

Original Research Article

Growth and Economic of Performance of Foxtail millet-millet Concerning Irrigation System in based Intercropping system for improving the Productivity, Sustainability and Economics in Western Zone of Tamil Nadu Under Irrigated Condition

ABSTRACT

We carried out a field experiment ~~was carried out~~ at the Eastern block farm, Agriculture college and ~~research~~ Research Institute, TNAU, Coimbatore, Tamil Nadu to study the performance of ~~the~~ Foxtail millet ~~concerning the based~~ intercropping system for improving the Productivity, Sustainability, and Economics in ~~the~~ Western Zone of Tamil Nadu Under Irrigated Condition. The experiment was laid out in Randomized Block Design (RBD) with seven treatments and replicated three times. The treatment details ~~is~~ were ~~???????????????~~ T₁ [Foxtail millet (sole crop)], T₂ [Foxtail millet + Green gram (3:1)], T₃ [Foxtail millet + Vegetable Cowpea (3:1)], T₄ [Foxtail millet + Coriander (3:1)], T₅ [Foxtail millet + Green gram (4:1)], T₆ [Foxtail millet + Vegetable Cowpea (4:1)], and T₇ [Foxtail millet + Coriander (4:1)]. They assessed the intercropping indices like Foxtail Millet Grain Equivalent Yield (FMGEY), Land Equivalent Ratio (LER), Relative Crowding Coefficient (RCC), Aggressivity, Competition Ratio (CR), and Competition Index (CI). They revealed that the effect of growth and yield on foxtail millet is influenced by intercrops. Even though the results were significant ($P < 0.05$), the plant height was found to be higher at all stages under the treatment, T₆ followed by T₅. Among the various intercrops, T₆ produced higher dry matter production followed by T₅ at harvest.

Keywords: Economics, Foxtail millet; Intercropping; Productivity; Sustainability; ~~Economics~~

INTRODUCTION

Millet, ~~often referred to as or~~ "Nutri grains," are ~~highly valued for their~~ rich content of ~~in~~ micronutrients, ~~including such as~~ minerals and B-complex vitamins. Small millets, in particular, have garnered attention ~~due to their ability to mature early for their~~ early maturation, achieve higher yields through the C4 plant type mechanism, and ~~thrive survive~~ in poor soil and low rainfall conditions. These qualities have earned them the reputation of being "climate resilient" crops in Indian agriculture. The cultivation of small millets contributes significantly to the nation's food and fodder security.

Foxtail millet (*Setaria italica*) grains are similar in structure to paddy rice but have an outer husk that requires removal before use. It was domesticated in China over 8,000 years ago and has played a significant role in the development of Chinese civilization. Foxtail millet ~~for its qualities~~ remains a staple cereal in arid and semi-arid regions ~~due to its drought tolerance and early maturity~~, making it suitable for short-term catch cropping. It adapts well to various elevations, soils, and temperatures but cannot withstand waterlogging. In India, small millets are cultivated ~~on in~~ an area of 440 million ha. producing 379 million tonnes with ~~the~~ a productivity of 789 kg ha⁻¹ (Indiastat. 2023). In Tamil Nadu, small millets are cultivated on an area of 24.57 million ha producing 30.51 million tonnes with a productivity of 1247 kg ha⁻¹. In Tamil Nadu, foxtail millet is cultivated in an area of 1508 thousand ha. producing 709 thousand tonnes with ~~a~~ productivity of 470 kg ha⁻¹.

Millets are suitable for arid lands with limited water and higher temperatures. Intercropping, growing multiple crops together, intensifies resource use and yields. ~~Advantages include~~ They are advantageous with better resource utilization, weed suppression, yield stability, higher equivalent yields, increased cropping intensity, reduced pest and disease incidence, improved soil health, and sustainable farming. Intercropping in small

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millet enhances resource efficiency, yields, and sustainability, making it advantageous for agriculture in arid regions.

The complementarity among the cultivated species is crucial for achieving higher crop yields in intercropping systems. Particularly, in dryland conditions, intercropping provides a natural insurance against total crop failure, ensuring production sustainability. The combination of foxtail millet with legumes in intercropping further enhances soil fertility and overall system resilience.

Material and Methods

The experiment was conducted at Eastern Block Farm, Tamil Nadu Agriculture University, Coimbatore, Tamil Nadu. ~~The aim of this study was~~ We aimed to study ~~the~~ performance of ~~the foxtail-Foxtail millet-millet-based~~ intercropping system for improving ~~the~~ productivity, sustainability, and economics in western ~~zone of~~ Tamil Nadu under irrigated ~~Condition~~ conditions. The experiment was laid out in a randomized block design with seven treatments and replication thrice. The treatments ~~comprised-were as follows~~ T₁ [Foxtail millet (sole crop)], T₂ [Foxtail millet + Green gram (3:1)], T₃ [Foxtail millet + Vegetable Cowpea (3:1)], T₄ [Foxtail millet + Coriander (3:1)], T₅ [Foxtail millet + Green gram (4:1)], T₆ [Foxtail millet + Vegetable Cowpea (4:1)], ~~and~~ T₇ [Foxtail millet + Coriander (4:1)] intercropping under replacement series and all the intercrops viz., greengram, vegetable cowpea, and coriander were raised separately in adjacent to the treatment plots for observation purpose. The yields were recorded to ~~work-out the~~ ~~assessthe~~ intercropping ~~assessment~~ indices like Foxtail Millet Grain Equivalent Yield (FMGEY), Land Equivalent Ratio (LER) (Mead and Willey, 1980) [9], Relative Crowding Coefficient (RCC) (De Wit, 1960) [4], Aggressivity (Mc Gihrist, 1965), Competition Ratio (CR) (Willey and Rao, 1980) [15], and Competition Index (CI) (Donald, 1963) [5] as per the standard formulae. Correspondingly grain and straw yield of foxtail millet was also recorded in all the treatments.

RESULTS AND DISCUSSION

Growth and yield attributes of foxtail millet

The effect of growth and yield on foxtail millet as influenced by intercrops. Even though the results were significant ($P < 0.05$), ~~the~~ plant height ~~of foxtail millet~~ was found to be higher at all stages under the treatment, ~~foxtail millet + vegetable cowpea at 4:1 ratio (120.7 cm at harvest)~~ T₆ followed by ~~foxtail millet + greengram at 4:1 ratio (114.2 cm at harvest)~~ T₅ (Table 1). Among the various intercrops, ~~foxtail millet + vegetable cowpea at 4:1 ratio~~ T₆ produced higher dry matter production ($6223.5 \text{ kg ha}^{-1}$) followed by ~~foxtail millet + greengram at 4:1 ratio~~ T₅ at harvest (Table 1).

The yield attributes foxtail millet like no of tillers plant⁻¹ and 1000 grain weight found to be increased when intercropped with vegetable cowpea followed by ~~greengram-green gram~~ at 4:1 ratio at harvest (Table 1). Sharmili and Manoharan et. al., (2018) reported that yield attributes of little millet like no of tillers plant⁻¹ and 1000 grain weight ~~are~~ increased when intercropped with pulses (blackgram and greengram at 8:2 ratio, respectively) and it is on par with a sole crop of little millet.

Assessment of Intercropping Indices

Relative crowding coefficient (RCC)

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Aggressivity

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Competition ratio (CR)

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Competition index (CI)

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Yield and system productivity

The grain yield of foxtail millet was significantly influenced by various intercrops at harvest and the grain yield ranged from 1085 to 2050 kg ha⁻¹ (Table 2). Foxtail millet sole crop recorded the highest grain yield (2050 kg ha⁻¹) followed by foxtail millet + vegetable cowpea (4:1) ratio T₆, foxtail millet + greengram (4:1) ratio T₅, foxtail millet + coriander (4:1) ratio T₇, foxtail millet + vegetable cowpea (3:1) ratio T₃, and foxtail millet + coriander (4:1) ratio T₇, and foxtail millet + greengram (4:1) ratio T₅ were on par. Basavarajappa et al., (2003) found higher yields in sole foxtail millet crops compared to intercropped treatments. The harvest index in different treatments ranged between 0.25 to 0.31.

Economics

Table 1. Growth and yield attributes of little millet, RCC, LAER, and CI as influenced by different intercropping systems.

Treatments	Plant height (cm)	Dry matter production (kg ha ⁻¹)	No of tillers plant ⁻¹	1000 grain weight (g)	Leaf Area Equivalent Ratio (LAER)	Relative Crowing Coefficient (RCC)	Competition Ratio (CI)
T ₁ - Foxtail millet (Sole crop)	112.4	5328	2.4				
T ₂ - Foxtailmillet+ Greengram (3:1)	102.8	4585	1.9				
T ₃ - Foxtail millet +Vegetable cowpea (3:1)	106.8	5285	2.4				
T ₄ - Foxtail millet + Coriander (3:1)	105.4	5068	2.3				
T ₅ - Foxtail millet + Greengram (4:1)	114.2	5939	2.45				
T ₆ - Foxtail millet + Vegetable cowpea (4:1)	120.7	6224	2.79				
T ₇ - Foxtail millet + Coriander (4:1)	110.4	5649	2.48				
Mean	96.6	4759	2.09				
SEd	5.84	299.3	0.366				

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CD (5%)	16.12	826.07	0.359				
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Table 2. Yield, Harvest index, Net returns, and B: C ratio of different little millet intercropping system

Treatments	Foxtail millet yield (kg ha ⁻¹)		Harvest index	Yield of intercrops (kg ha ⁻¹)	Foxtail millet Grain Equivalent yield (FMGEY)	Cost of Cultivation (Rs ha ⁻¹)	Net income (Rs ha ⁻¹)	B:C ratio
	Grain yield	Straw yield						
T ₁ - Foxtail millet (Sole crop)	2050	4587	0.31					
T ₂ - Foxtailmillet+ Greengram (3:1)	1085	3253	0.25					
T ₃ - Foxtail millet +Vegetable cowpea (3:1)	1575	4098	0.28					
T ₄ - Foxtail millet + Coriander (3:1)	1248	3515	0.26					
T ₅ - Foxtail millet + Greengram (4:1)	1640	4356	0.27					
T ₆ - Foxtail millet + Vegetablecowpea (4:1)	2015	4524	0.31					
T ₇ - Foxtail millet + Coriander (4:1)	1468	4165	0.26					
Mean								
SEd								
CD (5%)								

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Comment [es1]: MUST BE UPDATED as 25% (2 out of 8) of the listed references were published in the past five years. The application of old and un-updated references negatively impacts the manuscript.

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UNDER PEER REVIEW