Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.6, No.14. 2016
www.iiste.org

Effects of Sulphur and Lime Application on Yield of Sesame (Sesamum indicum L.) in Southern Tanzania

Happy Daudi* Omari Mponda Charles Mkandawile
Oilseeds and Grain Legume Department, Naliendele Agricultural Research Institute, P.O.BOX 509,Mtwara, Tanzania

Abstract
Yield and quality of oilseed crops are principally regulated by nutrient management at field level. Field experiments were conducted in Southern zone of Tanzania (Nachingwea and Naliendele) to study the effects of Sulphur and lime application on yield and yield components of sesame (*Sesamun indicum*). The soil texture of the study areas is sandy loam. The sesame variety Lindi 02, was grown during the cropping seasons 2013/2014 and 2014/2015 in a Randomized Completely Block Design. The source of Sulphur fertilizer was Elemental sulphur (S), while lime source was local lime. Three levels of S application (15, 30 and 45 kg ha-1), lime application in a rate of 37.5kg/ha and absolute control (without S and lime) were used as treatments of the experiment. Positive response between Lime application on yield components and seed yield of sesame was noticed in this study. The number of branches per plant, number of capsules in main stem was found to be higher with the application rate of 37.5 kg ha^{-1} of Lime. Application of 37.5 kg ha^{-1} of Lime recorded the highest seed yield. The highest seed yield (1185 kg ha^{-1}) was obtained from Nachingwea site. Sulphur application didn't show any significant differences in both sites regardless of highest seed yield of 605 kg ha^{-1} and 831 kg ha^{-1} recorded at Naliendele and Nachingwea respectively.This study calls for further experiments using different rates of lime for increased sesame yields.
Keywords: Sesame, Lime, Sulphur, Yield, Southern Tanzania**.**

1.0 Introduction

Sesame (*Sesamum indicum* L.) is one of the world's oldest spice and oilseed crop grown mainly for its seeds that contain approximately 50% oil and 25% protein. The world production is estimated at 3.66 million tonnes with Asia and Africa producing 2.55 and 0.95 million tons respectively (Anon, 2008). Sesame has recently emerged as a cash crop in many regions of Tanzania becoming major source of income for smallholder farmers. Sesame production in the country increased almost 5 times since 2005 rising from 100,000 to about 500,000 MT in 2014 (FAO 2015). This rapid growth in production could be said Tanzania has achieved "green revolution in sesame". Sesame has graduated from minor crop in 1980-1990s to major cash crop in Tanzania. Currently, Tanzania is the world's 3rd largest sesame producer and is the 1st in Africa and the production increasing 10 times in the past 5 years (Appendix 1). Sesame is considered to have both nutritional and medicinal values. The seeds are used either decorticated or whole in sweets such as sesame bars and halva, in baked products, or milled to get high grade edible oil or tahini, an oily paste (Morris, 2002; Bedigian, 2004). Sesame grows well in tropical to temperate climates and can yield well under fairly high temperatures. The continent of Africa is naturally endowed with favorable climatic and soil requirements that can support sesame production.

Sesame is drought-tolerant in part due to its extensive root system. However, it requires adequate moisture for germination and early growth. While the crop survives drought as well as presence of excess water, the yields are significantly lower in either condition. Moisture levels before planting and flowering impact yield most. At present, the average yields of seeds are just about 300- 500 kg ha^{-1} for many farmers growing sesame which needs to be increased to at least 1 and 1.5 tones which is the potential yield of all varieties released in Tanzania (www.kilimo.go.tz/naliendele/d-oil.seeds.html).

Sesame is adaptable to many soil types, but it thrives best on well-drained, fertile soils of medium texture and neutral pH. Sesame, which has an extensively branched feeder root system, appears to improve soil structure. However, these have low tolerance for soils with high salt and water-logged conditions. Commercial sesame crops require 90 to 120 frost free days. Warm conditions above 23 °C (73 °F) favor growth and yields. While sesame crops can grow in poor soils, the best yields come from properly fertilized farms (Oplinger *et al*., 1990)

The growth parameters like leaf area, crop growth rate and net assimilation rate index and yield parameters like branches per plant, capsules per plant, seeds per capsule and 1000 seed weight were improved by increased Sulphur in sesame (Thakur and Patel, 2004; Sarkar and Panik, 2002; Tiwari *et al*., 2000). The response of sesame to sulphur for producing higher yield was up to 40 kg ha^{-1} according to Nagwani *et al.* (2001) and Kathiresan (2002) and up to 50 kg ha^{-1} (Sarkar and Panik, 2002). Sulphur application not only improved the grain yield but also improved the quality of crops (Tiwari and Gupta, 2006). Adequate and continuous application of Lime and Farm yard manure are known to have effects on reducing the acidity. The benefit use of lime is well recognized in crop production in the southern China (Cifu et al., 2004. In Tanzania, especially southern part (Mtwara and Lindi) due to production of Cashewnut, they use sulphur to treat fungal diseases, so we used sulphur and lime together as a treatment in order to see what needed to improve soil fertility and to increase production of Sesame in sesame growing areas. Hence this study was attempted to study the effects of sulphur and lime in realizing the better growth, yield and quality of sesame crop.

2.0 Materials and Methods

2.1 Experimental Site, Design and Treatment Details

The experiments were conducted at Naliendele Agricultural Research Institute during the year 2013/2014 and 2014/2015 and Nachingwea sub- station during the year 2014/2015. Naliendele site is located at Latitude 10º 22'S and Longitude 40º 10'E, 120 m above sea level while Nachingwea site is located at Latitude of 10°20'S and Longitude of 38°46'E, 750 m above sea level. Both sites are characterized by sandy loam soil textural class. Soil pH for Naliendele was 5.2 at a depth of 0-20 and at Nachingwea soil pH was 5.2 at a depth of 0-20 (Appendix 2).The soil pH data were measured before planting.

The experiment was conducted during rainy season from January to May. The treatments consisted of one source of sulphur; sulphur powder and 3 levels of sulphur viz 15 (S1), 30(S2) and 45(S3) kgha^{-1} and one absolute control, also one level of lime 37.5kg ha^{-1} (recommended). The experiment was laid out in R.C.B.D with three replicates with a plot size of 5 x 5 m with a spacing of 50 cm x10 cm by using sesame variety Lindi 02. The recommended dose of urea; 45 kg of N ha^{-1} was applied four weeks after seedling emergence. Karate insecticide was used to control sesame flea beetle at the seedling stage.

The plant height, height to first branch, height to first capsule, number of branches per plant, number of capsules per plant, capsule on main stem were recorded at harvest stage. The crop was harvested separately from the plots, threshed and winnowed. A thousand (1000) seed weight was determined and grain yield calculated from the yield per plot. The observation and Data collected were analyzed using GENSTAT statistical software package.

3.0 Results and Discussion

3.1 Effect of Sulphur and Lime on Growth Parameters

At Naliendele in 2013/2014 (Table1) here was no significant difference in height to 1st branch, total height, height to 1st capsule and total capsule. For 2014/2015 (Table 2) statistically significant differences were detected for number of branches for both sites Naliendele and Nachingwea (Table 2 and 3). Significant difference was not detected for other parameters in both sites, this means that application of sulphur and lime has no any effect in other parameters of sesame crop.

3.2 Effect of Sulphur and Lime on Yield Parameters

3.2.1 Number of Capsules per Plant and capsule on main stem

There were no significant difference on application of Sulphur and lime on the total number of capsules for both sites in both years (Table 1, 2 and 3), but the significant difference was detected on the number of capsules on the main stem at Naliendele sitefor both years (Table 1 and 2). This implies that application of Sulphur and lime have an impact on the number of capsules which will increase sesame seeds and as a matter of fact, the variety used (Lindi 02), genetically has less branches, therefore number of capsules on the main stem are very important in the yield of sesame seeds.

Table 1: Effect of sulphur and Lime on sesame seed yield and yield components 2013/2014

Treatments	Ht to st Bra (cm)	Ht to st caps(cm)	Total height (cm)	Branches	Capsules on main stem	Total caps	Final stand	1000 seed wt (g)	Seed yield (kg/ha)
CONTROL	28	51	113	2	11	28	75	3.0	361
LIME	29	52	106	2	14	30	84	2.8	726
LIME S1	25	42	92	2	11	21	46	2.9	562
LIME S2	31	46	106	2	12	30	96	3.1	523
LIME S3	31	55	106	2	14	30	57	3.1	523
S1	26	46	104	2	15	26	65	3.0	359
S2	27	45	98	3	13	25	71	2.9	380
S3	27	47	103	2	12	28	90	2.7	458
Mean	**28**	**48**	**103**	**2**	**13**	**27**	**73**	**2.9**	**486**
CV %	**21.2**	**13.3**	**13.1**	**22.9**	**16.1**	**18.7**	**26.7**	**7.5**	**27.0**
LCD	**10.4**	**11.2**	**23.6**	**0.9**	**3.6**	**8.9**	**34.1**	**0.4**	**230.3**
P=0.05	**NS**	**NS**	**NS**	**NS**	**NA**	**NS**	**NS**	**NS**	*****

Table 2: Effect of Sulphur and Lime on seed yield component - Naliendele 2014/15

Treatments	Ht to st Bra (cm)	Ht to st caps(cm)	Total height (cm)	Branches	Capsules on main stem	Total caps	Initial stand	Final stand	Seed yield (kg/ha)	1000 seed wt (g)
CONTROL	46	67	126	4	13	20	72	70	471	2.8
LIME	47	67	118	5	23	38	66	63	823	3.0
LIME S1	43	58	109	4	18	30	64	61	679	3.0
LIME S2	49	62	118	4	16	30	70	68	661	3.0
LIME S3	49	68	122	5	17	30	67	64	623	3.0
S1	44	62	121	4	18	26	73	70	498	3.1
S2	45	61	120	4	16	25	78	76	499	3.0
S3	45	63	118	4	15	28	79	77	605	2.8
Mean	**46**	**64**	**119**	**4**	**17**	**28**	**71**	**69**	**607**	**3**
CV %	**10.4**	**11.3**	**20.79**	**8.22**	**3.5**	**9.77**	**10.78**	**12.0**	**19.3**	**3.3**
LCD	**12.9**	**10.1**	**9.95**	**0.62**	**11.7**	**19.7**	**8.68**	**10.0**	**205.3**	**0.2**
P=0.05	**NS**	**NS**	**NS**	*	**	**NS**	**NS**	**NS**	*	*

Table 3: Effect of sulphur and Lime on seed yield component-Nachingwea 2014/15

Treatments	Ht to st Bra (cm)	Ht to st caps(cm)	Total height (cm)	Branches	Capsules on main stem	Total caps	Initial stand	Final stand	Seed yield (kg/ha)	1000 seed wt (g)
CONTROL	26	47	110	4	16	27	79	77	721	2.8
LIME	27	46	104	6	18	41	83	81	1185	3.0
LIME S1	24	39	97	5	25	35	77	75	960	3.0
LIME S2	29	41	104	4	16	41	81	79	939	3.0
LIME S3	29	51	103	5	19	41	75	74	953	3.1
S1	18	39	111	4	21	37	73	72	717	3.0
S2	26	41	98	5	16	36	76	74	831	3.0
S3	26	42	104	4	18	39	85	84	736	2.7
Mean	**26**	**43**	**104**	**4**	**19**	**37**	**79**	**77**	**880**	**2.9**
CV %	**12.9**	**10.14**	**18.8**	**9.03**	**3.8**	**12.6**	**16.2**	**11.3**	**16.7**	**5.1**
LCD	**28.8**	**13.33**	**10.3**	**0.71**	**11.6**	**8.1**	**11.8**	**15.3**	**257.2**	**0.3**
P=0.05	**NS**	**NS**	**NS**	**	**NS**	**NS**	**NS**	**NS**	*	**NS**

3.2.2 Effect of Sulphur and Lime on Seed Yield

Results showed that there was a significant difference in seed yield following application of lime (Table 4). On the other hand, Sulphur application did not show any significant effect on seed yield. However, the highest seed yield (605kg ha^{-1}) was obtained with 45 kg sulphur ha^{-1} for Naliendele and the seed yield for this site was higher than that of the previous season and 831 for Nachingwea with 30kgsulphur/ha. The significantly higher seed yield (823 kg ha^{-1}) for Naliendele and 1185 kg ha^{-1} for Nachingwea were obtained when lime (37.5kgha^{-1}) was applied over the control which mean yield was 596kgha^{-1}

Table 4: Effect of Sulphur and Lime application 2014-2015: Yield (kg ha^{-1}) across sites

Treatment	Nachingwea	Naliendele	Mean
CONTROL	721	471	596
LIME	1185	823	1004
LIME S1	960	679	820
LIME S2	939	661	800
LIME S3	953	623	788
S1	717	498	608
S2	831	499	665
S3	736	605	670
Mean	**880**	**607**	**744**
CV %	**16.7**	**19.3**	**17.4**
LSD	**257.2**	**205.3**	**215.9**
P=0.5	*	*	

Basing on seed yield, there were highly significant differences for both sites in both years.As noted from the mean separation test (Appendix 3), this significant differences were neither due to sulphur application nor the interaction of sulphur and lime, but were caused by the application of Lime alone. This indicates that, for sandy soil with low pH need to apply lime in order to neutralize soil acidity and to increase production of sesame crop this is due to reason that sesame thrives best on well-drained, fertile soils of medium texture and neutral pH. A pH of 5.6 or above is satisfactory.

4.0 Conclusions and Recommendations

The positive response between Lime application and yield of sesame was noticed in this study. The number of branches per plant, number of capsules in main stem was found to be higher with the application of Lime. The seed yield was much influenced by the application of lime. At the rate of 37.5 kg ha^{-1} seed yield was significantly higher. For application of Sulphur there were no any significant different detected. From above findings therefore, it is recommended to conduct more studies by employing different rates of lime (since only one rate, 37 kg ha^{-1}, was used) in order to come up with optimum rate for optimum and increased sesame yield.

5.0 Acknowledgements

We acknowledge the Government of Tanzania for funding this study. We also thank all who reviewed this paper and provided valuable advice. Finally, we thank staff members of Oilseeds and Grain Legume sub program at Naliendele Agricultural Research Institute for their assistance in the field work

REFERENCES

Anonymous. (2008). World Sesame situation, American Sesame Growers Association.

Bedigian, B. (2004). History and Rule of sesame in Southwest Asia. *Economic Botany* 58(3): 329-353.

Oplinger, E.S., Putnam, D.H., Kaminski, A.R., Hanson, C.V., Oelke, E.A., Schulte, E.E. and Doll, J. (1990). "*Sesame: Field Manual*. Purdue University

Food and Agricultural Organisation of the United Nations (2015). FAOSTAT Database. Available on-line *at <http:/apps.fao.org/default.htm>*.

Govindarasu, R., Sivasubramanian, P. and Manian, K. (1998). Analysis of seed yield and yield components in sesame at coastal Karaikal. *J. Indian Soc. Coastal Agric. Res.,* 7: 95-97.

Kathiresan, G. (2002). Response of sesame (*Sesamum indicum*) genotypes to levels of nutrients and spacing under different seasons. *Indian J. Agron.,* 47: 537-540.

Meng Cifu, Lu, Xiaonga,Cao Zhihong, Hu Zhengy and Ma Wanzhu. (2004). Long term effect of Lime application on soil acidity and Crop Yield in Central Zhejiang. *Springe J. Plant and Soil*., 265: 101-109

Morris, J.B. (2002). Food, industrial, nutraceutical, and pharmaceutical uses of sesame genetic

Nagavani, A.V., Sumathi, V., Chandrika, V. and Babu, A.M. (2001). Effect of nitrogen and sulphur on yield and oil content of sesame (*Sesamum indicum L*.). *J. Oilseed Res*., 18: 73-77.

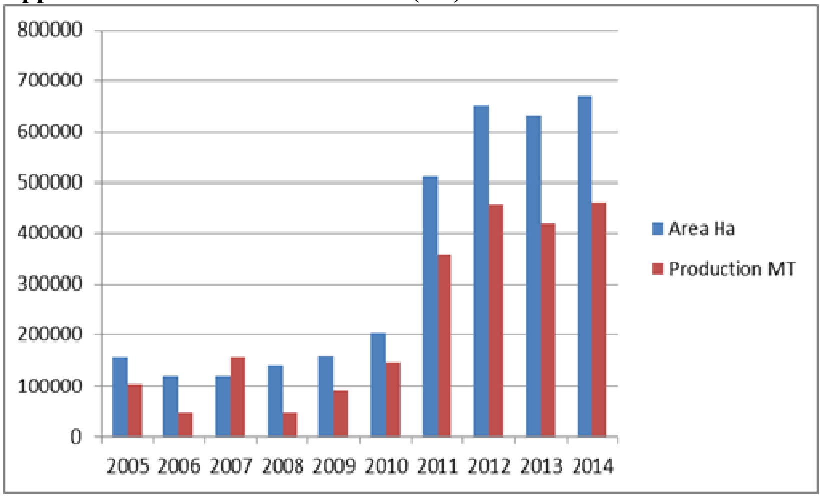
Sarkar, R.K. and Banik, P. (2002). Effect of planting geometry, direction of planting and sulphur application on growth and productivity of sesame (*Sesamum indicum*). *Indian J. Agric. Sci*., 72: 70-73.

Thakur, D.S. and Patel, S.R. (2004). Response of sesame to different levels of potassium and sulphur in light textured inceptisols of eastern part of Chattisgarh. *Indian J. Agric. Sci*., 74: 496-498.

Tiwari, K.N. and Gupta, B.R. (2006). Sulphur for sustainable high yield Agriculture in Uttar Pradesh. *Indian J. Fert. News,* 1: 37-52.

Tiwari, R.C., Namdeo,K. and Girisha, K.N. (2000). Effect of nitrogen and sulphur on growth, yield and quality of sesame varieties. *Res. Crops*, 1: 163-167.

Appendix 1: Tanzania Sesame area (Ha) and Production MT 2005-2014



Source: FAOSTAT 2015

Appendix 2: Soil characteristics of Naliendele and Nachingwea

Site	Depth	pH (H_2O)	pH(KCL)	N (%0	OC (%)	Ca^{2+}	Mg^{2+}	K^+	Na^+
Naliendele	0-20	5.2	4.3	0.04	0.62	2.13	0.38	0.25	0.17
Nachingwea	0-20	5.2	4.3	0.05	0.56	1.20	0.64	0.18	0.05

Appendix 3: Means separation of sesame seed yield
Means separation on seed yield - Naliendele 2013/2014

IdentifierMean			
LIME	726.0	|	
LIME S1	562.0	|	|
LIME S2	522.7	|	|
LIME S3	522.7	|	|
S3	458.0		|
S2	380.0		|
CONTROL	360.7		|
S1	358.7		|

Means separation for seed yield- across sites 2014/2015

Identifier	Mean		
CONTROL	596	|	
S1	607.7	|	
S2	664.7	|	
S3	670.3	|	
LIME S3	788.3	|	|
LIME S2	800	|	|
LIME S1	819.7	|	|
LIME	1003.7		|

First Author (Happy Makuru Daudi) was born Dar es salaam Tanzania 1983, went to Sokoine University of Agriculture, Morogoro Tanzania, where he obtained MSc in Plant breeding 2014 and Bachelor of Science in Agronomy 2008. His cureent research interests are in oilseed crops and grain legume. She works at Naliendele Agriculture Research Institute which located Mtwara, Tanzania under Ministry of Agriculture, Livestock and Fisheries.