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RESPONSE OF FOLIAR NUTRITION ON YIELD AND QUALITY OF FORAGE CROPS IN SUMMER SEASON

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SUMMARY

A field experiment was carried out at CCS HAU, Regional Research Station, Bawal during summer 2020 and 2021 laid out in split plot design with three replications, comprised of three forage crops (sudan grass, sorghum and maize) in main-plots and four nutrient combinations (RDF, RDF + Foliar spray of zinc sulphate (0.5%) + urea (2%) at 30, 45 DAS and 25 days after first cut, RDF + Foliar spray of ferrous sulphate (0.5%) + urea (2%) at 30, 45 DAS and 25 days after first cut and RDF + Foliar spray of zinc sulphate (0.5%) + ferrous sulphate (0.5%) + urea (2%)) at 30, 45 DAS and 25 days after first cut) in sub-plots. Soil of the experimental site was sandy loam in texture low in N, P and medium in K, with slightly alkaline in reaction (pH – 8.2). Among the fodder crops the green and dry fodder yield of maize was significantly higher over sudan grass and sorghum which was 22.1 and 22.2 % higher over sorghum and 10.4 and 10.5 % higher over sudan grass in respect of green and dry fodder, respectively. Among foliar nutrient management, RDF + Foliar spray of zinc sulphate (0.5%) + ferrous sulphate (0.5%) + urea (2%) at 30, 45 DAS and 25 days after first cut recorded significantly higher green fodder yield over rest of the treatments. Similar trend was found in case of dry matter yield, N content, crude protein content and crude protein yield. Net return in maize was higher to the tune of 31.6 and 74.1 % over sudan grass and sorghum, respectively. The B:C ratio was highest in maize (1.72) over sudan grass (1.54) and sorghum (1.42). Among foliar nutrient management higher Net return of Rs. 26273/ha was incurred in RDF + Foliar spray of zinc sulphate (0.5%) + ferrous sulphate (0.5%) + urea (2%) at 30, 45 DAS and 25 days after first cut over rest of the treatments. Similar trend was found in case of B:C ratio (1.69). Significantly higher available P, Zn and Fe content was found under RDF + Foliar spray of zinc sulphate (0.5) + ferrous sulphate (0.5%) + urea (2%) at 30, 45 DAS and 25 days after first cut over rest of the treatments, except Zn and Fe where it was at par with alone application of Zn and Fe, respectively.

Key words: Forage crops, foliar nutrition, yield, quality, and economics

In Indian agriculture, livestock plays a vital role in the development and progress of mankind with crop production program as a complementary enterprise. Marginal farmers may have limited opportunities to cultivate green fodder, particularly during the lean season, where owning livestock is an alternate income generator. It has been observed that imbalanced feeding with special reference to green fodder has tarnished the production potential of animals which in turn, affects the interest of dairy farmers due to low margin of profit leading to a nasty cycle. Therefore, to increase the production of dairy animals a reality, the availability of sufficient and economically balanced feed and fodder needs utmost attention as it affects both the quantity and quality of milk (Khadda *et al.,* 2015). The efficiency of milch as well as drought animals largely depends upon the supply of quantity and quality of fodder in which green fodder plays a vital role. In the recent years, shortage of fodder has remained the burning problem of the state which calls for the attention of scientists to initiate efforts that can ensure regular fodder supply for development of dairy farming and improving our cattle wealth (Khadda *et al.,* 2021). The agronomic information regarding suitability of varieties and their responses to nutrient and water is lacking in central part of India. Studying the effects of zinc and iron application in fodder sorghum is important for nutrient deficiency correction. Zinc and iron deficiencies are common in many soils, particularly in areas with alkaline or acidic soils or where intensive farming practices have depleted soil nutrients. Understanding how these micronutrients affect fodder sorghum growth and productivity can help to develop strategies to correct

deficiencies and optimize crop yields. The productivity of green fodder per unit area could be increased by adopting recommended scientific and sustainable packages and practices using a suitable high yielding variety. Keeping in view the present investigation attempts to study the effect of foliar application of nutrients on yield and quality of green fodder.

MATERIALS AND METHODS

A field experiment was carried out at CCS HAU, Regional Research Station, Bawal during summer 2020 and 2021 consisting of 12 treatment combinations laid out in split plot design with three replications, comprised of three forage crops (sudan grass, sorghum and maize) in main-plots and four nutrient combinations (RDF, RDF + Foliar spray of zinc sulphate (0.5%) + urea (2%) at 30, 45 DAS and 25 days after first cut, RDF + Foliar spray of ferrous sulphate (0.5%) + urea (2%) at 30, 45 DAS and 25 days after first cut and RDF + Foliar spray of zinc sulphate (0.5%) + ferrous sulphate (0.5%) + urea (2%)) at 30, 45 DAS and 25 days after first cut) in sub-plots. The forage crops were sown for fodder purpose in last week of March during both the years. The soil of experimental field was low in organic matter (0.21%) and available nitrogen (118 kg/ha) and medium in available phosphorus (11.5 kg/ha) and available potassium (148 kg/ha). The recommended dose of fertilizer (75 kg N+30 kg P2O5 /ha) was applied to the forage crops (sorghum and maize) and an additional dose of 25 kg N/ha after first cut in case of sudan grass. The dry matter percentage of fodder was calculated by measuring the weight of the fodder before and after drying, then dividing the weight of the dry matter by the weight of the initial sample and multiplying by 100 to get the percentage. Data on green fodder yield of crops were recorded from time to time; economics and benefit cost (B:C) ratio was worked out by simple tabular analysis.

RESULTS AND DISCUSSION

Fodder yield and quality

The perusal of pooled data (2020-21) in Table 1 reveals that among the fodder crops the green and dry fodder yield of maize (616.6 and 219.7 q/ha) was significantly higher over sudan grass (558.3 and 198.9 q/ha) and sorghum (504.8 and 179.8 q/ha) which was 22.1 and 22.2 % higher over sorghum and 10.4 and 10.5 % higher over sudan grass in respect of green fodder and dry fodder yield, respectively. Nitrogen content (%) in maize (1.15) was significantly higher over sudan grass (1.03) and sorghum (0.93). Better yield of maize over sudan grass and sorghum was probably due to the fact that this crop had higher vigour. Similar trend was found in case of crude protein content and crude protein yield. These results are in accordance with the findings of Satpal *et al*. (2020).

TABLE 1
Effect of foliar spray of nutrients on fodder yield and quality in forage crops (pooled mean of 2 years)

Treatments	Green fodder yield (q/ha)	Dry fodder yield (q/ha)	N content (%)	Crude protein content (%)	Crude protein yield (q/ha)
Forage crops					
Sudan grass	558.3	198.9	1.03	6.41	12.82
Sorghum	504.8	179.8	0.93	5.83	10.55
Maize	616.6	219.7	1.15	7.16	15.76
CD (p=0.05)	10.2	3.4	0.11	0.06	0.33
Foliar nutrient management					
Control (RDF)	517.7	184.5	0.96	5.99	11.16
RDF + Foliar spray of zinc sulphate (0.5%) + urea (2%) at 30, 45 DAS and 25 days after first cut	547.2	194.9	1.02	6.35	12.47
RDF + Foliar spray of ferrous sulphate (0.5%) + urea (2%) at 30, 45 DAS and 25 days after first cut	562.1	200.2	1.03	6.44	12.99
RDF + Foliar spray of zinc sulphate (0.5%) + ferrous sulphate (0.5%) + urea (2%) at 30, 45 DAS and 25 days after first cut	612.6	218.3	1.14	7.09	15.56
CD (p=0.05)	10.5	3.8	0.02	0.09	0.31

TABLE 2
Effect of foliar spray of nutrient on economics of different treatments (pooled mean of 2 years).

Treatments	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	B:C ratio
Forage crops				
Sudan grass	38050	58639	20589	1.54
Sorghum	37450	53010	15560	1.42
Maize	37650	64742	27092	1.72
Foliar nutrient management				
Control (RDF)	36867	54366	17500	1.48
RDF + Foliar spray of zinc sulphate (0.5%) + urea (2%) at 30, 45 DAS and 25 days after first cut	37967	57443	19477	1.51
RDF + Foliar spray of ferrous sulphate (0.5%) + urea (2%) at 30, 45 DAS and 25 days after first cut	37967	59039	21073	1.56
RDF + Foliar spray of zinc sulphate (0.5%) + ferrous sulphate (0.5%) + urea (2%) at 30, 45 DAS and 25 days after first cut	38067	64339	26273	1.69

Among foliar nutrient management, RDF + Foliar spray of zinc sulphate (0.5%) + ferrous sulphate (0.5%) + urea (2%) at 30, 45 DAS and 25 days after first cut recorded significantly higher green fodder yield (612.6 q/ha) over rest of the treatments. The green fodder yield was 18.8 % higher under RDF + Foliar spray of zinc sulphate (0.5%) + ferrous sulphate (0.5%) + urea (2%) at 30, 45 DAS and 25 days after first cut over control (RDF). Similar trend was found in case of dry matter yield, N content, crude protein content and crude protein yield. The higher green and dry fodder yield was due to application of zinc and iron which can be attributed to the role of these micronutrients in enhancing plant growth and development. The above observations on yield parameters are corroborated by the findings of Kumar *et al*. (2019) and Durgude *et al*. (2019).

ECONOMICS

A quick view of data presented in Table 2 indicates that gross return (Rs. 64742), net return (Rs. 27092) and B:C ratio (1.72) was obtained highest in maize which was higher over sudan grass and sorghum. Net return in maize was higher to the tune of 31.6 and 74.1 % over sudan grass and sorghum, respectively. The B:C ratio was highest in maize (1.72) over sudan grass (1.54) and sorghum (1.42). Among foliar nutrient management higher gross return of Rs. 64339/ha was incurred in RDF + foliar spray of zinc sulphate (0.5%) + ferrous sulphate (0.5%) + urea (2%) at 30, 45 DAS and 25 days after first cut over rest of the treatments. Similar trend was found in case of net return (Rs 26273/ha) and B:C ratio (1.69). Akhila *et al.* (2021) also reported that maximum gross return,

TABLE 3
Effect of foliar spray of nutrient on P, K, Zn and Fe content in leaves sample of forage crops (pooled mean of 2 years).

Treatments	Available P (%)	Available K (%)	Available Zn (ppm)	Available Fe (ppm)
Forage crops				
Sudan grass	0.130	1.058	0.832	0.56
Sorghum	0.132	1.062	0.829	0.57
Maize	0.132	1.061	0.832	0.56
CD (p=0.05)	NS	NS	NS	NS
Foliar nutrient management				
Control (RDF)	0.130	1.059	0.802	0.54
RDF + Foliar spray of zinc sulphate (0.5%) + urea (2%) at 30, 45 DAS and 25 days after first cut	0.131	1.059	0.849	0.54
RDF + Foliar spray of ferrous sulphate (0.5%) + urea (2%) at 30, 45 DAS and 25 days after first cut	0.132	1.061	0.812	0.58
RDF + Foliar spray of zinc sulphate (0.5) + ferrous sulphate (0.5%) + urea (2%)) at 30, 45 DAS and 25 days after first cut	0.133	1.061	0.860	0.60
CD (p=0.05)	0.002	NS	0.019	0.02

net return and B: C ratio of sorghum was obtained in plots where foliar spray of 0.5% $ZnSO_4$ at two stages (25 and 45 DAS) was done along with RDF. More and less similar results due to foliar spray of potassium nitrate has amply been documented by Satyajeet *et al.* (2018). Singh *et al.* (2022) also corroborated these findings.

Nutrient analysis

Fodder crops did not differ significantly among themselves in respect of available P, K, Zn and Fe content in leaves samples. Significantly higher available P, Zn and Fe content was found under RDF + Foliar spray of zinc sulphate (0.5) + ferrous sulphate (0.5%) + urea (2%) at 30, 45 DAS and 25 days after first cut over rest of the treatments, except Zn and Fe where it was at par with alone application of Zn and Fe, respectively. Significantly higher Zn (0.860 ppm) and Fe (0.60 ppm) content in leaves samples was found under RDF + Foliar spray of zinc sulphate (0.5) + ferrous sulphate (0.5%) + urea (2%) at 30, 45 DAS and 25 days after first cut over RDF alone (Table 3). Foliar spray of nutrients enhanced the nutritional quality of fodder by increasing the micronutrient content in the plant tissue. Optimal levels of zinc and iron ensure efficient nutrient uptake and utilization, supporting vigorous growth and development and quality in sorghum crops. Similar results have been reported by Kumar *et al*. (2019), Asif *et al.* (2020) and Sewhag *et al*. (2023).

CONCLUSION

Based on field study it may be concluded that among the fodder crops the green fodder yield of maize was significantly higher over sudan grass and sorghum. Foliar spray of zinc sulphate (0.5%) + ferrous sulphate (0.5%) + urea (2%) along with RDF at 30, 45 DAS and 85 DAS recorded statistically higher green fodder yield. It improves quality of fodder and was also found most economical. The finding suggested that the foliar application of zinc sulphate and ferrous sulphate can be an alternative approach to enhance quality of fodder during summer season.

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