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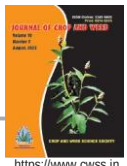

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# Comparative performance of single and multicut sorghum (*Sorghum bicolor* L. Moench) varieties under different nutrient sources

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## ABSTRACT

*A field experiment was conducted at Instructional Dairy Farm, Nagla, G. B. Pant University of Agriculture & Technology Pantnagar during kharif 2018 to 2020 (3 years) to study the performance of various sources of nutrition on fodder yield and quality of sorghum and their continuous use effect on soil fertility. Experiment in fixed plot was laid out in Factorial RandomisedBlock Design replicated thrice. Forage sorghum varieties did not vary significantly in terms of fodder yields and B : C ratio. However, higher values of green and dry fodder yield and B : C ratio was under multicut varieties. Protein content was significantly higher in multicut variety over single cut while HCN content was significantly higher in single cut variety. Soil fertility parametersviz. pH, EC, Organic carbon, available phosphorus and available potash were not increased significantly by different varieties. Sources of nutrition significantly influenced the soil pH, organic carbon, available phosphorus, and available potash. Recommended dose of fertilisers (RDF) increased the soil pH significantly compared to organic sources of nutrition. Organic carbon content was significantly higher under vermicompost 10t/ha and FYM 20t/ha. Higher available phosphorus was under organic sources compared to recommended dose of fertilisers. Potassium content was higher under RDF and lowest under jeevamrit. Multicut forage sorghum variety can give higher fodder yield under organic nutrition. Vermicompost 10 t/ha may begood option for producing higher sorghum fodder yield and also improve the soil health.*

***Keywords:*** Fodder yield, fodder quality, plant nutrition sources, soil fertility, sorghum

The livestock population is increasing day by day (Anon., 2018). This necessitates increasing demand for fodder. Presently, country is facing deficit of 35.6 % green fodder and 10.95% dry fodder (IGRI Vision, 2050). Condition may further be exasperated due to increasing growth of livestock particularly that of genetically improved animals.

Sorghum (*Sorghum bicolor* L. Moench) is very popular forage in most parts of north, India. It does well under both hot and dry climate. It provides good quantity as well as quality green fodder. There are single and multicut varieties and hybrids of sorghum producing 50-100 tonnes of green fodder per hectare. Sorghum fodder contains 8-10 per cent protein and also good source of calcium and phosphorus.

Inorganic or chemical fertilizers are the mostly used sources of plant nutrient worldwide which provides macro and micronutrients at different quantities. These sources played major role in agricultural production due to their positive effects on growth, development and crop yield. However, continuous and excessive use of chemical fertilisers especially to fulfil nitrogen requirement are leading to health problems, deterioration in soil quality and environmental pollution, especially of freshwater springs in the world wide. Timely availability and cost of these fertilisers is another problem faced by growers. The most use of nitrogenous fertilisers increased hydrocyanic acid (HCN) content to toxic level in sorghum (Karthika and Kalpana, 2017). To avoid these problems, ecology base natural farming is gaining importance. Biswas *et al.* (2022) concluded that combined use of FYM, vermicompost and neem cake would an effective combination of nutrient sources for achieving higher crop production. Organic agriculture is now a discussion at every crop cultivation platform. As livestock is an integral part of agriculture and farming, feeding them through organic produce will be a new topic in coming days. In comparison to other forage crop, sorghum is less input demanding and may fit well under organic forage cultivation system.

Keeping these points in mind an experiment was conducted to find out the comparative effect of different sources of nutrition on yield and quality of single and multicut forage sorghum varieties and soil fertility status in a three years cycle.

## MATERIALS AND METHODS

A field experiment was conducted during *kharif* season of 2018, 2019 and 2020 (3years) at Instructional Dairy Farm of G.B. Pant University of Agriculture and Technology, Pantnagar on fixed plots to find out the

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effect of various organic and inorganic sources of nutrition on yield and quality of single cut and multi-cut forage sorghum. The soil of experimental site was silty clay loam in texture initially having 7.2, 0.185dS $m^{-1}$ and 0.70 values of pH, EC and organic, respectively. Available nitrogen, phosphorus and potash were 280, 27.4 and 240 kg $ha^{-1}$, respectively. Treatments consisted of two factors viz. Multicut (Var. CSH 24 MF) and single cut (Var. CSV 32 F) varieties as first factor and nutrition sources namely farmer's practice (100 kg urea per ha), RDF (80:40:40 N, $P_2O_5$ and $K_2O$), Vermicompost 10 t $ha^{-1}$, FYM 20 t $ha^{-1}$., green manuring (in situ Dhaincha) and Palekar jeevamrit were laid out in factorial randomised block design with three replications. Nitrogen management for single cut and multicut was done differently. For single cut nitrogen was applied in two splits i.e 50% as basal and 50% at 35 DAS while in multicut it was applied in three splits i.e. 1/3 at basal, 1/3 at 30 DAS and 1/3 after first cut under RDF treatments. In farmer's practice 50 % urea was applied as basal and 50 % as topdressing at 35-40 DAS. Nitrogen, phosphorus and potash used were applied through urea, single super phosphate and muriate of potash, respectively. Vermicompost having 1.3 % N, 0.73% $P_2O_5$ and 0.47% $K_2O$ was applied as basal at the time of sowing. FYM containing of 0.38% N, 0.24% $P_2O_5$ and 0.47% $K_2O$ was incorporated 15 days before sowing in every year of experimentation. For green manuring treatment, dhaincha (Var. Pant Ses- 1) was sown in respective plots 60 days before sowing of sorghum and incorporated. Fresh biomass of green manure produced was on an average 29.64 t $ha^{-1}$. Both the varieties (CSH 24 MF and CSV 32 F) were sown on same date during end of June using 25 kg seeds per hectare at row spacing of 25 centimeter apart during all the experimental years. Other standard agronomical practices used for sorghum cultivation were common for all the treatment. Harvesting of single cut variety was done at 50% flowering while multicut variety was harvested at 60 DAS for first cut and for second cut it was harvested at 45 days after first cut. Content of HCN was measured at 35 days after sowing in both the varieties and crude protein was estimated through nitrogen content per cent at first cut multiply by 6.25 in both the varieties. Soil samples were taken from each plot after the harvest of both varieties after completion of 3 years cycle of experimentation. Composite soil samples were taken randomly from each plot from the depth 0-15 cm. After processing, a representative soil sample was taken for the physicochemical analysis of soil. Statistical analysis was done by applying the techniques of analysis of variance prescribed for design to test significance of the overall differences among treatments by the 'F'test and conclusion were drawn at 5 per cent probability levels (Gomez and Gomez, 1984).

## RESULTS AND DISCUSSION

### *Fodder yield*

Data presented in table-1 did not influence the green fodder yield and dry fodder yield significantly. Multicut variety gave 1.2 tonne higher green fodder yield over single cut. Higher yield in multicut was mainly because of one extra cut obtained after 45 days of first cut while a single harvest was taken in single cut variety. Various sources of nutrition significantly influenced the green and dry fodder yields. Recommended dose of fertilisers had significantly more green and dry fodder yields compared to other sources of nutrition. Among organic sources of nutrition, vermicompost (10 t $ha^{-1}$) produced only 84.4% green fodder followed by FYM (20 t $ha^{-1}$) (77.4%) and green manuring (73.4%) in comparison to RDF. Dry fodder was also significantly higher in RDF than other treatments because of higher green fodder yield. Vermicompost, FYM and green manure treatments being at par with each other were able to produce 84.3, 76.0 and 74.4% dry fodder yield of RDF. Production of fodder yields under organic sources of nutrition is near to RDF may be due to continues use of organic sources in same plot could improve the physical, chemical and biological conditions and provided good amount of nutrition to the plants. Highest production of forage sorghum at 25 t $ha^{-1}$ organic manure was also reported by Liman *et al.,* 2018. Lowest green fodder yield was recorded with application of Palekar jeevamrit which was at par with farmer's practice.

### *Fodder quality*

Prussic acid (HCN) and crude protein content are two important indicators of forage and fodder quality of sorghum. These two quality parameters were significantly influenced by varieties and sources of nutrition (Table- 1). Prussic acid (HCN) concentration in both the varieties was in safe limit (<250 ppm). Single cut variety CSV 32 F recorded significantly higher HCN content over multicut variety CSH 24 MF. Reason behind this may be due to varietal variation on HCN content. Among sources of nutrition, recommended dose of fertilisers recoded significantly higher HCN over other treatments mainly because of higher nitrogen content is rapidly supplied by RDF compared to other treatments which were organic in which nutrient release pattern is slow. Lowest HCN content with Jeevamrit, which was on par with other treatments expect RDF may be due to the lower availability of nitrogen.

**Table 1: Effect of organic and inorganic sources of nutrition on yield, HCN content, crude protein and economic of forage sorghum (Mean of 3 years)**

| Treatment | Green fodder yield (t ha$^{-1}$) | Dry fodder yield (t ha$^{-1}$) | HCN content (μg g$^{-1}$ fresh weight) | B:C ratio | Crude protein content (%) |
|---|---|---|---|---|---|
| **A. Forage varieties** | | | | | |
| Multicut (CSH 24 MF) | 43.3 | 9.5 | 76.6 | 2.27 | 7.55 |
| Single cut (CSV 32 F) | 42.1 | 9.3 | 91.1 | 2.10 | 6.42 |
| **SEm(±)** | **0.71** | **0.25** | **0.93** | **0.07** | **0.08** |
| **LSD(0.05)** | **NS** | **NS** | **2.75** | **NS** | **0.25** |
| **B. Sources of nutrition** | | | | | |
| Farmer's practice (100 kg urea ha$^{-1}$) | 36.6 | 8.0 | 82.2 | 2.82 | 6.93 |
| RDF (80:40:40)* | 55.7 | 12.1 | 89.0 | 4.36 | 7.66 |
| Vermicompost 10 t ha$^{-1}$ | 47.0 | 10.2 | 82.1 | 0.68 | 6.93 |
| FYM 20 t ha$^{-1}$ | 43.1 | 9.2 | 82.0 | 0.34 | 6.93 |
| Green manuring (Dhaincha) | 40.9 | 9.0 | 83.4 | 2.86 | 7.18 |
| Jeevamrit (Palekar) | 33.2 | 7.7 | 79.6 | 2.12 | 6.82 |
| **SEm(±)** | **1.24** | **0.45** | **1.42** | **0.11** | **0.15** |
| **LSD(0.05)** | **3.6** | **1.3** | **4.4** | **0.3** | **0.43** |

*RDF (recommended dose of fertilisers: 80:17.5:33.3 kg N: P :K ha$^{-1}$)

**Table 2: Effect of organic and inorganic sources of nutrients on soil fertility status (Mean of 3 years).**

| Treatment | pH | EC (dS m$^{-1}$) | OC (%) | Available P (kg ha$^{-1}$) | Available K (kg ha$^{-1}$) |
|---|---|---|---|---|---|
| **A. Forage varieties** | | | | | |
| Multicut (CSH 24 MF) | 7.40 | 0.157 | 0.80 | 20.86 | 159.3 |
| Single Cut (CSV 32 F) | 7.38 | 0.163 | 0.81 | 21.24 | 156.9 |
| **SEm(±)** | **0.025** | **0.004** | **0.02** | **0.32** | **1.45** |
| **LSD(0.05)** | **NS** | **NS** | **NS** | **NS** | **NS** |
| **B. Sources of nutrition** | | | | | |
| Farmer's practice (100 kg urea ha$^{-1}$) | 7.40 | 0.159 | 0.68 | 19.50 | 153.2 |
| RDF (80:40:40) | 7.54 | 0.174 | 0.74 | 20.12 | 165.4 |
| Vermicompost 10 t ha$^{-1}$ | 7.30 | 0.154 | 0.81 | 22.41 | 160.9 |
| FYM 20 t ha$^{-1}$ | 7.31 | 0.166 | 1.01 | 23.10 | 159.3 |
| Green manuring (Dhaincha) | 7.42 | 0.165 | 0.96 | 21.44 | 158.5 |
| Jeevamrit (Palekar) | 7.39 | 0.141 | 0.64 | 19.74 | 151.3 |
| **SEm(±)** | **0.044** | **0.008** | **0.04** | **0.55** | **2.52** |
| **LSD(0.05)** | **0.13** | **NS** | **0.11** | **1.62** | **7.39** |

Crude protein was significantly higher in multicut than single cut variety. Sources of nutrition influenced the crude protein similar as in case of HCN. Highest crude protein was estimated under RDF compared with other treatments. Rest of treatments were at par with each other in terms of crude protein content. Higher nitrogen availability in RDF is the main reason for higher crude protein content in sorghum. Similar results were obtained by Pholsen and Suksri (2004).

***Soil Fertility status***

Sorghum varieties did not significantly influenced the soil pH, EC, OC, available P and available K while sources of nutrition had significant influenced on these parameters except EC where difference between the treatments was found non-significant. RDF being at par with green manuring recorded significantly higher pH compared to other treatments. Organic sources of nutrition help in minimising the soil pH may be due to

release of carbonic acid during decomposition. Because of this reason comparatively lower soil pH value was observed under organic sources of nutrition. Lower pH over RDF was also observed by Gour *et al.*(2015). Significantly higher amount of organic carbon per cent was with farm yard manure application except green manuring where difference was found non- significant. Jeevamrit recorded lowest organic carbon content. Available P was significantly higher under use of farmyard manure and vermicompost. Available P was lower under farmers' practice followed by jeevamrit. Higher available K was with RDF which was at par with vermicompost, farmyard manure and green manuring but significantly higher than farmers practice and jeevamrit treatments. Similar results were also noticed by Gour *et. al.* (2015) in rice crop under organic and inorganic source of nutrition. Higher physical, chemical and biological properties of soil were also reported by Sharma *et al.*, 2022.

***Economics***

Benefit:cost ratio was not significantly influenced by sorghum varieties while sources of nutrition had significant effect on benefit : cost ratio (Table 1). Multicut sorghum variety gave higher economics over single cut variety. Higher B : C ratio in multicut was because of higher green fodder yield. Among the sources of nutrition RDF treatment was economically superior and recorded highest B:C ratio because of green fodder yield. Lower B:C ratio under bulk organic sources of nutrition is mainly because of higher cost.

Multicut forage sorghum variety gave higher green and dry fodder yield under different sources of nutrition compare to single cut variety. Vermicompost 10 t $ha^{-1}$ followed by FYM 20 t $ha^{-1}$ can be an alternative sources of nutrition of RDF by giving very close green and dry fodder yield of sorghum and are good for maintaining soil health but it would be economical only when these two sources are prepare at farm level. Purchasing of bulk organic manure increases cost of cultivation.

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