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Effect of Nitrogen Levels and Cattle Urine Foliar Sprays on Growth and Yield of Maize (*Zea mays* L.)

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A B S T R A C T

A field experiment was conducted to assess the effect of nitrogen levels and cattle urine foliar sprays on growth and yield of maize (*Zea mays* L.) at Agronomy Farm, College of Agriculture, Pune, during *Kharif*-2019-20. The experiment consisted of sixteen treatment combinations based on four levels of the recommended dose of nitrogen (@ 0, 50, 75 and 100 %) through urea and four levels of cattle urine foliar spray (@ 0, 5, 10 and 15 %) taken at 25, 45 and 60 DAS replicated thrice in Factorial Randomized Block Design. The results revealed that all the growth characters *viz*., plant height, number of functional leaves, leaf area and dry matter were found significantly higher with the application of 100% RDN. It was followed by the application of 75% RDN. However, a substantial reduction in growth characters was observed with the application of 0 and 5% RDN. While, cattle urine foliar spray @ 10 % taken at 25, 45 and 60 DAS was found superior for plant height, number of functional leaves and leaf area and dry matter of maize, which was closely followed by 15 % cattle urine foliar spray. The yield contributing characters like weight of the cob with and without husk, length and girth of the cob, number of grain row per cob, number of grains per cob, weight of grains per cob and hundred grain weight were found significantly higher with the application of 100% RDN. The number of cobs per plant was found to be maximum with the application of 100% RDN, which influenced non significantly. Statistically, the higher yield attributes were recorded with a 10% application of cattle urine. The grain and stover yield of maize was influenced significantly due to different levels of nitrogen and the statistically higher grain and stover yield were recorded with the application of 100% RDN. While the application of 10% cattle urine sprays recorded the statistically higher grain and stover yield, which was followed by 15% cattle urine spray.

Introduction

Among cereals, maize (*Zea mays* L.) is an important food and feed crop, which ranks third after wheat and rice in the world. It is one of the most versatile crops in nature, which can be grown over a wide range of climatic conditions and has acquired a

dominant role in the farming sector and macroeconomics of the Asian region. Intensive cultivation has resulted in the depletion of soil nutrients to a great extent. The deteriorating soil physical conditions due to long term use of chemical fertilizers, especially nitrogenous ones might have added to this problem (Parameshwar *et al.*, 1989). Maize is a heavy feeder of nutrients and removes a large amount of nutrients from the soil. Balanced nutrition is an essential component of nutrient management and plays a significant role in increasing crop production and its quality. Livestock is the oldest resource for mankind.

With smallholdings and small scale farming, there is no other better alternative than involving cattle in the farming system. The abundant quantity of cattle excreta consisting of dung and urine is available at the farm level. Though part of cattle dung is used as manure after decomposition cow urine usually drains out as waste material from the farmer household. Cattle urine is a good source of nitrogen, phosphate, potassium, calcium, magnesium, chlorite and sulphate. This nutrient source is available to farmers free of cost in their own house; being organic in nature, it is eco friendly and if used in crops, has no adverse effect on ecosystem and human health. Further organic nutrient spray (cow urine) can be sprayed at critical growth stage of crop to overcome the problem of slow release nutrients of organic sources affecting crop growth. Application of cattle urine works as a plant hormone and also been reported to correct the micro nutrient deficiency, being organic in nature it is also likely increase the fertilizer use efficiency.

Materials and Methods

An experiment was conducted to study the effect of nitrogen levels and cattle urine foliar sprays on growth and yield of maize at the Agronomy farm, College of Agriculture, Pune, during *kharif* -2019-20. The experiment was laid out in Factorial Randomized Block Design with sixteen treatment combinations consisting of four levels of nitrogen (@ 0, 50, 75 and 100% RDN) and four levels of cattle urine foliar sprays (@ 0, 5, 10 and 15%) imposed to maize variety Phule Rajarshi. The foliar sprays were taken at 25, 45 and 60th days after sowing.

The maize seed was dibbled at a spacing of 75$\times$ 20 cm^2. A full dose of phosphorus and potassium was applied as a basal application and on the basis of recommended dose of nitrogen for maize @ 120 kg ha^{-1}, four levels of nitrogen were formulated as 0%, 50%, 75% and 100%. In order undertook foliar sprays of cattle urine at 25, 45 and 60th DAS fresh cattle urine was collected at each time in early morning. Water sprays at respective days were undertaken for 0% as control.

Results and Discussion

All the growth characters *viz*., plant height, number of functional leaves, leaf area and dry matter were found significantly higher with the application of 100% RDN. The corresponding values were 173.2 cm, 11.13, 41.18 dm2 and 172.61 g, respectively at harvest. However, plant height and number of leaves with 75% RDN and 100% RDN were remained at par with each other. However, substantial reduction in growth characters was observed with the application of 0% RDN.

The growth of the maize crop in terms of growth attributes *viz*., plant height, number of leaves, leaf area and dry matter accumulation per plant were maximum with the application of 10% foliar spray of cattle urine. The corresponding values were 157.4 cm, 11.11, 35.29 dm^2 and 132.28 g, respectively at harvest. However, the application of 5, 10 and 15% foliar spray of cattle urine were found at

par with each other in respect to plant height. The next best results were observed with the application of 15% foliar spray of cattle urine.

The enhanced height of the plant due to foliar sprays of cattle urine might be due to nitrogen, phosphorus and potassium content with some growth stimulant harmones content in cattle urine (Choudhary *et al.*, 2017). Application of cow urine at 5 and 10% foliar spray significantly improved all vegetative growth like number of leaves, length and width of the leaves of gladiolus and enhanced plant height (Tamaraker, 2016).

An application of 6% cow urine spray in soybean found more effective in characters like leaf area and dry matter when compared with control (Deotale *et al.*, 2011). The higher dry matter and other growth characters with the application of 10% cattle urine foliar spray might be due to better supply of nitrogen and other major, secondary and micro-nutrients (Table 1 and 2).

Yield attributes and yield

The data regarding yield attributes *viz.*, number of cobs per plant, weight of the cob with and without husk, length and girth of the cob, number of grain row per cob, number of grains per cob, weight of grains per cob and hundred grain weight (seed index) were recorded and these were found significantly higher with the application of 100% RDN (120 kg N ha^{-1}) *viz.*, 1.08, 203.07 g $plant^{-1}$, 184.53 g $plant^{-1}$, 15.19 cm, 12.97 cm, 13.88, 368.22, 124.87 g and 32.46 g, respectively. An application of 75% RDN and 100% RDN were remained at par with each other in respect to weight of the cob without husk, girth of the cob, number of grains per cob and hundred grain weight whereas, the application of 50, 75 and 100% RDN remained at par with each other in case of number of grain row per cob. The significantly higher grain and stover yield (31.47 q ha^{-1} and 33.34 q ha^{-1}) were recorded with the application of 100% RDN than all other nitrogen application levels (Table 3).

Table.1 Mean plant height, number of functional leaves per plant, leaf area per plant and dry matter per plant at harvest as influenced by different treatments

Treatment	Plant height (cm)	Number of functional leaves per plant	Leaf area per plant (dm^2)	Dry matter per plant (g)
I. Nitrogen levels (N):				
N_1: 0% RDN	102.0	9.07	13.41	65.18
N_2: 50% RDN	150.0	10.12	27.79	122.40
N_3: 75% RDN	160.7	10.87	28.15	142.97
N_4: 100% RDN	173.2	11.13	41.18	172.61
S.E. m.±	4.7	0.26	0.57	0.77
C.D. at 5%	13.7	0.75	1.64	2.21
II. Cattle urine levels (U):				
U_1: 0%	125.6	9.68	23.17	116.94
U_2: 5%	151.2	10.12	24.49	125.05
U_3: 10%	157.4	11.11	35.29	132.28
U_4: 15%	151.8	10.27	27.57	128.89
S.E. m.±	4.7	0.26	0.57	0.77
C.D. at 5%	13.7	0.75	1.64	2.21
III. Interaction:				
S.E. m.±	9.5	0.52	1.14	1.53
C.D. at 5%	N.S.	N.S.	N.S.	4.43

Table.2 Mean number of cobs per plant, weight of the cob with husk, weight of the cob without husk, length of cob, girth of cob, number of grain row per cob, number of grains per cob, weight of grains per cob and hundred grain weight as influenced by different treatments

Treatment	No. of cobs plant^{-1}	Weight of cob with husk (g plant^{-1})	Weight of cob without husk (g plant^{-1})	Length of cob (cm)	Girth of cob (cm)	No. of Grain row cob^{-1}	No. of Grainscob^{-1}	Wt. of grains cob^{-1} (g)	Seed Index (g)
I. Nitrogen levels (N):									
N_1: 0% RDN	1.00	94.23	85.68	9.24	9.33	12.10	232.35	64.80	26.04
N_2: 50% RDN	1.00	152.03	139.78	12.22	11.51	13.23	320.40	95.15	29.01
N_3: 75% RDN	1.00	166.23	156.60	13.19	11.92	13.33	327.27	100.96	30.22
N_4: 100% RDN	1.08	203.07	184.53	15.19	12.97	13.88	368.22	124.87	32.46
S.E. m.±	0.04	11.56	10.55	0.51	0.47	0.35	15.79	6.77	0.99
C.D. at 5%	NS	33.41	30.47	1.47	1.36	0.99	45.62	19.57	2.87
II. Cattle urine levels (U):									
U_1: 0%	1.00	121.17	110.73	10.07	9.43	11.33	250.03	71.18	26.76
U_2: 5%	1.08	154.05	143.33	12.17	10.45	13.12	314.17	98.25	28.13
U_3: 10%	1.00	180.20	164.78	14.46	13.17	14.37	357.52	115.31	32.49
U_4: 15%	1.00	160.15	148.75	13.14	12.68	13.73	326.52	101.03	30.34
S.E. m.±	0.04	11.56	10.55	0.51	0.47	0.35	15.79	6.77	0.99
C.D. at 5%	NS	33.41	30.47	1.47	1.36	0.99	45.62	19.57	2.87
III. Interaction:									
S.E. m.±	0.08	23.13	21.09	1.02	0.94	0.70	31.58	13.55	1.99
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table.3 Mean of grain and stover yield as influenced by different treatments

Treatment	Grain yield (q ha^{-1})	Stover yield (q ha^{-1})
I. Nitrogen levels (N):		
N_1: 0% RDN	20.34	24.70
N_2: 50% RDN	24.80	27.52
N_3: 75% RDN	27.25	30.96
N_4: 100% RDN	31.47	33.34
S.E. m.±	0.18	0.25
C.D. at 5%	0.52	0.72
II. Cattle urine levels (U):		
U_1: 0%	22.20	25.26
U_2: 5%	24.34	27.59
U_3: 10%	29.48	32.81
U_4: 15%	27.84	30.86
S.E. m.±	0.18	0.25
C.D. at 5%	0.52	0.72
III. Interaction:		
S.E. m.±	0.36	0.50
C.D. at 5%	1.05	1.45

While the application of 10% cattle urine foliar spray recorded higher yield attributes i.e. weight of cob with husk (180.20 g $plant^{-1}$), weight of the cob without husk (164.78 g $plant^{-1}$), length of the cob (14.46 cm), girth of the cob (13.17 cm), number of grain row per cob (14.37), number of grains per cob (357.52), weight of grains per cob (115.31 g) and hundred grain weight (32.49 g). The application of 10 and 15% foliar spray of cattle urine were remained at par with each other in respect to length and girth of the cob, number of grains row per cob and hundred grain weight.

Whereas the application of 5, 10 and 15% foliar spray of cattle urine remained at par with each other in case of weight of cob with and without husk, number of grains per cob and weight of grains per cob. The application of 10% foliar spray of cattle urine recorded the highest grain (29.48 q ha^{-1}) and stover (32.81 q ha^{-1}) yield than rest of the foliar spray levels under study. The grain and stover yield were lower with the application of water spray i.e. 22.20 and 25.26 q ha^{-1}, respectively.

The combination effect of nitrogen levels and cattle urine foliar sprays had no significant influence on all the yield attributes but the combination of 100% RDN along with 10% cattle urine foliar spray recorded significantly the highest grain and stover yield.

The maximum value of grain yield was recorded with the application of 100% RDN may be due to improved nitrogen supply. The increasing grain yield of maize with increasing nitrogen levels might be attributed to significant improvement in the yield attributes. The increase in grain yield with high dose of nitrogen may be due to vigorous and luxurious growth of the crop. It has been observed that nitrogen supply increases the formation of nucleotides and coenzymes of which the nitrogen is a constituent (Epstein, 1972).

The higher values of grain yield registered with foliar spray of 10% of cattle urine might be because of it is a good source of nitrogen, phosphate, potassium, calcium, magnesium, chlorite and sulphate. Application of cattle urine works as a plant hormone and also been reported to correct the micro nutrient deficiency, being organic in nature it is also likely increase the fertilizer use efficiency. The increasing grain yield with this treatment might be owing to higher values of growth attributes. The grain and stover yield of maize varied significantly under different levels of cow urine levels. The maximum grain yield of 18.6 q ha^{-1} was recorded with application of cow urine as compared with control (Devakumar *et al.*, 2014). The application of 150 kg N ha^{-1} through foliar sprays of cow urine reported significantly highest biological yield (36.7 t ha^{-1}) in broccoli (Sharma *et al.*, 2016).

On the basis of above results, it could be concluded that for getting higher yield, maize crop should be fertilized with application of 100% RDN (120 kg ha^{-1}) along with 10% foliar spray of cattle urine.

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