Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(3): 916-918
Received: 10-03-2020
Accepted: 14-04-2020

Manju MJ
Senior Scientist & Head, ICAR-Krishi Vigyan Kendra, Sirsi, Uttara Kannada, Karnataka, India

Praveen T Goroji
Technical Officer, ICAR-Krishi Vigyan Kendra, Saidapur Farm, Dharwad, Karnataka, India

Roopa S Patil
Scientist (Agr.Ent.), ICAR-Krishi Vigyan Kendra, Sirsi, Uttara Kannada, Karnataka, India

Agasimani AD
Scientist, Department of Horticulture, ICAR-Krishi Vigyan Kendra, Saidapur Farm, Dharwad, Karnataka, India

Annapurna Neeralagi
Technical officer, ICAR-Krishi Vigyan Kendra, Sirsi, Uttara Kannada, Karnataka, India

Corresponding Author:
Shivashenkaramurthy M
Scientist, Department of Agronomy, ICAR-Krishi Vigyan Kendra, Sirsi, Uttara Kannada, Karnataka, India

Evaluation of crotonylidene diurea in turmeric

Shivashenkaramurthy M, Manju MJ, Praveen T Goroji, Roopa S Patil, Agasimani AD and Annapurna Neeralagi

Abstract
A Field experiment was conducted to evaluate Crotonylidene Di-urea (CDU) fertilizer on Turmeric crop at ICAR-Krishi Vigyan Kendra, Sirsi of University of Agricultural Sciences, Dharwad, Karnataka during 2015-16. The testing product Crotolydene Diurea was evaluated for its effect on Turmeric and compared with urea fertilizer and in different proportionate. The results revealed that significantly higher plant height, number of tillers and number of leaves, fresh rhizome yield, number rhizome fingers per plant, rhizome length, rhizome girth, rhizome yield per plant were observed in the treatment receiving 100% N through CDU (T_1) and which was *onpar* with 75% N through CDU + 25% N through Urea(T_3). Significantly higher N,P and K uptake by crop was recorded with the same treatment. The lowest values of all the parameters were recorded with treatment 100% N through Urea (T_2) recorded significantly lower.

Keywords: Crotonylidene Di-urea, growth, yield, uptake and turmeric

Introduction
Turmeric (*Curcuma longa* L.) an important spice cum medicinal plant belongs to family Zingiberaceae. Turmeric also known as the "golden spice" or "spice of life" and mainly its underground rhizomes which are of use in culinary, medicinal, cosmetics and textile industries. India is the largest producer and exporter of turmeric in the world that accounts about 80 per cent of the world's output. In India, it is mainly grown in the states of Andhra Pradesh, Orissa, Tamil Nadu, Assam, Gujarat, Maharashtra, Karnataka and Kerala. Turmeric requires heavy input of fertilizers being a nutrient exhaustive crop (Subramanian *et al*, 2001) [1]. Nitrogen is essential and primary nutrient, required by all the crops in large amount. Excessive nitrogen fertilization increases the nutrient loss into the environment by leaching, denitrification and volatilization (Follett, 2001) [2]. Urea is the widely used nitrogenous fertilizer in agriculture because of its high nitrogen content (46%). However, 50-70 per cent of the applied nitrogen lost due to different losses via volatilization and leaching reducing the use efficiency of applied fertilizers (Shaviv and Mikkelsen, 1993) [3]. Reducing water solubility would eliminate this problem and produce a fertilizer that is environmentally safe and also effective. Various methods recommended to increase fertilizer use efficiency are increasing the organic matter content of soil through application of organic manures, split application of fertilizers and application of coated or slow release fertilizers. Increasing the nitrogen use efficiency will lead to increase in productivity & substantially. In this context, the controlled released Nitrogenous fertilizer to increase the efficiency of fertilizer has been investigated. It is in this background that a field experiment was attempted to assess the effect of Crotonylidene Di-urea (CDU) and in combination with Urea fertilizer as Nitrogen source on growth, and yield of Turmeric.

Material and Methods
A Field experiment was conducted to evaluate Crotonylidene DI-urea (CDU) fertilizer on Turmeric crop at ICAR-Krishi Vigyan Kendra, Sirsi of University of Agricultural Sciences, Dharwad, Karnataka during 2015-16. Location of trial was in Agriculture Research Station, Malagi, Mundgod taluk (Uttara Kannada district) situated in the hill zone of Karnataka.
The testing product Crotolydene DI-urea was evaluated for its effect on Turmeric and compared with urea fertilizer and in different proportionate. Study was conducted on CDU alone, Urea alone and combination of both on equivalent basis to meet recommended nitrogen level of the crop, There were six treatments *viz*., 100% N through CDU (T_1), 100% N through Urea (T_2), 75% N through CDU + 25% N through Urea (T_3), 50% N through CDU + 50% N through Urea (T_4), 25% N through CDU + 75% N through Urea (T_5) and Absolute Control (T_6). The recommended farm yard manure (FYM) was applied @ 25 t/ha for all treatments.

The experiment was laid out in Randomized Block Design (RBD) with four replication. The plot size was 3.0 m X 6.0 m. Raised beds were prepared with size of 90 cm width, 300 cm length and gap of 30 cm between beds. The recommended dose of fertilizer (150:125:250 NPK Kg/ha) was followed as per the package of practice. The Nitrogen fertilizers were applied in 2 splits. 50% of nitrogen as basal dose and remaining 50% nitrogen after 45 days after planting. Full dose of phosphorus (P) and Potassium (K) were applied as basal at the time of planting. Rock phosphate was used as P source and Murate of potash as source of K. CDU and Urea were used as Nitrogen source as per the treatments. Turmeric cultivar 'Suguna' was used in the study. The rhizomes weighing 10-15 g were used as planting materials. Before planting, rhizomes were cut in to pieces and soak in solution containing Copper oxy chloride (3g/l) and streptocycline (0.5 g/l) for 20 minutes. The treated rhizome were planted in two rows per bed with the spacing of 45 x 30 cm on 4th of June,2015. Necessary plant protection, weed management and water management practices were followed as per the requirements. The crop was harvested on 20th December, 2015 at maturity to record various yield and yield attributing parameters. Five plants were randomly selected in each treatment plot of each replication and recorded observations at maximum growth stage (160 days after planting) on growth parameters *viz.*, plant height (cm), number of tillers/plant and number of leaves/plant. Yield parameters *viz.*, number of fingers/plant, finger length (cm), finger girth (cm), fresh rhizome yield per plant(g), fresh rhizome yield per plot (kg/18m^2) and fresh rhizome yield (t/ha) were recorded. Initial Soil samples were collected from plot and analyzed for N, Pand K content. After harvest turmeric crop, soil samples were collected from all the treatments in all replications and analyzed the N, P and K content. Soil samples collected from 0-15 cm depth. Plant samples were collected from all the treatments in all the replications at maximum growth stage (160 days after planting) for nutrient uptake study.

Results and Discussion

Effect of CDU on growth parameters (Table 1)

Different nutrient management practices had significant influence on growth parameters of turmeric crop. Among all the treatments, significantly lower plant height was recorded in control plot(63.60cm) as compared to other treatments. Significantly higher plant height (123.55cm) was observed in the treatment receiving 100% N through CDU(T_1) and which was *onpar* with treatment receiving 75% N through CDU + 25% N through Urea(T_3) (120.55cm). Among the fertilizer applied treatments, 100% N through Urea (T_2) recorded significantly lower plant height (97.70cm) and *onpar* with treatment receiving 25% N through CDU + 75% N through Urea (T_5) (105.75cm). Similar results were observed with respect to number tillers per plant and number of leaves per plant. Similar results reported by Ram (1999) [4] and Badgujar *et al.,* (2004) [5]. The Increase in growth parameters were due to increased available Nitrogen, Phosphorus, potassium and other micronutrients (Atul Pawar *et al*., 2017) [6].

Effect of CDU on Yield and Yield attributes (Table 2)

Yield and Yield attributes of Turmeric crop were significantly influenced by different treatments. Among all the treatments, significantly lower fresh rhizome yield was recorded in control plot (11.28t/ha) as compared to other treatments. Significantly higher fresh rhizome yield (31.20t/ha) was observed in the treatment receiving 100% N through CDU(T1) and which was onpar with treatment receiving 75% N through CDU + 25% N through Urea(T3) (27.80t/ha). Among the fertilizer applied treatments, 100% N through Urea (T2) recorded significantly lower fresh rhizome yield (22.18t/ha) and onpar with treatment receiving 25% N through CDU + 75% N through Urea (T5) (22.63t/ha). Similar results were obtained with respect to number rhizome fingers per plant, rhizome length, rhizome girth, rhizome yield per plant and rhizome yield per plot. Nitrogen is released from CDU through hydrolysis and microbial degradation in the soil. When dissolved in water, it gradually decomposes to urea and crotonaldehyde. The study conducted by Atul Pawar *et al*.,2017 [6] reported similar results with use of CDU as nitrogen source. Increased in yield and yield attributing values were due to slow and steady supply of nitrogen and increased nitrogen use efficiency. He report that the soil available micronutrients *viz*., Fe, Mn, Cu and Zn was significantly influenced by nitrogen application through CDU and hence improved the yield.

Effect on Nutrient uptake by crop and soil Nutrient status (Table 3)

The N P K nutrient uptake by crop was significantly influenced by different nutrient management practices. Among all the treatments, significantly higher N uptake by crop was recorded with the treatment receiving 100% N through CDU(T_1) (126.98 kg/ha) and which was *onpar* with treatment receiving 75% N through CDU + 25% N through Urea(T_3) (117.43 kg/ha). *Whereas*, control plot recorded significantly lower N uptake (53.30 kg/ha) as compared to other treatments. Among the fertilizer applied treatments, 100% N through Urea (T_2) recorded significantly lower N uptake (87.68 kg/ha) and *onpar* with treatment receiving 25% N through CDU + 75% N through Urea (T_5) (99.33 kg/ha). Similar trend was observed with respect P and K uptake. Among all the treatments, all the fertilizer applied treatments recorded significantly higher N content in the soil as compared to controlled plot (Table 3). *Whereas*, controlled plot recorded significantly lower N content. N content of soil in all fertilizer treatments were not significant. Similar results were observed with respect to P and K nutrient status in the soil. Numerically, N content in soil was increased with increase in CDU level in proportionate as result of decreased leaching losses. Similar findings were recorded by Atul Pawar *et al*., (2017) [6], Xiaoguang *et al*., (2004) [7] and Goutami *et al.,* (2015) [8]. They reported that the soil available nitrogen, Phosphorus and Potassium was significantly more N through CDU. The soil available micronutrients *viz*., Fe, Mn, Cu and Zn was significantly influenced by nitrogen application through CDU.

Table 1: Effect of Crotonylidene Diurea on growth parameters of Turmeric

Treatments	Plant Height (cm)	No. of Tillers per Plant	No. of Leaves per Plant
T_1	123.55	6.80	10.40
T_2	97.70	5.05	8.925
T_3	120.55	6.60	9.90
T_4	113.20	5.90	9.35
T5	105.75	5.275	8.75
T6	63.60	3.00	6.40
C.D. @ 5%	8.21	0.74	0.98
CV	5.20	8.95	7.23
S.Em +	3.13	0.28	0.37

Table 2: Effect of Crotonylidene Diurea on Yield and yield parameters of Turmeric

Treatments	No. of Fingers per Rhizome	Length of Finger (cm)	Girth of Finger (cm)	Fresh weight of Rhizome/Plant (g)	Rhizome Yield /plot (kg)	Rhizome Yield (t/ha)
T_1	13.55	6.98	3.03	561.65	56.17	31.20
T_2	9.25	4.8	2.39	399.15	39.92	22.18
T_3	12.00	6.38	2.84	500.40	50.04	27.80
T_4	10.70	5.91	2.68	477.50	47.75	26.53
T5	9.35	5.35	2.48	407.30	40.73	22.63
T6	6.30	3.06	1.61	203.00	20.30	11.28
C.D. @ 5%	1.64	1.02	0.28	75.18	7.52	4.18
CV	10.59	12.49	7.33	11.67	11.67	11.67
S.Em +	0.62	0.39	0.11	28.62	2.86	1.59

Table 3: Effect of Crotonylidene Diurea on Nutrient Uptake by Turmeric Crop

Treatments	Nutrient Uptake by crop (Kg/ha)			Nutrient status after harvest of the crop (Kg/ha)		
	N	P	K	N	P	K
T_1	126.98	22.85	196.65	222.95	34.30	192.60
T_2	87.68	18.50	124.13	205.83	36.50	206.45
T_3	117.43	21.55	175.05	220.70	34.55	193.33
T_4	110.20	20.98	157.10	215.33	35.25	196.40
T5	99.33	19.63	136.45	205.93	35.53	197.23
T6	53.30	5.45	73.45	169.95	21.20	181.90
C.D. @ 5%	15.46	1.45	27.72	19.53	2.85	14.95
CV	10.28	5.27	12.71	6.31	5.72	5.07
S.Em +	5.89	0.55	10.55	7.43	1.09	5.69
Initial status	-	-	-	245.2	15.2	235.3

Conclusions

1. Among the fertilizer applied treatments, application of 100% N through CDU (T_1) found to be more effective in influencing growth and yield of turmeric crop followed by 75% N through CDU + 25% N through Urea (T_3).
2. Application of N through 100% CDU is better than through 100%Urea.

Acknowledgement

The authors are thankful to Somaiah Sugars, Sameewrwadi, Mudhol taluk, Baglkot district, Karnataka for providing financial assistant to UAS, Dharwad for conducting the trial.

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