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Effect of Organic manure and Iron on Growth and Fodder Yield of Sorghum (*Sorghum bicolor* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. Author KS designed the study, performed the statistical analysis. Author BM guided the author KS. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted during *Zaid* 2022 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P), India, to study the Effect of organic manure and iron on growth and fodder yield of sorghum. The treatments consisted of 3 levels of organic manure (FYM 8 t ha^{-1}, Vermicompost 5 t ha^{-1}, Neem cake 250 kg ha^{-1}) and three levels of Iron (0.3,0.5 and 1.0%) as foliar spray. The experiment was laid out in Randomized Block Design with ten treatments each replicated thrice. The first harvest is taken at 60 days after sowing and second harvest was taken at 45 days after the first harvest. The results showed significantly higher in growth and yield attributes Viz. plant height at first cut (193.4cm) and second cut (154.7cm), plant dry weight at first cut

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(50.2gm) and second cut (25.0gm), Maximum Green fodder yield (80.6t ha^{-1}) was found in treatment (T_9) with the application of 250 kg ha^{-1} Neem cake + 1.0% FeSO4.

Keywords: FYM; iron; neemcake; vermicompost; growth attributes; yield attributes; zinc.

1. INTRODUCTION

"Sorghum is one such dual-purpose crop where all the plant parts have economic use due to whole plant utilization. It is a potential candidate for yield in terms of grain and biomass (feed) with optimal inputs during crop cultivation and or under adverse climatic conditions. The innate drought resistance nature of the crop has opened wide suitability for cultivation in the drier agro-ecologies. It competes with corn in the area where water is a scarcer resource, predominantly in semi-arid and tropics. Sorghum not only proved to be high yielding than maize under conditions of limited water supply [1] but also showed fodder quality on par with that of maize" [2]. "It is mostly cultivated in post rainy (rabi) season in India, and most of the cultivation is taken in vertisols as they have high water retention capability" [3].

"Up to 70% of milk production costs are livestock feed. Therefore, it is critical to develop economical yet nutritious sources of feed. Dual-purpose or fodder crops are among the least expensive sources of nutrients for livestock. However, against the annual forage requirement of 1325.7 million tons (816.8 and 508.9 million tons of green and dry fodder respectively) to support existing livestock population, the total annual forage production is 978.7 million tons (525.5 and 453.2 million tons green and dry fodder respectively). Currently, there is a net deficit of 35.6% for green fodder, 10.95% for dry crop residues and 44% for concentrate feed ingredients" [4]. "Among the micronutrient malnutrition situations afflicting the human population, iron deficiencies are of major concern not only because of the serious health consequences they may have, but also because of the number of people affected worldwide" (Frossard *et al.* 2000). Iron is required for biosynthesis of the chlorophyll molecule and functions as an electron carrier in the respiration and photosynthesis reactions. In addition, it participates in many enzymatic processes. Iron deficiency is a limiting factor of plant growth.

"Farmyard manure (FYM) is a decomposed mixture of dung, urine, litter and leaf Ober materials from roughages and fodder fed to animals. A well-decomposed FYM contains 0.5-1.5% N, 0.2-0.4% P_2O_5 and 0.5-1.0% K K_2O. FYM is a good source of organic carbon, which activates the biotic life of the soil flora and fauna. Ghoshal and Singh [5] found an increase in soil microbial biomass carbon, nitrogen and phosphorous in the soil applied with FYM. Using long term experiments" Kaur and Benipal [6] reported an increase in different form of K when FYM was applied in the soil.

Application of the Neem seed cake to crops provides them with various nutrients. Be- sides, the Neem seed cake also reduces the number of soil insect pests, fungi, bacteria and nematodes and protects the crop from damage caused by these organisms. Neem seed cake can also reduce alkalinity in the soil by producing organic acids when mixed with the soil. It contains Nitrogen 2% to 5%, Phosphorus 0.5% to 1%, Potash 1% to 2% and it is also rich in sulphur compounds.

Vermicomposting is a bio-technique and vermicompost are good superlatives for organic farming. During vermicomposting the nutrients are released and converted into soluble and available forms that's providing nutrients such as available N (nitrogen), soluble K (potassium), exchangeable Ca (calcium), Mg (magnesium), P (phosphorus) and microelements such as Fe (iron), Mo (molybdenum), Zn (zinc), and Cu (copper) which can easily take up by plants.

"Zinc is a vital micronutrient required for the plant growth. Zinc plays an important role in many biochemical reactions within the plant. It is important in synthesis of protein, tryptophan and indole-acetic acid. Zinc acts as a structural component of several enzymes in plants and an inadequate supply could result in serious physiological disturbances. Zinc plays important role in oxidation processes in cell and help in transformation of carbohydrates and regulation of sugar in plants" (Swaminathan and Kannan, 2001). Sorghum shows reduced photosynthetic carbon metabolism due to zine deficiency.

Function of zinc a micronutrient in plant is activation of enzymes. In especially carboxylases, carbonic anhydrases, and several

other type of dehydrogenases. It maintains normal auxin content in plant. There, it is essential for many metabolic processes. Enzyme carbonic anhydrase provide CO2 during photosynthesis and evolves the gas during respiration. Deficiency of this element can cause chlorosis of leave shortening of internode.

"Iron (Fe) and zinc (Zn) are essential trace elements in human nutrition. Among the micronutrient malnutrition situations afflicting the human population, iron and zinc deficiencies are of major concern not only because of the serious health consequences they may have, but also because of the number of people affected worldwide" (Frossard *et al.* 2000). Iron is required for the biosynthesis of the chlorophyll molecule and functions as an electron carrier in the respiration and photosynthesis reactions. In addition, it participates in many enzymatic processes. Iron deficiency is a limiting factor of plant growth.

2. MATERIALS AND METHODS

The present experiment was carried out during Zaid 2022 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, UP, which is located at 25.28 ^{o} N latitude, 81.54^{o}E longitude and 98^{o} m altitude above the mean sea level. The experiment laid out in Randomized Block Design which consisting of ten treatments with three replications was laid out with the different treatments are assigned randomly in each replication. The experimental site was uniform in topography and sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in Organic carbon (0.38%), medium available N (225 kg ha^{-1}), higher available P (19.50 kg ha^{-1}) and medium available K (213.7 kg ha^{-1}). The treatment combinations are T_1 : 8 t ha^{-1} - FYM + 0.3% $FeSO_4$, T_2 : 8 t ha^{-1} FYM + 0.5% $FeSO_4$, T_3: 8 t ha^{-1} FYM +1.0% $FeSO_4$,T_4: 5 t ha^{-1} Vermicompost + 0.3% $FeSO_4$, T_5: 5 t ha^{-1} Vermicompost + 0.5% $FeSO_4$, T_6 : 5 t ha^{-1} Vermicompost + 1.0% $FeSO_4$, T_7 : 250 kg ha^{-1} Neem cake + 0.3% $FeSO_4$, T_8 : 250 kg ha^{-1} Neem cake + 0.5% $FeSO_4$, T_9 : 250 kg ha^{-1} Neem cake + 1.0% $FeSO_4$, T_{10} - Control (RDF 80 – 40 - 40 Kg N- P- K /ha). And $ZnSO_4$ @0.6% was uniformly applied in all treatment combinations except control. In the period from germination to harvest several plant growth parameters were recorded at frequent intervals along with it after harvest several yield parameters were recorded those parameters are growth parameters viz. plant height (cm), and plant dry weight(gm) are recorded. The yield parameters like green fodder yield (t ha^{-1}) were recorded and statistically analysed using analysis of variance (ANOVA) as applicable to Randomized Block Design (Gomez K.A. and Gomez A.A. 1984).

3. RESULTS AND DISCUSSION

3.1 Growth Attributes

3.1.1 Plant height (cm)

At 60 DAS after sowing highest Plant height was recorded in treatment no. 9 with application of 250 kg ha^{-1} Neem cake +1.0% $FeSO_4$ (193.4cm) which was significantly superior over all other and treatment with application of 5 t ha^{-1} Vermi-compost + 1.0% $FeSO_4$ (186.4cm) statistically at par with application of 250 kg ha Neemcake + 1.0% $FeSO_4$. Similar findings with Vermicompost and FYM was observed by Govind *et al.* [7] treatments with vermicompost (7.5 t ha^{-1}) and farmyard manure (15 t ha^{-1}) had highest growth characters when compared with the no organic manure treatment highest plant height of (158.8 and 158.7) was observed in 2017 and 2018 years. Chand *et al.* [8] suggested that significantly higher plant height (138.27 cm was recorded with soil application of $ZnSO_4$ at 25 kg/ha+ foliar spray of $ZnSO_4$ at 0.2% at 25 DAS and at 40 DAS, with respect to baby corn recorded significant during first cut in (Table 1).

At 45 DAS after the first cutting, highest plant height was observed in treatment no.9 with the application of 250 kg ha^{-1} Neem cake +1.0% $FeSO_4$ (154.7cm) significantly high over all other and treatment with application of 5 t ha^{-1} Vermi-compost+ 1.0% $FeSO_4$ (151.0cm) statistically at par with the application of 250 kg ha^{-1} Neem cake+1.0% $FeSO_4$. Similar findings with vermicompost and FYM was observed by Sunitha et al. [9] conducted the 25% RDF+25% FYM +25% +25% Fly ash+ 25%. vermicompost in gave significant result in terms of growth characters with respect to control treatment at (255cm). Das et al. [10] carried a study during Rabi season and concluded that foliar spray of $ZnSO_4$ applied twice at 25 DAS and 40 DAS gave the highest growth components such as plant height (176.28 cm), leaves per plant (13.77) and in baby corn, in baby corn, respectively.

Table 1. Effect of organic manure and iron on growth attributes of fodder Sorghum

		1st CUT (60 DAS)		2nd Cut (45 DAFH)	
	Treatments	**Plant height (cm)**	**Dry weight (g)**	**Plant height (cm)**	**Dry weight (g)**
1.	8 t ha^{-1} FYM+ 0.3% $FeSO_4$	158.3	37.5	121.6	16.1
2.	8 t ha^{-1} FYM + 0.5% $FeSO_4$	166.5	39.1	133.1	19.1
3.	8 t ha^{-1} FYM+ 1.0% $FeSO_4$	178.5	45.4	148.3	20.3
4.	5 t ha^{-1} Vermicompost+ 0.3% $FeSO_4$	161.0	38.3	127.6	17.4
5.	5 t ha^{-1} Vermicompost + 0.5% $FeSO_4$	169.9	39.7	142.1	19.6
6.	5t ha^{-1} Vermicompost+ 1.0% $FeSO_4$	186.4	46.4	151.0	23.4
7.	250 kg ha^{-1} Neem cake + 0.3% $FeSO_4$	167.7	38.3	129.2	18.5
8.	250 kg ha^{-1} Neem cake + 0.5% $FeSO_4$	173.7	43.4	142.6	20.0
9.	250 kg ha^{-1} Neem cake + 1.0% $FeSO_4$	193.4	50.2	154.7	25.0
10.	RDF 80- 40- 40 kg/ha NPK (Control)	152.2	37.4	109.6	15.0
	F - Test	S	S	S	S
	SEm (±)	2.7	1.3	3.03	1.3
	CD (p=0.05)	8.10	3.9	9.0	3.9

Table 2. Effect of organic manure and micronutrients on yeild of fodder Sorghum

	Treatments	**Green fodder yield (t ha^{-1})**
1.	8 t ha^{-1} FYM+ 0.3% $FeSO_4$	49.9
2.	8 t ha^{-1} FYM +0.5%$FeSO_4$	51.2
3.	8 t ha^{-1} FYM+ 1.0% $FeSO_4$	60.8
4.	5 t ha^{-1} Vermicompost+ 0.3% $FeSO_4$	52.1
5.	5 t ha^{-1} Vermicompost + 0.5% $FeSO_4$	57.3
6.	5 t ha^{-1} Vermicompost+ 1.0% $FeSO_4$	76.0
7.	250 kg ha^{-1} Neem cake + 0.3% $FeSO_4$	51.6
8.	250 kg ha^{-1} Neem cake + 0.5% $FeSO_4$	55.5
9.	250 kg ha^{-1} Neem cake + 1.0% $FeSO_4$	80.6
10.	RDF 80- 40- 40 kg/ha NPK (Control)	39.4
	F- Test	S
	SEm (±)	2.9
	CD (p =0.05)	8.7

3.1.2 Dry weight (g/plant)

At 60 DAS after sowing highest dry weight was recorded with application of 250 kg ha^{-1} Neem cake +1.0% $FeSO_4$ (50.2 gm) was significantly superior over all other and treatment with application of 5 t ha^{-1} Vermicompost + 1.0% $FeSO_4$ (46.4 g) statistically at par with application of 250 kg ha^{-1} Neem cake +1.0% $FeSO_4$ during first cut in (Table 1) Similar findings with vermicompost and FYM was Vinod *et al.* [11] treatments with N:P: K at 100% + vermicompost at 100% had gave highest growth and yield characters in maize highest plant height of (158.22cm) and dry weight of (163.46 gm) significantly. With the zinc 4 kg/ha. Boya *et a*l. [12] concluded that "application of zinc 4 kg/ha was found significantly superior and produced highest green forage (254 quintals /ha) and dry matter yield (120 quintals /ha)".

At 45 DAS after the first cutting maximum dry weight was observed with application of 250 kg ha^{-1} Neem cake +1.0 $FeSO_4$ (25.0 g) significantly superior over all other and treatment with application of 5 t ha^{-1} Vermicompost + 1.0% $FeSO_4$ (23.4 g) is found to be statistically at par with application of 250 kg ha^{-1} Neem cake +1.0% $FeSO_4$ (Table 1). Similar findings with vermicompost. Nohong et al. [13] found that the results are consistent with reports that the yield of main sorghum dry matter was higher (22.87 t ha^{-1}) Vermicompost compared to the yield of raton dry matter (8.47 t ha^{-1}). Das et al. [10] also carried a study during Rabi season and concluded that foliar spray of $ZnSO_4$ applied twice at 25 DAS and 40 DAS gave the highest growth components such as plant height (176.28 cm), leaves per plant (13.77) and dry weight (433.94 gm) and green fodder yield (28.16 t ha^{-1}) in baby corn, in baby corn, respectively.

3.2 Yield Attributes

3.2.1 Green fodder yield

Treatment with the application of 250 kg ha^{-1} Neem cake + 1.0% $FeSO_4$ (80.6 t ha^{-1}) was recorded highest green fodder yield which was significantly over all other and treatment with the application of 5 t ha^{-1} Vermicompost + 1.0% $FeSO_4$ (76.0 t ha^{-1}) statistically at par with application of 250 kg ha^{-1} Neem cake +1.0% $FeSO_4$. Similar findings are found by the Nanjudappa *et al*. [14] Observed that "application of recommended dose of fertilizer (150:75:50) coupled with Farm yard manure 10t/ha has recorded higher green fodder yield (62.31t ha). And dry fodder yield of Fodder maize". Aadesh et al. [15] found that "20 kg $ZnSO_4$ per hectare + 20 kg $FeSO_4$ per hectare as basal +0.5% $ZnSO_4$ + 0.5% $FeSO_4$ as foliar spray at 45 DAS has green fodder yield of (554.80 t/ ha)". Sharma et al. [16] determined that "higher level of zinc had improved growth parameters such as green fodder yield (277.7 quintals /ha) and quality parameters of green fodder with successive increase in zinc level up to maximum level of fertility Zn (5.0 kg/ha), respectively" [17].

4. CONCLUSION

On the basis of one season experimentation, it may be concluded that application of 250 kg ha^{-1} Neem cake +1.0% $FeSO_4$ was found to be most desirable that gave significantly plant Height, maximum dry matter accumulation and more productive of green fodder yield (80.6 t ha^{-1}) as compared to other treatments.

The conclusions are based on data from single research, so additional trails are required to confirm findings.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Schittenhelm S, Schoettler S. Comparison of drought tolerance of maize, sweet Sorghum, and sorghum-Sudan grass hybrids. Journal of Agronomy Crop Science. 2014; 200:46-53. DOI:10.1111/jac.12039.
2. Getachew G, Putnam DH, De Ben CM, De Peters EJ. Potential of Sorghum as an alternative to corn forage. Am. J. Plant Sci. 2016; 07:1106-1121. DOI:10.4236/ajps.77106
3. Kholová J, McLean Valdez V, Craufurd P, Hammer GL. Drought stress characterization of post-rainy season (rabi) sorghum in India. Forage and Crop Research. 2013; 141:384.
4. ICRISAT Happenings Newsletter, Forage Sorghum hybrid hailed as A Landmark cultivar in India. Available:https://www.icrisat.org/forage-sorghum-hybrid-hailed-as-a-landmark-cultivar-in-india
5. Ghoshal N, Singh KP. Effects of Farmyard manure and inorganic fertilizer on the dynamics of soil microbial biomass in a tropical dryland agroecosystem. Bilo. Fert. Soils. 1995;19(2):231-238.
6. Kaur N, Beni Pal D. Effect of crop residue and farmyard manure on K forms on soils of long-term fertility experiment. Indian Journal of Crop Science. 2006;1(1 and 2):161-164.
7. Govind Prasad, Rinwa R, Kumar P. Growth and yield Responses in Maize to organic and inorganic Nutrient sources under Haryana Conditions. International Journal of Pure and Applied Biosciences; 2018.
8. Chand SW, Susheela R, Sreelatha D, Shanti M, Hussain SA. Effect of zinc fertilization on yield and economics of baby corn (*Zea mays* L.). Journal of Pharma-cognisee and Phytochemistry. 2017;6(5):989-992.
9. Sunita Rani, Kandpal Geeta, Jatana Singh Mansukh, Singh Gurminder. Effect of different fertilizers on growth Parameters of sorghum International Journal of Current Microbiology and Applied Sciences. 2018;7(6):2319-7706.
10. Das C, Barik AK, Mondal K. Effect of zinc application growth and yield of baby corn (*Zea mays* L.) in lateritic soil of West Bengal. International Journal of Chemical Studies. 2020;8(2):887-890.
11. Vinod Kumar P, Swaroop N, Masih. Effect of different dose of N:P: K and vermicompost on growth and yield attributes of maize. Journal of

Pharmacognosy and Phytochemistry. 2017;7(1):2830-2832.
12. Bhoyamitu, Chandari PP, Raval CH, Dhaft PK. Effect of Nitrogen and Zinc on growth and Yeild of Fodder Sorghum Varieties. International Journal of Agricultural Sciences. 2014; 10:294-297.
13. Nohong, Rinduwati, Yusuf M. Influences of different vemi compost level on growth, yield and quality forage sorghum (*Sorghum bicolor* L. Moench) Earth and Environmental Sciences. 2020;492.
14. Nanjudappa GB, Shiraj S, Jaharjuna S. Effect of Organic and inorganic sources of Nutrients alone and in combination on growth and yield of fodder maize Mysore Journal of Agricultural Sciences. 2000;34 (247-250).
15. Aadesh, Singh RP, Pal Pratap Ram, Deep Raj Verma. Effect of micro nutrient application on growth and yield and quality of fodder maize. The Pharma Innovation. 2021; 10:2356-2361.
16. Sharma AJ, Singh MK, Kumar S, Shambhav S, Sneha. Effect of plant geometry, graded fertility, and zinc level on growth characters, yield and quality of baby corn (*Zea mays* L.) fodder in Bihar. International Journal of Chemical Studies. 2020;8(3): 816- 821.
17. Rana DS, Bhagat Singh K. Gupta AK. Dhaka, Satya wan Arya. Response of fodder sorghum (*Sorghum bicolor* (L.) to zinc and iron. Forage Research. 2013;39(1):45-47.

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