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Effect of urea modified hydroxyapatite (UHA) Nano fertilizer on uptake of nitrogen, phosphorus and potassium by tomato

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Abstract
A greenhouse experiment was conducted during 2018 at College of Agriculture V.C. Farm, Mandya using CRD design with ten treatments and three replications with an objective to study the "Effect of urea modified hydroxyapatite Nano fertilizer (UHA) on uptake of major nutrients by tomato". Treatments includes T_1: RDF (NPK)+FYM, T_2 to T_4: NU:UHA @ 75:25, 50:50 and 25:75 per cent, respectively and T_5 to T_7: UHA @ 50, 75 and 100%, respectively, T_8 to T_9: RDF with 0.5 and 1.0 per cent foliar spray of UHA and T_{10}: Absolute control. Phosphorus, potassium and FYM are common for all treatments except T_1. The total N (5903.6 mg plant^{-1}), P (1571.1 mg plant^{-1}) and K (375.95 mg plant^{-1}) uptake were highest with the application of RDF (NPK) + FYM + 0.50 per cent UHA spray.

Keywords: UHA, Urea modified hydroxyapatite Nano fertilizer, nitrogen, phosphorus, potassium

Introduction
In recent years, advancement in nanotechnology has improved ways for large-scale production of nanoparticles of physiologically important metals, which are now used to improve fertilizer formulations for increased uptake by plants and thereby minimizing nutrient loss to the environment (Solanki *et al*., 2015 and Liu and Lal, 2015) [7, 4]. Nanoparticles have high surface area, sorption capacity and controlled release kinetics to targeted sites making them "smart delivery system". Nano structured fertilizers can increase the nutrient use efficiency through mechanisms such as targeted delivery, slow or controlled release. They could precisely release their active ingredients in responding to environmental triggers and biological demands (Solanki *et al*., 2015) [7]. In this regard an experiment was conducted with the objective to study the Effect of Urea Modified Hydroxyapatite Nano fertilizer on Uptake of Nitrogen, Phosphorus and Potassium by Tomato.

Material and Methods

Table 1: A greenhouse experiment was conducted at, CoA, V. C. Farm, Mandya. Details of the experiment are presented in

Crop	Tomato
Hybrid	Arka Samrat (F_1)
Design	Completely Randomised Design
Replications	Three
Treatments	Ten
Season	*Kharif* 2018
RDF(Recommended dose of fertilizer)	250:250:250 (N,P_2O_5, K_2O kg ha^{-1}) and FYM (39.75 t ha^{-1})

Collection and preparation of plant and fruit samples
After the harvest of crop, whole plant without roots were collected separately from each pot and dried in shade, then in oven at 65 ^{0}C for 72 hours Nitrogen content in plant and fruit was determined after digesting the samples with 15 ml conc. H_2SO_4 in the presence of digestion mixture (K_2SO_4: $CuSO_4$: Se in 100: 20: 1 ratio) as per the method outlined by Piper, (1966). Plant and fruit sample were digested using diacid mixture (HNO_3: $HClO_4$ in 9:4 ratio, respectively) after predigesting with concentrated nitric acid for the determination of P and K.

Table 2: Methods employed for analysis of fruit and plant samples

1	**Total nitrogen**	**Micro Kjedahl method**	Tandon (1998)
2	Total phosphorous	Vanadomolybdate phosphoric yellow colour method	
3	Total potassium	Flame photometer method	

The uptake of nutrients at harvest was worked out using the formula.

$$\text{Nutrient uptake (g plant}^{-1}\text{)} = \frac{\text{Nutrient concentration (\%)}}{100} \text{ X plant or fruit yield (g plant}^{-1}\text{)}$$

Total uptake = uptake by plant + uptake by fruit

Results and Discussion

N, P and K uptake (mg plant^{-1}) in tomato plant and fruit as influenced by the application of N through urea and UHA

The nitrogen, phosphorus and potassium uptake (Table 3) by plant, fruit and total were significantly varied due to treatments. The total (plant + fruit) uptake of N, P and K by tomato plant was significantly highest (5903.6, 1571.1 and 375.95 mg kg $^{-1}$, respectively) in the treatment T_8 that received RDF (NPK)+ FYM + 0.50 per cent UHA spray and showed significant difference with remaining treatments.

Addition of nitrogen, phosphorus and calcium through nano UHA results in synchronized release of N, P and Ca resulting in better absorption of these nutrients by the tomato plant thus contributing to higher nutrient content in plant and fruit. Higher nutrient content in foliar spray treatment plant might be due to better nutrients absorption through foliage because nano coatings on fertilizer particles can hold the material more strongly on the plant due to the higher surface tension (Ghormade *et al*., 2011; Yang *et al.,* 2012) [2]. Nanomaterial-increased uptake of nutrients by plants as they are small in size and have high rate of penetration through plant cell membrane (Liu and Lal., 2015; Khanm *et al*., 2018) [4, 3].

Nutrient uptake is the product of nutrient content and yield. Foliar application of nano UHA (0.50%) recorded significantly higher nutrient uptake. The higher uptake recorded with foliar application of nano UHA might be attributed to higher nutrient content and yields (both fruit and biomass) due to enhanced absorption of nutrients. Among the soil applied nano UHA treatments, application 100 per cent N through nano UHA has recorded higher nutrients uptake, may be due to higher availability of nutrients in soil coinciding with plant demand as nano UHA released nutrient in a sustained manner. In soil, the presence of an element essential for plants in the form of nano fertilizer allows better dissolution and faster absorption and assimilation by the plant compared to traditional fertilizers and it has been demonstrated for N, P, K, Ca and Mg by Ditta and Arshad (2016) [1]. Rajendran *et al*. (2017) [5] reported that nano slow release fertilizers along with PGPR increased the nutrient uptake by increasing the number and length of roots, and an increase in root length facilitated the absorption of nutrients from the soil. The higher uptake of nutrients in all the treatment except absolute control might be ascribed to the application of FYM (39.75 t ha^{-1}), which is considered as store house of nutrients (Ranpariya *et al.,* 2017) [6]. Similar results were reported by Taskin *et al.* (2017) [10] in lettuce; Soliman *et al*. (2016) [8] in Baobab.

Table 3: N, P and K uptake (mg plant-1) in tomato plant and fruit as influenced by the application of N through urea and UHA

Treatments	N (mg plant^{-1})			P (mg plant^{-1})			K (mg plant^{-1})		
	Plant	**Fruit**	**Total**	**Plant**	**Fruit**	**Total**	**Plant**	**Fruit**	**Total**
T_1: RDF (NPK)+ FYM	3623.10	167.51	3790.60	789.50	46.20	835.70	185.45	15.19	200.64
T_2: RD (PK) + 75% N-U + 25%N-UHA + FYM	3233.00	215.39	3448.40	669.00	47.56	716.50	177.40	17.51	194.91
T3: RD (PK) + 50% N-U + 50% N-UHA + FYM	3476.60	277.64	3754.20	946.40	79.97	1026.40	245.73	19.55	265.28
T_4: RD (PK) + 25% N-U + 75% N-UHA + FYM	3791.90	224.29	4016.20	1262.50	64.17	1326.70	293.51	17.55	311.06
T_5: RD (PK) + 50% N- UHA + FYM	3198.30	281.29	3479.60	1085.30	90.75	1176.10	242.16	19.95	262.11
T_6: RD (PK) + 75% N- UHA +FYM	3493.80	306.61	3800.40	1092.40	94.20	1186.60	313.22	28.78	342.00
T_7: RD (PK) + 100% N- UHA+FYM	4375.50	395.21	4770.70	1050.50	129.10	1179.60	267.25	22.88	290.13
T_8: T_1+ 0.50 per cent UHA spray	5403.70	499.87	5903.60	1474.30	96.81	1571.10	344.21	31.74	375.95
T_9: T_1+ 1.00 per cent UHA spray	4919.50	421.47	5341.00	975.40	65.68	1041.10	278.88	23.13	302.01
T_{10}: Absolute control	2184.60	156.90	2341.50	579.40	49.88	629.30	134.75	10.88	145.63
S.Em ±	115.36	10.07	115.45	23.09	2.25	23.34	6.14	0.47	6.25
CD (P=0.01)	464.20	40.52	464.56	92.95	9.05	93.93	24.70	1.90	25.16

Conclusion

The total N (5903.6 mg plant^{-1}), P (1571.1 mg plant^{-1}) and K (375.95 mg plant^{-1}) uptake were highest with the application of RDF (NPK) + FYM + 0.50 per cent UHA spray this is due to the addition of nitrogen, phosphorus and calcium through Nano UHA results in synchronized release of N, P and Ca resulting in better absorption of these nutrients by the tomato plant thus contributing to higher nutrient content and uptake in plant and fruit.

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