect of different pruning intensities on the nutrient status of neem tree

The effect of different pruning intensities on selected neem trees was analyzed for total nitrogen, total phosphorus and total potassium content at four stages namely new flush formation, flowering, fruit development and harvesting stage.

Total nitrogen

The effect of different pruning intensities on total nitrogen content at four growth stage was recorded maximum during the flowering stage in T_2 (25 % pruning) with the value of 2.839

percent followed by T_1-15 % pruning (1.869 %), T_3-45 % pruning (1.721 %) and minimum (1.574 %) in T_4 (Control). The T_2 (25 % pruning) treatment recorded the highest total nitrogen content in new flush formation, flowering, fruit development and harvesting stage with the value of 1.964 percent, 2.839 percent, 1.393 percent and 1.112 percent respectively

(Table 2). As growth progressed, total nitrogen content increased from new flush formation to flowering stage and gradually decreased from fruit development to harvesting stage, with significant variation between each other. Among the treatments, the mean total nitrogen content was the highest in T_2 (25 % pruning) with the value of 2.351 percent followed by T_1- 15 % pruning (1.658 %), T_3- 45 % pruning (1.444 %) and the minimum (1.376 %) was recorded in T_4 (Control).

Total phosphorus

Total phosphorus content among the treatments, T_2 (25 % pruning) was observed with the highest total phosphorus content in the new flush formation stage, flowering and fruit development stages with the values of 0.275 percent, 0.379 percent and 0.438 percent respectively. In fruit development stage, the maximum total phosphorus content (0.438 %) was recorded in T_2 (25 % pruning). On contrary, the lowest total phosphorus content (0.189 percent) was observed in T_4 (Control) at the new flush formation stage (Table 3).

Total potassium

The total potassium content observed was the highest (0.272 %) in T_2

(25 % pruning) followed by T_1-15 % pruning (0.245 %), T_3-45 % pruning (0.221%) and lowest in T_4 (Control) with a value of 0.165 percent at the flowering stage. Whereas, T_4 (Control) treatment registered the lowest total potassium content in three growth stages with the values of 0.106 percent (New flush formation), 0.165 percent (Flowering) and 0.133 percent (fruit development) respectively (Table 4).

The overall observations helped to conclude that T_2 (25 % pruning) and T_1

(15 % pruning) were found superior in nutrient status (total nitrogen, total phosphorus and total potassium) at four growth stages in neem plantation. On contrary, the lowest nutrient status at four growth stages was recorded in T_4 (Control).

Effect of different pruning intensities on chlorophyll content of neem tree

The effect of different pruning intensities on selected neem trees was analysed for chlorophyll 'a', chlorophyll 'b' and total chlorophyll at four growth stages namely new flush formation, flowering, fruit development and harvesting stage (Fig. 1).

Chlorophyll 'a'

The chlorophyll 'a' content was reported maximum at fruit development stage *viz*., T2 (25 % pruning) 0.668 mg g^{-1} followed by T1 (15 % pruning) 0.591, T3 (45 % pruning) 0.501 mg g^{-1} and control (0.433 mg g^{-1}). The control recorded the lowest chlorophyll 'a' content in new flush formation, flowering, fruit development and harvesting stages with the values of
0.124 mg g^{-1}, 0.237 mg g^{-1}, 0.433 mg g^{-1} and 0.222 mg g^{-1} respectively.

Chlorophyll 'b'

The chlorophyll 'b' content was observed minimum in control with the value of 0.322 mg g^{-1}, 0.431 mg g^{-1}, 0.420 mg g^{-1}, 0.537 mg g^{-1} in new flush formation, flowering, fruit development and harvesting stage respectively. On the contrary, the maximum value recorded in T_2 (25 % pruning) treatment at four growth stages 0.556 mg g^{-1} (New flush formation),
0.662 mg g^{-1} (flowering), 0.787 mg g^{-1} (fruit development) and 0.702 mg g^{-1} (Harvesting).

Total chlorophyll

The effect of different pruning intensities on total chlorophyll content was estimated at four growth stages are presented in Table 70. Among the different pruning intensities, total chlorophyll content was found superior (1.287 mg g^{-1}) in T_1 (15 % pruning) at fruit development stage followed by T_2 - 25 % pruning
(1.250 mg g^{-1}), T_3 - 45 % pruning
(1.215 mg g^{-1}) and the lowest in control with the value of 0.838mg g^{-1}. The lowest total chlorophyll content was found in control at a new flush formation stage with a value of 0.537 mg g^{-1}.

Resulting in the effect of the pruning in chlorophyll content (Chlorophyll 'a', chlorophyll 'b' and total chlorophyll), T_2 (25 % pruning) and T_1 (15 % pruning) recorded the highest values in all growth stages. The lowest chlorophyll content in neem leaves was recorded in control (Fig. 1).

Seed yield

25 % pruning (T_2) treatment registered significantly higher seed yield (3.80 kg) followed by 15 % pruning (2.79 kg) and control (1.58 kg) was the least performing treatment, compared to the grand mean (2.66 kg) (Table 5).

Nutrient status

When a commercial plantation is grown without silvicultural management practices like the pruning of tree then flowering may not be induced (Sivakumar and Korsten 2007). The time and position of pruning are essential (Bussi *et al.,* 2010).

The present study indicated that 25 % pruning intensity treatment resulted in the maximum amount of leaf nutrient status *viz*., total nitrogen (2.351 %), total phosphorus (0.349 %) and total potassium (2.351) respectively. Hossain and Fusao, (2008) suggested that nutrient status was maximum in pruned trees and minimum at unpruned peach trees. The nutrient status was found to increase from new flush formation to the flowering stage and started to decline from fruit development to harvesting. The leaf potassium content was increased by regular pruning which may induce earliness of the reproductive phase. The untreated trees contained a minimum amount of potassium (Saifuddin *et al.,* 2010). From the above findings, unpruned trees were documented with the least potassium content compared with other pruning treatments.

Chlorophyll content

The pruned trees have a higher amount of chlorophyll content due to enhancement in the vegetative phase along with the reproductive phase. Many researches on fruit yielding trees revealed that pruning treatment may increase the photosynthetic rate via changes in leaf chlorophyll contents (Calatayud *et al.,* 2007).

In the present investigation, 25 percent pruning intensity resulted in a higher rate of chlorophyll content in neem leaves and the lowest was in unpruned trees. The chlorophyll content gradually increased up to the fruit development stage and declined at the harvesting stage. The results revealed that imposing the different pruning intensities in the neem trees greatly influenced the chlorophyll content in leaves. These also play a major role in the neem seed yield. It is also recommended that imposing 25 percent and 15 percent pruning increases the chlorophyll content.

Seed yield

Pruning is an essential operation for improvement in seed yield, such it may alter the vegetative phase to the reproductive phase. The large sized trees, which have wide and dense canopy may prevent light penetration inside the canopy structure and lead to drop the fruit production (Mishra *et al.,* 2011). Among the different pruning intensities, the highest seed yield of 3.8 kg. was obtained in 25 percent pruning intensity followed by 15 percent (2.79 kg) and the lowest yield of 1.58 kg. in control trees. The results of the present investigation are supported by Prasath *et al.* (2017) who documented that pruning increased the fruit yield in *Tamarindus indica* at 30 percent pruning resulting in maximum fruit yield.

CONCLUSION:

Based on leaf nutrient analysis results was concluded that T_2 (25 % pruning) and T_1 (15 % pruning) were superior in nutrient status and chlorophyll contents at all the four growth stages

in neem plantation. As growth progressed, nutrient status and chlorophyll contents increased from the new flush formation stage to the flowering stage and slowly deteriorated from the fruit development stage to the harvesting stage, with significant variation between each pruning treatment. Hence the 25 percent pruning intensity is recommended as the optimum pruning intensity is to increase the seed yield of a neem plantation.

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Table 1: Standard procedures followed for leaf nutrient analysis

S.No.	Parameter	Method adopted	References
1	Nitrogen	Microkjeldahl method	Humphries (1973)
2	Phosphorus	Vanadomolybdate yellow color method	Jackson (1973)
3	Potassium	Flame photometry	Piper (1973)

Table 2. Effect of different pruning intensities on total nitrogen content in neem leaves

Total Nitrogen (%)					
Treatment	New Flush Formation	Flowering	Fruit Development	Harvesting	Mean
T1	1.606	1.869	1.648	1.509	1.658
T2	1.964	2.839	2.512	2.089	2.351
T3	1.374	1.721	1.393	1.287	1.444
Control	1.484	1.574	1.334	1.112	1.376
SED	0.009	0.028	0.062	0.025	
CD (0.05)	0.021	0.063	0.133	0.055	

Table 3. Effect of different pruning intensities on total phosphorus content in neem leaves

Total Phosphorus (%)					
Treatment	New Flush Formation	Flowering	Fruit Development	Harvesting	Mean
T1	0.254	0.305	0.347	0.258	0.291
T2	0.275	0.379	0.438	0.302	0.349
T3	0.189	0.233	0.268	0.243	0.232
Control	0.184	0.222	0.347	0.234	0.248
SED		0.004	0.003	0.001	
CD (0.05)		0.009	0.007	0.003	

Table 4. Effect of different pruning intensities on total potassium content in neem leaves

Total Potassium (%)					
Treatment	New Flush Formation	Flowering	Fruit Development	Harvesting	Mean
T1	0.143	0.245	0.205	0.178	0.193
T2	0.177	0.272	0.215	0.190	0.214
T3	0.137	0.221	0.184	0.149	0.173
Control	0.106	0.165	0.133	0.160	0.141
SED	0.002	0.004	0.002	0.001	
CD (0.05)	0.005	0.008	0.004	0.003	

Table 5. Effect of different pruning intensities on seed yield of treated neem trees

Treatment	Seed yield (kg)
T1	2.79
T2	3.80*
T3	2.46
T4	1.58
Mean	2.66
SED	0.273
CD (0.05)	0.628