Influence of sources and levels of sulphur on green pod yield and quality of summer cowpea (*Vigna unguiculata* L. Walp) under middle Gujarat conditions

Abstract :

A field experiment was conducted at Bidi Tobacco Research Station, Anand Agricultural University, Anand, during summer2013–2014 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. Different sources of sulphur did not reach to a level of significance on protein content in seeds.Even though, 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 %). Quality parameters viz., protein content, crude fiber content and chlorophyll content of leavesshowed that different sources of sulphur did not reach at a level of significance. Vegetable Cowpea1 could be secured by applying sulphur @ 20-30 kg S/ ha through Gypsum or Bentonite during summer season under middle Gujarat conditions.

Key word: Yield, Sources, Sulphur and Cowpea

……………………………………………………………………………………….

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 (Anon., 2007). 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. Sulphur is now correctly referred to as 4thessential 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. 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 (Tandon, 1991). 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.

MATERIAL AND METHOD

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 Sulphurasaswell 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 sown on March 21, 2013, with a seed rate of 25 kg/ha.

RESULT AND DISCUSSION

Impact of sources of sulphur

Results summarized in Table 1indicated that different sources of sulphur failed to exert their significant influence on different yield and yield attributing characters viz., numberof 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 sulphurproduced significantly longer green pods as compared to Bentonite application (Bandopadhyay and Samui, 2000).

Effects of levels of sulphur

Information provided in Table 1provedthat 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 regardingvarious yieldattributing parameters, an application 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. (Tamak*etal*. 1997).

Effect of control v/s rest

Data illustrated in Table1 indicated that significantly the highest values of different yield and yield attributing characters (Table1) 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 sulphurcould not establish their significant influence on yield attributing characters (Table 1).

Table1: Interaction effect of different sources and levels of sulphuron 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 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 indicated 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}).

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.

Table2: 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

Chlorophyll content of leaves at 60 DAS

An appraisal of data presented in Table 3revealed that sources and levels of sulphur treatments 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 DASas influenced bysources and levels of sulphur incowpea

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

CONCLUSION

According to aforementioned study, an application of sulphurat 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.

REFERENCES

Anonymous (2007). Directorate of Pulse Development (Bhopal) Annual Progress Report, Integrated Scheme of Oilseed, Pulses, Oil palm and Maize (ISOPOM) –Pulses.

Bandopadhyay P. and SamuiR. C. (2000). Response of groundnut (*Arachishypogaea*) cultivars to levels and sources of sulphur in West Bengal. ***Indian Journal of Agronomy,***45(4): 761-764.

Tamak J. C., Sharma H. C. and Singh K. P. (1997). Effect of phosphorus, sulphur and boron on seed yield and quality of sunflower (*Helianthus annuus* L.). ***Indian Journal of Agronomy*,** 42(1): 173-176.

Tandon H. L. S. (1991). Sulphur Research and Agricultural Production in India (3rdedn), Fertilizer Development and Consultation Organization, New Delhi.