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Physiological Evaluation of redgram-based cropping system on crop growth and competitiveness in Samai

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Abstract

The small millet with legume intercropping system benefits small farmers by reducing environmental risk and improving yield potential due to low input and enhanced soil fertility.

Due to climate changes, the significant reduction in agricultural by-products is caused by water scarcity, increasing temperatures, and variations in solar interception, leading to yield reduction. Planting both cereal and legume intercrops on the same piece of land helps reduce cultivation costs and effectively utilize resources. The different plant heights improve light interception, enhancing photosynthetic efficiency. The main focus of this research was to determine the yield advantage of a millet and legume-based intercropping system under rainfed conditions. Improving yield and water use efficiency were assessed by an 8:2 samai with redgram intercropping system compared to others. During Kharif 2016-2019, a study was carried out at the Centre of Excellence in Millets, Athiyandal, Tiruvannamalai district. Three replications of the experiment were carried out using a Randomized Block Design. In rainfed conditions, the morphological and physiological responses of samai planted with red gram showed a favourable correlation with yield components. Samai intercropped with red gram at 8:2 row ratio recorded the highest dry matter production and grain yield.

Keywords: Intercropping, total dry matter production, total chlorophyll content and yield

Introduction

The development and productivity of crops can be impacted by variable weather conditions (Malarkodi *et al.* 2023) [15]. Under changing weather conditions, there is a need to improve the development of cropping patterns to enhance farmers' income and food security (Balaji *et al.* 2023) [1]. Crop productivity and agricultural sustainability are at risk due to water scarcity (Piao *et al.*, 2010) [7].

An additional expense is the severe competition for water availability between the rapidly growing urbanization and agricultural sectors (Poumanyvong *et al.*, 2012) [8]. Chai *et al.* (2014) [4].

Outlines several strategies that have been employed in agriculture to conserve water, such as the implementation of innovative water-saving techniques and controlled irrigation in crop production. Yin *et al.* (2015) [13] reported that Intercropping was helpful in enhancing water use efficiency during rainfed cultivation. According to Sharma *et al.* (2017) [10], intercropping can improve soil water conservation, decrease runoff, and maximise the use of readily accessible soil water (Yang *et al.*, 2011 and Hu *et al.*, 2017) [12]. increase the production of crops cultivated the next year in the rotation, as well as the yield for the overall systems and the yield per unit of water supplied (Borghetti *et al.*, 2013; Qin *et al.*, 2013) [2, 9]. Enhancing the samai-based cropping system to increase farmers' revenue with low-cost efficiency was the goal of this experiment.

Materials and Methods

At the Centre of Excellence in Millets, Athiyandal, a randomised block design, three replications, and a field experiment were carried out in 2018. Samai with red gram intercropping is a common agricultural practice for enhancing crop diversity and production in rainfed environments. The recommended package of practices was followed during the cropping system. Treatments details are, T₁-Littlemillet + Red gram (4:1)- Mothbean, T₂.

Littlemillet + Red gram (4:1)- Blackgram, T₃ Littlemillet + Red gram (4:1)-Horsegram, T₄ Littlemillet + Red gram (6:2)- Mothbean, T₅ Littlemillet + Red gram (6:2)- Blackgram, T₆ Littlemillet + Red gram (6:2)- Horsegram, T₇ Littlemillet + Red gram (8:2)- Mothbean, T₈ Littlemillet + Red gram (8:2)- Blackgram and T₉ Littlemillet + Red gram (8:2)- Horsegram.

Plant height

Five randomly chosen plants from each treatment and replication were measured for height from the base of the shoot to the longest leaf tip. The mean value was calculated and reported in centimetres.

Leaf Area (LA): Using a Leaf Area Meter (Li-Cor Model 3100), the leaf area of the entire sampling unit was calculated and reported as cm² plant⁻¹.

Leaf Area Index (LAI)

The LAI was calculated by employing the formula of Williams (1946) ^[14].

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

Chlorophyll Meter

The amount of chlorophyll present in leaves was also qualitatively measured using a non-destructive method with the SPAD-502 Chlorophyll Meter. (Minolta Co., Japan) as suggested by Gratani (1992) ^[16].

Results and Discussion

Samai intercropped with redgram at 8:2 row ratio (T₈) recorded, increased growth attributes of plant height (113.3 cm), productive tillers (7.5), LAI (1.75) and Total chlorophyll content (41.7). Similarly the highest grain yield (1032 kg /ha), straw yield (1721 kg/ha) was recorded with samai intercropped with red gram at row ratio of 8:2 compared to other row ratios (Gangadhar *et al.*, 2023) ^[5]. The succeeding crop of horse gram performed better followed by moth bean and black gram. Sivagamy *et al.*, (2024) ^[11] reported that the samai with a red gram 8:2 ratio improved chlorophyll content, grain yield, number of pods per plant, panicle length, and straw yield.

To increase productivity and net income for rainfed farmers, productivity of intercrops in contrast to production from a single crop could be selected based on the yield of redgram grain and samai intercropping under irrigated and rainfed settings.

Table 1: Impact of intercropping on yield of little millet under rain fed situations

Treatments	Little millet Plant height (cm)	Productive tillers/hill of little millet	LAI	SPAD Chlorophyll	Grain yield kg/ha		Fodder yield (Kg/ha)
					Little millet	Redgram	
T ₁	99.5	4.2	1.37	36.3	620	312	1296
T ₂	97.2	3.7	1.65	42.5	524	276	1160
T ₃	108.3	4.3	1.31	46.6	578	308	1228
T ₄	111.7	6.8	1.42	38.2	765	387	1317
T ₅	89.3	7.2	1.46	39.3	822	445	1362
T ₆	101.6	6.3	1.69	41.1	890	472	1439
T ₇	103.7	6.8	1.34	39.0	980	510	1542
T ₈	113.3	7.5	1.75	41.7	1032	528	1721
T ₉	99.5	7.3	1.34	47.3	956	473	1506
SEm	3.1	0.4	0.06	2.4	51.5	26.7	88.1
CD (0.05)	8.8	1.1	0.18	7.0	159.5	79.9	264.1

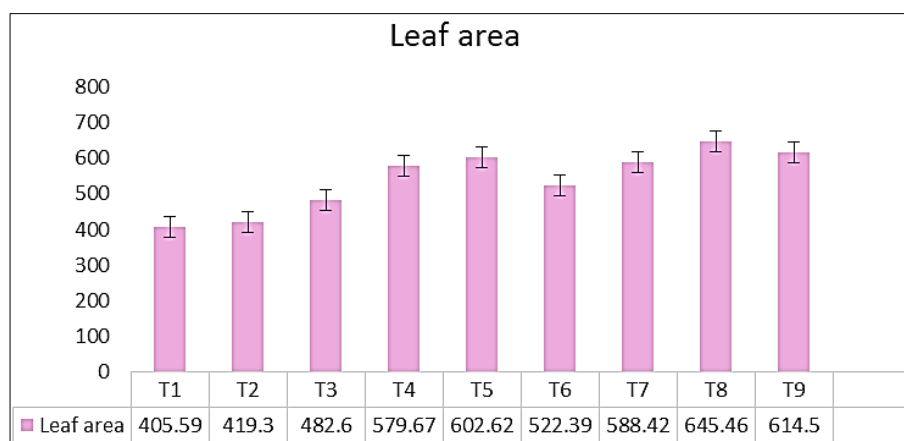


Fig 1: Impact of intercropping on leaf area of little millet under rainfed situations

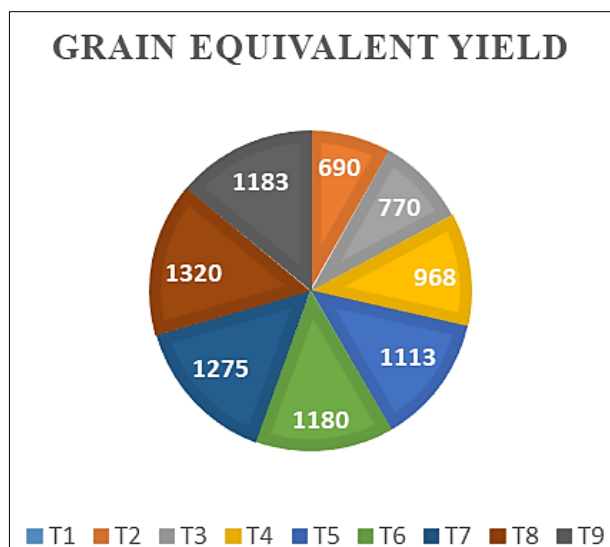


Fig 2: Impact of intercropping on grain equivalent yield of little millet under rainfed situations

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