

Original Research Article

Effect Of Organic Manures on Growth, Yield and Quality of *Parching* Sorghum

ABSTRACT

Aims: The combination of various sources of organic manures along with liquid organic manures is important to maintain nutrient availability to crop and sustain higher level of soil fertility. The aim is to meet the nutrient demand of crops as per requirement at different stages which can give greater productivity of crops.

Study Design: The experiment was laid in Randomized Complete Block Design with 9 treatments replicated thrice.

Place and Duration of Study: A field experiment was conducted at College of Agriculture, Vijayapur, during Rabi, 2020-21.

Methodology: The treatments were T₁-Ghanajeevamrutha based on 100% RDN as basal dose, T₂-Vermicompost based on 100% RDN as basal dose, T₃- T₁ + foliar application of 10% vermiwash at 20 & 45 DAS, T₄- T₁ + foliar application of 10% cow urine at 20 & 45 DAS, T₅- T₁ + foliar application of 25% jeevamrutha at 20 & 45 DAS, T₆-T₂ + foliar application of 10% vermiwash at 20 & 45 DAS, T₇-T₂ + foliar application of 10% cow urine at 20 & 45 DAS, T₈-T₂ + foliar application of 25% jeevamrutha at 20 & 45 DAS and T₉-Organic RPP of *parching* sorghum with SMJ-1 variety of *parching* sorghum.

Results: The application of ghanajeevamrutha based on 100 per cent RDN as basal dose+ foliar application of 25 per cent jeevamrutha at 20 and 45 days after sowing recorded significantly higher dry matter production (55.86 g plant⁻¹), leaf area index (3.49), raw and roasted grain weight (39.49 g and 51.73 g respectively), raw and roasted grain yield (1063 kg ha⁻¹ and 1505 kg ha⁻¹ respectively) of *parching* sorghum (*hurda*) at harvest as compared to other treatments. In addition to improvement in the major plant nutrient uptake were recorded with incorporation of ghanajeevamrutha or vermicompost along with the liquid organic manure.

Conclusion: The application of ghanajeevamrutha based on 100 per cent RDN as basal dose coupled with foliar application of 25 per cent jeevamrutha at 20 and 45 days after sowing recorded significantly higher growth, yield, quality and plant nutrient uptake by *Parching* sorghum.

Comment [U1]: 1. Specify the crops studied and the specific types of organic manures used to add more clarity.

2. Use consistent units throughout the abstract for better readability (e.g., use "g plant⁻¹" instead of "g/plant," and "kg ha⁻¹" instead of "kg/ha").

3. Clarify the abbreviation "DAS" (days after sowing) when it is first introduced.

4. Avoid using technical terms without defining them (e.g., "RDN" is not explained).

5. Consider providing a brief statement about the significance of the findings or their implications.

Key words: *Parching* sorghum, *Hurda*, Organics, Ghanajeevamrutha, Vermiw

1. INTRODUCTION

Sorghum [*Sorghum bicolor*(L.) Moench] commonly known as jowar, is an ancient cereal grain belonging to the grass family Poaceae (Graminaceae). It holds a prominent position among cereal crops, ranking after wheat, rice, maize, and barley. Sorghum plays a crucial role in providing food for millions of people residing in semiarid tropics. In India, sorghum is one of the staple food crops of many states like Maharashtra, Karnataka, Madhya Pradesh, Tamil Nadu, Gujarat and cultivated in nutrient-poor soils in frequently drought-prone areas, it offers food and fodder security through risk aversion on sustainable basis.

The tender jowar grains in English is called as *parching* Sorghum. Basically, the period during late winter when sorghum grain is juicy and very tender, panicle is roasted over cakes of dried cow dung. *Hurdas* commonly eaten with the hull, which retains most of the nutrients and very high in fiber and iron, with a fairly high protein content and also a good source of phosphorus and thiamine. *Parching* sorghum is rich in dietary fiber. A single serving of this provides the dietary fiber by 48 per cent of the daily recommended value. This assist in preventing the health conditions such as bloating, cramping, stomach aches, constipation, diarrhea and excess gas. The high amount of fiber helps to eliminate LDL cholesterol level which upgrades the heart health and also prevents heart attacks, atherosclerosis and strokes (Porter *et al.*, 1977). Sorghum can be a gluten free diet option for celiac patients (Ciacci *et al.*, 2007).

Prolonged use of chemical fertilizers causes an increase in pest and kills the beneficial microbes present in the soil. Chemical fertilizers are highly soluble in water hence they leach away into groundwater without fully benefiting the plant. Thus, fewer nutrients are available for the plant. Organic systems use 45 per cent less energy than conventional systems. Production efficiency is 28 per cent higher in the organic systems, while the conventional no-till system being the least efficient in terms of energy usage. The soil and climatic conditions in the drylands are well adapted to organic farming. Now a days agro-tourism business is increasing in the rural areas and in the contest of supplying sorghum *hurdaas* a niche product get the more profit to the farmers and producers (Taylor *et al.*, 2006). Hence, the current study was intended to find the response of organic manures on growth, yield, quality and plant nutrient uptake by *parching* sorghum.

2. MATERIAL AND METHODS

The experiment was conducted at College of Agriculture, Vijayapur, situated in the Northern Dry Zone of Karnataka (Zone 3), at 16° 49' North latitude, 75° 43' East longitude and at an altitude of 593.8 m above the mean sea level. The soil was low in organic carbon (0.37%), low in available nitrogen (188 kg ha⁻¹), high in both available phosphorus (29.5 kg ha⁻¹) and available potassium (390 kg ha⁻¹ high). During the cropping period of 2020-21, a total rainfall of 865.5 mm was received in 51 rainy days from April 2020 to March 2021 as against the normal rain of 594.4 mm which was received in 38 rainy days. The maximum monthly temperature over the years (1981-2019) was the highest in the month of May (39.6°C), while it was the lowest in the month of December (29.1°C). The normal monthly mean minimum temperature was the lowest in the month of January (14.6°C).

2.1 Experimental design and treatment combination

The field experiment was laid out in Randomized Complete Block Design with 9 treatments (T₁-Ghanajeevamrutha based on 100% RDN as basal dose, T₂-Vermicompost based on 100% RDN as basal dose, T₃-T₁ + foliar application of 10% vermiwash at 20 & 45 DAS, T₄- T₁ + foliar application of 10% cow urine at 20 & 45 DAS, T₅- T₁ + foliar application of 25% jeevamrutha at 20 & 45 DAS, T₆-T₂ + foliar application of 10% vermiwash at 20 & 45 DAS, T₇-T₂ + foliar application of 10% cow urine at 20 & 45 DAS, T₈-T₂ + foliar application of 25% jeevamrutha at 20 & 45 DAS and T₉-Organic RPP of *parching* sorghum) and 3 replications.

Comment [U2]: 1. Provide more context about the importance of sorghum as a cereal crop and its nutritional significance.

2. Clarify the process of "parching" sorghum for readers who may not be familiar with the term.

3. Cite additional sources to support the health benefits of parching sorghum, especially in terms of its high fiber content and potential impact on heart health.

4. Expand on the advantages of organic farming systems over chemical-based systems in the context of the study

5. Provide more context and details about the relevance of agro-tourism and its potential impact on parching sorghum's marketability.

Comment [U3]: 1. Provide more information about the rationale behind selecting specific treatments and their importance in relation to the research question.

2. Organize the section into subheadings to enhance the clarity and flow of information.

3. Consider providing more details about the specific parameters observed during the growth stages and at harvest.

4. Describe the randomization process and how the blocks were assigned to treatments in the experimental design.

2.2 Crop management

After the previous crop was harvested, the ground was ploughed once again and planking was done in both the direction to prepare a levelled and fine seed bed. The total quantity of ghanajeevamrutha and vermicompost were calculated based on their respective nitrogen content in order to meet the recommended dose of N (40 kg ha^{-1}). The variety SMJ-1 was used after treatment with biofertilizers and dried under the shade. Sowing was done on 20th October with the spacing of $45 \times 15 \text{ cm}$. Intercultivation was done to remove all weeds from the field in order to check crop weed competition. Observation on growth attributes were taken on 30, 60 days after sowing and at harvest. Harvesting was done when crop had attained milky dough stage. The sorghum heads from net plot were cut, panicles were subjected for baking in cow dung fire for 5 min. Then the roasted sorghum grains were separated by hand by holding the panicle in both the hands and then rubbing it with palm. The raw and roasted grains were weighed. The stalks were separately weighed after drying which is useful green fodder for cattle. Using the formula suggested by Donald (1962), the ratio of economic yield to biological yield was computed. The yield attributes and yield observations were recorded from the net plots and grain yield was converted to hectare basis in kilograms. The quality parameter like sugar content of grains and nutrient uptake by both grains and straw was also computed.

The data collected from the experiment at different growth stages and at harvest were subjected to statistical analysis as described by Gomez and Gomez (1984). The level of significance used for 'F' and 't' tests was $P=0.05$. Critical Difference (CD) values were calculated at 5 per cent probability level if the F test was found to be significant.

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

3.1.1 Dry matter production

The dry matter production per plant of *parching* sorghum did not differ significantly at 30 DAS under different treatments. At 60 DAS and at harvest significantly higher dry matter production per plant was observed with the application of ghanajeevamrutha based on 100 per cent RDN as basal dose coupled with foliar application of 25 per cent jeevamrutha at 20 & 45 DAS ($26.03 \text{ g plant}^{-1}$ and $55.86 \text{ g plant}^{-1}$ respectively) (Table 1).

3.1.2 Leaf area index

There was no significant difference in leaf area index at 30 DAS. But at 60 DAS and at harvest, it was observed that ghanajeevamrutha based on 100 per cent RDN as basal dose + foliar application of 25 per cent jeevamrutha at 20 & 45 DAS registered significantly higher leaf area index (3.71 and 3.49) compared to other treatments (Table 1).

This increment was mainly due to the combined addition of organics which helped in better photosynthetic capacity of plant which in turn increased translocation of photosynthates to the sink. Kasbeet *et al.* (2009) also reported similar results that supply of jeevamrutha at 10638 l ha^{-1} produced significantly higher total dry matter in rice which is in conformity to the parallel findings of Patil *et al.* (2012).

Comment [U4]: 1. Consider providing more context and background information for the discussion of the results to enhance the reader's understanding.

2. Cite more recent and relevant sources to support the findings and strengthen the discussion.

Table 1: Dry matter production and leaf area index of *parching* sorghum as influenced by different organic sources

Treatments	Dry matter production (g plant ⁻¹)			Leaf area index		
	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest
T ₁ : Ghanajeevamrutha based on 100% RDN as basal dose	2.56	18.74	45.02	0.40	2.76	2.22
T ₂ : Vermicompost based on 100% RDN as basal dose	2.45	18.17	43.67	0.39	2.73	2.11
T ₃ : T ₁ + foliar application of 10% vermiwash at 20 & 45 DAS	2.72	20.66	48.59	0.41	3.17	2.62
T ₄ : T ₁ + foliar application 10% cow urine at 20 & 45 DAS	2.89	22.43	50.03	0.46	3.28	2.93
T ₅ : T ₁ + foliar application 25% jeevamrutha at 20 & 45 DAS	3.13	26.03	55.86	0.55	3.71	3.49
T ₆ : T ₂ + foliar application 10% vermiwash at 20 & 45 DAS	2.65	19.92	48.12	0.41	3.14	2.45
T ₇ : T ₂ + foliar application 10% cow urine at 20 & 45 DAS	2.88	21.84	49.89	0.42	3.24	2.80
T ₈ : T ₂ + foliar application 25% jeevamrutha at 20 & 45 DAS	3.11	25.18	54.99	0.51	3.69	3.40
T ₉ : Organic RPP of <i>parching</i> sorghum	2.59	19.89	46.31	0.40	2.95	2.32
SEm±	0.22	0.75	1.78	0.04	0.12	0.09
CD (P=0.05)	0.66	2.24	5.35	0.11	0.37	5.78

Note: RDN- Recommended dose of Nitrogen
RPP- Recommended package of practice

DAS- days after sowing

3.2 Yield parameters

3.2.1 Grain weight per plant

Raw and roasted *hurdagrains* per plant at harvest differed significantly among the treatments. Application of ghanajeevamrutha based on 100 per cent RDN as basal dose+ foliar application of 25 per cent jeevamrutha at 20 & 45 DAS recorded significantly higher raw grain weight per plant (39.49 g and 51.73 g respectively) compared to other treatments (Table 2).

3.2.2 Grain yield

Increase in raw grain yield and roasted grain weight was noticed with infusion of ghanajeevamrutha based on 100 per cent RDN as basal doseplus foliar application of 25 per cent jeevamrutha at 20 & 45 DAS (1063 kg ha⁻¹, 1505 kg ha⁻¹, 5932 kg ha⁻¹ and 3318 kg ha⁻¹ respectively) over other treatments (Table 2).

This increment in panicle weight and grain yield was mainly due to inclusion of organic manures as well as jeevamrutha as a foliar spray which improved the soil health, so that plants got benefited with the balanced level of nutrition which led to higher yield. Significant enhancement in the growth and yield parameters of foxtail millet can be seen on application of jeevamrutha + mulching + compost + vermicompost + panchagavya treatment over control as reported by Upendranaik *et al.* (2018) which is in conformity to the similar findings of Kumbar and Devakumar (2014).

3.3 Seed quality parameter

3.3.1 Total sugars (%)

Total sugars in grains of *parching* sorghum did not differ significantly but higher with supply of ghanajeevamrutha based on 100 per cent RDN as basal doseplus foliar application of 25 per cent jeevamrutha at 20 & 45 DAS (13.77%) (Table 2).

This higher total sugars in grains might be attributed to the incorporation of organics and foliar spray of jeevamrutha which led to more availability of N in soil and for absorption. El-Hoda and El-Koliey (1999) observed that the brix percent, sucrose percent, juice and syrup yield increased with increasing N rates.

3.4 Plant nutrient uptake

Significantly higher uptake of N by grains and fodder was observed with incorporation of ghanajeevamrutha based on 100 per cent RDN as basal doseplus foliar application of 25 per cent jeevamrutha at 20 & 45 DAS (47.72 kg ha⁻¹ and 37.76 kg ha⁻¹ respectively), uptake of P₂O₅ by grains and fodder was higher with vermicompost based on 100 per cent RDN as basal doseplus foliar application of 25 per cent jeevamrutha at 20 & 45 DAS (6.84 kg ha⁻¹ and 15.74 kg ha⁻¹ respectively), whereas higher uptake of K₂O was observed with vermicompost based on 100 per cent RDN as basal doseplus foliar application of 10 per cent cow urine at 20 & 45 DAS (32.75 kg ha⁻¹ and 81.07 kg ha⁻¹ respectively) (Figure 1).

This increment observed in uptake was mainly because of combined application of organic manures along with liquid organic manures which helped in enhancement of available nutrient status of the soil there by support the root for better uptake of nutrients. There is a slow and steady rate of nutrients release pattern which was observed in incubation study might be another reason for higher uptake of nutrients by the crop. These outcomes are in agreement with the findings of Shete *et al.* (2011) who revealed that total nitrogen and phosphorus uptake in greengram was directly proportional to the application of FYM at 5 t ha⁻¹.

Table 2: Grain weight per plant, grain yield and total sugars in grain of *parching* sorghum as influenced by different organic sources

Treatments	Grain weight per plant (g)		Grain yield (kg ha ⁻¹)		Total sugars (%)
	Raw	Roasted	Raw	Roasted	
T ₁ : Ghanajeevamrutha based on 100% RDN as basal dose	27.74	819	819	77.43	13.05
T ₂ : Vermicompost based on 100% RDN as basal dose	24.43	804	804	76.07	12.93
T ₃ : T ₁ + foliar application of 10% vermiwash at 20 & 45 DAS	32.89	907	907	81.66	13.21
T ₄ : T ₁ + foliar application 10% cow urine at 20 & 45 DAS	33.62	936	936	82.89	13.34
T ₅ : T ₁ + foliar application 25% jeevamrutha at 20 & 45 DAS	39.49	1063	1063	93.68	13.77
T ₆ : T ₂ + foliar application 10% vermiwash at 20 & 45 DAS	31.08	884	884	79.59	13.12
T ₇ : T ₂ + foliar application 10% cow urine at 20 & 45 DAS	32.70	924	924	82.05	13.26
T ₈ : T ₂ + foliar application 25% jeevamrutha at 20 & 45 DAS	38.86	1045	1045	92.46	13.60
T ₉ : Organic RPP of <i>parching</i> sorghum	28.43	853	853	79.75	12.47
SEm±	1.5	42	42	3.81	0.34
CD (P=0.05)	4.49	127	127	11.42	1.03

Note: RDN- Recommended dose of Nitrogen
RPP- Recommended package of practices

DAS- days after sowing

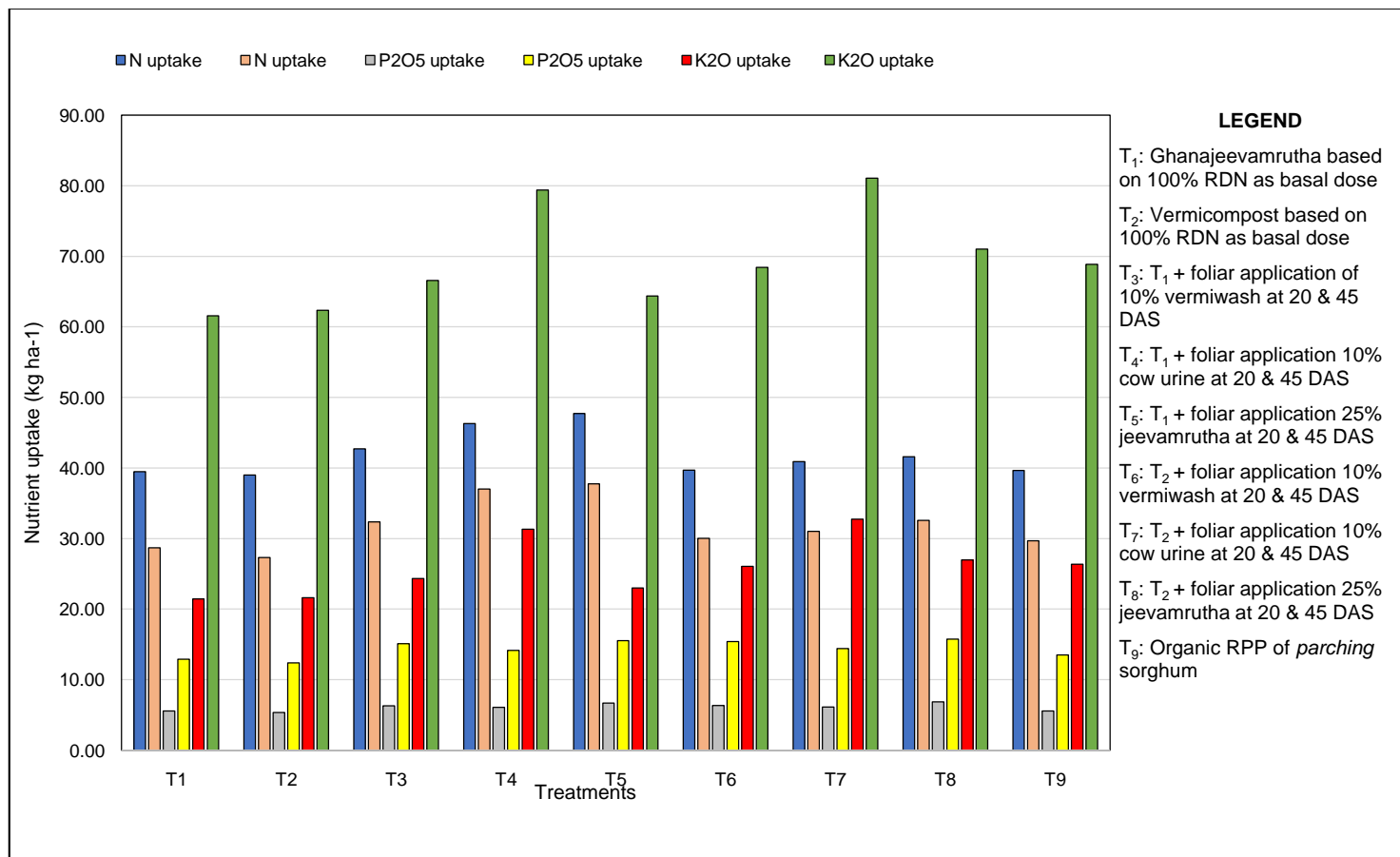


Fig 1: N, P₂O₅ and K₂O uptake of *parching* sorghum as influenced by different organic sources

4. CONCLUSION

The application of ghanajeevamrutha (2963 kg ha⁻¹) based on 100 per cent RDN as basal dose coupled with foliar application of 25 per cent jeevamrutha at 20 and 45 days after sowing recorded significantly higher dry matter production, leaf area index, grain weight, grain yield of *parching* sorghum (*hurda*) at harvest as compared to other treatments. In case of plant nutrient uptake application of ghanajeevamrutha (2963 kg ha⁻¹) based on 100 per cent RDN as basal dose coupled with foliar application of 25 per cent jeevamrutha at 20 and 45 DAS to *parching* sorghum recorded significantly higher uptake of N, application of vermicompost (4 t ha⁻¹) based on 100 per cent RDN as basal dose coupled with foliar application of 25 per cent jeevamrutha at 20 and 45 DAS to *parching* sorghum recorded significantly higher uptake of P₂O₅ and application of vermicompost (4 t ha⁻¹) based on 100 per cent RDN as basal dose plus foliar application of 10 per cent cow urine at 20 and 45 DAS to *parching* sorghum recorded significantly higher uptake of K₂O.

REFERENCES

1. Ciacci C, Maluri L, Caporaso N, Bucci C, Guidice LD, Massardo DR *et al.* Celiac disease: In vitro and in vivo safety and palatability of wheat-free sorghum food products. *Clin Nutr.* 2007;26(6):799-805.
2. Donald CN. In search of yield. *J Aust Inst Agric Sci.* 1962;28:1971-1978.
3. El-Hoda MT, El-Kolily MM. Response of sweet sorghum to irrigation intervals and nitrogen fertilization. *J Agric Sci.* 1999;30:65-80.
4. Gomez KA, Gomez AA. Statistical procedure for agriculture research, 2nd edition. A Wiley inter-science publication. 1984; New York (USA):246-266.
5. Kasbe SS, Mukund J, Bhaskar S. Characterization of farmers jeevamrutha formulations with respect to aerobic rice. *Mysore J Agric Sci.* 2009;43(3):570-573.
6. Kumbhar B, Devakumar N. Effect of jeevamrutha and panchagavya on growth, yield and microbial population of french bean (*Phaseolus vulgaris* L.). *Adv Life Sci.* 2016;5(9):3619-3623.
7. Patil SV, Halikatti SI, Gurumurthy SB, Lokesh MS. Influence of integrated organic nutrient management practices on quality parameters of chickpea grown in *Vertisol* of northern dry zone of Karnataka. *Int J For Crop Improv.* 2012;3(1):8-12.
8. Porter KS, Axtell JD, Lechtenberg VL, Colen brander VF. Phenotype, fiber composition, and in vitro dry matter disappearance of chemically induced brown midrib mutants of sorghum. *Crop Sci.* 1977;18(2):205-208.
9. Shete PG, Thanki JD, Baviskar VS, Bhoje K. Yield, nutrient uptake and economics of greengram as influenced by land configurations and FYM levels. *Green Farming.* 2011;2(4):425-427.
10. Taylor JRN, Schober TJ, Bean SR. Novel food and non-food uses for sorghum and millets. *J Cereal Sci.* 2006;44:252-271.

Comment [U5]: 1. Clearly mention the treatment combination that yielded the best results for each parameter studied.

2. Avoid repeating the same values multiple times; instead, summarize the main findings concisely.

3. Emphasize the importance of organic sources of nutrients for sustainable crop production in the conclusion.

4. Provide a brief context or implication of the findings in terms of their relevance to the broader agricultural practices or research.

Comment [U6]: 1. Look for recent and relevant research related to your study topic. Recent books, journals, and articles tend to have more up-to-date and accurate information.

2. Expand the scope of your reference search to various sources such as scientific journals, conferences, research reports, books, and reputable websites. Ensure that the references used come from trustworthy and verified sources.

3. Update the publication years of the references to match the actual publication year of the works. Make sure the years are correct so that readers can recognize the freshness of the information used in your study.

4. When searching for references, consider looking for recent research conducted by the same or prominent researchers in the same field. This can provide deeper insights into the latest developments in the field.

11. Upendranaik P, Satyanarayana Rao, Desai BK, Krishnamurty D, Vidyavathi GY. Effect of different sources of organic manures on growth and yield of foxtail millet (*Setaria italica*) under integrated organic farming system. Adv Res. 2018;13(2):1-6.

UNDER PEER REVIEW