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# Benefits of Vermicast in point form.

## The value of vermicast lies in:

The **plant growth stimulants,** the **cationic exchange rate** and the **soil benevolent biota.**

## Definitions:

**Biota** – Micro-organisms beneficial to the soil.
**Cationic Exchange Rate** – Exchange rate at which trace elements (cationic = positive) are attracted to vegetative matter (anionic = negative).

## Plant growth stimulants:

During the vermicomposting process when organic matter passes through the worm's gut, it undergoes physico-chemical and biochemical changes by the combined effect of earthworm and microbial activities.
**Vermicasts are coated with mucopolysaccharides and enriched with nutrients.** The cellulolytic, nitrifying and nitrogen fixing microbes are found established in the worm cast.
**Earthworms directly cycle the nitrogen** by excretion in the casts, urine and mucoprotein and through the turnover of earthworm tissues.
**Earthworms increase the amount of mineralized nitrogen from organic matter in soil.** The microbial composition changes **qualitatively** and **quantitatively** during passage through the earthworm intestine (Pedersen and Hendriksen, 1993).
**Vermicompost also contained Mg, Ca, Fe, B, Mo and Zn** in addition to some of the plant growth promoters and **beneficial microflora**.
**Several valuable compounds were also produced through the earthworm** – microfloral interaction, which included **vitamins such as B12** and **plant growth hormones such as gibberellins.**
Many researchers have found that **vermicast stimulates further plant growth** even when the plants are already receiving optimal nutrition.
**Vermicomposts** have **consistently improved seed germination, enhanced seedling growth** and **development,** and **increased plant productivity.**
**Vermicompost includes plant-growth regulators which increase growth and yield.**

## Cationic Exchange rate benefit:

In simple terms this means that **trace elements are attracted to vermicast** and readily bond to it in the same way that opposite poles of a magnet attract each other.
**Plants** have a stronger pull than the vermicast and can therefore **draw the trace elements** away from the vermicast and **into their roots.**
Within a year of application of vermiculture technology to the saline soil, **37% more N, 67% more $P_2O_5$ and 10% more $K_2O$** were recorded as compared to chemical fertilizer (Phule, 1993).
Atiyeh et al. (2000) found that compost was higher in ammonium, while **Vermicompost tended to be higher in nitrates**, which is the more plant-available form of nitrogen.
Similarly, work at NSAC by Hammermeister et al. (2004) indicated that "Vermicomposted manure has higher N availability than conventionally composted manure on a weight basis". The latter study also showed that the **supply rate of several nutrients, including P, K, S and Mg, were increased by vermicomposting as compared with conventional composting.**

## Soil Benevolent Biota Benefit:

**The biota** introduced to the soil in vermicast (or its derivatives) can work away out of sight, **releasing the minerals already there and trapping free nitrogen** from the atmosphere.
**Vermicasts are excellent media for harbouring N-fixing bacteria** (Bhole, 1992).
**Vermicompost** can be as much as **1000 times as microbially active** as conventional compost.

**These are microbes which are much better at transforming nutrients** into forms readily taken up by plants than you find in compost – because we're talking about thermophillic microbes in compost – so that the microbial spectrum is quite different and also much more beneficial in a Vermicompost.

**Vermicast acts as a disease suppressor**

Edwards and Arancon (2004) report that "…we have researched the effects of relatively small applications of commercially-produced vermicomposts, on attacks by Pythium on cucumbers, Rhizoctonia on radishes in the greenhouse, and by Verticillium on strawberries and Phomopsis and Sphaerotheca fulginae on grapes in the field.

**In all of these experiments, the Vermicompost applications suppressed the incidence of the disease significantly."**

**Earthworms** not only **disperse microorganisms important in food production** but also associated with mycorrhizae and other root symbionts, **biocontrol agents and microbial antagonists of plant pathogens** as well as microorganisms that act as pests (Edwards and Bohlen, 1996).

## Fungus Control with Worm Castings:

Four research articles were found where **fungus control using worm castings** was carried out under close academic protocol. **Phytophthora nicotiniae3**, **fusarium oxysporum4**, **sclerotinia sclerotium5**, and **sclerotum cepivorum6**, were able to be controlled with the use of earthworm castings.

Fungus control in inoculated soil tests was not achieved when too little of the earthworm castings were used. The **20% level** (one inch layer) that the field tests showed effective was confirmed as an **effective concentration** in the research articles.

Improved Application and Further Tests: Several rose applications with definite fungus problems were tested with the same 20% application and showed clear improvement in less than 30 days.

## Using worm castings for insect repellence.

**Chitin** is a compound that makes up the main component of the exoskeleton of insects.

**Chitosan** is a compound that is created from the breakdown of chitin.

**Chitinase** is the naturally occurring enzyme that breaks chitin down into chitosan.

These **worm castings contain enzymes known as various forms of chitinase** of which insects have a strong aversion.

The **worm castings** also have the ability to **activate multiplication of the chitinase-producing bacteria** found naturally in plants.

Testing has shown that the **natural level of chitinase found in most plants is not sufficient to repel insects**. The level of **chitinase is multiplied to a repulsion level with the use of worm castings**.

The level of the chitinase enzyme for **effective repellence** is in the range of **1 million cfu/gdw** (Colony Forming Units/ gram dry weight). **Worm castings** were submitted for tests to determine the **level of the chitinase** enzyme production. The tests showed concentrations of chitinase in the range of **54 million CFU/gdw.** This is concentration is over 50 times the estimated level for repellence.

It was observed that **ants refuse to cross a layer of worm castings**.

**It has been found that worm castings can be used effectively to repel insects that feed on the internal liquid or nectar of various plants.**

**These include a large array of insect pests including white fly, aphids, spider mites, fruit flies, and other nectar-sucking insects.**

When worm castings are put into the soil of the plant feeding area (stem to drip line), the evidence indicates that the worm castings activate an increase in the internal concentration of chitinase.

The level of chitinase in the nectar of leaves before treatment with worm castings is low.

When the chitinase concentration is low, insects are not repelled.

The increase in the chitinase level on small plants to a level sufficient to repel small insects occurs in a few weeks.

The increase in the level of chitinase in large plants sufficient to repel the insects takes longer.

The time to increase the level of chitinase in a large plant such as a full grown hibiscus can take several months and trees will take longer.

The pollination nectar and pollen do not appear to get an increased level of chitinase producing organisms with the use of worm castings.

White fly infested hibiscus plants were treated with worm castings.

Worm castings were applied in a ½ inch layer from the stems to the drip line.

In about two months all white fly residue and cocoons were gone.

White flies from neighbouring plants, which had not been treated, would fly around the treated leaves but not land on these leaves.

**<u>Some important revelations by farmers: (Study in India)</u>**

· **Reduced use of 'water for irrigation'** as application of Vermicompost over successive years improved the 'moisture holding capacity' of the soil.

· **Reduced 'pest attack'** (by at least 75%) in crops applied with Vermicompost. Cauliflowers grown on Vermicompost remain 95% 'disease free'. Late Blight (fungal disease) in banana was almost reduced by over 95%.

· **Reduced 'termite attack'** in farm soil especially where worms were in good population.

· **Reduced 'weed growth'.**

· **Faster rate of 'seed germination' and rapid seedlings growth and development.**

· **Greater numbers of fruits per plant** (in vegetable crops) and greater numbers of seeds per ear (in cereal crops), heavier in weight-better in both, quantity and quality as compared to those grown on chemicals.

· **Fruits and vegetables had 'better taste'** and texture and could be safely stored up to 6-7 days, while those grown on chemicals could be kept at the most for 2-3 days.

· **Flower production (commercial floriculture) was increased by 30-50%** @ 15-20 quintal/hectare. Flower blooms were more colorful and bigger in size.

**<u>Case study of a South African Apple Farmer using Vermiculture:</u>**

**Points made by Mike Leslie – Commercial apple farmer in the Free State using vermiculture.**

By incorporating vermicomposting and worm-casting tea in its apple production system, Clan Leslie Estate has **improved its fruit quality**, **reduced input costs** and **improved the soil and tree health** in its orchards.

Mike points to the contrast between mineral soil and the rich organic matter resulting from earthworm activity. "The earthworms manage the environment for me," he says. "**The soil is moving towards a natural state of balance (homeostasis) without chemical fertiliser."**

He estimates that this **production system needs one-third less irrigation water**. "The savings are significant."

Mike was astonished when he first saw the **increase in root growth** as a result of the mulch and soil feed. "**This increased nutrient uptake has resulted in healthier, stronger apple trees**."

Incorporating earthworms has **increased yields from 50t/ha to 75t/ha in Pink Lady apples**, and **by 15t/ha in other varieties**.