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Effect of coated urea on yield and quality of soybean

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Abstract
The experiment was conducted to assess the "Effect of Coated Urea on yield and quality of soybean", at Post Graduate Institute Farm, Mahatma Phule Krishi Vidyapeeth, Rahuri during *kharif* of the year 2025-26 with the objectives to effect of coated urea on growth and yield attributes of soybean. The experiment was laid out in a Randomized Block Design with ten treatments and three replications. The treatments comprised of Absolute control (T_1), 100% RDN through Neem-Coated Urea (NCU) (T_2), 75% RDN through Neem-Coated Urea (NCU) (T_3), 50% RDN through Neem-Coated Urea (NCU) (T_4), 100% RDN through Sulphur-Coated Urea (SCU) (T_5), 75% RDN through Sulphur-Coated Urea (SCU) (T_6), 50% RDN through Sulphur-Coated Urea (SCU) (T_7), 50% RDN through Neem-Coated Urea (NCU) + 50% RDN through Sulphur-Coated Urea (SCU) (T_8), 75% RDN through Neem-Coated Urea (NCU) + 25% RDN through Sulphur-Coated Urea (SCU) (T_9) and 25% RDN through Neem-Coated Urea (NCU) + 75% RDN through Sulphur-Coated Urea (SCU) (T_{10}). The experimental soil was medium-deep black belonging to the Inceptisol order. The results revealed significant influence of coated urea on growth and yield. Application 50% RDN through Neem-Coated Urea (NCU) + 50% RDN through Sulphur-Coated Urea (SCU) (T_8) recorded the highest plant height at harvest (84.00 cm), number of branches and number of pods plant^{-1}, number of grains pod^{-1} (66.63 and 2.97, respectively), and chlorophyll content at 30 and 45 DAS (0.58 and 0.63 mg g^{-1}, respectively) grain yield (25.88 q ha^{-1}) and stover yield (31.06 q ha^{-1}). However, it was statistically at par with 100% RDN through Sulphur-Coated Urea (SCU) (T_5) at harvest, which recorded 83.33 cm plant height, 9.33 number of branches 65.32 number of pods plant^{-1}0.57 and 0.60 mg g^{-1} chlorophyll content at 30 and 45 DAS respectively, grain yield (25.04 q ha^{-1}) and stover yield (30.05 q ha^{-1}).

Keywords: Soybean, Coated urea, Neem-coated urea, Sulphur-coated urea, Nutrient uptake, Growth, Yield

Introduction

Soybean (*Glycine max* (L.) Merr.) is an important leguminous oilseed crop belonging to the family Fabaceae. It is widely recognized as a "Wonder Crop" due to its high nutritional value and diverse applications in food, feed and industry. Soybean seeds contain approximately 40% protein and 20% oil, making them an important source of vegetable protein and edible oil (Bellaloui *et al*., 2015) [1]. The crop also contributes to sustainable agriculture through its symbiotic association with nitrogen-fixing bacteria.

Nitrogen (N) and sulphur (*S*) are essential nutrients that significantly influence soybean growth, productivity and seed quality. Nitrogen plays a vital role in vegetative growth and protein synthesis, whereas sulphur contributes to the synthesis of sulphur-containing amino acids and influences protein composition. An adequate and balanced supply of nitrogen and sulphur is essential for efficient nitrogen assimilation, biological nitrogen fixation and improved soybean yield and quality (Khalili *et al*., 2021; Khalili *et al*., 2023) [2, 3].

Neem-coated urea (NCU) contains neem-derived compounds that inhibit nitrification by slowing the conversion of ammonium nitrogen into nitrate, thereby reducing nitrogen losses and improving nitrogen-use efficiency (Bains *et al*., 1971.) [4] Neem also possesses insecticidal properties that may provide additional benefits in crop production (Parmar *et al*., 1993.) [5] Sulphur-coated urea (SCU), on the other hand, supplies both nitrogen and sulphur and helps regulate nitrogen release, thereby supporting balanced nutrient availability for crop growth and seed development. The combined application of NCU and SCU may improve nutrient uptake, soybean yield and seed quality (Luo *et al*., 2000.) [6]

Considering the importance of efficient nutrient management in soybean cultivation, the present investigation entitled "Effect of Coated Urea on Yield and Quality of Soybean" was undertaken to study the efficacy of coated urea on crop yield, nutrient uptake and quality of soybean, to assess its effect on soil properties, and to evaluate the economics of soybean cultivation.

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Materials and Methods

A field experiment was conducted during the *kharif* season of 2025 at the Post Graduate Institute Farm, Mahatma Phule Krishi Vidyapeeth, Rahuri, to study the effect of coated urea on yield and quality of soybean. The soil was alkaline in reaction, with a pH of 8.32 and low soluble salt content (0.19 dS m^{-1}). The organic carbon content was moderate (0.58%), while calcium carbonate content was high (8.72%). The soil was low in available nitrogen (204 kg ha^{-1}) and phosphorus (18.50 kg ha^{-1}), very high in available potassium (390 kg ha^{-1}) and contained 11.80 mg kg^{-1} available sulphur. The DTPA-extractable micronutrients, namely iron, manganese, zinc and copper, were 4.64, 0.64, 6.21 and 3.90 mg kg^{-1}, respectively. The experimental area falls under the semi-arid region and subtropical zone, with an average annual rainfall of 407 mm. The average annual maximum temperature was 31.24 °C, fluctuating between 30 °C and 40 °C, while the average minimum temperature was 19.93 °C, with a range of 15 °C to 20 °C. The average relative humidity was 82.5% in the morning and 61.63% in the afternoon. The experiment was conducted in a Randomized Block Design (RBD) comprising ten treatments with three replications. The soybean variety *Phule Sangam (KDS-726)* was sown at a spacing of 45 cm × 10 cm. The treatments consisted of absolute control (T_1), 100% recommended dose of nitrogen (RDN) through neem-coated urea (NCU) (T_2), 75% RDN through NCU (T_3), 50% RDN through NCU (T_4), 100% RDN through sulphur-coated urea (SCU) (T_5), 75% RDN through SCU (T_6), 50% RDN through SCU (T_7), 50% RDN through NCU + 50% RDN through SCU (T_8), 75% RDN through NCU + 25% RDN through SCU (T_9), and 25% RDN through NCU + 75% RDN through SCU (T_{10}). The recommended dose of fertilizers (GRDF), comprising 50:75:45 kg ha^{-1} $N:P_2O_5:K_2O$, along with farmyard manure (FYM) at 10 t ha^{-1}, was applied as per the experimental treatments. Different proportions of nitrogen were supplied through neem-coated urea and sulphur-coated urea according to the respective treatments. Growth parameters, including plant height, number of branches per plant, number of pods per plant, number of grains per pod and chlorophyll content, were recorded during crop growth. At harvest, grain and stover yields were recorded and expressed in quintals per hectare.

Results and Discussion

Growth parameters of kharif soybean as influenced by various treatments

The effect of different treatments on growth parameters such as plant height, number of branches $plant^{-1}$ and chlorophyll content is summarized in Table 1.

Plant height

The plant height of soybean as influenced by different treatments is presented in table 1. The significantly higher plant height (84 cm) of soybean was observed in treatment 50% recommended dose of nitrogen through Neem coated urea (NCU) + 50% recommended dose of nitrogen through Sulphur coated urea (SCU) T_8 over rest of the treatments except plant height (83.33 cm) recorded in treatment 100% recommended dose of nitrogen through Sulphur coated urea (SCU) treatments T_5 which was statistically at par. The lowest plant height (64.00 cm) was recorded in (absolute control) T_1. The increase in plant height may be attributed to the balanced and prolonged nitrogen availability from neem-coated urea (NCU) and sulphur-coated urea (SCU), which enhanced cell division, elongation, and vegetative growth. Their combined application may have improved nitrogen-use efficiency and reduced nutrient losses. Sulphur also supported protein synthesis, enzyme activity, and chlorophyll formation, promoting plant growth. Similar findings were reported by Naidu *et al.* (1980) [7] and Shivay *et al.* (2016) [8].

Number of branches per plant

The number of branches $plant^{-1}$ of soybean as influenced by different treatments is presented in Table 1. Significantly highest number of branches $plant^{-1}$ (11.67) was observed in treatment, comprising 50% recommended dose of nitrogen through neem-coated urea (NCU) + 50% recommended dose of nitrogen through sulphur-coated urea (SCU) T_8. The lowest number of branches $plant^{-1}$ (4.00) was recorded in T_1 (absolute control). The increase in branches $plant^{-1}$ may be attributed to the balanced and sustained nitrogen supply from neem-coated urea (NCU) and sulphur-coated urea (SCU), which promoted vegetative growth and axillary bud development. Sulphur further supported protein synthesis and enzyme activity, enhancing branch development in soybean. Similar findings were reported by Singh (2016) [9] and Takahashi *et al.* (1991) [10].

Chlorophyll content

The total chlorophyll content of soybean at 30 and 45 DAS, as influenced by different treatments, is presented in Table 1. Significantly higher chlorophyll content was recorded in T_8, comprising 50% recommended dose of nitrogen through neem-coated urea (NCU) + 50% recommended dose of nitrogen through sulphur-coated urea (SCU), with values of 0.58 and 0.63 mg g^{-1}, respectively. However, T_5 (100% recommended dose of nitrogen through SCU), which recorded 0.57 and 0.60 mg g^{-1}, respectively, was statistically at par with T_8. The lowest chlorophyll content at 30 and 45 DAS was recorded in T_1 (absolute control), with values of 0.30 and 0.42 mg g^{-1}, respectively. The higher chlorophyll content under T_8 might be attributed to improved and sustained availability of nitrogen and sulphur, which supported chlorophyll accumulation and photosynthetic activity. Similar findings were reported by Sexton *et al.* (1998) [11], Palled *et al.* (2006) [12], and Trivedi *et al.* (2011) [13].

Yield and yield parameters of kharif soybean as influenced by various treatments

The effect of different treatments on growth parameters such as number of pods plant-1, grain and stover yield is presented in Table 1.

Number of pods plant-1

The number of pods $plant^{-1}$ of soybean as influenced by different treatments presented in Table 4.2. Significantly higher number of pods $plant^{-1}$ (66.63) was observed in treatment comprising 50% recommended dose of nitrogen through neem-coated urea (NCU) + 50% recommended dose of nitrogen through sulphur-coated urea (SCU) T_8. over the rest of the treatments, except (100% recommended dose of nitrogen through sulphur-coated urea T_5 which recorded (65.32) pods $plant^{-1}$ and was statistically at par with T_8. The lowest number of pods $plant^{-1}$ (49.48) was recorded in (absolute control) T_1. The higher number of pods $plant^{-1}$ under T_8 may be attributed to improved nitrogen-use efficiency and sustained nutrient availability from NCU and SCU, which enhanced assimilate production and translocation to reproductive organs, promoting pod initiation and retention. Similar findings were reported by Takahashi *et al.* (2006) [14], Kaushal *et al.* (2004) [15], and Bahr *et al.* (2006) [16].

Grain yield

The grain yield of soybean as influenced by different treatments is presented in Table 1 Significantly higher grain yield (25.88 q ha^{-1}) was observed in treatment T_8, comprising 50% recommended dose of nitrogen through neem-coated urea (NCU) + 50% recommended dose of nitrogen through sulphur-coated urea (SCU), over the rest of the treatments, except T_5 (100% recommended dose of nitrogen through sulphur-coated urea), which recorded (25.04 q ha^{-1}) and was statistically at par with T_8. The lowest grain yield (11.66 q ha^{-1}) was recorded in T_1 (absolute control). The higher grain yield under T_8 (50% RDN through NCU + 50% RDN through SCU) may be attributed to sustained nitrogen and sulphur availability, which improved nutrient uptake, photosynthesis, pod setting, and grain filling. Sulphur also supported protein synthesis and reproductive growth, contributing to the maximum grain yield of 25.88 q ha^{-1}. Similar findings

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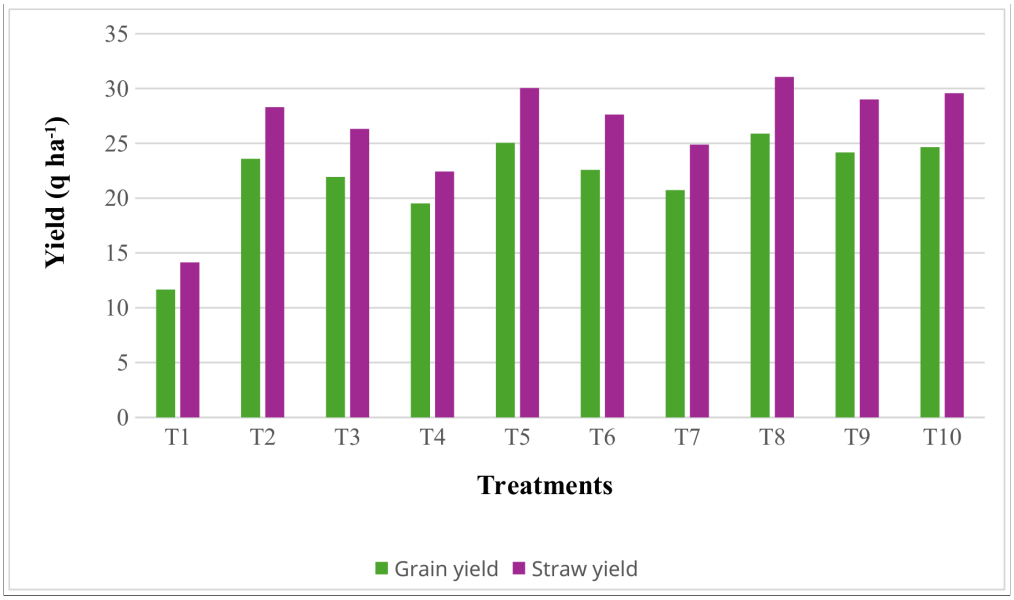
were reported by Abou-Zied *et al.* (2014) [17], Shrivastava *et al.* (2000) [18], and Kaushal *et al.* (2004) [19].

Straw yield

The straw yield of soybean as influenced by different treatments is presented in Table 1 Significantly higher straw yield (31.06 q ha^{-1}) was observed in treatment T_8, comprising 50% recommended dose of nitrogen through neem-coated urea (NCU) + 50% recommended dose of nitrogen through sulphur-coated urea (SCU), over the rest of the treatments, except T_5 (100% recommended dose of nitrogen through sulphur-coated urea), which recorded (30.05 q ha^{-1}) and was statistically at par with T_8. The lowest straw yield (14.13 q ha^{-1}) was recorded in T_1 (absolute control). The higher straw yield recorded under T_8 may be attributed to the synchronized and prolonged availability of nitrogen and sulphur from NCU and SCU, which supported sustained vegetative growth. The combined nutrient supply may have enhanced leaf development, branching, photosynthetic activity and dry matter accumulation, resulting in greater straw production. Similar findings were reported by Subbiah *et al.* (1979) [20] and Shah *et al.* (2015) [21].

Table 1. Growth and yield of kharif soybean as influenced by different treatments.

Tr. No.	Treatment details	Plant height (cm)	Branches plant^{-1}	Pods plant^{-1}	Chlorophyll (30DAS) (mg g^{-1})	Chlorophyll (45 DAS) (mg g^{-1})	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})
T_1	Absolute control	64.00	4.00	49.48	0.30	0.42	11.66	14.13
T_2	100% RDN through NCU	77.00	6.67	61.85	0.48	0.53	23.59	28.30
T_3	75% RDN through NCU	72.67	5.67	59.84	0.42	0.46	21.94	26.32
T_4	50% RDN through NCU	66.00	5.00	58.43	0.37	0.42	19.52	22.43
T_5	100% RDN through SCU	83.33	9.33	65.32	0.57	0.60	25.04	30.05
T_6	75% RDN through SCU	75.33	6.33	60.50	0.44	0.50	22.58	27.62
T_7	50% RDN through SCU	70.00	5.33	58.43	0.40	0.45	20.73	24.88
T_8	50% RDN through NCU + 50% RDN through SCU	84.00	11.67	66.63	0.58	0.63	25.88	31.06
T_9	75% RDN through NCU + 25% RDN through SCU	78.67	7.33	62.45	0.52	0.56	24.17	29.00
T_{10}	25% RDN through NCU + 75% RDN through SCU	80.33	8.33	62.86	0.54	0.59	24.65	29.57
SEm (±)	—	0.91	0.31	0.52	0.015	0.009	0.37	0.48
CD at 5%	—	2.72	0.92	1.55	0.045	0.023	1.11	1.44



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Conclusion

The study demonstrated that application of GRDF (50:75:45 kg ha^{-1} $N:P_2O_5:K_2O$) + 10 t ha^{-1} FYM + T_8 – 50% Recommended Dose of Nitrogen (RDN) through Neem-Coated Urea (NCU) + 50% Recommended Dose of Nitrogen (RDN) through Sulphur-Coated Urea (SCU) was found beneficial for increasing yield-contributing characters and yield of soybean grown in Inceptisol. However, the treatment T_5 – 100% Recommended Dose of Nitrogen (RDN) through Sulphur-Coated Urea (SCU) was found at par with the above treatment.

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Disclaimer

The findings and conclusions presented in this research article are based on the soil samples collected and analysed during 2025–26 under the specific soil and environmental conditions of Post Graduate Institute Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra. Experimental results regarding fertilizer performance may vary depending on local microclimatic conditions, soil types, and agronomic management practices.

Conflict of interest

The authors declare no conflicts of interest, and no external funding or sponsorship influenced the study design, data collection, analysis, publication decision, or manuscript preparation.

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