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LEAF NUTRIENT STATUS AND FRUIT YIELD IN DIFFERENT AGE-CLASSES OF TAMARIND PLANTATION IN NORTHERN TAMIL NADU, INDIA

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ABSTRACT
An experiment was conducted to study the leaf nutrient status, chlorophyll content and fruit yield in different age-classes *viz*., age class of 10-20 years, age class of 20-30 years, age class of 30-40 years, age class of 40-50 years and age class of 50-60 years from Paiyur, Kaveripattinam taluk, Krishnagiri district of Tamil Nadu, India. Among the five age-classes, age class of 40-50 years exhibited maximum amount of total nitrogen (2.10 %), total phosphorus (0.359 %), total potassium (0.230 %), chlorophyll 'a' (0.527 mg g^{-1}), chlorophyll 'b' (0.461 mg g^{-1}), total chlorophyll (0.988 mg g^{-1}) and chlorophyll a/b ratio (1.143). On contrary, the lowest leaf macro nutrients (Total nitrogen - 1.54 %, Total potassium - 0.143 %) were recorded in age class of 10-20 years and lowest chlorophyll content (Chlorophyll 'a' - 0.339 mg g^{-1}, Chlorophyll 'b' - 0.333 mg g^{-1}, Total Chlorophyll - 0.672 mg g^{-1}) were observed in age class of 50-60 years. The tamarind fruit yield was exhibited maximum in age class of 40-50 years with the yield of 153 kg./tree and the minimum of 76 kg./tree in age class of 10-20 years. On concluding the study, the age class of 40-50 years bestow maximum in leaf nutrient status, chlorophyll content and tamarind fruit yield and hence it can be recommended for tamarind fruit production in seed raised plantation.

INTRODUCTION

Tamarind (*Tamarindus indica* L.,) commonly known as tamarind tree is one of the most important multipurpose tree species in the Indian sub-continent. It thrive in regions with lower rainfall of even 500-750 mm; it is a drought resistant tree and tolerates highest temperature even upto 47ºC. It grows economically successful in a wide range of soils varied from red loam, black clay loam, eroded hills to sandy loam situations in India. The tamarind tree is a medium sized, semi evergreen with short strong trunk with grey scaly bark. The leaves are alternate pinnately compound 7-15 cm long with pulvinus at the base of the petiole. There are 10-20 pairs of small leaflets, arranged opposite with almost sessile and oblong. The inflorescence is small terminal drooping raceme with 5-10 cm long. The flowers are small, scented and attractive with yellow and red colour. The seeds are obovate, flattened, brown with 1-15 mm long and joined to each other with tough fibre running through brown sticky pulp.

Leaves yield a red dye, which is used to give a yellow tint to cloth previously dyed with indigo. Tamarind leaves are a fair source of tannin, vitamin C and ß-carotene and the mineral content is high, particularly potassium, phosphorous, calcium and magnesium (El-Siddig *et al*., 2006). The chemical composition of the dried leaves (Nordeide *et al*., 1996) shows that the nutritional value is comparable to those of baobab leaves, except amounts of Ca, which in baobab are about five times higher. As reported in Morton (1987), leaves and roots of tamarind contain a number of glycosides such as vitexin, isovitexin, orientin and isoorientin. The amino acid profile of tamarind leaves showed that the leaves of Tamarind were potentially acceptable protein sources that would complement the amino acid profile and thus improve the protein quality of local diets (Nordeide *et al*., 1996). Chlorophylls are the universally occurring photosynthetic pigments, while carotenoids belonging to the group of terpenoids are orange or yellow accessory pigments in flowers and fruits (Bhardwaj *et al*., 2009).

No studies however, evaluated the relationship between the characteristics of nutrient status and chlorophyll content under different age-classes. So that, the present investigation was carried in Krishnagiri district of Tamil Nadu to study the influence of age-classes in nutrient status and chlorophyll content in tamarind leaves.

MATERIALS AND METHODS

The tamarind leaves collected in different age-classes *viz*., Age class of 10-20 years, age class of 20-30 years, age class of 30-40 years, age class of 40-50 years and age class of 50-60 years were taken from Paiyur, Kaveripattinam taluk, Krishnagiri district of Tamil Nadu from seed raised plantation. The tamarind leaves collected from different age-classes were processed and analysed at Forest College and Research Institute, Mettupalayam. Further the tamarind leaves collected were subjected to macro nutrient and chlorophyll analysis.

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', total chlorophyll and chlorophyll a/b ratio were estimated by adopting the method of Yoshida *et al*. (1976) and expressed as mg per gram of fresh weight.

Fully matured young fresh leaf samples of 250 mg were collected, washed in distilled water and then ground with 10 ml of 80 per cent 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 per cent acetone. The optical density of the content was measured at 663 and 645nm using double beam UV Spectrophotometer (Tanee and Albert, 2013).

Fruit Yield

The pods harvested from each tree were weighed and expressed in kg tree^{-1}.

Statistical analysis

The data obtained were subjected for statistical analysis to evaluate the possible relationship between the different parameters and analysis of variance employing statistical methods described by Panse *et al*. (1985).

RESULTS AND DISCUSSION

Age-classes influence on nutrient status

Plant nutrition in the form of macro elements is playing important role in fruit set, retention, development and cause impressive yield and quality improvement in crop plants (Khan *et al.,* 1993). Among different age-classes, age class of 40-50 years was found to be superior in total nitrogen content and total phosphorus content in leaves with the value of 2.10 per cent and 0.359 per cent respectively (Table 2).

Potassium is primarily responsible for energy production in the form of ATP and NADPH in chloroplasts by maintaining balanced electric charges as K involved in phloem loading and unloading of sucrose, amino acids and storage in the form of starch in developing fruits by activating the enzyme starch syntheses (Mengel and Kirkby, 1987) In present investigation, total potassium was recorded maximum in age class of 30-40 years with the value of 0.230 per cent. On contrary, the lowest total nitrogen content and total potassium content was accounted in age-class of 10-20 years with the macro nutrients content of 1.54 per cent and 0.143 per cent respectively.

Age-classes influence on chlorophyll content

Chlorophyll content signifies photosynthetic activity as well as growth and development of plant biomass (Agbaire and Esiefarienrhe, 2009). It is evident that chlorophyll content of plants varies from species to species based on age of leaf and also with the pollution level, biotic and abiotic conditions (Katiyar and Dubey, 2001). Prabhat *et al*. (2014) reported that chlorophyll content of plant varies from species to species and similarly it also changed with different age-classes. They also explained that chlorophyll content of plant signifies its photosynthetic activity. The present study observed variation in chlorophyll 'a', chlorophyll 'b', total chlorophyll and chlorophyll a/b ratio in different age-classes of tamarind (Table 3). The highest chlorophyll 'a', total chlorophyll and chlorophyll a/b ratio were accounted in age class of 40-50 years with the value of 0.527 mg g^{-1}, 0.988 mg g^{-1} and 1.143 respectively. The variability study by Sharma and Meena Bakshi (2014) reported that high chlorophyll content of *Dalbergia sissoo* clones (1.291 mg/g) was due to high photosynthetic rate which influence on growth parameters. The leaves (lower stratum) are rich in chlorophyll 'b' to chlorophyll 'a' ratio than leaves exposed to better sunlight (upper stratum) due to environmental changes and changes in specific leaf area (Mishra *et al*., 2013).

In the study, age class of 50-60 years accounted lowest chlorophyll 'a', chlorophyll 'b', total chlorophyll and chlorophyll a/b ratio with the value of 0.339 mg g^{-1}, 0.333 mg g^{-1}, 0.672 mg g^{-1} and 1.018 respectively. The lowest chlorophyll content in leaves may be due to internal factors of plants to absorb light (Malik *et al.,* 2003). The present study as

Table 1: Standard procedures followed for leaf nutrient analysis

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

Table 2: Macro nutrient status of tamarind leaves in different age-classes

Sl.No.	Age-classes (years)	Macro nutrients (%)		
		Total nitrogen	Total phosphorus	Total potassium
1	10 – 20	1.54	0.326	0.143
2	20 – 30	1.96	0.266	0.16
3	30 – 40	2.01	0.341	0.23
4	40 – 50	2.1	0.359	0.211
5	50 – 60	1.63	0.283	0.15
SEd		0.176	0.019	0.029
CD (0.05)		0.374	0.04	0.062

well as the study of other workers help to conclude that chlorophyll content in the tamarind tree was greatly influenced which eventually affects the yield in tamarind.

Tamarind fruit yield

The tamarind fruit yield was found maximum in age class of 40-50 years with the yield of 153 kg./tree followed by age class of 50-60 years (131 kg./tree), age class of 30-40 years (117 kg./tree), age class of 20-30 years (98 kg./tree) and the minimum of 76 kg./tree was recorded in age class of 10-20 years (Table 4).

Table 4: Tamarind fruit yield in different age-classes

Sl.No.	Age-classes (years)	Yield (kg./tree)
1	10 – 20	76
2	20 – 30	98
3	30 – 40	117
4	40 – 50	153
5	50 – 60	131
SEd		5.84
CD (0.05)		12.39

Table 3: Chlorophyll content of tamarind leaves in different age-classes

Sl. No.	Age-classes (years)	Chlorophyll 'a' (mg g^{-1})	Chlorophyll 'b' (mg g^{-1})	Total Chlorophyll (mg g^{-1})	Chlorophyll a/b ratio
1	10 – 20	0.424	0.357	0.781	1.187
2	20 – 30	0.491	0.477	0.968	1.029
3	30 – 40	0.514	0.452	0.966	1.137
4	40 – 50	0.527	0.461	0.988	1.143
5	50 – 60	0.339	0.333	0.672	1.018
SEd		0.059	0.041	0.108	0.182
CD (0.05)		0.113	0.089	0.269	0.342

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