Production of Bark Compost and Its Application to Agriculture and Forestry

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Wood residues in lumber industry in Japan amount to more than 8 million tons annually, including bark, sawdust, and chip dust, etc. Most of them are burnt or abandoned, causing a source of public nuisance. On the other hand, as the heavy application of chemical fertilizers with decreased amounts of composts and stable manures has continued since after the War, soil deteriolation and reduced soil fertility become a serious problem in recent years, with a renewed recognition of the importance of organic fertilizers. Reflecting such a situation, the production of dark compost has come to be undertaken in a large scale in paper manufactories, pulp and chip factories as well as saw mills. The production of bark compost has increased from year to year, and in 1976 it reached about 250,000 tons in scores of factories.

Method of production

For the bark compost production, the thermophilic fermentation method developed in the Government Forest Experiment Station is being used. As barks have extremely high C : N ratios, i.e., 200–400, direct application of barks causes nitrogen starvation of plants. Barks are also lacking of K_2O and P_2O_5, and contain growth-inhibiting substances like phenolic acids, tannins etc. Therefore, it was made possible to produce good quality composts by supplying nitrogen and other nutrients, by inducing thermophilic fermentation and at the same time by removing growth-inhibiting substances.

The procedure of producing bark compost in factories is given in Fig. 1. Major materials to be used are barks of domestic hard woods or foreign soft woods. In many cases, they are piled up out doors for several months to several years to decompose them considerably, and then used, because fresh barks cause the low efficiency in grinding and require the long duration in making compost. As the supplemental materials, micro-organisms, chicken-dropping as a source of decomposer nutrients, and urea as a nitrogen source are used. Dried chicken-droppings are easily available in Japan, because of recent large-scale poultry production. The dried chicken-droppings have high contents of N, P_2O_5, K_2O, CaO and MgO etc., and are available in the market. As the content of P_2O_5 is close to that of N in the

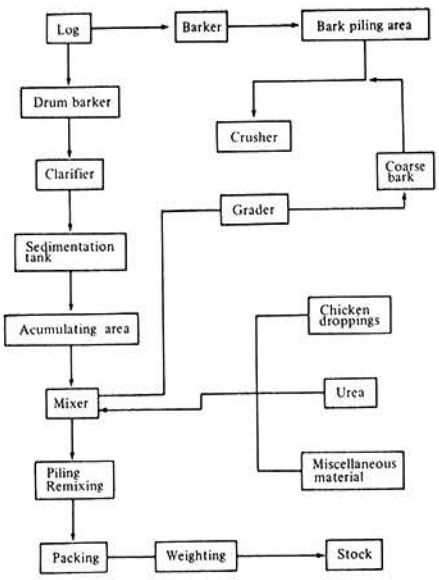

Fig. 1. Shematic modei of bark compost production in factory

dried chicken-droppings, the urea addition is made to give a well-balanced proportion of N to P_2O_5 in the material as a whole. In some cases, specific decomposing microorganisms are added to promote the compost-making, but the addition of chicken-dropping alone is good enough.

A standard of mixing these materials is 50 kg of dried chicken-dropping and 10 kg of urea to 1 ton (about 2 m^3) of bark. The bark crushed to a particle size less than 10 mm, preferrably 3–5 mm, is mixed with chicken dropping and urea, and water is applied to give a 55–60% moisture content (water exudes when squeezed by hand). The mixed material thus prepared is transported to the heaping place by shovel loader.

The heaping of the material is made in the heaping frame consisted of concrete floor with concrete-block walls at three sides (4 m front, 10–20 m in depth and 2–3 m in height), steel skeleton and slate roof. Outdoor heaps have to be covered by vinyl sheet to avoid the effect of rainwater. Following the heaping, temperature rises due to the heat of fermentation, and after 4–5 days it reaches 40°C near the surface and 60–75°C in the central portion of the heap. Then, the temperature begins to lower gradually with time. It occurs due to the water loss caused by high temperature, poor aeration caused by natural setting-down of the material, and the consumption of nutrients by microorganisms. At 2–3 weeks after the heaping, the first re-mixing of the material is made with the purpose of assuring a homogeneous product by promoting fermentation of immature portions and of replenishing water as well as improving aeration. To do the re-mixing, water is sprayed to recover the moisture content of the material to the initial level, and the material is repiled up in another heaping frame by using shovel loader.

After the re-mixing, temperature rises again and drops following the same trend as in the first heap. The re-mixing is repeated for 3–4 times with an interval of about 3 weeks, and the thermophilic fermentation is completed in about 3–4 months, i.e., no high temperature occurs if further re-mixing is done. After that, the heap is left as it is for the following 1–2 months for maturing. During the maturing period, temperature at the central portion of the heap is kept at 30–40°C, by repeating 1–2 times of re-mixing and adjusting moisture content when needed. During the period of thermophilic fermentation, thermophilic cellulose-decomposer and some actinomycetes carry out their works, but in the maturing stage the decomposition by mesophilic bacteria, fungi, and actinomycetes proceeds. When the maturing is completed, the product is bagged (20 kg) for shipment.

Composition and property of bark compost

Composition and property of bark compost, produced by the above method, are shown in Table 1. The bark compost is regarded excellent, having higher content of fertilizer nutrients, and higher CEC with greater nutrient-holding capacity than popular straw composts.

Being coarse granules with great mechanical strength, the bark compost is very effective in improving physical property of soil: it develops coarse pores in soil and increases aeration and water percolation of soil. In contrast to straw compost which disappears by decomposition

Table 1. Comparison of chemical property and composition of bark and straw composts

	Moisture content %	pH (H_2O)	C %	N %	P_2O_5 %	K_2O %	CaO %	MgO %	CEC me/100 g	Max. water holding capacity %
Bark compost	60	6.0~7.5	45	1.2~1.5	0.5~1.0	0.5	2.5~4.0	0.5~1.0	80	300~500
Straw compost	65~80	6.5~7.5	45	0.5	0.3	0.6	—	—	50	500~700

within one crop reason or one year, the bark compost remains for 3–4 years due to its slow decomposition, and hence it is appreciated as soil amendment material.

Use of bark compost in agriculture and forestry

At present, the bark compost is widely used for various purposes in agriculture and forestry, in Japan, and its consumption is increasing from year to year. There is a great demand in tobacco cultivation, greenhouse culture of vegetables and ornamental plants, both of which have required so far a large amount of leaf mold, and as the material for basal dressing in new planting of fruit trees and for mulching in orchards and tea gardens. In addition, it is used as the material for soil dressing to lawns as well as for establishing golf courses and parks. In recent years, it was found that the bark compost has remarkable effectiveness as a soil amendment material to tree lands newly established in and outskirts of big cities, and in the use for root-prunning works prior to the transplanting of trees (adult) in green belts and for rejuvenating old trees. Thus, the usefulness of the bark compost is being expanding.

Methods and amounts of application to the above-mentioned crops are shown in Table 2.

Conclusion

The bark compost, which has come to attract a wide attention as a new organic manure, still has a number of problems to be solved. The market price of bark compost produced by the above method is 15,000–20,000

Table 2. Methods and rates of bark compost application

Application		Rate	Method
Field, Greenhouse		3～5 kg/m²	Broadcast and/or plow into soil
Paddy field		0. 5～1 t/10 a	Ibid.
Tobacco field		1～1. 5 t/10 a	Ibid.
Forest nursery		3～5 t/10 a	Ibid.
Orchard:	Planting	30% of planting hole (volume)	Mix with soil of planting hole
	Adult	2～3 t/10 a	Mulch and plow into top soil next year
Tea garden:	Planting	7～10 kg/m²	Ibid.
	Adult	2～3 t/10 a	
Lawn:	Maintenance	3～5 kg/m²	Broadcast
	Establishment*	40～60 kg/m²	Mix with soil
Transplanting of tree:			
	short	5 kg/stand	Mix with soil of planting hole
	medium	10 kg/stand	
	tall	20～50 kg/stand	
Rejuvenation of weakened old tree		2～3 t/stand	Plow into surrounding top soil and mulch 5～10 cm in thickness
Flower-bed		20～30 kg/m²	Broadcast and mix with top soil
Flower-pot		20～50% of pot volume	Mix with soil

Remark: Establishment of green golf links.

Yen per ton, which seems to give an impression that the bark compost is considerably expensive to the farmers who have so far produced their composts by themselves. In addition, more cost is needed for the transportation because the bark compost contains more moisture than traditional composts. Distance of about 150 km from the compost factory is regarded a limitation of transporting bark compost. Therefore, the full consideration will have to be paid to achieve the rational distribution of factories and improved marketing systems.