Influence of sulfur coated urea and algae fertilization on productivity of some leguminous crops in sandy soils

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Abstract

Background: This studies the influence of algae and coated urea fertilization on the productivity of some leguminous crops in order to reach the best methods of fertilization to get on highest productivity in sandy soils.

Results: The results proved that both yield and its components a better result in the focus of the SCU + algae than utilizing sulfur-coated fertilizers and algae in both seasons. A large amount extreme yield and straw yield were established with the algae treatment. The outcomes uncovered that SCU + algae improved plant productivity and quality soybean and mungbean seeds. The utilization of SCU + algae expanded protein, carbohydrates and oil %, compared with sulfur-coated urea and algae.

Conclusion: Along these lines, it could be finished from the results that of SCU + algae with 60 kg N/fed observed to be the best portion to accomplish or gain with exertion the greatest quality.

Keywords: Sulfur-coated fertilizers (SCU), Algae, Soybean, Mungbean

Background

Soybean [*Glycine max* (L.) Merrill] is a standout among the mainly significant protein and oilseed crops all through the world. Its oil is the largest piece of the worlds ready to be eaten oils. Soybean is otherwise called the Golden bean or Miracle crop on account of its different employments. The mungbean legume crop is successfully absorbable, worthy to eat, nutritive, and no bombast. It is wealthy in absorbable protein (25–28%), oil (1.0–1.5%), fiber (3.5–4.5%), ash (4.5–5.5%) and carbohydrates (62–65%), vitamin C, folic acid, thiamine, iron, zinc, potassium, magnesium, copper, manganese, phosphorus an enemy of nourishing changeable that is the primary storage form of regular phosphorus in seeds (Sahar 2017). It assumes a significant job in the dirt prosperity by fixing the air, nitrogen (Dhole and Reddy 2015). The outcomes demonstrated that algae application to improve the physiological exhibition of plants (Dela et al. 1988).

Microorganisms assume a significant role in soil forms that decide the plant productivity. There are a lot of soil microorganisms like Blue green algae, which can be utilized to increase the productivity of the plants (Goel et al. 1999; Fernandes and Bhalerao 2015). Natural manure means to improve biodiversity, biological cycles and soil biological faction to accomplish perfect characteristic frameworks that are socially, environmentally and economically sustainable (Samman et al. 2008). Nikhil (2014) showed that algae are limitless and various gatherings of basic, autotrophic living beings, running from unicellular to multicellular structure. Most of them can direct photosynthesis, and energy is changed into sugar, subsequently become biomass. Ruby and Mala (2014) found that the control, fertilizers have quickened the protein action amid germination and it was in charge of the observed addition in seed vigor index of mungbean. Bio-fertilizers are minimal attempt, inexhaustible sources of plant nutrients which supplement chemical fertilizers. Bio-fertilizer

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is a standout among the greatest and current apparatuses for agriculture, and they are also financially effective and inexhaustible source of energy for plants and to help in decreasing the utilization of chemical fertilizers for practicable farming (Wahane et al. 2020). It contains every one of the nutrients and plant development hormones, which is necessary for plants to improve yield (Latique et al. 2013).

The capacity of clear kinds of blue-green algae completes both photosynthesis and nitrogen fixation, which provide them biological and agricultural inclinations a different sort of bio-fertilizer, which can improve soil structure, mostly saline alkaline soil and increase the yielding and quality of crops. They are valuable in water refinement to some degree (Gupta et al. 2015). Algae improve soil structure and increment yield productivity regardless of whether connected in a little zone. The employment of algae in plants has brought about increment in root, shoot length with a number of leaves and thus by and a large improvement of the plant has been expanded (Vyomendra and Kumar 2016). Essa et al. (2019) showed that all forms of coated urea extended seed yields and straw yield by 3–16% and 2–18% independently for mungbean. The goal of this is to research the impact of algae and sulfur-coated urea (SCU) on yield and quality of soybean and mungbean under sandy soil conditions.

Methods

Two field experiments were approved out in two successive summer seasons, 2017 and 2018 at a private farm in Wadi El-Natroun, El-Behaira Governorate, Egypt. The goal of the study is to study the efficiency of sulphur coated urea (SCU) and algae fertilization on the yield and quality of soybean and mungbean under sandy soil conditions.

A representative surface soil sample (0–30 cm) was taken from experimental field before growing and after harvesting for each season to determine physical and chemical properties of the soil (Table 1), as well as the chemical analysis of the irrigated water.

The field experiments in both seasons were conducted under drip irrigation system with 30 cm distance between drippers (2 L/hour) and 60 cm between rows. The plot size was 15 m^2 (1/280 fed). Each plot consisted of five ridges 5 m long and 0.6 m wide. The irrigation system was settled at 3–4 day intervals. The experimental design was split-plot design in a randomized complete block arrangement with three replications. Fertilizers were allocated to the main plots, while rates of treatments were distributed at random in the subplots.

Well water was used for irrigating the experiments in order to maintain the soil moisture at about 60–70% of the soil water holding capacity (Table 2). To bring leaching, the experiment was occasionally irrigated with excess water. Metrological data for the growing period are given in (Table 3).

Soybean and mungbean were sown in May 15 in the 1st and 2nd seasons. Soybean (Giza 35) and mungbean (Kawmy-1) seeds were inoculated previous to sowing with the specific strain of *Rhizobium japonicum*. Soybean and mungbean in the rate of 30 kg/fed (fed = 4200 m^2) were sown one side of the ridge in the hills 15 cm apart,

Table 1 Physico-chemical properties of the preferred experimental site during the two seasons

Growing season	Particle size distribution (%)				OM (%)	CaCO$_3^-$ (%)	pH	EC (dSm^{-1})
	Sand	Silt	Clay	Texture				
2017	85.15	9.07	5.78	Sandy	0.23	1.39	8.84	1.35
2018	83.76	10.02	6.22	Sandy	0.35	1.33	7.78	1.20
Growing season	Cations (1:2) (meq/L)				Anions (1:2) (meq/L)				NPK available (mg/kg)		
	Ca^{++}	Mg^{++}	Na$^+$	K$^+$	CO$_3^=$	HCO$_3^-$	Cl$^-$	SO$_4^=$	N	P	K
2017	2.20	1.70	5.50	1.60	0.00	2.35	7.35	1.30	33.22	72.34	115.42
2018	2.15	1.72	5.25	1.63	0.00	2.20	7.30	1.25	23.28	79.34	98.22

Table 2 Chemical analysis of irrigation water. (Average of two years)

pH	EC dSm^{-1}	Soluble cations (mg/L)				Soluble anions (mg/L)			
		K$^+$	Na$^+$	Mg^{++}	Ca^{++}	CO$_3^=$	HCO$_3^-$	Cl$^-$	SO$_4^=$
7.60	0.86	3.14	3.06	6.00	7.00	0.00	4.15	0.60	14.45

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Table 3 Metrological data of the growing period (2017/2018)

Year	Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017	Min (°C)	9	9	11	13	17	20	23	23	21	18	14	11
	Max (°C)	18	19	21	24	27	29	30	30	30	28	24	20
2018	Min (°C)	9	9	11	14	16	20	23	23	21	17	14	10
	Max (°C)	18	19	20	24	27	29	30	30	30	28	24	20
2017	Prec.(mm)	55	30	15	4	1	0	0	0	1	9	30	55
	Days	11	9	6	2	1	0	0	0	0	3	5	10
2018	Prec.(mm)	51	27	13	4	1	0	0	0	1	11	29	52
	Days	11	7	6	2	1	0	0	0	0	3	7	10

and two plants/hill were left at thinning (21 days after sowing).

Phosphorus and potassium were additional at rate of 60 kg P_2O_5/fed and 50 kg K_2O/fed, respectively. Phosphorus was applied as a single super phosphate (15.5% P_2O_5) pre-sowing. Potassium was applied as potassium sulfate (48% K_2O) at 45 days after sowing in one dose. The second half portion of uncoated urea, sulfur-coated urea and algae were applied at two rates 30 and 60 kg/fed at 20 days after sowing in one dose as in Table 4.

Preparation of sulfur-coated urea fertilizer

Several attempts were made to produce sulfur-coated urea (SCU) through coating with materials imposing their function physically. Several laboratory trials were carried out to synthesize sulfur containing 20% pure coating material in a fine form. This was based on the idea of the physical incorporation of some completely soluble compounds containing N, such as urea, in a media of coating material.

Urea was heated for 20 min. and then receiving a mixture of conditioner and coating material, the whole being stirred for 30–40 min. to be finally removed to a drum. By heating to 70–80 °C and stirring again, the mixture in another drum was mixed with wax for 20–30 min. The final product was air-dried for one day, and sieved.

According to the method given by Trenkel (2010) and Essa (2015), the sulfur-coated urea was prepared at the field crops department included with soils and water use department, National Research Centre, Egypt.

Preparation of algae

The used algae in the present study *Spirulina platens* is a photosynthetic and multi-cellular blue green micro-algae which grows in wide range fresh, marine and brackish water. The fresh algae material (One kg) was cutted into small pieces and weighted. The sample was extracted using blender. The blended material was filtered through a double layered of muslin cloth to remove debris and designated as 100% (Marrez et al. 2014). Samples were air-dried during 2 4 days followed by thermostat dry at 60 °C for 12 h, and dried algae were hand-crushed grind. The source of algae fresh is Algae Biotechnology Unit, NRC, Egypt. The plants were applied SCU and algae after 20 days from sowing, and the untreated plants were applied with urea (Table 5).

Treatments nitrogen fertilizer rates were applied

1. Control (Urea) (46% N) 30 and 60 kg N/fed
2. Sulfur-coated urea (SCU) (33% N) 30 and 60 kg N/fed.

Table 4 Rates of application (kg N/fed) and total amount of fertilizers

Fertilizers	Formula	N (%)	Soybean		Mungbean	
			Rate (kg N/fed)	Amount (kg fert./fed)	Rate (kg N/fed)	Amount (kg fert./fed)
U	$O=C(NH_2)_2$	46.00	30	65	30	65
			60	130	60	130
SCU	$O=C(NH_2)_2 + S$	34.00	30	88	30	88
			60	176	60	176
Algae	–	11.50	30	260	30	260
			60	520	60	520

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Table 5 Chemical composition and mineral concentration of algae

Chemical composition (%)		Macronutrients (%)		Micronutrients (ppm)	
Moisture	6.42	Nitrogen	11.50	Iron	19.30
Protein	15.60	Phosphorus	1.15	Zinc	7.76
Ash	10.75	Potassium	1.96	Manganese	2.45
Fiber	4.51	Sodium	0.02	Lycine (mg/g)	18.86
Carbohydrates	20.82	Magnesium	0.11	Methionine (mg/g)	5.64

3. Algae (11.5% N) 30 and 60 kg N/fed.
4. Mixed (SCU + Algae) (50:50) kg N/fed.

Data recorded

At harvest (120 days after sowing), ten plants were taken randomly from the two central rows guarded (from all plots) to determine the following traits:

1. Plant height (cm) 2. Seed weight/plant (g).

All plants of each plot were harvested, and then, seed and straw yields (ton/fed) were determined by multiplying seed and straw yields/plot*280 (Kung et al. 2015).

Methods of analysis

For each plot, the following traits were done:

1. Method of soil analysis, physical and mineralogical properties according to Black (1982).
2. Method of soil analysis, chemical properties according to Black (1982).
3. Total nitrogen was determined by Kjeldahl method using the method described by Cottenie et al. (1982)
4. Crude Protein was calculated as N % × 6.25 according to the Association of Official Agricultural Chemists—A.O.A.C. (2000).
5. Total Carbohydrates were determined according to Dubois et al. (1956)
6. Seed oil percentage: the soxhlet continuous extraction apparatus with
7. petroleum ether (40–60 C) as an organic solvent was used to determine the oil seed percentage according to A.O.A.C. (2000).
8. Phosphorus was determined spectrophotometrically using the method described by Cottenie et al. (1982).

9. Potassium was determined using flame photometer as described by Cottenie et al. (1982).
10. Total carbon, organic carbon and organic matter were done according to Nelson and Summer (1982).
11. Statistical analyses were performed using the analysis of variance. The least significant differences LSD at 5% were used to compare between means. (Snedecor and Cochran 1990).

Results

Soybean

Yield attributes

The collected data in Table 6 show the result of fertilizers with SCU, algae and mixed on soybean yield and its components. Results cleared significant differences the three studied fertilizers concerning the yield and its component. However, SCU + algae (60 kg N/fed) agreed the top result of all yields and its component than SCU and algae in the two seasons.

On the other side, the differences between the fertilizers reached to the amount of significance in all yield and its components. It is worthy to mention that the superiority of SCU + algae fertilizers in all yield and its components had happened. However, SCU + algae fertilizers significantly affected all the individuality of soybean yield and its component compared to the control. The interaction stuck between algae and SCU was significant in the two seasons.

Data in Table 6 revealed that all treatments significantly increased straw yield/fed in both seasons. The increases of straw yield due to SCU + algae treatment more than the SCU and algae in the two seasons, respectively.

Generally, SCU + algae fertilizers resulted in height values of yield and its components compared with SCU and algae. It could be completed from the obtained results that SCU + algae with 60 kg N/fed found to be the majority helpful dose to achieve the highest yield and its components.

Seed quality attributes

The results presented in Table 7 indicated that adopted treatments of algae and SCU showed a helpful statistical result on the seed nitrogen percentage of the soybean in together growing seasons. It is realized from Table 7 that SCU, algae and mixed treatments significantly better grain, crude protein percentage of soybean seeds in both seasons. The maximum percentage of seed crude protein was recorded with SCU + algae in both seasons more than the SCU and algae treatment in the first and second season, respectively.

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Table 6 Effect of algae and sulfur-coated urea fertilizers on yield and yield component of soybean

Sources	Plant height (cm)		Mean	Seed yield /plant (g)		Mean	Seed yield (ton/fed)		Mean	Straw yield (ton/fed)		Mean
	30	60		30	60		30	60		30	60	
2017												
Control	88.67	89.33	**89.00**	12.33	12.33	**12.33**	0.79	0.81	**0.80**	1.33	1.35	**1.34**
SCU	97.00	116.00	**106.50**	14.74	20.02	**17.38**	0.94	1.33	**1.14**	1.78	2.12	**1.95**
Algae	104.00	118.00	**111.00**	17.21	20.23	**18.72**	1.03	1.35	**1.19**	1.94	2.33	**2.14**
SCU + Algae	109.00	126.00	**117.50**	18.89	21.27	**20.08**	1.09	1.40	**1.25**	1.88	2.49	**2.19**
Mean	**99.67**	**112.33**	106.00	**15.79**	**18.46**	17.13	**0.96**	**1.22**	1.09	**1.73**	**2.07**	1.90
LSD$_{0.05}$	Sources 2.90			1.15			0.05			0.07		
	Rates 1.43			0.94			0.03			0.03		
	S x R 2.85			1.87			0.06			0.06		
2018												
Control	91.67	92.00	**91.84**	12.00	13.00	**12.50**	0.87	0.89	**0.88**	1.37	1.40	**1.39**
SCU	103.00	131.00	**117.00**	14.87	19.81	**17.34**	1.03	1.42	**1.23**	1.89	2.22	**2.06**
Algae	113.00	130.00	**121.50**	16.21	20.36	**18.29**	1.07	1.46	**1.27**	1.95	2.38	**2.17**
SCU + Algae	117.00	141.00	**129.00**	19.10	22.01	**20.56**	1.24	1.49	**1.37**	2.02	2.51	**2.27**
Mean	**106.17**	**123.50**	114.83	**15.55**	**18.80**	17.17	**1.05**	**1.32**	1.18	**1.76**	**2.08**	1.92
LSD$_{0.05}$	Sources 2.64			1.36			0.05			0.02		
	Rates 0.84			0.56			0.04			0.03		
	S x R 1.68			1.12			0.08			0.06		

S x R = *Sources x Rates*

Table 7 Effect of algae and sulfur-coated urea fertilizers on quality of soybean

Sources	Nitrogen (%)		Mean	Protein (%)		Mean	Carbohydrates (%)		Mean	Oil (%)		Mean
	30	**60**		**30**	**60**		**30**	**60**		**30**	**60**	
2017												
Control	2.96	3.00	**2.98**	18.50	18.75	**18.63**	23.67	24.00	**23.84**	17.67	18.00	**17.84**
SCU	3.90	4.21	**4.06**	24.38	26.31	**25.35**	30.70	33.30	**32.00**	20.19	22.82	**21.51**
Algae	4.01	4.29	**4.15**	25.06	26.81	**25.94**	31.11	35.20	**33.16**	20.49	22.92	**21.71**
SCU + Algae	4.09	4.42	**4.26**	25.56	27.63	**26.60**	31.75	35.12	**33.44**	20.75	23.13	**21.94**
Mean	**3.74**	**3.98**	3.86	**23.38**	**24.88**	24.13	**29.31**	**31.91**	30.61	**19.78**	**21.72**	20.75
LSD$_{0.05}$	Sources 0.15			0.95			0.60			0.78		
	Rates 0.13			0.84			0.39			0.19		
	S x R ns			Ns			0.78			0.39		
2018												
Control	3.13	3.15	**3.14**	19.58	19.69	**19.64**	24.00	24.67	**24.34**	18.00	19.00	**18.50**
SCU	3.94	4.28	**4.11**	24.63	26.75	**25.69**	31.12	33.77	**32.45**	20.59	22.86	**21.73**
Algae	4.05	4.38	**4.22**	25.31	27.38	**26.35**	31.24	36.00	**33.62**	20.58	23.01	**21.80**
SCU + Algae	4.18	4.53	**4.36**	26.13	28.31	**27.22**	31.92	37.13	**34.53**	20.86	23.95	**22.41**
Mean	**3.83**	**4.09**	3.96	**23.91**	**25.53**	24.72	**29.57**	**32.89**	31.23	**20.01**	**22.21**	21.11
LSD$_{0.05}$	Sources 0.04			0.26			0.87			0.23		
	Rates 0.03			0.23			0.62			0.68		
	S x R 0.07			0.46			1.25			Ns		

S x R = *Sources x Rates*

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The results in Table 7 clearly show that treatments of SCU + algae significantly increased total carbohydrates in two seasons. The greatest increase in the total carbohydrates in both seasons recorded more than the SCU and algae in the first and second seasons, respectively.

The data also revealed that SCU + algae significantly surpassed SCU and algae in carbohydrate in both seasons. The oil content was positively affected by SCU, algae and mixed treatments in both seasons (Table 7). Fertilizer treatments of SCU + algae significantly increased the mean of the seed oil of soybean in both seasons. The increases more than the SCU + algae due to SCU and algae treatments in the tow seasons, respectively.

Generally, algae fertilizers resulted in higher values of quality compared with SCU and algae. Therefore, it could be finished from the obtained results that of SCU + algae with 60 kg N/fed found to be the mainly useful dose to achieve the highest quality.

The interaction between algae and SCU was significant in both seasons except for nitrogen and protein in first season and oil in second season.

Mungbean
Yield attributes
Data in Table 8 revealed that all treatments significantly improved plant height in both seasons. The increases in the plant height due to SCU + algae treatment over the control. The data show that SCU + algae (60 kg/fed)

surpassed SCU and algae in a seed yield/plant in the first and second seasons.

Data of seed yield/fed of mungbean as affected by SCU + algae are given in Table 8 The obtained consequences revealed that all treatments with SCU and algae significantly increased mungbean yield of seeds/fed in both seasons. It is clear that SCU + algae fertilizers significantly surpassed SCU and algae in both seasons. The highest increases of seeds yield/fed were obtained by SCU + algae (7.02 and 4.76%) over the control treatment in both seasons, respectively. It is worthy to note that the increase in seed yield could be mainly approved to the increase in the seeds/fed.

Data in Table 8 revealed that all treatments significantly increased straw yield/fed in both seasons. The increases of straw yield due to SCU + algae treatment were (5.91 and 4.98%) over the control in the first and second seasons, respectively.

Generally, SCU + algae fertilizers resulted in great values of yield and its components compared with SCU and algae. Therefore, it could be concluded that algae with 60 kg N/fed found to be the most successful dose to achieve the maximum yield and its components.

The interaction between algae and SCU were significant in both seasons except seed yield/plant and seed yield in first season and except for plant height, seed yield/plant and straw yield/fed in second season.

Table 8 Effect of algae and sulfur-coated urea fertilizers on yield and yield component of mungbean

Sources	Plant height (cm)		Mean	Seed yield /plant (g)		Mean	Seed yield (ton/fed)		Mean	Straw yield (ton/fed)		Mean
	30	60		30	60		30	60		30	60	
2017												
Control	121.00	123.00	**122.00**	6.30	6.98	**6.64**	0.77	0.83	**0.80**	1.89	1.93	**1.91**
SCU	137.67	143.00	**140.34**	8.16	8.39	**8.28**	1.00	1.12	**1.06**	2.26	2.52	**2.39**
Algae	139.33	146.33	**142.83**	8.20	8.52	**8.36**	1.04	1.15	**1.10**	2.42	2.62	**2.52**
SCU + Algae	142.83	151.50	**147.17**	8.25	8.60	**8.43**	1.06	1.22	**1.14**	2.45	2.63	**2.54**
Mean	**135.21**	**140.96**	138.08	**7.73**	**8.12**	7.93	**0.97**	**1.08**	1.02	**2.26**	**2.43**	2.34
LSD$_{0.05}$	Sources 2.74			0.53			0.07			0.11		
	Rates 1.30			0.30			0.04			0.04		
	S x R 2.60			ns			ns			0.08		
2018												
Control	126.00	130.00	**128.00**	7.30	7.43	**7.37**	0.82	0.86	**0.84**	1.92	2.04	**1.98**
SCU	140.00	146.00	**143.00**	9.56	10.29	**9.93**	1.13	1.26	**1.20**	2.30	2.66	**2.48**
Algae	142.33	147.33	**144.83**	9.80	10.32	**10.06**	1.20	1.31	**1.26**	2.43	2.69	**2.56**
SCU + Algae	145.33	154.67	**150.00**	10.09	10.60	**10.35**	1.26	1.37	**1.32**	2.52	2.70	**2.61**
Mean	**138.42**	**144.50**	141.46	**9.19**	**9.66**	9.42	**1.10**	**1.20**	1.15	**2.29**	**2.52**	2.41
LSD$_{0.05}$	Sources 2.71			0.32			0.04			0.06		
	Rates 1.97			0.20			0.02			0.05		
	S x R ns			ns			0.03			ns		

Table 9 Effect of algae and sulfur-coated urea fertilizers on quality of mungbean

Sources	Nitrogen (%)		Mean	Protein (%)		Mean	Carbohydrates (%)		Mean	Oil (%)		Mean
	30	60		30	60		30	60		30	60	
2017												
Control	2.25	2.28	**2.27**	14.06	14.25	**14.16**	29.37	41.67	**35.52**	1.12	1.16	**1.14**
SCU	2.98	3.05	**3.02**	18.63	19.06	**18.85**	46.32	51.09	**48.71**	1.17	1.30	**1.24**
Algae	3.16	3.30	**3.23**	19.75	20.63	**20.19**	49.00	53.51	**51.26**	1.25	1.40	**1.33**
SCU + Algae	3.27	3.39	**3.33**	20.44	21.19	**20.82**	47.45	54.00	**50.73**	1.29	1.45	**1.37**
Mean	**2.92**	**3.01**	**2.96**	**18.22**	**18.78**	**18.50**	**43.04**	**50.07**	**46.55**	**1.21**	**1.33**	**1.27**
LSD$_{0.05}$	Sources 0.11			0.59			1.79			0.07		
	Rates 0.07			0.42			2.01			0.06		
	S x R ns			ns			ns			ns		
2018												
Control	2.40	2.52	**2.46**	15.00	15.75	**15.38**	42.50	46.67	**44.59**	1.15	1.23	**1.19**
SCU	3.04	3.12	**3.08**	19.00	19.50	**19.25**	48.79	53.79	**51.29**	1.29	1.39	**1.34**
Algae	3.27	3.39	**3.33**	20.44	21.19	**20.82**	51.00	55.51	**53.26**	1.34	1.48	**1.41**
SCU + Algae	3.37	3.49	**3.43**	21.06	21.81	**21.44**	49.15	55.70	**52.43**	1.41	1.57	**1.49**
Mean	**3.02**	**3.13**	**3.08**	**18.88**	**19.56**	**19.22**	**47.86**	**52.92**	**50.39**	**1.30**	**1.42**	**1.36**
LSD$_{0.05}$	Sources 0.09			0.53			2.93			0.07		
	Rates 0.04			0.28			1.67			0.05		
	S x R ns			ns			ns			ns		

S x R = Sources x Rates

Seed quality attributes

The results in Table 9 showed that adopted treatments of SCU + algae showed a constructive statistical result on the seed nitrogen % of the mungbean in both seasons. It is achieved from Table 9 that SCU + algae treatment significantly increased grain, crude protein % of mungbean seeds in both seasons. The maximum percentage of seed crude protein was recorded by SCU + algae in both seasons in excess of the SCU and algae treatment in the first and second season, respectively.

Data in Table 9 clearly show that the treatment, SCU + algae significantly increased total carbohydrates in both seasons. The maximum increase in both seasons recorded by SCU + algae more the SCU and algae in the first and second seasons, respectively. Data also showed that SCU + algae significantly surpassed SCU and algae in carbohydrate in both seasons. The oil content was positively precious by SCU, algae and mixed treatments in both seasons (Table 9). Fertilizer treatments of SCU + algae significantly increased the average of the seed oil of mungbean in both seasons, respectively.

Generally, algae fertilizers resulted in superior values of quality compared with SCU + algae. Therefore, it could be concluded that SCU + algae with 60 kg N/fed found to be the mostly helpful quantity to achieve the most quality.

The interaction stuck between algae and SCU was no significant in the two seasons.

Economic feasibility

Individually of the crops has two types of yield harvest (seeds and straw). According to the price of all yield product, the economic feasibility was calculated as in Table 10 for the average of the two seasons.

According to the data, the highly total income was for the accumulation of SCU with algae (50:50) followed by the adding of the algae and SCU alone, while the control was the least income.

Discussions

In this connection, Ali and Mostafa (2009) reported that the similar results on peanut and maize. Using algae fertilizer in such soil showed a superior means in that affect where it is careful as an imperative group of microorganisms capable of fixing atmospheric nitrogen. Algae naturally contain ouxin, cytokines and gibberellic acid and activate some enzymes as dehydrogenises, pretenses, peptidases and phosphohydrolases (Crouch and Van Stander 1991).

In this relation, the results in this study cleared that there was a wide difference between the algae and SCU of soybean and mungbean plant in their response of yield

Table 10 Economic feasibility of algae and sulfur-coated urea fertilizers on yield of soybean and mungbean. (Average of two years)

Fertilizers	Soybean				
	Seed yield (ton/fed)	Price (L.E.)	Straw yield (ton/fed)	Price (L.E.)	Total yield income
Control (U)	0.85	6800	1.38	3450	10,250
SCU	1.38	11,040	2.17	5425	16,465
Algae	1.41	11,280	2.36	5900	17,180
SCU + algae	1.45	11,600	2.50	6250	17,850
Seed yield of soybean = 8 L.E/kg			Straw yield of soybean = 2.5 L.E/kg		
Fertilizers	Mungbean				
	Seed yield (ton/fed)	Price (L.E.)	Straw yield (ton/fed)	Price (L.E.)	Total yield income
Control (U)	0.85	8500	1.99	3980	12,480
SCU	1.19	11,900	2.59	5180	17,080
Algae	1.23	12,300	2.66	5320	17,620
SCU + algae	1.30	13,000	2.67	5340	18,340
Seed yield of mungbean = 10 L.E/kg			Straw yield of mungbean = 2 L.E/kg		

and yield components. Regarding the treatments, the outcome showed that 60 kg N/fed was promising and gave an encouraging result. This product may be attributed to algae fertilizers added helpful to the crop plants than the ordinary chemical fertilizers. Also, El-Umolari and Rengasamy (2012) showed that seaweed contains macro- and micronutrients and amino acids which encourage the growth and yield plants.

More than that, the physiological factors, including of inefficient partitioning of assimilating poor pod setting, too some flower abscission and lack of nutrients during the critical stages of soybean and mungbean growth. In the present study, it was shown that the additionally of algae increased the seed weight/plant and finally seed yield per plant which are the largely important yield determining components in soybean and mungbean. The increased yield attributes may be due to the presence of various growth promoting substances such as IAA and IBA, gibberellins, cytokinins, micronutrients and amino acids. This is in conformity with the result reported for Ganesh et al. 2015; Zodape et al. 2010; Venkata Rao et al. 2015 and Vyomendra and Kumar 2016.

Finally, application of the algae and SCU fertilizers to soybean and mungbean caused improve in plant height, seed weight/plant, seed yield/fed., straw yield, crude protein %, total carbohydrates and oil %. The effects may be because of the helpful cause algae on a plant which instruction of nutrient algae and increase the nitrogen use efficiency by plant compare to SCU fertilizers and reducing N leaching losses and provide a constant supply of nutrients to the root. This algae also provides an efficient way of applying nitrogen to such soils to enhance the efficiency of N use and the minimize leaching as well as to prevent environmental pollution by the excess nitrogen in the soil. In this connection, Latique et al. (2013) and Nikhil (2014) mentioned that application of algae significantly increased NPK, crude protein content, total carbohydrates and oil % of soybean and mungbean seeds.

Conclusion

In this research, trial proof shows that algae fertilizers are successful and superior grain yield of soybean and mungbean. The grain yield of soybean and mungbean was extended by use of SCU + algae, in both seasons, respectively, at 60 kg N/fed in treatments. This may be because of the statement get of development, advancing substances such as, gibberellins, cytokinins, nutrients, amino acids and micronutrients. It may be that algae fertilizer could serve as cost effective, eco-friendly product for sustainable agriculture, yet their dimension should be proper to upgrade development and profitability. However, long-term effects, such as those that might occur from potential soil sulfur accumulation more several years.

This paper concisely underlines the use of algae fertilizers as an important tool for sustainability and other choice use against the chemical fertilizers. Therefore, this fertilizer can be viewed as the new decision and unlimited advancing sustainable agriculture. Algae not only

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provide nutrients to the plants, but in fact also help in increasing plant growth and soil fertility.

Authors' contributions
This work was carried out in collaboration between all authors. Author R.E. designed the study, the field works; the literature searches, tabled the field data for the statistical analyses, prepared the samples for analyses and reviewed the final draft of manuscript. Author A.A. participated in the field works; tabled the data for statistical analyses and reviewed the final draft of manuscript. Author S.E. conducted the field applications, prepared the samples for analyses, conducted the physical and chemical analyses, and reviewed the final draft of manuscript. All authors read and approved the final manuscript.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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