Original Research Article

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 determine the Effect of organic manure and iron on growth and fodder yield of sorghum (Sorghum bicolor L.) .The treatments consisted of 3 levels of Organic manure (FYM 8t/ha ,Vermicompost 5t/ha, Neem cake 250 kg /ha) and three levels of Iron as (0.3,0.5,1.0%) zinc as (0.6 %) as foliar spray and control .the experiment was laid out in Randomized Block Design with ten treatments each replicated thrice on the basis of one year experimentation . 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 that application of Neem cake – 250kg/ha+ Fe – 1.0%. Maximum Plant height at first cut (193.4cm), and second cut(154.7cm), plant dry weight first cut (51.2gm) and second cut(25.0gm) , Maximum Green fodder yield(80.0t/ha) as compared to other treatments .

***Keywords*:** FYM, Growth, Iron, Neemcake, Vermicompost, Yield, Zinc.

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 Schroetter2014**) 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 *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 micro- nutrient 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 the biosynthesis of the chlorophyll molecule and functions as an electron carrier in the respira tion 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 leafober 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_2O. FYM is a good source of organic carbon, which activates the biotic life of the soil flora and fauna**. Goshal 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. 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%to5%, Phosphorus 0.5%-1%, Potash 1%-2% and it is also richinsulphurcompounds.Vermicomposti ng 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 taken 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 maintain normal auxin content in plant. There, it is essential for a large number of metabolic process. Enzyme carbonic anhydrase provide CO_2 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.

Materials and Methods

The present examination 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 m altitude above the mean sea level. The experiment laid out in Randomized Block Design which consisting of ten treatments T_1: 8 t/ha - FYM + 0.3% - $FeSo_4$, T_2: 8 t/ha - FYM + 0.5% - $FeSo_4$, T_3: 8 t/ha - FYM + 1.0% - $FeSo_4$, T4: 5 t/ha - Vermicompost + 0.3% - $FeSo_4$, T_5: 5 t/ha - Vermicompost + 0.5% - $FeSo_4$, T_6: 5 t/ha - Vermicompost + 1.0% - $FeSo_4$, T_7: 250kg/ha -Neem cake +0.3% - $FeSo_4$, T_8: 250kg/ha -Neem cake +0.5% - $FeSo_4$, T_9: 250kg/ha -Neem cake +1.0% - $FeSo_4$ and T_{10}- Control (RDF 80 –

40 - 40 Kg N- P- K /ha) are used The experimental site was uniform in topography and sandy loam in texture, nearly neutral in soil reaction (P^H 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}). 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, plant height, and plant dry weight are recorded. The yield parameters like Green fodder yield (t/ha) was recorded and statistically analyzed using analysis of variance (ANOVA) as applicable to Randomized Block Design (Gomez K.A. and Gomez A.A. 1984).

Results and Discussion

Growth attributes

Plant height

Plant height measurements increased as crop growth as seen in Table 1.Treatment with 250kg/ha - Neem cake + 1.0% - FeSo4 recorded significantly higher plant height (193.4 cm) during first cut. However, minimum was found at the Control - 80:40:40 N:P:K Kg/ha with (152.2cm). Similar findings with vermicompost and FYM was observed by **Govind *et al.* (2018)** treatments with vermicompost (7.5t/ha) and farmyard manure (15t/ha) 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.

At 45 days after the first cutting, treatment with 250kg/ha – Neem cake + 1.0% - FeSo4 Foliar Application recorded significantly higher plant height (154.7 cm). However, the treatments with 5t/ha – Vermicompost + 1.0% - FeSo4 (151.0cm) and which were found to be at par with 250kg/ha – Neem cake + 1.0% - FeSo4 as compared to all other treatment. Similar findings with vermicompost and FYM was observed by **Sunitha *et al.* (2018)** conducted the 25% RDF+25% FYM+25%+25%Flyash +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.

Dry weight (g/plant)

Treatment with 250kg/ha - Neem cake + 1.0% - FeSo4 recorded significantly higher dry weight (51.2gm) in first cutting. However, minimum was found at the Control - 80:40:40 N:P:K Kg/ha with (37.4gm). Similar findings with vermicompost and FYM was **vinod *et al.* (2017)** treatments with N:P:K @100% + vermicompost @ 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 4kgzn/ha was found significantly superior and produced highest green forage (254 q/ha) and dry matter yield (120q/ha).

At 45days after the first cutting, in second cutting there was significant difference among the treatments. However, highest dry weight (25.0gm) was observed with the application of 250kg/ha -Neem cake+ 1.0% - FeSo4 were found to be statistically at par with 5t/ha - Vermicompost +1.0% - FeSo4 with (23.4gm) 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 tons/ha) vermicompost compared to the yield of raton dry matter (8.47 tons/ha). **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 g/m^2) and green fodder yield (28.16 t/ha) in baby corn, in baby corn, respectively

Yield attributes and Yield

There was a significance difference between all the treatments and the highest green fodder yield was observed at the treatment with 250kg/ha - Neem cake + 1.0%- $FeSo_4$ with (80.0 t/ha) which was at par with 5t/ha - Vermicompost + 1.0% - $FeSo_4$ with (76.0 t/ha).

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 (554.80t/ha). **Sharma *et al.* (2020)** determined that higher level of zinc had improved growth parameters such as green fodder yield (277.7 q/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.

CONCLUSION

It is concluded that application of treatment 250kg/ha - 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 as compared to other treatments.

REFERENCES

Adesh., singhR.P., Pal Pratap ram and Deepraj verma. (2021). Effect of micro nutrient ap- plication on growth and yield and quality of fodder maize. *The Pharma Innovation* **10**(10): 2356-2361.

Bhoya mitu., Chandari P.P., Raval CH., and Dhaft PK.(2014). Effect of Nitrogen and Zinc on growth and Yeild of Fodder Sorghum Varities. *International Journal of Agricultural Sciences*, **10** 294-297.

Chand, S. W., Susheela, R., Sreelatha, D., Shanti, M. and Hussain, S.A. (2017). Effect of zinc fertilization on yield and economics of baby corn (*Zea mays* L.). *Journal of Pharma- cognosy and Phytochemistry*, **6**(5): 989-992.

Das, C., Barik, A. K. and Mondal, K. (2020). Effect of zinc applicatioon growth and yield of baby corn (*Zea mays* L.) in lateritic soil of West Bengal. *International Journal of Chem-ical Studies*, **8**(2): 887-890.

D . S . Rana , Bhagat Singh , k . gupta , A. k. Dhaka and Satyawan Arya (2013). Response of fodder sorghum (Sorghum bicolor (L.) to zinc and iron .forage research , **39** (1):45-47.

Getachew, G., Putnam, D. H., De Ben, C. M., De Peters, E. J., Potential of Sorghum as an alternative to corn forage. *Am. J. Plant Sci.*, **07**: 1106-1121, 10.4236/ajps.(2016) .77106.

Goshal, N. and Singh, K.P.(1995). Effects of Farmyard manure and inorganic fertilizer on the dynamics of soil microbial biomass in a tropical dryland agroecosystem. *Bilo. Fert. Soils*. 19(2):231-238.

Govind Prasad., Rinwa r., Kumar P.(2018). Growth and yield Responses in Maize to organic and inorganic Nutrient sources under Haryana Conditions. *International Journal of Pure and applied biosciences*

ICRISAT Happenings Newsletter, Forage Sorghum hybrid hailed as A Landmark cultivar in India, https://www.icrisat.org/forage-sorghum-hybrid-hailed-as-a-landmark-cultivar-in-india

Kaur, N. and Benipal, D. (2006). Effect of crop residue and farmyard manure on K forms on soils of long term fertility

experiment. *Indian Journal of Crop Science*, 1(1 and 2), 161-164

Kholová,J., McLean,G., Vadez, V., Crauf urd, P.and Hammer, G. L. (2013).Droughtstress characterization of post-rainy season (rabi) sorghum in India.*ForageandCropResearch*, **141**: 3846, 10.1016/j.fcr.2012.10.020.

Nanjudappa GB., Shiraj S., Jaharjuna S.(2000). Effect of Organic and inorganic sources of Nutrients alone and in combination on growth and yield of fodder maize *Mysore Journal of Agricultural Sciences,* **34** (247-250).

Nohong, Rinduwati and M Yusuf. (2020). Influences of different vemi compost level on growth, yield and quality forage sorghum (*Sorghum bicolor* L. Moench) *Earth and En- vironmental Sciences*.492.

Schittenhelm, S., Schroetter, S. (2014). Comparison of drought tolerance of maize, sweet Sorghum and sorghum-sudangrass hybrids. *Journal of Agronomy Crop Science*. **200**:46-53, 10.1111/jac.12039.

Sharma, A, J., Singh, M. K., Kumar, S., Shambhavi, S. and Sneha. (2020). Effect of plant geometry, graded fertility and zinc level on growth characters, yield and quality of baby corn (*Zea mays* L.) fodder in Bihar. Internat*ional Journal of Chemical Studies,* **8**(3): 816-821.

Sunita rani., Kandpal Geeta., Jatana Singh Mansukh., Singh Gurwinder. (2018). Effect of different fertilizers on growth Parameters of sorghum *International Journal of Current Microbiology and applied sciences,* **7**(6) 2319-7706.

Vinod Kumar P., Swaroop N., and Masih. (2017). Effect of different dose of N:P:K and ver- micompost on growth and yield attributes of maize. *Journal of Pharmacognsosy and Phytochemistry,* **7**(1) 2830-2832

.

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

	Treatments	1st CUT		2nd Cut	
		Plant Height (cm)	Dry Weight (g)	Plant Height (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
	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
	SEm (±)	2.9
	CD (P =0.05)	8.7