www.journalworlds.com
AGRI JOURNAL WORLD
VOLUME 4 ISSUE 12 DECEMBER, 2024

MAXIMIZING SORGHUM POTENTIAL THROUGH NUTRIENT OPTIMIZATION

Savankumar P Patel[1], Munira S Mandviwala[2], Maulik R Sutariya[1]

[1] Agriculture Officer, Government of Gujarat, Gujarat
[2] Department of Agronomy, Navsari Agricultural University, Navsari, Gujarat

Corresponding author email: munira0412@gmail.com

ABSTRACT

Sorghum (Sorghum bicolor L.), a key cereal crop in semi-arid regions, demands effective nutrient management to ensure sustainable production. Nutrient management enhances crop productivity, soil fertility, and resource use efficiency while minimizing environmental impacts. Innovative strategies like the 4R framework (Right Source, Rate, Time, and Place), integrated nutrient management, and the use of bio-fertilizers and organic manures have shown promising results in improving yields and soil health. Challenges include soil nutrient imbalances, low organic matter, and overdependence on chemical fertilizers. Adopting sustainable practices, along with farmer education, is crucial for enhancing sorghum productivity and environmental resilience.

KEYWORDS: Sorghum, 4R, Integrated Nutrient Management, Biofertilizers,

INTRODUCTION

Sorghum (Sorghum bicolor L.), an integral member of the Poaceae family, stands as the fifth most significant cereal crop globally after wheat, rice, maize, and barley. Known for its adaptability, sorghum thrives in diverse environmental conditions, providing substantial green and dry fodder. This highly nutrient-demanding crop plays a pivotal role in ensuring food and fodder security, especially in semi-arid regions. According to USDA, the area under sorghum in India in 2023/24 was 40.76 lakh hectares with production of 47.37 lakh tons.

Table.1. Nutritional constitution of Sorghum.

Energy (kcal)	329
Protein (g)	10.4
Carbohydrate (g)	70.7
Fat (g)	3.1

Crude fibre (g)	2.0
Ca (mg)	2.5
Fe (mg)	5.4
Thiamin (mg)	0.38
Riboflavin (mg)	0.15
Niacin (mg)	4.3

(Source: Council/National e : Hulse, Laing and Pearson, 1980 : United states National research Academy of Sciences,1982.)

WHY NUTRIENT MANAGEMENT MATTERS IN SORGHUM?

Sorghum being an exhaustive crop needs more attention in terms of nutrient inputs. Proper nutrient management in sorghum has following advantages:

1. *Enhanced crop productivity:* Proper nutrient management ensures that sorghum plants receive adequate nutrients, leading to higher grain and fodder yields.
2. *Improved soil fertility:* Balanced fertilization, including organic amendments, helps maintain and improve soil health, ensuring sustainable production over the long term.
3. *Efficient resource use:* Optimal nutrient application enhances the efficiency of inputs like water and fertilizers, reducing waste and production costs.
4. *Resistance to stress:* Adequate nutrition improves the plant's tolerance to biotic (pests and diseases) and abiotic (drought, salinity) stresses, making sorghum more resilient.
5. *Enhanced grain quality:* Nutrient management improves grain size, weight, and nutritional content, benefiting both food and feed purposes.
6. *Minimized environmental impact:* Avoiding over-fertilization reduces nutrient runoff and leaching, protecting water bodies and the environment.
7. *Optimized nutrient partitioning:* Proper management supports the allocation of nutrients to economically important parts, like grains and fodder, maximizing output.
8. *Cost-effectiveness:* Balanced use of inorganic and organic fertilizers minimizes the need for expensive chemical fertilizers, enhancing profitability.
9. *Sustainability:* Integrating bio-fertilizers and organic matter ensures long-term productivity while reducing dependence on synthetic fertilizers.

10. *Climate adaptation:* Nutrient management practices like precision agriculture help sorghum adapt to changing climatic conditions, ensuring stable production.

NUTRIENT MANAGEMENT FRAMEWORK

The principles of the 4R nutrient management strategy—Right Source, Right Rate, Right Time, and Right Place—are central to sustainable practices. These ensure efficient nutrient utilization, cost-effectiveness, and environmental safety.

1. *Right source:* Use of fertilizers and nutrient sources according to the crop's nutrient requirements and soil characteristics. Combining chemical fertilizers with organic sources fulfil both macro and micro nutrients requirement.
2. *Right rate:* Apply nutrients in optimum quantities to meet crop demand without over- or under-fertilizing. Application rates based on soil testing to address deficiencies, particularly micronutrients like zinc and iron.
3. *Right time:* Apply nutrients at the right growth stage of the crop for maximum efficiency and uptake. Split application of nitrogen: Basal dose at sowing and topdressing at the vegetative stage. Foliar sprays during reproductive stages to boost grain filling and quality.
4. *Right place:* Apply nutrients in locations where roots can access them efficiently, reducing losses and improving uptake. Eg.: Incorporation of fertilizers into the soil or band placement to minimize volatilization and runoff.

KEY METHODS INCLUDE

1. *Chemical fertilizers:* Providing immediate nutrients, fertilizers like Urea (46% N) and DAP (18:46:00 NPK) ensure high productivity. 100:50:50 N + P_2O_5 + K_2O kg/ha resulted in higher growth, dry matter, grain and fodder yield, chlorophyll content, crude fibre and protein **(**Meena *et al.*, 2018). Application of micronutrients by fertilizers is also important or optimum growth and production of sorghum. 30 kg $FeSO_4$/ha increased seed and stover yield. (Age *et al*., 2021).
2. *Bio-fertilizers:* Microbial preparations such as *Azospirillum* and phosphate-solubilizing bacteria (PSB) enhance nutrient availability.
3. *Organic manures:* Products like farmyard manure (FYM), vermicompost, and castor cake improve soil properties and nutrient recycling. Ghanajeevamrutha + foliar application 25% *Jeevamrutha* at 20 and 45 DAS resulted in higher yield and net returns. (Potadar *et al.*, 2023)
4. *Foliar spray:* Spraying of urea, DAP or combination of macronutrients or micronutrients influences plant growth, reproductive phase and seed setting. Lagad *et al.* (2020) observed that plant growth,

leaf:stem ratio, grain yield and dry fodder yield significantly increased when foliar spray of 2% urea spray was applied along with RDF.

SUSTAINABLE PRACTICES

1. *Integrated nutrient management* (INM): Combining organic and inorganic inputs maximizes nutrient efficiency. RDF + 10 t FYM + 4 kg Zn/ha significantly increased nutrient content and uptake in sorghum (Bhunwal *et al.*, 2016).
2. *Crop residue recycling:* Utilizing residues for composting reduces dependence on synthetic inputs and promotes circular agriculture.
3. Green manuring: Crops like Dhaincha and Sesbania enrich the soil with organic matter and nutrients when ploughed under. Along with nitrogen fixation they increase soil nitrogen and carbon content on decomposition.

CHALLENGES

1. Soil Nutrient Imbalance
   - Depleted Soils
   - Micronutrient Deficiencies
   - Acidic or Alkaline Soils
2. Unpredictable Rainfall Patterns
3. Low Organic Matter Content
4. Overdependence on Chemical Fertilizers
5. Low Adoption of Integrated Nutrient Management (INM)
6. High Cost and Limited Availability of Inputs
7. Nutrient Use Efficiency (NUE)
8. Pest and Disease Pressure
9. Knowledge Gaps and Extension Services

CONCLUSION

The integration of chemical, organic, and biological inputs is crucial for sustainable sorghum cultivation. By adopting nutrient management techniques like the 4R framework and INM, farmers can

achieve higher yields, improved soil health, and environmental sustainability. Future efforts should focus on increasing access to bio-fertilizers, promoting organic farming, and enhancing farmer education.

REFERENCES

Age, A. B., Satpute, S., Laharia, G. S., Kankal, D. S., Kadu, P. R., Jadhao, S. D. and Konde, N. M. (2021). Effect of soil and foliar application of iron on productivity and nutrient uptake by parching sorghum. *Journal of Natural Resource Conservation and Management*, **2**(2), 103-109.

Bhunwal, V., Patel, V., Bharti, N. and Jat, J. (2016). Effect of integrated nutrient management on yield, nutrient uptake and economics of sorghum and soil fertility. *Annals of Plant and Soil Research*, **18**(4), 348-352.

https://ipad.fas.usda.gov/countrysummary/Default.aspx?id=INandcrop=Sorghum

Lagad, P. M., Pathan, S. H., Damame, S. V. and Sinare, B. T. (2020). Effect of foliar nutrient management on growth, yield and quality of summer forage sorghum. *Forage Research*, **46**(3), 271-273.

Meena, B. S., Nepalia, V., Gautam, P. and Kishor, K. (2018). Effect of fertility levels on quality, nutrient content and uptake of single cut fodder sorghum genotypes. *Int. J. Curr. Microbiol. App. Sci*, **7**(3), 2859-2865.

Potadar, J., Patil, M. B. and Nooli, S. S. Influence of solid and liquid organic manures on growth, yield and economics of parching sorghum (*Sorghum bicolor*). *Int. J. Adv. Biochem. Res.*,**7**(2): 280-283.

How to cite:

Patel, S. P., Mandviwala, M.S., and Sutariya (2024). Maximizing sorghum potential through nutrient optimization. Leaves and Dew Publication, New Delhi 110059. *Agri Journal World* 4(12): 23-27.

**********XXXXX**********