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Effect of Different Natural Oil Coated Urea Fertilizers on Productivity and Nutrient Uptake of Maize

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ABSTRACT

A field experiment was conducted using maize as a test crop at Agronomy field unit of College of Agriculture, University of Agricultural and Horticultural Sciences (UAHS), Navile, Shivamogga during Kharif 2015 to study the effect of different oil coated urea fertilizers on nutrient content and uptake in maize. The experiment consists ten treatments laid out in three replications using three different coated urea products viz., neem coated urea, pongamia oil coated and castor oil coated urea. The results indicated that neem coated urea significantly increased nutrient availability and uptake by maize. Application of 100 % Rec. N through NCU as basal was recorded significantly higher NPK content in rainfed maize. Significantly higher nutrient uptake was observed in the treatment which received application of 100 % Rec. N through NCU as basal over other treatments.

Key words: *Maize, Neem coated urea (NCU), Pongamia oil coated urea (POCU), Castor oil coated urea (COCU), Nutrient uptake*

INTRODUCTION

Maize is the third most important cereal crop species in the world (after wheat and rice) and is grown across a wide range of climates, but mainly in the warmer temperate regions and humid subtropics. Maize has multiple uses, including for human foods, animal feeds, and the manufacture of pharmaceutical and industrial products. Agriculture in the Indian sub-continent aims at competitive production of higher level of food, vegetables and fruits and industrial raw materials from the existing cultivable land through innovative research and development applications. The land holdings with the farmers are small, not amendable to the mechanized agricultural practices responsible for high crop yields, such as obtained in the developed part of the globe. Production of agriculture per unit area and time is largely dependent on provision of fertilizers and irrigation in ample measure for the adequate expression of genetic potential of improved varieties of food grain, vegetable crops and industrial crops.

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Urea is the widely used nitrogenous fertilizer. However, it appears that benefits from large level of urea fertilizer can be expanded by increasing the effectiveness of fertilization. Applied nitrogen subjected to various kinds of losses in soil mainly due to leaching denitrification and volatalisation. The problem is very serious under certain condition when heavy down pour occurs in a short period. The losses of N by way of leaching are very intense in sandy soil (light textured soils). It is therefore paramount importance to adopt such fertilizer practices to ensure maximum efficiency of applied N fertilizers. The present investigation was conducted to find out how far natural oil coated urea products were able to increase the efficiency of applied N in maize as compared to application of urea without coating.

MATERIALS AND METHODS

A field experiment was carried out during *kharif* 2015 at Agronomy field unit of College of Agriculture, University of Agricultural and Horticultural Sciences, Navile, Shivamogga. The experiment was carried out in Red sandy loam soil (81.1 % sand, 7.4 % silt and 11.5 % clay. The soil was found to be acidic in reaction (pH 5.58), normal electrical conductivity of 0.02 dSm^{-1} and low in organic carbon (0.23 %). The soil is low in available nitrogen (219.52 kg ha^{-1}), high in phosphorus (55.62 kg ha^{-1}) and medium in potassium (220.14 kg ha^{-1}) status. In all, there are ten treatments assigned to Randomised complete block design with three replications. The treatments consisted of three different coated urea fertilizers *viz.,* Neem coated urea, Pongamia oil coated urea and Castor oil coated urea were applied either in a single dose at sowing or in two splits (75 % at sowing and remaining 25 % at 30 days after sowing). Common dose of 50 kg P_2O_5 and 25 kg K_2O was applied at sowing. The fertilizers were applied in bands at a distance of 6 cm from the row and 2 cm deep. Periodic observations on growth parameters were made and the grain and stover yield was recorded from net plots of each individual treatment at harvest. After harvest of crop, plant samples were collected separately from each plot and analysed for nutrient content by using standard methods.

RESULTS AND DISCUSSION

Grain and stover yield of maize

From the results (Table 1), we noticed that all the different natural oil coated urea fertilizers were significantly increased the grain and stover yield over the application of 100 % Rec. N urea without coating (47.29 and 56.92 q ha^{-1}). In the present investigation, the grain and stover yield of maize (Table 1) was significantly influenced by application of different slow release nitrogenous fertilizers and among the treatments, application of 100 % Rec. N through NCU as basal was recorded significantly higher grain and stover yield of 69.05 and 79.42 q ha^{-1} followed by 100 % Rec. N through POCU and COCU as basal (66.74 and 78.90 q ha^{-1} and 66.42 and 76.40 q ha^{-1}) and these treatments were on par with application of 75 % Rec. N through NCU as basal + 25 % Rec. N through NCU at 30 DAS (65.86 and 75.49 q ha^{-1}). In these treatments the extent of increase for grain and stover yield compared to application of 50 % Rec. N urea as basal + 50 % Rec. N through urea at 30 DAS was 46.01 and 39.52 per cent, 45.35 and 38.60 per cent, 40.44 and 34.22 per cent and 39.26 and 32.62 per cent, respectively. The higher grain and stover yield with application N through different oil coated urea might be due to enhancement of growth parameters attributed to higher yield parameters due to higher availability and steady supply of nutrients in these treatments.

These results indicated that the increase in grain and stover yield was related to availability of on nutrient mainly nitrogen by neem coated urea, Pongamia oil coated urea and castor oil coated urea were helped in reducing the leaching and volatilization losses thereby accelerated the availability. Use neem coated urea also saved 20 kg of N ha^{-1}. These

results are in harmony with the findings of Rao and Shinde[5], Singh and Singh[10], Siddalinga *et al*[8]., Sharma and Prasad[7], Chikkamath[1], Gagnon *et al*[2]., and Joshi *et al*[4]..

Nutrient concentration in grain and stover of maize: The data on major nutrient content nitrogen, phosphorus and potash content (%) in the plant as influenced by different natural oil coated urea fertilizers are presented in Table 2. From the results (Table 2) indicated that primary nutrient concentration in maize grain and stover showed variable response to different natural oil coated urea fertilizers. The treatment which received 100 % Rec. N through NCU as basal was recorded significantly higher value of N (0.66 and 1.09 % stover and grain respectively), P (0.21 and 0.24 % stover and grain respectively) and K (1.00 and 0.45% stover and grain respectively) concentration in grain and stover of maize over the application of 100 % Rec. N through uncoated urea and it was on par with treatment which received, 100 % Rec. N through POCU as basal (N: 0.59 and 1.09 %, P : 0.18 and 0.24% and K : 0.97 and 0.45 % stover and grain, respectively) and 75 % Rec. N through NCU as basal + 25 % Rec. N through NCU at 30 DAS (N: 0.55 and 1.08%, P : 0.17 and 0.23% and K : 0.92 and 0.42% stover and grain, respectively). This may ascribed to increase availability of N, P and K in soil due to mobilization and release of nutrients from sources. All the coated urea products reduced the leaching and volatilization losses and also inhibit the nitrification process resulting in increased availability of nutrients in soil and in plant parts. These results are in conformity with findings of Singh *et al*[9]., Singh and Singh[10], Sharma and Prasad[7], Jaiswal and Singh[3], Sujatha *et al*[12]., Virendra Singh[13], Joshi *et al*[4]. and Sanjaykumar *et al*[6].

Total major nutrient by maize: The total major nutrient uptake in maize significantly increased due to application of different natural oil coated urea fertilizers (Table 3). Among the different treatments, significantly higher major nutrient uptake (N, P and K) was recorded in treatment which received 100 % Rec. N through NCU(128.54, 38.36 and 110.95 kg ha^{-1} total N, P and K uptake respectively) as basal and it was on par with treatment which received 100 % Rec. N through POCU as basal (121.52, 30.44 and 107.48 kg ha^{-1} total N, P and K uptake respectively), 100 % Rec. N through COCU as basal (116.14, 29.31 and 110.30 kg ha^{-1} total N, P and K uptake respectively) and 75 % Rec. N through NCU as basal + 25 % Rec. N through NCU at 30 DAS (112.80, 27.92 and 97.69 kg ha^{-1} total N, P and K uptake respectively). The lowest nutrient uptake was recorded in the treatment receiving 50 % Rec. N through urea as basal + 50 % Rec. N through urea at 30 DAS (85.37, 15.38 and 66.95 kg ha^{-1} total N, P and K uptake respectively). This mainly depends on crop yield and nutrient concentration in maize crop. This may be ascribed to higher availability of nutrients in soil due to their addition through NPK fertilizers and FYM, higher uptake of nutrients by the crop will also causes considerably higher yield of crop due to slow and steady release of these nutrients from native sources in soil as a result of inhibition of nitrification process. Considering the total uptake (grain + straw) together, it was seen that the K uptake was increased with increased uptake of nitrogen due to positive relationship between N and K. This might be due to the better uptake of nutrients because of favorable condition created in rhizosphere that caused increased economic and biological yield leaving low available nutrients in soil and small loss of nutrients prone to different types of losses like volatilization, leaching, fixation and through flood of water. Uptake of these nutrients was mainly influenced by releasing of nutrients from sources and biological activity of soil organisms. These results are in conformity with the findings of Singh *et al*[9]., Subbiah *et al*[11]., Chikkamath[1], Virendra Singh[13], Joshi *et al*[4]., and Sanjaykumar *et al*[6].

Table 1: Effect of different natural oil coated urea fertilizers on grain yield (q ha^{-1}) and stover yield (q ha^{-1}) of maize

Treatments	Grain yield (q ha^{-1})	Stover yield (q ha^{-1})
T_1: 50 % Rec. N through urea as basal + 50 % Rec. N through urea at 30 DAS	47.29	56.92
T_2: 100 % Rec. N through NCU as basal	69.05	79.42
T_3: 75 % Rec. N through NCU as basal + 25 % Rec. N through NCU at 30 DAS	65.86	75.49
T_4: 75 % Rec. N through NCU as basal + 25 % Rec. N through urea at 30 DAS	62.50	72.67
T_5: 100 % Rec. N through COCU as basal	66.42	76.40
T_6: 75 % Rec. N through COCU as basal + 25 % Rec. N through COCU at 30 DAS	63.00	73.11
T_7: 75 % Rec. N through COCU as basal + 25 % Rec. N through urea at 30 DAS	58.28	68.65
T_8: 100 % Rec. N through POCU as basal	66.74	76.90
T_9: 75 % Rec. N through POCU as basal + 25 % Rec. N through POCU at 30 DAS	63.91	73.47
T_{10}: 75 % Rec. N through POCU as basal + 25 % Rec. N through urea at 30 DAS	59.76	69.88
S. Em. ±	2.00	1.94
C.D. at 5%	5.94	5.77

Table 2: Effect of different natural oil coated urea fertilizers on nitrogen, phosphorus and potassium content (%) in grain and stover of maize

Treatment	Nitrogen (%)		Phosphorus (%)		Potassium (%)	
	Stover	Grain	Stover	Grain	Stover	Grain
T_1: 50 % Rec. N through urea as basal + 50 % Rec. N through urea at 30 DAS	0.45	0.89	0.12	0.18	0.72	0.35
T_2: 100 % Rec. N through NCU as basal	0.66	1.09	0.21	0.24	1.00	0.45
T_3: 75 % Rec. N through NCU as basal + 25 % Rec. N through NCU at 30 DAS	0.55	1.08	0.17	0.23	0.92	0.42
T_4: 75 % Rec. N through NCU as basal + 25 % Rec. N through Urea at 30 DAS	0.51	1.06	0.15	0.18	0.85	0.39
T_5: 100 % Rec. N through COCU as basal	0.58	1.08	0.17	0.25	0.95	0.44
T_6: 75 % Rec. N through COCU as basal + 25 % Rec. N through COCU at 30 DAS	0.53	1.07	0.17	0.19	0.89	0.40
T_7: 75 % Rec. N through COCU as basal + 25 % Rec. N through urea at 30 DAS	0.48	1.05	0.14	0.18	0.77	0.36
T_8: 100 % Rec. N through POCU as basal	0.59	1.09	0.18	0.24	0.97	0.45
T_9: 75 % Rec. N through POCU as basal + 25 % Rec. N through POCU at 30 DAS	0.55	1.07	0.17	0.20	0.90	0.41
T_{10}: 75 % Rec. N through POCU as basal + 25 % Rec. N through urea at 30 DAS	0.50	1.06	0.15	0.18	0.81	0.39
S. Em. ±	0.03	0.04	0.01	0.01	0.05	0.02
C.D. at 5%	0.09	0.11	0.03	0.03	0.14	0.05

Table 3: Effect of different natural oil coated urea fertilizers on total nitrogen, phosphorus and potassium uptake by maize

Treatments	Nitrogen (Kg ha^{-1})	Phosphorus (Kg ha^{-1})	Potassium (Kg ha^{-1})
T_1: 50 % Rec. N through urea as basal + 50 % Rec. N through urea at 30 DAS	85.37	15.38	66.95
T_2: 100 % Rec. N through NCU as basal	128.54	38.36	110.95
T_3: 75 % Rec. N through NCU as basal + 25 % Rec. N through NCU at 30 DAS	112.80	27.92	97.69
T_4: 75 % Rec. N through NCU as basal + 25 % Rec. N through urea at 30 DAS	103.39	22.45	86.00
T_5: 100 % Rec. N through COCU as basal	116.14	29.31	101.30
T_6: 75 % Rec. N through COCU as basal + 25 % Rec. N through COCU at 30 DAS	106.05	24.31	90.06
T_7: 75 % Rec. N through COCU as basal + 25 % Rec. N through urea at 30 DAS	99.11	21.33	77.41
T_8: 100 % Rec. N through POCU as basal	121.52	30.44	107.48
T_9: 75 % Rec. N through POCU as basal + 25 % Rec. N through POCU at 30 DAS	108.73	25.28	92.59
T_{10}: 75 % Rec. N through POCU as basal + 25 % Rec. N through urea at 30 DAS	101.44	21.91	82.19
S. Em. ±	3.53	3.57	4.79
C.D. at 5%	10.50	10.62	14.25

CONCLUSION

From result, it can be concluded that different natural oil coated urea fertilizers recorded significantly higher yield and nutrient concentration in maize which resulting in higher nutrient uptake. These results were quite interestingly brought out the need for basal application of nitrogen at sowing through coated urea fertilizers can be avoided by application of coated urea fertilizers in split application, rather than uncoated urea.

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