Original Research Article

ASSESSING THE PHYSIOLOGICAL PARAMETERS OF FILLER CROPS INTERCROPPED UNDER RUBBER PLANTATION

ABSTRACT

Cut foliage's assume a significant place in domestic and international flower markets and it make up a prime section of floral industry as fillers. Cut foliages are being used in large quantities for floral decoration either on its own or in association with flowers in bouquets and flower arrangements. Most of these are shade loving and so they are suitable for intercropping in rubber plantations under shade. In this study a total of nine species where intercropped in rubber plantations. The experiment was laid down in Randomized Block Design (RBD) with three replications. The physiological parameters of filler crops were analysed. It was found that the species *Dypsis lutesence* exhibited highest leaf area (188.4cm^2/plant), leaf area index (0.0232), Absolute Growth Rate (0.41 g/day) and Crop Growth Rate (g/m^2/day) whereas the total chlorophyll content was found to be the highest (1.77 mg/g leaf tissue) in *Dracaena fragrans* cv. *massangeana.*

Key Words: Filler crops, Physiology, Rubber.

INTRODUCTION:

Cut foliages are valued for their coloration, shape and texture. These plants range from small *Alternanthera* to the majestic Traveller's Palm. Cut foliages play a vital role in a flower arrangements and are as important as the flowers themselves (Benedetto, 2015). They create the shape for arrangements, like the spiky foliage for linear arrangements, the large and rounded foliage for mass arrangements or using a combination of these two to create a linear-mass arrangement (Jain *et al.*, 2019). Further, green foliages provides a dark background and highlight the bright colors of flowers. They are shade loving plants of economic importance (Suryapriya *et al*, 2015; Safeena *et al.*, 2019). Usually these filler crops are being cultivated in shade net structure. The cost of erecting shade net contributes to higher cost of production. By introducing these plants under the natural shade of plantation crops will solve the purpose of reducing the cost of cultivation in the erection of artificial shade net structure for the cultivation of filler crops.

Among the plantation crops of South India, rubber is an important crop that plays a key role for income generation of small-scale farmers in humid tropics. Though rubber is an remunerative plantation crop, the initial gestation period of seven year remains unproductive and the land efficiency in these plantations is very low (Langenberger *et al.*, 2017). The wider alley space available between the rubber trees offers a great scope for the cultivation of filler crops upon utilization of natural shade. Usually, seven years after planting the light intensity under the rubber plantations is reduced and the shade tolerant filler crops can be grown as intercrop. Few commercially important foliage fillers are *Asparagas, Dracaena mahathma, Dracaena fragrans* cv. *Massangeana, Schefflera variegated, Dypsis lutesence, Philodendron xanadu, Spathiphylum* and *Syngonium.* Intercropping with these plants can enhance both the land use efficiency and also generates income. With this in view, a research programme was formulated to evaluate the various physiological parameters of the selected fillers under the shade of rubber.

MATERIALS AND METHOD

The present investigation on assessing the physiological parameters of filler crops intercropped in rubber plantation was carried out at Horticultural Research Station, Tamil Nadu Agricultural University, Pechiparai. This research work was carried out under field conditions. The experiment was laid out in Randomized Block Design (RBD) with three replications and 9 treatments in seven year old rubber field. The filler crops taken for the study are T_1 – *Asparagas,* T_2 - *Dracena mahathma* , T_3 - *Dracaena fragrans* cv. *Massangeana,* T_4 - *Schefflera variegated,* T_5 - *Dypsis lutescens,* T_6 - *Philodendron xanadu,* T_7 – *Spathiphylum,* T_8 – *Syngonium,* T_9 – *Calopagonium*. *Calopagonium* is used as check as the existing practice is growing this species as a cover crop in the alley spaces of rubber. The size of each experimental plot was 4.0 × 3.0 m. Raised beds were formed and pits of size 30 x 30 x30 cm^3 were dug at a spacing of 90 x 90 cm and seedlings of height 15cm of *Asparagas, Dracena mahathma, Dracaena fragrans cv. Massangeana, Schefflera variegated, Dypsis lutescens, Philodendron xanadu, Spathiphylum, Syngonium* and *Calopagonium* were planted. Irrigation was given on the day of sowing and again on third day. Subsequently weekly irrigations were given during summer months. The following physiological parameters viz., total chlorophyll content, leaf area, leaf are index, absolute growth rate and crop growth rate were assessed:

1) Total chlorophyll content

The leaves were collected on 60, 120 and 180 days after planting, weighed and macerated in a homogenizer with 80 per cent acetone. The extract was centrifuged at 3000 rpm for 15 minutes. The supernatant was collected and were made up to a known volume of 10 ml. The absorbance of the extract was read in a spectronic 20 photoelectric colorimeter at 645 and 663 nm (Yoshida *et al.*, 1971). The total chlorophyll content was expressed in mg g^{-1} leaf tissue.

$$\text{Chlorophyll a} = 12.7 \times (A_{663}) - 2.69 \times (A_{645}) \times \frac{V}{1000\ x\ W}$$

$$\text{Chlorophyll b} = 22.9 \times (A_{645}) - 4.68 \times (A_{663}) \times \frac{V}{1000\ x\ W}$$

$$\text{Total chlorophyll} = 20.2 \times (A_{645}) + 8.02 \times (A_{663}) \times \frac{V}{1000\ x\ W}$$

Where, A = Absorbance at specific wavelength

V = Final volume of chlorophyll extract in 80 % acetone

W = Fresh weight of tissue extracted

2. Leaf area

The fully expanded fifth leaf from the tip was selected and length and breadth was measured. The apparent leaf area was calculated from length and breadth of each leaf multiplied with the constant k (0.4774) and expressed in $cm^2 leaf^{-1}$. The total leaf area of the plant was calculated by multiplying leaf area with number of leaves and expressed in cm^2 $plant^{-1}$

3. Leaf area index

The Leaf area index (LAI) was calculated by employing the formula of Williams (1946).

$$\text{LAI} = \frac{Leaf\ area\ per\ plant\ (cm^2)}{Land\ area\ occupied\ by\ a\ plant\ (cm^2)}$$

4. Absolute growth rate

Absolute growth rate (AGR) is the dry matter production per unit time (g day^{-1}), which was calculated by using the formula given by Radford (1967).

$$\text{AGR} = \frac{W_2 - W_1}{t_2 - t_1}$$

Where,

W1 = Dry matter of the plant (g) at time t_1

W2 = Dry matter of the plant (g) at time t_2

5. Crop growth rate (CGR)

Crop Growth Rate is the rate of dry matter production per unit ground area per time (Watson, 1952). It was calculated by using the following formula and expressed in $g/m^2/day$.

$$\text{CGR} = \frac{W_2 - W_1}{P\ (t_2 - t_1)}$$

Where, W_2 and W_1 are dry weight of the plant at time t_2 and t_1 respectively. P is the area in m^2 occupied by a single plant.

RESULTS AND DISCUSSION

1. Total Chlorophyll Content:

The observations recorded on total chlorophyll content are presented in Table 1. Among the treatments, T_3 *Dracaena fragrans* cv. *massangeana* recorded significantly highest total chlorophyll content (1.77 mg/g) from 60 to 180 DAP followed by T_5 (*Dypsis lutesence*) which recorded 1.71 mg/g. The minimum total chlorophyll content was in T_2 (0.97) **(Table 1 & Fig. 1)**. The chlorophyll is an essential component for photosynthesis. The high chlorophyll content in plants leads to higher growth through increased uptake of nitrogen (Nagaraj *et al.*, 2019; Garcia *et al.*, 2020).

2. Leaf Area

In this experiment the leaf area was significantly influenced by different treatments throughout the growth period. Among the treatments, the leaf area was maximum in T_5 (188.4 cm) and was followed by T_1 (177.8 cm^2) **- Table 1**. Leaf area is an important component for filler crops. More the leaf area, the coverage of fillers in an floral arrangements will be good and in this study the leaflets has contributed to an overall increase in leaf area and it is of prime importance as for as the purpose for which the filler crops are used. The rate of leaf initiation and leaf emergence had linear relationships with temperature. In this experiment the increased leaf area in the higher extent of leaf elongation rate and leaf width of upper leaves and in several cases it could be associated with an increase of apical dome size. In comparison with duration of leaf elongation, the leaf expansion rate (LER) is more sensitive to fluctuating environment as was also stated by Hay and Porter (2006). LER decreased exponentially with raised accumulated temperature. In this study the increased leaf area in *Dypsis* is mainly due to the shade effect created by the canopy of this plant which could have reduced the temperature and thus more leaf elongation. This result is in conformity with the findings of Daniel and Mark (2003).

3. Leaf Area Index

The leaf area index (LAI) varied significantly between the treatments. Among the treatments, the LAI was significantly superior in T_5 *Dypsis lutesence* (0.0232), followed by T_3 *Dracaena fragrans* cv. *massangeana* (0.0177) on 60 days after planting **(Table 1)**. Success in competition for light depends on allocation to stem height, whereas reproduction depends on the productive part of the plant (foliage area). Differences in individual leaf area in shaded variant was related to increased final leaf length and leaf elongation rate (Benedetto, 2015).

4. **Absolute growth rate**

Absolute Growth Rate indicates the dry matter production. The Absolute Growth Rate varied significantly between the treatments **(Table 2).** As AGR denotes the dry matter production per unit time, in this experiment the absolute growth rate ranged between 0.04 g day $^{-1}$ in *Calopagonium* to 0.28 g day $^{-1}$ in T_5 (*Dypsis lutesence*) at 60 days after planting. The same trend was continued and on 120 DAP also T_5 *Dypsis lutesence* recorded the highest (0.41 g day $^{-1}$) AGR. The least AGR was recorded in *Calopagonium* (0.06 g day^{-1}) when compared to all other treatments.

5. **Crop growth rate**

Crop Growth Rate (CGR) is the rate of dry matter production per unit ground area per unit per unit time. It is also influenced by leaf area index, photosynthetic rate, leaf angle and it is also an index of amount of light interception. In this experiment a progressive increase in the CGR was noticed up to 180 days after planting **(Table 2).** The progressive increase in CGR in T_5 might be due to higher production of dry matter which led to better utilization of carbon and subsequent increase in photosynthetic activities coupled with increased cell multiplication. Rhodes (1969) stated that difference between the CGR of vegetative and reproductive growths occur due to newly expanding leaves with elongating stems which also contributes for light interception.

CONCLUSION:

Rubber is one among the important remunerative plantation crop, but the initial seven years period remains unproductive. The foliage plants are mostly shade loving and they are cultivated in artificial shade nets. Introducing these plants under the shade of rubber will solve the purpose for reducing the cost of cultivation of these crops by the construction of artificial shade net as well as the natural shade of rubber can be utilized. This also generates additional income. So this study was carried out to evaluate different fillers under rubber plantation. The physiological parameters *viz.*, leaf area, leaf area index, Absolute Growth Rate (AGR) and Crop Growth Rate (CGR) contributed for the growth and yield of filler crops. Hence, it is concluded that the assessment based on physiological parameters T_5 - *Dypsis lutescence* is best for cultivars in alley spaces of rubber plantations

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Treatments	Total Chlorophyll Content (mg/g)			Leaf area (cm^2 $plant^{-1}$)			Leaf area index (LAI)		
	Days after planting			Days after planting			Days after planting		
	60	**120**	**180**	**60**	**120**	**180**	**60**	**120**	**180**
T_1 – *Asparagus*	1.20	1.28	1.40	152.1	168.2	177.8	0.0137	0.0157	0.0169
T_2 – *Dracaena mahathma*	0.86	0.90	0.97	87.56	94.0	99.0	0.0107	0.0118	0.0121
T_3 - *Dracaena fragrans* cv. *Massangeana*	1.36	1.44	1.77	113.9	128.6	143.8	0.0147	0.0163	0.0177
T_4 - *Schefflera variegated*	1.26	1.36	1.48	98.03	107.7	114.4	0.0120	0.0127	0.0128
T_5 - *Dypsis lutesence*	1.32	1.41	1.71	145.03	169.6	188.4	0.0192	0.0211	0.0232
T_6 - *Philodendron Xanadu*	1.25	1.38	1.56	63.86	68.7	74.9	0.0078	0.0084	0.0092
T_7 - *Spathiphylum*	1.21	1.35	1.43	110.2	117.0	124.0	0.0132	0.0144	0.0152
T_8 - *Syngonium*	1.52	1.61	1.69	89.03	95.4	100.4	0.0116	0.0117	0.0123
T_9 - *Calopagonium*	0.98	1.07	1.16	15.46	17.0	19.3	0.0018	0.0020	0.0024
Mean	**1.25**	**1.38**	**1.48**	**102.80**	**110.65**	**116.4**	**0.01**	**0.14**	**0.01**
SEd	**0.16**	**0.05**	**0.05**	**10.58**	**11.30**	**11.77**	**0.0013**	**0.0015**	**0.0015**
CD(P=0.05)	**0.34**	**0.12**	**0.12**	**22.43**	**23.96**	**24.95**	**0.0028**	**0.0032**	**0.0031**

Table 1: Effect of different treatments on Total Chlorophyll Content (mg/g), Leaf area, and Leaf area index.

Table 2: Effect of different treatments on Absolute growth rate and Crop growth rate

Treatments	**Absolute Growth Rate (AGR) g day $^{-1}$**		**Crop Growth Rate (CGR) gm^{-2} day^{-1}**	
	Days after planting		**Days after planting**	
	60-120	**120-180**	**60-120**	**120-180**
T_1 – *Asparagus*	0.15	0.21	0.15	0.10
T_2 – *Dracaena mahathma*	0.18	0.25	0.18	0.15
T_3 - *Dracaena fragrans* cv. *Massangeana*	0.16	0.20	0.17	0.13
T_4 - *Schefflera variegated*	0.16	0.29	0.15	0.18
T_5 - *Dypsis lutesence*	0.28	0.41	0.22	0.35
T_6 - *Philodendron Xanadu*	0.12	0.17	0.11	0.10
T_7 - *Spathiphylum*	0.13	0.16	0.15	0.11
T_8 - *Syngonium*	0.15	0.24	0.12	0.15
T_9 - *Calopagonium*	0.04	0.06	0.06	0.09
Mean	**0.19**	**0.22**	**0.15**	**0.22**
SEd	**0.01**	**0.03**	**0.0016**	**0.0024**
CD(P=0.05)	**0.04**	**0.06**	**0.033**	**0.005**

Fig 1: Effect of different treatments on Total Chlorophyll Content (mg/g)