CHICKEN MANURE TEA: RESEARCH REPORT

BY DR. MARTIN L. PRICE & NATHAN DUDDLES

Published 1984

ECHO TECHNICAL NOTE

INTRODUCTION

One aspect of ECHO's ministry is behind the scenes for most of our readers. We help college professors and students in the sciences identify research projects that would be of benefit to the small Third World farmer. Several ideas that could be done at an undergraduate level are written up in what we call Academic Opportunity Sheets. Nathan Duddles, while an undergraduate at California Polytechnic University, did an outstanding job on one of these projects, evaluating the suitability of chicken manure tea as a fertilizer. I believe the quality of his work is at a Masters level.

PREPARATION OF THE MANURE TEA

Fresh chicken manure was obtained from the University poultry unit from beneath cages containing laying hens that were not being fed hormones or special additives. The manure was placed in a burlap bag, a rock was added to make sure it did not float, and the bag was placed in water in a 35-gallon garbage can. The concentration of both ammonia and nitrate nitrogen were measured at weekly intervals for 4 weeks. To determine what effect different weights of manure would have, trials were done with 20, 35 and 50 pounds of manure per bag. Here are the results:

ECHO, 17391 Durrance Rd., North Ft. Myers FL 33917, USA
Phone: (239) 543-3246; Fax: (239) 543-5317
e-mail: echo@echonet.org; website- http://www.echonet.org/

Table 1. **AMOUNT S OF NO_3 AND NH_4 NITROGEN FOUND AT WEEKLY INTERVALS IN MANURE TEA MADE FROM 20, 35, AND 50 LBS. OF CHICKEN MANURE.**

	1 week	2 weeks	3 weeks	4 weeks
	ppm (parts per million)			
20 lbs. manure				
NO_3	102	32	42	18
NH_4	655	732	832	860
Total	757	764	874	878
35 lbs. manure				
NO_3	10	10	10	--
NH_4	725	1142	1456	1514
Total	735	1152	1466	1514
35 lbs. manure				
NO_3	5	--	8	--
NH_4	753	1128	1302	1424
Total	758	1128	1310	1424

In each treatment, the concentration of soluble nitrogen increased over the four-week period. The increase was entirely due to increase of ammonium, with nitrate decreasing at 20 lbs. or remaining extremely low at higher weights of added manure. The available nitrogen was appreciably leached from the 20-pound bag within1 week, whereas it took 3 or 4 weeks with the higher weights.

When the three treatments reached their respective concentration plateaus, the 35 and 50 lb. treatments contained about the same amount of nitrogen, 1,514 ppm and 1,425, while the 20 lb. was only 878. Apparently the concentration became so high with heavier loading that bacteria stopped working, causing less nitrogen to be obtained with 50 than with 35 pounds. The ppm of nitrogen in solution per pound of manure is 44, 43, and 28 for 20, 35 and 50 lbs. of manure respectively.

In the greenhouse experiment, manure tea was made using the 20 pound loading of fresh chicken manure. After 4 weeks, the tea was diluted by a factor of 4 to achieve a final concentration of 200 ppm of soluble nitrogen, an amount that would be comparable to a hydroponic solution.

COMPARISON OF NUTRIENT CONCENTRATIONS IN MANURE TEA AND A HYDROPONIC SOLUTION

The concentration of several nutrients in the tea made from 20 pounds of manure soaked for 4 weeks then diluted 4 fold were measured. This was then compared to one standard hydroponic formula (the Resh solution). The tea concentrations followed by the standard are: total nitrogen (219; 175), nitrate (4; 145), ammonium (215; 30), phosphorous (54; 65), potassium (295; 400), calcium (6; 197), sodium (62; 0), magnesium (0; 2), iron (0; 2), manganese (0; 0.5), copper (0; 0.03), zinc (0.05; 0.05).

The pH of the diluted tea was 7.3, very nearly neutral, compared with 6.0-6.5 for the Bridwell hydroponic solution that was used for greenhouse trials.

The major nutrients and zinc are adequate. Total nitrogen was ideal, though it would preferably be in the nitrate rather than ammonium form. Only calcium and tiny amounts of iron, manganese and copper would need to

come from another source. Unless you are growing hydroponically where all nutrients must come from the tea, these should be available from the soil or compost. Lowering the pH from 7.3 to near 6 might provide some of these, or some might come from dilute seawater.

GREENHOUSE EXPERIMENT WITH TOMATOES

In order to evaluate the efficiency of the manure tea beyond just mineralogical analysis, it was used as a fertilizer solution in an actual growing situation using tomato seedlings (Cal Ace variety). Each plant was grown in a separate 5-inch deep wooden lug of the type used in the table grape industry. The fertilizer solution was delivered to each plant by an inverted hard plastic milk jug. The mouth of each jug was fitted with a plastic cap which had a flat piece of corrugated plastic attached by a ringshank nail. Three holes were drilled through the piece of plastic and the cap so solution could flow into the tray. Each time the level of solution dropped below the depth of the plastic spacer (about 5 mm) in the mouth of the jug, air would bubble into the jug and more solution would gurgle into the tray. This assured a constant supply of both fertilizer and moisture.

A total of 24 plants were used. Half of the plants were fed a chemical hydroponic fertilizer solution (Bridwell mixture) while the other half were fed the manure tea. Three different growing media were used: sand, sawdust and woodchips. These served as models of the kind of media that might be available for rooftop gardens in the Third World. Plants were arranged in a complete randomized block design and standard statistical tests were run on the results.

The author (Duddles) believes it was unfortunate that the Bridwell mixture was used as the standard hydroponic formula for the greenhouse trials, because it is quite low in micronutrients. Nevertheless, the concentrations of nitrogen, potassium, phosphorous, calcium and magnesium were near ideal.

Conditions in the greenhouse and the season were sufficiently unfavorable (low light and cool temperatures) that tomatoes had only reached the blossom stage when the experiment had to be terminated. Growth in woodchips was superior in every case, including greater height, superior root mass, higher blossom/bud count, and fewer nutrient deficiency symptoms. Plants in sawdust were very spindly with malformed stems and widespread chlorosis of the leaves. Plants grown in sand differed visually from those grown in woodchips primarily in height.

Roots were concentrated near the surface with sand or sawdust media, suggesting that the inferior performance was due to insufficient air reaching the lower parts of these media. The coarser texture of the woodchips prevented water saturation and allowed more air to reach the roots. It should be noted that a type of wood less resistant to decay than redwood would likely have begun to decay and tie up micronutrients, resulting in deficiencies.

It appeared that the chemical solution gave slightly better results in all measurements (dry weight, nitrogen concentration, root proliferation and blossom/bud count). However, this was not significant at the 0.05 confidence level. The only significant difference in the concentrations of nutrients present in plant tissues was that plants grown with manure had more sodium. The micronutrients must have come from the growing medium (i. e. wood chips, sand or sawdust).

FERTILIZER CONSUMPTION

The pounds of chemical fertilizer or manure tea can be calculated. The average consumption of solution was 4.5 gallons per plant for 90 days. It took 20 pounds of manure to make 32 gallons of tea, which was then diluted by a factor of four to make 128 gallons. This is 72.6 grams (0.16 pounds) of manure per gallon and 326.7 g (0.72 pounds) per plant. Similar calculations with the chemical fertilizer give 37.8 g of dry chemical per plant or 8.4 grams per gallon. If a six-month growing season was needed for one crop and if each plant used 9 gallons of fertilizer solution, 636 g (1.4 pounds) of poultry manure would be needed for each plant.

SUMMARY

The method of preparation of chicken manure tea that was most efficient in terms of recovery of nitrogen was to soak 20 or 35 pounds of fresh manure in burlap bags placed in 32 gallons of water for 3 weeks. The greenhouse experiment showed that in a three month growing period, manure tea could perform nearly as well in the production of tomato plants as a chemical fertilizer. This was true in all media: redwood chips, redwood sawdust and sand. Laboratory analysis showed that raw poultry manure tea is not a complete fertilizer solution, but that nitrogen, phosphorous, potassium and zinc are at adequate levels in the solution. Nathan suggested a further experiment might look at the possibility of using dilute seawater to provide some of those micronutrients.