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## Effect of Organic Production Practices on Yield and Soil Health of Irrigated Maize (*Zea mays* L.) as Influenced by Various Levels of FYM and Cattle Urine Application

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**Abstract** An experiment was conducted during *kharif* 2009 in sandy clay loam soil to study the yield and soil health of irrigated maize (*Zea mays* L.) as influenced by various levels of FYM and cattle urine application. The investigation consisted of ten treatments replicated thrice. Among the treatments application of FYM 12.5 t/ha + cattle urine at 34300 l/ha recorded significantly more number of seeds per cob (423.5), test weight (24.5 g), number of rows per cob (14.9), Grain yield (49.0 q/ha), Stover yield (8.5 t/ha), soil organic carbon (0.58%), available nitrogen (272.4 kg/ha), phosphorus (23.5 kg/ha), potassium (199.9 kg/ha), soil microbial population viz., bacteria ( $47.0 \times 10^5$  cfu / g), fungi ( $34.6 \times 10^4$  cfu / g) and actinomycetes ( $40.0 \times 10^3$  cfu / g) as compared to control.

**Keywords** Grain yield, Test weight, Nitrogen, Bacteria, Actinomycetes.

### Introduction

Maize (*Zea mays* L.) is one of the important staple

food crops of the world and ranks next only to wheat and rice. It is considered as an economically important cereal crop, major ingredient for food, feed and other products. It is third most important cereal crop in India occupying about 8.12 million ha producing 19.77 mt with an average productivity of 2.4 tones/ ha during 2007/08 (1). Forty five per cent of the total maize, produced in India is being used as human food and 52 percent goes to feed industry (2). In India, greater increase in food and feed production is expected to come from coarse cereals, primarily maize, which have a comparative advantage in assured rainfall areas. The future of maize is now brighter than in the past. Today, increasing the maize productivity, production and utilization are not a matter of choice but a necessity due to high population pressure.

Green revolution in India witnessed phenomenal increase in fertilizer consumption and during 2000-01 it was 17.6 million tones NPK (3). India is not in a position to spend huge foreign exchange towards import of fertilizers. The present hike in the price of chemical fertilizers has compelled the Indian farmers to resort to imbalanced nutrition of crops and thus reduction in crop yields. At this critical juncture there is an urgent need to optimize nutrient recycling to sustain crop production without affecting soil health and protection of environment from pollution (4). Keeping in this view the prospects, of organic farming has gained popularity in recent years not only in India but also in Australia, USA, UK, Germany, South Africa, China, Japan and other Asian countries like Srilanka and Pakistan. Globally, organic agriculture is

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**Table 1.** Nutrient composition of FYM and cattle urine. FYM : Farm yard manure.

Parameters	FYM	Cattle urine
pH	8.1	7.6
EC (dsm <sup>-1</sup> )	0.16	45.4
OC (%)	10.71	2.5
N (%)	0.54	0.51
P (%)	0.29	0.02
K (%)	0.40	0.61

practiced in over 24 million ha during 2005 (5). General acceptance of organic farming is not only due to greater demand for pollution free food but also due to natural advantage of organic farming in supporting the sustainability in agriculture. In this aspect no systematic studies carried out to find out response of irrigated maize to varying FYM and cattle urine. Therefore, an attempt has been made to study the effect of FYM and cattle urine on yield and soil health of irrigated maize, in order to achieve sustainability in production.

### Materials and Methods

An experiment was conducted during *kharif* 2009 at Agricultural Research Station, Kathalagere, Davanagere Dist, Karnataka. The soil of the experimental site was sandy loam clay with slightly acidic

in pH (5.5), medium in organic carbon (0.50%), medium in available nitrogen (284.6 kg/ha), available phosphorus (23.3 kg/ha), available potassium (198.5 kg/ha) and initial soil microbial population viz., bacteria ( $35.0 \times 10^5$  cfu/g), fungi ( $12.0 \times 10^4$  cfu/g) and actinomycetes ( $25.0 \times 10^3$  cfu/g). The experiment was laid out in randomized complete block design with ten treatments was replicated thrice. Recommended dose of fertilizer (150 : 75 : 50 kg N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O/ha, respectively) was applied through chemical fertilizers. N was applied in two split doses viz., 50 per cent as basal and 50 per cent was top dressed on 30th day after sowing with full dose of P and K as basal. The fertilizer application was done in treatment (T<sub>10</sub>). The manurial treatment, FYM was applied as basal dose and cattle urine was applied in two splits. The nutrient composition of FYM and cattle urine is given in the Table 1. The seed of hybrid maize DEKALB-DK 984 was used for this experiment. The land was ploughed once with mould board plough, soil was brought to fine tilth by crushing the clods and harrowing two times, later the land was leveled with a wooden plank. Plots were laid out by forming small section bunds and individual plots were leveled. The seeds were sown in field at a Shallow furrow of 5 cm deep with 60 cm row spacing were opened with marker and two seeds were dibbled at 30 cm apart in the furrows. A week after emergence, seedlings were thinned to maintain one healthy seedlings per spot.

**Table 2.** Yield and yield parameters of maize as influences by various levels of FYM and cattle urine application.

Treatments	Number of seeds per cob	Test weight (g)	Number of rows per cob	Grain yield (q/ha <sup>-1</sup> )	Stover yield (t ha <sup>-1</sup> )
T <sub>1</sub> : FYM 7.5 t ha <sup>-1</sup> + cattle urine at 24500 l ha <sup>-1</sup>	375.4	21.8	12.9	23.2	6.0
T <sub>2</sub> : FYM 7.5 t ha <sup>-1</sup> + cattle urine at 29400 l ha <sup>-1</sup>	378.5	22.0	13.2	25.2	6.2
T <sub>3</sub> : FYM 7.5 t ha <sup>-1</sup> + cattle urine at 34300 l ha <sup>-1</sup>	382.4	22.1	13.5	27.7	6.5
T <sub>4</sub> : FYM 10 t ha <sup>-1</sup> + cattle urine at 24500 l ha <sup>-1</sup>	395.3	22.2	13.9	32.3	7.2
T <sub>5</sub> : FYM 10 t ha <sup>-1</sup> + cattle urine at 29400 l ha <sup>-1</sup>	398.3	22.3	14.1	33.5	7.4
T <sub>6</sub> : FYM 10 t ha <sup>-1</sup> + cattle urine at 34300 l ha <sup>-1</sup>	402.0	22.7	14.3	34.5	7.7
T <sub>7</sub> : FYM 12.5 ha <sup>-1</sup> + cattle urine at 24500 l ha <sup>-1</sup>	410.4	23.0	14.5	39.3	7.9
T <sub>8</sub> : FYM 12.5 t ha <sup>-1</sup> + cattle urine at 29400 l ha <sup>-1</sup>	417.4	23.9	14.8	45.7	8.3
T <sub>9</sub> : FYM 12.5 t ha <sup>-1</sup> + cattle urine at 34300 l ha <sup>-1</sup>	423.5	24.5	14.9	49.7	8.5
T <sub>10</sub> : FYM 10 t ha <sup>-1</sup> + 150 : 75 : 50 kg NPK ha <sup>-1</sup>	412.2	23.6	14.6	43.7	8.2
SEm±	4.2	0.9	0.1	3.4	2.1
CD at 5%	12.8	NS	0.4	10.2	6.4

**Table 3.** Soil quality parameters of maize as influences by various levels of FYM and cattle urine application. FYM : Farmyard manure, NS : Non-significant, cfu : Colony forming unit.

Treatments	Soil available nutrients			Soil Microbial population (cfu / g)			
	Organic carbon (%)	Nitrogen (kg/ha)	P <sub>2</sub> O <sub>5</sub> (kg/ha)	K <sub>2</sub> O (kg/ha)	Bacteria (×10 <sup>5</sup> )	Fungi (×10 <sup>4</sup> )	Actinomycetes (×10 <sup>3</sup> )
Initial soil status	0.50	268.5	22.7	198.5	35.0	12.0	25.0
T <sub>1</sub> : FYM 7.5 t ha <sup>-1</sup> + cattle urine at 24500 l ha <sup>-1</sup>	0.52	289.7	30.6	210.5	37.0	18.5	28.3
T <sub>2</sub> : FYM 7.5 t ha <sup>-1</sup> + cattle urine at 29400 l ha <sup>-1</sup>	0.52	288.4	29.1	208.6	38.6	21.3	29.6
T <sub>3</sub> : FYM 7.5 t ha <sup>-1</sup> + cattle urine at 34300 l ha <sup>-1</sup>	0.53	287.3	28.5	206.1	39.0	22.2	31.0
T <sub>4</sub> : FYM 10 t ha <sup>-1</sup> + cattle urine at 24500 l ha <sup>-1</sup>	0.54	284.6	27.1	205.6	41.0	25.3	33.0
T <sub>5</sub> : FYM 10 t ha <sup>-1</sup> + cattle urine at 29400 l ha <sup>-1</sup>	0.55	283.2	27.0	203.4	42.3	28.1	33.6
T <sub>6</sub> : FYM 10 t ha <sup>-1</sup> + cattle urine at 34300 l ha <sup>-1</sup>	0.55	281.3	24.5	202.6	42.3	28.9	35.0
T <sub>7</sub> : FYM 12.5 t ha <sup>-1</sup> + cattle urine at 24500 l ha <sup>-1</sup>	0.56	274.2	23.3	202.3	44.6	31.6	35.5
T <sub>8</sub> : FYM 12.5 t ha <sup>-1</sup> + cattle urine at 29400 l ha <sup>-1</sup>	0.57	273.5	23.1	201.1	46.6	32.3	37.0
T <sub>9</sub> : FYM 12.5 t ha <sup>-1</sup> + cattle urine at 34300 l ha <sup>-1</sup>	0.58	272.4	23.5	199.9	47.0	34.6	40.0
T <sub>10</sub> : FYM 10 t ha <sup>-1</sup> + 150 : 75 : 50 kg NPK ha <sup>-1</sup>	0.57	255.6	21.3	198.6	35.0	12.0	25.0
SEm±	0.03	2.98	2.60	3.03	0.8	1.0	2.8
CD at 5%	NS	8.93	7.79	9.08	2.4	3.1	8.4

Final thinning was attended two weeks after the emergence to maintain only one healthy seedling per hill. The observation on yield parameters and soil quality parameters were recorded and analyzed by the statistical method adapted by Gomez and Gomez (6).

## Results and Discussion

The result obtained from the present investigation is presented in Tables 2 and 3.

Effect of FYM and cattle urine application on yield and yield parameters of maize

The results of the investigation showed that various levels of FYM and cattle urine significantly influenced the grain yield of maize. Application of FYM 12.5 t/ha

+ cattle urine at 34300 l/ha was found to be superior in giving maximum grain yield (49.0 q/ha) and stover yield (8.5 t/ha). However, it was on par with FYM 12.5 t/ha and cattle urine at 29400 l/ha and FYM at 10 t/ha and 150 : 75 : 50 kg NPK / ha. The grain yield is directly influenced by cob weight, test weight, number of grains per cob and grain weight per cob (Table 2). The increase in grain yield and Stover yield may be due to better translocation of photosynthate from source to sink.

Application of FYM 12.5 t/ha + cattle urine at 34300 l/ha produces significantly higher number of seeds per cob (423.5), test weight (24.5 g), number of rows per cob (14.9), but it was on par with FYM 12.5 t/ha and cattle urine at 29400 l/ha and FYM at 10 t/ha and 150 : 75 : 50 kg NPK / ha (Table 2). The higher grain and stover yield with higher levels of organic manures application than other treatments can be at-

tributed to better expression of yield components, which might be due to higher rate of nutrients release with FYM and cattle urine i.e. 175 kg N equivalent was used which resulted in superior components. The above reasons were also supported by the presence of higher NPK content in shoot and grain due to increased uptake of the nutrients released during early growth stages which resulted in obtaining higher economic yield as compared to control. These results are in accordance with those obtained by Jha et al. (7), Srinivasan (8) and Patil et al. (9) and Reddy et al. (10).

#### Effect of FYM and cattle urine application on soil health

Application of FYM 12.5 t/ha + cattle urine at 34300 l/ha recorded higher soil organic carbon (0.58%), available nitrogen (272.4 kg/ha), phosphorus (23.5 kg/ha), potassium (199.9 kg/ha) and soil microbial population viz., bacteria ( $47.0 \times 10^5$  cfu/g), fungi ( $34.6 \times 10^4$  cfu/g) and actinomycetes ( $40.0 \times 10^3$  cfu/g) as compared to control. The soil pH was increased due to application of cattle urine and FYM which might have improved activity of beneficial micro-organisms. Application of higher levels of organic manures might have improved the activity of beneficial micro-organisms due to increase in the fast decomposing organic matter fraction as a consequence these was higher availability of NPK in soil. These results are in accordance with Naveen Kumar (11). Microbial population in soil decreased with the application of recommended dose of fertilizer (150 : 75 : 75 kg N : P<sub>2</sub>O<sub>5</sub> : K<sub>2</sub>O ha<sup>-1</sup>) along with 25 tonnes of FYM/ha. This might be due to the lower availability of organic matter and unfavorable condition due to various kinds of losses of applied nutrients viz., volatilization, leaching, fixation and through flood of water (12) and the less or-

ganic matter build up in the soil which resulted in lesser microbial activity (13).

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