TWO METHODS OF COMPOSTING GIN TRASH

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INTRODUCTION

A necessary situation that occurs in the cotton ginning process is the accumulation of about 200 lb of waste per ginned bale. This waste, called gin trash, has to be disposed of at some point in time. Much of the gin trash was incinerated for many years, but certain regulations, such as the Clean Air Act of 1970, have removed burning as an option. Using gin trash as a livestock feed is done to an extent, but there is some concern regarding chemical residues.

Another option in the disposal of gin trash is to spread it directly on the fields. Returning the organic material and nutrients can be beneficial, but certain problems might occur when spreading raw gin trash onto fields. Weed seed and disease, particularly Verticillium wilt, may be introduced to or increased in fields when spreading raw gin trash. The removal of these two potential problems makes the spreading of gin trash much more attractive.

An effective method of handling gin trash and reducing the problems associated with weed seed and disease organisms is to compost the material. With adequate moisture, approximately 70%, the heat generated in the composting process can be sufficient to kill weed seed (140 F for 10 days) and disease organisms (145 F for two days) (Alberson and Hurst, 1964; Griffis and Mote, 1978b; Parnell et al., 1980). Commercial contained-composting-systems have demonstrated this. However, the high cost of commercial contained-composting-systems tends to be prohibitive, so alternative composting methods have been investigated.

Windrow-composting-systems can generate the necessary heat if there is adequate volume, moisture and aeration. The aeration is usually provided by turning the composting material with some type of implement. In the humid Southern region, rainfall could conceivably supply sufficient water for initial wetting of the gin trash as well as keeping it moist for the duration of the composting process. This would eliminate a wetting step and make the overall process cheaper.

Recently, new gin trash handling methods have been developed. The Lipsey®-gin-trash-composting-system requires the compost to stay in place. The compost pile is formed in a circular pattern by rotating back and forth around a pivot point (Fig 1. top view). The rotation motion is at a constant speed so the thickness of gin trash deposited on top of the compost pile is a function of 1) amount of trash in un-ginned cotton, 2) rate of ginning and 3) current depth of compost pile (as the sides are slanted as shown in Fig. 1 side view). Uniform wetting throughout the pile is facilitated by wetting the gin trash as it is delivered to the top of the compost pile. The resulting compost pile has layers of various thicknesses that are applied at varying rates. Thus, the zone of aeration is controlled by the depth from an outside surface and the duration of the compost at this depth.

Experiments were conducted to evaluate certain aspects of windrow-composting-systems and the Lipsey® system.

MATERIAL AND METHODS

Experiment 1

In March 1977 gin trash from Mann's Gin in Lee County, Arkansas, was placed in windrows for composting. A typical windrow is approximately 40 ft long, 4.5 ft at the base, 2 ft across the top and 1.33 ft tall. The experimental design was a randomized complete block with five replications. The treatment design was a split-split plot. The main plots were timing of turning of the windrow with a root rake. Main plot treatments included 1) turned weekly or 2) turned when the temperature 6 in. below the surface reached 80 F. Main plots were split with half receiving 4.2 lb of nitrogen (N) per plot as a commercial fertilizer and the other receiving no N. The N-treated plots were then split and one-half of each plot inoculated with Roebic™ aerobic inoculum. Temperatures at 6 in. from the windrow top surface were taken daily until mid-April when composting was complete and were used to evaluate the benefit of additives in the composting process. Rainfall was the only water received by the compost piles.

Composite samples were collected before and after composting and analyzed for nutrients and selected chemicals.

Experiment 2

Composting plots were established in Lee County, Arkansas, during November 1978 to evaluate aeration methods. Two implements were compared for effectiveness of turning a windrow–a root rake and a modified combine

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(Lalor et al., 1978). The experimental design was a randomized complete block with four replications. Treatments consisted of turning the compost weekly and every two weeks by each machine. Moisture was monitored. Those plots turned with the combine had water added to the compost pile to adjust moisture to circa 70%. The plots turned with the root rake received only rainfall for wetting the compost pile. Effectiveness was determined by measuring internal temperatures as in Experiment 1.

Experiment 3

In February 1995 three gin trash compost piles that were formed during the fall of 1994, using the Lipsey® gin trash composting system, were selected for sampling and evaluating weed seed germination. Two compost piles were located in Phillips County, Arkansas, and one in Crittenden County, Arkansas. In Phillips County samples were taken from both piles to a depth of 30 in. in 6-in. increments from the surface using a bucket. Approximately 2.5 gallons of compost was removed from each depth increment in each pile for subsequent analysis for chemicals and organisms.

The compost pile in Crittenden County was sampled using a front-end bucket loader to cut into the pile 10 to 15 ft. Again, approximately 2.5 gallons of compost was collected at 5-in. increments from the compost surface to a depth of 48 in. for subsequent analysis by grabbing material from an 8-ft-long vertical face.

All samples from each location were stored in plastic bags and kept at room temperature until they were taken to the University of Arkansas at Fayetteville within one to two weeks after collection. The samples were divided into two sub-samples of approximately 1 gallon each. The subsamples were placed in containers measuring 16 in. long by 12 in. wide by 2 in. tall. The containers were placed in a greenhouse for 10 weeks. The compost in each container was kept moist and stirred every two weeks. Observations were made two to three times weekly on the number and weed species that germinated. Chemical composition was determined for N, C, P, K, Ca and Mg. The pH was also measured.

RESULTS AND DISCUSSION

Experiment 1

Neither use of a starter aerobic inoculum (Fig. 2) nor addition of N (Fig. 3) was needed to initiate the composting process. Regardless of treatment, temperatures were similar over the composting period. This indicated that no addition of inoculum or N was needed for proper composting to occur. These findings agree with those of Griffis and Mote (1978a). Heating criteria for turning the pile gave slightly higher internal temperature than just turning weekly (Fig. 4). Neither method resulted in temperatures high enough or long enough to kill Verticillium wilt fungi or weed seeds. Weeds observed growing on top of the windrows after composting was complete were annual bluegrass (*Poa annua*), large crabgrass (*Digitaria sanguinalis*), purple nutsedge (*Cyperus rotundas*), yellow nutsedge (*Cyperus esculentus*), pigweed (*Amaranthus* spp.), morningglory (*Ipomoea* spp.), horsenettle (*Solanum carolinense*) and prickly sida (*Sida spinosa*). Reproductive characteristics of certain weeds listed above make it obvious that the seed were mixed with the compost during the turning process rather than being delivered in the gin trash.

The nutrient analysis of gin trash samples is shown in Table 1 as total analysis and soil test analysis. The pH levels remained below 7, indicating aerobic composting conditions. Higher pH levels would indicate anaerobic composting that favors the conversion of N to ammonia. High temperatures enhance the volatility of ammonia (Golueke, 1972).

We observed that using natural rainfall for wetting resulted in channeling of water through selective pathways in the compost pile. As a result, some of the material was very slow in wetting and did not necessarily go through a heat. These pockets of dry material were mechanically incorporated with wetter compost during the turning process.

Experiment 2

Due to the non-uniform wetting, a modified combine (Lalor et al., 1978) that would mix and wet a windrow uniformly was built. The modified combine accelerated the composting process, as evidenced by increased early composting temperatures (Fig. 5). The temperatures were still not high enough or long enough to kill weed seeds and wilt organisms 6 in. below the compost pile surface.

Weekly mixing moves materials from the outside of the compost pile to the inside where heat can be accumulated. This should result in temperatures high enough and long enough in duration (140 F for 48 hr) to kill Verticillium wilt organisms and weed seeds between weekly turnings. Assuming that 50% of the pile is wet enough to generate sufficient heat, complete weekly mixing provides sufficient aeration and carbon supply for the composting organisms to function. After each mixing, the reduction in the compost volume containing viable diseases and weed seeds should be halved. Therefore, 15 mixes or weeks would be required to produce a 99.99% compost with essentially no weeds or diseases, which is about twice as long as it took our composting operation to be completed. Hence, a different method other than windrow-composting with mechanical mixing will be necessary.

Experiment 3

No viable weed seeds were detected from the compost samples obtained from the compost piles made by the Lipsey® composting system. Two months after the ginning season, temperature within the pile was too hot for more than 10 to 15 seconds contact with the bare hands. Since no weed seeds germinated in our greenhouse test, it appears that the weed seed viability was destroyed from the heat of composting. The outside of the pile, which had not gone through a heating process, had several weeds growing on it. This might be easily sterilized using a solar technique, such as covering the entire pile with a sheet of black plastic for a few days.

The carbon/nitrogen ratio (C/N) tends to increase at the deeper sampling depths, indicating an anaerobic composting process with a possible loss of N as ammonia (Table 2). The pH levels being greater than 7 at depths greater than 6 in. confirm anaerobic conditions. The anaerobic composting process appears to generate sufficient heat for sterilization but will result in a compost of a fibrous consistency with a bad odor.

CONCLUSIONS

The results presented here indicate that the windrow composting system does not solve the two problems of Verticillium wilt or weeds associated with gin trash. Otherwise, the compost obtained is quite satisfactory as a product. The Lipsey® composting system produced a compost pile whose outer layer had problems with weed seed and Verticillium wilt survival. These problems could be easily eliminated by using a solar sterilization process consisting of covering the pile with a continuous sheet of plastic. Otherwise, the composting process turns anaerobic within a couple of feet of the surface, resulting in incomplete composting and in offensive odors.

LITERATURE CITED

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Table 1. Analysis of gin trash used in 1977 experiments.

Total Analysis	N	P	K	Ca	Mg	Na	Zn	Fe	Mn	As	pH
	%						ppm				
Before Composting	1.66	0.29	0.78	1.90	0.34	0.05	41.0	2218	343	2.0	6.9
After Composting	1.04	0.14	0.52	0.51	0.21	0.02	-	1280	313	-	6.2

Soil Test Analysis	Nitrate-N	P	K	Ca	Mg	Na	EC	pH
	lb/acre						µmhosx10^3	
	1620	160+	2740	1699	710	193	1.4	6.2

Table 2. Chemical analysis of compost from a Lipsey® system for handling gin trash in Phillips County (PC) and Crittenden County (CC), Arkansas.

Depth from	N		C		C/N		P		K		Ca		Mg		pH	
compost surface	PC	CC	PC	CC	PC	CC	PC	CC	PC	CC	PC	CC	PC	CC	PC	CC
in.	%															
0-6	4.0	4.0	26.70	30.2	6.8	7.5	0.6	0.4	0.6	0.5	2.6	2.2	0.6	0.4	6.2	5.6
6-12	4.5	4.0	29.20	13.7	6.4	6.2	0.7	0.6	2.1	2.4	2.5	2.2	0.8	0.6	7.0	7.8
12-18	3.9	3.9	29.70	31.1	7.7	8.0	0.8	0.6	1.6	1.9	2.8	2.2	0.7	0.6	7.4	7.5
18-24	4.0	3.9	32.40	27.1	8.0	6.9	0.6	0.6	1.6	2.3	2.9	2.3	0.6	0.6	8.0	7.7
24-30	4.0	4.1	31.50	29.7	8.0	7.2	0.6	0.5	2.3	1.7	2.7	1.7	0.7	0.5	7.3	6.9
30-36	3.9	3.5	36.50	28.7	9.4	8.3	0.6	0.6	2.8	1.9	2.5	2.9	0.7	0.6	7.0	7.7
36-42	-	3.3	-	34.1	-	10.5	-	0.6	-	1.8	-	2.9	-	0.6	-	7.3
42-48	-	2.7	-	36.1	-	13.1	-	0.5	-	1.9	-	2.7	-	0.5	-	7.6

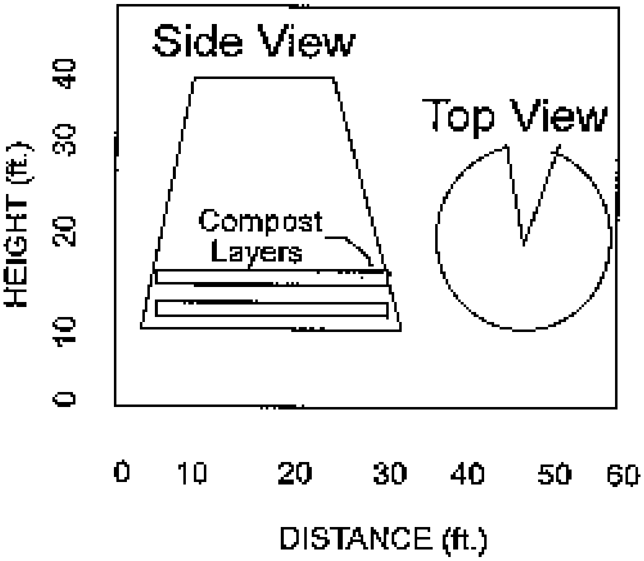

Fig. 1. Schematic diagram of a Lipsey™ compost pile.

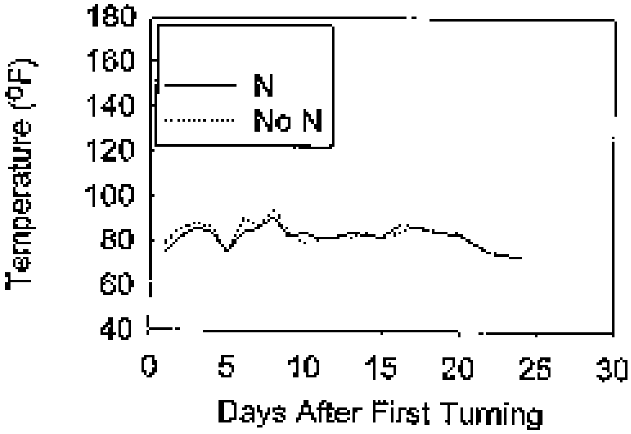

Fig. 3. Influence of N additions at the rate of 4.2 lb/48 ft of windrow on the composting temperature at 6 in. from the surface.

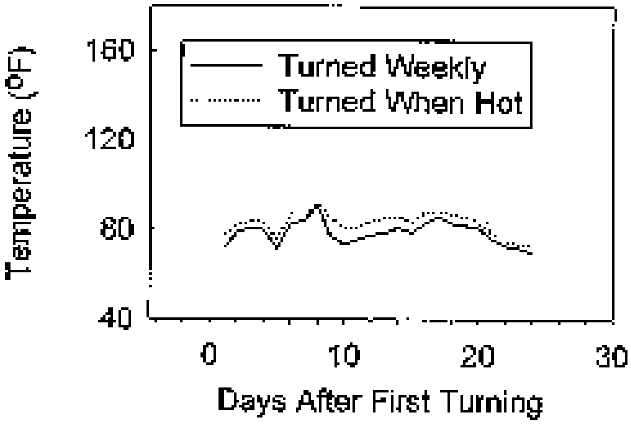

Fig. 4. The influence of turning regime on the composting temperature at 6 in. below the surface.

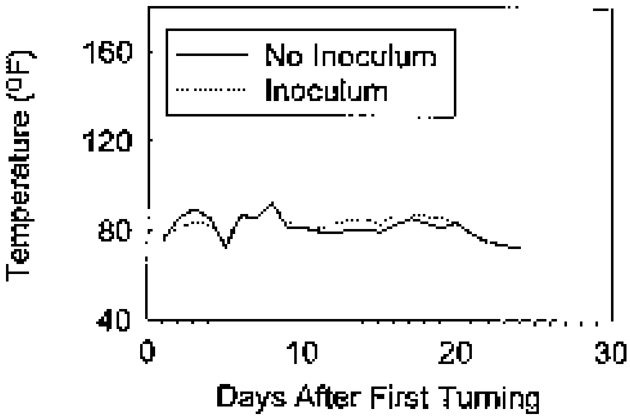

Fig. 2. Influence of starter inoculum on the composting temperature at 6 in. from the surface.

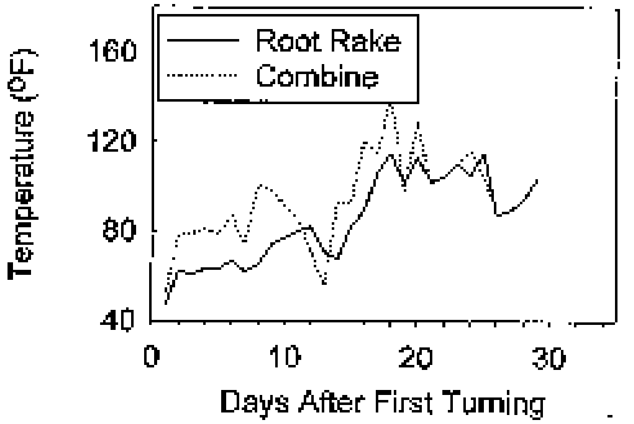

Fig. 5. The influence of turning machine on the composting temperature at 6 in. from the surface.