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Improving nutrient efficiency of soil using urea coats by mustard byproducts in wheat

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Abstract
Urea applied to soil was leached out or vaporize to an extent of 60%, which can be reduced by nitrification inhibitors. The study was conducted to know the byproduct utilization of mustard as urea coating material in turn studied soil properties and additional effect on weeds in wheat. It was found that addition of botanical byproducts like mustard and karanj had increased the N (2.33%), P (0.14%) and K (1.21%) content. However, each nutrient enhancement was different in different products. N content recorded highest in coat with mustard and karanj (2.33%), P content in coat with mustard byproduct (0.16%) and K content recorded highest in coat neem oil and karanj byproduct (2.30%). The coated urea also recorded to enhance the organic matter content ranged from 1.21 to 2.30%. Per cent organic carbon was highest in coat with neem oil and karanj byproduct (1.03%). The application of urea coated with botanical byproducts and neem oils has an influence on weed, *Eragrotis tremulo.* The least weeds were observed in urea coated with mustard byproduct (26.60 weeds per plot).

Keywords: Mustard, neem coated urea, allyl isothiocyantae, glucosinolates

Introduction
The mustard belongs to family *Brassicaceae*. It is mainly used in food as a mixture of seeds from two or more species of *Brassicaceae*, viz., *Sinapis Alba L.* (White/yellow mustard), *Brassica nigra* (black mustard) and *Brassica juncea* L. (Brown/oriental mustard). Mustards are functional foods having useful physiological effects in humans. These are having wide range of active components, including iso-thiocyanates, phenolics, di-thiolthiones and dietary fiber [1]. Due to the presence of higher erucic acid and glucosinolates, rapeseed and mustard oil is not used as ordinary cooking oil. Glucosinolates are sulfur containing compounds that occur widely in *Brassica spp*. These substances can lower rapeseed cake palatability and thus produce a range of nutritional disorders in farm livestock [2,3]. Though the plant is cultivated as oilseed crop, the leaves of new plants are used as vegetable and they are a good source of vitamin A, vitamin C, Calcium and iron. Mustard seed contains about 24-40% oil, 17-26% protein and 19% hull. Seeds are processed for oil extraction and the residue obtained is called mustard cake. Mustard cake, about 60% of the seed, is generated as by-product during extraction of the oil. India holds third position in the world for the production of mustard cake (5.7 Mt every year) [7]. Mustard is used to prevent microbial growth of food spoilage bacteria and increase the shelf life of processed food due to their antioxidant properties. Antimicrobial components include a broad range of glucosinolates as well as proteins which have the ability to hinder bacterial growth in foodstuffs. Antioxidant components such as quercetin, catechin, vitamin C and vitamin E in mustard suppress the formation of hydrogen peroxides, superoxides, peroxynitrites and thus reduce the rate of food oxidation [5, 6]

Like mustard, Azadirachtin of Neem oil is a famous natural anti-fee dent, growth regulator and Ovi-positional repellent for insects, as a major active ingredient, which make it a perfect substitute for chemical pesticides. Generally, neem is coated on urea to make slow release formulation. Nitrogen from Urea is discharged into the soil and water and leached by the activity of nitrifying bacteria Nitrobactor and Nitrosomonas [4]. These bacteria turn nitrogen into nitrite and then nitrate, which are highly liquid in nature when present in soil. 60% of nitrogen leached out or vaporize which can be reduced by these coats. The use of slow or controlled release fertilizers can effectively reduce nutrition loss, and one important type is coated fertilizer [9]. Coated fertilizers are prepared by coating granules of conventional fertilizers with various materials that reduce their dissolution rate. The release and disintegration rates of water-soluble fertilizers depend on the coating materials [10]. Neem has nitrification inhibition properties. So, it slows down the process of nitrogen release from urea. Neem coated urea can slow down the process of nitrification of urea and its enhance the yield by 48% [8]. Likewise, allyl isothiocyante, a bitter element in mustard can be separated and used for many purposes. With the hypothesis a study was conducted to know the byproduct utilization of mustard as urea coating material inturn studied soil properties and additional effect on weeds in wheat.

Materials and methods

a. Experimental site: experiment was laid out using wheat cultivar PBW43. Seeds were procured from local market. Plots were prepared (3 x 3 ft) and crops were raised using standard practices. The soil type of the site was sandy loam.

b. Treatment details: Urea was taken under study and the treatments were implemented in different combinations. Three botanical byproducts were mainly used. The details are given below,

Treatment details

Treatment	Details (quantity per 100g of soil)
1	Urea alone (5g)
2	Urea coated with mustard byproduct (1g)
3	Urea coated with Neem oil (1ml)
4	Urea coated with Karanj byproduct (1g)
5	Urea coated with Mustard (0.5g) and karanj (0.5g) byproduct
6	Urea coated with Mustard (0.5g) byproduct and neem oil (0.5 ml)
7	Urea coated with karanj (0.5g) byproduct and neem oil (0.5 ml)
8	Urea coated with neem oil (0.3 g), karanj (0.3 g) and mustard (0.3 g) byproduct
9	Control without urea

c. Coating method: the botanical byproducts were sprayed soon the urea granules and were shade dried. Approximately 5g of urea per 100g soil. Different combinations of botanicals were used based on compatibility. In mixing treatments, all botanicals were mixed and then sprayed. Water was used at very low quantity to proper spraying for urea coats.

d. Observations: different soil parameters like N, P, K content, organic matter, organic carbon, conductivity and pH were analyzed using standard protocols. In addition, a common weed (*Ergarotis tremula*) count was recorded in wheat after 20 days of application.

e. statistical analysis: the experiment was conducted using randomized block design with 3 replications. In total 9 different treatment combinations were used. The analysis was done using standard web agri stat package (a freeware). In case of weed observations a simple percentile calculations was done to check the efficiency.

Results and Discussion

During the studies, it was found that soil treated with mustard byproduct brought the effective changes in soil compositions. The soil samples were prepared by mixing desired quantity of mustard byproducts, karanj byproducts and neem oil on the weight basis in separate cups of 150 ml capacity. The soil samples were analysed by M/s Shriram Research Industrial Institute, New Delhi. Results are presented in Table 1. The results were found that additional of botanical byproducts like mustard and karanj had increased the N (2.33%), P (0.14%) and K (1.21%) content. However, each nutrient enhancement was different in different products. N content recorded highest in coat with mustard and karanj (2.33%), P content in coat with mustard byproduct (0.16%) and K content recorded highest in coat eith neem oil and karanj byproduct (2.30%). The coated urea also recorded to enhance the organic matter content ranged from 1.21 to 2.30%, highest was found in coat with karanj and neem oil (2.30%). Per cent organic carbon was highest in coat with neem oil and karanj byproduct (1.03%).

The results were in line with the studies of Hou et al (2014) [7], prepared four kinds of new developed urea, some of which were amended with biological inhibitors and coated and some of which were only coated with inorganic materials, were prepared by coating conventional granular urea (nitrogen 46.0%) and found that, decreased NO3 −-N content by 46.56% as compared to conventional urea treatment. Similar studies were also conducted using Karanja seed cake and its isolates, Karanjin, afurano-flavonoid from Karanja seed, *Azadirachta indica*, *A. juss* cake and its isolates; *Citrullus colocynthis* cake; *Madhuca indica* (syn. *Bassia latifolia)* cake; Vegetable tannin, waste tea; Nimin, Mint essential oil [9,11,15,18,19,20].

Table 2 revealed that the application of urea coated with botanical byproducts and neem oils has an influence on weed, *Eragrotis tremulo* significantly in wheat plots. The least weeds were observed in urea coated with mustard byproduct (26.60 weeds per plot). It was followed by plots applied neem coated urea. The highest weeds were observed in control plots (51.00 in wheat). All treatments were found to differ to each other significantly. Interestingly, the plots received urea only had relatively lower weeds than in control. The probable reason that the germinating weed seeds might have come in contact with urea granules and resulted in mortality of germinating seeds under the soil surface [13,14]. Studies in this area are meagre, however coating of urea with nitrification inhibitors is getting popular and will be soon under in depth study.

Conclusion

Nutrient efficiency of urea can be managed by using the coting methodology. Although there are several chemical nitrification inhibitors were present but still the natural or botanical byproducts to be used as nitrification inhibitors for the slow release of nitrogen. In our study, it was found that the different soil composition was altered by using of coated urea with neem, mustard and karanj byproducts. In addition, it also found reducing the weed population. Thus, these products are further studied for the commercialized utilization.

Table 1: Soil composition after application of urea coated mustard byproducts and neem

Soil sample (100 g each)		N (%)	P_2O_5 (%)	K_2O (%)	Organic matter (%)	Organic carbon (%)	Conductivity (µmho/cm)	PH (30 gm/75 ml)
1	Urea alone (@5g/100 g)	1.64	0.12	1.73	0.72	0.42	168	7.0
2	UR (5g) + MB (1 g)	1.75	0.16	1.76	1.00	0.60	271	6.8
3	UR (5g) + NO (1 g)	1.65	0.13	1.52	0.71	0.41	300	6.9
4	UR (5g) + KB (1 g)	1.51	0.15	1.76	1.36	0.80	301	7.4
5	UR (5g) + MB (0.5 g) + KB(0.5 g)	2.33	0.14	1.21	1.23	0.70	342	6.7
6	UR (5g) + MB (0.5 g) + NO(0.5 g)	1.37	0.15	1.56	1.19	0.70	275	6.7
7	UR (5g) + NO (0.5 g) + KB(0.5 g)	1.64	0.14	2.30	1.78	1.03	336	7.1
8	UR (5g) + NO (0.3 g) + KB(0.3 g) + MB(0.3 g)	1.92	0.15	1.93	1.20	0.71	217	7.0
9	No urea control	0.64	0.14	2.11	0.73	0.42	89	8.8

Note: UR: Urea, MB: Mustard byproduct, KB: Karanj byproduct, NO: Neem oil

Table 2: Effect of population of weed *Eragrostis tremula* (L) in wheat

Trt. No.	Soil treatment (@5g by wt. per 100 g of urea)	Population of *E. tremula* per slot (Plot size: 9.0 sqf)	
		No. of weeds	Reduction over control (%)
1	Urea alone	38.80	23.92
2	Neem coat	30.80	39.61
3	Mustard coat	26.60	47.84
4	Control	51.00	-
	Mean	36.80	-
	LSD at 0.05	13.527	-

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