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Evaluating effect of different doses of coated urea on yield and yield attributes of wheat in Punjab region

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Abstract
An experiment was performed out at the Research Farm, University Institute of Agricultural Sciences and Technology Chandigarh University, Gharaun Mohali titled with "Relative Efficacy of Different Doses and Types of Coated Urea on Wheat Growth and Productivity in Punjab Region "during Rabi season 2020 and 2021. The soil in the experimental field had a clayey loam texture, and neutral in reactions, contained low organic carbon, accessible nitrogen and also had a medium amount of available potassium and phosphorus. The experiment consisted of 11 treatments T_1: No N + Rec. P, K & Zn, T_2: 100 % Rec. N through Urea + Rec. P, K & Zn, T_3: 70% Rec. N through NCU + Rec. P, K & Zn, T_4: 85% of Rec. N through NCU + Rec. P, K & Zn, T_5: 100% of Rec. N through NCU + Rec. P, K & Zn, T_6: 70% of Rec. N through ZnCU + Rec. P, K & Zn, T_7: 85% of Rec. N through ZnCU + Rec. P, K & Zn, T_8: 100% of Rec. N through ZnCU + Rec. P, K & Zn, T_9: 70% of Rec. N through NCU + ZnCU+ Rec. P, K & Zn, T_{10}: 70% of Rec. N through NCU + ZnCU+ Rec. P, K & Zn, T_{11}: 70% of Rec. N through NCU + ZnCU+ Rec. P, K & Zn arranged in randomized block design with three replications. On December 9, 2020, the crop variety UNNAT PBW-343 was sowed. Full doses of P and K, as well as one-third of N, were applied at the time of sowing via inorganic sources of nutrients such as urea (Neem coated urea, Zinc coated urea, and Neem +Zinc coated urea), and the remaining two-thirds of N were applied in two equal splits at the CRI stage and pre-booting stage, depending on the treatments. Treatment T8: 100% Rec. N through ZnCU + Rec. P, K, & Zn had significantly higher plant height, leaf area index, number of tillers per metre square dry matter accumulation, number of tillers per metre row length, length of spike, grains per spike, test weight, grain yield (44.35), and straw yield (71.47) than other treatments. T8, on the other hand, remained on equality with treatments T11, T5, and T2. Treatment T8: 100 % of Rec. N through ZnCU + Rec. P, K, & Zn also had the highest net return and B: C ratio in respect to T1 and other treatments.

Keywords: coated urea; yield and attribute of wheat; zinc coated urea; neem coated urea

Introduction

Wheat *(Triticum aestivum)* is second most important cereal crop in the world after rice and is one of the most important stable food crops. Wheat is cereal grain, originated from the Levant region (Feldman and Mordechai, 2007) [9] but now cultivated in at least 43 countries of the world. The country leading in wheat cultivation are China, Thailand, Indonesia and U.S.A. globally it is cultivated on an area of 224.72 million ha with the production and productivity of 734.62 million tones and 3.27 tonnes per ha, respectively (Anonymous, 2016) [2]. In India is one of the main wheat producing countries of the world after China. Wheat is second most important stable food crop of India after rice, cultivated in about 31.00 hectare with production and productivity of 88.9 million tones and 2.87 tons per ha, respectively (Anonymous, 2016 a) [3]. In Punjab region the area under wheat cultivation is 3.4 million ha with a production of 14.9 million tones and productivity of 4.3 tons per ha (Anonymous, 2019-2020) [1]. The trend during last five years has shown a marginal decline in production and productivity of wheat.

Wheat is a major source of carbohydrates (Shewry and Hey, 2015) [23], as well as one of the most critical sources of nutrition, protein, and fiber in the human diet (Arya *et al*., 2012) [4]. Wheat has a protein content of about 13%, which is relatively high when compared to other major cereals, but poor in protein quality for providing essential amino acids.

Nitrogen, the most important element, is a major component of proteins, hormones, chlorophyll, vitamins, and enzymes necessary for plant life, and its requirement in wheat crops in this region is generally met by urea. Leaching, ammonia volatilization, and denitrification losses account for approximately half of the overall N added by urea, according to comprehensive studies. The use of slow or managed release fertilizers is one way to reduce fertilizer N losses (Wu *et al*., 2008) [33]. N-use/recovery efficiency is critical, according to Singh and Singh (2003) [26], not only for achieving and maintaining high crop yields, but also for protecting natural resources from degradation. In August 2015, the Indian government directed producers to manufacture only coated urea in the future, for the benefit of farmers and to prevent chemical industries from misusing urea (Swami, 2015) [28]. In the past, neem cake was mixed with regular urea to increase nitrogen usage efficiency (NUE) in various crops. Azadirachtin, meliacin, nimbin, and their derivatives have been isolated from neem seed and are biologically active. These compounds, which are found in natural products called triterpenoids or limonoids and make up the bitter principles of neem seed oil, have been shown to have nitrification inhibition properties, slowing the release of nitrogen from urea and thus increasing crop yield. Tanwar (2014) [29] investigated neem oil coated urea and found a substantial increase in maize grain and straw yield, owing to increased nitrogen availability from neem coated

urea, which helped to reduce leaching and volatilization losses. According to Shivay *et al*., (2015) [25], zinc coated urea is a promising fertilizer for growing rice production while also saving a large amount of Zn from being added. Zinc application in the form of 1.5 percent bio-activated Zn coated urea has a major impact on rice crop root, shoot, and grain growth, yield, and Zn acquisition. Bio-activation by zinc-solubilizing bacteria and then coating on urea is an environmentally friendly method for achieving Zn bio-fortification in rice. This method of supplying Zn to plants is advantageous because it is environmentally friendly, less expensive, and time consuming. Research regarding relative efficacies of other compound proved to slow down hydrolysis if applied in a coated form, is lacking in wheat for Punjab region.

Material and Methodology

The field experiment took place at the Research Farm, Division of Agronomy, University Institute of Agriculture Science and Technology Chandigarh University Gharaun, Mohali during the Rabi season 2020-21. The experimental site was mainly subtropical in nature. The soil at the experimental site showed that the soil was clayey loam, neutral in reaction, low in organic carbon, available nitrogen, and medium in potassium and phosphorus, and electrical conductivity was in the safer range. The experiment was laid out in RBD with eleven treatments replicated thrice i.e. T_1: No N + Rec. P, K & Zn, T_2: 100 % Rec. N through Urea + Rec. P, K & Zn, T_3: 70% Rec. N through NCU + Rec. P, K & Zn, T_4: 85% of Rec. N through NCU + Rec. P, K & Zn, T_5: 100% of Rec. N through NCU + Rec. P, K & Zn, T_6: 70% of Rec. N through ZnCU + Rec. P, K & Zn, T_7: 85% of Rec. N through ZnCU + Rec. P, K & Zn, T_8: 100% of Rec. N through ZnCU + Rec. P, K & Zn, T_9: 70% of Rec. N through NCU + ZnCU+ Rec. P, K & Zn, T_{10}: 70% of Rec. N through NCU + ZnCU+ Rec. P, K & Zn, T_{11}: 70% of Rec. N through NCU + ZnCU+ Rec. P, K & Zn. The tested variety was UNNAT PBW-343 sown on 9 December 2020 with broadcasting method. Plant height, number of tillers, dry matter accumulation and leaf area index were observed before the harvesting of crop and after harvesting number of effective tillers, length of spike, grain per spike, test weight, grain yield, straw yield and harvest index were calculated. Specific soil samples from all plots were taken from the surface after the wheat crop was harvested to determine pH, EC, OC, available nitrogen, phosphorus, and potassium. The samples were dried in the shade, ground, and sieved at 2 mm before being analyzed. Relative economics of crop were also calculated on the basis of their cost of cultivation, gross return, net return and benefit cost ratio. By adding all of the variable cost factors in the production process, the cost of cultivation for each treatment was computed. Similarly, gross returns were estimated using the produce's current market price. After subtracting the cost of cultivation from the gross returns, the net returns were calculated. By dividing total returns from a unit by total cost of a unit, the benefit-cost analysis was obtained.

Result and Discussion

The research on numerous yield attributes, shows the effect of coated urea on effective tillers per metre row length, number of spikes per metre square, number of grains per spike, spike length, and test weight. (Fig. 1)

The number of tillers per running metre row length is a crucial metric to consider when estimating the impact of any treatment on wheat growth and yield. At harvest, the number of tillers was tallied. The number of tillers per metre row length at harvest was significantly influenced by the usage of coated urea. T8 (100 %of Rec. N through ZnCU + Rec. P, K, & Zn) had a substantially greater (60.38) number of tillers per metre row length than the control and other treatments in comparison. Moreover, it was found to be comparable to treatments T11 (100 % of Rec. N through NCU + ZnCU+ Rec. P, K & Zn), T5 (100 % of Rec. N through NCU + Rec. P, K & Zn), T2 (100 % Rec. N through Urea + Rec. P, K & Zn), and T7 (85 % of Rec. N through ZnCU + Rec. P, K & Zn), with values of 60.00, Treatment T1 (No N + Rec. P, K, & Zn) had significantly less tillers per metre row length (48.47).

Data revealed that significantly maximum spike length (11.99 cm) was recorded in T8 (100% of Rec. N through ZnCU + Rec. P, K & Zn) which was at par with T11 (100% of Rec. N through NCU + ZnCU+ Rec. P, K & Zn at 120 DAS), T5 (100% Rec. N through NCU + Rec. P, K & Zn) and T2 (100% of Rec. N through Urea + Rec. P, K & Zn) with the values 11.22cm, 11.18cm and 11.18cm,respectively. Treatments T11, T5 and T2 were statistically at equality with each other. However, minimum spike length (9.19 cm) was observed in treatment T1 (No N + Rec. P, K & Zn).A perusal of data depicted in Table 5 revealed that the numbers of grains per spike were not significantly influenced by different doses. Coated urea showed significant effect on the test grain weight, as depicted in Table (5).Treatments, T8 (100% of Rec. N through ZnCU + Rec. P, K & Zn) recorded significantly higher test weight (48.32 g) over other treatments in comparison. However, it was found to be at equality with T11 (100% of Rec. N through NCU + ZnCU+ Rec. P, K & Zn), T5 (100% of Rec. N through NCU + Rec. P, K & Zn) and T2 (100 % of Rec. N through Urea + Rec. P, K & Zn) with their respective values of 47.15, 46.09 and 45.67. Significantly lowest test weight (40.22 g) was recorded in treatment T1 (No N + Rec. P, K & Zn) at harvest. Jan *et al*., (2013) [10], Shivay *et al*., (2015) [25], and Kumar *et al*., (2016) reported similar findings of increased tillers due to the synergistic effect of NPK and Zn by soil application of Zn, which could be the underlying mechanism for enhanced growth and quantity of tillers.

The use of different types and doses of coated urea had significant effect on the grain yield. The data presented in Table 6 showed that treatment T8 (100% of Rec. N through ZnCU + Rec. P, K & Zn) observed significantly maximum grain yield (44.35 q/ha) which was however statistically at equality with T11(100% of Rec. N through NCU + ZnCU+

Rec. P, K & Zn), T5 (100 % of Rec. N through NCU + Rec. P,K & Zn), T2(100 % Rec. N through Urea + Rec. P, K &Zn) and T7 (85 % of Rec. N through ZnCU + Rec. P,K & Zn) with the values 42.77, 42.64, 42.21 and 42.18 q/ha respectively, whereas treatment T1 (No N + Rec. P, K & Zn) observed significantly lowest grain yield of 27.11 q/ha.

The use of different types and doses coated urea had significant effect on the straw yield. The data depicted that treatment T8 (100% of Rec. N through ZnCU + Rec. P, K & Zn) recorded significantly maximum straw yield (71.47 q/ha) which was however statistically at equality with T11 (100% of Rec. N through NCU + ZnCU+ Rec. P, K & Zn), T5 (100 % of Rec. N through NCU + Rec. P,K & Zn), T2 (100 % Rec. N through Urea + Rec. P, K &Zn) and T7 (100 % Rec. N through Urea + Rec. P, K &Zn) with the values 70.12, 70.19, 70.10 and 69.53 q/ha respectively. Whereas treatment T1 (No N + Rec. P, K & Zn) recorded significantly lower straw yield (57.52 q/ha). The improved availability of nutrients, particularly nitrogen, due to coated urea, which helped to reduce leaching and volatilization losses and hence expedited their availability, was linked to an increase in grain and straw yield (Upadhyay and Tripathi 2000) [32]. The increase in grain and straw yields could be attributed to sufficient quantities and a balanced proportion of plant nutrients being supplied to the crop as needed during the critical growth period, resulting in a desirable increase in yield attributing characters and improved nutrient uptake by plant cells. All of this resulted in optimal plant growth, and metabolic processes such as photosynthesis resulted in higher photosynthates accumulation and translocation to the plant's economic portions, resulting in high yield. Thind *et al*., (2010) [31], Pandey *et al*., (2009), Keram *et al*., (2012), Shivay and Prasad (2012) [24], Jan *et al*., (2013) [10], Jat *et al*., (2013) [10], Shivay *et al*., (2015) [25], Kumar *et al*., (2015), Jan *et al*., (2013) [10], Jat *et al*., (2013) [10], Shivay *et al*., (2015) [25], Jan *et al* (2016). The data of harvest index shows the effect of use of coated urea on the harvest index and was found to be significant for all the treatments. Among all the treatments T8 (100% Rec. N through NCU + Rec. P, K & Zn) recorded the maximum harvest index (38.16%) followed by T11 (100% of Rec. N through NCU + ZnCU+ Rec. P, K & Zn), T5 (100 % of Rec. N through NCU + Rec. P,K & Zn), T2 (100 % Rec. N through Urea + Rec. P, K &Zn) and T7 (100 % Rec. N through Urea+ Rec. P, K &Zn) with the values 37.84%, 37.45%, 37.35% and 36.99% whereas the minimum harvest index i.e. 32.16% was recorded in treatment T1 (No N + Rec. P, K & Zn).

Table 1: Effect of coated urea on different yield attributes of wheat

	Treatments	No. of tillers/m row length	No. of spike/m^2	Grains/spike	Test weight (gm)	Length of spike (cm)
T1	No N + Rec. P, K & Zn RDF (Control)	48.47	251.98	46.78	40.22	9.19
T2	100% Rec. N through Urea + Rec. P, K & Zn	56.91	292.06	53.00	45.67	11.18
T3	70% Rec. N through NCU + Rec. P, K & Zn	53.11	276.54	48.00	41.39	9.53
T4	85% of Rec. N through NCU + Rec. P, K & Zn	56.06	290.32	50.00	43.42	10.04
T5	100% of Rec. N through NCU + Rec. P, K & Zn	59.54	306.07	54.33	46.09	11.18
T6	70% of Rec. N through ZnCU + Rec. P, K & Zn	54.00	278.99	50.00	41.85	9.73
T7	85% of Rec. N through ZnCU + Rec. P, K & Zn	56.79	291.55	51.33	44.41	10.16
T8	100% of Rec. N through ZnCU + Rec. P, K & Zn	60.38	309.98	55.67	48.32	11.99
T9	70% of Rec. N through NCU + ZnCU+ Rec. P, K & Zn	53.55	278.49	48.00	41.77	9.55
T10	85% of Rec. N through NCU + ZnCU+ Rec. P, K & Zn	56.20	291.16	50.67	44.01	10.14
T11	100% of Rec. N through NCU + ZnCU+ Rec. P, K & Zn	60.00	308.29	55.33	47.15	11.22
	CD (P=0.05)	0.44	0.25	NS	0.32	0.23

Table 2: Effect of coated urea on grain yield, straw yield and harvest index

	Treatments	Grain yield q/ha	Straw yield q/ha	Harvest index
T1	No N + Rec. P, K & Zn RDF (Control)	27.11	57.52	32.16
T2	100% Rec. N through Urea + Rec. P, K & Zn	42.21	70.10	37.35
T3	70% Rec. N through NCU + Rec. P, K & Zn	36.96	67.29	35.27
T4	85% of Rec. N through NCU + Rec. P, K & Zn	40.69	69.46	35.97
T5	100% of Rec. N through NCU + Rec. P, K & Zn	42.64	70.19	37.45
T6	70% of Rec. N through ZnCU + Rec. P, K & Zn	37.54	68.04	35.53
T7	85% of Rec. N through ZnCU + Rec. P, K & Zn	42.18	69.53	37.28
T8	100% of Rec. N through ZnCU + Rec. P, K & Zn	44.35	71.47	38.16
T9	70% of Rec. N through NCU + ZnCU+ Rec. P, K & Zn	37.44	67.50	35.41
T10	85% of Rec. N through NCU + ZnCU+ Rec. P, K & Zn	41.12	69.52	36.99
T11	100% of Rec. N through NCU + ZnCU+ Rec. P, K & Zn	42.77	70.12	37.84
	CD(P=0.05)	0.26	0.30	0.24

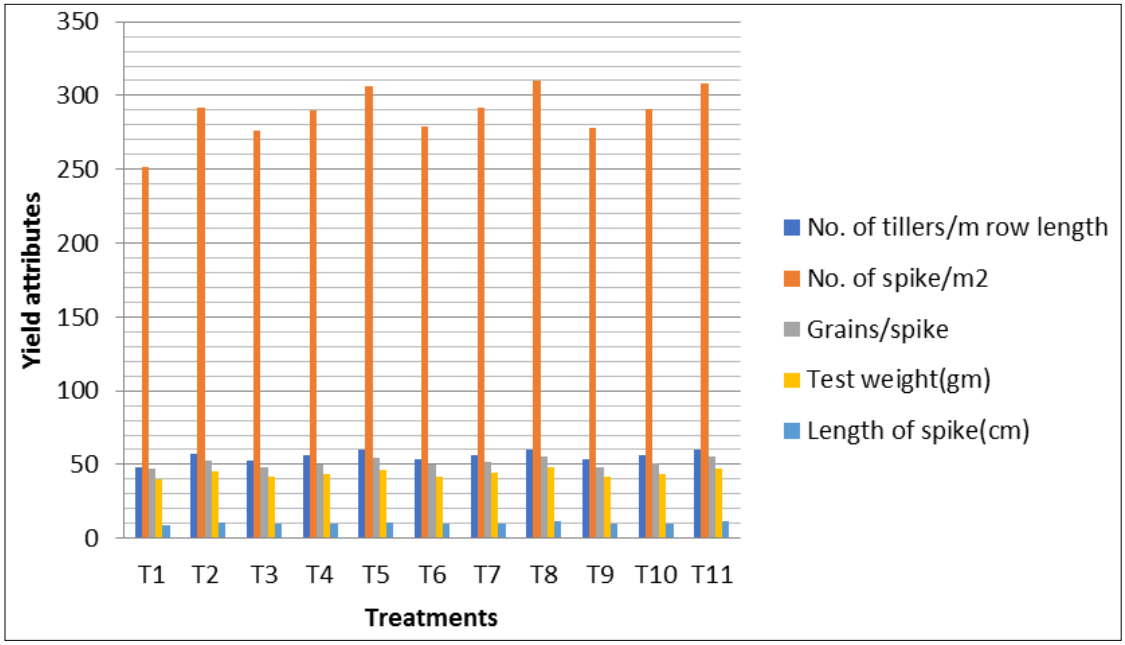

Fig 1: Effect of urea on different yield attribute of wheat

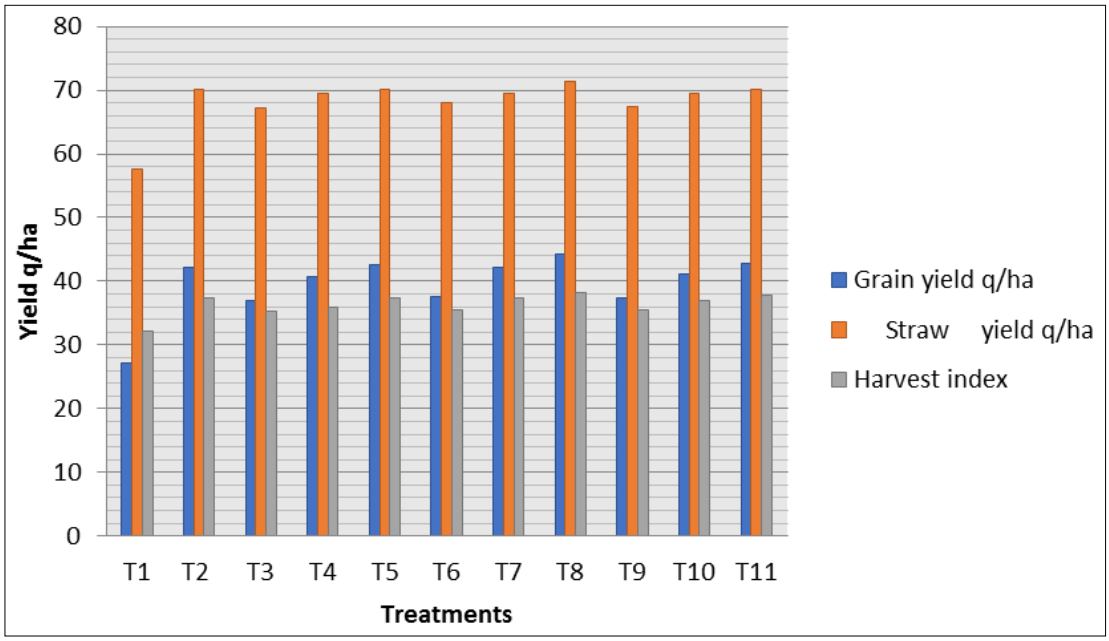

Fig 2: Effect of coated urea on grain yield and straw yield and harvest index of wheat.

Conclusion

On the basis of the findings of the current investigation, it was determined that among the various doses of coated urea, 100 % of Rec. N through ZnCU + Rec. P, K, and Zn (T8) produced the highest grain yield, which was statistically equal to 100 % of Rec. N through NCU + ZnCU+ Rec. P, K, and Zn (T11).

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