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Effect of urea briquettes deep placement on yield and nitrogen use efficiency of rice

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Abstract
Effect of urea briquette deep placement with applicator on yield and yield attributing parameters of rice studied and experiment was conducted at "Research cum Instructional farm", "Indira Gandhi Krishi Vishwavidhyalaya", Raipur (C.G.) during *kharif*-2019 in randomized block deign with ten treatments and three replication with rice variety "IGKV-R1" used as test crop.The treatment consists of different level of nitrogen combine with different mode of urea application, i.e. T_1 (control), T_2 (N0), T_3 (100 kg N ha^{-1}), T_4 (75 kg N ha^{-1}), T_5 (120 kg N ha^{-1}), T_6 (150 kg N ha^{-1}), T_7 (75 kg N ha^{-1} applied as urea briquette deep placement manually), T_8 (75 kg N ha^{-1} applied as urea briquette deep placement using applicator), T_9 (150 kg N ha^{-1} applied as urea briquette deep placement manually) and T_{10} (150 kg N ha^{-1} applied as urea briquette deep placement using applicator) and uniform dose of P_2O_5 and K_2O @ 60 kg P_2O_5 ha^{-1} and 40 kg K_2O ha^{-1}, respectively applied uniformly in each treatment except T_1 (Control). The plant height, total and effective tillers/hill, number of filled grains/panicle were found significantly higher in treatment under Urea Briquette @ 150 kg N ha^{-1} applied through UB applicator (T_{10}). The yield of rice (i.e. straw and grain yield) was also significantly influenced by different mode of urea application and treatment under urea briquette application @ 150 kg N ha^{-1} (T_{10}) found significantly higher than other. Total nitrogen uptake by the rice plant was also significantly higher in treatment under 150 kgNha^{-1} urea briquette placed either manually or by applicator (T_9 and T_{10}) than others. The highest NUE was recorded with application of 75 kg N ha^{-1} urea briquette through UB applicator (T_8).

Keywords: Urea briquette, NUE, broadcasting, deep placement

Introduction
Nitrogen is one of the most important and also limiting plant nutrients among the 17 identified nutrient essential for plant growth and development. It affects the production of rice to a great extent. The importance of nitrogenous fertilizer in increasing rice yields has been widely recognized. The efficiency of urea-N is very low, often only 30-40%, in some cases even lower (Choudhury and Khanif, 2004) [1]. A substantial amount of nitrogen applied in form of fertilizer is lost through various mechanism including ammonical volatilization, de-nitrification and leaching.

Deep placement of urea enhance its use efficiency as well as provide an environmental advantage by reducing losses of nitrogen by runoff and volatilization. Moreover, emission of nitrous oxide is also checked resulting from nitrification-denitrification due to placement of the urea in the oxygen depleted soil layer. Deep placement of urea briquette reduces the nitrogen concentration in the flood water, thereby losses like ammonia volatilization and runoff also minimised and increases the use efficiency of applied urea. On an average deep placement of urea briquette saves about 35% of fertilizer and increment yield up to 15%–25% (Savant *et al*., 1992) [12]. However, the problem vis-à-vis with deep placement of urea, it is a labour intensive process (Rahman *et al*., 2016) [10]. Therefore, the use of briquette applicator could be an easy, less labour intensive, precise (free of human error) and very effective mode of urea briquette placement.

Materials and Methods
The experiment was conducted on *Vertisol* of Instructional cum Research Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh (Table 1).

Experiment was laid out in randomized completely block design (RBD) with three replications. Three method of urea application were taken for study i.e. broadcasting, manual placement of urea briquette and placement of urea briquette by applicator. Various agronomical parameters *viz*. plant height, number of tillers, grain per panicle, grain yield and straw yield was recorded. Plant sample was collected randomly from each treatment combination of all three replications at the time of harvest for further chemical analysis. Nitrogen content of "plant samples were determined using salt mixture method as described by Chapman and Pratte (1961).

Table 1: Treatments detail

Treatment no.	Treatment name
T1	$N:P_2O_5:K_2O$ @ 0:0:0
T2	$N:P_2O_5:K_2O$ @ 0:60:40
T3	$N:P_2O_5:K_2O$ @ 100:60:40
T4	$N:P_2O_5:K_2O$ @ 75:60:40
T5	$N:P_2O_5:K_2O$ @ 125:60:40
T6	$N:P_2O_5:K_2O$ @ 150:60:40
T7	$N:P_2O_5:K_2O$ @ 75:60:40 (N applied as urea briquette deep placement manually)
T8	$N:P_2O_5:K_2O$ @ 75:60:40 (N applied as urea briquette deep placement through applicator)
T9	$N:P_2O_5:K_2O$ @ 150:60:40 (N applied as urea briquette deep placement through manually)
T10	$N:P_2O_5:K_2O$ @ 150:60:40 (N applied as urea briquette deep placement through applicator)

Results

Agronomical parameters

The agronomical parameter affected by different method of urea application which is presented in table 2. The height of rice plant recorded 90DAT was found to be highest under T_{10} (132.67 cm) which was significantly taller than all other treatments. Significantly higher number of total and effective tillers 8.11 recorded under 150 kg ha^{-1} N as urea briquette via UB applicator (T_{10}) followed by T_9(7.66), T_8(6.86) and T_7(6.75) respectively. The highest number of grains/panicle 145 was recorded in treatment 150 kg ha^{-1} N as urea briquette via UB applicator (T_{10}) and lowest 98 grains in control (T_1). Jagtap (2007) [4], Mendhe *et al* (2006) [8], Jaiswal (2001) [6] and Nuruzzaman *et al.* (2000), reported improvement in agronomical growth parameters as nitrogen dose applied as UB placement.

Grain and straw yield

Among the different urea application methods, maximum grain and straw yield of 76.20 q ha^{-1} and 99.06 q ha^{-1} respectively (table 2), was recorded under the treatment receiving urea briquette (150 kg N ha^{-1}) that are deep placed using UB applicator (T_{10}) and is significantly higher than the treatment in which prilled urea was broadcasted and under the control. There was no significant effect of method by which urea is deep placed. Treatment which received urea briquette applied @75 kg N ha^{-1} T_7 (64.5 q ha^{-1}) and T_8 (65.5 q ha^{-1}) either manually or through applicator recorded significantly higher yield than the treatment in which urea is broadcasted at same level of nitrogen dose. However placement of briquette manually or with applicator can increase the yield of rice even at 20-25% lower nitrogen dose. Kadam *et al.* (2001) [7] found that the placement of urea briquette enhance grain yield of rice over split application of urea and the additional yield varied from 0.23 to 1.48 t ha^{-1}. The deep placed Urea-DAP briquette increased grain yield of rice from 11 to 86 per cent and gross yield 9 to 62 per cent prilled urea. The deep placement of UB reduces the losses of ammonium volatilization and nitrate losses enhancing plant growth and yield. Also proper placement of UB made availability of nitrogen for longer period which enhance vegetative growth. Elbadry *et al.* (2004) [2] and El-Rewainy (2002) [3] observed similar view on straw yield due to nitrogen application.

Nitrogen Use Efficiency

Highest total N uptake recorded was in 150 kg N ha^{-1} UB applied through UB applicator (T_{10}) and lowest was [1] recorded under control (T_1). Nitrogen uptake of treatment T_7 and T_8 was at par with T_3. Treatments in which UB is applied by UB applicator had shown significantly higher uptake than broadcasting method at same level of fertilizer dose i.e. T_7~T_8 > T_4 (75 kg N ha^{-1}). The highest value of NUE i.e. 59.90% under different urea application mode was recorded by treatment under 75 kg N ha^{-1} UB applied through UB applicator (T_8) followed by 75 kg N ha^{-1} UB applied manually (T_7) and lowest by 75 kg N ha^{-1} prilled urea broadcasting (T_4).

Table 2: Effect of different method of urea application on agronomical parameters, yield and Nitrogen uptake of rice

S. No.	Treatments name	Agronomical parameter			Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Nitrogen use efficiency (%)
		Plant height (cm)	No. of effective tillers per panicle	No. of filled grain per panicle			
T_1	CONTROL	89.88	3.57	98	24.83	29.80	-
T_2	N_0PK	92.62	3.37	100	34.33	41.20	-
T_3	$N_{100}PK$	102.7	4.53	129	64.00	76.80	43.59
T_4	$N_{75}PK$	99.68	4.07	109	54.00	64.80	37.25
T_5	$N_{125}PK$	105.37	4.71	133	65.33	78.40	36.17
T_6	$N_{150}PK$	125.09	6.50	144	69.66	90.56	34.25
T_7	$N_{75(UB)}PK$ (M)	127.32	6.75	139	64.50	81.27	57.16
T_8	$N_{75(UB)}PK$ (A)	128.26	6.86	141	65.50	82.53	59.90
T_9	$N_{150(UB)}PK$ (M)	128.82	7.66	142	75.33	97.93	40.17
T_{10}	$N_{150(UB)}PK$ (A)	132.67	8.11	145	76.20	99.06	40.66
	SEm(±)	0.60	0.12	1.45	2.11	2.59	
	CD (p = 0.05)	1.78	0.37	4.32	6.28	7.70	

Jena *et al.* (2003) [5] reported that deep placement of USG significantly improved NUE of rice and reduced volatilization loss of ammonia relative to the application of PU. Savant and Stangel (1998) [14] also reported that the agronomic performance and NUE of deep placed USG was found to be superior to that of two or three split applications of urea through RDF.

Conclusion

Application of urea in form of urea briquette improve crop growth and yield as revealed by increase in plant height, effective tillers per panicle, grains per panicle, grain and straw yield. Deep placement of urea briquette under submerged rice condition provide better physical, chemical and biological soil condition to plants and improve soil fertility as indicated by increased in available NPK. Deep placement induce slow release of nutrient reducing the losses and improve use efficiency of applied nutrient which is showcased by higher N uptake which in turn resulting in higher NUE.

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