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Nutrient uptakes of Sorghum crop influenced by top dressing and foliar appliaction of organic nutrient sources

KEYWORDS

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ABSTRACT *A field experiment entitled "Effect of top dressing and foliar application of organic nutrient sources on growth and yield of sorghum" was conducted during kharif, 2012 at Student farm, College of Agriculture, Rajendranagar, Hyderabad, Southern Telangana climatic Zone of Andhra Pradesh. The soil of experimental site was sandy clay loam with pH of 7.9, electrical conductivity 0.96 dSm-1, low in organic carbon (0.69%), low in available nitrogen (221 kg ha-1) and high in phosphorus (86 kg ha-1) and high in potassium (446 kg ha-1). The experiment was laid out in randomized block design with nine treatments and three replications. The results of the experiment indicated significant influence of organic nutrient management on nutrient uptakes. The Nutrient uptake (N, P and K) by crop at 60 days to harvest stages was higher with application of foliar spray of fulvic acid @ 1% (T8) on par with top dressing of vermicompost @ 5 t ha-1(T2).*

Introduction

Sorghum is the fifth most important cereal crop and is the dietary staple of more than 500 million people in 30 countries. It is grown in an area of 40 million ha in 105 countries of which USA, India, México, Nigeria, Sudan and Ethiopia are the major sorghum producers. Its stover is an increasingly important source of dry season fodder for livestock, especially in Asia. Global sorghum area trends indicate that area increased from 45 million ha in 1970s to 51 million ha in 1980s. Later there was fluctuation in area by 4 to 10 million ha and it declined to 40 million ha by 2009. Grain yields have increased from 1200 kg ha^{-1} in 1970s to 1400 kg ha^{-1} in 2009.

The sorghum area in India was more than 16 million ha in 1981, but has gradually decreased to 7.8 million ha in 2007-08 (still 20 % of the world's sorghum area). Of this, 3.5 million ha was grown in the rainy (*kharif*) season and 4.3 million ha in the post-rainy (*Rabi*) season. Production increased from 9 million tonnes in early 1970s to 12 million tonnes in early 1980s and maintained this level for over a decade until early 1990s, followed by a steep decline to 7.3 million tonnes. Despite the decrease in area over the years, production has been sustained at 7.3 million tonnes (2009) mainly due to adoption of improved varieties and hybrids. Sorghum grain yields in India have averaged 1170 kg ha^{-1} in the rainy season and 880 kg ha^{-1} in the post-rainy season in recent years. (www.icrisat.org/sorghum.htm).

Organic agriculture is one of the ways that can produce high quality crops (Higa, 1994). Organic manures also play an important role in maintaining a high level of soil fertility. The positive influence of organic fertilizers on soil fertility, crop yield and quality has been demonstrated in the works of many researchers (Naeem *et al., 2006*).

Among the organic fertilizers vermicompost is rich in all essential plant nutrients and provides excellent effect on overall plant growth encourages growth of new shoots/leaves and improves the quality and shelf life of the produce (en.wikipedia.org./vermicompost).

Natural organic substances such as humic and fulvic acids play an essential role in ensuring soil fertility and plant nutrition. Addition of such molecules either to the soil or through foliar spray along with adequate amount of conventional fertilizers improves the efficiency of applied fertilizers apart from promoting the conversion of unavailable form of nutrients to available forms. The organic compounds prepared from humic and fulvic substances have chelating, plant growth stimulating effects and positive effect on the growth of various groups of microorganisms.

Material and Methods

The investigation "Effect of top dressing and foliar application of organic nutrient sources on growth and yield of Sorghum" was conducted during *kharif*, 2012 at student farm, College of Agriculture, Rajendranagar, Hyderabad, Southern Telangana climatic Zone of Andhra Pradesh. The soil of experimental site was sandy clay loam with pH of 7.6, Electrical conductivity 0.65 dSm^{-1}, low in organic carbon (0.69 %), low in available nitrogen (276 kg ha^{-1}) and high in phosphorus (149.32 kg ha^{-1}) and high in potassium (411.26 kg ha^{-1}). The experiment was laid out in randomized block design of nine treatments and three replications. T_1 - Top dressing of vermicompost @ 2.5 t ha^{-1},T_2 - Top dressing of vermicompost @ 5 t ha^{-1}, T_3 - Foliar spray of vermiwash @ 1%, T_4 - Foliar spray of vermiwash @ 2%, T_5 – Foliar spray of humic acid @ 0.5%, T_6 – Foliar spray of humic acid @ 1%, T_7 - Foliar spray of fulvic acid @ 0.5%, T_8 - Foliar spray of fulvic acid @ 1%, T_9 - Control (80:40:40 N, P_2O_5 and K_2O kg ha^{-1} through fertilizers). *Insitu* Green manuring with sunhemp and basal application of FYM @ 3 t ha^{-1} and neem cake @ 0.5 t ha^{-1} is done commonly to all treatments except control. Top dressing of vermicompost and foliar spray of organic nutrient sources are done in two splits i.e at maximum vegetative stage (40-45 DAS) and flowering stage (60- 65 DAS). Sorghum hybrid (CSH-9) was sown on 27th of June adopting a spacing 45 x 15 cm. In general the climatic conditions were congenial during crop growth period and incidence of pest and disease attack was not noticed to a greater extent. The salient findings of the experiment are summarized here under.

The observations on nutrient uptakes parameters *viz.*, nitrogen, phosphorus and potassium at 30, 60, 90 DAS and at harvest were taken.

Results and Discussion

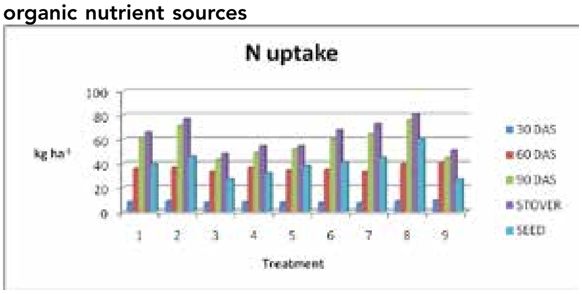
The effect of treatments on nitrogen uptake

At 30 DAS N uptake has not differed significantly with treatments. At 60 DAS N uptakes was significantly higher with application of foliar spray of fulvic acid @ 1% (T_8) over other treatment and on par with top dressing of vermicompost @ 5 t ha^{-1} (T_2) and foliar spray of vermiwash @ 2% (T_4). At 90 DAS and harvest N uptake was significantly higher with application of foliar spray of fulvic acid @ 1% (T_8) over all other treatment and which was on par with top dressing of vermicompost @ 5 t ha^{-1} (T_2) both in grain and stover.

Higher nitrogen uptake was mainly due to adequate supply of nitrogen. Nitrogen application increases the availability of nitrogen thus resulting in higher nitrogen uptake and higher nitrogen content in plant. This is might be due to more rapid increase in dry matter accumulation with nitrogen supply. Similar trend in the uptake pattern of nitrogen was also noticed by Tripathi and Karla (1980). Further, increase nitrogen uptake was due to efficient root system with improved permeability coupled with better absorption due to better availability of nutrients in the soil solution (Sumathi and Rao, 2007).

The nutrient content in the plant reduced sharply at 60 days after sowing which coincided with grain forming stage of the crop. This reduction could possibly be attributed to the senescence of lower leaves and the translocation of the nutrients from the young leaves to the panicle through the stems. The NPK content in the stem was also low at grain filling than in the flowering stage. Obviously, this reduction also owe to their translocation to the sink. At maturity, most of the leaves senesced and were not functional. This was in confirmation with the findings of Yadava *et al.* (1998), Amruthavalli and Reddy (2000) and Thavaprakash *et al.* (2002).

N uptake (kg ha^{-1}) of sorghum as influenced by different organic nutrient sources

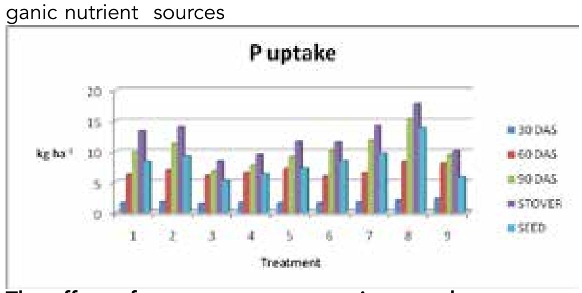


The effect of treatments on phosphorus uptake

At 30 days after sowing P uptake was not significantly differed between all treatments. P uptake was significantly high with application of foliar spray of fulvic acid @ 1% (T_8) over other treatment and on par with foliar spray of humic acid @ 0.5 % (T_5) at 60 days after sowing. At 90 DAS and at harvest phosphorus uptake was significantly high with foliar spray of fulvic acid @ 1% (T_8) over other treatments followed by foliar spray of fulvic acid @ 0.5% (T_7) which was on par with top dressing of vermicompost @ 5 t ha^{-1}(T_2), top dressing of vermicompost @ 2.5 t ha^{-1}(T_1), foliar spray of humic acid @ 0.5% (T_5) and foliar spray of humic acid @ 1% (T_6).

A linear trend in P availability was observed for graded dose of humic acid till the end of crop growth period. However the increase in the availability of P could be attributed to chemical and biological process involved. The humic acid and fulvic acid might have helped in solubilizing P from insoluble to soluble form resulting in its increase. Similar increase was reported by Khan *et al.*, (1997). Pal and Sengupta (1985) observed that the when black soil was incubated with humic acid, the P availability increased. The reason attributed was phosphate ions were expected to interact with humic acid and fulvic acid more through its phenolic and hydroxyl group which might have changed the behaviour of P. The increase in P availability might also be due to the mineralization of soil organic P (Dusberg *et al.* 1989) as well as humic acid (Vaughan and Ord, 1985).

P uptake (kg ha^{-1}) of sorghum as influenced by different organic nutrient sources

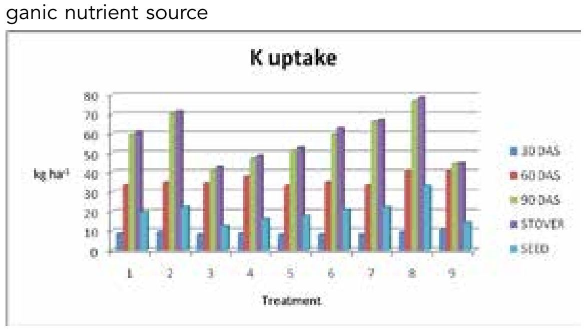


The effect of treatments on potassium uptake

At 30 days after sowing potassium uptake was not significantly differed between all treatments. At 60, 90 DAS and at harvest K uptake was significantly higher with foliar spray of fulvic acid @ 1% (T_8) over all other treatment and was on par with top dressing of vermicompost @ 5 t ha^{-1}(T_2) at 90 days after sowing and in stover at harvest. Uptake K by grain was significantly higher with foliar spray of fulvic acid @ 1% (T_8) followed by top dressing of vermicompost @ 5 t ha^{-1}(T_2) and foliar spray of fulvic acid @ 1% (T_7) which are on par with each other.

The humic acid and fulvic acids are believed to play a definite role in liberating fixed K because of their chelating power. In addition, the lower molecular weight fractions of humic compounds are capable of penetrating the intermicellar spaces of expanding types of clays and reach the specific sorption sites for K, where they might react or compete for sites with K and increases its availability in soil observed by (Schnitzer and Kodama, 1972 and Tan and McCreery, 1975). The enhanced microbial activity due to humic acid application would also have paved way for increased availability of K through reducing its fixation in the soil and dissolution of fixed K. Tan (1978) reported that, at pH 7.0, humic and fulvic acids were capable of dissolving small amounts of K from the minerals by chelating action, complex reactions or both.

K uptake (kg ha^{-1}) of sorghum as influenced by different organic nutrient source



Conclusions:

The observations on nutrient uptake studies included nitrogen, phosphorus and potassium uptake at 30, 60, 90 DAS and at harvest. Nitrogen, phosphorus and potassium uptake at intial stage was not significantly influenced by treatments where as at 60,90 DAS and at harvest foliar spray of fulvic acid @ 1% (T_8) on par with top dressing of vermicompost @ 5 t ha^{-1} (T_2).

Table 1. N uptake (kg ha^{-1}) of sorghum as influenced by different organic nutrient sources

Treatment	N uptake (kg ha^{-1})				
	30 DAS	60 DAS	90 DAS	At harvest stover	At harvest grain
T_1-Top dressing of vermicompost @ 2.5 t ha^{-1}	8.0	35.6	61.5	66.1	39.7
T_2-Top dressing of vermicompost @ 5 t ha^{-1}	8.4	36.9	71.4	76.9	45.8
T_3-Foliar spray of vermiwash @ 1 %	7.3	33.3	43.3	48.2	26.9
T_4-Foliar spray of vermiwash @ 2 %	7.9	36.6	49.1	54.6	32.2
T_5-Foliar spray of humic acid @ 0.5 %	7.4	34.3	51.8	54.7	37.8
T_6-Foliar spray of humic acid @ 1 %	7.1	35.0	60.4	68.0	41.0
T_7-Foliar spray of fulvic acid @ 0.5%	6.9	33.4	64.6	73.1	44.9
T_8-Foliar spray of fulvic acid @ 1 %	8.4	39.7	76.0	81.5	60.3
T_9-Control (80:40:40 of NPK fertilizers)	7.4	32.8	44.8	50.9	26.7
S.E.m ±	0.5	1.1	2.4	2.7	2.20
C.D (P = 0.05)	NS	3.3	7.2	8.2	6.7

Table 2. P uptake (kg ha^{-1}) of sorghum as influenced by different organic nutrient sources

Treatment	**P uptake (kg ha^{-1})**				
	30 DAS	**60 DAS**	**90 DAS**	**At harvest stover**	**At harvest grain**
T_1-Top dressing of vermicompost @ 2.5 t ha^{-1}	1.61	6.26	9.94	13.31	8.31
T_2-Top dressing of vermicompost @ 5 t ha^{-1}	1.78	6.94	11.19	14.03	9.20
T_3-Foliar spray of vermiwash @ 1 %	1.46	6.01	6.72	8.41	5.18
T_4-Foliar spray of vermiwash @ 2 %	1.66	6.53	7.67	9.46	6.32
T_5-Foliar spray of humic acid @ 0.5 %	1.56	7.16	9.10	11.65	7.20
T_6-Foliar spray of humic acid @ 1 %	1.57	5.93	10.11	11.44	8.53
T_7-Foliar spray of fulvic acid @ 0.5%	1.67	6.49	11.79	14.16	9.65
T_8-Foliar spray of fulvic acid @ 1 %	2.04	8.30	15.35	17.77	13.92
T_9-Control (80:40:40 of NPK fertilizers)	1.48	6.09	9.38	10.08	5.84
S.E.m ±	**0.18**	**0.40**	**0.73**	**0.90**	**0.58**
C.D (P = 0.05)	**NS**	**1.22**	**2.20**	**2.73**	**1.76**

Table 3. K uptake (kg ha^{-1}) of sorghum as influenced by different organic nutrient sources

Treatment	K uptake (kg ha$^{-1)}$				
	30 DAS	60 DAS	90 DAS	At harvest stover	At harvest grain
T_1-Top dressing of vermicompost @ 2.5 t ha^{-1}	8.78	33.55	59.35	61.25	19.8
T_2-Top dressing of vermicompost @ 5 t ha^{-1}	9.49	35.03	70.45	71.49	22.3
T_3-Foliar spray of vermiwash @ 1 %	8.28	34.53	41.19	42.93	12.6
T_4-Foliar spray of vermiwash @ 2 %	8.74	37.75	47.28	48.93	15.9
T_5-Foliar spray of humic acid @ 0.5 %	8.11	33.37	51.33	52.80	17.5
T_6-Foliar spray of humic acid @ 1 %	8.17	35.11	59.67	62.88	21.0
T_7-Foliar spray of fulvic acid @ 0.5%	8.26	33.54	66.18	67.22	22.2
T_8-Foliar spray of fulvic acid @ 1 %	9.42	40.43	76.66	78.68	33.2
T_9-Control (80:40:40 of NPK fertilizers)	8.38	34.81	44.67	45.33	14.3
S.E.m ±	0.49	0.85	2.38	2.42	1.1
C.D	NS	2.57	7.19	7.32	3.32

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REFERENCE

Amruthavalli, S and Reddy, R.K. 2000. Effect of nitrogen and Azospirillum on seed quality and nitrogen uptake of sunflower (Helianthus annuus L.). Journal of Oilseeds Research. 17: 304-306. | Dusberg, J.M., Smith, M.S and Doran, J.W. 1989. Dynamics of SOM in tropical ecosystems. University of Hawaii, Hawaii, USA. | En.wikipedia.org./vermicompost | Higa, T. 1994. The complete data of encyclopedia, Sogo unico in Japanese Tokyo. 2nd edition: 385-388. | Khan, S., Qureshi, M.A., Singh, J and Praveen, G. 1997. Influence of Ni (ii), Cr (iii) and humic acid (HA) complexes on major nutrients (NPK) status of soil. Indian Journal of Agricultural Chemistry. 31: 1-5. | Naeem, M., Iqbal, J and Bakhsh, M. A. A. 2006. Comparative study in organic fertilizers and organic manures on yield and yield components of mung bean. Journal of Agricultural Social Science. 2: 227-229. | Pal, S and Sengupta, M.B. 1985. Nature and properties of humic acid prepared from different sources and its effect on nutrient availability. Plant and Soil. 88: 71-91. | Schnitzer, M and Kodama, H. 1972. Differential thermal analysis of metal fulvic acid salts and complexes. Geoderma. 7: 93-103. | Sumathi, V and Rao, D.S.K. 2007. Effect of organic sources of nitrogen with different irrigation schedules on growth and yield of sunflower. Indian Journal of Agronomy. 52 (1): 77-79. | Tan, K. H and McCreey, R.A. 1975. Humic acid complex formation and intermicellor adsorption by bentonite. Processing of International Clay Conference, Mexico City, pp. 629-641. | Tan, K. H. 1978. Effect of humic and fulvic acids on release of fixed potassium. Geoderma. 21: 67-74. | Thavaprakash, N., Kumar, S.S.D., Raja, K and Kumar, S.G. 2002. Effect of nitrogen and phosphorus levels and ratios on seed yield and nutrient uptake of sunflower hybrid, DSH-1. Helia 25: 59-68. | Tripathi, P.N and Kalra, G.S. 1980. Effect of NPK on maturity and yield of sunflower. Indian Journal of Agronomy. 26: 66-70. | Vaughan, D and Ord, B.G. 1985. Soil organic matter-a perspective on its nature, extraction, turn over and role in soil fertility. Soil organic matter and biological activity. Pp. 4-18. Junk publishers, Water land. | www.icrisat.org/sorghum.htm | Yadava, N., Tiwari, O.P and Shrivastava, G.K. 1998. Response of spring sunflower (Helianthus annuus L.) to nitrogen and row spacing with different intercrops for rice fallows of Eastern Madhya Pradesh. Journal of Oilseeds Research. 15: 377-378. |