



ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(3): 1498-1500
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www.thepharmajournal.com
Received: 01-01-2023
Accepted: 06-02-2023

PM Chavan
M.Sc. (Agri.) Scholar,
Department of Agronomy,
College of Agriculture, Latur,
Maharashtra, India

YM Waghmare
Assistant Professor of
Agronomy, College of
Agriculture, Ambajogai,
Maharashtra, India

SD Maindale
Ph.D. Scholar, Department of
Botany, Science College, Nanded,
Maharashtra, India

BK Chaudhari
M.Sc. (Agri.) Scholar,
Department of Agronomy,
College of Agriculture, Latur,
Maharashtra, India

Corresponding Author:
PM Chavan
M.Sc. (Agri.) Scholar,
Department of Agronomy,
College of Agriculture, Latur,
Maharashtra, India

Studies on effect of foliar application of nano N fertilizer on yield and economics of sorghum (*Sorghum bicolor* L)

PM Chavan, YM Waghmare, SD Maindale and BK Chaudhari

Abstract

A field experiment was undertaken at Farm of Agronomy section, College of Agriculture, Latur (Maharashtra) during *kharif* season of 2021 to study the “Effect of foliar application of nano N fertilizer on yield and economics of sorghum (*Sorghum bicolor* L)”. The experiment was laid out in Randomized Block Design with nine treatments and was replicated thrice *viz.*, T₁ - Control, T₂ - 75% RDN with commercial urea in 2 equal splits - At sowing & 30 DAS, T₃ - Foliar spray of 75% RDN with nano urea in 2 equal splits - 20 & 40 DAS, T₄ - Foliar spray of 75% RDN with nano urea in 3 equal splits - 15, 30 & 45 DAS, T₅ - 100% RDN with commercial urea in 2 equal splits - At sowing & 30 DAS, T₆ - Foliar spray of 100% RDN with nano urea in 2 equal splits - 20 & 40 DAS, T₇ - Foliar spray of 100% RDN with nano urea in 3 equal splits - 15, 30 & 45 DAS, T₈ - Foliar spray of 125% RDN with nano urea in 2 equal splits - 20 & 40 DAS, T₉ - Foliar spray of 125% RDN with nano urea in 3 equal splits - 15, 30 & 45 DAS. The results showed that the application of 100% RDN with commercial urea in 2 equal splits - At sowing & 30 DAS (T₅) gave significantly higher grain yield, straw yield, biological yield, gross return, net return and B:C ratio.

Keywords: Sorghum, commercial urea, nano urea, foliar application, economics

Introduction

India is major sorghum growing country in the world. Sorghum stands third in respect of area and production among the cereals. Its importance is ever increasing as a major source of staple food for human. It serves as an important source of cattle feed, fodder and also raw material for industries. Sorghum is a genus of about 25 species of flowering plants in the grass family *Poaceae*. Some of these species are grown as cereals for human consumption and some in pastures for animals.

Low soil fertility, particularly N and P deficiencies are among the major biophysical constraints affecting agriculture. According to Sanchez *et al.* (1997)^[7], soil fertility depletion in smallholder farmers’ holdings is the fundamental biophysical root cause of declining per capita food production. Black (1957)^[2] reported that plant growth is affected more due to deficiency of nitrogen than that of any other nutrient. Nitrogen (N) is commonly the most limiting nutrient factor for crop production in the majority of the world's agricultural areas and therefore adoption of good N management strategies often results in large economic benefits to farmers. Meena *et al.* (2012)^[4] reported that nitrogen application enhanced the growth parameters like plant height, leaves plant⁻¹, leaf: stem ratio, which ultimately reflected in increased total grain and straw yields. Nitrogen is a major input in sorghum production, affecting both yield and quality through influencing those components which have great contribution in increasing grain yield of sorghum (Wondimu 2004)^[14].

Nano fertilizers enhance growth parameters (plant height, leaf area, number of leaves per plant), dry matter production, chlorophyll production, rate of the photosynthesis which result more production and translocation of photosynthesis to different parts of the plant compare with traditional fertilizers (Ali and Al-Juthery 2017; Singh *et al.* 2017)^[1, 8]. Foliar application is the technique of feeding plants by spraying liquid fertilizers or other chemical or natural product directly to the leaves of macro and micronutrients are more effective in term of getting maximum yield and reduce losses (Rahman *et al.* 2014)^[6]. Keeping these facts in view the present field experiment entitled “Studies on effect of foliar application of nano N fertilizer on yield and economics of sorghum (*Sorghum bicolor* L).” was planned.

Material and Methods

A field experiment was carried out during *kharif* season of 2021 at Experimental Farm of Agronomy Section, College of Agriculture, Latur to study the effect of foliar application of nano N fertilizer on yield and economics of sorghum (*Sorghum bicolor* L). The soil of experimental plot was clayey in texture with chemical composition such as low in available nitrogen (230.00 kg ha⁻¹), very low in available phosphorous (17.50 kg ha⁻¹) and very high in available potassium (443 kg ha⁻¹). The soil was slightly alkaline in reaction having pH (7.7). A field experiment was laid out in a Randomized Block Design (RBD) with nine treatments replicated three times. The treatments were T₁ - Control, T₂ - 75% RDN with commercial urea in 2 equal splits - At sowing & 30 DAS, T₃ - Foliar spray of 75% RDN with nano urea in 2 equal splits - 20 & 40 DAS, T₄ - Foliar spray of 75% RDN with nano urea in 3 equal splits - 15, 30 & 45 DAS, T₅ - 100% RDN with commercial urea in 2 equal splits - At sowing & 30 DAS, T₆ - Foliar spray of 100% RDN with nano urea in 2 equal splits - 20 & 40 DAS, T₇ - Foliar spray of 100% RDN with nano urea in 3 equal splits - 15, 30 & 45 DAS, T₈ - Foliar spray of 125% RDN with nano urea in 2 equal splits - 20 & 40 DAS, T₉ - Foliar spray of 125% RDN with nano urea in 3 equal splits - 15, 30 & 45 DAS. The gross plot size of each experimental unit was 5.4 m x 4.5 m and net plot size was 4.5 m x 3.9 m. The recommended dose of fertilizer

(RDF) was 80:40:40 NPK kg ha⁻¹ given as per treatment.

Results and Discussion

Yield

Due to different treatments grain yield (kg ha⁻¹), straw yield (kg ha⁻¹), biological yield (kg ha⁻¹) and harvest index (%) was influenced significantly (Table 1). The higher grain yield (2730 kg ha⁻¹), straw yield (6152 kg ha⁻¹) and biological yield (8882 kg ha⁻¹) was recorded with the soil application of 100% RDN with commercial urea in 2 equal splits - At sowing & 30 DAS (T₅) which was at par with foliar spray of 125% RDN with nano urea in 3 equal splits - 15, 30 & 45 DAS (T₉), foliar spray of 125% RDN with nano urea in 2 equal splits - 20 & 40 DAS (T₈) and foliar spray of 100% RDN with nano urea in 3 equal splits - 15, 30 & 45 DAS (T₇) and also found significantly superior over rest of the treatments. The control treatment (T₁) observed lowest grain yield (1343 kg ha⁻¹), straw yield (3756 kg ha⁻¹) and biological yield (5099 kg ha⁻¹). Increase in grain yield, straw yield and biological yield might be due to balanced supply of NPK nutrients which helped in increased rate of photosynthesis and also active absorption of various nutrients and translocation of photosynthates to the site of storage organ (sink). These results are in accordance with the findings of Poornima *et al.* (2008)^[5], Soleymani *et al.* (2011)^[11], Singh *et al.* (2012)^[4], Singh *et al.* (2013)^[9] and Uchino *et al.* (2013)^[13].

Table 1: Effect of different treatments on yield of sorghum

Treatments	Grain Yield (Kg ha ⁻¹)	Straw Yield (Kg ha ⁻¹)	Biological Yield (Kg ha ⁻¹)	Harvest Index (%)
T ₁ – Control	1343	3756	5099	26.35
T ₂ - 75% RDN with commercial urea in 2 equal splits - At sowing & 30 DAS.	2012	5115	7127	28.23
T ₃ - Foliar spray of 75% RDN with nano urea in 2 equal splits - 20 & 40 DAS.	1854	4565	6419	28.89
T ₄ - Foliar spray of 75% RDN with nano urea in 3 equal splits - 15, 30 & 45 DAS.	1937	4875	6812	28.43
T ₅ - 100% RDN with commercial urea in 2 equal splits - At sowing & 30 DAS.	2730	6152	8882	30.74
T ₆ - Foliar spray of 100% RDN with nano urea in 2 equal splits - 20 & 40 DAS.	2348	5413	7761	30.25
T ₇ - Foliar spray of 100% RDN with nano urea in 3 equal splits - 15, 30 & 45 DAS.	2536	5649	8185	30.98
T ₈ - Foliar spray of 125% RDN with nano urea in 2 equal splits - 20 & 40 DAS.	2606	5913	8519	30.59
T ₉ - Foliar spray of 125% RDN with nano urea in 3 equal splits - 15, 30 & 45 DAS.	2664	6004	8667	30.73
SEm ±	107.65	239.61	279.00	-
CD at 5%	322.73	718.35	836.43	-
General Mean	2226	5271	7497	29

Economics

The gross monetary returns (GMR), cost of cultivation, net monetary returns (NMR) and benefit cost ratio were influenced significantly due to different treatments (Table 2). The highest gross monetary returns (₹ 105507) and net monetary returns (₹ 68478) were recorded with the soil application of 100% RDN with commercial urea in 2 equal splits - At sowing & 30 DAS (T₅) which was at par with foliar spray of 125% RDN with nano urea in 3 equal splits - 15, 30 & 45 DAS (T₉), foliar spray of 125% RDN with nano urea in 2 equal splits - 20 & 40 DAS (T₈) and foliar spray of 100% RDN with nano urea in 3 equal splits - 15, 30 & 45 DAS (T₇)

and also found significantly superior over rest of the treatments. The control treatment (T₁) observed lowest gross monetary returns (₹ 55551) and net monetary returns (₹ 22750). The results are in close conformity with the findings of Singh *et al.* (2012)^[4], Singh *et al.* (2013)^[9], Sujathamma *et al.* (2015)^[12] and Kubsad (2018)^[3].

The highest B: C ratio (2.85) was observed with the soil application of 100% RDN with commercial urea in 2 equal splits - At sowing & 30 DAS (T₅) followed by treatment with foliar spray of 125% RDN with nano urea in 2 equal splits - 20 & 40 DAS, whereas treatment (T₁) control gave minimum benefit cost ratio *i.e.*, 1.69.

Table 2: Effect of different treatments on economics of sorghum

Treatments	Yield (Kg ha ⁻¹)		Economics (₹ ha ⁻¹)			B:C Ratio
	Grain Yield	Stalk Yield	GMR (₹ ha ⁻¹)	CC (₹ ha ⁻¹)	NMR (₹ ha ⁻¹)	
T ₁ – Control	1343	3756	55551	32801	22750	1.69
T ₂ - 75% RDN with commercial urea in 2 equal splits - At sowing & 30 DAS.	2012	5115	80663	36768	43895	2.19
T ₃ - Foliar spray of 75% RDN with nano urea in 2 equal splits - 20 & 40 DAS.	1854	4565	73587	38412	35175	1.92
T ₄ - Foliar spray of 75% RDN with nano urea in 3 equal splits - 15, 30 & 45 DAS.	1937	4875	77410	39312	38098	1.97
T ₅ - 100% RDN with commercial urea in 2 equal splits - At sowing & 30 DAS.	2730	6152	105507	37029	68478	2.85
T ₆ - Foliar spray of 100% RDN with nano urea in 2 equal splits - 20 & 40 DAS.	2348	5413	91353	38621	52732	2.37
T ₇ - Foliar spray of 100% RDN with nano urea in 3 equal splits - 15, 30 & 45 DAS.	2536	5649	97680	39521	58159	2.47
T ₈ - Foliar spray of 125% RDN with nano urea in 2 equal splits - 20 & 40 DAS.	2606	5913	100917	38829	62088	2.60
T ₉ - Foliar spray of 125% RDN with nano urea in 3 equal splits - 15, 30 & 45 DAS.	2664	6004	102960	39729	63231	2.59
SEm ±	107.65	239.61	3366.39	—	3366.39	—
CD at 5%	322.73	718.35	10092.43	—	10092.43	—
General Mean	2226	5271	87292	37891	49400	2.29

Conclusion

The soil application of 100% RDN with commercial urea in 2 equal splits - At sowing & 30 DAS (T₅) recorded higher grain yield (2730 kg ha⁻¹), straw yield (6152 kg ha⁻¹), biological yield (8882 kg ha⁻¹) and also gross monetary returns (₹ 105507) and net monetary returns (₹ 68478) of sorghum. It was followed by foliar spray of 125% RDN with nano urea in 3 equal splits - 15, 30 & 45 DAS (T₉), foliar spray of 125% RDN with nano urea in 2 equal splits - 20 & 40 DAS (T₈) and foliar spray of 100% RDN with nano urea in 3 equal splits - 15, 30 & 45 DAS (T₇).

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