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The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(4): 775-777

www.thepharmajournal.com
Received: 05-01-2022
Accepted: 16-03-2022

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Effect of nutrient omission on growth and yield of *Rabi* Sorghum under rainfed and irrigated ecosystems

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Abstract
A field experiment was conducted at MARS, University of Agricultural Sciences, Dharwad during *rabi* 2020-21. The experiment was laid out in split plot design under rainfed and irrigated ecosystems as main plots and nutrient omission treatments as subplots replicated thrice. The results indicated that significantly higher plant height (236.0cm), leaf area (45.09 dm^2 $plant^{-1}$), leaf area index (6.67), dry matter accumulation (214.79g $plant^{-1}$) and grain yield (44.87 q ha^{-1}) of *rabi* sorghum were recorded under irrigated condition. Among nutrient omissions, application of 50:25 kg NP ha^{-1} + FYM @ 3 t ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} recorded significantly higher plant height (243.50 cm), leaf area (50.35 dm^2 $plant^{-1}$), leaf area index (7.45), dry matter accumulation (242.56 g $plant^{-1}$), grain yield (49.56 q ha^{-1}). Per cent increased in grain yield of sorghum was 18.96 under irrigated condition over rainfed ecosystem. Further, application of 50:25 kg NP ha^{-1} + FYM @ 3 t ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} recorded 34.88 per cent increase in grain yield as against the treatment received none of the nutrients. Omission of N resulted in 26.65 per cent, omission of P and NP resulted in 12.3 per cent and 31.88 per cent reduction, respectively in grain yield of *rabi* sorghum.

Keywords: Nutrient omission, *rabi* Sorghum, $ZnSO_4$

Introduction
Sorghum (*Sorghum bicolor* L. Moench) is a staple food crop in semi-arid areas considered as the king of millets and fourth important crop in the country after rice, wheat and maize. It is the most effective C_4 plant as far as photosynthesis pathway. In India, sorghum is grown in 4.82 m ha with a productivity of 989 kg ha^{-1} (Anon., 2020) [1]. In Karnataka sorghum is grown in 0.826 m ha with productivity of 1194 kg ha^{-1} (Anon., 2020) [1].The production and productivity of this crop is restricted by insufficiency of present fertilizer recommendations, low fertilizer efficiency, no application of micronutrients and continuous deterioration of soil quality. Adequate supply of plant nutrients decides optimum productivity of any crop or cropping system. All other factors of crop production are in the optimum, the fertility of a soil largely determines the ultimate yield. When the soil does not supply sufficient nutrients for normal plant development and optimum productivity, application of supplemental nutrient is required. Since soil reserves alone are not sufficient to meet the nutrient requirement of the crop, a balance nutrient supply has to be provided keeping in view of the soil inherent nutrient supplying capacity to achieve higher crop yields (Das *et al.* 2014) [3]. Fertilizer is one of the most important sources to meet the target yield. Indiscriminate use of fertilizers may cause adverse effect on soils and crops both nutrient toxicity and deficiency either by over use or inadequate use. Thus the current investigation was designed to determine the effect of nutrient omission under rainfed and irrigated condition on growth and yield parameters of *rabi* sorghum.

Materials and Methods
A field experiment was conducted during *rabi* 2020-2021 on clay loam soil at AICRP on sorghum, MARS, University of Agricultural Sciences, Dharwad (15^0 29' N, 74^0 59' E 689m altitude). The experiment was laid out in split plot design with three replications the experiment consists of Rainfed (M_1) and Irrigated (M_2) as main plots. Nutrient omission treatments *viz*., FYM, N, P, Zn, NP, NZn omissions compared with no omission and absolute control (Table 1). Recommended dose of fertilizers for sorghum (CSV-29R) in the region was 50:25 kg NP ha^{-1} + FYM @ 3 t ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} (S_1) was considered as no omission treatment. Nitrogen, phosphorus and zinc were applied in the form of urea, single super phosphate and $ZnSO_4$ respectively at the time of sowing.

Common irrigation was given to both main plots (M_1 and M_2) after sowing to ensure the proper germination and establishment of the crop. Rainfall recieved during cropping period was 38.2mm.For irrigated condition irrigation was provided at booting, flowering and milky stage of the sorghum.
Growth and yield parametes were recorded. Leaf area was estimated by following the procedure given by Stickler *et al*. (1961) [9], leaf area index was calculated as suggested by Sestak *et al*. (1971) [8]. The data collected were subjected to statistical analysis as described by Gomez and Gomez (1984) [4].

Results and Discussion

Significantly maximum plant height (236.04 cm), leaf area (45.09 dm^2 $plant^{-1}$), leaf area index (6.67) and higher total dry matter accumulation (214.79 g $plant^{-1}$) were recorded under irrigated condition over rainfed condition (Table 1). There was 6.94 per cent, 1.72 per cent, 1.81 per cent, 6.75 per cent improvement in plant height, leaf area, leaf area index and total dry matter accumulation in irrigated ecosystem compared to rainfed ecosystem. Application of 50:25 kg N P ha^{-1} + FYM @ 3 t ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} (S_1) recorded significantly higher plant height (243.5 cm), leaf area (50.35 dm^2 $plant^{-1}$), leaf area index (7.45) and higher total dry matter accumulation (242.56 g $plant^{-1}$) compared to rest of the treatments but was at par with application of 50:25 kg N P ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} (S_2).The increase in plant height, leaf area, leaf area index and total dry matter accumulation might be due to availability of adequate moisture at all critical stages of the crop plant which in turn led to the increased absorption and utilization of applied nutrients. Increase in leaf area was due to the increase in plant height under the application of recommended dose of fertilizer, which enhanced the interception, absorption and utilization of radiant energy which in turn increased leaf area index, photosynthesis and finally accumulation of dry matter per plant. The results obtained in this study are in line with Sujathamma *et al*. (2014) [7]. Omission of N reduced plant height, leaf area, leaf area index and total dry matter accumulation to an extent of 8.6, 13.7, 13.6 and 15.96 per cent respectively. The per cent reduction of plant height, leaf area, leaf area index and total dry matter accumulation was to the tune of 5.2, 8.46, 8.45 and 13.18 respectively due to omission of P. The results are similar to those of Joshi *et al.* (2016), who reported that growth and yield attributes were significantly influenced by nutrient omission treatments and their values were higher when nutrient were applied according to STCR approach.

Yield and Yield Parameters

Significantly higher panicle length (23.20 cm), panicle weight (142.60 g $plant^{-1}$), grain weight (105.67 $panicle^{-1}$), 1000 – grain weight (34.69 g) and grain yield (44.87 q ha^{-1}) of sorghum were recorded under irrigated condition compared to rainfed condition. The increased grain yield and yield parameters was due to favorable moisture condition which helped for better translocation of photosynthates. Application of 50:25 kg N P ha^{-1} + FYM @ 3 t ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} (S_1) recorded significantly higher panicle length (24.54 cm), panicle weight (154.77 g $plant^{-1}$), grain weight (121.88 $panicle^{-1}$), 1000 – grain weight (37.65 g) and grain yield (49.56 q ha^{-1})over control but at par with FYM omission. The higher yield and yield parameters might be due to better photosynthates and translocation of nutrients. The results are in line with the study shows that maize grain yield was the highest for the NPK treatment followed by NPK+ treatment but lowest for the unfertilized control and N omitted plots (Atnafu *et al.*, 2021) [2]. Omission of N caused 7.78, 12.50, 21.9, 9.13 and 26.65 per cent reduction in panicle length, panicle weight, grain weight, 1000 – grain weight and grain yield respectively. This may be due to the absence of nitrogen before or at sowing resulted in reduction of yield and yield parameters and proved that N is the major limiting factor of the crop for its growth and productivity (Kumar *et al.*, 2018) [5].Omission of P caused 12.3 per cent grain yield reduction, due to inadequate amount of phosphorus in early growth stages of the crop. The inadequate amount of P may be one of the reason for low absorption of N which led to the reduction in yield. Further, omission of NP together reduced the grain yield to an extent of 31.88 per cent over non omission treatment. These results are in consonance with the findings, the omission of N, P and S reduced the yield attributing parameters and grain yields significantly over the treatment receiving all the nutrients. Nutrient uptake by rice was significantly reduced with omission of N, P and S (Singh *et al.*, 2020) [6].

Table 1: Plant height, Leaf area, Leaf area index and Total dry matter accumulation of *rabi* sorghum as influenced by nutrient omission and growing ecosystems

Treatments	Plant height(cm)			Leaf Area (dm^2 $plant^{-1}$)			Leaf area index			Dry matter accumulation(g/plant)		
	Rainfed	Irrigated	Mean	Rainfed	Irrigated	Mean	Rainfed	Irrigated	Mean	Rainfed	Irrigated	Mean
S_1 - No Omission	234.7	252.3	243.5	51.16	49.53	50.35	7.33	7.57	7.45	234.5	250.6	242.6
S_2 - FYM Omission	230.9	245.1	238.0	47.75	48.67	48.21	7.20	7.07	7.14	219.5	233.9	226.7
S_3 - N omission	215.1	231.3	223.2	42.36	44.51	43.44	6.59	6.27	6.43	196.4	211.3	203.8
S_4 - P omission	222.1	239.2	230.7	44.57	47.62	46.09	6.60	7.05	6.82	206.1	215.0	210.6
S_5 - Zn omission	223.5	244.2	233.8	45.15	48.41	46.78	6.68	7.17	6.93	211.8	226.9	219.4
S_6 - NP omission	214.6	225.4	220.0	41.74	42.35	42.04	6.18	6.27	6.22	180.5	192.8	186.7
S_7- N, Zn Omission	215.8	228.4	222.1	42.57	42.48	42.53	6.29	6.30	6.30	188.5	202.8	195.7
S_8 - P, Zn Omission	214.4	234.7	224.6	43.49	43.34	43.41	6.41	6.44	6.43	202.1	218.3	210.3
S_9 - Control (N, P, K and Zn Omission)	210.4	223.8	217.1	40.12	38.88	39.50	5.75	5.94	5.85	167.1	181.4	174.2
Mean	220.2	236.0		44.32	45.09		6.55	6.67		200.7	214.7	
	S.Em. ±	CD at 5%		S.Em. ±	CD at 5%		S.Em. ±	CD at 5%		S.Em. ±		CD at 5%
Main plot	2.21	8.63		0.05	0.16		0.01	0.05		0.89		5.44
Sub plot	4.98	14.37		1.05	3.02		0.15	0.44		2.90		8.35
Interaction (Main x Sub)	7.05	20.32		1.480	4.27		0.22	0.63		4.10		11.81

Recommended package of practice 50:25 kg NP ha^{-1} + FYM @ 3 t ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} (RPP)

Table 2: Grain yield, panicle weight, grain weight and 1000 – grain weight of *rabi* sorghum as influenced by nutrient omission and growing Ecosystem

Treatment	Panicle length (cm)			Panicle weight (g $plant^{-1}$)			Grain weight (g $panicle^{-1}$)			1000 – grain weight (g)			Grain yield (q ha^{-1})		
	Rainfed	Irrigated	Mean	Rainfed	Irrigated	Mean	Rainfed	Irrigated	Mean	Rainfed	Irrigated	Mean	Rainfed	Irrigated	Mean
S1 - No Omission	24.18	24.91	24.54	146.70	162.85	154.77	115.45	128.30	121.88	37.63	37.67	37.65	44.38	54.73	49.56
S2 - FYM Omission	23.70	24.23	23.96	140.94	154.51	147.72	113.78	123.70	118.74	36.00	36.07	36.03	43.02	53.10	48.06
S3 - N omission	22.36	22.89	22.63	129.47	141.35	135.41	93.95	96.20	95.08	33.81	34.62	34.21	32.67	40.03	36.35
S4 - P omission	22.95	23.53	23.24	134.17	147.63	140.80	110.50	119.41	114.96	34.17	35.60	34.88	38.67	48.20	43.43
S5 - Zn omission	23.23	23.83	23.53	136.19	150.60	143.40	110.30	116.87	108.59	34.31	35.43	34.57	40.57	50.65	45.61
S6 - NP omission	22.04	22.35	22.20	116.29	128	122.14	82.75	89.92	86.34	32.20	33.10	32.65	30.22	37.30	33.76
S7- N, Zn Omission	21.65	22.11	21.88	122.83	136.12	129.47	90.15	94.82	92.48	32.67	33.51	33.09	32.40	39.76	36.08
S8 - P, Zn Omission	22.49	23.01	22.75	129.29	143.40	136.34	95.54	98.28	96.91	33.32	34.16	33.74	36.21	44.66	40.44
S9 - Control (N, P, K and Zn Omission)	21.52	21.96	21.74	109.47	119.14	114.30	79.27	83.50	81.39	31.17	32.10	31.63	29.13	35.40	32.27
Mean	22.68	23.23		129.48	142.60		97.97	105.67		33.92	34.69		36.36	44.87	
	S.Em ±	CD at 5%		S.Em ±	CD at 5%		S.Em ±	CD at 5%		S.Em ±	CD at 5%		S.Em ±	CD at 5%	
Main plot	0.02	0.07		0.59	2.52		0.38	2.35		0.22	1.36		0.69	4.24	
Sub plot	0.54	1.56		3.20	9.22		2.00	5.77		0.72	2.08		1.01	2.91	
Interaction (Main x Sub)	0.76	2.21		4.52	13.03		2.83	8.16		1.02	2.95		1.43	4.12	

Recommended package of practice 50:25 kg NP ha-1 + FYM @ 3 t ha-1 + ZnSO4 @ 15 kg ha-1 (RPP)

Conclusion

Based on the experimental results, it could be concluded that application of 50:25 kg NP ha^{-1} + FYM @ 3 t ha^{-1} + $ZnSO_4$ @ 15 kg ha^{-1} along with irrigation at booting, flowering and milky stage significantly recorded higher growth, yield and yield parameters of *rabi* sorghum. Omission of either nitrogen or phosphorus alone or both nitrogen and phosphorus adversely affected growth parameters, yield and yield components of *rabi* sorghum.

References

1. Anonymous. Area, production and productivity of sorghum in India. http//www.Indiastat.com, 2020.
2. Atnafu O, Balemi T, Regassa A. Effect of nutrient omission on grain yield and yield components of maize (*Zea mays* L.) at Kersa District, Jemma Zone, Southwestern Ethiopia. International Journal of Agriculture Forestry and Fisheries. 2021;10(1):7-15.
3. Dass A, Vyas AK, Kaur R. Nitrogen management imprecision farming by soil plant analyses development meter. Indian Farming. 2014;63(12):33-35.
4. Gomez KA, Gomez AA. Statistical procedures for agricultural research, 2nd ed. John Wiley and Sons. New York, 1984, 639.
5. Kumar B, Sharma GK, Mishra VN, Pradhan A. Chandrakar. Assessment of nutrient deficiencies based on response of rice (*Oryzasativa* L.) to nutrient omission in *inceptisols* of Kondagaon District of Chhattisgarh in India. Int. J Curr. Microbiol. App. Sci.2014;7(9):350-359.
6. Singh SP, Paikra KK, Patel CR, Nutrient Omission: An plant nutrient deficiencies assessment technology of rice (*Oryza sativa)* in *Inceptisols*, J Pharmacogn. Phytochem.2020;9(1):27-30.
7. Sujathamma P, Kavitha K, Suneetha V. Response of grain sorghum (*Sorghum bicolor* L.) cultivars to different fertilizer levels under rainfed condition. Int. J Agric. Sci, 2014, 381-385.
8. Sestak AL, Catasky T, Jarvis PG. Plant Photosynthetic Production Manual of Methods, Ed. Dr. Junk, W. N. V., Publication, The Haghu, 1971, pp. 343-345.
9. Stickler FC, Weadson S, Poul A. Leaf area determination in grain sorghum. Agron. J. 1961;53:187-188.