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SHORT COMMUNICATION

EFFECT OF MULTI-CUT FORAGE SORGHUM GENOTYPES AND FERTILITY LEVELS ON NUTRIENT UPTAKE AND SOIL NUTRIENT BALANCE

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SUMMARY

A field experiment was conducted during the *zaid* season of 2013 at Udaipur, Rajasthan on clay loam soil to assess the effect of fertility levels on multi-cut genotypes of forage sorghum. Among genotypes, fodder produced by genotype SPH 1697 accumulated significantly higher nitrogen, phosphorus and potassium in both the cuttings as well as total compared to genotypes SPH 1698, CSH 20 MF, CSH 24 MF and SSG 59-3. The multi-cut genotypes resulted in negative nitrogen and positive phosphorus and potassium balance over initial status. The crop fertilized with 100 per cent RDF accumulated significantly higher quantum of nitrogen, phosphorus and potassium in fodder during both the cuttings thereby total over control and lower fertility levels. The nitrogen, phosphorus and potassium status of soil after crop harvest was significantly improved with the application of 75 and 100 per cent RDF. Further crop under the influence of 50, 75 and 100 per cent RDF reduced net nitrogen loss but increased net gain of phosphorus and potassium in soil over initial.

Key words : Fertility levels, nutrient uptake, soil nutrient balance, multi-cut sorghum

India supports nearly 20 per cent of the world's livestock and 16.8 per cent human population with only 2.3 per cent of the world's geographical area. It is the leader of cattle (16%) and buffalo (55%) population which contributes 32 per cent of the agricultural output which is 27 per cent of total GDP. It is expected to rise to 50 per cent by 2020 (Agriculture Statistics, 2010). In India, there is short supply of about 38 per cent green fodder especially during summer season. Sorghum is the important forage crop grown for green as well as dry forage production. It is fast growing, palatable, nutritious and utilized as silage and hay besides fresh feeding. The available varieties were of single cut type and were not suitable for their distribution of fodder for longer period of the year. Considering this, multi-cut genotypes were developed for continuous supply of green fodder for longer period. These multi-cut genotypes have high nutritive value and possess a wide range of ecological adaptability because of their zerophytic characteristics. The new multi-cut genotypes of sorghum fodder are heavy feeder of nutrients from the soil. These genotypes are responding well to high doses of fertilizer. Keeping the above points in view, an experiment was conducted to assess the effect of multi-cut forage sorghum genotypes and fertility levels on nutrient uptake, soil nutrient status after crop harvest and its balance.

A field experiment was conducted during *zaid* season of 2013 at Instructional Farm, Rajasthan College of Agriculture, Udaipur (Rajasthan) situated at 24º34' N latitude, 73º42' E longitude and altitude of 579.5 m above mean sea level. The soil of the experimental field was clay loam in texture, slightly alkaline in reaction (pH 8.0), medium in available nitrogen (295.3 kg/ha) and phosphorus (16.6 kg/ha) while high in available potassium (270.7 kg/ha). The experiment consisted of 20 treatment combinations comprising five multi-cut forage sorghum genotypes (SPH 1697, SPH 1698, CSH 20 MF, CSH 24 MF and SSG 59-3) and four fertility levels viz., control, 50 per cent recommended dose of fertilizer (RDF), 75 per cent RDF and 100 per cent RDF (80 kg N+40 kg P_2O_5+40 kg K_2O/ha). These treatments were tested in factorial randomized block design with three replications. As per treatment, full dose of

phosphorus and potassium and one-third dose of nitrogen was applied at the time of sowing. Remaining nitrogen dose was splitted into two equal parts, first half was applied at knee high stage while second half at 30 days after first cutting. The sorghum genotypes as per treatment were sown on 25 April 2013 in opened furrows at 30 cm apart using seed rate of 40 kg/ha. A plant to plant distance of 10 cm was maintained by thinning and gap filling operation at 15 DAS. The crop was irrigated at 10-15 days interval as per need during summer. Other agronomic and plant protection measures were adopted as and when crop needed. The net gain or loss of the nutrient was calculated on the basis of following formula (Initial soil status – Soil status after crop harvest).

Nutrient Uptake

An examination of data (Table 1) reveals that fodder produced due to genotype SPH 1697 at par with CSH 20 MF and both accumulated significantly higher quantum of nitrogen, phosphorus and potassium in 1st cut, while in 2nd cut, genotype SPH 1697 recorded highest nitrogen, phosphorus and potassium uptake which was significantly higher over other genotypes under test. Thus, when compared to CSH 20 MF, SPH 1698, CSH 24 MF and SSG 59-3, genotype SPH 1697 significantly enhanced total nitrogen uptake by 5.5, 19.2, 31.5 and 79.4 per cent, phosphorus uptake by 4.8, 18.0, 29.5 and 77.0 per cent and potassium uptake by 5.8, 17.5, 28.6 and 76.6 per cent. This improvement in nutrient status of fodder under genotype SPH 1697 must be due to their genetic make-up. Further greater availability of nutrient with genotype SPH 1697 seemed to have critical concentration of these nutrients at cellular level and fulfilled their requirement and efficient translocation in various plant parts. As the uptake is a product of fodder yield and nutrient content, considerable increase in either of components may increase nitrogen, phosphorus and potassium uptake. The results are in close conformity with the findings of Rana *et al*. (2012) and Duhan (2013).

Data further show that fertility levels had significant influence of nutrient uptake. The crop under the influence of 100 per cent RDF accumulated significantly higher nitrogen, phosphorus and potassium in fodder during both the cuttings as well as total of these over control, 50 and 75 per cent RDF application. The corresponding increase in total nitrogen uptake due to 100 per cent RDF was 102.0, 45.1 and 13.1 per cent, respectively, while the extent of increase in total phosphorus and potassium uptake was 97.9, 45.0, 13.3 and 113.3, 55.2, 16.0 per cent, respectively. The magnitude of difference in nitrogen, phosphorus and potassium uptake between 50 and 75 per cent RDF was also significant. It is well established fact that uptake of nutrient by crop is primarily governed by total biomass production and secondly nutrient concentration at cellular level. Thus, improvement in both these factors under

TABLE 1
Effect of multi-cut sorghum genotypes and fertility levels on nutrient uptake

Treatment	N uptake (kg/ha)			P uptake (kg/ha)			K uptake (kg/ha)		
	1st cut	2nd cut	Total	1st cut	2nd cut	Total	1st cut	2nd cut	Total
Genotypes									
SPH 1697	151.4	74.6	226.0	29.3	14.6	43.9	155.0	79.9	234.9
SPH 1698	122.1	67.5	189.6	23.9	13.3	37.2	127.4	72.5	199.9
CSH 20 MF	146.6	67.6	214.2	28.6	13.3	41.9	150.2	71.9	222.1
CSH 24 MF	102.9	69.0	171.9	20.3	13.6	33.9	108.5	74.1	182.6
SSG 59-3	72.5	53.5	126.0	14.1	10.7	24.8	74.8	58.2	133.0
S. Em±	2.75	1.49	4.07	0.54	0.28	0.67	2.77	1.56	4.04
C. D. (P=0.05)	7.87	4.27	11.65	1.55	0.82	1.92	7.93	4.48	11.57
Fertility levels									
Control	76.3	44.4	120.7	15.2	8.9	24.1	77.9	45.0	122.9
50% RDF	107.3	60.7	168.0	21.0	11.9	32.9	106.4	62.5	168.9
75% RDF	138.3	77.2	215.5	27.1	15.0	42.1	143.0	83.0	226.0
100% RDF	157.4	86.4	243.8	30.7	17.0	47.7	166.4	95.8	262.2
S. Em±	2.46	1.34	3.64	0.48	0.25	0.60	2.48	1.40	3.61
C. D. (P=0.05)	7.03	3.83	10.42	1.39	0.73	1.72	7.10	4.00	10.35

100 per cent RDF application resulted in higher uptake of added nutrients. Similar results were also reported by Sathiya *et al*. (2013).

Soil Nutrient Balance

The genotypes (Table 2) failed to influence nitrogen, phosphorus and potassium status of soil at the end of crop season or cuttings. The highest nitrogen, phosphorus and potassium content in soil was noted under application of 100 per cent RDF registering significant increase over 50 per cent RDF and control but at par with 75 per cent RDF. Amongst genotypes, net loss of nitrogen was highest under varieties SPH 1697 and SPH 1698. Whereas net gain of phosphorus and potassium was higher in genotype CSH 20 MF.

A negative nitrogen, phosphorus and potassium balance was observed in unfertilized control treatment. Multi-cut forage sorghum genotypes fertilized with 100 per cent RDF recorded less net nitrogen loss of – 33.5 as against – 36.5 and – 50.5 noted under 75 and 50 per cent RDF, respectively. A net gain of phosphorus and potassium over initial phosphorus and potassium status was higher under 100 per cent RDF application indicating balanced amount of nutrients is essential for soil health sustainability and production of sorghum crop.

TABLE 2
Balance sheet of available N, P and K (kg/ha) in soil as influenced by different treatments

Treatment	Total available nutrients (kg/ha) (initial+added)			Soil status crop harvest (kg/ha)			Net gain (+)/loss (-) nutrient in soil (kg/ha)		
	N	P	K	N	P	K	N	P	K
Genotypes									
SPH 1697	340.3	26.3	286.4	242.6	17.3	285.7	– 52.7	+ 0.7	+ 10.0
SPH 1698	340.3	26.3	286.4	242.8	17.8	285.9	– 52.5	+ 1.2	+ 10.2
CSH 20 MF	340.3	26.3	286.4	247.0	17.8	287.8	– 48.3	+ 1.2	+ 12.1
CSH 24 MF	340.3	26.3	286.4	247.4	17.5	278.6	– 47.9	+ 0.9	+ 2.9
SSG 59-3	340.3	26.3	286.4	245.7	17.1	286.6	– 49.6	+ 0.5	+ 10.9
S. Em±	–	–	–	2.28	0.24	2.88	–	–	–
C. D. (P=0.05)	–	–	–	NS	NS	NS	–	–	–
Fertility levels									
Control	295.3	16.6	275.7	214.8	15.1	244.1	– 80.5	–1.5	–31.6
50% RDF	335.3	25.2	292.3	244.8	17.5	286.4	– 50.5	+ 0.9	+ 10.7
75% RDF	355.3	29.5	300.6	259.0	18.5	298.4	– 36.3	+ 1.9	+ 22.7
100% RDF	375.3	338	308.9	261.8	18.9	310.8	– 33.5	+ 2.3	+ 35.1
S. Em±	–	–	–	2.04	0.21	2.58	–	–	–
C. D. (P=0.05)	–	–	–	5.81	0.61	7.34	–	–	–

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