APPLICATION OF MUNICIPAL SOLID WASTE COMPOST TO NEMATODE-INFECTED CITRUS[1] [APLICACION DE LA BASURA DE LAS CIUDADES EN ABONOS PARA LOS CITRICOS CON NEMATODES].

A. C. Tarjan, Institute of Food and Agricultural Sciences, University of Florida, Agricultural Research and Education Center, Lake Alfred, Florida 33850, U. S. A.

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ABSTRACT

One of the most acute problems facing the more affluent countries of an over-populated world is the accumulation of its wastes, specifically in urban areas. Historically, trash has been dumped outside the window, outside the town or in a sanitary (or unsanitary) landfill. The recent environmental movement has indirectly brought focus upon the potential value of municipal refuse, and current technology has proposed alternatives to the usual indiscriminate throw-away practices. The only logical alternative yet proposed has been the transformation of municipal wastes into a workable agricultural compost. During the past 11 yrs. a number of tests have been conducted in which refuse compost has been applied at rates up to 18MT/ha (8 T/A) to hothouse lemon seedlings infected with *Tylenchulus semipenetrans* or *Pratylenchus coffeae* and to field plantings of Valencia orange trees infected with *Radopholus similis*. Hothouse applications resulted in increased plant weight and improved plant appearance. Established nematode-infected trees to which compost had been applied yielded either about 5% more fruit or fruit that was about 1% heavier and with a slightly higher percentage of soluble solids than fruit from untreated trees. The differences between treated and untreated trees, even though detectable, have been slight and usually statistically non-significant. This could have been due to the inadequate amounts of refuse compost added to the soil since greater amounts have been recommended by others for optimum application

INTRODUCTION

The Nature and Use of Municipal Refuse:

The burgeoning world population has created many problems, among the lesser of which is what to do with the waste it creates. The majority of urban centers have traditionally used a "dump" or sanitary landfill, usually situated in the outskirts of the community. The creeping expansion of urban communities which eventually coalesce into a sprawling megalopolis, and the increasing scarcity and higher price of land are fast making obsolescent the landfill concept. Governmental environment protection agencies also are aware of the threat such refuse depositories present, e.g., to the subterranean aquifer (3).

Conversion of solid wastes through pyrolysis into gas or low grade fuels, or into power plant fuel, has been attempted but, as yet, is economically unproven. Salvage of glass, metals, plastics, and paper from solid wastes can be productive only in large, efficiently-run operations (11).

Solid Waste Compost:

Composted solid wastes have successfully been used as agricultural soil amendments and have stimulated growth in sorghum (8), alfalfa, and fescue (2),

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tomatoes and cotton (4), and other crops. Yet, such material cannot be regarded as fertilizer since it usually has a low plant nutrient content of about 0.3% to 0.6% nitrogen and from 0.2% to 0.4% potassium and phosphorus. Solid waste compost, due to its high content of paper and organic yard trash wastes, has a carbon:nitrogen ratio of 50 or 60 to 1 (7), which determines the rate of decomposition and amount of nitrogen needed to aid such decomposition (15). A carbon:nitrogen ratio of 20 or less has been suggested as desirable (13).

An accumulation of copper and zinc was detected in soil where sewage sludge had annually been applied for 30 to 80 yrs (12). Yet, application of solid waste compost at rates near 448/ MT/ ha (200 T/ A) was not injurious to forage crops, even though quantities of boron potentially detrimental to plant growth were in the added compost (2). Refuse compost added to soil at rates of 144 MT/ ha (64 T/ A) or more resulted in an increase in potassium, phosphorus, calcium, magnesium, pH, total soluble salts and the nutrient and water-holding capacities of the soil (7). Halvorson (6) reported that, at the optimum rate of 224 MT/ ha (100 T/ A), municipal refuse compost moved readily into the soil and that only minimal problems resulted from the presence of excess soluble salts.

Effects of Refuse Compost on Nematodes and Nematode-Infected Plants:

An early reference on use of municipal refuse compost reported application of 4 MT/ha (2 T/ A) in 1966 to Valencia oranges on rough lemon rootstock infected with the burrowing nematode, *Radopholus similis* (Cobb). The compost contained 0.83% nitrogen; for 2 preceding yrs, the trees had received the same rate of a manure compost with 0.96% nitrogen. It was found that the most important single interaction was that resulting when compost treatment was applied with a 40% natural organic nitrogen fertilizer and lime. Differences in mean value for fruit weight, juice weight, % brix (soluble solids), and % acid were significant at odds of only 20 to 1 (14). Although such results do not necessarily imply that the applied compost was toxic to nematodes, it had been reported that water extracts from saturated composted municipal refuse will induce immobility and death of *Belonolaimus longicaudatus* (Rau) (10). In another test comparing the growth of oats *(Avena sativa* L.) and sorghum *Sorghum bicolor* (L. Moench) in plots receiving mineral fertilizers or refuse composts, populations of the spiral nematodes were lowest in plots receiving compost from 18 to 72 MT/ ha (8 to 32 T/ A) (9). Similar results have been reported by the use of sewage sludge which reduced galling of tomato plants by root-knot nematodes (5).

RESULTS

The municipal refuse compost used in the following tests was SUPERSOIL®, a product of Conservation International Incorporated, Ft. Lauderdale, FL made at its Kingston, Jamaica plant.

Greenhouse Test

One-yr-old lemon seedlings infected with *T. semipenetrans* or *P. coffeae* growing in Astatula fine sand in 20.3 cm (8-inch) clay pots received either tankage (containing 5% nitrogen) or refuse compost (0.3 to 0.6% nitrogen) at simulated rates of 2, 4, 9 or 18 MT/ha (1, 2, 4 or 8 T/ A). After 8 mos, weights of all plants infected with *Pratylenchus* and most plants parasitized by *Tylenchulus* were greater than the weights of control plants which received no soil supplements.

Outdoor Tests

Two-yr-old Valencia orange seedlings infected with *R. similis* and growing in 19-liter (5-gal) containers with Astatula fine sand were treated with refuse compost at a simulated rate of 0, 1, 2 or 4 MT/ha (0, ½, 1 or 2 T/A). After 22 mos, during which time foliage from each plant was clipped and weighed, the plants receiving compost at a 4 MT/ha (2T/A) rate had produced 23% more foliage than produced by the untreated controls. These results, however, were not statistically significant.

Field Tests

A valuable opportunity to evaluate the effect of municipal compost in nematized citrus trees presented itself in a field test involving several cultural techniques and cooperatively conducted with J. H. O'Bannon. Sixty replicate 27-yr-old Valencia orange trees on rough lemon root infected with burrowing nematodes and growing in Astatula fine sand were treated annually for 2 yrs with 2 MT/ha (1 T/A) of refuse compost. Annual measurements of fruit diameter and yield were obtained for 2 yrs. The data for 1976 in the following table show slight increases in both responses measured from those trees receiving refuse compost, as compared to the untreated trees.

Treatment	Fruit diameter in cm	Mean yield boxes/tree
Refuse compost at 2 MT/ha (1 T/A)a applied annually	7.465b	4.41c
No refuse compost	7.391	4.21

a Two applications made
b Based on 400 fruit measurements; data not significant, P - 0.05
c Based on yield from 60 trees; data not significant, P - 0.05

CONCLUSIONS

One of the major deficiencies in most of Florida's citrus soils is an acute shortage of organic matter. Municipal refuse can contain as much as 77% organic matter (13) which, when added to the soil in sufficient amounts as a compost, can increase water-holding capacity, cation-exchange capacity, and improve soil structure (7). If municipal refuse is composted with sewage sludge, or other nitrogenous materials, the increase in total nitrogen content will result in a more favorable carbon:nitrogen ratio, thus helping to eliminate the undesirable effects of nitrogen starvation to the plants.

Excessive application of solid waste compost to soils can result in accumulations of soluble salts. Boron and copper, in particular, may be toxic to plants if present in sufficient quantity. Fortunately, boron is easily leached from the soil, whereas copper accumulates (1). Copper availablitly to plants, however, can be controlled by maintaining a non-acid soil pH. In general, the amount of compost to be applied should be determined by nature of the soil, condition of the trees, and even by particular geographic localities, since composition of refuse may vary (2).

It is evident that the world must do something constructive with the mass of refuse produced by its population. It seems illogical and antiutilitarian to discard or bury the material since it has a reclaimable value. As stated earlier, burning compost as a fuel or pyrolyzing it are economic risks. Salvaging some of the usable components of refuse is only feasible in a large-scale, well-managed operation. Thus, converting municipal solid wastes to an agricultural compost seems the only rational alternative.

Research results obtained from applying municipal refuse compost to citrus signify that there is a slight beneficial effect as measured by growth response, plant appearance, and fruit yield. These tendencies are especially noteworthy since only relatively low rates of refuse compost of up to 18 MT/ha (8 T/A) had been applied in citrus groves. Application at 45 to 224 MT/ha (20 to 100 T/A) to other crops has been recommended as the optimum rate in Florida and Oregon, respectively (6, 7). Although results from tests of several yrs duration are needed before blanket recommendations can be made, results at hand justify cautious optimism for applying municipal refuse compost to citrus.

RESUMEN

Uno de los problemas mas graves que encaran los países pudientes de un mundo sobrepoblado es la acumulación de desechos, principalmente en áreas urbanas. Tradicionalmente los desperdicios se han botado por la ventana, fuera de las ciudades o en soterramientos. El nuevo movimiento ambientalista ha traído indirectamente la realidad del valor potencial de desperdicios municipales y la tecnología ha propuesto alternativas a las prácticas usuales de desechar indiscriminadamente. Entre las propuestas la única alternativa lógica ha sido la transformación de desperdicios municipales en estiércol. En los últimos 11 años hemos efectuado un buen número de pruebas en las que el estiércol municipal se añadió a nivel de 18 TM/ha (8 T/A) a plántulas de limón en invernadero infectadas con *Tylenchulus semipenetrans* o *Pratylenchus coffeae* y en el campo a naranjos Valencia infectados con *Radopholus similis*. Las aplicaciones de invernadero aumentaron el peso de las plantas y mejoraron la apariencia de las mismas. Los naranjos infectados con nematodos dieron o bién un rendimiento de fruta superior en un 5%, o fruta que resultó ser 1% más pesada y con un pequeño aumento en el porcentage de solidos solubles en comparación con el testigo. Las diferencias entre árboles con o sin tratamientos, aunque detectables, han sido siempre pequeñas y por lo general estadisticamente insignificantes. Esto puede deberse a que se utilizaron cantidades de estiércol inferiores a las que se consideran como óptimas para añadir al suelo.

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