International Journal of Plant & Soil Science

Volume 36, Issue 8, Page 817-822, 2024; Article no.IJPSS.120872
ISSN: 2320-7035

Effect of Sulphur Sources and Levels on Yield and Quality of Summer Cowpea in Middle Gujarat, India

Mayur P. Ramani [a++*], K. M. Gediya [b#], K. N. Rana [c†] and Maheshvari M. Birari [d‡]

[a] Directorate of Research, Anand Agricultural University, Anand, Gujarat, India.
[b] Bidi Tobacco Research Station, Anand Agricultural University, Anand, Gujarat, India.
[c] Krishi Vigyan Kendra, Navsari Agricultural University, Vyara, Gujarat, India.
[d] Office of the Assistant Director of Agriculture (T & V Scheme), Dharmpur, Valsad, Gujarat, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/ijpss/2024/v36i84912

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/120872

Original Research Article

Received: 04/06/2024
Accepted: 06/08/2024
Published: 13/08/2024

ABSTRACT

A field experiment was conducted at Bidi Tobacco Research Station, Anand Agricultural University, Anand, during summer 2013–2014 to investigate the "Effect of sources and levels of sulphur on green pod yield of summer cowpea (*Vigna unguiculata* L. Walp) under middle Gujarat conditions. Nine treatment combinations comprising of three sources of sulphur (Gypsum, Bentonite and

[++] *Agriculture Officer;*
[#] *Associate Research Scientist (Ret.);*
[†] *Scientist (Agronomy);*
[‡] *Assistant Director of Agriculture (Plant Protection);*
**Corresponding author: E-mail: mayurakbari99@gmail.com;*

Cite as: *Ramani, Mayur P., K. M. Gediya, K. N. Rana, and Maheshvari M. Birari. 2024. "Effect of Sulphur Sources and Levels on Yield and Quality of Summer Cowpea in Middle Gujarat, India". International Journal of Plant & Soil Science 36 (8):817-22. https://doi.org/10.9734/ijpss/2024/v36i84912.*

Elemental sulphur), and three levels of sulphur (10, 20 and 30 kg ha^{-1}) along with one control were tried out in a Randomized Block Design (Factorial) with four replications. Different sources of sulphur did not show their significant influence on number of green pods $plant^{-1}$, number of seeds pod^{-1}, length of pod, total green pod yield, dry stover yield and dry weight of root nodules $plant^{-1}$. However numerically higher values of total green pod and dry stover yields were obtained due to source of Gypsum. Quality parameters viz., protein content, crude fiber content and chlorophyll content of leaves showed that different sources of sulphur did not reach at a level of significance. Even though, the highest protein content in seeds and higher crude fiber content were recorded due to application of 30 kg S/ha. Whereas, chlorophyll content in leaves at 30 and 60 DAS was not affected significantly due to different sources and levels of sulphur. But, rest of the treatments registered significantly the maximum values of yields and yield as well as quality parameters of cowpea. Vegetable Cowpea could be secured by applying sulphur @ 20-30 kg S/ ha through Gypsum or Bentonite during summer season under middle Gujarat conditions.

Keywords: Yield; sources; sulphur; cowpea.

1. INTRODUCTION

Cowpea, also known as black-eyed pea or southern pea, is an annual plant in pea family (*Fabaceae*) farmed for its edible legumes. The plants assumed to be native to West Africa are commonly cultivated in tropical and subtropical climates around the world. Cowpeas are widely produced as a hay crop, as well as a green manure or cover crop, in addition to being a protein-rich food crop**,** forage, fodder, green manuring and vegetable**.** Cowpea is recognized for its drought tolerance; its wide and droopy leaves store soil and soil moisture due to its shading effect. Cowpea seed is a nutritious component of human diet as well as a low-cost cattle feed. Green and dried seeds are both acceptable for canning and boiling. It is a minor pulse cultivated primarily in arid and semi-arid parts of Punjab, Haryana, Delhi, and West UP, as well as a significant area in Rajasthan, Karnataka, Kerala, Tamilnadu, Maharashtra, and Gujarat. Cowpea seeds have 0.1% fat, 24.1% protein and 54.5% carbohydrate. Additionally, it is a good source of calcium, iron and phosphorus [1]. Being a component of amino acids cysteine, cystine and methionine, sulfur plays a crucial part in production of proteins, oils, coenzymes, and enzymes as well as synthesis of chlorophyll. Despite the fact that crops absorb almost as much sulfur as phosphorus, there is diversity among many crop species [2,3]. Sulphur is now correctly referred to as 4^{th}essential plant nutrient after nitrogen, phosphorus and potassium. Sulphur is a developing plant nutrient that is essential for pulse crops. It is absorbed by plants in the form of sulphates from the soil. Sulphur plays an important role in total pulse production by boosting protein content, nodule development and plant biomass through the synthesis of sulphur-containing amino acids [4-7]. Use of S-free fertilizers, sparing use of organic matter, intense farming with high yielding cultivars and increased irrigation infrastructure are the main causes of sulphur deficit in soils and crops [8]. Sulphur content in soils of Gujarat is about 37% below average. Therefore, it’s necessary to study the Effect of sources and levels of sulphur on green pod yield of summer cowpea (*Vigna unguiculata* L. Walp) under middle Gujarat conditions.

Objectives:

- To study the effect of level and sources of sulphur on green pod yield and quality of summer cowpea.

2. MATERIALS AND METHODS

During summer season of 2013–2014, a field experiment was carried out in plot No. 7–A at Bidi Tobacco Research Station, Anand Agricultural University, Anand (Gujarat) to investigate the effect of sulphur sources and levels ongreen pod yield of summer cowpea (*Vigna unguiculata* L.) under middle Gujarat condition. The soil in experimental field had a loamy sand texture, low levels of accessible nitrogen (190.10 kg/ ha) and organic carbon (0.39%), medium levels of phosphorus (45.70 kg/ ha) and potash (280 kg/ ha) and low levels of sulphur (9.50 mg/ kg). Cowpea variety AVC1 was grown to investigate the effects of treatments, which included three sulphur sources, S_1- Gypsum, S_2- Bentonite, and S_3- Elemental Sulphuras as well as three doses of Sulphur, L_1- 10 kg S/ ha, L_2- 20 kg S/ ha, and L_3- 30 kg S/ ha. Nitrogen and phosphorus were supplied using urea and DAP, respectively. Each plot received a basic application of these fertilizers in opened furrows. Soil was treated with elemental sulfur two weeks prior to seeding. Bentonite and gypsum were added to the soil as part of treatment. Green pods from border row plants were harvested first and all of the green pods from each net plot were then gathered, weighed and recorded. Total green pod yield, which was then converted into kg/ha, was calculated by adding green pod yield data from four pickings. Cowpea was shown on March 21, 2013, with a seed rate of 25 kg/ha.

3. RESULT S AND DISCUSSION

3.1 Effect of Treatments on Yield and Yield Attributes

Effect of sources of sulphur: Results summarized in Table 1 indicated that different sources of sulphur failed to exert their significant influence on different yield and yield attributing characters viz., number of green pods per plant, length of pod, number of seeds per pods, total output of green pods and yield of dry stover as well as dry weight of root nodules per plant. Eventhough,an application of Gypsum as a source of Sulphur produced significantly longer green pods as compared to Bentonite application [9].

Effects of levels of sulphur: Information provided in Table 1 proved that varying amounts of sulphur had a substantial impact on many yield metrics, including number of green pods per plant, length of pod, number of seeds per pod, total yield of green pods, yield of dry stover and dry weight of root nodules per plant. Additionally, according to the results regarding various yield attributing parameters, an application of sulfur@ 30 kg S/ha established their superiority over both the lower levels of sulphur (10 and 20 kg S/ha) by recording significantly the highest values for number of green pods per plant, length of pod, and number of seeds per pod. With regard to green pod yield, significantly higher total green pod yield was produced with an application of 30 kg S/ha but it was comparable with optimum level of sulphur (20 kg S/ha). However, upper level of sulphur (30 kg S/ha) established its superiority over both the lower levels of sulphur (10 and 20 kg S/ha) by recording the highest values of dry strover yield and dry weight of root nodules per plant [10].

Table 1. Effect of different sources and levels of sulphur on yield and yield attributes of summer cowpea

Treatment	No. of green pods/ plant	No. of seeds/ pod	Length of pod (cm)	Yield (kg/ ha)		Dry weight of root nodule (mg/ plant)
				Total green pod	Dry stover	
Sources of sulphur (S)						
S_1: Gypsum	73.25	11.73	12.39	6482	6358	87.36
S_2: Bentonite	69.75	11.20	11.49	6068	5958	81.59
S_3: ES	70.33	11.54	12.02	6316	6100	84.88
S. Em. ±	1.65	0.39	0.25	177.5	157.0	2.65
CD(P=0.05)	NS	NS	0.71	NS	NS	NS
Levels of sulphur (L)						
L_1 : 10 kg/ ha	68.83	10.59	11.57	5818	5833	80.61
L_2 : 20 kg/ ha	69.83	11.13	11.71	6382	6083	83.11
L_3 : 30 kg/ ha	74.67	12.75	12.63	6667	6500	90.11
S. Em. ±	1.65	0.39	0.25	177.5	157.0	2.65
C. D. at 5%	4.79	1.13	0.71	515.1	455.5	7.70
Control v/s Rest						
Control	64.25	9.50	10.75	5495	5325	74.30
Rest	71.11	11.49	11.97	6289	6139	84.61
S.Em. ±	3.01	0.71	0.45	324	287	4.84
CD (P=0.05)	6.18	1.46	0.92	665.0	588.0	9.94
Interaction (S x L)						
CD (P=0.05)	NS	NS	NS	NS	NS	NS
CV%	7.53	12.38	7.51	8.74	8.13	10.49

Effect of control v/s rest: Data illustrated in Table 1 indicated that significantly the highest values of different yield and yield attributing characters viz., number of green pods per plant, length of pod, number of seeds per pod, total green pod yield, dry stover yield and dry weight of root nodules per plant were registered under the treatment of rest.

Interaction effect: All possible interactions between different sources and levels of Sulphur could not establish their significant influence on yield attributing characters (Table 1).

3.2 Effect of Treatments on Quality Parameters

Protein content in green seed: Data pertaining to protein content (%) in green seeds as influenced due to different sources and levels of sulphur and their interaction effect are presented in Table 2.

It was evident from the data presented in Table 2 that different sources of sulphur did not reach to a level of significance on protein content in seeds. Further. The data revealed that significantly the highest protein content in seeds (21.86%) was recorded under level L_3 (30 kg ha$^{-1\%}$). Whereas significantly lower protein content in seeds (20.04%) was found under level L_1 (10 kg ha^{-1}) which was at par with level L_2 (20 kg ha^{-1}, 20.44%).

The result indicated in Table 2 revealed that protein content in seeds was found significantly the highest (20.78%) under treatment of rest whereas significantly the lowest protein content in seeds (18.53%) was found due to treatment control.

An interaction effect between different sources and levels of Sulphur (S x L) on protein content of green seed of vegetable cowpea was found non-significant (Table 2).

Crude Fiber content in green seed: The result pertaining to crude fiber content (%) in green pod as influenced due to different sources and levels of sulphur are illustrated in Table 2.

A perusal of data presented in Table 2 revealed that different sources of sulphur failed to reach at significant level on crude fiber content in green seed. Whereas, significantly higher crude fiber content in green pod (15.53%) was recorded under level L_3 (30 kg ha^{-1}), which was at par with level L_2 (20 kg ha^{-1}, 15.24%). While, significantly the lowest crude fiber content in green pod (13.86%) was found under level L_1 (10 kg ha^{-1}).

Table 2. Protein content and crude fiber content in seed as influenced by sources and levels of sulphur in cowpea

Treatment	Protein content (%)	Crude fiber content (%)
A. Sources of sulphur (S)		
S_1 : Gypsum	21.33	15.50
S_2 : Bentonite	20.21	14.17
S_3 : Elemental sulphur	20.80	14.95
S. Em. ±	0.47	0.41
C. D. at 5%	NS	NS
B. Level of sulphur (L)		
L_1 : 10 kg ha^{-1}	20.04	13.86
L_2 : 20 kg ha^{-1}	20.44	15.24
L_3 : 30 kg ha^{-1}	21.86	15.53
S. Em. ±	0.47	0.41
C. D. at 5%	1.37	1.19
Control v/s Rest		
Control	18.53	12.88
Rest	20.78	14.88
S. Em. ±	0.86	0.75
C. D. at 5%	1.77	1.54
Interaction (S x L)		
C. D. at 5%	NS	NS
C. V.%	8.23	9.51

The result indicated in Table 2 revealed that crude fiber content in green pod was significantly the highest (14.88%) under treatment of rest whereas significantly the lowest crude fiber content in green pod (12.88%) was found due to treatment control.

An interaction effect between different sources and levels of Sulphur (S x L) on crude fiber content of green seed was found non-significant (Table 2).

Chlorophyll content of leaves: The data related to chlorophyll content of leaves (mg g^{-1} fresh weight) at 30 and 60 DAS as influenced due to different sources and levels of sulphur are illustrated in the Table 3.

Chlorophyll content of leaves at 30 DAS: A perusal of data presented in Table 3 revealed that different sources and levels of sulphur treatments failed to reach at significant level on chlorophyll content of leaves recorded at 30 DAS.

The result indicated in Table 3 revealed that chlorophyll content of leaves was found significantly the highest (1.68 mg g^{-1}) under treatment of rest whereas significantly the lowest chlorophyll content of leaves (1.51 mg g^{-1}) was found due to treatment control.

The statistical analysis of the data presented in Table 3 revealed that chlorophyll content of leaves was not influenced significantly due to an interaction effect (S x L) between different sources and levels of sulphur.

Chlorophyll content of leaves at 60 DAS: An appraisal of data presented in Table 3 revealed that sources and levels of sulphur failed to reach at significant level with respect to chlorophyll content of leaves at 60 DAS.

The result indicated in Table 3 revealed that chlorophyll content of leaves was found significantly the highest (1.56 mg g^{-1}) under treatment of rest whereas significantly the lowest chlorophyll content of leaves (1.41 mg g^{-1}) was found due to treatment control.

Interaction effect between different sources and levels of sulphur on chlorophyll content was found non-significant (Table 3).

Table 3. Chlorophyll content of leaves at 30 and 60 DAS as influenced by sources and levels of sulphur in cowpea

Treatment	Chlorophyll content in leaves (mg g^{-1})	
	30 DAS	**60 DAS**
A. Sources of sulphur (S)		
S_1 : Gypsum	1.70	1.58
S_2 : Bentonite	1.66	1.53
S_3 : Elemental sulphur	1.66	1.57
S. Em. ±	0.04	0.02
C. D. at 5%	NS	NS
B. Level of sulphur (L)		
L_1 : 10 kg ha^{-1}	1.64	1.55
L_2 : 20 kg ha^{-1}	1.66	1.54
L_3 : 30 kg ha^{-1}	1.73	1.59
S. Em. ±	0.04	0.02
C. D. at 5%	NS	NS
Control v/s Rest		
Control	1.51	1.41
Rest	1.68	1.56
S. Em. ±	0.08	0.05
C. D. at 5%	0.16	0.09
Interaction (S x L)		
C. D. at 5%	NS	NS
C. V.%	9.20	5.69

4. CONCLUSION

According to aforementioned study, an application of sulphur at 20–30 kg S/ha resulted in significantly greater protein contain, crude fiber and total green pod yield values of cowpea as compared to application of 10 kg S/ ha.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Anonymous. Directorate of Pulse Development (Bhopal) Annual Progress Report, Integrated Scheme of Oilseed, Pulses, Oil palm and Maize (ISOPOM) – Pulses; 2007.
2. Singh SP, Kumar YO, Singh SO. Effect of sources and levels of sulphur on yield, quality and uptake of nutrients in green gram (Vigna radiata). Annals of Plant and Soil Research. 2017; 19(2):143-7.
3. Singh R, Pratap T, Singh D, Singh G, Singh AK. Effect of phosphorus, Sulphur and biofertilizers on growth attributes and yield of chickpea (*Cicer arietinum* L.). Journal of Pharmacognosy and Phytochemistry. 2018; 7(2):3871-5.
4. Kodavali MR, Khurana MP. Sulphur and its significance in higher pulse production. Environment Conservation Journal. 2022 May 29;23(3):367-73.
5. Arunraj M, Vasanthi D, Mansingh MD. Effect of sulphur on growth and yield of greengram [*Vigna radiata*]. International Journal of Science, Environment and Technology. 2018; 7(5):1861-7.
6. Yadav A, Kumawat A, Meena PK, Yadav D, Choudhary S, Khangarot AK. Impact of different sources of phosphorus and sulphur levels on growth, yield attributes and performance of chickpea under light textured soil. Journal of Experimental Agriculture International. 2024;14;46(6): 575-82.
7. Sahu S, Shankar T, Maitra S, Adhikary R, Mondal T, Duvvada SK. Impact of phosphorus and sulphur on the growth and productivity of green gram (*Vigna radiata*). Research on Crops. 2021;22(4):785-91.
8. Tandon HLS. Sulphur Research and Agricultural Production in India (3rdedn), Fertilizer Development and Consultation Organization, New Delhi; 1991.
9. Bandopadhyay P, Samui RC. Response of groundnut (*Arachis hypogaea*) cultivars to levels and sources of sulphur in West Bengal. Indian Journal of Agronomy. 2000; 45(4):761-764.
10. Tamak JC, Sharma HC, Singh KP. Effect of phosphorus, sulphur and boron on seed yield and quality of sunflower (*Helianthus annuus* L.). Indian Journal of Agronomy.1997; 42(1):173-176.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/120872