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RESEARCH

Effective Microorganisms Reduce the Chemical Fertilizer Need in Fodder Cultivation in Sri Lanka

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ABSTRACT

Purpose: *The purpose of this study was to evaluate the potential of integrating reduced levels of chemical fertilizers with effective microorganisms (EM) as a sustainable alternative to sole reliance on recommended chemical fertilizers. Therefore, the study aimed to evaluate the growth and yield performances, nutritional value and economic parameters of premier fodder varieties grown with reduced inorganic fertilizer with EM.*

Research Method: *The experiment was carried out in a 2x4 factorial layout in a Randomized Complete Block Design. Selected commercially available EM was assigned with 50% recommended level of inorganic fertilizer (RLIF), and 100% RLIF was considered as the control. Four fodder varities; Napier (Pennisetum purpureum x Pennisetum glaucum) cv Pakchong-1, Red Napier, Fodder Sorghum (Sorghum bicolor) var. Sugargraze and Fodder Maize (Zea mays) var. Weera were grown under recommended management practices. At the time of harvest, growth and yield parameters were recorded, Brix value was measured and nutrient contents were analyzed.*

Findings and Values: *There was no significant interaction (P>0.05) between fodder and fertilizer for growth and yield parameters. Further dry matter percentage, Brix value and other nutritive parameters were not significant between two treatments (P>0.05). The study concludes that the reduction of inorganic fertilizer up to 50% does not affect the yield, growth and nutritive parameters compared with 100% application in studied fodder varieties. Thus, the usage of EM can be recommended to reduce the heavy dependency on inorganic fertilizers.*

Keywords: *Dry matter yield, Fodder Maize, Fodder Sorghum, Fresh yield, Napier*

INTRODUCTION

Hybrid Napier, fodder Sorghum and fodder Maize varieties/cultivars are premier fodder crops under most dairy production and feeding systems in Sri Lanka. They are known for their adaptability to various soils and climatic conditions, making them suitable for diverse agricultural settings (Premaratne & Premalal 2006). The utilization of these premier fodder crops is vital for sustaining dairy production in Sri Lanka. They offer a reliable source of nutrition for dairy animals, contributing to milk production and overall herd health. Most of the fodder growers depend exclusively on chemical fertilizers to meet the high nutrient requirements of these fodder crops (Korale Gedara 2019).

However, the rising costs of chemical fertilizers have encouraged to find more cost-effective and sustainable alternatives. Effective microorganisms (EM) are recommended as optional strategies to address the challenges

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associated with expensive chemical fertilizers (Abebe *et al.* 2022). Effective microorganisms consist of mixed cultures of beneficial and naturally occurring microorganisms. These microorganisms are non-harmful, non-pathogenic, not-genetically modified or not-chemically synthesized. These microorganisms promote the process of beneficial anti-oxidative fermentation, accelerate the decomposition of organic matter and promote the balance of the microbial flora. This enhances the soil texture by increasing the humus content (Odongo 2010, Joshi *et al.* 2019). The use of EM involves the application of beneficial microorganisms to enhance soil fertility which increases beneficial microbes in the soil thus maintaining the natural ecosystem of the cultivated land (Joshi *et al.* 2019). This diminishes the risk of environmental pollution. Further, EM is known to solubilize and make available the nutrients required by plants with improved crop productivity and quality. Also, it is evident that the application of EM suppresses the infestation of harmful microorganisms (Higa 1991).

Research indicates that EM can have a positive impact on yield, quality, and various physiological parameters of different fodder varieties (Singh *et al.* 2018). The use of EM enables sustainable agriculture by promoting biological processes in the soil and reducing dependence on inorganic fertilizer. Farmers often apply EM as a soil drench, foliar spray, or in combination with other organic inputs.

Although Hybrid Napier, fodder Sorghum, and fodder Maize are widely cultivated as premier fodder crops in Sri Lanka and their role in sustaining dairy production is well recognized, most studies and farming practices have focused primarily on maximizing yield through the exclusive use of chemical fertilizers. While the benefits of EM in improving soil health, nutrient availability, and crop productivity have been reported in other contexts, there is limited scientific evidence on their effectiveness when combined with reduced levels of chemical fertilizers for fodder production in Sri Lanka. In particular, systematic evaluations of growth, yield, nutritional value, and economic feasibility of these major fodder crops under integrated fertilization strategies are lacking. The growing emphasis on integrated and sustainable agricultural practices, where the combination of organic inputs, microbial technologies, and reduced dependence on synthetic fertilizers contributes to environmental sustainability and cost-effectiveness. Further, comparing the recommended chemical fertilizer alone with reduced chemical fertilizer supplemented by EM allows for a comprehensive assessment of the effectiveness of alternative strategies. Therefore, the objectives of this study were to 1. evaluate the yield and growth performance of four fodder varieties under two fertilization strategies; recommended chemical fertilizer alone and reduced chemical fertilizer supplemented with EM, 2. assess the nutritional value of these fodder varieties under the two fertilization strategies and 3. analyze the economic parameters associated with fodder production under the two fertilization strategies. The outcome of the research may be vital for providing insights into sustainable and cost-effective fodder production practices.

MATERIALS AND METHODS

Experimental location

The experiment was carried out in a farmer's field at *Rambewa*, Sri Lanka (Latitude: $7°46'0''$ N, Longitude: $80°4'0''$ E, Altitude: 94 m above mean sea level) with mean maximum and minimum temperatures of $34.65°C$ and $25.46°C$, respectively, and annual average precipitation of 142.6 mm (Meteorology Department 2024).

Experimental design

The study was a 2 x 4 factorial layout in a Randomized Complete Block Design. Recommended Level of Inorganic Fertilizer (RLIF) was used as the control (Con) and selected commercially available EM was assigned with 50% RLIF as the treatment (EM). Four fodder varieties; Super Napier (*Pennisetum purpureum x Pennisetum glaucum*) cv Pakchong-1 (SN), Red Napier (*Pennisetum purpureum x Pennisetum glaucum*) (RN), Fodder Sorghum (*Sorghum bicolor*) var. Sugargraze

(SO) and Fodder Maize (*Zea mays*) var. Veera (MA) were grown under recommended management practices. There were three replicates in the control treatment and nine replicates were included in the other treatment.

Land preparation and planting space for fodder crops

Land preparation was done as per the recommendations at 30 cm soil depth using machinery. Randomly collected topsoil samples were tested for various soil parameters (Table 1). Plots at 5 x 5 m with a 1.5 m border were demarcated by considering the block factor.

Napier was planted in single pits at 1 x 1 m using fresh and healthy two-nodal stem cuttings. Fodder Sorghum was established after the preparation of soil beds with a 30 cm plough depth and at 20 x 30 cm space using commercially available seeds. Fodder Maize was also established with soil bed preparation with a 30 cm plough depth and at 20 x 45 cm space using commercially available seeds.

Manual weeding was done two weeks after establishment and after each harvesting. Thinning out of excess plants in Sorghum and Maize was also done on the above spacing after 2 weeks of establishment.

Fertilizer and EM application

Organic manure was applied at a rate of 10,000 kg ha^{-1} as a basal dressing for all fodder varieties. For Super Napier, Red Napier, and Sorghum, a basal dressing was applied at rates of 100 kg ha^{-1} of Urea, 100 kg ha^{-1} of Triple Super Phosphate (TSP), and 75 kg ha^{-1} of Muriate of Potash (MOP). For Maize, the basal application included 75 kg ha^{-1} of Urea, 100 kg ha^{-1} of TSP, and 50 kg ha^{-1} of MOP. An additional top dressing of 240 kg ha^{-1} of Urea was applied on Maize, 20 days after crop establishment. After each harvest (up to the third harvest), 100 kg ha^{-1} of Urea was applied to Super Napier, Red Napier, and Sorghum. All planting materials (seeds and cuttings) were treated with an EM solution one day before planting, followed by foliar application of EM at 15-day intervals until harvest, according to the recommendations provided by the commercial producer.

Harvesting

Napier and Fodder Sorghum were harvested on day 60 after establishment as 1st harvest and subsequent harvests were done in 45-day intervals (maximum 3 harvests). Fodder Maize was harvested 75 days after establishment as a single harvest.

Data collection/laboratory sample collection and recording

Growth parameters; plant height, number of tillers, leaf length, leaf width, leaf/stem ratio and fresh yield (Biomass) were recorded at the time of harvesting using randomly selected 3 plants/clumps in the middle portion of the plot. Same random plants were used for the preparation of laboratory samples. As a nutritional quality parameter, the Brix value was recorded using the same plant samples at field level for leaves and stems separately. Samples were immediately submitted to the laboratory for sample preparation for further analysis of nutritional parameters.

Laboratory samples were analyzed on nutritive quality parameters; crude protein (CP), neutral detergent Fiber (NDF) and acid detergent fiber (ADF) using a Near Infrared Reflectance Spectroscopy (Agri NIRTM, USA).

Data analysis

The data from three harvests of multi-cut Fodder Sorghum and Napier were pooled, while Maize, being a single-cut crop, was treated as a single data set. Data were statistically analyzed by Analysis of Variance (ANOVA) and mean separation was done by Least Significant Difference (LSD) using a standard Statistical Analysis Software. Statistical significance was declared at $P < 0.05$.

Table 1. Soil parameters of the experimental site at Rambewa after land preparation and fertilizer application.

Soil parameter	Value
Organic matter (%)	1.75
Electrical conductivity (μS cm^{-1})	293.2
Ammonium nitrogen (ppm)	58.7
Available Phosphorus (ppm)	117.3
Exchangeable Potassium (ppm)	230.1
Exchangeable Calcium (ppm)	1278.7
Exchangeable Magnesium (ppm)	404.4
Available Sulfur (ppm)	38.0
Available Cupper (ppm)	4.3
Available Ferrous (ppm)	118.1
Available Manganese (ppm)	54.9
Available Zink (ppm)	1.9
Cation exchange capacity (cmol kg^{-1})	10.2

Table 2. Comparison of forage yield in Napier, Sorghum, and Maize under recommended and reduced levels of chemical fertilizer with effective microorganisms.

Fodder*	Fertilizer**	Fresh yield/plant (kg)	Fresh yield/ha (kg)	DM yield/ha (kg)
SN	EM	2.16	22,228	4,279
	Con	2.29	22,631	4,419
RN	EM	2.19	22,090	4,500
	Con	2.41	26,888	5,259
SO	EM	0.44	41,028	10,468
	Con	0.55	46,807	12,137
MA	EM	0.53	43,190	10,779
	Con	0.58	42,978	10,311
SE		0.15	2284	513
P value		0.989	0.792	0.656

*SN-Super Napier; RN-Red Napier; SO-Sorghum; MA-Maize

**EM-50% Chemical fertilizer + EM; Con - 100% Chemical fertilizer.

RESULTS AND DISCUSSIONS

Forage yield

Table 2 presents a comparative analysis of the forage yield in Napier, Sorghum and Maize when subjected to recommended and reduced levels of chemical fertilizer with EM. Fresh yield per plant, fresh and DM yields per ha of the studied forage varieties with the application of RLIF and reduced level with EM application were not significantly different ($P > 0.05$). This indicates that up to 50% reduction of inorganic fertilizer with EM application would not negatively affect the forage yield.

Sabas *et al.* (2010), Panchaban (1991) and Lim *et al.* (1999) observed yield increase with use of EM in Maize. Aslam & Ahmad (2020) also received the highest shoot dry weight of Maize in response to bio fertilizer application. Masowa *et al.* (2024) found that the co-application of EM with organic and inorganic fertilizers enhanced Maize growth and yield attributes. Further, Srinivasaperumal *et al.* (2019) reported that dry matter production and yields increase in fodder Sorghurm with the application of reduced inorganic fertilizer levels with EM. Nohong *et al.* (2020) also showed that DM yield of Sorghurm is influenced by the application of biofertilizer over the control treatment. Sadafzadeh *et al.* (2023) demonstrated that the highest dry forage yield of Sorghum was achieved under monoculture conditions with a density of 15 plants m^{-2} and inoculation with biofertilizer. Moreover, higher fodder yield in hybrid Napier was observed with the application of EM compared to the control treatment by Singh *et al.* (2018).

Rupasinghe *et al.* (2024) assessed the synergy between EM and vermitea technology in reducing chemical fertilizer use in fodder cultivation. Their study indicated that the combination of EM with reduced chemical fertilizers maintained or even improved forage yield, aligning with our observations. In our study, we reduced the inorganic fertilizer level by 50% without observing any yield reduction. This suggests that EM can enhance soil status and nutrient availability to plants, compensating for up to 50% of inorganic fertilizer without diminishing yield. Therefore, forages can maintain their growth and yield even with reduced levels of inorganic fertilizer.

Dry matter yield per ha was significantly different ($P < 0.05$) among the studied forages. The DM yields of Maize and Sorghum were significantly higher than the Red Napier and Super Napier (Figure 1). Further, fresh yield per ha were significantly different ($P < 0.05$) among the studied forages and followed the same trend. The fresh DM yields of Maize (43,084 ± 3,860 kg ha^{-1}) and Sorghum (43,917 ± 2,284 kg ha^{-1}) were significantly higher than the Red Napier (24,489 ± 2,403 kg ha^{-1}) and Super Napier (22,429 ± 2,175 kg ha^{-1}).

Forage growth parameters

Table 3 presents the growth performances of hybrid Napier, fodder Sorghum and Maize with RLIF and application of 50% inorganic fertilizer with EM. However, there was no significant difference ($P > 0.05$) among the four forage varieties with these two fertilizer application levels. Sabas *et al.* (2010) reported better height in Maize with the application of EM while Lim *et al.* (1999) and Aslam & Ahmad (2020) reported an increase in shoot length. They also noted a higher number of leaves and increased leaf length with the addition of bio fertilizer compared to the control. As reported by Nohong *et al.* (2020) application of bio fertilizer on Sorghum influences the plant height. A greater number of tillers were observed by Srinivasaperumal *et al.* (2019) with the application of EM in fodder Sorghum.

Singh *et al.* (2018) reported improved plant heights in hybrid Napier when applied reduced levels of inorganic fertilizer with EM. Similar to our findings, Rupasinghe *et al.* (2024) also did not observe any differences in growth parameters, plant height, leaf number, leaf length and width in hybrid Napeir, fodder Sorghum and Maize when reducing the inorganic fertilizer application with EM. Our findings confirm that EM can enhance nutrient absorption by improving soil structure, root formation, and root mass. This leads to better plant growth, reflected in increased height, number of tillers, leaves, and leaf length and width. Consequently, applying EM, even with a 50% reduction in inorganic fertilizer, does not diminish the plant growth.

Nutrient composition

Nutritive parameters of hybrid Napier, fodder Sorghum and Maize with RLIF and application of 50% inorganic fertilizer with EM are present in Table 4. However, there was no significant difference ($P > 0.05$) among the four forage varieties with these two fertilizer application levels. As reported by Singh *et al.* (2018), CP content of hybrid Napier was found to be higher under the application of reduced inorganic fertilizer with EM compared to the recommended dose of inorganic fertilizer application.

Further, Nohong *et al.* (2020) confirmed that CP content greatly influenced the application of biofertilizers in Sorghurm. Srinivasaperumal *et al.* (2019) observed that the application of EM in fodder Sorghum led to improved nutritional quality, including CP content. Moreover, Sadafzadeh *et al.* (2023) demonstrated that bio fertilizer application improved nutritional quality, including crude CP and digestibility, in Sorghum.

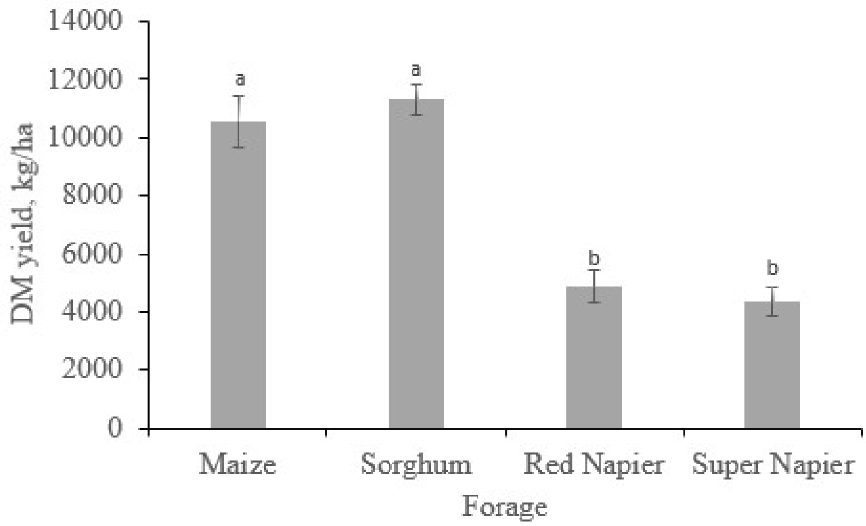

Figure 1. Comparison of forage dry matter yield of Napier, Sorghum, and Maize.
Means followed by same letters against each observation are not significantly different from each other at P < 0.05.

Table 3. Comparison of growth parameters in Napier, Sorghum, and Maize under recommended and reduced levels of chemical fertilizer with effective microorganisms.

Fodder*	Fertilizer**	Height (cm)	Tillers	Leaf number	Leaf length (cm)	Leaf width (cm)
SN	EM	183.10	11.17	115.35	77.85	3.31
	Con	196.96	11.18	120.17	82.27	3.34
RN	EM	161.79	14.48	140.64	58.01	2.98
	Con	159.29	15.26	149.32	59.89	3.18
SO	EM	165.99	–	10.96	53.84	6.15
	Con	174.00	–	12.38	57.66	6.39
MA	EM	184.07	–	8.44	52.76	7.86
	Con	192.33	–	9.33	52.43	8.00
SE		8.91	1.47	8.28	2.86	0.23
P value		0.728	0.943	0.990	0.855	0.957

*SN-Super Napier; RN-Red Napier; SO-Sorghum; MA-Maize
**EM-50% Chemical fertilizer+EM; Con - 100% Chemical fertilizer.

Application of EM with a reduced level of inorganic fertilizer reduced the crude fiber (CF) contents in hybrid Napier and maximum CF contents was recorded under no bio-fertilizers treatment (Singh *et al.* 2018). However, Nohong *et al.* (2020) only observed a trend of reduced CF contents in Sorghum with the application of biofertilizer.

Also, they showed an increased level of NDF contents in Sorghurm with biofertilizer application though there were no changes in ADF contents. Similar to the findings reported by the above researchers, our study demonstrates that the application of EM positively impacts nutritional parameters. Our results indicate no significant differences in nutritional parameters when using reduced levels of inorganic fertilizer combined with EM compared to the control.

Further, there was no significant difference (P > 0.05) among the four forage varieties with these two fertilizer application levels on the brix values. However, it was significantly different (P < 0.05) among the studied forages. The brix values of Maize (11.6± 0.7) and Sorghum (12.2 ± 0.4) were significantly higher than the Red Napier (6.2 ± 0.4) and super Napier (5.6 ± 0.4).

Further, DM percentage was significantly

Table 4. Comparison of nutritive parameters in Napier, Sorghum, and Maize under recommended and reduced levels of chemical fertilizer with effective microorganisms.

Fodder*	Fertilizer**	DM (%)	Brix value	CP (%)	NDF (%)	ADF (%)
SN	EM	18.86	5.49	9.93	60.41	40.93
	Con	19.39	5.62	9.67	56.83	38.40
RN	EM	21.01	6.07	8.66	58.47	41.71
	Con	19.63	6.26	11.53	60.77	41.47
SO	EM	26.64	11.96	8.87	54.32	38.61
	Con	25.06	12.51	10.37	55.03	40.10
MA	EM	24.99	11.66	8.39	52.80	37.37
	Con	24.34	11.63	7.50	55.43	39.83
SE		0.53	0.41	0.45	1.12	0.79
P value		0.483	0.977	0.022	0.202	0.143

*SN-Super Napier; RN-Red Napier; SO-Sorghum; MA-Maize
**EM-50% Chemical fertilizer+EM; Con - 100% Chemical fertilizer
DM – Dry matter; CP – Crude protein; NDF – Nutrient detergent fiber; ADF – Acid detergent fiber

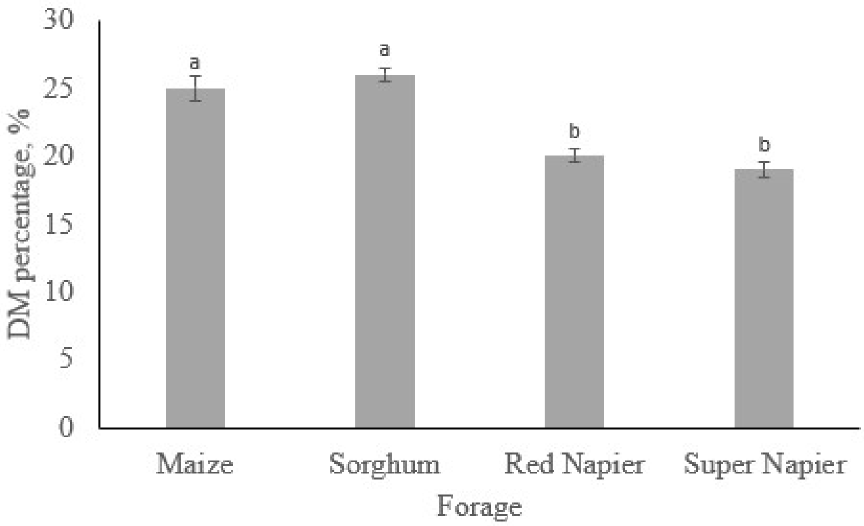

Figure 2. Comparison of dry matter percentage in Napier, Sorghum, and Maize.
Means followed by same letters against each observation are not significantly different from each other at P<0.05.

different (P < 0.05) among the studied forages. The DM percentages of Maize and Sorghum were significantly higher than the Red Napier and Super Napier (Fig. 2).

CONCLUSIONS

Reducing inorganic fertilizer by up to 50% did not significantly impact the biomass yield or nutritive quality of hybrid Napier, fodder Sorghum, and Maize. This study demonstrates that effective microorganisms can partially substitute inorganic fertilizers, maintaining forage productivity and quality, which contributes to more sustainable and cost-effective fodder production practices for dairy farmers. However, this study was limited to a single season and specific soil conditions, and the long-term effects of EM application on soil fertility and crop performance remain to be evaluated. Future research should investigate multi-season trials, different soil types, and economic analyses to validate the broader applicability of EM in integrated fertilizer management for fodder crops.

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REFERENCES

Abebe TG, Tamtam MR, Abebe AA, Abtemariam KA, Shigut TG, Dejen YA, Haile EG (2022) Growing use and impacts of chemical fertilizers and assessing alternative organic fertilizer sources in Ethiopia. *Applied and Environmental Soil Science*. https://doi.org/10.1155/2022/4738416.

Aslam Z, Ahmad A (2020) Effects of vermicompost, vermi-tea and chemical fertilizer on morpho-physiological characteristics of Maize (Zea mays L.) in Suleymanpasa District, Tekirdag of Turkey. *Journal of Innovative Sciences*, 6 (1), 41-46. http://dx.doi.org/10.17582/journal.jis/2020/6.1.41.46.

Higa T (1991) Effective microorganisms: A biotechnology for mankind. In Parr JF, Hornick SB, Whitman CE (Ed.) Proceedings of the First International Conference on Kyusei Nature Farming. U.S. Department of Agriculture, Washington, D.C., USA.

Joshi H, Somduttand PC, Mundra SL (2019) Role of Effective microorganisms (EM) in sustainable agriculture. *International Journal of Current Microbiology and Applied Sciences*, 8 (3), 172-181. https://doi.org/10.20546/ijcmas.2019.803.024.

Korale Gedara P (2019) Analyzing opportunities for commercial fodder cultivation in Sri Lanka. Market Orientated Dairy (MOD) Project. Colombo, Sri Lanka.

Lim YD, Pak TW, Jong CB (1999) Yields of rice and maize as affected by effective microorganisms. In Proceedings of the 5th International Conference on Kyusei Nature Farming, Bangkok, Thailand.

Masowa MM, Babalola OO, Mulidzi AR, Kutu FR (2024) Potential of co-application of microbial enriched winery solid waste compost and inorganic fertilizers to enhance maize growth and yield parameters. *Discover Sustainbility* 5, 512. https://doi.org/10.1007/s43621-024-00777-3.

Meteorology Department (2024) Weather forecasting. (Retrieved from https://www.meteo.gov.lk/index.php?lang=en).

Nohong B, Rinduwati, Yusuf M (2020) Influence of different vermicompost levels on growth, yield and quality of forage Sorghum (Sorghum bicolor L. Moench). *Earth and Environmental Science*, 492. https://doi.10.1088/1755-1315/492/1/012029.

Odongo NE, Garcia M, Viljoen GJ (2010) Benefits of EM technology on animal production. Food and Agriculture Organization of the United Nations, Rome.

Panchaban S (1991) Effect of EM on growth and yield of corn. In Proceedings of 1st International Conference on Kyusei Nature Farming, 132-139.

Premaratne S, Premalal GGC (2006) Hybrid Napier (*Pennisetum perpureum X Pennisetum americarnum*) VAR. CO-3: A resourceful fodder grass for dairy development in Sri Lanka. *Journal of Agricultural Sciences*, 2 (1), 22-33. https://doi.10.4038/jas.v2i1.8110.

Rupasinghe RM, Gunathilaka RMS, Rajapaksha RMCL, Lakmini GWAS (2024) Assessing the synergy between effective microorganisms and vermitea technology in reducing chemical fertilizer on fodder cultivation. National Symposium on Agriculture and Life Sciences, NSALS '24, Uva Wellassa University, Badulla, Sri Lanka, 63p.

Sabas SP, Amos CD, Wostry A, Fares MJ (2010) Evaluation of effective microorganisms (EM) technology on Maize (*Zea mays* L.) growth, development and yield in Morogoro, Tanzania. Tushikamane Centre in Kilakala, Morogoro, Tanzania.

Sadafzadeh E, Javanmard A, Machiani MA, Sofo A (2023) Application of bio-fertilizers improves forage quantity and quality of Sorghum (*Sorghum bicolor* L.) intercropped with soybean (*Glycine max* L.). *Plants*, 12 (16), 2985. https://doi.org/10.3390/plants12162985.

Singh OM, Chaturvedi VB, Verma MR, Singh HC (2018) Effect of integrated nutrient management on hybrid napier production under irrigated conditions. *International Journal of Current Microbiology and Applied Sciences*, 7 (4), 2731-2737. https://doi.org/10.20546/ijcmas.2018.704.311.

Srinivasaperumal AP, Tthamizhmani R, Kalaisudarson S, Perumal SM, Sivakumar G (2019) Effect of integrated nutrient management on yield attributes and yield of fodder Sorghum CO (FS)26. *Journal of Pharmacognosy and Phytochemistry*, 8 (3), 1165-1167.