

EFFECT OF REDGRAM RESIDUE INCORPORATION ON YIELDS OF REDGRAM AND FOXTAIL MILLET IN REDGRAM-FOXTAIL MILLET INTERCROPPING SYSTEM

ABSTRACT

A field experiment was conducted at RARS, Lam in *Kharif*, 2021 and 2022 to evaluate the effect of organics (Redgram residue and FYM) and bio-fertilizers (VAM and PSB) on grain yields of Redgram and Foxtail millet in Redgram-Foxtail millet intercropping system. The experiment was laid out in Randomized Block Design comprising eight treatments replicated thrice and the treatment combinations include different organics (FYM @ 10 t ha⁻¹, Redgram residue @ 4 t ha⁻¹), Bio-fertilizers and microbial inoculants (Decomposing inoculum, VAM @ 12.5 kg ha⁻¹, PSB @ 1.25 L ha⁻¹) and Inorganic fertilizers (RDF @ 20-50 kg N-P₂O₅ ha⁻¹). Redgram residue incorporation (RRI) when combined with decomposing inoculum (DI), FYM, VAM and PSB resulted in significantly higher redgram seed yields of 1326 kg ha⁻¹ in *Kharif*, 2021 and 1492 kg ha⁻¹ in *Kharif*, 2022 respectively. A similar trend was also observed in foxtail millet in both the years with significantly higher grain yield of 1252 kg ha⁻¹ in *Kharif*, 2021 and 1492 kg ha⁻¹ in *Kharif*, 2022 respectively. Redgram equivalent yields were also found to be significantly higher in the treatment involving Redgram residue incorporation (RRI) when combined with decomposing inoculum (DI), FYM, VAM and PSB being 2414 kg ha⁻¹ in *Kharif*, 2021 and 1997 kg ha⁻¹ in *Kharif*, 2022 respectively.

Keywords: Redgram Residue Incorporation; Farm Yard Manure; Decomposing Inoculum; Vesicular Arbuscular Mycorrhizae; Phosphate Solubilizing Bacteria; Redgram; Foxtail-millet; Redgram Equivalent Yield.

1. INTRODUCTION

Intercropping systems are vital for enhancing productivity and sustainability in agriculture, particularly in rainfed conditions. The integration of organics and bio-fertilizers plays a crucial role in improving soil fertility, nutrient availability, and crop yields. In this context, redgram (*Cajanus cajan*) and foxtail millet (*Setaria italica*) are promising crops for intercropping due to their drought resistance, nutritional value, and adaptability to varied agro-climatic conditions.

The use of organic residues, such as redgram residue and farmyard manure (FYM), along with bio-fertilizers like vesicular arbuscular mycorrhizae (VAM) and phosphate solubilizing bacteria (PSB), has gained importance in sustainable farming. These inputs enhance nutrient cycling, improve soil structure, and increase microbial activity, which contributes to better crop growth and higher yields.

In the present study, a field experiment was conducted during *Kharif* 2021 and 2022 at the Regional Agricultural Research Station (RARS), Lam, to assess the effect of organics

(Redgram residue and FYM) and bio-fertilizers (VAM and PSB) on the grain yields of redgram and foxtail millet in an intercropping system. The findings from this experiment provide insights into optimizing nutrient management practices for enhanced productivity in redgram-foxtail millet intercropping systems.

2. MATERIAL AND METHODS

The field experiment was conducted during *kharif*, 2021 and *kharif*, 2022 at the Regional Agricultural Research Station (RARS), Lam, Guntur, which is situated in Krishna Zone of Andhra Pradesh (15° 55' N latitude and 80° 30' E longitude) at an altitude of 31.5 m above mean sea level. Experimental soil was sandy clay loam in texture, neutral in reaction, non-saline, medium in organic carbon, low in available nitrogen, medium in available phosphorus, high potassium and sufficient in Sulphur and all available cationic micro nutrients (Fe, Mn, Zn and Cu). The (gross) plot size used was 3.6 m × 7.5 m = 27.0 m². Redgram (LRG52) and Foxtail millet (SIA3156) were sown in 1:5 ratio. The experiment was laid out in a randomized block design with eight treatments replicated thrice and the treatment combinations were T₁: Inorganic farming; T₂: RDF + FYM @ 10 t ha⁻¹; T₃: FYM @ 10 t ha⁻¹; T₄: Red gram Residue Incorporation by Shredding @ 4 t ha⁻¹ + Decomposing inoculum + FYM @ 10 t ha⁻¹ + VAM @ 12.5 kg ha⁻¹ + PSB @ 1.25 L ha⁻¹ (soil application); T₅: Red gram Residue Incorporation + RDF; T₆: Red gram Residue Incorporation + FYM @ 10 t ha⁻¹; T₇: Red gram Residue Incorporation + Decomposing inoculum + FYM @ 10 t ha⁻¹; T₈: Red gram Residue Incorporation + Decomposing inoculum + FYM @ 10 t ha⁻¹ + VAM @ 12.5 kg ha⁻¹. **Note:** a) For organic farming (T₃, T₄, T₆, T₇, T₈) seed inoculation with *Rhizobium*; Pest management in organic farming will be through seed treatment with *Pseudomonas* @ 5g kg⁻¹, basal application of *Trichoderma viridae* @ 2.5 kg ha⁻¹ and need based application neem oil @ 5ml L⁻¹ and NSKE @ 50 ml L⁻¹. b) For (T₁, T₂ & T₅) inorganic farming (IF) with (20-50-0 kg N-P₂O₅-K₂O ha⁻¹) through chemical fertilizers and pest management was through chemical means. Grain yield from each net plot was sun dried for 4 to 6 days and then the weight of grains per net plot area was recorded and expressed in kg ha⁻¹. The data were analysed statistically using Fisher's method of analysis of variance as suggested by Panse and Sukhatme (1978) for the randomized block design adopted in this study. Statistical significance was tested by applying F-test at 0.05 level of probability. Critical differences at 0.05 levels were worked out for the effects, which were significant.

3. RESULTS AND DISCUSSION

3.1 Grain yield

Grain yield of redgram and foxtail millet were recorded during 2021 & 2022 and redgram equivalent yield was calculated using standard formulae and were presented in table 1. along with pooled yield.

3.1.1 Kharif, 2021

Redgram seed yields were significantly lower (704 kg ha⁻¹) with the application of FYM @ 10 t ha⁻¹ alone which was on par with the yield obtained when FYM was integrated with redgram residue incorporation (735 kg ha⁻¹) and RDF alone (860 kg ha⁻¹). Redgram residue incorporation (RRI) when combined with decomposing inoculum (DI), FYM, VAM either with or without PSB were found to be significantly higher resulting in redgram seed yields of 1326 and 1290 kg ha⁻¹ respectively.

Similarly, the intercrop, foxtail millet showed significantly lower grain yield of 673 kg ha⁻¹ with FYM alone which was on par with the yield realized when it was applied in conjunction with

redgram residue incorporation. Application of RRI + FYM + DI + VAM + PSB resulted in a significantly higher grain yield of 1252 kg ha⁻¹.

Redgram Equivalent Yields were significantly lower with FYM i.e., 1289 kg ha⁻¹ which increased significantly to 2414 kg ha⁻¹ when RRI + FYM + DI + VAM + PSB were imposed; however, without PSB also comparable Redgram Equivalent Yields were realized (2243 kg ha⁻¹).

3.1.2 Kharif, 2022

During 2022, redgram seed yield was significantly higher when RRI + FYM+ DI + VAM were combinedly applied either with PSB (1092 kg ha⁻¹) or without PSB (1057 kg ha⁻¹) and were at a par. Significantly lower seed yield of 655 kg ha⁻¹ was recorded with RDF.

Grain yield of foxtail millet also was significantly influenced by the residue incorporation along with FYM and microbial consortia. Grain yield was significantly higher when RRI + FYM+ DI + VAM were combinedly applied either with PSB (1492 kg ha⁻¹) or without PSB (1306 kg ha⁻¹) and were at a par.

Redgram Equivalent Yield (RGEY) also followed similar trend. RDF and FYM were at a par in realizing significantly lower RGEY with corresponding yields of 1352 and 1365 kg ha⁻¹.

3.1.3 Pooled

In pooled data, FYM was found to result in significantly lower redgram, foxtail millet and RGE yields of 718, 858 and 1327 kg ha⁻¹ respectively. RRI + FYM +DI+VAM+PSB was found to be significantly superior with a yield of 1209, 1372 and 2206 kg ha⁻¹ respectively of redgram, foxtail millet and RGEY.

Incorporation of redgram residue along with decomposing inoculum might have resulted in the release of plant nutrients for crop absorption. Coupled with this FYM acts both as a source of nutrients and also as substrate for VAM and PSB for proliferation and brought about better crop nutrition and yields.

These results were in corroboration with studies of Kumar *et al.* (2014), Yaseen *et al.* (2016), Nalatwadmath *et al.* (2006), Aparna *et al.* (2019), Kalaiyarasi *et al.* (2019), Garg *et al.* (2023), Nissi and Debbarma (2022), Aechraet *et al.* (2017), Kumar *et al.* (2016).

Table 1. Grain Yields of Redgram, Foxtail millet crops and redgram equivalent yield of foxtail millet in kharif, 2021 and kharif, 2022 as influenced by redgram residue incorporation.

Grain yield	2021			2022			Pooled		
	Red gram	Foxtail millet	RGEY	Red gram	Foxtail millet	RGEY	Red gram	Foxtail millet	RGEY
T1: RDF	860	869	1616	655	1148	1352	758	1009	1484
T2: RDF + FYM	954	985	1810	766	1231	1514	860	1108	1662
T3: FYM	704	673	1289	731	1043	1365	718	858	1327
T4: RRI + FYM + DI + VAM + PSB	1326	1251	2414	1092	1492	1997	1209	1372	2206
T5: RRI + RDF	938	833	1663	723	1296	1510	831	1065	1587
T6: RRI + FYM	735	717	1358	825	1114	1501	780	916	1430
T7: RRI + FYM + DI	1080	991	1942	893	1287	1674	987	1139	1808
T8: RRI + FYM + DI + VAM	1290	1096	2243	1057	1306	1849	1174	1201	2046
SEm (±)	68	44	66	58	63	60	102	87	158
SEd	96	62	93	82	89	86	144	123	223

CD (p=0.05)	205	132	199	176	192	183	293	249	453
CV (%)	12	8	6	12	9	7	27	20	23
	*	*	*	*	*	*	*	*	*

*RDF: 20-50-0 kg N-P₂O₅-K₂O ha⁻¹ through urea and DAP; RRI: Red gram Residue Incorporation by Shredding @ 4 t ha⁻¹; DI: Decomposing inoculum; FYM: Farm Yard Manure @ 10 t ha⁻¹; VAM: Vesicular Arbuscular Mycorrhizae @ 12.5 kg ha⁻¹; PSB: Phosphate Solubilizing Bacteria @ 1.25 L ha⁻¹ (soil application).

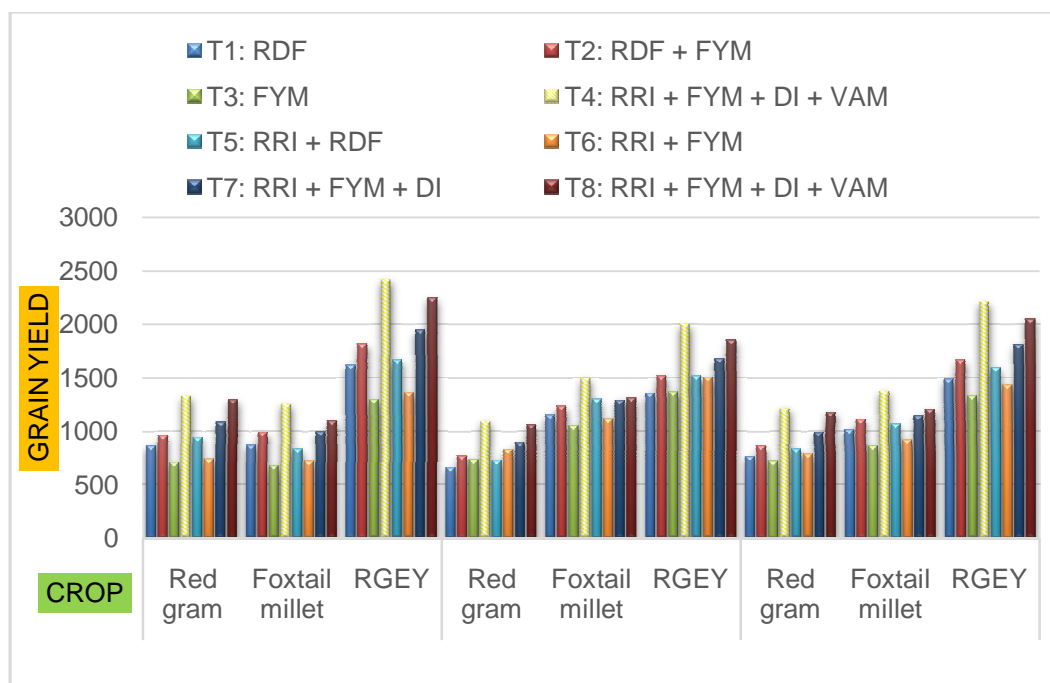


Fig. 1. Effect of Redgram residue incorporation on grain Yields of Redgram, Foxtail millet crops and redgram equivalent yield of foxtail millet in *kharif*, 2021 and *kharif*, 2022.

4. CONCLUSION

The field experiment conducted over two consecutive *kharif* seasons (2021 and 2022) demonstrated the positive effects of integrating organics, bio-fertilizers, and microbial inoculants in a Redgram-Foxtail millet intercropping system. The following conclusions can be drawn from the study:

1. **Superior Yield Performance:** The treatment involving Redgram residue incorporation (RRI) combined with FYM, decomposing inoculum (DI), VAM, and PSB (T₄) consistently produced the highest grain yields of both redgram and foxtail millet in 2021 and 2022. This treatment also resulted in the highest Redgram Equivalent Yields (RGEY) in both individual years and pooled results.
2. **Organic and Bio-fertilizers Boost Productivity:** The combination of redgram residue, farmyard manure, and bio-fertilizers (VAM and PSB) significantly enhanced the yields compared to treatments with only inorganic fertilizers or organics applied alone. This highlights the importance of integrating organic and biological inputs for sustainable yield improvement.

3. **Sustainability in Intercropping Systems:** The use of organics, especially redgram residue, and microbial inoculants not only increased crop productivity but also potentially improved soil health and nutrient cycling, making the system more sustainable in the long term.
4. **Economic Viability:** The highest redgram equivalent yields (RGEY) observed in the treatment with RRI + FYM + DI + VAM + PSB suggest that this combination offers a more economically viable option for farmers, enhancing overall productivity in intercropping systems.

In conclusion, the integration of organics and bio-fertilizers in intercropping systems holds great potential for improving crop yields and sustainability. Among the tested treatments, T₄ (RRI + FYM + DI + VAM + PSB) proved to be the most effective in maximizing yield and ensuring long-term soil fertility.

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