

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

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, Zinc (0.6%) was foliar applied uniformly in all treatment combinations except control. 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 (51.2gm) and second cut (25.0gm), Maximum Green fodder yield (80.0t/ha) was found in treatment (T₉) 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 (Schittenhelm and Schoettler, 2014) but also showed fodder quality on par with that of maize” (Getachew *et al.*, 2016). “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” (Kholová, J *et al.*, 2013).

“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” (ICRISAT, 2021). “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% P₂O₅ and 0.5-1.0% K₂O. FYM is a good source of organic carbon, which activates the biotic life of the soil flora and fauna. Ghoshal and Singh (1995) found an increase in soil microbial biomass carbon, nitrogen and phosphorous in the soil applied with FYM. Using long term experiments” Kaur and Benipal (2006) 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. Besides, 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 zinc 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 °N latitude, 81.54°E longitude and 98° 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 T₁: 8 t ha⁻¹ - FYM + 0.3% - FeSO₄, T₂: 8 t ha⁻¹ - FYM + 0.5% - FeSO₄, T₃: 8 t ha⁻¹ - FYM + 1.0% - FeSO₄, T₄: 5 t ha⁻¹ - Vermicompost + 0.3% - FeSO₄, T₅: 5 t ha⁻¹ - Vermicompost + 0.5% - FeSO₄, T₆: 5 t ha⁻¹ - Vermicompost + 1.0% - FeSO₄, T₇: 250 kg ha⁻¹ -Neem cake +0.3% - FeSO₄, T₈: 250 kg ha⁻¹ -Neem cake +0.5% - FeSO₄, T₉: 250 kg ha⁻¹ -Neem cake +1.0% - FeSO₄ and T₁₀- Control (RDF 80 – 40 - 40 Kg N- P- K /ha) and ZnSO₄ @ 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% - FeSO₄ (193.4cm) which was significantly superior over all other and treatment with application of 5 t ha⁻¹ - Vermicompost + 1.0% - FeSO₄ (186.4cm) statistically at par with application of 250kg ha⁻¹ - Neem cake +1.0% - FeSO₄. Similar findings with vermicompost and FYM was observed by **Govind et al., (2018)** 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., (2017)** suggested that significantly higher plant height (138.27 cm was recorded with soil application of ZnSO₄ at 25 kg/ha+ foliar spray of ZnSO₄ 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% - FeSO₄ (154.7cm) significantly high over all other and treatment with application of 5 t ha⁻¹ - Vermicompost +

1.0% - FeSO₄ (151.0cm) statistically at par with the application of 250 kg ha⁻¹ -Neem cake +1.0%- FeSO₄. Similar findings with vermicompost and FYM was observed by **Sunitha et al., (2018)** 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., (2018)** carried a study during Rabi season and concluded that foliar spray of ZnSO₄ 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.

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% - FeSO₄ (51.2gm) was significantly superior over all other and treatment with application of 5 t ha⁻¹ - Vermicompost + 1.0% - FeSO₄ (46.4 g) statistically at par with application of 250 kg ha⁻¹ -Neem cake +1.0% - FeSO₄ during first cut in (Table 1) Similar findings with vermicompost and FYM was **vinod et al., (2017)** 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 al., (2014)** 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% - FeSO₄ (25.0 g) significantly superior over all other and treatment with application of 5 t ha⁻¹ - Vermicompost + 1.0% - FeSO₄ (23.4 g) is found to be statistically at par with application of 250 kg ha⁻¹- Neem cake +1.0% - FeSO₄ (table 1). Similar findings with vermicompost. **Nohong et al. (2020)** 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., (2018)** also carried a study during Rabi season and concluded that foliar spray of ZnSO₄ 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) 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% - FeSO₄ (80.0 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% - FeSO₄ (76.0 t ha⁻¹) statistically at par with application of 250 kg

ha-1 - Neem cake +1.0% - FeSO₄. Similar findings are found by the **Nanjudappa et al., (2000)** 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”. **Adesh et al., (2021)** found that “20 kg ZnSO₄ per hectare + 20 kg FeSO₄ per hectare as basal +0.5% ZnSO₄ + 0.5% FeSO₄ as foliar spray at 45 DAS has green fodder yield of (554.80 t/ ha)”. **Sharma et al., (2020)** 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”.

4. CONCLUSION

On the basis of one season experimentation, it may be concluded that application of 250kg ha⁻¹ - Neem cake +1.0% - FeSO₄ was found to be most desirable that gave significantly plant Height, maximum dry matter accumulation and more productive of green fodder yield 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.

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UNDER PEER REVIEW

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

	Treatments	1 st CUT (60 DAS)		2 nd Cut (45 DAFH)	
		Plant Height (cm)	Dry Weight (g)	Plant Heigh (cm)	Dry Weight(g)
1.	8t/ha - FYM+ 0.3% - FeSo ₄	158.3	37.5	121.6	16.1
2.	8t/ha - FYM +Fe – 0.5% - FeSo ₄	166.5	39.1	133.1	19.1
3.	8t/ha - FYM+ Fe – 1.0% - FeSo ₄	178.5	45.4	148.3	20.3
4.	5t/ha - Vermicompost+ 0.3%- FeSo ₄	161.0	38.3	127.6	17.4
5.	5t/ha - Vermicompost + 0.5% - FeSo ₄	169.9	39.7	142.1	19.6
6.	5t/ha - Vermicompost+ 1.0% - FeSo ₄	186.4	46.4	151.0	23.4
7.	250 – kg /ha Neem cake + 0.3% - FeSo ₄	167.7	38.3	129.2	18.5
8.	250 – kg /ha Neem cake +0.5% - FeSo ₄	173.7	43.4	142.6	20.0
9.	250 – kg /ha Neem cake + 1.0% - FeSo ₄	193.4	51.2	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	1.2	3.03	1.3
	CD (P=0.05)	8.10	3.7	9.0	3.9

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

	Treatments	Green fodder yield (t/ha) (105 DAS)
1.	8t/ha - FYM+ 0.3% - FeSo4	49.3
2.	8t/ha - FYM +Fe – 0.5% - FeSo4	51.0
3.	8t/ha - FYM+ Fe – 1.0% - FeSo4	60.3
4.	5t/ha - Vermicompost+ 0.3% - FeSo4	52.6
5.	5t/ha - Vermicompost + 0.5% - FeSo4	57.3
6.	5t/ha - Vermicompost+ 1.0% - FeSo4	76.0
7.	250 – kg /ha Neem cake + 0.3% - FeSo4	51.0
8.	250 – kg /ha Neem cake + 0.5% - FeSo4	55.3
9.	250 – kg /ha Neem cake + 1.0% - FeSo4	80.0
10.	RDF 80- 40- 40 kg/ha NPK (Control)	39.3
	F- Test	S
	SEm (±)	2.9
	CD (P =0.05)	8.7

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