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Bioscience Research

Print ISSN: 1811-9506 Online ISSN: 2218-3973

Journal by Innovative Scientific Information & Services Network

RESEARCH ARTICLE BIOSCIENCE RESEARCH, 2019 16(1):878-887. **OPEN ACCESS**

Production of mungbean under fertilization some slow fertilizers

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Trials were conducted in order to study the impact of some slow fertilizers application on productivity and quality of mungbean (*Vigna radiata* L. Wilczek). Sulphur coated urea (SCU), phosphogypsum coated urea (PGCU) and bentonite coated urea (BCU) were compared with uncoated urea (U) and applied at 20, forty and 60 kg N/fed for mungbean. The effect showed that application of control release fertilizers significantly increased the growth parameter, plant height, 100-seed weight and finally seed yield per plant which are the most necessary yield determining components in mungbean. Also utility of the gradual control release nitrogen fertilizers to mungbean plants caused an increase in seed yield, straw yield, seed oil %., crude protein % and total carbohydrates of mungbean. The results of crop indicated that it seems that mungbean is more responsive to the different coated urea forms than that occurred by mungbean especially SCU. All forms of coated urea increased seed yields and straw yield by 3-16% and 2-18% respectively for mungbean. Similarly, such tendency was true for mungbean when SCU was applied at 40 kg N/fed mungbean plants could effectively produce equal or better seed yield than the plants were fertilized with 60 kg N/fed. Therefore, such results indicate the potentiality of reducing application rates for both crops by 20 kg N/fed units if the coated forms of urea were adopted than the uncoated urea.

Keywords: Sulphur coated urea (SCU), Bentonite coated urea (BCU), Phosphogypsum coated urea (PGCU), Mungbean.

INTRODUCTION

The fertilizer industry faces a continuing challenge to improve its products to increase the efficiency of their use, particularly of nitrogenous fertilizers, and to minimize any possible adverse environmental impact. This is done either through improvement of fertilizers already in use, or through development of new specific fertilizer types. Mungbean (*Vigna radiata* L. Wilczek) is one of the most important protein and oil seed crops throughout the world. Its oil is the largest component of the world's edible oils. It has emerged as one of the important commercial crops in many countries. Schmitt, et al., (2001) evaluated N applications on soybean. Treatments of urea and poly coated urea applied broadcast and in subsurface bands increased soil nitrate at the full seed stage. Nitrogen did not increase grain yields but slightly increased seed N removal and seed protein. While Zhang et al., (2002) studied the effect of slow release fertilizer on dry matter accumulation/partitioning, nutrient absorption and yield of soybean was investigated in pot experiments. Dry matter accumulation during the growing period in all treatments was higher than that of the control. The slow release fertilizer with short releasing time had less effect on N absorption, while the long time one reduced the N absorption at the earlier stage. However, control release fertilizers in general can increase the absorption of K^+ to a certain extent and yield and yield components of soybean. In addition, Daniel and John (2005) concluded that growers should not consider fertilizer N applied to soil during early reproductive stages as a method to increase soybean yield or seed quality. While, (Kaushal et al., 2005) indicate that of coated urea (CU) is effective to improve soybean growth and seed yield. The combination of deep placement and control release N fertilizers is important to supply N until the maturation stage, resulting in the increase of seed yield. Under Egyptian conditions, (El-Tohamy et al., 2009) indicated that increasing levels of slow release fertilizer significantly improved vegetative growth and yield of bean plants. The highest level of control release fertilizer had significantly higher growth and yield compared to control plants that received the conventional nitrogen application of ammonium sulfate. Chemical analysis of leaves showed that the high levels of treatments significantly increased N content and protein content of pods. (Ruby and Mala 2014) found that the control release fertilizers have accelerated the enzyme activity during germination and it was responsible for the observed increase in seed vigour index of *Vigna Raidata*. The objective of this study is to investigate the effect of different slow release nitrogen fertilizer forms on yield and quality in mungbean compared with the uncoated urea. Essa (2015) found that the control release fertilizers in soybean fertilization to a slow scud of nitrogen element, which reduces the loss processes that may occur due to rapid soluble of nitrogen fertilizers and thus increasing the effectiveness of control fertilizer which is reflected in quantity as well as quality of crop.

MATERIALS AND METHODS

Therefore, two field experiments were carried out in two successive summer seasons, 2017 and 2018 at Miet Ghamr, El-Dakahilia Governorate, Egypt. To study the efficiency of some manufactured forms of control release fertilizers (SCU, BCU and PGCU on growth, yield and yield components of mungbean (Kawmy-1) characteristics compared with uncoated urea under clay soil conditions.

Representative soil sample (0-30) was taken from experimental field before growing and after harvesting for each season to determine physical and chemical properties of the soil (Table 1).

The soil samples were air dried ground and analyzed for physical and chemical characteristics according to (Olsen et al., 1958, Black, 1965 and Jackson, 1973). Mungbean seeds were inoculated prior to sowing with the specific strain of Rhizobium leguminous arum. Mungbean were sown in May 20th in the 1st and 2nd seasons. Each experimental plot area was 10.5 m^2. Mungbean in the rate of 30 kg/fed (fed=4200 m^2) were sown one side of the ridge in hills 15 cm apart and two plant/hill were left at thinning (21days after sowing). Phosphorus and potassium were added 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 sulphate (48 % K_2O) at 45 days after sowing in one dose. Nitrogen fertilizer forms and rates were applied as Urea (U) was applied in two dose, Sulphur coated urea (SCU), Bentonite coated urea, (BCU) and Phosphogypsum coated urea (PGCU) at the rates of 20, 40 and 60 kg N/fed for mungbean nitrogen fertilizer rates were applied in once dose after sowing for mungbean in after 21 days from sowing. Irrigation system was surface irrigation at 12 days intervals. The experiment included 12 treatments which were the combinations of 3 rates and four nitrogen fertilizer forms. The design of the experiments was established as spilt plot design with replicated three.

Table (1). Soil physico-chemical properties of the experimental sites before sowing.

Characteristics	2017	2018	Characteristics	2017	2018
Particle size distribution			**Soluble cations and cations (meq/l)**		
Sand (%)	10.13	10.22	K^+	0.37	0.42
Silt (%)	29.44	30.10	Na^+	2.16	2.39
Clay (%)	60.43	59.68	Ca^{++}	2.20	2.43
Texture	Clay soil	Clay soil	Mg^{++}	1.10	1.39
pH (1:2.5 soil:water)	7.81	7.86	$CO_3^=$	0.00	0.00
E.C (1:5) (dS/m)	0.56	0.66	$SO_4^=$	2.18	2.40
$CaCO_3$ (%)	2.07	2.12	HCO_3^-	0.60	0.75
O. M. (%)	1.23	1.25	Cl^-	3.05	3.42
Total N (%)			**Available P (ppm)**		
N	0.07	0.09	P	8.35	9.30

At harvest (120 days after sowing) ten plants were taken at random from middle three ridges of each plot for the following measurements were recorded:

Seed yield/plant (g).

100-seed weight (g).

All plants of each plot were harvested then seeds threshed, seed and straw yields (ton/fed) were determined by multiply seed and straw yields/plot*400.Representative seed samples were taken after harvest and analyzed for macronutrients after washing in sequence with tap water, 0.01 N HCI acidified bidistilled water and bidistilled water, respectively, and then dried in a ventilated oven at 70°C till constant weight. The plant samples were grounded in stainless steel mill 0.5 mm sieve and kept in plastic containers for chemical analysis. The suspension was filtered on an ash free filter paper into 100 ml volumetric flask. The total nitrogen was determined using Micro-kjeldahal, while K was measured using flame photometer; P was determined spectro photometricaly using the method of Cottenie et al., (1982).

Growth parameters

Ten plants in each treatment were uprooted randomly at 45, 60 after days sowing and at harvest and used for recording dry matter distribution, leaf area and other growth characteristics as described below. (1) Leaf area/plant was determined using leaf area meter (LI-2000, LI-COR, USA) after 60 days sowing. (2) Absolute growth rate (AGR) is the dry matter production per unit time (g day^{-1}), which was calculated by using formula given by Radford (1967).

$AGR = (W_2 - W_1) / (T_2 - T_1)$

Where: W_1 = Dry matter of the plant (g), W_2 = Dry matter of the plant (g), T_1 = Time after 45 days sowing, T_2= Time after 60 days sowing. (3) Crop growth rate (CGR) is the ratio of dry matter production per unit ground area per unit time, which was calculated by adopting the formula given by Burren et al., (1974) and expressed as g day.

$CGR = (W_2 - W_1) / (T_2 - T_1) * 1/A$

Where: A = Land area by the plant (m^2). (4) Biomass duration (BMD) was calculated by using the following formula of Sestak et al., (1971).

BMD (kg days) = $(TDM_1 + TDM_2)/2 * (T_2 - T_1)$

Where: TDM_1 = Total dry matter of the plant (g), TDM_2 = Total dry matter of the plant (g), T_1 = Time after 45 days sowing, T_2 = Time after 60 days sowing.

Crude protein was obtained by N % x 6.25 according to A.O.A.C. (1990).Total Carbohydrates percentage was determined according to Dubois (1956). Oil percentage was determined according to PN-EN ISO (1999).

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 AND DISCUSSION

Growth parameters

Leaf area/plant (m^2)

Leaf area plays an important role in plant growth analysis. Data in Tables (2) indicated that BCU significantly increased either PGCU or SCU in leaf area/plant. The average of increase due to different fertilizers type (BCU, SCU and PGCU) compared with uncoated urea were (0.38, 0.36 and 0.35 m^2) and (0.39, 0.37 and 0.36 m^2) respectively, in both seasons. Similar results were obtained by Khan et al., (2008), reported that application of control release fertilizers increased the leaf area/plant of mungbean. The data clearly show that mungbean plants responded to the rate 60 kg N/fed under any fertilizers type. The greatest leaf area/plant was obtained when mungbean was fertilized with 60 kg N/fed. Also, the advantage of one time application, the application of slow release fertilizers is environment friendly and resource efficient.

Absolute growth rate = AGR (g/plant day^{-1})

The effect of slow release fertilizers on AGR are shown in tables (2) indicated that SCU significantly increased either BCU or PGCU in absolute growth rate. The percentage of increased due to fertilizers type was (13.04, 8.70 and 4.35 %) and (12.50, 8.33 and 4.17 %) for SCU, BCU and PGCU in both seasons respectively, compared with uncoated urea. These results are in accordance with those obtained by Maekawa and Kokubun (2005) and El-Tohamy et al., (2009), reported found that application of slow release fertilizers increased the absolute growth rate for mungbean.

Crop growth rate (g/m^2 day^{-1})

Data in Table (3) revealed that in general as the plant growth increased the CGR decreased data, also show significant differences due to fertilizers type and rate on mungbean crop growth rate.

Table (2) Influence of N application rate from U, SCU, PGCU and BCU fertilizers on Leaf area/plant and absolute growth rate of mungbean.

Fertilizers	Leaf area/plant (LA/Plant) (m^2)								Absolute growth rate (AGR) (g/plant day^{-1})							
	20	40	60	Mean	20	40	60	Mean	20	40	60	Mean	20	40	60	Mean
	2017				2018				2017				2018			
U	0.31	0.34	0.36	0.34	0.32	0.33	0.36	0.34	0.23	0.23	0.24	0.23	0.23	0.24	0.25	0.24
SCU	0.34	0.37	0.37	0.36	0.36	0.38	0.38	0.37	0.24	0.26	0.27	0.26	0.25	0.27	0.28	0.27
PGCU	0.35	0.35	0.36	0.35	0.35	0.36	0.37	0.36	0.23	0.24	0.24	0.24	0.24	0.25	0.26	0.25
BCU	0.35	0.37	0.40	0.38	0.37	0.38	0.41	0.39	0.24	0.25	0.25	0.25	0.25	0.26	0.27	0.26
Mean	0.34	0.36	0.37		0.35	0.37	0.38		0.23	0.24	0.25		0.24	0.26	0.27	
$LSD_{0.05}$ Fertilizer type	0.01				0.02				0.04				0.04			
$LSD_{0.05}$ Rate (kg/fed)	0.02				0.02				0.03				0.05			

Urea = U Sulphur coated urea =SCU Phosphogypsum coated urea = PGCU Bentonite coated urea = BCU

The data clearly shows that all coated urea types significantly exceeded the uncoated urea in crop growth rate. The comparison between fertilizers type in their effects on CGR data showed that SCU increased CGR either BCU or PGCU. The percentage increases due to fertilizers type were (9.02, 3.01 and 2.26 %), was (8.06, 7.11 and 6.64 %) for SCU, BCU and PGCU in both seasons respectively and compared uncoated urea. These results of control release fertilizers effect are in accordance with those obtained by Similar results were obtained by Maekawa and Kokubun (2005) and El-Tohamy et al., (2009). The interaction among type and rate of control release fertilizers had non-significant effects. The data clearly show that mungbean plants responded to the rate (60 kg N/fed) under any type.

Biomass duration (g/day)

The data of biomass duration (BMD) presented in Tables (3) showed that there are a significant differences due to fertilizers type and rate mungbean biomass duration. The data clearly indicated that all coated urea types significantly exceeded the uncoated urea in biomass duration. Biomass duration under SCU significantly increased either BCU or PGCU rate. The percentage increase due to fertilizers type was (6.81, 10.08 %), (5.96, 6.72 %) and (2.98, 2.94 %) for SCU, BCU and PGCU in both seasons respectively, compared uncoated urea. BMD indicates the maintenance of dry matter over a period of time and is essential for prolonged supply of photosynthesis to the developing sinks. Significantly higher BMD values were recorded in growth regulator treatments at all the stages of mungbean crop. This suggests that growth regulators resulted in increased LA/plant, AGR, and CGR and finally resulted in increased BMD. These results of control release fertilizers effect are in accordance with those obtained by Maekawa and Kokubun (2005); El-Tohamy et al., (2009) and Essa (2015), where they found that application of CRF increased the biomass duration of soybean. The interaction effect was non-significant at all treatments in both seasons.

Yield and yield components

Data in Table (4) revealed that all treatments significantly increased weight of seeds per plant in both seasons. The increases in weight of seeds per plant due to SCU and BCU treatment were (16.57 and 11.57) %) and (15.40 and 10.89 %) over the control in both seasons. From the same table, the data indicate that SCU surpassed BCU and PGCU in seed yield/plant with significant differences in the first and the second seasons. In this concern Zhang et al., (2002) and El-Tohamy et al., (2009) and Essa (2015) found that control release fertilizers application increased the weight of seeds per plant.

It is revealed from Tables (4) that the seed index was positively affected by SCU, BCU and PGCU treatments in both seasons. Fertilizer treatments of SCU, BCU and PGCU significantly increased the average of 100-seed weight of soybean in both seasons. The increases over the control due to SCU treatment was (11.75 and 6.78 %) in the first and second seasons, respectively. It is worthy to note that SCU significantly exceeded 100-seed weight than the other coated forms differences in both seasons. These data agreed with the findings of Salvagiotti et al., (2009).

Data of seed yield/fed of mungbean as affected by SCU, BCU and PGCU are given in Table (5) The obtained results revealed that all treatments with SCU, BCU and PGCU significantly increased mungbean yield of seeds/fed in both seasons. It is clear that SCU significantly surpassed BCU and PGCU in this respect in both seasons. The highest increases of seeds yield/fed were obtained by SCU and BCU (16.00 % and 10.57 %) and (11.76 and 9.41 %) over the control treatment in both seasons respectively. The increases over the control due to SCU treatment were (0.12 and 0.08 ton) and (0.10 and 0.08 ton) in the first and second seasons, respectively. It is worthy to note that the increase in seed yield could be mainly attributed to the increase in the weight of seeds per plant and partially in weight of 100 seed. The present findings are in accordance with those reported El-Tohamy et al., (2009) and Zhang et al., (2002).

Data in Table (5) revealed that all treatments significantly increased straw yield/fed in both seasons. The increases of straw yield due to SCU and BCU treatment were (14.35 and 18.58 %) and (7.41 and 10.18 %) over the control in the first and second seasons, respectively. In this concerning, El-Tohamy et al., (2009) found that control release fertilizers application increased the weight of straw yield.

Data of rates the mungbean as affected by SCU, BCU and PGCU are given in Table (4). There were gradual increases in growth characters i.e., plant height, seed yield/plant, 100-seed weight, seed yield/fed and straw yield/fed as fertilizer rate increased from 20, 40 or 60 kg N/fed.

Table (3) Influence of N application rate from U, SCU, PGCU and BCU fertilizers on crop growth rate and biomass duration of mungbean.

Fertilizers	Crop growth rate (CGR)(g/m²/day)								Biomass duration (BMD)(g/day)							
	20	40	60	Mean	20	40	60	Mean	20	40	60	Mean	20	40	60	Mean
	2017				2018				2017				2018			
U	1.27	1.30	1.41	1.33	2.07	2.12	2.14	2.11	2.24	2.37	2.43	2.35	2.29	2.34	2.50	2.38
SCU	1.36	1.46	1.54	1.45	2.13	2.26	2.45	2.28	2.40	2.45	2.67	2.51	2.46	2.63	2.77	2.62
PGCU	1.31	1.37	1.39	1.36	2.17	2.28	2.30	2.25	2.32	2.44	2.51	2.42	2.37	2.46	2.51	2.45
BCU	1.31	1.33	1.47	1.37	2.14	2.25	2.38	2.26	2.37	2.52	2.59	2.49	2.36	2.61	2.64	2.54
Mean	1.31	1.37	1.45		2.13	2.23	2.32		2.33	2.45	2.55		2.37	2.51	2.61	
$LSD_{0.05}$	**Fertilizer type** 0.06				0.09				0.13				0.09			
	Rate (kg/fed) 0.05				0.07				0.08				0.10			

Urea = U Sulphur coated urea =SCU Phosphogypsum coated urea = PGCU Bentonite coated urea = BCU

Table (4) Influence of N application rate from U, SCU, PGCU and BCU fertilizers on seed weight/plant and 100-seed weight of mungbean.

Fertilizers	Seed weight/plant (g)								100-Seed weight (g)							
	20	40	60	Mean	20	40	60	Mean	20	40	60	Mean	20	40	60	Mean
	2017				2018				2017				2018			
U	7.73	8.22	8.69	8.21	8.48	9.02	9.53	9.09	3.75	4.09	4.17	4.00	3.83	4.18	4.84	4.28
SCU	8.71	9.69	10.32	9.57	9.54	10.62	11.30	10.49	3.97	4.39	5.06	4.47	4.06	4.49	5.17	4.57
PGCU	8.13	9.29	9.70	9.04	8.90	10.19	10.61	9.90	3.79	4.24	4.77	4.27	3.88	4.33	4.88	4.36
BCU	8.74	8.90	9.83	9.16	9.58	9.76	10.89	10.08	3.85	4.18	4.88	4.30	3.93	4.28	4.99	4.40
Mean	8.33	9.03	9.64		9.13	9.90	10.59		3.84	4.23	4.72		3.93	4.32	4.97	
$LSD_{0.05}$	**Fertilizer type** 1.09				1.10				0.33				0.35			
	Rate (kg/fed) 0.77				0.78				0.34				0.33			

Urea = U Sulphur coated urea =SCU Phosphogypsum coated urea = PGCU Bentonite coated urea = BCU

Table (5) Influence of N application rate from U, SCU, PGCU and BCU fertilizers on seed yield/fed and straw yield/fed of mungbean.

Fertilizers	Seed yield/fed (ton)								Straw yield/fed (ton)							
	20	40	60	Mean	20	40	60	Mean	20	40	60	Mean	20	40	60	Mean
	2017				2018				2017				2018			
U	0.68	0.74	0.84	0.75	0.71	0.76	0.88	0.85	1.98	2.19	2.32	2.16	2.07	2.20	2.51	2.26
SCU	0.74	0.84	1.03	0.87	0.84	0.89	1.11	0.95	2.33	2.50	2.58	2.47	2.31	2.75	2.97	2.68
PGCU	0.69	0.78	0.87	0.78	0.78	0.91	1.05	0.91	2.09	2.26	2.36	2.24	2.08	2.34	2.56	2.33
BCU	0.73	0.81	0.95	0.83	0.85	0.90	1.05	0.93	2.23	2.33	2.40	2.32	2.27	2.49	2.71	2.49
Mean	0.71	0.79	0.92		0.80	0.87	1.02		2.16	2.32	2.42		2.18	2.45	2.69	
$LSD_{0.05}$	**Fertilizer type** 0.10				0.10				0.33				0.37			
	Rate (kg/fed) 0.04				0.04				0.19				0.21			

Urea = U Sulphur coated urea =SCU Phosphogypsum coated urea = PGCU Bentonite coated urea = BCU

Table (6) Influence of N application rate from U, SCU, PGCU and BCU fertilizers on potassium and protein of seeds.

Fertilizers	Potassium (%)								Protein (%)							
	20	40	60	Mean	20	40	60	Mean	20	40	60	Mean	20	40	60	Mean
	2017				2018				2017				2018			
U	1.21	1.31	1.42	1.31	1.26	1.36	1.47	1.36	18.46	18.54	19.69	18.90	18.10	18.81	20.07	18.99
SCU	1.42	1.52	1.61	1.52	1.48	1.57	1.67	1.57	19.15	21.00	22.81	20.99	19.88	21.81	23.69	21.79
PGCU	1.27	1.38	1.45	1.37	1.32	1.43	1.50	1.42	18.56	18.90	19.07	18.84	18.18	18.54	19.36	18.69
BCU	1.36	1.43	1.47	1.42	1.41	1.48	1.53	1.47	18.92	20.27	21.00	20.06	19.65	21.06	21.81	20.84
Mean	1.32	1.41	1.49		1.37	1.46	1.54		18.77	19.68	20.64		18.95	20.06	21.23	
$LSD_{0.05}$	Fertilizer type			0.03	0.03				0.50				0.54			
	Rate (kg/fed)			0.02	0.03				0.61				0.59			

Urea = U Sulphur coated urea =SCU Phosphogypsum coated urea = PGCU Bentonite coated urea = BCU

Table (7) Influence of N application rate from U, SCU, PGCU and BCU fertilizers on total carbohydrates and oil of seeds.

Fertilizers	Total carbohydrates (%)								Oil (%)							
	20	40	60	Mean	20	40	60	Mean	20	40	60	Mean	20	40	60	Mean
	2017				2018				2017				2018			
U	48.22	49.65	53.57	50.48	50.08	51.57	54.64	52.10	0.98	1.07	1.22	1.09	1.06	1.15	1.31	1.17
SCU	50.61	54.17	57.99	54.26	52.57	56.26	60.23	56.35	1.11	1.22	1.48	1.27	1.20	1.31	1.59	1.36
PGCU	48.57	51.12	53.44	51.04	50.44	53.09	55.79	53.11	1.00	1.18	1.28	1.16	1.08	1.27	1.38	1.24
BCU	49.79	51.9	54.57	52.09	51.72	53.9	56.68	54.10	1.10	1.19	1.35	1.21	1.18	1.28	1.45	1.30
Mean	49.30	51.71	54.89		51.20	53.71	56.84		1.05	1.17	1.33		1.13	1.25	1.43	
$LSD_{0.05}$	Fertilizer type			1.35	1.23				0.02				0.03			
	Rate (kg/fed)			1.61	1.34				0.03				0.04			

Urea = U Sulphur coated urea =SCU Phosphogypsum coated urea = PGCU Bentonite coated urea = BCU

3. Quality

Results in Table (6) indicated that all adopted treatments of SCU, BCU and PGCU showed positive statistical effect on seed potassium percentage of the mungbean in both growing seasons. The present findings are in accordance with those reported by Zhang et al., (2002). In this concern, El-Tohamy et al., (2009) reported that application of slow release fertilizers increased the potassium percentage in seeds of bean. Essa (2015) found that application of control release fertilizers increased the percentage of potassium in seeds of soybean.

It is realized from Table (6) that SCU, BCU and PGCU treatments significantly increased grain crude protein percentage of mungbean seeds under investigation in both studied seasons. The highest percentage of seeds crude protein was recorded with SCU in both seasons being (11.06 and 14.74 %) more than the control treatment in the first and second season, respectively. In this concern, El-Tohamy et al., (2009) reported that application of slow release fertilizers increased the percentage of crude protein in seeds of bean. Essa (2015) found that application of control release fertilizers increased the percentage of crude protein in seeds of soybean.

Data in Table (7) clearly show that all treatments of SCU, BCU and PGCU significantly increased total carbohydrates of the under investigation in both seasons. The maximum increase in the total carbohydrates in both seasons recorded by SCU over the control by (7.49 %) and (8.16 %) in the first and second seasons, respectively. Data also revealed that SCU significantly surpassed PGCU and BCU in carbohydrate in both seasons. It is the same table that the oil content was positively affected by SCU, BCU and PGCU treatments in both seasons. Fertilizer treatments of SCU, BCU and PGCU significantly increased the average of seed oil of mungbean in both seasons. The increases over the control due to SCU and BCU treatments were (16.51 and 11.01 %) and (16.24 and11.11 %) in the both seasons, respectively. These results are in accordance with those obtained by (Salvagiotti et al., 2009) and (Zhang et al., 2002) and Essa (2015).

Generally, application of the control release nitrogen fertilizers to mungbean plants caused an increase in 100-seed weight, seed yield, straw yield, oil %, crude protein % and total carbohydrates. The results may be due to the beneficial effect coating material on plant which regulation of nutrient release and enhancement the nitrogen use efficiency by plant than uncoated fertilizers and reducing N leaching losses and provide a constant supply of nutrients to the root. This approach also provides an efficient way of applying nitrogen to such soils to increase the efficiency of N application and the minimize leaching as well as to prevent environmental pollution by the excess nitrogen in the soil. Moreover, apart from the genetic constitution, the physiological factors such as inefficient partitioning of assimilates, poor pod setting, excessive flower abscission and lack of nutrients during the critical stages of soybean growth were found to be some of the yield barriers of soybean (Alberta and Bower, 1983; Promila and Varma, 1983) and nutrients play a pivotal role in increasing the seed yield in pulses. In the present study, it was revealed that the application of control release fertilizers significantly increased the 100-seed weight and finally seed yield per plant which are the most important yield determining components in mungbean.

CONCLUSION

Control slow nitrogen fertilizers (CRNF) such as SCU, BCU and PGCU improved the quantity and quality of mungbean. The obtained results of both crops indicate that it seems that mungbean is more responsive to the different coated urea forms than that occurred by mungbean especially SCU. All forms of coated urea increased seed yield 3-12 % for mungbean. Similarly, such tendency was true for mungbean when SCU was applied at 40 kg N/fed mungbean plants could effectively produce equal or better seed yield than the plants were fertilized with 60 kg N/fed Therefore, such results indicate the potentiality of reducing application rates for both crops by 20 kg N/fed units if the coated forms of urea were adopted than the uncoated urea.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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