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Earthworms - Surprising Partners in the Creation of Fertile Soils

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While most soil-dwelling creatures are micro- scopic, most gardeners are aware of the presence of earthworms. Gardeners are aware, too, that a healthy earthworm population is a well-recognized indication of a productive soil. Most people, however, are not aware that what they generally call “worms” are really several distinct species. Further, in North America and several other parts of the world, the most familiar and productive species are not even native, but have been unintentionally introduced from southern Europe and other earthworm “hearths.”

The earthworm story is a fascinating one. An outline of the role played by the earthworm has been developed by scientists, yet its role is nevertheless clouded by a fair amount of conjecture and controversy. Much remains to be learned about the relationship of these prolific creatures to healthy soils, as well as the development of effective techniques for enhancement of their agricultural environments.

EARTHWORM HISTORY

Jerry Minnich, in The Earthworm Book (1977, Rodale Press, now out of print), provides a historical overview which indicates that at the end of the last Ice Age, some 10,000 years ago, earthworm populations had been decimated in many regions by glaciers and other adverse climatic conditions. Many surviving species were neither productive nor prolific. In places where active species and suitable environments were found, such as the Nile River Valley, earthworms played a significant role in agricultural sustainability. While the Nile’s long-term fertility is well known and attributed to rich alluvial deposits brought by annual floods, these materials were mixed and stabilized by valley-dwelling earthworms. In 1949 the USDA estimated that earthworms contributed approximately 120 tons of their castings per year to each acre of the Nile floodplain.

In Europe we find the original home of some of our most common and productive earthworm species, Lumbricus rubellus (the red worm or red wiggler), Eisenia foetida (the brandling or manure worm), Lumbricus terrestris (the common night crawler), and Allolobophora ealignosa (the field worm). The first two species are the major ‘‘earthworms of commerce, whose ideal living environments are manure or compost heaps. The night crawler and field worms, on the other hand, both prefer grasslands and woodland margins.

Under suitable conditions the productivity and “reproductivity” of the earthworm are impressive, and during the last 40 years many get-rich-quick worm farming schemes have been advertised. Thousand of people have grown worms for the fishing bait market, as well as for a few other limited uses (not the least of which has been sales of “nursery stock” to new worm growers).

Gardeners and orchardists have been enticed to implant earthworm populations in the hope that these tireless workers will remain and flourish, enchancing soil and plant productivity for an extended period. These hopes, like those of many enterprising earthworm entrepreneurs, remain largely unrealized. The production and use of earthworms has, however, grown steadily, with

perhaps the greatest potential for large-scale utilization in the biological processing of solid wastes. Pilot and commercial sized vermicompostin g plants are operating at this time in several states and foreign countries, particularly Japan.

The real success story of the earthworm is found in the soil-building benefits that these prodigious immigrants have contributed on their own. The advent of European earthworm species made a great difference in soil fertility in North America, first following, and then preceding agricultural development, much as the European honeybee did. Little attention was paid to these subterranean colonists, though, and immigrant farmers took for granted the presence of these agricultural associates. Research in subsequent times has indicated that the impact of imported earthworms has been of major ecological significance. For example, a modern survey of earthworm species in the state of Arkansas (one of very few such surveys to date) revealed that of the 17 species located, 6 were regarded as native, 3 had come from Asia, and 8 had been introduced from Europe. (Causey, David. Journal Series Research Paper No. 1035, University of Arkansas, 1961.)

In New Zealand, where settlement and European-style agriculture came much later than in North America, the rapid spread of European earthworm species was noted by soil scientists. As Jerry Minnich relates, “Hill pastures that could barely support a stand of grass gradually became lush and green, even though no fertilizer was applied. Counts of European earthworms ran as high as 4,300,000 per acre, more than three times the maximum populations of the same species in their Old World habitats.” In 1925, one farmer, observing these welcome changes in nearby valley lands, began a twenty-year program of implanting earthworm- inhabited sods in hillside pastures. New Zealand soil research station scientists evaluated this project in 1949 and found not only richer, more productive soils, but the composition of grass species also changed, with the land now supporting richer forage crops and permanently established worm populations.

Benefits of Earthworms

- Increased moisture absorption
- Improved soil aeration and drainage
- Leaching counteracted by nutrient-rich castings brought to the surface
- Nutrients are pre-digested, making them readily available to microorganisms and plants
- Worm castings form aggregates which improve soil structure
- Castings neutralize soil by buffering acid and alkaline conditions
- Worm tunnels create fertile channels for the growth of plant roots
- The bottom line: Earthworms increase crop yields while building soil fertility reserves.

ENCOURAGING EARTHWORMS

Since these productive worm species have arrived (and they took some time to become established in the forest or semi-arid lands of the Pacific Northwest), how may the farmer or gardener further take advantage of their soil-building abilities? The practicality of implanting

worms has raised considerable debate, with numerous scientifically undocumented ‘‘success stories ‘‘ as well as many failures. Environmental conditions ,soil type, climate, season, etc. must be just right for introduced earthworms to survive and flourish.

Earthworms are implanted by depositing worms or worm-egg capsules in the soil, alone or in a compost or turf medium. Compost or turf provides an initial food source and environmental buffer. Care must be taken, though, that hungry birds or moles don’t swoop in to chow down on the fledgling soil workers. To complicate matters, the species most commonly sold by bait worm farmers, the redworm or red wiggler and brandling, will not survive without large amounts of compostable materials, while supplies of agriculturally important field worms are not readily available.

A good, practical recommendation for attracting earthworms is to apply agricultural lime. The desired field worm, while able to tolerate acidity to pH 5.4, prefers a neutral or slightly alkaline soil. Worms also require some calcium in their diet, and amply repay the farmer’s favor by returning their castings to the soil increased in available calcium by 40% compared to the surrounding soil.

The other primary requirement of the earthworm is ample organic matter. This may be applied as green manure, compost, or mulch. Minimum tillage practices, which include shallow cultivation and incorporation of organic matter into the soil surface, are most effective in providing food and habitat for beneficial earthworms. Another innovative approach for attracting and nurturing worms has been developed in Portland, Oregon by Maryanne Caruthers-Akin, who attracts worms to mulched and moistened planting beds with a solution of molasses spread on the underlying soil. (Her technique is described in detail in her article, “No-Till Gardening Easy and Productive,” in Tilth, Vol. 7, No. 4.)

Bacteria are a key link to providing available soil nutrients to plants. Earthworm castings contain 200% more magnesium, 300% more nitrogen, and over 600% more available phosphorus than the surrounding soil, as well as having 33% greater bacterial population. When these nutrient and biological advantages are combined with the air channels made by the passage of these “intestines of the earth,” the result is practically perfect medium for plant growth.

Charles Darwin was one of the earliest, and certainly the most thorough, researchers to study the ways of the earthworm and its effect on the soil. His book, The Formation of Vegetable Mould Through the Action of Worms, with Observations on Their Habits, was published in 1881, the year before his death. It was the result of studies that Darwin began in college and continued throughout his life.

Darwin and the Earthworm

“Worms have played a more important part in the history of the world than most persons would at first suppose. In almost all humid countries they are extraordinarily numerous, and for their size possess great muscular power. In many parts of England a weight of more than ten tons (10,516 kilo-grammes) of dry earth annually passes through their bodies and is brought to the surface on each acre of land; so that the whole superficial bed of vegetable mould passes through their bodies in the course of every few years... . Thus the

particles of
earth, forming the superficial mould, are
subjected
to conditions eminently favourable for their
decom-
position and disintegration....
"The plough is one of the most ancient and
most
valuable of man's inventions; but long before
he
existed the land was in fact regularly ploughed,
and still continues to be thus ploughed by
earth-
worms. It may be doubted whether there are
many
other animals which have played so important
a part
in the history of the world, as have these lowly
organized creatures."

Charles Darwin, *The Formation of Vegetable Mould Through the Action of Worms*, 1881

Darwin's book was re-published in 1948 and became a pivotal text in the organic agriculture movement. Sir Albert Howard, the founder of modern organic agri- culture, contributed an introduction to the 1948 edition of Darwin's book. In it Howard wrote that, "For some time I had been seeking for the most effec- tive and convincing foundation on which the reformed agriculture of the West could be based and which would, at the same time, direct future agricultural research into biological channels... . Directing attention to one of Nature's chief agents for restoring and maintaining the fertility of our soils.., will do much to establish the truth that Nature is the supreme farmer and gardener, and that the study of her ways will provide us with the one thing we need—sound and reliable direction."

Much earthworm research remains to be done. It has heretofore been limited in scope by the need for cooperative study involving soil scientists, microbiologists, zoologists, and others. Conventional, chemical agricultural methods are responsible for massive destruction of beneficial earthworm populations, and agronomists (partic- ularly in the USDA, which regards the earthworm's role in agriculture with cynicism) have been slow to recognize the proven value of these humble soil builders. Biological agriculture's methods promise to rehabilitate and enhance the living soil community to the benefit of all, "that the earth may feed creatures great and small."