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Effect of vesicular arbuscular mycorrhiza and integrated nutrient management on yield of sorghum in vertisols

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ABSTRACT

The present investigation was conducted to study the effect of mycorrhizal inoculation (VAM) and integrated nutrient management on yield of sorghum at Res. Farm, Dept. of Soil Science, Dr. PDKV, Akola on Vertisols during kharif 2025-26. The experiment was laid out in RBD with eight treatments replicated thrice. The treatments comprised of absolute control, 100 % RDF, 100 % RDF + VAM @ 5 kg ha⁻¹, 75 % RDF + VAM @ 5 kg ha⁻¹ and 75 % RDF + VAM @ 5 kg ha⁻¹ with and without FYM @ 5 t ha⁻¹ and vermicompost @ 2.5 t ha⁻¹. The results revealed that significantly highest grain and straw yield of sorghum was observed with the integrated application of 75% RDF + vermicompost @ 2.5 t ha⁻¹ along with VAM @ 5 kg ha⁻¹ which was statistically at par with application of 75% RDF + Vermicompost @ 2.5 t ha⁻¹ and 75% RDF + FYM @ 5 t ha⁻¹ along with VAM @ 5 kg ha⁻¹. The low-est yield was observed under the absolute control.

Hence, it can be concluded that application of 75 % RDF + VAM @ 5 kg ha⁻¹ along with vermicompost @ 2.5 t ha⁻¹ or FYM @ 5 t ha⁻¹ was found equally beneficial for enhancing yield of sorghum on Vertisols in Maharashtra.

Keywords: *Sorghum*, Integrated Nutrient management, *Vesicular arbuscular mycorrhiza*, FYM, Yield, Vertisol

Introduction

Sorghum (*Sorghum bicolor* L.), locally known as jowar is an annual short day C4 plant that belongs to family *Gramineae* and genus sorghum and widely grown especially in tropical and sub-tropical regions of India. As sorghum is generally cultivated in nutrient poor soils in frequently drought prone areas. It offers food and fodder security through risk aversion on sustainable basis. *Sorghum* plant has a well-developed deep root system. In India, sorghum is a significant cereal crop. It ranks fifth among the major cereal crops in the world, after rice, wheat, maize, and barley.

In India, sorghum occupies the third position among food grains, after rice and wheat. It is one of the most important and nutritious millet crops and serves as a staple food for rural poor people. It ranks third in area and production after rice and wheat. *Sorghum* is cultivated on about 10.5 million hectares, producing 7.89 million tonnes, with an average productivity of 850 kg ha⁻¹ (Mangal Rai, 2002) [1].

Vesicular arbuscular mycorrhiza (VAM) is a fungal obligate symbiont to many crops (Tylka *et al.*, 1991) [2] which shows mutualistic symbiosis with roots in a variety of plant species. The beneficial effects of VAM on plant growth are mainly due to increased nutrient uptake, especially phosphorus, by enhancing the root surface area for absorption. Integrated Nutrient Management (INM) involves the proper use and management of all major sources of plant nutrients in an efficient and careful manner. It includes the use of chemical fertilizers along with organic sources such as animal manures, compost, and green manures. INM helps in sustaining agricultural production by improving soil health and reducing the gap between nutrient removal by crops and nutrient supply. It also reduces the dependence on chemical fertilizers. The combined use of chemical fertilizers and organic manures increases nutrient use efficiency and helps in maintaining higher crop productivity. Therefore, the INM system is an effective approach for achieving sustainable crop yields and improving soil health in different cropping systems (Kaushal, 2002) [3]. In view of above, the present study was undertaken to study the effect of mycorrhizal inoculation and integrated nutrient management on yield of sorghum

2. Materials and methods

The field experiment was conducted during *kharif* 2025-26 at the Research farm of Department of Soil Science, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra, India. Geographically, the region is located at 20°42' 01.13" North and 77°03' 47.93" East, at an elevation of 307.8 meters above mean sea level (MSL). It has a semi-arid climate with three well-defined seasons. There are a hot, dry summer from March to May, a warm, rainy monsoon from June to October, and a mild, cold winter from November to February. The average annual precipitation is 711.1 mm. The soil of the experimental site was deep,

clayey black soil taxonomically classified as very fine, smectitic, calcareous, hyperthermic family of Typic Haplusterts.

The experiment comprised eight nutrient management treatments, viz., Absolute control (T_1), 100% RDF (T_2), 100% RDF + VAM @ 5 kg ha⁻¹ (T_3), 75% RDF + VAM @ 5 kg ha⁻¹ (T_4), 75% RDF + FYM @ 5 t ha⁻¹ along with VAM @ 5 kg ha⁻¹ (T_5), 75% RDF + FYM @ 5 t ha⁻¹ (T_6), 75% RDF + Vermicompost @ 2.5 t ha⁻¹ along with VAM @ 5 kg ha⁻¹ (T_7), and 75% RDF + Vermicompost @ 2.5 t ha⁻¹ (T_8). The treatments were replicated thrice in a Randomized Block Design (RBD). *Sorghum* variety was CSH-9 and recommended dose of fertilizer (RDF) for sorghum was 80:40:40 kg N, P₂O₅, and K₂O per hectare. Half dose of N and total amount of P and K was applied at the time sowing. The remaining half quantity of N was applied after 30 DAS as top dressing.

The recorded data on yield was statistically analysed using analysis of variance (ANOVA) for a Randomized Block Design, as described by Gomez *et al.* (1984) [4]. Treatment means were compared using the critical difference (CD) at the 5 percent level of significance.

Result and Discussion

The results pertaining to the grain of sorghum as influenced by VAM and INM are presented in figure 1. The vesicular arbuscular mycorrhiza and integrated nutrient management practices significantly ($p < 0.05$) impacted the grain and straw yield of sorghum. The grain yield of sorghum was significantly influenced due to *Vesicular arbuscular mycorrhiza* (VAM) and Integrated Nutrient Management. The significantly highest grain yield (33.15 q ha⁻¹) was recorded in application of 75% RDF + vermicompost @ 2.5 t ha⁻¹ along with VAM @ 5 kg ha⁻¹ (T_7). This treatment was statistically comparable with the treatment 75% RDF + vermicompost @ 2.5 t ha⁻¹ (T_8) and 75% RDF + FYM @ 5 t ha⁻¹ along with VAM @ 5 kg ha⁻¹ (T_6). The treatments T_7 , T_8 and T_6 produced 67.59, 60.36% and 47.27 % higher grain yield over 100 % RDF through chemical fertilizers (T_2). This results clearly suggested that integration of VAM and vermicompost / FYM along with 25 % reduced dose of fertilizers found superior over the balanced application of nutrient i.e. 100 % RDF through mineral fertilizers.

The fodder yield of sorghum was also significantly affected due to the various treatments (Fig. 2). The integrated application of 75 % RDF + vermicompost @ 2.5 t ha⁻¹ + VAM (T_7) produced significantly highest fodder yield (78.95 q ha⁻¹) followed by 75% RDF + vermicompost @ 2.5 t ha⁻¹ (76.97 q ha⁻¹) and 75% RDF + FYM @ 5 t ha⁻¹ along with VAM @ 5 kg ha⁻¹ (68.46 q ha⁻¹) which were statistically at par with each other. The relative increase in fodder yields due to these treatments i.e. T_7 , T_8 and T_6 was 67.09, 62.90 and 47.65 % higher compared to 100 % RDF.

Overall, the INM treatments (T_5 to T_8) were statistically superior over control and RDF also emphasizing the beneficial effect of organic sources and VAM. This increase was might be due to organic sources releases macro and micronutrients gradually and slowly the crop throughout the growth period besides stimulating microbial activities (Adediran *et al.*, 2005) [5]. The increase in sorghum yield in INM treatments was due to more absorption of nutrients by extra rhizosphere mycelium and supply to plants. Besides, organic manure (vermicompost and FYM) combined with chemical fertilizer directly added nutrients to the soil, improved microbial activity and soil physical conditions (Ingle *et al.* 2011). This results clearly suggested that sustainability in productivity of sorghum could be maintained with integration of chemical fertilizers and organic manures (vermicompost and FYM) along with mycorrhizae. The superiority of 25 % reduced dose of RDF along with organics over chemical fertilizers only alone was also reported by Sonune *et al.* (2025) [6]. Similar enhancement was also reported by Chaudhary *et al.* (2024) [7] in cowpea and Shegokar *et al.* (2024) [8] in sorghum.

On the contrast, the lowest grain and fodder yield (8.21 & 19.48 q ha⁻¹) was noted in absolute control clearly indicating without supply of any nutrient, crop yield could not sustain.

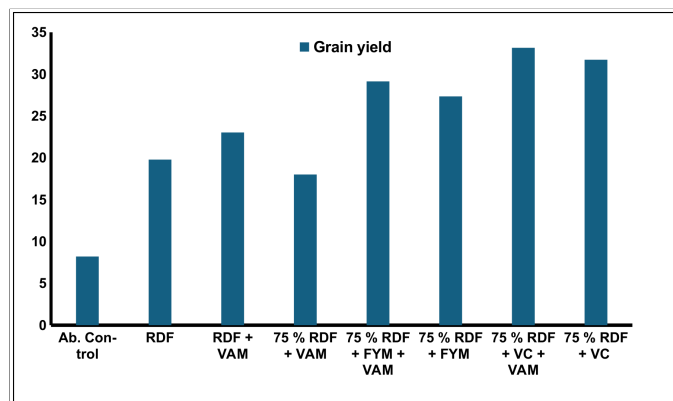


Figure 1. Grain yield of sorghum as influenced by nutrient management treatments.

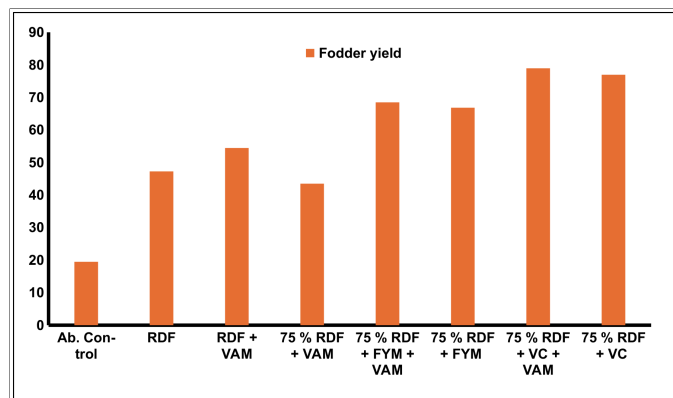


Figure 2. Fodder yield of sorghum as influenced by nutrient management treatments.

Conclusion

Hence, it can be concluded that the integrated application of VAM along with 75% RDF + Vermicompost @ 2.5 t ha⁻¹ or FYM @ 5 t ha⁻¹ found superior for enhancing the yield of sorghum in Vertisols.

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