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Original Research Article

Effect of Levels and Sources of Sulphur on Yield, Quality and Economics of Niger

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A B S T R A C T

A field experiment was conducted during *kharif* season 2015 at the Experimental Farm of Agronomy, College of Agriculture, Latur (Maharashtra) to study the effect of different levels and sources of sulphur on yield, quality and economics of niger. The experiment was laid out in Factorial Randomized Block Design with nine treatment combinations which included three levels and three sources of sulphur. The levels of sulphur were L_1: 10 kg S ha^{-1}, L_2:20 kg S and L_3: 30 kg S ha^{-1} and sources of sulphur were S_1- ammonium sulphate, S_2- elemental sulphur and S_3- gypsum. Results revealed that the higher seed yield, maximum gross and net monetary return was obtained with the application of 30 kg S ha^{-1} while it was found significantly superior than 10 kg S ha^{-1} and remains at par with 20 kg S ha^{-1} and addition of ammonium sulphate recorded maximum gross and net monetary return while it at par with gypsum. The higher B: C Ratio was recorded with application of 30 Kg S ha^{-1} and lower with 10 S ha^{-1}.

Introduction

Niger (*Guizotia abyssinica* Cass.) is one of the important oilseed crops of India belonging to family compositae.

It is considered as a minor neglected oilseed crop both at global and national level. Niger seed is principally used for extraction of edible oil and contains 37 to 42 per cent oil. It is generally used as spice in chutney, pickles and ketchup for adding taste in diet. Raw oil has low acidity and can be used directly for cooking. Niger cake is used as manure consists of 5 % N, 2 % P_2O_5 and 1.5 % K_2O.

Sulphur is important nutrient for oilseed crops. It helps in synthesis of oils and increases seed and oil yield of niger. Sulphur acts as binding agent of oil component.

Materials and Methods

The experiment was conducted during *kharif* season of 2015 at the Experimental farm, Department of Agronomy, College of Agriculture, Latur (Maharashtra). The soil of the experimental site was shallow, black in colour with good drainage, clayey in texture and alkaline in reaction having pH of 8.3. The experiment was laid out in factorial randomized block design with three replications and treatments were consisting of nine combinations of three levels of sulphur and three sources of sulphur.

Results and Discussion

Yield

The higher seed yield was obtained with the application of 30 kg S ha^{-1} which was found significantly superior over 10 kg S $ha^{-1}$and at par with 20 kg S ha^{-1}. The increased seed yield caused by higher levels of sulphur. This might be due to higher photosynthetic activity and effective translocation of Photosynthate to sink, which resulted in better development of flower heads, good seed filling and consequently higher yield.

The increase in yield due to application of sulphur may be due to better metabolism and increased efficiency of other nutrients. In general, sulphur demand of oilseed crops is higher than those of cereal crops. Similar findings were also reported by Vala *et al.,* (2014) and Yadav *et al.,* (2010). The higher seed yield was obtained with the application of ammonium sulphate than elemental sulphur and at par with gypsum. This might be due to water soluble and readily available sulphate from ammonium sulphate. Sulphur involved in the protein and enzyme synthesis as well it was a constituent of amino acids, methionine, cystin and cysteine. Similar findings were also reported by Patel *et al.,* (2002). The interaction effect between different levels and sources of sulphur on seed yield was found significant and is presented in Table 2. Application of 30 kg S ha^{-1} through ammonium sulphate gave maximum seed yield (497 kg ha^{-1}) which was at par with application of 20 kg S ha^{-1}through ammonium sulphate (486 kg ha^{-1}) and 30 kg sulphur through gypsum (454 kg ha^{-1}) and significantly superior over rest of all the interactions.

Table.1 Yield and economics of niger

Treatment	Seed yield (kg $ha^{-1)}$	Gross monetary returns (`ha^{-1})	Cost of cultivation (` ha^{-1})	Net monetary returns (` ha^{-1})	Benefit Cost ratio
Levels of sulphur (kgha^{-1}): (L)					
L_1 – 10	315	34650	12131	13519	1.63
L_2 – 20	419	46090	21623	24467	2.13
L_3 – 30	445	48950	22053	26897	2.21
S.Em ±	11	1210	-	1210	-
C.D. at 5%	31	3410	-	3410	-
Sources of sulphur: (S)					
S_1- Ammonium sulphate	432	47520	21490	26030	2.21
S_2-Elemental sulphur	338	37180	22073	15107	1.68
S_3 –Gypsum	410	45100	21245	23855	2.12
S.Em ±	11	1210	-	1210	
C.D. at 5%	31	3410	-	3410	
Interaction (LxS)					
S.Em ±	18	1980	-	1980	-
C.D. at 5%	54	5940	-	5940	-
General Mean	393	43230	21602	21627	2.001

Table.2 Interaction effect between different levels and sources of sulphur on seed yield (kg ha^{-1}) of niger

Levels of sulphur/Sources of sulphur	S_1 Ammonium sulphate	S_2 Elemental sulphur	S_3 Gypsum	Mean
L_1- 10 kg/ha	313	276	357	315
L_2- 20 kg/ha	486	351	419	419
L_3-30 kg/ha	497	385	454	445
Mean	432	338	410	393

L/S	Levels of S	Sources of S	LXS
S.Em ±	**10.48**	**10.48**	**18.16**
C.D. at 5%	**31.43**	**31.43**	**54.44**

Table.3 Oil content and oil yield of niger as influenced by different treatments

Treatment	Oil content (%)	Oil yield (kg ha^{-1})
Levels of sulphur (kgha^{-1}): (L)		
L_1 – 10	39.47	124
L_2 – 20	39.60	166
L_3 – 30	39.75	177
S.Em ±	0.30	4.36
C.D. at 5%	NS	13.1
Sources of sulphur: (S)		
S_1 -Ammonium sulphate	39.57	171
S2-Elemental sulphur	39.73	134
S_3 –Gypsum	39.80	163
SEm ±	0.30	4.36
C.D. at 5%	NS	13.1
Interactions (LxS)		
S.Em ±	0.53	8.94
C.D. at 5%	NS	26.8
General Mean	39.70	156

Table.4 Interaction effect between different levels and sources of sulphur on oil yield kg ha^{-1}

Sulphur levels/Sulphur sources	S_1 Ammonium sulphate	S_2 Elemental sulphur	S_3 Gypsum	Mean
L_1 (10 kg S ha^{-1})	124	109	141	124
L_2 (20 kg S ha^{-1})	192	139	166	166
L_3 (30 kg S ha^{-1})	197	153	181	177
Mean	171	134	163	156
S.Em ± 8.94				
C.D. at 5% 26.8				

Economics

The highest gross monetary returns (`48950 $ha^{-1}$) and netmonetary returns (26897 $ha^{-1}$) was obtained by the application of 30 kg S $ha^{-1}$ which was found significantly superior over the 10 kg sulphur and at par with 20 kg sulphur $ha^{-1}$.The higher gross monetary returns (`47520 ha^{-1}), net monetary returns (` 26030 ha^{-1}) was obtained with the application of sulphur through ammonium sulphate. It might be due to higher economic yield. There was marginal deviation in cost of cultivation resulted in higher net monetary returns and B: C ratio. The higher Benefit: Cost ratio (2.21) was recorded with the application of 30 kg S ha^{-1} and lower B: C ratio (1.63) was noticed with 10 kg S ha^{-1}. The maximum Benefit: Cost ratio (2.21) was noticed when ammonium sulphate was applied to niger. Whereas, gypsum was found intermediate (2.12) in respect of B: C ratio and application of elemental sulphur recorded the lowest B: C ratio (Table 1)

Oil Content and Oil Yield

The highest oil content (39.75 %) and oil yield (177 kg ha^{-1}) of niger was obtained with the application of 30 kg S ha^{-1} (Table 3). The oil content did not significantly influenced by different levels of sulphur. Improvement in oil content with sulphur application might be due to involvement of sulphur directly in oil synthesis. Higher yield and oil content with increased sulphur application also attributed protein and enzyme synthesis as it is a constituent of sulphur containing amino acids namely methionine, cysteine and cysteine. Similar result recorded by Tejeswara Rao *et al.*, (2013) and Satish Kumar and Singh (2005). The higher oil content 39.80 obtained by Gypsum and 39.57%by ammonium sulphate and higher oil yield (171 kg ha^{-1}) of niger was observed by the application of ammonium sulphate because ammonium sulphate contained sulphur which played important role in oil synthesis. In fatty acid synthesis, acetyl co-enzyme A is converted to malonyl co-enzyme. The activity of this enzyme depends upon sulphur supply. Oil content is generally influenced by sulphur. Moreover, acetyl co-enzyme A itself contains sulphur and sulphohydryl group. This might be the reason for increasing the oil content. Similar result recorded by Prasad and Sah (2006). Interaction effect on oil yield was found significant due to the different levels and sources of sulphur and presented in (Table 4).

The data presented in (Table 3) indicated that the application of 30 kg S through ammonium sulphate gave maximum oil yield (197 kg ha^{-1}) which was found significantly superior over rest of the inter combination of levels and sources of sulphur except L_2S_1, L_3S_3 and L_3S_2 treatments. Lowest oil yield was recorded by the application of 10 kg S through elemental sulphur (109 kg ha^{-1}).

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