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Effect of Crotonylidene Di-Urea on Yield and Quality of Banana on Inceptisol

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A B S T R A C T

Field experiment was conducted at the research farm of Soil Test Crop Response (STCR) Correlation Project, Mahatma PhuleKrishi Vidyapeeth, Rahuri during 2015-16 to study the effect of crotonylidenediurea on yield and quality of banana on inceptisol. The growth parameters of banana, number of leaves and pseudostem girth was on par with each other in treatment GRDN and 100% N through CDU. The yield attributing characters, number hands, number of fingers per bunch and bunch weight was on par in treatment GRDN and 100 % N through CDU. The banana yield and quality viz., total sugar, reducing sugars and pulp: peel ratio was significantly higher in treatment GRDN and statistically on par with 100 % N through CDU. Thus, the addition of nitrogen through urea and crotonylidenediurea as per general recommended dose of nutrients in an incubation study was found beneficial for periodical soil enzyme activity, microbial population, ammonical and nitrate nitrogen and soil available phosphorus and potassium. The banana yield and banana yield attributing character and residual soil fertility was benefited by an application of nitrogen through urea and 100 % through CDU as GRDN. The GRDN are beneficial for nitrogen, phosphorus and potassium uptake (582.27 kg ha^{-1}, 156.27 kg ha^{-1} and 1031.7 kg ha^{-1} respectively)

Introduction

The banana is botanically, Musa Sp. also referred to as the tree of paradise. India, with an annual production of 26.22 million tonnes from 4,04,000, ha area is the largest producer of banana in the world. It contributes 27% of the global production and about 37% of total fruit crop production in the country (FAO 2015). Grand Naine is a popular variety of banana grown mostly in all export oriented countries of Asia, South America and Africa due to its excellent fruit quality.

This is a superior selection of Giant Cavendish introduced to India in 1990’s (Singh and Chundawat, 2002). Among the Indian States, Maharashtra contributes maximum area of about 90,000 ha for banana cultivation and accounts for 25% of the total banana production. Despite being the most productive, contribution of banana accounts only 0.1% to world trade (Aquil *et al.,* 2012).

Nitrogen is essential and primary nutrient, required by all the crops in large amount.

However, nitrogen fertilizer added in soil get leached or washed out. It not only causes economic loss but also gives invitation to soil, water and environmental pollution. It has harmful effect on soil health as well as human health, the use of slow release fertilizer up to some extent useful and ecofriendly option to overcome these problems. Excess nitrogen in banana promotes pseudosteme longation which results in plant lodging and consequently yield loss, an oversupply of nitrogen increases the time needed for banana fruit filling and affects fruit quality (Lahav, 1995). Excessive nitrogen fertilization also increases the nutrient loss into the environment by leaching, denitrification and volatilization (Follett, 2001). These losses have the potential of disrupting the environment. To ameliorate this problem, recommended that nitrogen fertilization should be kept to the lowest level that is consistent with an optimum yield (Lorenz, 1978). 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). This reduces the productivity and increases the cost of cultivation besides polluting the environment. Increasing the nitrogen use efficiency will lead to increase in productivity & substantially. 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. In this context, the controlled release technology by coating urea with different materials such as phosphogypsum, sulphur, resin polymers, Dicyclo-pentadiene (DCPD), pine tree Kraft lignin and neem using different techniques of rotating drum, fluidized bed and spouted bed to increase the efficiency of urea fertilizer has been investigated (Susherman and Anggoro, 2011). It was reported that the thickness of coating fertilizers, affects the release pattern of nitrogen from fertilizers.

Studies of enzyme activities in soil are important as they indicate the potential of the soil to support biochemical processes which are essential for the maintenance of soil fertility (Dkhar and Mishra, 1983). Any management practice that influences microbial communities in soil may be expected to produce changes in soil enzyme activity level (Perucci *et al.*, 1984). Soil dehydrogenase activity is often used as a measure of any disruption caused by pesticides, trace elements or management (Reddy and Faza, 1989, Wilke, 1991, Frank and Malkomes, 1993). In view of the above considerations, the present research work is planned and conducted at Soil Test Crop Responses Correlation and Project Research Farm, M.P.K.V., Rahuri.

Materials and Methods

The present investigation was carried out by conducting a field experiment entitled, "Effect of Crotonylidene Diurea on Yield and Quality of Banana on Inceptisol" at Soil Test Crop Response Correlation Project (ICAR), Research Farm, Mahatma PhuleKrishi Vidyapeeth, Rahuri during 2014-16. Geographically the central campus of Mahatma PhuleKrishi Vidyapeeth, Rahuri is situated 38 km away from Ahmednagar, on Ahmednagar-Manmad State Highway. It lies between 190 48' N and 190 57' N latitude and 740 19' E longitude. The altitude varies from 495 to 569 meters above mean sea level. This tract is lying on the Eastern side of Western ghat and falls under rain shadow area. The soils of the experimental site of the present investigation was grouped under inceptisols order belong to Sawargaon (Pather) soil series which comprises of fine montmorillioniticiso hyperthemic family of VerticHaplustepts. The soil was medium black with 80 cm depth having swell shrink property. The texture of the soil was clayey with low in available nitrogen (188.16 kg ha-1), medium in available phosphorus (21.43 kg ha-1) and very high in potassium (548.80 kg ha-1). The soil was slightly alkaline in reaction (pH 8.12) with calcium carbonate content of 7.90 %. Urease activity was 19.60ug NH4-N g-1 of soil hr-1 and Dehydrogenase activity was 0.97 ug TPF g-1 soil hr-1. Banana crop (Grand Naine) was taken as a test crop in the present investigation, the fruit, shoot & leaf yield of banana were recorded at harvest. The treatment wise representative fruit, shoot and leaf samples were collected from each plot for studied the uptake of NPK. The representative five plants were tagged for observations from each treatment replication wise. These plants were used to record the number of leaves, height, pseudostem girth, bunch weight, number of hands per bunch, banana yield, pseudostem yield, dry matter yield and nutrient concentration in banana fruits and leaves. Treatment wise soil samples were collected from all the replications at grand growth, shooting and at harvest stage and analysed for residual soil fertility by adopting standard analytical procedure. The soil enzyme activity viz., urease and dehydrogenase were also reported.

Experiment was laid out in randomized block design with four replications comprising of six treatment viz., general recommended dose of nutrients (GRDN) and nitrogen @ 100 %, 75 %, 50 %, 25 % through crotonylidenediurea (CDU), and absolute control. The FYM was applied @ 10 kg plant1except absolute control treatment. Tissue cultured plantlets of banana (Musa sp.-cv Grand Naine) were planted at 1.75 m x 1.75 m spacing. Nitrogen was applied in seven splits, phosphorus was applied at the time of planting, potassium was applied in four splits and FYM at the time of planting. Representative soil samples were collected from each plot at 20 cm depth before planting of banana, at juvenile, grand growth, shooting and at harvest stage. In standing crop soil sample was taken from the point in between two water drippers and within the active root zone area. The collected samples were air dried in shade on paper sheet, gently ground, mixed and sieved through 2 mm sieve. The processed soil samples were used for analysis of chemical properties by adopting standard methods of analysis. Total fresh weights of plants from each plot were recorded. The leaves and pseudostem were partitioned in equal parts and a representative composite sample was drawn. The middle three fruits of third hand from the top were selected and cut into small slices. The collected samples were air dried followed by oven dried at 70°C temperature till constant weight. Dry matter yield was recorded. The uptake of major nutrients was determined by using dry matter present and nutrient concentration in different plant parts at harvest of banana.

Results and Discussion

The growth parameters viz., pseudostem height, pseudostem girth, number of functional leaves, are presented in Table 1.The pseduostem height was significantly more in GRDN over the rest of treatment. The nitrogen application to banana through GRDN numerically recorded higher pseudostem height (261.30 cm) followed by 100 % (256.65 cm) and 50 % N through CDU (246.10 cm) respectively. Similar results reported by Allen (1986), Alvan and Tucker (1996), Ram (1999) and Badgujar *et al.*, (2004). The pseudostem girth was significantly influenced by the application of CDU (Table 1). The pseudostem girth was significantly more in GRDN (63.05 cm) than rest of treatment and statistically on par with

100 % N through CDU(62.75 cm). The pseudostem girth of banana was statistically on par with each other for 75 and 50 % nitrogen application through CDU(61.50 and 60.95 cm), the absolute control treatment having the minimum pseudostem girth compared to all treatment. These results are accordance with those reported by Babu *et al.,* (2004). The number of leaves and was significantly more in GRDN (12.45) than rest of treatment and statistically on par with 100 % N through CDU (12.35).

Application of CDU exerted positive influence on yield and yield attributing characters viz., number of hands per bunch, number of fingers per bunch, and bunch weight (Table 2). The number of hands per bunch was significantly higher and statistically on par with each other in treatment GRDN, (12.25) and 100 % N through CDU (12.20). The number of hands per bunch was significantly higher and statistically on par with each other in treatment GRDN, (197.50) and 100 % N through CDU (195.20). However, it was numerically decreased in 75, 50 and 25 % N through CDU (Table 2). The bunch weight and was significantly higher in GRDN (22.24 kg) and 100 % N through CDU (21.58) over rest of the treatment but statistically on par with each other. However, 75% N and 50% N through CDU to banana recorded statistically on par bunch weight (20.86 and 19.97 kg). Similar trend of results were also reported by Mustaffa (1988) and Srinivas *et al.,* (2001). The data on yield are presented in Table 3, revealed that the application of GRDN recorded the highest banana yield (72.61 t ha-1) and 100 % N through CDU(70.45 t ha-1) over rest of the treatment but statistically on par with each other. This increase was also associated with the corresponding increase in the number of hands per bunch, number of fingers per bunch and higher bunch weight. However, 75 % N and 50 % N through CDUto banana recorded statistically on par (68.12 and 65.21 t ha-1) to banana yield. The increased banana yield and yield attributing characters with increase in nitrogen level was largely due to the increase in morphological traits and also due to higher nutrient uptake by the plants. Significantly lower banana yield 55.66 t ha-1 was recorded in the treatment where no fertilizers and FYM was applied. Similar finding have been also reported by Gour *et al.,* (1990), Mansour *et al.,* (2007) and Kandil *et al.,* (2010). The total N, P and K uptake by banana are presented in Table 3.

The GRDN was recorded significantly higher nitrogen uptake (582.27 kg ha-1) than the other treatment but at par with 100 % nitrogen through CDU (545.67 kg ha-1). The treatment of 75 %, 50 % and 25 % N through CDU recorded 489.79, 404.48 and 345.02 kg ha-1 nitrogen uptake respectively. The significantly higher phosphorus uptake of 156.27 kg ha-1 was recorded by treatment GRDN, which was at par with 100 % N through CDU (144.36). The treatment of T3, T4, T5, recorded phosphorus uptake of120.06, 105.11 and 80.32 kg ha-1, respectively. Control treatment recorded 66.79 kg ha-1 phosphorus uptake (Table 3). The total potassium uptake was significantly more in GRDN (1031.7 kg ha-1) than rest of treatment and statistically on par with 100 % N through CDU(998.9 kg ha-1). The uptake of potassium was higher than nitrogen and phosphorus and the sequence of uptake was K>N>P. Similar trend of results are also reported by Srinivas *et al.,* (2001). The quality parameters of banana after ripening viz., reducing sugars, non-reducing gars, total sugars, pulp: peel ratio of banana fruit are presented in Table 4. The total sugars and non reducing sugars content was significantly more in GRDN (17.22 and 2.12%) and statistically on par with 100 % N through CDU(16.98 and 2.07%).

Table.1 Effect of crotonylidenedi urea on growth parameters of banana

Sr. No.	Treatment	No. of leaves	Pseudostem girth (cm)	Pseudostem height (cm)
1.	GRDN (200:40:200 g N:P_2O_5: K_2O + 10 kg FYM plant^{-1})	12.45	63.05	261.30
2.	100 % N–CDU+ (40:200 g P_2O_5: K_2O + 10 kg FYM plant^{-1})	12.35	62.75	256.65
3.	75 % N- CDU+ (40:200 g P_2O_5: K_2O + 10 kg FYM plant^{-1})	11.65	61.50	251.95
4.	50 % N-CDU+ (40:200 g P_2O_5: K_2O + 10 kg FYM plant^{-1})	11.05	60.95	246.10
5.	25 % N- CDU+ (40:200 g P_2O_5: K_2O + 10 kg FYM plant^{-1})	10.95	59.10	240.45
6.	Absolute control	10.75	58.35	236.30
	S.E. $\pm$	0.194	0.432	0.651
	CD at 5 %	0.585	1.303	1.962
	Mean	11.53	60.95	248.79

Table.2 Effect of crotonylidenedi urea on yield attributing characters of banana

Sr. No.	Treatment	No. of hands bunch^{-1}	No. of fingers bunch $^{-1}$	Bunch wt. (kg)
1.	GRDN (200:40:200 g N:P_2O_5: K_2O + 10 kg FYM plant^{-1})	12.25	197.50	22.24
2.	100 % N–CDU+ (40:200 g P_2O_5: K_2O + 10 kg FYM plant^{-1})	12.20	195.20	21.58
3.	75 % N- CDU+ (40:200 g P_2O_5: K_2O + 10 kg FYM plant^{-1})	11.25	185.75	20.86
4.	50 % N-CDU+ (40:200 g P_2O_5: K_2O + 10 kg FYM plant^{-1})	10.80	180.03	19.97
5.	25 % N- CDU+ (40:200 g P_2O_5: K_2O + 10 kg FYM plant^{-1})	10.40	172.80	18.26
6.	Absolute control	09.40	165.95	17.05
	S.E. $\pm$	0.136	1.231	0.370
	CD at 5 %	0.411	3.712	1.116
	Mean	11.05	182.87	19.99

Table.3 Effect of crotonylidenedi urea on yield and nutrient uptake of banana

Sr.no.	Treatment	Yield (MT/ha^{-1})			Total Nutrient uptake (kg ha^{-1})		
		Fruit	Shoot	Leaves	N	P	K
1	GRDN (200:40:200 g N:P_2O_5: K_2O + 10 kg FYM plant^{-1})	72.60	122.67	29.47	582.27	156.27	1031.7
2	100 % N–CDU+ (40:200 g P_2O_5: K_2O + 10 kg FYM plant^{-1})	70.44	117.75	27.58	545.67	144.36	998.59
3	75 % N- CDU+ (40:200 g P_2O_5: K_2O + 10 kg FYM plant^{-1})	68.12	113.17	25.56	489.79	120.06	908.93
4	50 % N-CDU+ (40:200 g P_2O_5: K_2O + 10 kg FYM plant^{-1})	65.21	107.22	22.52	404.48	105.11	803.12
5	25 % N- CDU+ (40:200 g P_2O_5: K_2O + 10 kg FYM plant^{-1})	59.62	101.68	20.56	345.02	80.32	746.26
6	Absolute control	55.65	97.59	19.36	286.83	66.79	638.50
	S.E. $\pm$	1.209	1.548	0.616	16.903	4.00	18.010
	CD at 5 %	3.645	4.667	1.858	50.952	12.07	54.289

Table.4 Effect of crotonylidenedi urea on quality parameters of banana

Sr. No.	Treatment	Total sugars (%)	Reducing sugars (%)	Non reducing sugars (%)	Pulp:peel ratio
1.	GRDN (200:40:200 g N:P_2O_5: K_2O + 10 kg FYM plant^{-1})	17.27	15.04	2.12	3.60
2.	100 % N–CDU+ (40:200 g P_2O_5: K_2O + 10 kg FYM plant^{-1})	16.98	14.79	2.07	3.48
3.	75 % N- CDU+ (40:200 g P_2O_5: K_2O + 10 kg FYM plant^{-1})	16.75	14.70	1.95	3.37
4.	50 % N-CDU+ (40:200 g P_2O_5: K_2O + 10 kg FYM plant^{-1})	16.41	14.66	1.66	3.20
5.	25 % N- CDU+ (40:200 g P_2O_5: K_2O + 10 kg FYM plant^{-1})	16.06	14.20	1.77	3.12
6.	Absolute control	15.71	14.16	1.48	2.90
	S.E. $\pm$	0.128	0.141	0.075	0.036
	CD at 5 %	0.386	0.427	0.226	0.110

Table.5 Effect of crotonylidenedi urea on soil available nutrients

Sr. No	Treatment	Soilavailable NPK (kg ha^{-1})								
		Grand growth			Shooting stage			Harvest stage		
		N	P	K	N	P	K	N	P	K
1.	GRDN (200 : 40:200 g N:P_2O_5: K_2O + 10 kg FYM plant^{-1})	236.77	23.22	546.00	206.98	17.03	504.00	178.75	14.54	478.8
2.	100 % N–CDU+ (40:200 g P_2O_5: K_2O + 10 kg FYM plant^{-1})	229.71	22.26	549.40	199.92	17.22	512.40	174.05	14.99	478.8
3.	75 % N- CDU+ (40:200 g P_2O_5: K_2O + 10 kg FYM plant^{-1})	221.09	22.82	548.80	190.51	18.18	520.80	167.78	15.69	484.4
4.	50 % N-CDU+ (40:200 g P_2O_5: K_2O + 10 kg FYM plant^{-1})	213.25	22.64	534.80	184.24	18.50	520.80	162.29	16.20	492.8
5.	25 % N- CDU+ (40:200 g P_2O_5: K_2O + 10 kg FYM plant^{-1})	210.90	23.28	543.20	178.75	19.07	504.00	159.15	16.58	492.8
6.	Absolute control	181.90	19.01	487.25	172.48	15.44	456.40	146.61	12.37	411.6
	Initial value	**188.16**	**21.43**	**548.8**	**188.16**	**21.43**	**548.8**	**188.16**	**21.43**	**548.8**
	S.E. ±	1.280	0.283	10.97	1.001	0.170	5.537	1.080	0.128	4.61
	CD at 5 %	3.859	0.854	33.07	3.020	0.513	16.69	3.257	0.388	13.90

Table.6 Effect of crotonylidenediureaon soil available micronutrient of soil

Sr. No	Treatment	Soilavailablemicronutrient (µg g^{-1})											
		Grand growth stage				Shooting stage				Harvest stage			
		Fe	Mn	Cu	Zn	Fe	Mn	Cu	Zn	Fe	Mn	Cu	Zn
1.	GRDN (200 : 40:200 g N:P_2O_5: K_2O + 10 kg FYM plant^{-1})	6.32	13.82	2.98	1.08	5.35	13.03	2.33	0.81	4.34	12.13	2.49	0.70
2.	100 % N–CDU+ (40:200 g P_2O_5: K_2O + 10 kg FYM plant^{-1})	6.37	13.87	2.99	1.10	5.51	13.10	2.45	0.84	4.48	12.28	3.06	0.70
3.	75 % N- CDU+ (40:200 g P_2O_5: K_2O + 10 kg FYM plant^{-1})	6.21	13.60	3.10	1.07	5.57	13.08	2.46	0.92	4.63	12.36	2.49	0.61
4.	50 % N-CDU+ (40:200 g P_2O_5: K_2O + 10 kg FYM plant^{-1})	6.15	13.75	3.05	1.11	5.55	13.00	2.51	0.90	4.53	12.45	2.55	0.55
5.	25 % N- CDU+ (40:200 g P_2O_5: K_2O + 10 kg FYM plant^{-1})	6.10	12.50	3.09	0.99	5.48	13.02	2.35	0.91	4.70	12.46	2.58	0.57
6.	Absolute control	5.84	12.20	2.37	0.76	5.26	11.69	2.04	0.66	4.42	11.42	2.44	0.50
	Initial value	**6.27**	**12.78**	**2.92**	**0.96**	**6.27**	**12.78**	**2.92**	**0.96**	**6.27**	**12.78**	**2.92**	**0.96**
	S.E. ±	0.043	0.068	0.051	0.052	0.079	0.064	0.059	0.022	0.05	0.065	0.051	0.010
	CD at 5 %	0.131	0.207	0.115	0.158	N.S	0.193	0.180	0.066	0.17	0.196	0.155	0.031

Table.7 Effect of crotonylidenediurea on Biological properties of soil

Sr. No	Treatment	Urease enzyme (ug NH_4-N g^{-1} of soil hr^{-1})			DHA enzyme (ug TPF g^{-1} soil hr^{-1})			Bacterial count (CFU x 10^6)		
		Grand growth	Shooting Stage	Harvest stage	Grand growth	Shooting stage	Harvest stage	Grand growth	Shooting stage	Harvest stage
1.	GRDN (200 : 40:200 g N:P_2O_5: K_2O + 10 kg FYM $plant^{-1}$)	30.80	34.65	32.38	1.35	1.44	1.42	21.00	22.75	21.50
2.	100 % N–CDU+ (40:200 g P_2O_5: K_2O + 10 kg FYM $plant^{-1}$)	28.00	31.50	29.58	1.24	1.32	1.29	20.50	22.50	21.50
3.	75 % N- CDU+ (40:200 g P_2O_5: K_2O + 10 kg FYM $plant^{-1}$)	25.90	28.88	27.46	1.18	1.24	1.21	20.00	21.50	20.25
4.	50 % N-CDU+ (40:200 g P_2O_5: K_2O + 10 kg FYM $plant^{-1}$)	24.68	27.65	26.08	1.17	1.20	1.19	19.00	21.00	19.00
5.	25 % N- CDU+ (40:200 g P_2O_5: K_2O + 10 kg FYM $plant^{-1}$)	23.10	27.30	24.50	1.06	1.10	1.08	18.00	19.75	18.25
6.	Absolute control	19.95	20.30	20.30	0.98	1.01	1.00	17.75	18.25	16.75
	Initial value	**19.60**			**0.97**			**17.25**		
	S.E. ±	0.220	0.445	0.334	0.017	0.013	0.018	0.562	0.430	0.430
	CD at 5 %	0.664	1.342	1.007	0.051	0.041	0.055	1.694	1.297	1.794

It was decreased with decreased levels of nitrogen application through CDU. The reducing sugars content of banana was found statistically on par with each other in GRDN, 100, 75 and 50 % N through CDU(15.04, 14.79, 14.70 and 14.66 per cent respectively). Significantly lower reducing, non reducing and total sugars of 14.16, 1.48 and 15.71 % were recorded by the treatment of absolute control. Similar finding have also been reported by Ram (1999) and Kavino *et al.*, (2003). The pulp:peel ratio was increased numerically with increase in the level of nitrogen for banana. Application of GRDN recorded significantly higher pulp:peel ratio of 3.60 (Table 4) over the rest of treatment.

The residual soil fertility at harvest of banana was significantly influenced by the GRDN and nitrogen application to banana through CDU. The soil available nitrogen content was significantly more in GRDN (178.75 kg ha-1) and decrease in treatment 100, 75, 50 and 25 % N through CDU (Table 5). The residual soil available phosphorus was found statistically on par with each other in all the treatment except absolute control but less than the initial soil available phosphorus content (21.43 kg ha-1). The soil available potassium content in GRDN, 100, 75, 50 and 25 % N through CDU was found statistically on par with each other (478.8, 478.8, 484.4, 492.8 and 492.8 kg ha-1 respectively) but considerably less than initial soil available potassium content (548.80 kg ha-1).

The soil available micronutrients viz., Fe, Mn, Cu and Zn was significantly influenced by GRDN and nitrogen application through CDU (Table 6). The manganese (12.13 and 12.28 µg g-1 soil) and zinc (0.70 and 0.70 µg g-1 soil) content was statistically on par with GRDN and 100 % N through CDU, whereas, copper content was significantly higher in 100 % N through CDU (3.06 µg g-1 soil). The urease and dehydrogenase soil enzyme activity was significantly higher are presented in general recommended dose of nutrients (34.65 µgNH¬4+-N g-1 of soil hr-1 and 1.44 µg TPF g-1 soil hr-1)(Table 7). It was followed by 100 % N through CDU(31.50 µg NH¬4+-N g-1 of soil hr-1 and 1.32 µg TPF g-1 soil hr-1).The bacterial population count in treatment GRDN, 100 % and 75 % N through CDU were statistically on par with each other (21.50, 21.50 and 20.25 cfu x 106 g-1 soil respectively). Maximum bacterial population observed in grand growth stage in GRDN and 100 % N through CDU and thereafter bacterial population was reduced up to harvest (Table 6). These results are in close conformity with the results of Xiaoguang *et al.*, (2004), Chang *et al.*, (2006) and Goutami *et al.*, (2015).

References

Allen, S.E. 1986. Slow release nitrogen fertilizers in crop production. ASA., CSSA, Madison, 192-206.

Alvan, A.K. and Tucker, D.P. 1996. Evaluation of a resin coated nitrogen fertilizer for young citrus trees on a deep sand. Proc. Fla. *State Horticulture Society*, 106, 4-8.

Aquil, B., Jan, A.T., Sarin, N.B. and Haq, Q.R. 2012. Micro propagation and genetic transformation of banana for crop improvement and sustainable agriculture. *J. Crop Sci.*, 3: 64-77.

Babu, N. and Sharma, A. 2005. Effect of integrated nutrient management on productivity of 'Jahajee' banana and soil properties under Nagaland foot hills conditions. *Orrisa J. Horticulture*, 33: 31-34.

Badgujar, C.D., Dusane, S.M. and Deshmukh, S.S. 2004. Influence of plant spacing on growth, maturity and yield of Grand Naine (AAA). banana. *South Indian Horticulture*, 52: 13-17.

Brady, N.C and Weil, R.P. 1999. Soil organic matter. In The nature and properties of soils, (Brady, N.C, Weil, R.P., Eds.), Upper Saddle river, New Jersey, pp. 446-490

Casida, L.E., Klein, D.A. and Sautor, T. 1964. Soil dehydrogenase activity. *Soil Sci.*, 98: 371-376.

Chapman, H.D. and Pratt, P.F. 1961. Methods of Analysis for Soil, Plant and Water.Division of Agricultural Sciences, California University USA.

FAO. 2015. Food and Agriculture Organization of the united Nations.

Follett, R.F. 2001. Innovative 15N microplot research techniques to study nitrogen use efficiency under different ecosystems. In (Mills, H. A, eds.), *Communications in Soil Science and Plant Analysis*, 32: 951-979.

Frank, T. and Malkomes, H.P. 1993. Influence of tem¬perature on microbial activities and their reaction to the herbicide "Goltix" in different soils under laboratory conditions. *Zentralblatt fur Mikrobiologie*, 148:403-412.

Gour, G.R., Tomar, S.S., Rathi, G.S. and Tomar, G.S. 1990. Studies on the relative efficiency of slow release nitrogenous fertilizers and nitrification inhibitors in lowland rice. *Narendra Deva J. Agri. Res.*, 5: 26-34.

Goutami, N., Rani, P.P., Pathy, R.L and Babu, P.R. 2015. Soil properties and biological activity as influenced by nutrient management in Rice-fallow Sorghum. *Int. J. Agri. Res. Innovations and Technol.*, 5: 10-14.

Jackson, M.L. 1973. Soil Chemical Analysis, Prentice Hall of India Pvt. Ltd., New Delhi.

Kavino, M., Kumar, N., Soorianathasundaram, K. and Jeykumar, P. 2003. Effect of fertigation on the growth and development of first ratoon crop (R-1. of banana cv. Robusta (AAA. under high density planting system. *Indian J. Horticulture*, 61: 39-41.

Lahav, E. 1995. Banana nutrition. In (Gowen, S. ed.),Bananas and plantains. Chap¬man and Hall, New York, pp. 258-316.

Lane, J.H. and Eynon, L. 1923. Determination of sugars by fehling solution methylene blue as indicator. *J. Chem. Society of India*, 42: 32-34.

Lindsay, W.L. and Norvell, W.A. 1978. Development of DTPA soil test for zinc, iron, manganese, and copper. *Soil Sci. Society of America J.*, 42: 421-428.

Lorenz, O.A. 1978. Potential nitrate levels in edible plant parts. In, (Nielsen, D.R. and J.G. MacDonald eds.), Nitrogen in the environment, Vol. 2. Soil plant nitrogen relationships. Academic Press, New York, San Francisco, London, pp. 201-252.

Mansour, A.E., Ahmed F.F., Abdelaal, A.M and Cimpoies, G.P. 2007. Use of mineral, organic, slow release and biofertilizers for Anna apple trees in a sandy soil. *African Crop Science Conference Proceedings*, 8: 265-271.

Mustaffa, M.M. 1988. Effect of spacing and nitrogen on growth, fruit and yield of Robust banana grown under rainfed conditions. *South Indian Horticulture*, 36: 228-231.

Perucci P., Scarponi, L. and Businelli, M. 1984. Enzyme activities in a clay-loam soil amended with various crop residues. *Plant and Soil*, 81: 345-351.

Ram, R.A. 1999. Effect of controlled-release fertilizers on growth, yield and fruit quality of guava cv. Sardar in Ustochrepts. *Indian J. Horticulture*, 56, 104-111.

Reddy, G.B. and Faza, A. 1989. Dehydrogenase activity in sludge amended soil. *Soil Biol. Biochem.*, 21: 327.

Shaviv, A. and Mikkelsen, R.L. 1993. Controlled-release fertilizer to increase efficiency of nutrient use and minimize environmental degradation. *A Review Fertilizer Res.*, 35: 1-12.

Srinivas, K., Reddy, B.M.C., Chandra, S.S., Thimooe Gowda., Raghupati, H.B. and Padma, P. 2001. Growth, yield and nutrient uptake of Robust banana in relation to N and K fertigation. *Indian J. Horticulture*, 58: 287-293.

Susherman, S. and Anggoro. 2011. Producing slow release urea by coating Starch/Acrylic in fluid Bed Sprayinging. *IJET-IJENS*, 11: 77-80.

Tabatabai, M.A. and Bremner, J.M. 1972. Assay of urease activity in Soil. *Soil Biol. Biochem.*, 4: 479-487.

Wilke, B.M. 1991. Effects of single and successive ad¬ditions of cadmium, nickel and zinc on carbon dioxide evolution and dehydrogenase activity in a sandy Luvisol. *Biol. Fertility of Soils*, 11: 34-37.

Xiaoguangjiao, Liang wenju., Chen lijun, Zhang haijun and Li qi wangpeng. 2004. Effects of slow-release urea fertilizers on urease activity, microbial biomass, and nematode communities in an aquatic brown soil. *Sci. China Life Sci.*, 48: 26-32.

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