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Effects of Cattle Urine and FYM on Yield of Broccoli and Soil properties

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ABSTRACT

A field experiment was conducted at Bharatpur, Chitwan, Nepal at farmer's field in 2011 winter season to evaluate the nitrogen efficiency of cattle urine and FYM on soil properties, nitrogen uptake and yield of broccoli cv. Calabrese. The experiment was carried out in a randomized complete block design with eight treatments: N0, N100kg/ha by urine with soil application, N150kg/ha by urine by soil application, N100kg/ha by FYM, N150kg/ha by FYM, N50kg/ha by urine by foliar application, N100kg/ha by urine by foliar application and N150kg/ha by foliar application with three replications. The results of the field experiment revealed that the highest pH (6.1) was given by N150kg/ha Urine by soil application. The treatment N50kg/ha by urine by foliar application gave the highest potassium 242 kg/ha which was significantly higher than the lowest 187 kg/ha from N0. N150kg/ha by foliar application gave the highest soil organic matter 5.43%, the nitrogen 0.31% significantly higher to the lowest 0.07% from N_0 and phosphorus 147kg/ha significantly higher than the lowest. N150 kg/ha through urine by foliar application also gave the biological yield 36.7 t/ha which was significantly higher than the lowest 25.5t/ha from N0 and significantly higher curd yield 19.05 t/ha to the lowest 11.2 t/ha.

Keywords: Cattle Urine, broccoli, FYM, Soil property

INTRODUCTION

Soil fertility management is a major tool for improving crop yields, especially for crops requiring high nitrogen (N) application (Singh *et al*., 2011). Generally, excessive amounts of inorganic fertilizers are applied to vegetables as compare to other crops, in order to achieve a higher yield and maximum value of growth (Singh *et al*., 2012). Organic manure can serve as alternative practice to mineral fertilizers for improving soil structure and microbial biomass (Oelhaf, 1978). In Nepal, farmers pay good attention for collection and utilization of cattle dung but little or no attention has been given in collection and utilization of cattle urine. The nutrient content in cattle urine, especially nitrogen, is much higher than other locally available manures. Therefore, Use of cattle urine alone or in combination with chemical fertilizer can increase the productivity of soil and crop. Urine allows farmers to cut dependency and costs on fertilizers. Large amount of nitrogen rich cattle urine is being wasted in the rural Nepal, which can be used as an organic substitute of chemical fertilizers for higher crop production. Cattle urine is logically a nitrogen source and has been used as manures/fertilizer source (Sharma, 2001) to supplement the nutritional requirement of the crop. One-third to one-half of the nitrogen and three-fourths or more of the potassium is excreted through urine and the remaining amount through feces by the dairy cattle. Farm Yard Manure (FYM) is bulky for the amount of actual N, P, K and other elements it contains. Furthermore, the concentrations of elements are variable and the sources may be limited. As resources become more limited and as people realize the value of compost that goes beyond the elements added, there will hopefully be more recycling of these "waste" materials and an improvement in the sustainability of our wider society (including the use of composted sewage on e.g. green manure areas or tree crops).

MATERIALS AND METHODS

The geographical location

The experiment was carried out at Bharatpur, Chitwan, Nepal, in November (winter) 2011. The geographical location of the experimental site was about north latitude east longitude at an altitude of about 256masl in subtropical region. November to February fad the minimum temperature of 6-10^0 C or even lower, but never reaches to freezing point. Seedlings of Calabrese variety of broccoli were raised in the nursery at the same area of the experiment. The experiment was laid out in a randomized complete block design with different concentrations of cattle urine consisting of eight treatments with three replications.

Nutrient status of soil, FYM and Cattle urine

Recommended dose of nitrogen for broccoli was farm yard manure: 10000 kg/ha and NPK: 100:60:50 kg/ha. Each treatment was randomly allocated. Soil samples from each block were taken before seedling transplanting and from each plot at the crop harvest. The plot size was 9 m^2 with spacing of 60 cm x 60 cm. Soil samples were analyzed for Nitrogen, phosphorus, potash, Organic matter, pH and other soil properties at soil science division, NARC, Khumaltar. The soil

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properties before the experiment setting was pH 5.91, OM (4.33%), Available nitrogen 0.4%, available phosphorus 89.1 kg ha^{-1} and available potassium 176 kg ha^{-1}. Cattle urine was collected and analysed for nutrient content and it was found as 0.38 N%, 0.008 P_2O_5%, 0.05 K_2O% and 8.9 PH. Composite sample of FYM was analysed on the dry weight basis. Nutrient contents of FYM were Nitrogen 0.25%, phosphorus (P_2O_5) 0.07 % and potassium (K_2O) 0.12% and pH 8.

Method of cattle urine and FYM application

Calculated amount of urine was mixed with water in the ratio of 1:2 (Hamdine, 2008) and the mixture was applied basally in the soil about 5 cm away from the main stem of plant. Urine was applied in six equal split doses which were at basal, 7, 14, 21, 28, 35, and 42 DAT (Days after transplanting). Farm yard manure dose was applied double because only 50% of FYM is mineralized in a season.

Soil analysis after harvesting and calculation of broccoli yield

After the crop harvest, five soil samples were taken from the rhizosphere of each plot. Those composite samples from each treatment were analyzed at NARC for total nitrogen, available phosphorus, available potassium, organic matter and pH content. Biological yield was calculated by adding curd, shoot and root weights. The data were analyzed by MSTAT-C program. Data were subjected to analysis of variance (ANOVA) to evaluate the significance of treatment effect. Mean values of the significant treatment parameters were compared by Duncan's Multiple Range Test (DMRT) at 5 % level of significance.

RESULTS AND DISCUSSION

Dynmics in physico-chemical properties of soil

The laboratory results of soil test before crop planting and after the crop harvest are presented in Table 1. The soil pH increased with the application of urine in both soil and foliar form. Application of urine increased pH as reported by Groenigen *et al.* (2005) and Powell *et al.* (1998).

Table 1: Effects of cattle urine and FYM on physico-chemical properties of soil after the harvest of broccoli at Bharatpur 14, Chitwan, Nepal 2011-2012

Treatment	Physico-chemical Properties				
	Soil pH	Soil Organic Matter (%)	Total N (%)	Available P_2O_5 (kg/ha)	Available K_2O (kg/ha)
N0	5.9	3.21	0.07^{d}	32.6^{d}	187^{d}
N100 Urine(SA)	6.0	3.62	0.23^{abc}	82.2^{c}	200^{c}
N150 Urine (SA)	6.1	4.41	0.26^{ab}	130.6^{ab}	208^{ab}
N100FYM	5.9	4.56	0.10^{cd}	88.0^{bc}	205^{bc}
N150FYM	5.9	5.0	0.20^{bcd}	138^{a}	214^{bc}
N50Urine(FA)	6.0	4.82	0.14^{bcd}	81.85^{c}	242^{c}
N100 Urine(FA)	5.9	5.39	0.15^{bcd}	120^{abc}	196^{abc}
N150 Urine(FA)	6.0	5.43	0.31^{a}	147.6^{a}	196^{abc}
Mean	6.01	4.43	0.19	102.61	206.5
SEM	0.03	0.34	0.04	13.76	16.36
LSD0.05		0.56	0.13	41.73	52.05
CV%	1.65	22.25	41.66	23.22	22.41

Source: National Agriculture Research Council (NARC), Nepal

SA= Soil application, FA=Foliar application, N = Nitrogen, P = Phosphorus and K = Potassium

Means followed by the same letter (s) in the column are not significantly different at 5% level of significance as determined by DMRT.

Khanal *et al.* (2010) reported that the soil pH increased with the application of urine but the application of urea leads to decreased in pH. Application of urine increased the soil pH in pearl millet field as reported by Powell *et al.* (1998). N125kg/ha by Urine increased the organic matter content in soil. The amount of soil total nitrogen increased with the application of urine and FYM. Potassium also increased with the application of urine in increasing amounts. The soil available phosphorus increased compared to before harvest and its availability increased with increase application of urine. Similar result of increased availability of phosphorous and its subsequent uptake by pearl millet after application of cattle urine was reported by (Powell *et al.*, 1998). These results are due to the fact that urine contains nitrogen along with potassium. Urine increased the soil pH which may leads to higher P availability.

Biological yield

There was a non significant ($p < 0.05$) effect of cattle urine and FYM on biological yield (sum of curd, shoot and root weights) of broccoli. The highest biological yield 36.7 t/ha was recorded from N150kg/ha by urine as foliar application followed by 32.46 t/ha from N50kg urine as foliar application (Table 2). The lowest biological yield 25.43t/ha was obtained from N_0 which was significantly lower from 36.7 t ha^{-1}. Biological yield was increased as the level of urine application increased in foliar application. The N 100kg urine as foliar application gave the biological yield greater than N100 kg urine as soil application

and also than N50kg urine and N150kg urine as foliar application.

Table 2: Effects of cattle urine and FYM on Biological yield (t/ha) of broccoli at Bharatpur 14, Chitwan, Nepal 2011-12

Treatment	Biological yield (t ha^{-1})
N0	25.5^{c}
N100Urine(SA)	32.1^{b}
N150 urine(SA)	31.1^{b}
N100FYM	30.1^{b}
N150FYM	31.1^{b}
N50 Urine(FA)	32.4^{b}
N100 Urine(FA)	31.3^{b}
N150 Urine(FA)	36.7^{a}
Mean	31.1
SEm (±)	7.4
$LSD_{0.05}$	4.7
CV%	8.75%

Means followed by the same letter (s) in the column are not significantly different at 5 % level of significance as determined by DMRT.

Khanal *et al.* (2010) reported the highest biological yield (53.71 t ha^{-1}) from N125Kg Urine in cauliflower. Double yield of bitter gourd was observed by SSM-P (2009) from cattle urine. Increment in biomass of broccoli with the application of cattle urine might be due to supplement of nitrogen and other minerals at all the growth stages at regular interval. Adeoluwa *et al.* (2009) also reported the highest total fresh amaranth biomass from cattle urine fortified organic fertilizer. Increased biomass of cabbage from human urine was also reported by Pradhan *et al.* (2007).

Curd yield

The effects of cattle urine, and FYM was significant ($p<0.01$) on curd yield (Table 3). The highest curd yield (19.05 t ha^{-1}) was from N150kg/ha by urine as foliar application followed by (17.35 t ha^{-1}) from N100kg/ha by urine as foliar application and they were similar. The lowest curd yield was 11.22 t ha^{-1} from N_0 which was significantly lower than the highest 19.05 t ha^{-1}. The highest curd yield (20.08 t ha^{-1}) of cauliflower was obtained from N100kg/ha by urine application (Khanal, 2010).

The growth of broccoli was better from the optimum supply of urine and gave higher yield than FYM application. Higher yield of curd from urine application /plot might be due to greater availability of different essential nutrient elements and hormones from cattle urine at various growth stages of broccoli. Hormones present in urine helped to produce higher yield in alfalfa (Erb *et al.*, 1977).

Sub-optimal supply of nitrogen led to delay in maturity and caused reductions in yield and quality of cauliflower crops (Rahn *et al.*, 1993). Increase in the yield of bitter gourd from the application of cattle urine was also reported by SSMP (2009). Similar result in pearl millet was also reported by Powell *et al.* (1998). Increased growth and yield of cabbage from human urine was also reported by Pradhan *et al.* (2007).

Table 3: Effects of cattle urine and FYM on curd yield of broccoli at Bharatpur 14, Chitwan, Nepal (2011-012)

Treatment	Curd yield (t/ha)
N0	11.2b
N100kg/ha Urine(SA)	16.2ab
N150 kg/ha urine(SA)	15.9ab
N100 kg/ha FYM	14.8bc
N150 kg/ha FYM	15.1abc
N50 kg/ha Urine(FA)	14.4bc
N100kg/haUrine(FA)	17.3ab
N150kg/ha Urine(FA)	19.05a
Mean	15.3
SEm (±)	4.5
$LSD_{0.05}$	3.3
CV%	13.8%

Means followed by the same letter (s) in the column are not significantly different at 5 % level of significance as determined by DMRT.

Excessive application of urine caused death of new leaves and produced small firm curds, which might be due to luxuriant vegetative growth and ammonium toxicity. Mullins and Straw (1990) and Everaarts (1994) also found that excessive application of nitrogen showed reduction in marketable yield of cauliflower and broccoli along with detrimental effects on harvest quality.

Yield increased with an increase in N and humus levels. The highest yield was produced by a combination of 12 t humus ha-1 and 120 kg-N ha-1. There was, however, no interaction between humus and N (Ping, 1989).

CONCLUSION

The present study revealed that soil nitrogen was found higher with the application of N150kg/ha supplied through cattle urine by foliar application followed by the same amount of urine by soil application. Similarly, the highest biological yield was obtained from N150kg/ha by urine as foliar application followed by N50 kg/ha through urine by foliar application which was significantly higher than from no Nitrogen. The difference in the 1st two highest and the lowest biological yield was found significantly different.

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