EFFECTS OF ANIMAL MANURE APPLICATION ON THE GROWTH AND YIELD OF CORN

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ABSTRACT

Application of chicken dung and cow manure at higher rates seemed to hasten tasseling, silking and maturity of the corn plants and favor production of larger ears, more grains, and higher shelling percentage. Overall performance of the crop was better with application of 9 to 12 t/ha of chicken dung than inorganic fertilizer and cow manure at all rates. The bulk density and pH of the soil were not significantly affected by application of either inorganic or organic fertilizers. An increase in the NPK contents of the soil was noted when 6 t/ha or more of animal manure was applied.

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KEY WORDS: Corn. Growth. Yield. Farm manure. Bulk density. Soil nutrients. Tropical soils.

INTRODUCTION

Soil composition is one of the limiting factors in the utilization of tropical areas for better crop production. Approximately 15% of tropical soils is composed of highly weathered and leached soil like oxisols, ultisols and alfisols. Erosion in these soils is very pronounced due to high rainfall, improper land use and poor management practices (Sanchez, 1976). This condition has been further aggravated by the planting of high yielding crop varieties which require sufficient amount of nutrients. This results in rapid depletion of soil nutrients, hence fertilizers are needed to replenish or augment the fertility of the soil.

Many developing countries are now reeling from the effects of rising prices of inorganic fertilizers. It is therefore important to determine whether organic fertilizers could be used to reduce if not totally replace inorganic fertilizers.

Organic materials such as farm manures are good substitutes for inorga-

nic fertilizers because they supply a wide variety of nutrients such as nitrogen, phosphorus, potassium and micronutrients to the plant. Once applied, these nutrients are slowly but continuously released preventing their leaching from the soil. They also contain a large number of microorganisms which increase the rate at which plant food becomes available (Worthen, 1948). Furthermore, farm manures improve soil tilth and structure directly through their action as bulky diluents in compacted soils. In light soils, they enhance soil granulation which increases its waterholding capacity.

MATERIALS AND METHODS

Treatments and Experimental Design. The experiment was laid\out in a randomized complete block design with three replications. The area of the individual experimental plot was 24 m^2. The treatments were designated as follows:

T_0 = control (no manure application)
T_1 = inorganic fertilizer (45-30-30 kg/ha)
T_2 = chicken dung at the rate of 6 t/ha
T_3 = chicken dung at the rate of 9 t/ha
T_4 = chicken dung at the rate of 12 t/ha
T_5 = cow manure at the rate of 6 t/ha
T_6 = cow manure at the rate of 9 t/ha
T_7 = cow manure at the rate of 12 t/ha

Soil Analysis. Before manure application and after harvesting, soil samples were collected at random from the whole area, composited and analyzed for bulk density, pH, organic matter, N, P and K contents. Bulk density was determined following the procedure used by Black (1965) and the organic matter content, using the Walkley Black method (Jackson, 1958).

Manure and Fertilizer Application. Dried chicken dung and cow manure were incorporated into the soil two weeks prior to planting. Inorganic fertilizer applied at the recommended rate for corn (45-30-30 kg NPK/ha) was included as one of the fertilizer treatments for comparison. All P and K and 30 kg of N/ha were basally applied and the remaining 15 kg/ha of N was applied one month after planting.

Planting and Cultural Management. Corn (var. DMR 2) seeds were planted on ridges at a distance of 0.75 m between rows and between hills. Plant population was maintained at 53,333 plants/ha. Handweeding was done whenever necessary. Alternate application of Parapest and Thiodan was performed every 2 weeks starting from 15 days after seedling emergence up to 25 days before harvesting to control insect infestation.

Harvesting. Plants from the four inner rows of each experimental plot excluding one hill from both ends of each row were harvested. The ears were sundried and husked before shelling.

RESULTS AND DISCUSSION

Agronomic Parameters

Application of organic or inorganic fertilizer did not significantly affect the growth and development of the corn plant. Table 1 shows that application of fertilizer slightly accelerated seedling emergence, tasseling, silking and maturity of corn.

Among the fertilizers used, chicken dung appeared to be the most effective in promoting the growth and development of corn, followed by cow manure and the least was inorganic fertilizer. Plants treated with chicken dung grew the tallest with highest leaf area index (LAI) and stover yield while the inorganic fertilizer-treated plants gave the lowest values (Table 1). Cervallos (1954) claimed that chicken dung is better than cow manure because it contains greater amounts of nutrients and releases them more readily for plant use than the latter.

The bulk density of the soil was not significantly affected by the application of inorganic fertilizer and animal manure. However, the bulk density slightly decreased when higher rates of animal manures were applied. Although the magnitude of increase was not large enough to show a pronounced effect, it seemed that the application of 12 t/ha chicken dung and cow manure reduced the bulk density of the soil from 1.33 g/cc to 1.29 and 1.31 g/cc, respectively (Table 2).

Yield and Yield Components

The number of ears per plant, ear width, and weight of 100 seeds were not significantly affected by inorganic fertilizer and manure application. However, ear length, shelling percentage and total grain yield were markedly influenced by the treatments used (Table 3). The longest ear (11.85 cm) was noted in plots treated with 9 t/ha chicken dung while the shortest (7.94 cm) developed in the control plots.

The highest shelling percentage (82.97%) was obtained in plots manured with 12 t/ha chicken dung. This was considerably higher than those obtained from plants treated with 6 t/ha (73.88%) chicken dung and inorganic fertilizer (68%) (Table 3). The significant influence of the chicken dung on shelling percentage might be attributed to the high and better regulated nutrient release during its decomposition. On the other hand, the inorganic fertilizer more significantly reduced shelling percentage than the control.

Application of inorganic fertilizer to corn plant did not cause significant increases in ear size (length and diameter) as well as in the number and weight of kernels that developed per ear. The shelling percentage of the ears of inorganic fertilizer-treated plants was lower than that of the manure-treated ones. It is possible that the increase in size and weight of ears in the inorganic fertilizer-treated

Table 1. Agronomic characteristics of corn as affected by inorganic fertilizer and different levels of animal manure.

Treatment	Number of Days				Plant Height at Maturity (cm)	Leaf Area Index (LAI)
	Seeding to Emergence	Emergence to Tasseling	Emergence to Silking	Emergence to Maturity		
T_0 – no fertilizer (control)	6.33	47.67	60.67	91.67	145.63	1.62
T_1 – inorganic fertilizer (45-30-30 kg NPK/ha)	6.00	46.67	59.67	90.00	158.03	1.61
T_2 – 6 tons chicken dung/ha	5.67	47.00	59.67	91.67	161.33	1.84
T_3 – 9 tons chicken dung/ha	5.67	46.33	58.67	89.00	176.90	1.92
T_4 – 12 tons chicken dung/ha	5.33	45.67	57.00	86.00	177.53	2.20
T_5 – 6 tons cow manure/ha	5.33	46.33	58.33	91.00	162.27	1.71
T_6 – 9 tons cow manure/ha	5.67	47.00	59.33	91.67	154.40	1.62
T_7 – 12 tons cow manure/ha	5.33	46.00	58.33	89.67	166.30	1.70
C. V. (%)	14.97	3.13	3.19	3.00	8.40	13.53

Table 2. Initial and final pH values, organic matter, nitrogen, available phosphorus and extractable potassium contents and bulk density of the soil applied with inorganic fertilizer and animal manure.

Treatment	pH	Organic Matter (%)	Nitrogen (kg/ha)	Available Phosphorus (ppm)	Extractable Potassium (ppm)	Bulk Density (g/cc)
Initial Soil Analysis (Before manure application)						
Soil before treatment application	6.30	2.50	60.00	48.00	264.00	1.33
Final Soil Analysis (After harvest)						
T_0 – no fertilizer (control)	6.29	2.97	42.43	17.00	248.60	1.33
T_1 – inorganic fertilizer (45-30-30 kg NPK/ha)	6.29	2.50	44.16	16.00	250.13	1.33
T_2 – 6 tons chicken dung/ha	6.30	3.10	67.67	49.00	270.28	1.33
T_3 – 9 tons chicken dung/ha	6.30	3.30	69.08	53.00	296.36	1.30
T_4 – 12 tons chicken dung/ha	6.34	3.49	71.31	62.00	324.19	1.29
T_5 – 6 tons cow manure/ha	6.29	3.10	58.00	46.00	258.14	1.33
T_6 – 9 tons cow manure/ha	6.29	3.10	60.30	47.00	262.20	1.33
T_7 – 12 tons cow manure/ha	6.30	3.20	64.42	51.00	289.41	1.31

Table 3. Yield and yield components of corn as affected by inorganic fertilizer and different levels of animal manure.

Treatment	Ears			Shelling Percentage (%)	Weight of 100 Seeds (gm)	Total Grain Yield (tons/ha)
	No./plant	Length (cm)	Width (cm)			
T_0 – no fertilizer (control)	1.07	7.94 c	2.82	78.77abc	14.83	1.20b
T_1 – inorganic fertilizer (45-30-30 kg NPK/ha)	1.00	8.11c	2.89	68.00d	17.37	1.35b
T_2 – 6 tons chicken dung/ha	1.03	8.46bc	2.99	73.88 cd	16.08	1.51ab
T_3 – 9 tons chicken dung/ha	1.17	11.85a	3.39	81.42ab	16.92	2.97a
T_4 – 12 tons chicken dung/ha	1.17	10.92a	3.16	82.97a	16.60	3.15a
T_5 – 6 tons cow manure/ha	1.13	8.91bc	3.13	71.93cd	15.74	1.73ab
T_6 – 9 tons cow manure/ha	1.03	8.20c	2.90	74.39bcd	15.97	1.52ab
T_7 – 12 tons cow manure/ha	1.13	10.21abc	3.19	75.06bc	17.28	2.67ab
C. V. (%)	10.46	13.97	9.80	4.81	8.99	38.21

Treatment means within a column followed by a common letter are not significantly different at 5% level.

plants was not proportional to the increase in number and weight of the kernels formed per ear. Formation and development of ears in the former treatment could have been faster during the early reproductive stage but formation of kernels was not sustained by the available nutrients in the soil during the active phase of this stage.

In the control plants, smaller but fully filled ears with smaller and lighter grains were developed, hence, higher shelling percentage but slightly lower grain yield per hectare was obtained.

Application of 9 and 12 tons of chicken dung significantly increased total grain yield over the control and the inorganic fertilizer treatments. Although the inorganic fertilizer produced heavier grains, this was offset by the shorter ears and the lower shelling percentage, hence, low grain yield was obtained in this treatment. No significant differences were noted among the manure-treated plots. Plants manured with 12 t/ha of chicken dung produced the highest yield (3.15 t/ha) followed by those which received 9 t/ha of chicken dung (2.97 t/ha). The higher grain yield obtained in manure-treated plots could be attributed to the effectiveness of the manure in increasing ear length, number of kernels that developed per ear, and shelling percentage. Soil analysis revealed that organic manure application tended to increase the final concentration of nutrients in the soil (Table 2). As the rate of organic manure application was increased, there was also a corresponding increase in the NPK content of the soil. This might be due to the gradual but continuous release of nutrients since decomposition of manure persisted even after harvest.

The final nutrient content of the soil decreased in the control and in the inorganic fertilizer-treated plots. The observed decrease could be due to crop removal and leaching of nutrients.

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