International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(5): 1470-1473

Received: 21-07-2018
Accepted: 30-08-2018

Effect of nutrient seed dressing on nutrient concentration and nutrient uptake of *kharif* sorghum (*Sorghum bicolor* L. Monech)

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Abstract
A field experiment was conducted to know the effect of seed dressing treatments on nutrient dynamics and uptake of *kharif* sorghum (*Sorghum bicolor* L. Monech) at, Research farm Dept. of Soil Science & Agricultural Chemistry, VNMKV Agricultural University, Parbhani, Maharashtra during 2017. The experiment consists of nine treatments with three replications in randomized block design. The results revealed that seed dressing with RDF + Zn EDTA @ 3 g per kg of seed recorded significantly higher N, P, K concentration and higher N, P, K uptake.

Keywords: Sorghum, micronutrient, seed dressing, nutrient uptake

1. Introduction
Sorghum (*Sorghum bicolar* (L) Moench) belongs to family Graminae and the word sorghum is derived from Latin word ‘Sargo’ means ‘rising above’ i.e., growing taller than the other crops in field. Sorghum grain contains 10 to 12 per cent protein, 3 per cent fat, and 70 per cent carbohydrates. The major sorghum producing countries of the world are India, USA, South Africa, China, Nigeria, Sudan and Argentina. In India, the average area of *kharif* sorghum is 2268.8 ha. The average production of *kharif* sorghum is 1816 tonne and average productivity of *kharif* sorghum is 850 kg ha^{-1} (Agristat, Indiastat.com 2014-2015). At present, Maharashtra is largest producer of sorghum, and the state has total area of 680.0 (000) ha in *kharif.* The average productivity of sorghum in *kharif* is 1014 kg ha^{-1} and the average production of sorghum in *kharif* is 585.0 (000) ton (Agristat, Indiastat. com 2014-2015). Seed priming technique is used to increase viability of deteriorated seed or to increase their ability to grow under wide range of environmental condition or to get high, fast and homogeneous per cent of germination and field emergence, strong seedling and good field establishment. Seed priming technique means control on process of seed imbibition during soaking or moisturizing and allows proceeding with metabolic events before planting without allowing emergence of radicle or plumule (Murungu *et al*., 2004; Nawaz, 2013) [6, 7]. That technique may lead to improve initiate germination, homogeneous growth of seedlings, field establishment and high yield and nutrient content and uptake even under condition of environmental stress compared with non-primed seed.

Material and methods
A field experiment was conducted during *kharif* 2016-2017 at Sorghum research station, College of Agriculture, VNMKV, Parbhani to investigate the effect of seed dressing treatments on growth, quality and seed yield of *kharif* sorghum (*Sorghum bicolor* L. Monech) PVK-801. The experiment was laid out in RBD with three replication the experiment consisted of 9 treatments *viz.*, seed dressing with T_1- RDF only (control), T_2- RDF + 3 g $ZnSO_4$ kg^{-1}, T_3- RDF + 3 g Zn EDTA kg^{-1}, T_4- RDF + 3 g B kg^{-1}, T_5- RDF + 3 g $MnSO_4$ kg^{-1}, T_6- RDF + 4 g Na_2MoO_4 kg^{-1}, T_7- RDF + 3 g $CuNO_3$ kg^{-1}, T_8- RDF + 3 g $FeSO_4$ kg^{-1}, T_9- RDF + 3 g Fe EDTA kg^{-1}. Sorghum variety PVK-801 was sown on 26 June 2017 at 45 cm row spacing using a seed rate of 10 kg ha^{-1}. The crop was harvested after 120 days. All the plots were fertilized with recommended dose of NPK (80:40:40 kg NPK ha^{-1}) as basal at time of sowing and remaining half dose of N at 30 days after sowing. Total amount of rainfall during the crop growth period was 141.00 mm in 2017 respectively. Nutrient content in plant sample were

analysed for nitrogen (Micro-kjeldahl's method AOAC., 1965), phosphorus (Vanadomolybdate phosphoric acid yellow colour method by Jackson, 1973), potash estimated by flame photometers Jackson, 1973). The data collected from the above observation were analysed statistically by the procedure prescribed by Panse and Sukhatme (1985) [8].

Result and discussion

Table 1: Nitrogen concentration in plant and grain of *kharif* sorghum as influenced by different nutrient seed dressing treatments of micronutrient

Treatment No	Treatments	Nitrogen (%)			
		Grand growth (45 DAS)	Flowering (70 DAS)	At harvest (135 DAS)	Grain
T_1	RDF only (control)	0.40	0.50	0.50	1.08
T_2	RDF + 3g $ZnSO_4$ kg^{-1}	0.59	0.72	0.70	1.71
T_3	RDF + 3g Zn EDTA kg^{-1}	0.67	0.76	0.80	1.81
T_4	RDF + 3g B kg^{-1}	0.49	0.59	0.58	1.54
T_5	RDF + 3g $MnSO_4$ kg^{-1}	0.48	0.52	0.52	1.57
T_6	RDF + 4g Na_2MoO_4 kg^{-1}	0.45	0.55	0.48	1.66
T_7	RDF + 3g $CuNO_3$ kg^{-1}	0.44	0.55	0.53	1.68
T_8	RDF + 3g $FeSO_4$ kg^{-1}	0.42	0.59	0.66	1.69
T_9	RDF + 3g Fe EDTA kg^{-1}	0.66	0.67	0.55	1.71
SE ±		0.046	0.051	00.58	0.06
CD at 5%		0.13	0.15	0.17	0.18
Grand mean		0.51	0.60	0.59	1.61

N content in plant and grain

Nitrogen content in plant of *kharif* sorghum is presented in Table 1. The N content in plant was markedly increased after addition of recommended dose of fertilizer along with micronutrient seed dressing. The nitrogen content was varied from 0.40 to 0.67 per cent at grand growth stage (45 DAS), 0.50 to 0.76 per cent at flowering stage (70 DAS) and 0.50 to 0.80 at harvesting stage (135 DAS), respectively. At grand growth stage (45 DAS), the N content (0.67 %) was found highest in treatment T_3 (RDF + 3 g Zn EDTA kg^{-1}) and it was at par with treatment T_2 (0.59 %) and T_9 (0.66 %). The lowest N content (0.40 %) was noticed in treatment T_1 (control). At flowering stage (70 DAS), the treatment T_3 showed significantly more N (0.76 %) followed by treatment T_2 (0.72 %) and it was found at par with treatment T_9 (0.67 %). The minimum N content (0.50 %) was observed in treatment T_1 (control). At harvesting stage (135 DAS), the N content (0.80 %) was found higher in treatment T_3 (RDF + 3 g Zn EDTA) and it was at par with treatment T_2 (0.70 %) and treatment T_9 (0.66 %). The lowest N content (0.50 %) was found in treatment T_1 (control). Similar findings were reported by Zeidan *et al*. (2010) [10]. Maximum N content (0.67 %) in plant of *kharif* sorghum was recorded in treatment T_3 (RDF + 3 g Zn EDTA kg^{-1}) at grand growth stage and also (0.76 %) at flowering stage and (0.80 %) at harvest stage respectively.

The nitrogen content in grain as influenced by the different nutrient seed dressing treatments of micronutrient is presented in Table 1. The N content in grain was varied from 1.08 to 1.81 per cent. The N content in grain (1.81%) was found superior in treatment T_3 (RDF + 3 g Zn EDTA kg^{-1}) and treatment T_2, T_9, T_8 recorded 1.71, 1.71, 1.69 per cent N content in grain respectively and was found at par with treatment T_3. Comparably, N content in grain was found maximum as compared to fodder of sorghum. Similar results were reported by Zeidan *et al*. (2010) [10]. Maximum N content (1.81 %) in grain of *kharif* sorghum was recorded in treatment T_3 (RDF + 3 g Zn EDTA kg^{-1}).

Table 2: Phosphorus concentration in plant and grain of *kharif* sorghum as influenced by different nutrient seed dressing treatments of micronutrient

Treatment No	Treatments	Phosphorus (%)			
		Grand growth (45 DAS)	Flowering (70 DAS)	At harvest (135 DAS)	Grain
T_1	RDF only (control)	0.31	0.35	0.30	0.59
T_2	RDF + 3g $ZnSO_4$ kg^{-1}	0.48	0.52	0.42	0.79
T_3	RDF + 3g Zn EDTA kg^{-1}	0.53	0.58	0.56	0.80
T_4	RDF + 3g B kg^{-1}	0.40	0.45	0.42	0.68
T_5	RDF + 3g $MnSO_4$ kg^{-1}	0.39	0.43	0.40	0.73
T_6	RDF + 4g Na_2MoO_4 kg^{-1}	0.38	0.44	0.42	0.72
T_7	RDF + 3g $CuNO_3$ kg^{-1}	0.36	0.46	0.42	0.67
T_8	RDF + 3g $FeSO_4$ kg^{-1}	0.42	0.48	0.46	0.73
T_9	RDF + 3g Fe EDTA kg^{-1}	0.45	0.50	0.54	0.74
SE ±		0.039	0.038	0.034	0.02
CD at 5%		0.11	0.11	0.10	0.05
Grand mean		0.41	0.46	0.43	0.72

P content in plant and grain

Phosphorus content in plant of *kharif* sorghum is presented in Table 2. and P content in plant varied from 0.31 to 0.53 per cent at grand growth (45 DAS), 0.35 to 0.58 per cent at flowering and (70 DAS) 0.30 to 0.56 per cent at harvest stage (135 DAS) respectively. At grand growth stage (45 DAS), phosphorus content (0.53 %) was found highest in treatment T_3 (RDF + 3 g Zn EDTA) which were found at par with treatment T_2 and T_9 recorded as 0.53 and 0.45 per cent respectively. The treatment T_1 (control) recorded lowest

(0.31%) content of phosphorus. At flowering stage (70 DAS), phosphorus content (0.58 %) in *kharif* sorghum was found highest in treatment T_3 (RDF + 3 g Zn EDTA) which were found at par with treatment T_2 and T_9 recorded 0.52 and 0.50 per cent P respectively. Phosphorus content in plant of sorghum (0.56 %) at harvesting stage (135 DAS) of crop was found highest in treatment T_3 (RDF + 3 g Zn EDTA). The lowest p content (0.30 %) was found in control treatment. Maximum P content (0.53 %) in plant of *kharif* sorghum was recorded in treatment T_3 (RDF + 3 g Zn EDTA kg^{-1}) at grand growth stage and also (0.58 %) at flowering stage and (0.56 %) at harvest stage respectively.

Generally maximum phosphorus content was observed in grain than fodder of sorghum. Data presented in Table 2. Indicated that, the grain content in p varied from 0.59 to 0.80 per cent. The treatment T_3 showed highest phosphorus content (0.80 %) and was found significantly superior over rest of the treatments. Maximum P content (0.80 %) in grain of *kharif* sorghum was recorded in treatment T_3 (RDF + 3 g Zn EDTA kg^{-1}). Zeidan *et al.* (2010) [10] reported that, the phosphorus content was highest in grain at harvest stage of the crop.

Table 3: Potassium concentration in plant and grain of *kharif* sorghum as influenced by different nutrient seed dressing treatments of micronutrient

Treatment No	Treatments	Potassium (%)			
		Grand growth (45 DAS)	Flowering (70 DAS)	At harvest (135 DAS)	Grain
T_1	RDF only (control)	0.65	0.70	0.60	0.28
T_2	RDF + 3g $ZnSO_4$ kg^{-1}	0.76	0.89	0.82	0.43
T_3	RDF + 3g Zn EDTA kg^{-1}	0.88	0.92	0.96	0.45
T_4	RDF + 3g B kg^{-1}	0.74	0.86	0.79	0.37
T_5	RDF + 3g $MnSO_4$ kg^{-1}	0.72	0.79	0.81	0.37
T_6	RDF + 4g Na_2MoO_4 kg^{-1}	0.70	0.74	0.76	0.35
T_7	RDF + 3g $CuNO_3$ kg^{-1}	0.71	0.80	0.70	0.37
T_8	RDF + 3g $FeSO_4$ kg^{-1}	0.76	0.82	0.82	0.40
T_9	RDF + 3g Fe EDTA kg^{-1}	0.86	0.89	0.92	0.43
SE ±		0.033	0.042	0.03	0.03
CD at 5%		0.09	0.12	0.09	0.08
Grand mean		0.75	0.82	0.79	0.38

K content in plant and grain

The potassium content in fodder as influenced by different nutrient seed dressing treatments of micronutrients are presented in Table 3. Potassium content in plant was varied from 0.65 to 0.88 per cent at grand growth stage (45 DAS), 0.70 to 0.92 per cent at flowering stage (70 DAS) and 0.60 to 0.96 per cent at harvest stage (135 DAS) respectively. At grand growth stage (45 DAS), the highest potassium content (0.88 %) was found in treatment T_3 (RDF + 3 Zn EDTA) which was at par with treatment T_9 (RDF + 3 g Fe EDTA) and lowest potassium content (0.65 %) was noticed in control. At flowering stage (70 DAS), the highest potassium content (0.92 %) was observed in treatment T_3 (RDF + 3 g Zn EDTA) which was at par with treatment T_2, T_9 and T_8 recorded 0.89, 0.89 and 0.82 per cent respectively. The lowest potassium content (0.70 %) was noticed in control. At harvest stage (135 DAS) of crop, maximum K content (0.96 %) was seen in treatment T_3 (RDF + 3 g Zn EDTA) followed by treatment T_9 (RDF + 3 g Fe EDTA). The lowest k content (0.60 %) was obtained in treatment T_1 (control). Maximum K content (0.88 %) in plant of *kharif* sorghum was recorded in treatment T_3 (RDF + 3 g Zn EDTA kg^{-1}) at grand growth stage and also (0.92 %) at flowering stage and (0.96 %) at harvest stage.

The data presented in Table 3. revealed that, the k content in grain was ranged from 0.28 to 0.45 per cent. The K content (0.45 %) was maximum in treatment T_3 (RDF + 3 g Zn EDTA) and it was at par with treatment T_9 (0.40 %), T_4 (0.37 %), T_5 (0.37 %) and T_7 (0.37 %). The lowest k content (0.28 %) was recorded in T_1 (control). Maximum K content (0.45 %) in grain of *kharif* sorghum was recorded in treatment T_3 (RDF + 3 g Zn EDTA kg^{-1}).

It was noticed that, the k content was maximum in fodder of *kharif* sorghum than that of grain. Dhamak *et al.* (2010) [1] reported that, the potassium content in fodder was found maximum than that of grain in *kharif* sorghum.

Table 4: Effect of different nutrient seed dressing treatment of micronutrients on N, P and K uptake (kg ha^{-1}) at harvesting stage by *kharif* sorghum

Treatment No	Treatment	N (kg ha^{-1})			P (kg ha^{-1})			K (kg ha^{-1})		
		Plant	Grain	Total	Plant	Grain	Total	Plant	Grain	Total
T_1	RDF only (control)	21.96	11.84	33.8	13.17	6.47	19.64	26.35	3.07	29.42
T_2	RDF + 3 g $ZnSO_4$ kg^{-1}	35.85	33.99	69.84	21.51	15.70	37.21	42.00	8.54	50.54
T_3	RDF + 3 g Zn EDTA kg^{-1}	42.42	36.59	79.01	29.69	16.17	45.86	50.90	9.09	59.99
T_4	RDF + 3 g $Na_2B_4O_7.10H_2O$ kg^{-1}	27.38	22.17	49.55	19.82	9.79	29.61	37.29	5.32	42.61
T_5	RDF + 3 g $MnSO_4$ kg^{-1}	25.26	28.52	53.78	19.43	13.26	32.69	39.34	6.72	46.06
T_6	RDF + 4 g Na_2MoO_4 kg^{-1}	22.8	28.45	51.25	19.95	12.34	32.29	36.1	5.99	42.09
T_7	RDF + 3 g $CuNO_3$ kg^{-1}	24.96	25.92	50.88	19.78	10.33	30.11	32.97	5.70	38.67
T_8	RDF + 3 g $FeSO_4$ kg^{-1}	33.11	31.85	64.96	23.07	13.76	36.83	41.13	7.54	48.67
T_9	RDF + 3 g Fe EDTA kg^{-1}	28.52	32.83	61.35	28.00	14.20	42.2	47.71	8.25	55.96
SE±		2.92	1.32		1.73	0.49		1.58	0.36	
CD at 5 %		8.75	3.97		5.19	1.48		4.73	1.09	
Grand mean		29.13	28.02	57.15	21.60	12.56	34.16	39.30	6.69	45.99

Nitrogen uptake

The data presented in Table 22 and depicted in fig. 1 revealed that, the plant N uptake was ranged from 21.96 to 42.42 kg ha^{-1} and N uptake in grain was in the range from 11.84 to 36.59 kg ha^{-1} respectively. The treatment T_3 (RDF + 3 g Zn EDTA kg^{-1}) had maximum value (42.42 kg ha^{-1}) at harvesting stage (135 DAS) and it was at par with treatment T_2 (RDF + 3 $ZnSO_4$ kg^{-1}). In grain, treatment T_3 (RDF + 3 g Zn EDTA kg^{-1}) recorded (36.59 kg ha^{-1}) maximum uptake of N and found to be at par with treatment T_2 (RDF + 3 $ZnSO_4$ kg-1) and it was significantly superior over control. Similar results were also reported by Sharma *et al.* (1981). Nutrient uptake was maximum in treatment T_3 (RDF + 3 g Zn EDTA kg^{-1}) i.e., in plant (42.42 kg ha^{-1}) and in grain (36.59 kg ha^{-1}) respectively.

Phosphorus uptake

The data presented in Table 4 depicted in fig. 1 indicated that, the significant increase in P uptake by sorghum with different nutrient seed dressing treatment of micronutrients was observed. The P uptake in plant was in the range from 13.17 to 29.69 kg ha^{-1} and grain P uptake was in the range from 6.47 to 16.17 kg ha^{-1} respectively. The highest P uptake (29.69 kg ha^{-1}) in plant was noticed in treatment T_3 (RDF + 3 g Zn EDTA kg^{-1}) and it was at par with treatment T_9 (RDF + 3 g Fe EDTA kg^{-1}) recorded as 28.00 kg ha^{-1}. The highest P uptake (16.17 kg ha^{-1}) in grain was recorded in treatment T_3 (RDF + 3 g Zn EDTA kg^{-1}) and it was at par with treatment T_9 (RDF + 3 g Fe EDTA kg-1) and significantly superior over control. Similar trend was noticed by Mughara *et al.* (1996) [1]. Nutrient uptake was maximum in treatment T_3 (RDF + 3 g Zn EDTA kg^{-1}) i.e., in plant (29.69 kg ha^{-1}) and in grain (16.17 kg ha^{-1}) respectively.

K uptake

The data pertaining in Table 4 depicted in fig. 1 revealed that, the K uptake was influenced due to different nutrient seed dressing treatment. The K uptake in plant was ranged from 26.35 to 50.90 kg ha^{-1} at harvesting stage (135 DAS). The K uptake in grain was ranged from 3.07 to 9.09 kg ha^{-1}. The maximum uptake of K (50.90 kg ha^{-1}) was in treatment T_3 (RDF + 3 g Zn EDTA kg^{-1}) and it was at par with treatment T_9 (RDF + 3 g Fe EDTA kg-1). In grain, the maximum K uptake was observed (9.09 kg ha^{-1}) in treatment T_3 (RDF + 3 g Zn EDTA kg^{-1}) and it was at par with T_2 (RDF + 3 g $ZnSO_4$ kg^{-1}), which recorded the value of 8.54 kg ha^{-1}, which denoted its significance over rest of the treatments. Results are inconformity with the findings of Sharma *et al.* (1981) [9]. Nutrient uptake was maximum in treatment T_3 (RDF + 3 g Zn EDTA kg^{-1}) i.e., in plant (50.90 kg ha^{-1}) and in grain (9.09 kg ha^{-1}) respectively.

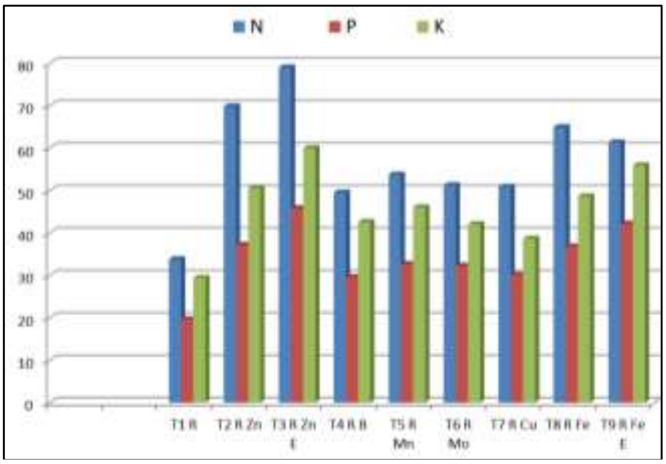

Fig 1: Total Nutrient uptake of NPK in *kharif* sorghum as influenced by different nutrient seed dressing treatments of micronutrient at harvesting stage

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