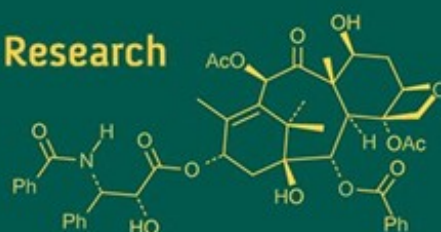


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J Venkata Naga Madhuri
M.Sc (Ag), Department of
Agronomy, Advanced Post
Graduate Centre, Lam, Guntur,
Andhra Pradesh, India

S Prathibha Sree
Principal Scientist
(Agronomy) & Head, IWMU,
RARS, Lam, Guntur, Andhra
Pradesh, India

S Bharathi
Professor and Head
(Agronomy), Advanced Post
Graduate Centre, Lam, Guntur,
Andhra Pradesh, India

Ch. Sujani Rao
Principal Scientist (SS) &
Head RRU (Chemistry), RARS,
Lam, Guntur, Andhra Pradesh,
India

Effect of organic nutrient and weed management strategies on soil microbial population and dehydrogenase activity in sorghum

J Venkata Naga Madhuri¹, S Prathibha Sree², S Bharathi³, Ch. Sujani Rao⁴

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ABSTRACT

A field experiment was conducted during rabi 2025-26 at the Regional Agricultural Research Station, Lam, Guntur, to study the effect of organic nutrient and weed management strategies on soil microbial population and dehydrogenase activity in sorghum. The experiment was laid out in split-plot design with four nutrient management strategies as main-plots and four weed management strategies as sub-plots and replicated thrice. Higher microbial population (fungi, bacteria and actinomycetes) and dehydrogenase activity were recorded with the application of 50% N through Ghanajeevamrutham and 50% N through vermicompost. Mulching with maize stalks at 5 t ha⁻¹ recorded maximum microbial population and enzyme activity when compared to other weed management strategies tested. However, the interaction effect of organic nutrient and weed management strategies on soil microbial population and dehydrogenase activity was found to be non-significant.

Keywords: Mulching, Dehydrogenase, Sorghum, Microbial population, Vermicompost, Ghanajeevamrutham

Introduction

Sorghum is an important millet crop cultivated widely in the semi-arid and arid regions of the world because of its adaptability to diverse agro-climatic conditions and tolerance to drought and high temperatures. It serve as a major source of food, feed, fodder and biofuel production. With increasing demand for limited freshwater resources, expansion of marginal farmland and changing climatic patterns, sorghum can play a crucial role in feeding vulnerable population (Saddam *et al.*, 2022) [1].

However, increased use of chemical fertilizers in modern agriculture has raised concerns regarding soil health deterioration, nutrient imbalances and reduced biological activity (Andong *et al.*, 2018) [2]. Consequently, there is increasing interest in sustainable agricultural practices to promote higher crop productivity and minimize environmental impact (Ivan *et al.*, 2023) [3]. Organic nutrient sources viz; farmyard manure, compost, green manures, biofertilizers, jeevamrutham, ghanajeevamrutham has emerged as a viable alternative for improving soil physical, chemical and biological properties (Dhiraj *et al.*, 2015) [4]. Mulching with organic residues is a cost-effective and sustainable agricultural practice that suppresses weed growth, improves soil fertility, enhances beneficial microbial activity and can reduce dependence on herbicides, thereby supporting sustainable crop production (Pranav *et al.*, 2025) [5].

Alternate to chemical herbicides, eco-friendly weed management practices including hand weeding combined with intercultivation reduced weed growth in sorghum fields (Bavalgave *et al.*, 2017). Therefore, the integration of organic farming practices into sorghum production systems can enhance crop productivity while promoting environmental sustainability in dryland agriculture.

Materials and methods

The study was performed at Regional Agricultural Research Station, Lam, Guntur, (16°36' N latitude, 80°43' E longitude and 31.5 m above mean sea level) Andhra Pradesh during rabi 2025-26 to investigate the effect of organic nutrient and weed management strategies on soil microbial population and dehydrogenase activity in sorghum. The experimental soil was clayey in texture, slightly alkaline and non-saline, with medium organic carbon (0.5%), low available nitrogen (175 kg ha⁻¹), medium phosphorus (32 kg ha⁻¹) and high potassium (289 kg ha⁻¹).

The experiment design was split-plot with three replications. The treatments consisted of four main plots (M₁: 50 per cent N through FYM + 50 per cent N through vermicompost, M₂: 75 per cent N through FYM, M₃: 50 per cent N through ghanajeevamrutham + 50 per cent N through vermicompost and M₄: 75 per cent N through ghanajeevamrutham) and four sub-plots (S₁: weedy check, S₂: one hand weeding + one inter-cultural operation, S₃: two hand weedings + two inter-cultural operations and S₄: mulching with available crop

Corresponding Author:

J Venkata Naga Madhuri

M.Sc (Ag), Department of
Agronomy, Advanced Post
Graduate Centre, Lam,
Guntur, Andhra Pradesh,
India

residue @ 5 t ha⁻¹). The recommended dose of nutrients for sorghum was 74 kg N, 39 kg P₂O₅, 30 kg K₂O ha⁻¹.

Sorghum crop (Nandyal Tella Jonna -5) was sown on 21-10-2025 with a spacing of 45 cm × 15 cm. The recommended dose of FYM was applied as basal 15 days before sowing, vermicompost and ghanajeevamrutham were applied at the time of sowing. In this study, dhravajeevamrutham was applied as a soil drench at 15 days interval from 20 DAS up to crop maturity @ 500 L ha⁻¹. The nutrient content of FYM was 0.57% N, 0.30% P, 0.50% K, vermicompost 1.46% N, 0.98% P, 1.10% K and of ghanajeevamrutham 0.98% N, 0.45% P and 0.60% K. The microbial population of experimental soil was determined by serial dilution plate count method given by [Pramer et al. \(1965\)](#) [6] and dehydrogenase activity test by [Casida et al. \(1964\)](#) [7].

Results and discussion

Soil microbial population

The soil microbial population viz; fungi, bacteria and actinomycetes were significantly influenced by different organic nutrient and weed management strategies. However, the interaction effect between organic nutrient and weed management practices were found to be non-significant. Data presented in table. 1 and [fig. 1](#) revealed that organic nutrient management practices, 50% N through Ghanajeevamrutham + 50% N through Vermicompost (M₃) recorded highest bacteria, actinomycetes and fungal populations which was followed by 50% N through FYM + 50% N through Vermicompost (M₁). The lowest microbial population was recorded in 75% N through FYM applied treatment (M₂). Application of vermicompost and ghanajeevamrutham provided a favourable environment and energy source for soil microorganisms which enhance quick growth and survival ([Shwetha, 2008](#)) [8].

Mulching with maize stalk @ 5 t ha⁻¹ (S₁) resulted in significantly the highest soil microbial population when compared to other weed management practices (Table. 1) and [Fig. 1](#). Weedy check (S₁) recorded the lowest microbial populations. Mulching increases the soil organic carbon content, which might be one of the main food sources for microorganisms and resulted in the rise of microbial colonies in soil. Similar to the composting process, straw and other organic mulches break down over time through the mineralization

process, creating humus that helps to increase soil microbial population. The results are in line with [Tiquia et al. \(2002\)](#) [9].

Soil dehydrogenase activity (µg TPF g⁻¹ soil day⁻¹)

The data presented in the table 1 and [fig. 2](#) revealed that organic nutrient and weed management practices significantly influenced the dehydrogenase activity in soil, whereas their interaction was found to be non-significant and independent of each other.

Application of organic nutrient sources 50% N through Ghanajeevamrutham + 50% N through Vermicompost (M₃) recorded the highest soil dehydrogenase activity (64.6 µg TPF g⁻¹ soil day⁻¹) than other organic nutrient management treatments. The lowest dehydrogenase activity (48.2 µg TPF g⁻¹ soil day⁻¹) was observed in 50% N through FYM + 50% N through Vermicompost (M₂). The application of balanced amounts of various manures improved soil organic matter and microbial biomass carbon levels, resulting in enhanced enzyme activity. These findings are in conformity with [Mandal et al. \(2007\)](#) [10].

Among the weed management treatments, mulching @ 5 t ha⁻¹ maize stalk (S₄) recorded higher dehydrogenase activity (64.2 µg TPF g⁻¹ soil day⁻¹) which was superior than the other weed management treatments. The weedy check (S₁) recorded the lowest dehydrogenase activity (47.8 µg TPF g⁻¹ soil day⁻¹) when compared to others. Higher soil enzymatic activity under mulching might be attributed to improved soil moisture retention resulting from reduced water loss through evaporation, which favoured microbial activity. Similar observations were made by [Siczek et al. \(2011\)](#) [11].

Conclusion

The experimental results revealed that the highest soil microbial populations (fungi, bacteria and actinomycetes) and dehydrogenase activity were recorded with the combined application of 50% N through Ghanajeevamrutham + 50% N through Vermicompost over other organic nutrient management practices. Mulching with maize stalk @ 5 t ha⁻¹ improved the microbial count and dehydrogenase activity than the weedy check treatment. Therefore, application of organic sources of nutrients ghanajeevamrutham, vermicompost along with mulching improved the soil microbial population and dehydrogenase activity and provided favourable conditions for the growth of sorghum crop.

organic nutrient and weed management strategies

Table 1. Soil microbial populations (fungi, bacteria and actinomycetes) and dehydrogenase activity at harvest as influenced by

Treatments	Fungi (×10 ⁴ CFU g ⁻¹ soil)	Bacteria (×10 ⁸ CFU g ⁻¹ soil)	Actinomycetes (×10 ⁵ CFU g ⁻¹ soil)	Dehydrogenase activity (µg TPF g ⁻¹ soil day ⁻¹)
Nutrient management strategies (M)				
M1	18.8	62.4	25.8	54.9
M2	16.4	51.2	24.3	48.2
M3	20.3	70.2	30.6	64.6
M4	17.5	55.5	25.4	52.7
SEm (±)	0.4	1.2	0.7	1.4
CD (P = 0.05)	1.4	4.1	2.7	4.9
CV (%)	7.8	6.8	10.4	8.9
Weed management strategies (S)				
S1	14.3	47.6	21.0	47.8
S2	17.8	57.2	25.8	52.1
S3	19.5	62.8	28.2	56.4
S4	21.4	71.5	31.2	64.2
SEm (±)	0.5	1.5	0.8	1.5
CD (P = 0.05)	1.6	4.5	2.4	4.3
CV (%)	10.3	9.0	10.7	9.4
Interaction (M×S)	NS	NS	NS	NS

(continued on next page)

Treatments	Fungi ($\times 10^4$ CFU g^{-1} soil)	Bacteria ($\times 10^8$ CFU g^{-1} soil)	Actinomycetes ($\times 10^5$ CFU g^{-1} soil)	Dehydrogenase activity (μg TPF g^{-1} soil day^{-1})
Interaction (S $\times$ M)	NS	NS	NS	NS

*CFU- Colony forming units TPF- Triphenylformazan

M₁– (50% N through FYM + 50% N through Vermicompost), M₂ – (75% N through FYM), M₃ – (50% N through Ghanajeevamrutham + 50% N through Vermicompost), M₄ – (75% N through Ghanajeevamrutham), S₁ – (Weedy check), S₂ – (One hand weeding + one intercultural operation), S₃ – (Two hand weedings + two intercultural operation), S₄ – (Mulching @ 5 t ha⁻¹ with maize stover).

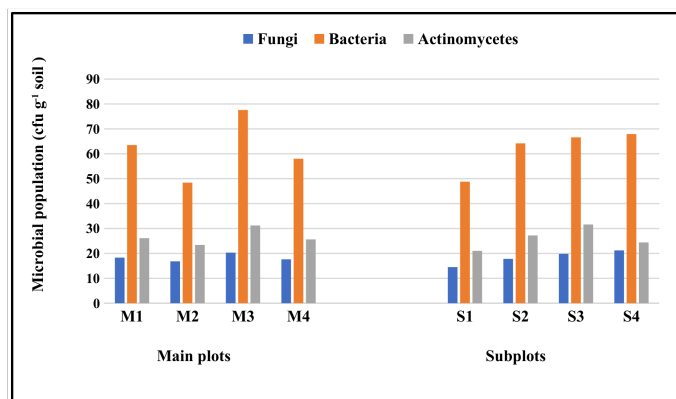


Figure 1. Soil microbial population (CFU g^{-1} soil) at harvest as influenced by organic nutrient and weed management strategies in sorghum

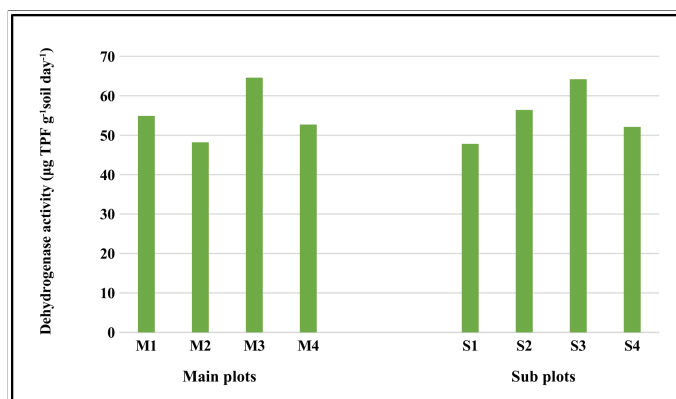


Figure 2. Dehydrogenase activity in soil (μg TPF g^{-1} soil day^{-1}) at harvest as influenced by organic nutrient and weed management strategies

*CFU- Colony forming units TPF- Triphenylformazan
Treatment details were given under material and methods

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