Effect of Various Feedstocks on Compost Properties and Use

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Composting is a natural biological process which results in the degradation of organic waste to a stable end product, commonly referred to as compost, which can be utilized for various agricultural purposes. Increasing landfill costs and regulations which limit many types of waste accepted at landfills has increased interest in composting as a component of waste management (Goldstein and Spencer, 1990, Goldstein, 1991). Composition of waste varies from yard waste, municipal solid waste (MSW), source separated MSW, agricultural production and processing waste and various other industrial organic waste. With such diversity in waste products coupled with variation in the composting processes one would expect extreme variability in the chemical and physical properties of final product as reported by (Cook et al. 1994; He et al. 1992; Bugbee, 1994; Elwell et al 1994).

The variability in physical and chemical properties of composts resulting from different feedstocks and processes may account for the inconsistent results from the use of compost as reported by Cooke, 1979. There are relatively few studies which have considered the composition of the waste stream when determining compost performance or compared composts from totally different feedstocks. Cook et al 1994, evaluated the influence of disposable diaper content of the waste stream on properties of compost and Bugbee 1994 compared the effects of three different feedstocks on the response of Rudbeckia growth in compost from these feedstock. These results suggest that compost derived from various feedstocks can be effectively used to enhance soil productivity and as amendment in greenhouse and container growing media. However, as is the case with different soil types and fertilizer materials, it is essential that the properties of each type of compost be understood and that appropriate management systems be used. Utilization information is not generally available for composts formed from different waste streams, such as municipal solid waste (MSW), source separated MSW (SSMSW), wastewater biosolids - wood waste (WB), and fish waste (FW) (Brinton and Seekins, 1994).

The objectives of the research reported herein was to compare the chemical and physical properties and agricultural value of composts formed from several organic waste materials.

Feedstocks Composting Processes

Municipal solid waste (MSW), MSW + wastewater biosolids (CC), selected loads of restaurant waste (RW), and mixed paper + urea 3# N/yd^3 (MP), from the same waste stream was windrow composted for 56 days using a Wildcat 700 compost turner and allowed to mature for another 42 days prior to sampling for laboratory analyses. Fish processing waste + wood chips (FW) was composted using an aerated static pile system for 36 days and matured for an additional 42 days. Wastewater biosolids + woodchips (WB) was composted for 29 days and matured for an additional 30 days. All composts were screened through a ½ inch screen for analyses and utilized for various crops to be described. With the exception of CC and WB, which had slightly elevated SS, all composts met state and federal regulations for high quality - unrestricted use.

Results and Discussion

Laboratory analysis of composts from six different feedstocks are presented in Table 1. Elemental composition of composts varied according to the feedstock. The co-compost was significantly higher in N, S, Cu, Zn, Pb, Ni, Cr, Na, and Cl and had a higher salt index than the MSW from the same waste stream. Source separated components of the waste stream RW and MP composts also varied considerably from the mixed waste with RW having a higher N, P, K, Fe, Pb and Na content. Mixed paper waste compost was generally lower in elemental content except for the heavy metals, had a lower salt index and significantly lower bulk density. With EPA estimates of 40-45% of the waste stream consisting of paper products this component has the potential for being a controlling factor in determining the chemical and physical properties of MSW compost. Restaurant waste, FW and WB compost had a higher primary nutrient content, similar in micronutrient and with the exception of Cr in the WB compost were lower in Pb, Cd, Ni than the MSW, CC, RW or MP composts.

Table 1. Properties of compost from selected feedstocks. Municipal solid waste (MSW), MSW + wastewater biosolids (CC), restaurant waste (RW), mixed paper + urea (MP), fish processing waste + woodchips (FW), and wastewater biosolids + woodchips (WB) (on dry weight basis).

	Feedstock Source					
Element	MSW	CC	RW	MP	FW	WB
	%					
C	24.5	37.4	18.7	5.30	39.2	39.8
N	0.8	1.38	1.6	0.29	1.48	1.75
P	0.6	0.30	1.0	0.07	0.27	0.63
K	0.5	0.7	1.1	0.28	0.22	0.31
Ca	2.7	2.60	2.3	0.42	1.10	1.56
Mg	0.4	0.3	0.6	0.31	0.16	0.19
S	0.07	0.56	0.4	0.04	0.14	0.34
Fe	3.93	1.24	4.03	0.09	1.19	0.94
Al	3.14	1.61	2.76	0.11	0.81	0.92
	mg kg^{-1}					
B	66.7	35.3	66.0	37.6	18.0	15.0
Mn	648.0	233.7	435.1	136.5	315.0	628.7
Cu	68.6	80.0	98.3	119.8	69.9	119.2
Zn	135.0	582.7	256.0	165.0	166.7	306.0
Ph	39.3	132.0	230.1	195.3	56.0	24.0
Ni	19.0	32.0	18.1	87.1	6.0	9.7
Cd	1.7	1.9	1.8	2.1	0.7	1.1
Cr	19.0	43.7	21.3	6.4	22.0	92.7
Na	690.0	6306.7	1085.0	321.2	248.3	275.0
Cl	370.0	5733.3	420.0	<200	<200	413.3
	m mhos cm^{-1}					
Soluble Salts	8.0	16.2	9.1	5.0	8.6	10.1
	g cc^{1}					
Bulk Density	0.53	0.49	0.60	0.39	0.45	0.51

Bluegrass-turf fescue grass was seeded on 1.5 inches of MP, MSW, and RW compost in a greenhouse trial. The compost received no fertilizer amendments for the first 45 days at which time soluble fertilizer 20-20-20 at three concentrations - 50, 100, or 200 ppm was applied on a weekly basis. Germination was excellent in all three composts. However, tip burn of plants occurred in the RW compost due to the relatively high soluble salts levels but did not affect growth as shown in first clipping at 45 days (Figure 1). Growth up until the first clipping reflected the primary nutrient value of these composts. During the second growth period the grass growing on MP compost was variable in growth with no significant response to the fertilizer treatments. Grass growing on MSW compost responded to each level of fertilizer treatment while that growing on RW received adequate nutrients from the compost and did not respond to additional fertilizer (Figure 1). At the time of the third clipping salts levels in the RW compost had increased, at the two higher fertilizer rates, and resulted in a significant growth reduction.

Following the third clipping the dry weight of four inch square plugs taken from the root system were not significantly different at the two higher rates of fertilization for grass growing on MSW or RW (Figure 2). Mixed paper compost resulted in poorer growth than the other two composts which may have been due to excessive moisture retained by this media as dead roots were observed at time of harvest.

In a second grass seeding MSW, FW and WB composts were compared at lower fertilizer application rates of 0, 50, and 100 ppm applied weekly after the first clipping. At the time of first clipping, taken 19 days after seeding, there was no significant difference in the dry weight of clippings (Figure 3). However, the second clipping, taken at 48 days after seeding, the dry weight of grass grown on MSW compost was significantly greater than the other sources, and fertilization rates increased yield of grass growing on WB and MSW compost but not on the FW compost. At the third clipping, 92 days after seeding, the dry weight of grass grown on WB compost was greater than the other sources and also responded to increasing fertilizer application rates. The rate of mineralization of compost from different feedstocks is being investigated but such difference may account for growth differences observed and to the type of response to fertilization.

Peat moss represents a significant cost of greenhouse and container grown nursery stock growing media. Compost substituted for peat moss in these media could represent considerable savings to growers. Schefflera grown in pine bark-peat or pine bark-MSW compost media at 0, 25, 50, 75 or 100% MSW compost or peat with weekly applications of 200 or 400 ppm N-P-K from 20-20-20 fertilizers resulted in higher rate of growth when grown in the compost containing media than in the peat moss containing media (Figure 4). There was a significant interaction between the compost and fertilization which resulted in a decreasing growth at compost rates exceeding 50% of the growing media. Although there was no increase in growth rate in peat moss containing media above 50% peat the decrease due to fertilizer rate did not occur in these media (Figure 4).

Rooted cuttings of 'Fire Power' dwarf nandina were set April 6, 1993 in media composed of pine bark and municipal solid waste compost containing 0, 25, 50, 75 or 100% compost with rates of 5, 10, or 15 lbs/cu yd of 18-6-12 osmocote slow release fertilizer blended with the media prior to setting and topdressed with the same rates on July 8, 1993. Increasing the percentage of compost in the media increased plant growth and quality with highest ratings occurring with the media containing 75% compost followed by 100, 50, 25 and 0% compost (Figure 5).

The 15 lbs/cu yd rate of fertilizer application reduced growth in all media. In the 0, 25, and 50% compost media the reduced growth was due to high soluble salts and resulted in severe leaf scorch. However, reduced growth differences at the 15 lbs/cu yd in the 75% and 100% compost media were not significant and no visual symptoms of damage occurred. This difference in salt damage may be due to the higher buffering capacity of the higher percentage compost media. Fall color development was delayed at the highest level of fertilization in all treatments and at higher rates of compost amendment.

Rooted cuttings of dwarf nandina set March 31, 1994 in pine bark-compost media containing 0, 25, 50, 75, or 100% WB or FW compost received 5, 10, or 15 lbs/cu yd of osmocote 18-6-12 slow release fertilizer. Marketable plants were rated for growth quality August 1994. Media containing either WB or FW compost produced higher quality plants than a standard nursery media. All media containing WB compost produced superior quality plants to those in FW compost (Figure 6). Response to fertilizer rates was dependent on the composition of the media. No significant response to fertilizer occurred in the FW containing media. However, with WB compost media a

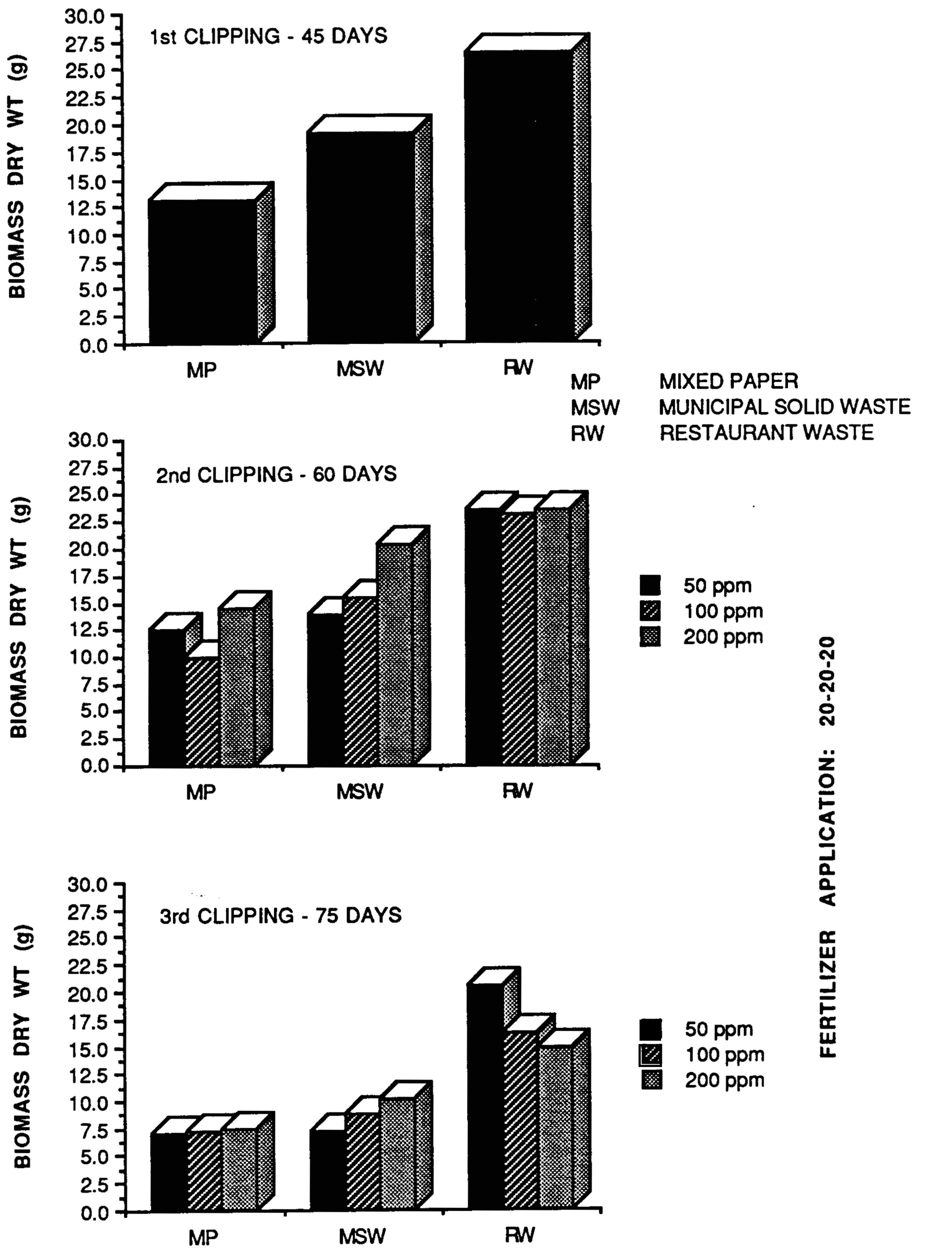
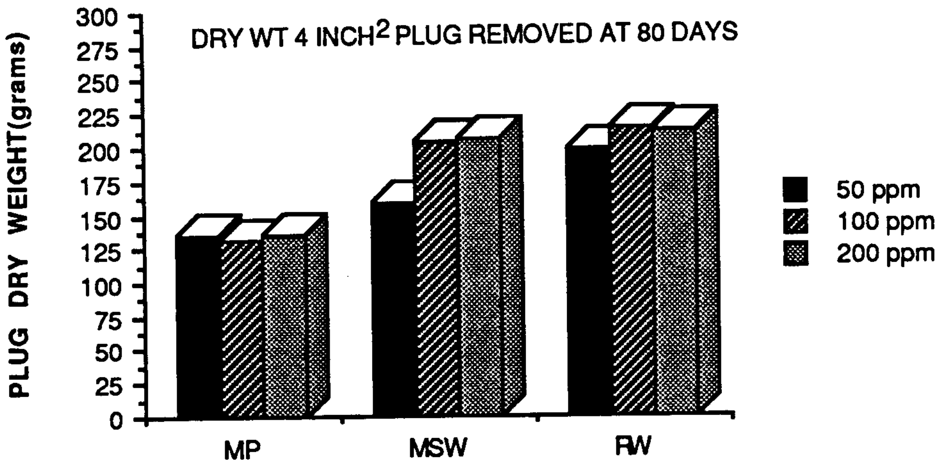


Fig. 1. Effect of compost derived from three feedstock sources and fertilizer rates on topgrowth of bluegrass/fescue sod.



MP	MIXED PAPER
MSW	MUNICIPAL SOLID WASTE
RW	RESTAURANT WASTE

FERTILIZER APPLICATION : 20-20-20

Fig. 2. Effect of compost derived from three feedstock sources and fertilizer rates on root growth of bluegrass/fescue sod .

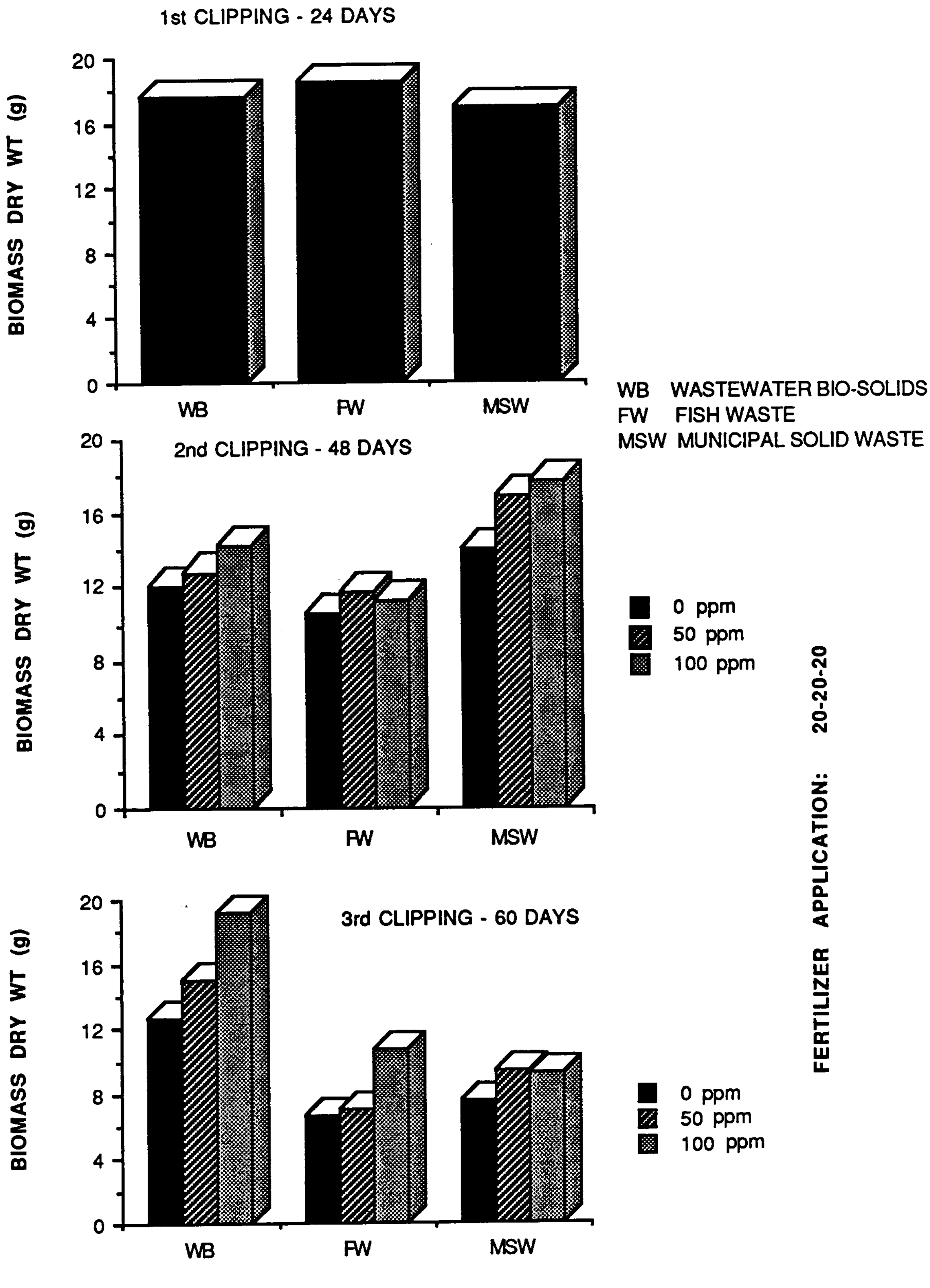


Fig. 3. Effect of compost derived from three feedstock sources and fertilizer rates on topgrowth of bluegrass/fescue sod.

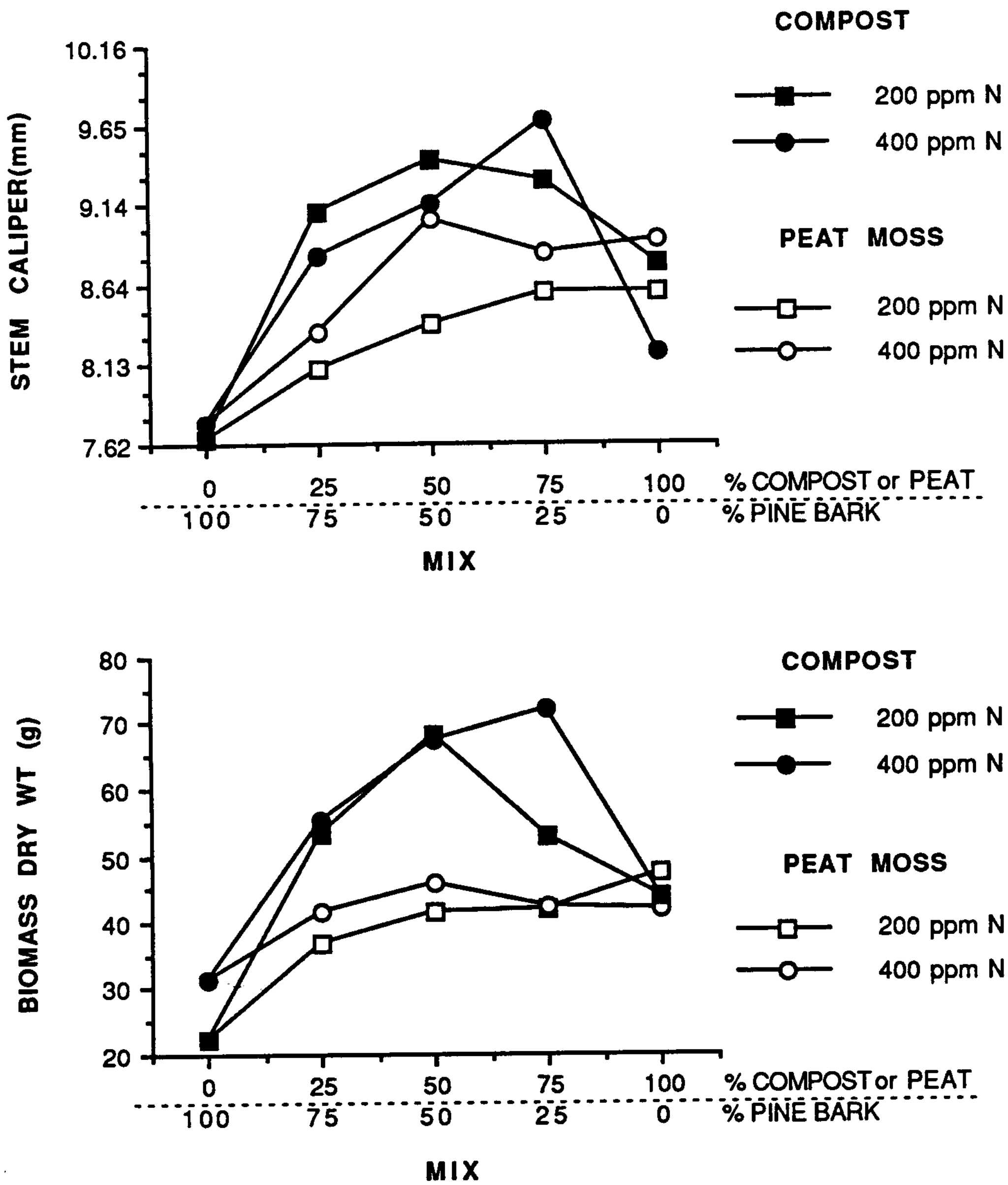


Fig. 4. Effect of compost (MSW) vs. peat moss in media at 2 levels of weekly fertilization on growth of schefflera.

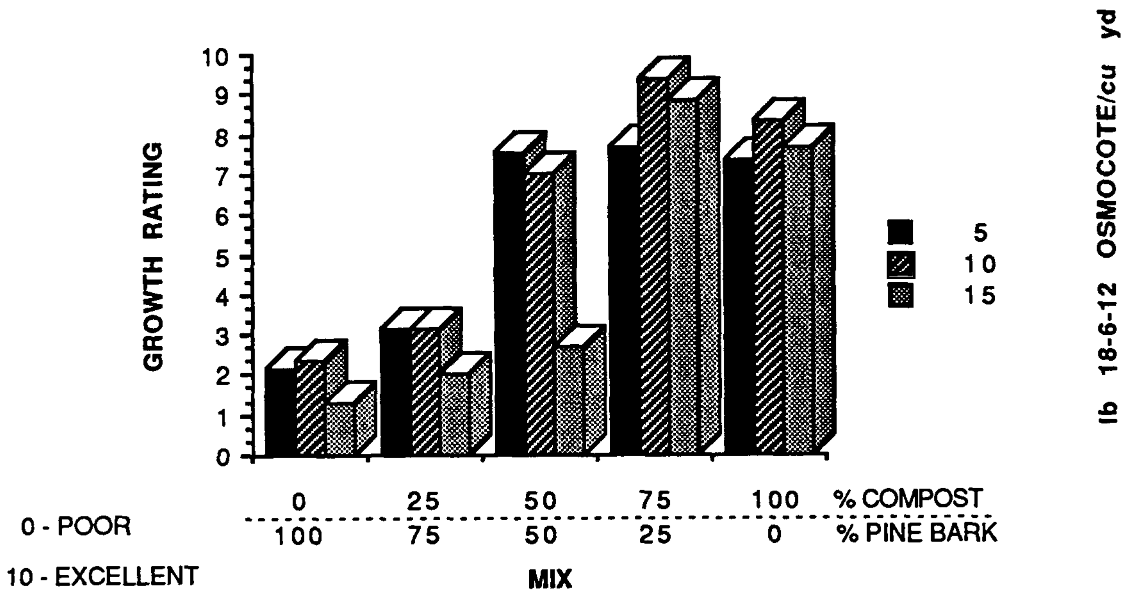
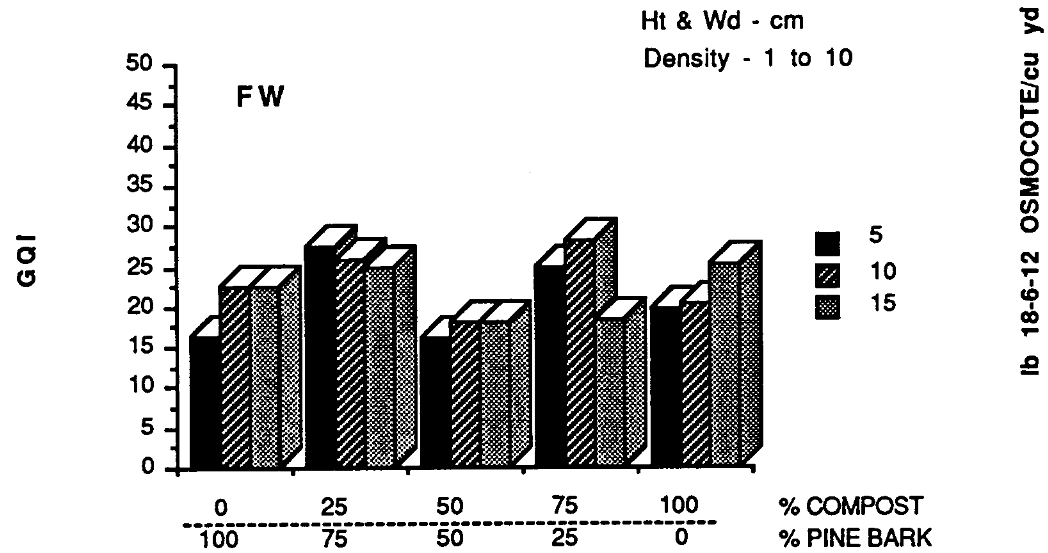


Fig. 5. Effect of MSW compost amended media and fertilizer rates on growth of dwarf nandina.



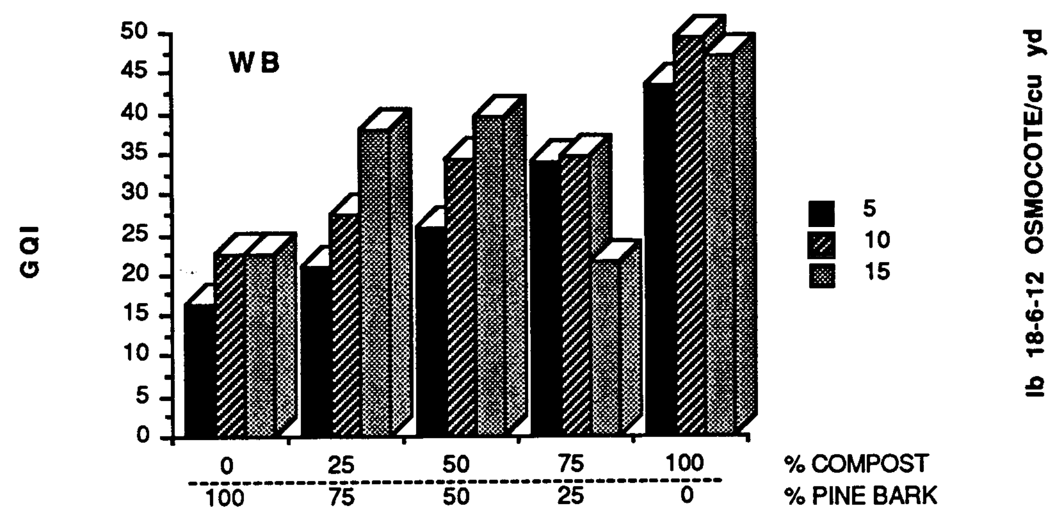


Fig. 6. Effect of FW or WB compost ammended media on GQI (growth quality index) of dwarf nandina at 3 levels of fertilization.

positive growth response occurred with 50 percent or less compost and no response in 100% media. The rates of mineralization of WB compost supplied adequate nutrition at the lowest fertilizer rate.

The nature of growth responses occurring with different crops are consistent with chemical analyses of composts from various feedstock sources. Greenhouse, turf, and nurserymen could benefit from the use of compost. Each of these potential end users will have specific compost quality needs. The quality and composition required for each compost type must be established and must be consistent and readily available for the establishment of these markets.

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