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Nagaraj
Department of Agricultural Microbiology, College of Agriculture, UAS, Raichur, Karnataka, India

Gundappagol RC
Department of Agricultural Microbiology, College of Agriculture, UAS, Raichur, Karnataka, India

Mahadevswamy
Department of Agricultural Microbiology, College of Agriculture, UAS, Raichur, Karnataka, India

Nagaraj M Naik
Department of Agricultural Microbiology, College of Agriculture, UAS, Raichur, Karnataka, India

Sathynarayan Rao
Department of Agronomy, College of Agriculture, UAS, Raichur, Karnataka, India

Corresponding Author:
Nagaraj
Department of Agricultural Microbiology, College of Agriculture, UAS, Raichur, Karnataka, India

Microbial parameters in sorghum in different organic farming system

Nagaraj, Gundappagol RC, Mahadevswamy, Nagaraj M Naik and Sathynarayan Rao

Abstract
The field experiment was conducted at Agricultural Research Station, Kalaburagi during 2017-18 to study the microbial population dynamics and its relation to growth and yield of sorghum in organic farming system. The results showed improvement in the soil microbiological and biochemical properties in the treatments applied with organic manures. Among the different treatments, fully organic manures (100% NP) recorded significantly higher population of general and beneficial microbes viz., bacteria (114.25 X 106 cfu/g), fungi (75.50 X 104 cfu/g), actinomycetes (54.50 X 104 cfu/g), *Azotobacter* (17.50 X 104 cfu/g). The crop responded well to the different treatment combinations and found higher growth and yield parameters in the treatment applied as per recommended package of practices recorded (Plant height- 212.75 cm, Number of leaves- 10.09/plant, Dry matter accumulation-91.32 g/plant, Grain weight per ear head-31.00 g Stover yield-5.06 t/ha, Grain yield- 1568 kg/ha). Finally, to find the comparative profits between the treatments, the economics of the crop was worked out and found that the treatment which was maintained fully organically with 75 percent N and P (T_1) was superior among all the treatments with highest B:C ratio (2.84).

Keywords: Microbial parameters, sorghum, organic farming system

Introduction
Organic farming, characterized by its reliance on biological fertilizers and sustainable pest control methods derived from natural sources, has emerged as a response to the environmental challenges posed by the widespread use of chemical pesticides and synthetic fertilizers in conventional agriculture. This agricultural practice places a strong emphasis on sustainable techniques, including crop rotation, the utilization of animal manures, crop residues, green manures, and the biological management of pests and diseases, with the primary goal of maintaining soil health and productivity.

Organic farming practices not only contribute to environmentally responsible agriculture but also cater to the growing consumer demand for organic produce. Organic crops often command higher prices in the market than their conventionally grown counterparts, and the production of organic crops continues to show a consistent upward trend. To maintain the integrity of the organic label, the sale of crops labeled as organic or biological is subject to stringent regulations in most advanced markets.

One of the most significant advantages of organic farming is its minimal environmental footprint, as it actively works towards rehabilitating and improving degraded agricultural land. This approach goes beyond conventional agriculture's reliance on synthetic inputs and instead fosters a holistic ecosystem approach to farming. As a result, organic farming practices have a significant positive impact on soil physico-chemical properties, creating a healthier and safer environment for beneficial microorganisms, such as bacteria, fungi, and actinomycetes

Numerous studies have demonstrated the benefits of organic farming practices on soil health and microbial populations. Krishnakumar *et al*. (2005) [3] investigated the effects of organic farming with various sources of organic manures and their combinations on soil biological fertility. Their research indicated that microbial populations, including bacteria, fungi, and actinomycetes, significantly increased with the application of different organic nitrogen sources compared to the control. Among the organic nitrogen sources, the application of farmyard manure (FYM) in combination with neem cake registered the highest microbial populations in the soil.

In a similar vein, Shashidhar *et al*. (2009) [4] explored the effects of different types of organic manures and microbial inoculants on leaf yield, native soil microflora, and soil fertility in a mulberry garden. Their findings highlighted that specific combinations of organic sources and microbial inoculants significantly enhanced soil microbial populations, further emphasizing the soil health benefits of organic farming.

In the initial year of organic management, crop productivity is typically lower compared to subsequent years. This is due to the gradual increase in soil fertility levels over time as organic materials are incorporated into the organic management system, as reported by Yadav *et al*. (2013) [1]. Similarly, Surekha and Rambabu (2007) [5] noted a gradual increase in grain yield when organic fertilizers were employed over an extended period. Singh (2000) [6] observed that the application of vermicompost at rates of 13-20 tons per hectare led to increased yields of peas (23.62 tons per hectare) and groundnuts (12.16 tons per hectare). In the case of chickpeas, the soil application of organic manures and foliar spray of liquid organic manures at specific growth stages significantly enhanced growth and yield parameters, as demonstrated by Patil *et al*. (2011) [2]. Thus, the current study on microbial population dynamics and its impact on the growth and yield of sorghum within an organic farming system was conducted at ARS Kalaburagi, driven by the following objectives.

Material and Methods

The current study was conducted at the Department of Agricultural Microbiology, College of Agriculture, Raichur, with the primary objectives of quantifying the general and beneficial soil microflora, determining soil microbial biomass carbon, and evaluating various soil biochemical properties within the context of sorghum cultivation under organic farming practices. This investigation took place at the Agricultural Research Station in Kalaburagi during the 2017-18 agricultural season. Furthermore, the study aimed to explore the correlations between microbiological properties and the growth and yield characteristics of sorghum in organic farming systems.

Results and Discussion

In our study, we aimed to comprehensively assess general and beneficial soil microflora, estimate soil microbial biomass carbon, evaluate soil biochemical properties, and investigate the growth and yield attributes of sorghum within the context of both organic and conventional farming systems. We also sought to compare the microbiological parameters between these two farming approaches to understand their impact on soil health and crop performance.

Our observations were conducted at multiple growth stages of the sorghum crop, specifically at 30, 60, 90 Days After Sowing (DAS), and at harvest (120 DAS). These observations revealed significant variations in the bacterial population across different treatments. Notably, the treatment involving 100 percent organic manures (T_2) displayed the highest bacterial population when compared to other treatments. This observation underscores the positive effect of organic manure application on promoting a thriving bacterial community within the soil.

Furthermore, we observed that the highest bacterial population was consistently recorded at 60 DAS, indicating that this growth stage is particularly conducive to bacterial growth. However, as the crop approached the harvest stage, there was a decline in the bacterial population. These trends were quantified on a dry weight basis, as detailed in Table 01.

Our findings align with previous research. Sharada (2013) [7] reported that a combination of organic manures and panchagavya spray resulted in higher populations of various soil microorganisms, including bacteria, fungi, actinomycetes, free-living nitrogen fixers, and PSB, at different growth stages of rabi Sorghum compared to the application of recommended dose of fertilizer (RDF) and RDF with farmyard manure (FYM).

Similarly, Mallesha *et al*. (2017) emphasized the benefits of organic farming practices. Their research highlighted that soil application of organic manures and foliar application of liquid organic manure led to significantly higher microbial populations, specifically in terms of bacterial population (27.73 × 107 CFU g-1 of soil), fungi (35.23 × 104 CFU g-1 of soil), and phosphorus solubilizers (30.82 × 103 CFU g-1 of soil) when using a combination of compost, vermicompost, and panchagavya.

At 30 DAS, the population of bacteria was significantly higher in the treatment utilizing 100 percent organic manures (T_2) with a count of 55.00 X 106 colony-forming units per gram (cfu/g) in comparison to all other treatments. Conversely, the treatment exclusively receiving inorganic fertilizers (T_4) exhibited the lowest bacterial population, measuring 28.75 X 106 cfu/g. The trend observed at 60 DAS and 90 DAS remained consistent, with the highest bacterial populations occurring in the fully organic manure treatment and the lowest populations in the fully inorganic fertilizer treatment (T_4).

At the time of harvest, the observations revealed the highest bacterial population in the treatment managed with 100 percent organic manures (T_2), registering a count of 31.48 X 106 cfu/g, compared to all other treatments. Notably, the treatment receiving 75 percent organic manures (T_1) exhibited a bacterial population (26.41 X 106 cfu/g) equivalent to the treatment T_2. The lowest bacterial population was recorded in the treatment solely using fully inorganic fertilizers (T_4), with a count of 14.43 X 106 cfu/g.

The fungal population was meticulously monitored during various growth stages of the sorghum crop, specifically at 30 DAS, 60 DAS, 90 DAS, and at the time of harvest. Notably, the fungal population exhibited the highest counts in the treatment that utilized 100 percent organic manures (T_2), significantly surpassing the counts in the plots managed with inorganic practices (T_4). Overall, the observations made at different crop growth stages consistently indicated that the highest population of fungi was observed at 60 DAS, with the lowest counts registered at the time of crop harvest, and these counts were expressed per unit of dry soil weight (refer to Table 02).

At 30 DAS, the fungal population was notably higher in the treatment that exclusively employed fully organic manures (T_2), with a count of 34.75 × 104 colony-forming units per gram (cfu/g) of dry soil, compared to all other treatments. In contrast, the treatment relying solely on fully inorganic fertilizers (T_4) recorded the lowest fungal population, measuring 19.75 × 104 cfu/g of dry soil. This trend persisted at 60 DAS and 90 DAS, with the highest and lowest fungal populations consistently observed in the organically managed treatment (T_2) and the inorganic practice treatment (T_4).

Upon reaching the harvest stage, the observations revealed a significantly higher fungal population in the treatment that employed 100 percent organic manures (T_2), with a count of 20.61 × 104 cfu/g, compared to all other treatments. Worth noting, the treatment that received 75 percent organic manures (T_1) exhibited a fungal population (16.18 × 104 cfu/g) equivalent to that of the treatment T_2, while the lowest fungal population was recorded in the treatment relying solely on fully inorganic fertilizers (T_4) with a count of 7.25 × 104 cfu/g.

Table 1: Effect of different farming systems on the population of bacteria at different growth stages of sorghum

Treatment	Bacterial population (cfu X 10^6 g^{-1})			
	30 DAS	60 DAS	90 DAS	120 DAS
T_1 - Fully organic (75% NP)	45.50	95.75	65.5	26.41
T_2 - Fully organic (100% NP)	55.00	114.25	71.75	31.48
T_3 - Integrated (50% organic + 50% inorganic)	42.00	93.25	53.25	22.75
T_4 - Fully inorganic	28.75	61.25	30.50	14.43
T_5 - Recommended Package of Practices	35.55	70.75	34.00	17.67
T_6 - Beejamrutha + Jeevamrutha	30.45	85.50	46.75	20.29
S.Em±	1.213	1.941	1.334	2.14
C.D. at 5%	3.66	5.85	4.02	6.41

DAS – Days after sowing
* Values are average of four replications

Table 2: Effect of different farming systems on the population of fungi at different growth stages of sorghum

Treatment	Fungi population (cfu X 10^4 g^{-1})			
	30 DAS	60 DAS	90 DAS	120 DAS (Harvest)
T_1 - Fully organic (75% NP)	31.00	62.75	45.00	16.18
T_2 - Fully organic (100% NP)	34.75	75.50	45.50	20.61
T_3 - Integrated (50% organic + 50% inorganic)	26.25	51.75	30.00	13.52
T_4 - Fully inorganic	19.75	27.25	24.25	7.25
T_5 - Recommended Package of Practices	20.75	31.25	27.25	10.74
T_6 - Beejamrutha + Jeevamrutha	25.00	47.75	29.75	12.43
S.Em±	1.273	1.105	4.264	1.59
C.D. at 5%	3.84	3.33	12.85	4.78

DAS – Days after sowing
* Values are average of four replications

Effect of different farming systems on the population of actinomycetes at different growth stages of sorghum

The observations made at different stages of crop growth, including 30 DAS, 60 DAS, 90 DAS, and at the time of harvest, highlighted that the population of actinomycetes was notably higher in organically managed soils (T_2) when compared to other agricultural practices. In general, the population of actinomycetes exhibited a peak at 60 DAS and declined at the time of harvest, as opposed to other growth stages, with counts expressed based on dry soil weight (see Table 3).

At 30 DAS, the population of actinomycetes was significantly higher in the treatment utilizing 100 percent organic manures (T_2), recording a count of 25.55 × 104 colony-forming units per gram (cfu/g) of dry soil, in comparison to other treatments. It's worth noting that the treatment receiving 75 percent organic manures (T_1) exhibited a comparable actinomycetes population (22.50 × 104 cfu/g) to that of the treatment T_2. On the contrary, the treatment exclusively relying on fully inorganic fertilizers (T_4) demonstrated the lowest actinomycetes population, measuring 8.25 × 104 cfu/g of dry soil.

Moving to 60 DAS, the observations regarding the actinomycetes population showed that the treatment embracing full organic farming practices (T_2) exhibited the highest population (54.50 × 104 cfu/g) when compared to all other treatments. Conversely, the lowest actinomycetes population was observed in the treatment exclusively relying on fully inorganic fertilizers (T_4), with a count of 20.75 × 104 cfu/g. The actinomycetes populations recorded at 90 DAS followed a trend similar to the one observed at 30 DAS, while the observations at the time of harvest mirrored the trend seen at 60 DAS (refer to Table 3).

The enhancement of actinomycetes populations under organic farming practices is consistent with existing research. Surekha (2007) [5] noted a gradual increase in grain yield when organic fertilizers were employed over an extended period. Additionally, organic farming practices have been found to create a conducive environment for actinomycetes, which play a vital role in decomposing organic matter, improving soil structure, and cycling nutrients.

Table 3: Effect of different farming systems on the population of actinomycetes at different growth stages of sorghum

Treatment	Actinomycetes population (cfu X 10^4 g^{-1})			
	30 DAS	60 DAS	90 DAS	120 DAS
T_1 - Fully organic (75% NP)	22.50	45.75	23.25	12.2
T_2 - Fully organic (100% NP)	25.25	54.50	31.75	16.28
T_3 - Integrated (50% organic + 50% inorganic)	17.50	39.25	20.50	10.38
T_4 - Fully inorganic	8.25	20.75	12.50	5.86
T_5 - Recommended Package of Practices	14.25	25.25	13.00	7.45
T_6 - Beejamrutha + Jeevamrutha	16.50	38.00	18.25	9.17
S.Em±	0.794	0.962	0.794	1.06
C.D. at 5%	2.39	2.90	2.39	3.20

Conclusion

The general and beneficial soil microflora, including bacteria, fungi, actinomycetes, Azotobacter, Azospirillum, and PSM, exhibited significantly higher populations in the treatment using 100 percent organic manures compared to other treatments. Notably, these microorganisms reached their peak populations at 60 Days After Sowing (DAS) during the crop's growth stage (Bacteria 114.25 X 106 cfu/g, Fungi 75.50 X 104 cfu/g, Actinomycetes 54.50 X 104 cfu/g, Azotobacter 17.50 X 104 cfu/g, Azospirillum 70.00 X 104 cfu/g, and PSM 52.25 X 104 cfu/g). Conversely, the lowest microbial populations were observed in the treatment exclusively relying on fully inorganic fertilizer

References

1. Yadav SK, Subhash B, Yadav MK, Singh K, Yadav GS, Suresh P. A review of organic farming for sustainable agriculture in northern India. Int. J Agron. 2013;2013:1-8.
2. Patil SV, Halikatti SI, Hiremath SM, Babalad HB, Sreenivasa MN, Hebsur NS. *et al*., Effect of organic manures and rock phosphate on growth and yield of chickpea (*Cicer arietinum* L.) in vertisols. Karnataka J Agric. Sci., 2011;24(5):636-638.
3. Krishnakumar S, Saravanan A, Natarajan SK, Veerabadran V, Mani S. Microbial population and enzymatic activity as influenced by organic farming. Res. J Agric. Bio Sci. 2005;1(1):85-88.
4. Shashidhar KR, Narayanaswamy TK, Bhaskar RN, Jagadish BR, Mahesh M, Krishna KS. Influence of organic based nutrients on soil health and mulberry (*Morus indica* L.) production. J Biol. Sci. 2009;1(1):94-100.
5. Surekha K, Ravindrababu V. Nutrient management in organic rice farming–research experiences. Modern Concepts and Practices of Organic Farming for Safe Secured and Sustainable Food Production; c2007. p. 186.
6. Singh RA. Feasibility of vermi-farming in peanut (*Arachis hypogaea*)-vegetable pea (*Pisum sativum*) cropping system, Indian Journal of Agronomy. 2000;45(2):257-262.
7. Sharada. Studies on nutrient management practices through organics in greengram – rabi sorghum cropping system. M.Sc. (Agri.) Thesis, Univ. Agric. Sci., Raichur. (India); c2013.
8. Mallesha, Rao S. Effect of Phosphorus Management through Rock Phosphate Application to Preceding Crops on Soil Enzymes and Microbial Biomass in Organic Cultivation of Groundnut. Int. J Curr. Microbiol. App. Sci. 2017;6(9):479-482.