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Effect of neem coated urea on nutrient availability, yield attributing characters and yield of pearl millet on vertisol

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Abstract
A field experiment was carried out during the *Kharif* season of 2017 at the Pearl Millet Research Scheme, College of Agriculture, Dhule (M.S.) to study the effect of neem coated urea on nutrient availability, yield attributing characters and yield of pearl millet on vertisol. The experiment was laid out in a randomized block design with three replications and eight treatments of neem coated and uncoated urea. The organic carbon content (8.37 g kg^{-1}), available N (188.40 kg ha^{-1}), P (18.10 kg ha^{-1}) and K (490.63 kg ha^{-1}) were observed highest with 100% recommended N through neem coated urea. The maximum available Fe (4.97 mg kg^{-1}), Zn (0.71 mg kg^{-1}) and Cu (0.96 mg kg^{-1}) was noticed under 100% recommended N through neem coated urea, while, the maximum availability of Mn (8.18 mg kg^{-1}) was observed with 100% recommended N through uncoated urea. The significantly maximum plant height (178.33 cm), total number of effective tillers (1.54) and 1000 grain weight (14.10 gm) were recorded in the treatment receiving 75% recommended N through neem coated urea. Significantly higher grain yield (33.11 q ha^{-1}) was recorded in 75% recommended N through neem coated urea followed by 100% recommended N through neem coated urea (32.96 q ha^{-1}).

Keywords: Neem coated urea, nutrient availability, pearl millet, yield

Introduction
Pearl millet (*Pennisetum glaucum*) is most widely grown type millet. Pearl millet is the world's hardiest warm season cereal crop. Globally it ranks 6th after rice, wheat, maize, barley and sorghum in terms of area and share 42 per cent of total world production (Ramesh *et al*., 2006) [14]. Pearl millet is an indispensable arid and semi-arid crop of India cultivated as dual purpose (food and feed) crop in over 8.3 m ha ranking 4th among total cereals (Yadav *et al*., 2011) [19]. Pearl millet is well adapted to growing area characterized by drought, low productivity and high temperature. In Maharashtra, this crop is grown on 6.80 lakh ha of land with 6.15 lakh tons of grain production having productivity of 905 kg ha^{-1} in 2017-2018 (Anonymous, 2018) [2]. However, in Dhule district, pearl millet is grown on 0.77 lakh ha of land with 0.60 lakh tons of grain production having productivity of 780 kg ha^{-1} in 2016-2017 (Anonymous, 2017) [3]. Nitrogen is one of the most important and essential nutrient which directly influences the growth, development, yield and quality of pearl millet. Nitrogen is universally deficient in majority of the agricultural soils and successful arable farming is impossible without the use of nitrogenous fertilizers. Moreover, nitrogen fertilization aims at a high economic return of the investment through optimized crop yield and quality.

Rising cost of commercial fertilizers and increasing demand to produce more food is necessary. Incorporation of chemical fertilizer directly to field subjected to more losses. In case of N fertilizers, leaching and volatilization losses are more and only 30 to 40 per cent of added N fertilizer used by crops (Rizwan *et al.* 2008) [15]. To avoid the losses of urea fertilizer the Indian Government brought the neem coated urea in market. The various scientist work on neem coated urea and they found that coating saved the 20 per cent of the N dose. Nitrification inhibiting property of neem and its role in increasing urea N use efficiency in rice was first reported in early 1970s by Bains *et al*. (1971) [4]. In most of the studies conducted up till 1990, neem cake was used for coating of urea. Neem cake coated urea (NCU) was produced either manually on a small scale or in factories by mixing 0.1–0.2 tone neem cake per tonne urea. Although promising results in terms of increased crop yields were obtained, coating urea with neem cake manually or in factories did not turn out to be practically feasible on a large scale. Quality assurance of the neem cake coated urea was another problem. Therefore, neem oil as an alternative to neem cake has been used to coat urea granules to retard nitrification of ammonium-N in the soil. Very little information is available on these aspects in respect to pearl millet.

Therefore, the present study was conducted to determine the neem coated requirement for pearl millet crop and also to evaluate the nutrient availability and yield of crop.

Materials and Methods

The present investigation was carried out at Pearl Millet Research Scheme, College of Agriculture, Dhule (Maharashtra) during *kharif* 2017. The experiment was laid in Randomized Block Design with eight treatments each replicated thrice. The treatment comprised T_1: Control, T_2: GRDF (50:25:25 NPK kg ha^{-1} + FYM @ 5t ha^{-1}); T_3: 50% recommended N through neem coated urea; T_4: 75% recommended N through neem coated urea; T_5: 100% recommended N through neem coated urea; T_6: 50% recommended N through uncoated urea; T_7: 75% recommended N through uncoated urea; T_8: 100% recommended N through uncoated urea. The FYM @ 5 ton ha^{-1} along with P and K fertilizer common for T_3 to T_8 treatments. The gross plot size was 5.00 m x 3.60 m. Spacing was adopted 45cm x 15cm and the variety is Adishakti. The soil was deep black, vertisol having clayey in nature with pH-7.69, EC- 0.186 dSm^{-1}, free $CaCO_3$ – 10%, organic carbon– 7.6 g kg^{-1}, available N-155.47 kg ha^{-1}, P_2O_5-14.12 kg ha^{-1} K_2O- 465.51 kg ha^{-1} and DTPA, Fe- 4.62 mg kg^{-1}, Zn-0.66 mg kg^{-1}, Mn-7.10 mg kg^{-1}, and Cu-0.92 mg kg^{-1}. The pH was estimated by potentiometry and electrical conductivity by conductometry as suggested by Jackson (1973). Free $CaCO_3$ was estimated by acid neutralization (Allison and Moodier 1965), organic C by wet oxidation (Nelson and Sommer 1982), available N by alkaline permanganate (Subbiah and Asija, 1956), available P by colorimetric 0.5 M $NaHCO_3$ (Watanabe and Olsen 1965), available K by Flame photometry Neutral N NH_4OAc (Jackson 1973) and DTPA extractable Fe, Mn, Zn, Cu by atomic absorption spectrophotometer (Lindsay and Norvell 1978) [11].

Results and Discussion

Soil organic C and available nutrients

Organic carbon content at harvest was ranged between 7.67 to 8.37 g kg^{-1} (Table 1). The highest content of 8.37 g kg^{-1} was noted with 100% recommended N through neem coated urea (T_5) followed by 75% recommended N through neem coated urea (T_4) i.e. 8.30 g kg^{-1}. Lowest organic C was found in control (7.67 g kg^{-1}). Results further indicated that the treatment T_5 was statistically at par with T_4 and T_8.

Further, data (Table 1) indicated that significantly maximum N, P and K content in soil (188.40, 18.10 and 490.63 kg ha^{-1}, respectively) were noticed in treatment receiving 100% recommended N through neem coated urea (T_5) which was followed by 75% recommended N through neem coated urea (T_5). The lowest available nitrogen was found under treatment control (145.77 kg ha^{-1}). The treatment T_5 was found at par with T_4, T_8 and T_2. Neem coated urea reduced the leaching and volatilization losses and also inhibit the nitrification process resulting increased the availability and mobilization of nutrient from source. The findings are similar to those obtained by Jaiswal and Singh (2000) [6] and Sujatha *et al.* (2008) [17].

The iron content in soil ranged between 4.54 to 4.97 mg kg^{-1} under different treatments (Table 1). At harvest stage iron content was found non-significantly higher under treatment 100% recommended N through neem coated urea (4.97 mg kg^{-1}) followed by 100% recommended N through uncoated urea (4.93 mg kg^{-1}).The lowest iron content was found under control (T_1). Manganese content was found non significantly higher under treatment T_8-100% recommended N through uncoated coated urea (8.18 mg kg^{-1}) followed by T_4-75% recommended N through neem coated urea (8.06 mg kg^{-1}) and T_5- 100% recommended N through neem coated urea (8.05 mg kg^{-1}). At harvest stage zinc and copper content was found non-significantly higher under treatment T_5-100% recommended N through neem coated coated urea(0.71 and 0.96 mg kg^{-1}) followed by T_8-100% recommended N through uncoated urea and T_7-75% recommended N through uncoated urea i.e. (0.69 and 0.95 mg kg^{-1}).

Plant height, number of effective tillers and 1000 grain weight

Plant height is an important growth parameter of plant which is an expression of vegetative growth that directly linked with biological (grain + stover) yield. Among all the treatments, the treatment (T_4) was found significantly superior (Table 2). At the time of harvest of pearl millet, maximum plant height was recorded under treatment (T_4) 75% recommended N through neem coated urea (178.33 cm) followed by treatment (T_5) 100% recommended N through neem coated urea (176.53 cm). The T_4 treatment was found at par with T_5, T_8, T_6, T_7 and T_2. While, the mean minimum plant height (159.13 cm) was recorded at harvest in control (T_1). The significantly maximum numbers of effective tillers per plant (1.54) was noted in treatment T_4-75% recommended N through neem coated urea followed by 100% recommended N through neem coated urea (T_5) i.e. 1.41. Results further indicated that the treatment T_4 was statistically at par with T_5, T_8 and T_7.The results obtained similar to those of Khandey *et al.* (2017) [9].

The 1000 grain weight (g) of pearl millet was recorded at harvest. The maximum grain weight of 14.10 g was recorded with 75% recommended N through neem coated urea (T_4) and this was followed by 100% recommended N through neem coated urea (T_5) having 13.81 g grain weight. Lowest grain weight was recorded in T_1 control- 10.95 g. The treatment T_4 was at par with T_5, T_2, T_8 and T_7. Pushpanathan *et al*. (2005) observed that coated fertilizers improved the yield components like productive tillers and 1000 grain weight when applied at a proper time. These results also corroborate with the findings of Kumar *et al.* (2011) [10].

Grain and stover yield

The results (Table 3) revealed that the grain and stover yields of pearl millet were significantly affected due to neem coated urea fertilizer. The significantly highest grain (33.11 q ha^{-1}) and stover (55.70 q ha^{-1}) yield of pearl millet was recorded in the treatment receiving 75% recommended N through neem coated urea (T_4) and this was followed by 100% recommended N through neem coated urea (T_5). And T_4 was at par with T_5, T_8, T_2 and T_3 respectively. 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 there by accelerated the availability. Use of neem coated urea also saved 20 kg of N ha^{-1}. These results are in harmony with the findings of Gagnon *et al*. (2012) [5] and Joshi *et al*. (2014) [8].

Table 1: Organic carbon and available N, P and K and micronutrients at harvest as influenced by neem coated urea application

Treatments	Organic carbon (g kg^{-1})	Available nutrients (kg ha^{-1})			Micronutrients (mg kg^{-1})			
		N	P	K	Fe	Mn	Zn	Cu
T_1: Control	7.67	145.77	10.41	455.04	4.54	7.58	0.60	0.86
T_2: GRDF (50:25:25 NPK kg ha^{-1} + FYM @ 5t ha^{-1})	7.90	175.90	15.87	487.07	4.76	7.93	0.65	0.90
T_3: 50% recommended N through neem coated urea	7.79	169.80	14.90	483.67	4.72	7.86	0.66	0.89
T_4: 75% recommended N through neem coated urea	8.30	186.46	17.33	490.20	4.80	8.06	0.68	0.95
T_5: 100% recommended N through neem coated urea	8.37	188.40	18.10	490.63	4.97	8.05	0.71	0.96
T_6: 50% recommended N through uncoated urea	7.87	153.70	14.53	483.47	4.81	7.77	0.65	0.91
T_7: 75% recommended N through uncoated urea	7.87	161.67	15.90	484.14	4.78	7.84	0.69	0.93
T_8: 100% recommended N through uncoated urea	8.10	176.40	16.87	488.57	4.93	8.18	0.69	0.94
S.E. ±	0.12	4.68	0.74	4.77	0.086	0.12	0.022	0.023
C.D. at 5%	0.38	14.20	2.25	14.47	NS	NS	NS	NS

Table 2: Plant height, number of effective tillers and 1000 grain weight of pearl millet at harvest influenced by neem coated urea application

Treatments	Plant height (cm)	No. of effective tillers per plant	1000 Grain weight (g)
T_1: Control	159.13	1.12	10.95
T_2: GRDF (50:25:25 NPK kg ha^{-1} + FYM @ 5t ha^{-1})	166.00	1.15	13.28
T_3: 50% recommended N through neem coated urea	159.93	1.20	12.52
T_4: 75% recommended N through neem coated urea	178.33	1.54	14.10
T_5: 100% recommended N through neem coated urea	176.53	1.41	13.81
T_6: 50% recommended N through uncoated urea	171.23	1.13	11.81
T_7: 75% recommended N through uncoated urea	167.70	1.31	13.07
T_8: 100% recommended N through uncoated urea	173.80	1.40	13.40
S.E. ±	4.07	0.09	0.23
C.D. at 5%	12.35	0.29	0.71

Table 3: Grain and stover yield of pearl millet influenced by neem coated urea application

Treatments	Yield (q ha^{-1})	
	Grain Yield	Stover Yield
T_1: Control	27.53	45.07
T_2: GRDF (50:25:25 NPK kg ha^{-1} + FYM @ 5t ha^{-1})	30.94	51.38
T_3: 50% recommended N through neem coated urea	30.75	49.93
T_4: 75% recommended N through neem coated urea	33.11	55.70
T_5: 100% recommended N through neem coated urea	32.96	53.70
T_6: 50% recommended N through uncoated urea	28.57	49.63
T_7: 75% recommended N through uncoated urea	29.48	49.44
T_8: 100% recommended N through uncoated urea	30.87	52.24
S.E. ±	0.95	1.92
C.D. at 5%	2.88	5.82

Conclusion

On the basis of the results obtained from the present investigation, it is concluded that the neem coated urea found beneficial in improving the soil nutrient status and there by pearl millet yield. Experimental findings indicate that application of 75% recommended N through neem coated urea significantly increases the plant height, number of effective tillers and 1000 grain weight of pearl millet. However, the treatment 100% recommended N through neem coated urea improved the soil organic carbon content, available N, P, K and micronutrients (Fe, Mn, Zn and Cu). The highest grain and stover yield was obtained in the treatment T_4-75% recommended N through neem coated urea and T_5 -100% recommended N through neem coated urea. Therefore, application of 75% neem coated urea fertilizer over 100% neem coated urea fertilizer considerably improved yield, yield components of pearl millet on Vertisol.

References

1. Allison LE, Moodier CD. Carbonate In: Method of Soil Analysis. Chemical and Microbiological properties. Part-II Black C.A. (Ed.). American Society Agronomy Incorporation. Madison, Wisconsin, USA, 1965, 1387-1388.
2. Anonymous. Economic survey of Maharashtra Directorate of economic statistics, Department of agriculture government of Maharashtra, MPKV, Rahuri, 2017.
3. Anonymous. Economic survey of Maharashtra Directorate of economic statistics, Department of agriculture government of Maharashtra, MPKV, Rahuri, 2018.
4. Bains SS, Prasad R, Bhatia PC. Use of indigenous materials to enhance the efficiency of fertilizer nitrogen for rice. Fertilizer News. 1971; 16(3):30-32.
5. Gagnon B, Ziadi N, Grant C. Urea fertilizer forms affect grain corn yield and nitrogen use efficiency. Canadian Journal of Soil Science. 2012; 92:341-351.
6. Jaiswal VP, Singh GR. Performance of super granule and prilled urea under different planting method in irrigated rice (*Oryza sativa*). Indian Journal of Agriculture Science. 2000; 71(3):187-189.
7. Jackson ML. Soil Chemical Analysis. Prentice Hall Publication Pvt. Ltd. New Delhi, 1973.
8. Joshi A, Gupta JK, Choudhary SK, Paliwal DK. Efficiency of different Nitrogen Source, doses and Split application on growth and yield of maize (*Zea mays* L.) in the Malwa region of Madhya Pradesh. IOSR Journal of Agriculture and Veterinary Science. 2014; 7:39-42.

9. Khandey, Neha Singh, Anurag RN, Sengar SS, Kumar R. Response of applied neem coated urea (NCU) on yield and yield attributing parameters of rice (*Oryza sativa* L) in Vertisol. Internatonal Journal of Chemical Studies, 2017; 5(4):1670-1675.
10. Kumar D, Devakumar C, Kumar R, Panneerselvam P, Dasa A, Shivay YS. Relative efficiency of prilled urea coated with major neem (*Azadirachta indica* A. Juss) oil components in lowland irrigated rice of the Indo-Gangetic plains. Archives of Agronomy and Soil Science. 2011; 57(1):61-74.
11. Lindsay WL, Norvell WA. Development of DTPA soil test of Zn, Fe, Mn and Cu. Soil Science Society of American Journal. 1978; 42:421-428.
12. Nelson DW, Sommer LE. Total carbon, organic carbon and organic matter. In: *Methods of Soil Analysis*, Part-II, Page, A.L. (Ed.), American Society of Agronomy Incorporation. Soil Science American Incorporation. Madison, Wisconsin, USA, 1982, 539-579.
13. Pushpanathan KR, Vijayakumar M, Siddeswaran K. Effect of forms of fertilizer nitrogen and timing of application on growth and yield of rice (*Oryza sativa* L.) Agriculture Review. 2005; 2:153-156.
14. Ramesh S, Santhi P, Ponnuswamy K. Photosynthetic attributes and grain yield of pearl millet (*Pennisetum glaucum* (L.) R.Br.) As influenced by the application of composted coir pith under rainfed conditions. Acta Agronomica Hungarica. 2006; 54(1):83-92.
15. Rizwan Ahmad, Arshad M, Azeem Khalid, Zahir AZ. Effectiveness of organic-bio-fertilizer supplemented with chemical fertilizers for improving soil water retention, aggregate stability, growth and nutrient uptake of maize (*Zea mays* L.). Journal of Sustainable Agriculture. 2008; 31(4):57-77.
16. Subbiah B, Asija G. A rapid procedure for determination of available nitrogen in soil. Current Science. 1956; 25:256-260.
17. Sujatha MG, Lingaraju YB, Palled BY, Ashalatha KV. Importance of integrated nutrient management practice in maize under rainfed condition. Karnataka Journal of Agriculture Science. 2008; 21(3):334-338.
18. Watanabe FS, Olsen SR. Test of ascorbic acid methods for phosphorus in water and sodium bicarbonate extract of soil. Proceeding of Soil Science America, 1965; 21:677-678.
19. Yadav OP, Rai KN, Khairwal IS, Rajpurohit BS, Mahala RS. Breeding pearl millet for arid zone of northwester India: constraints, opportunities and approaches. All India coordinated pearl millet improvement project, Jodhpur, India, 2011, 28.