

# EARTHWORMS

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Earthworms are segmented invertebrates that inhabit soils and organic waste. They are hermaphrodite and usually reproduce by mating, each partner fertilizing the other. After mating they retract their bodies through the "saddle" or clitellum and pass it over their heads. Each cocoon contains one or more eggs and can survive adverse conditions, hatching when environmental conditions are favorable.

They take one to eight months to become sexually mature and continue to reproduce at regular intervals. They require moisture and aerobic conditions for survival and reproduction.

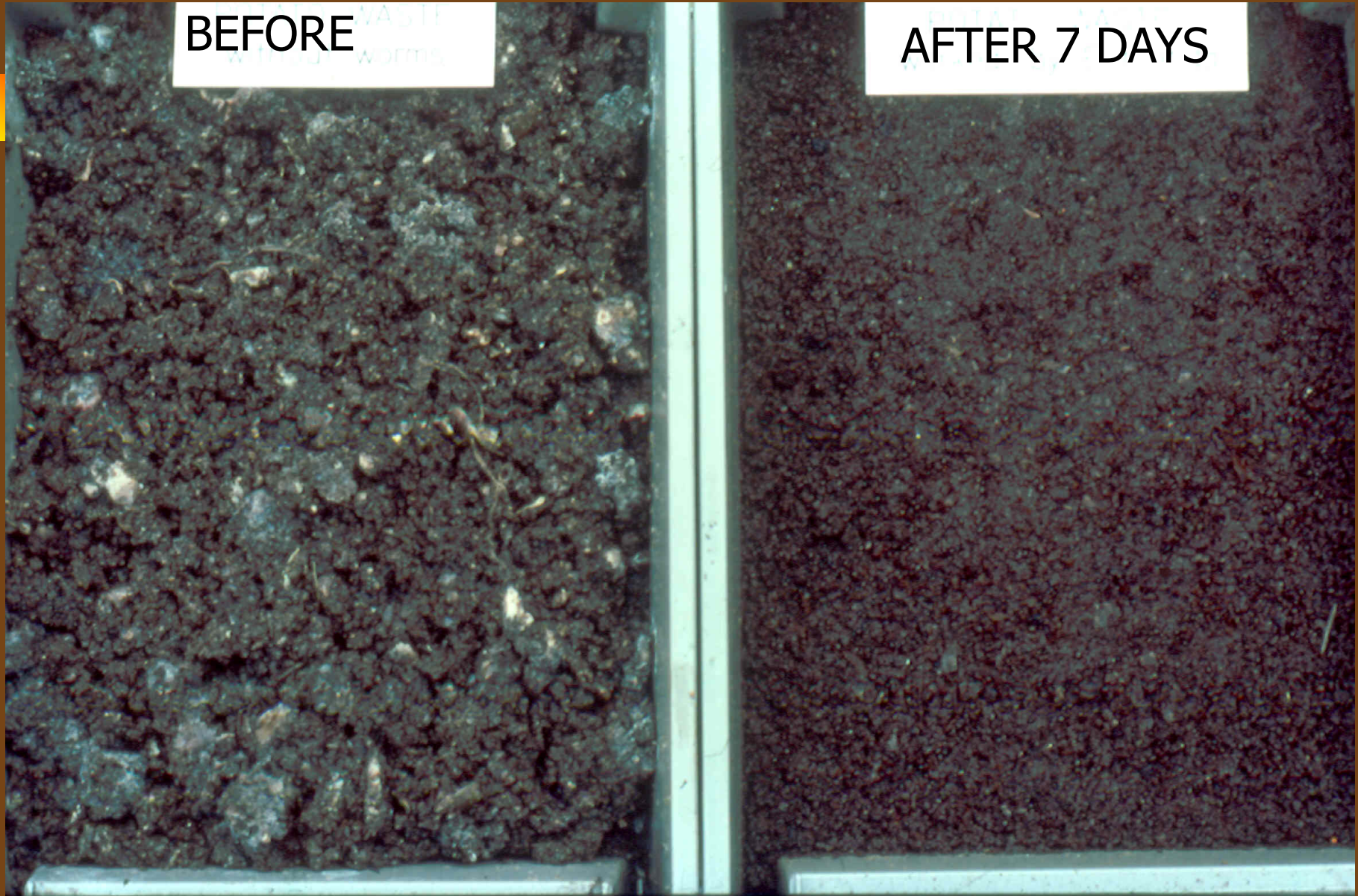


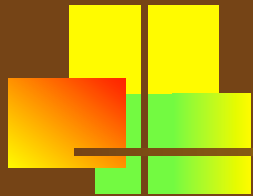


# BREAKDOWN OF POTATO WASTES

BEFORE

AFTER 7 DAYS



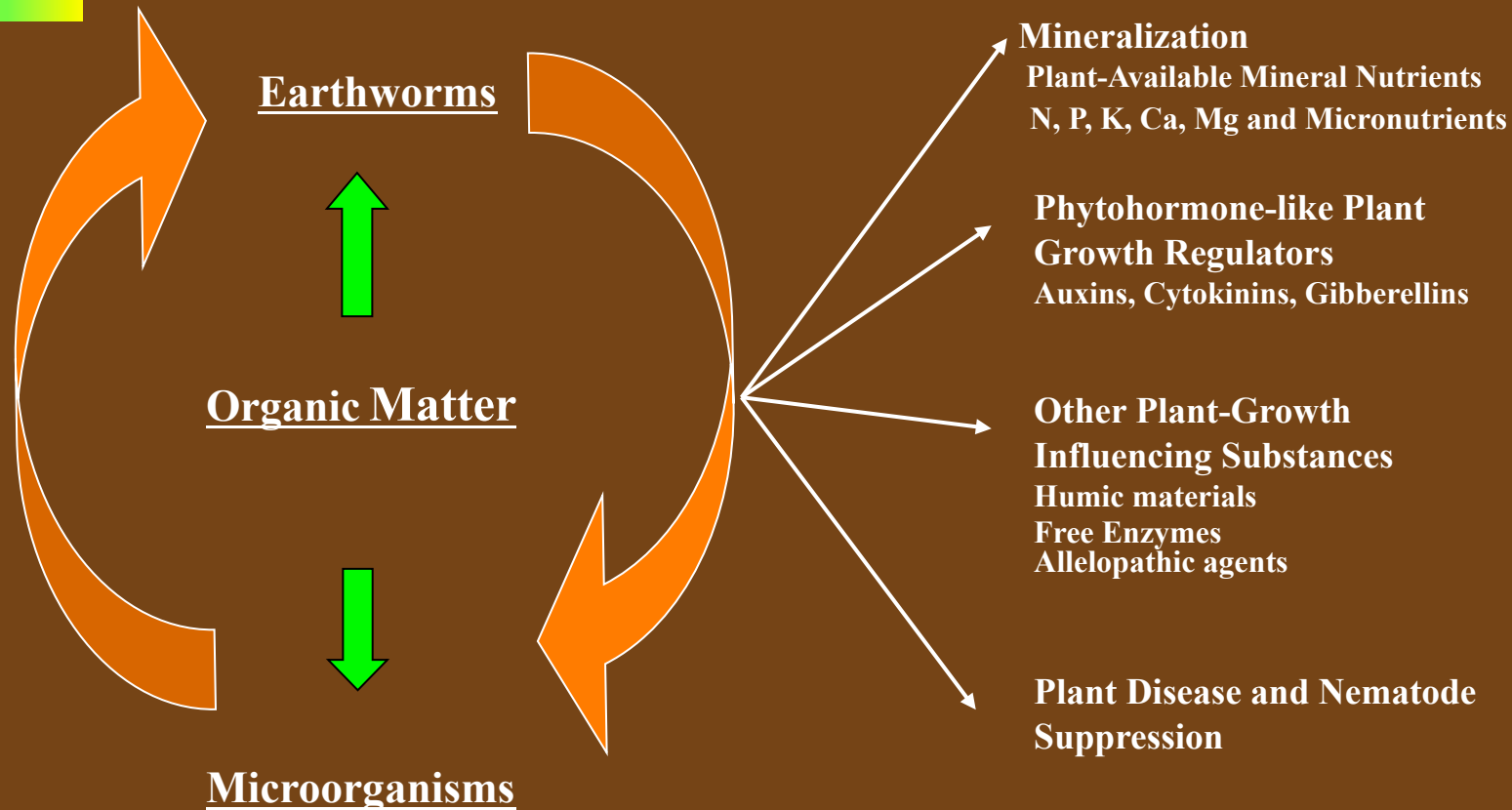


# VERMICOMPOSTS

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Vermicomposts are organic materials, broken down by interactions between earthworms and microorganisms, in a mesophilic process (up to 25 °C), to produce fully-stabilized organic soil amendments with low C:N ratios. They have a high and diverse microbial and enzymatic activity, fine particulate structure, good moisture-holding capacity, and contain nutrients such as N, K, P, Ca and Mg in forms readily taken up by plants. They contain plant growth hormones and humic acids which act as plant growth regulators.

# POTENTIAL INTERACTIONS BETWEEN EARTHWORMS & MICROORGANISMS IN VERMICOMPOSTS

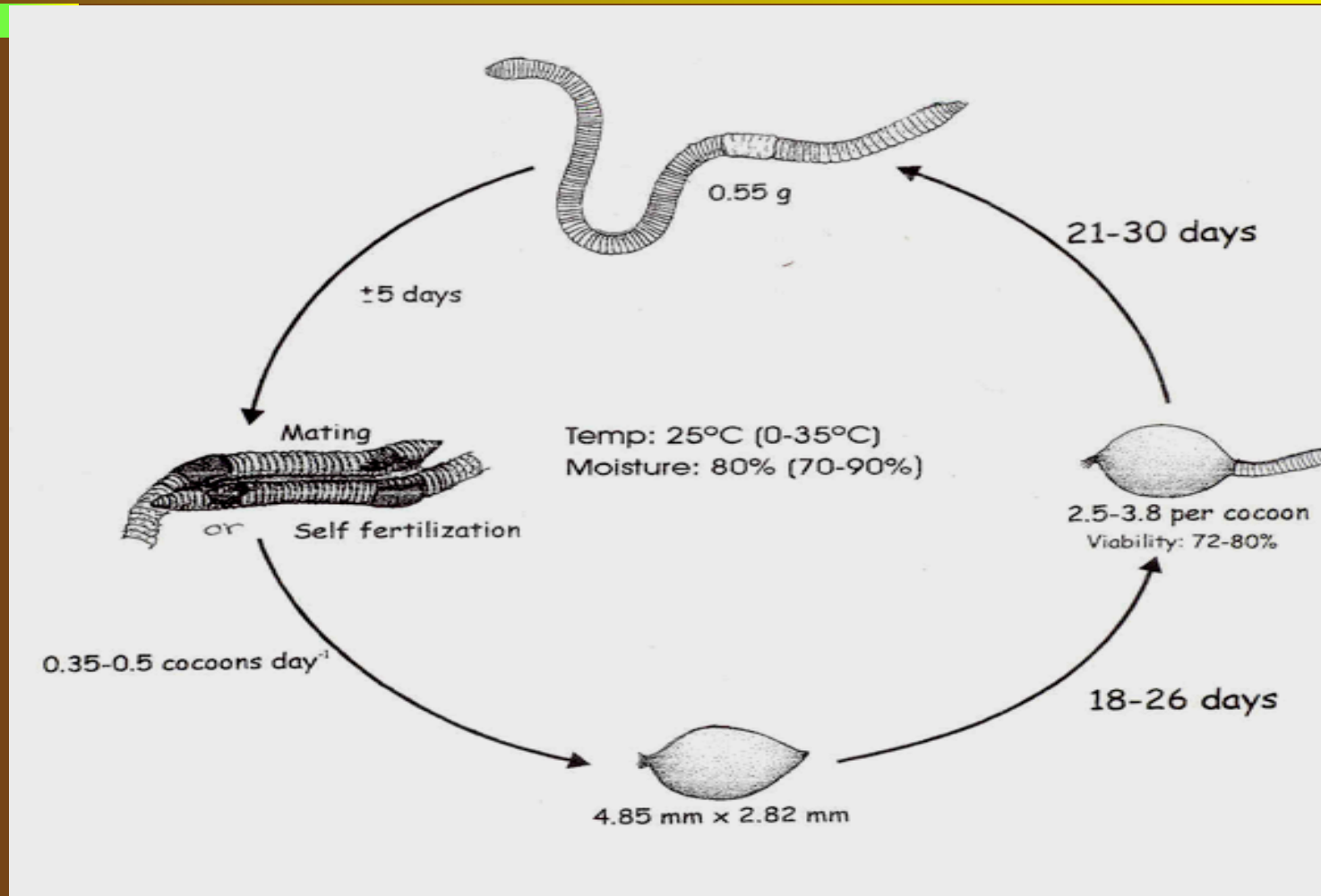


# PRINCIPLES OF VERMICOMPOSTING

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- Species of organic waste-consuming earthworms such as *Eisenia fetida* and *Eudrilus eugeniae* are used
- Temperature should be maintained at 20-25 °C
- Moisture content should be 75% - 90%
- Organic materials are added to systems in thin layers (2.5-5.0 cm)
- Earthworms require aerobic conditions and remain in the top 10-15 cm of a system – moving up as new organic matter is added to the surface

# LIFE CYCLE OF *EISENIA FETIDA*





# EFFECTS OF VERMICOMPOSTS ON PLANT GROWTH

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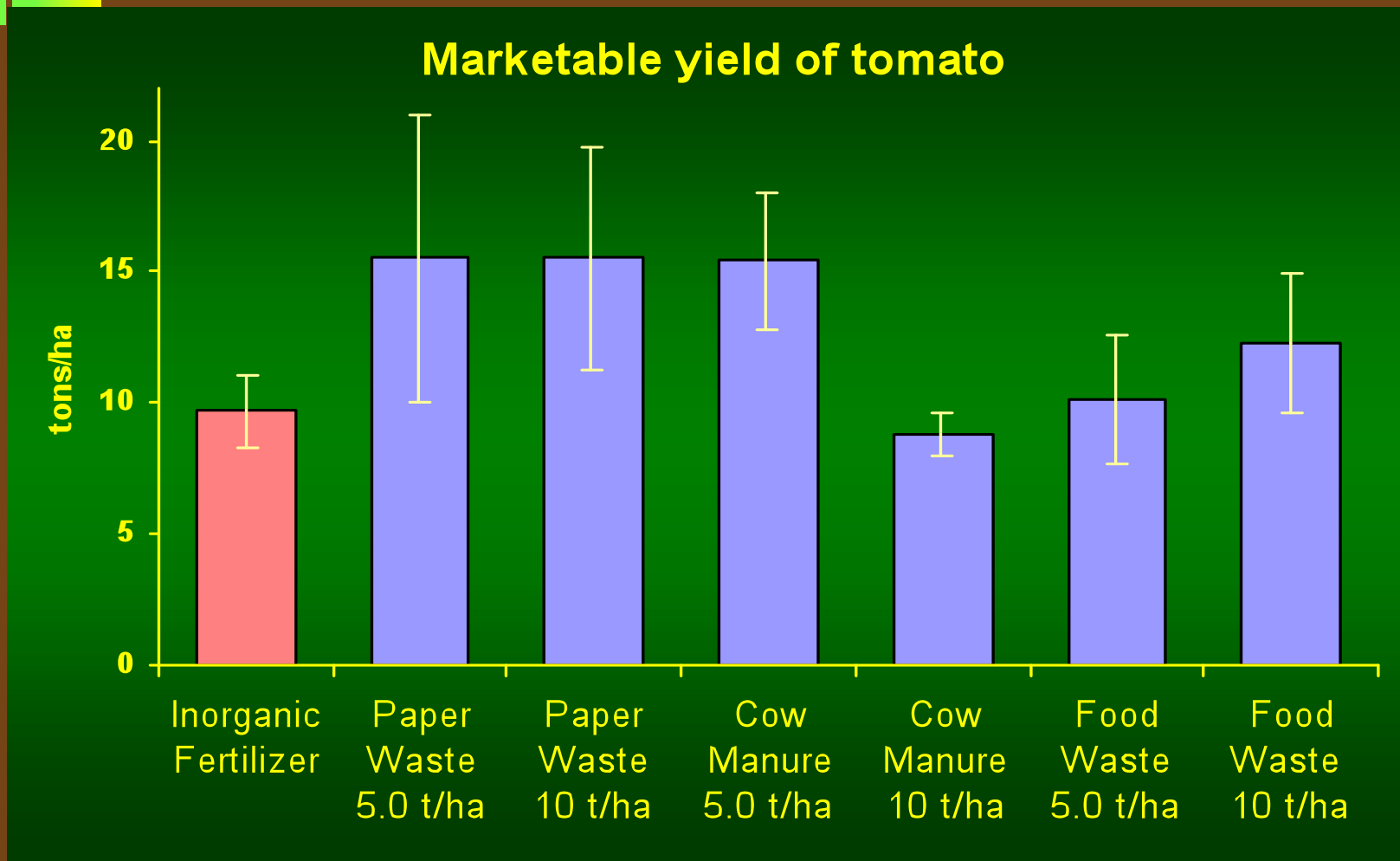
We have demonstrated very considerable increases in rates of germination, growth, flowering and fruiting and yields in crops grown with small substitutions or amendments with vermicomposts. These increases were usually independent of nutrient availability.



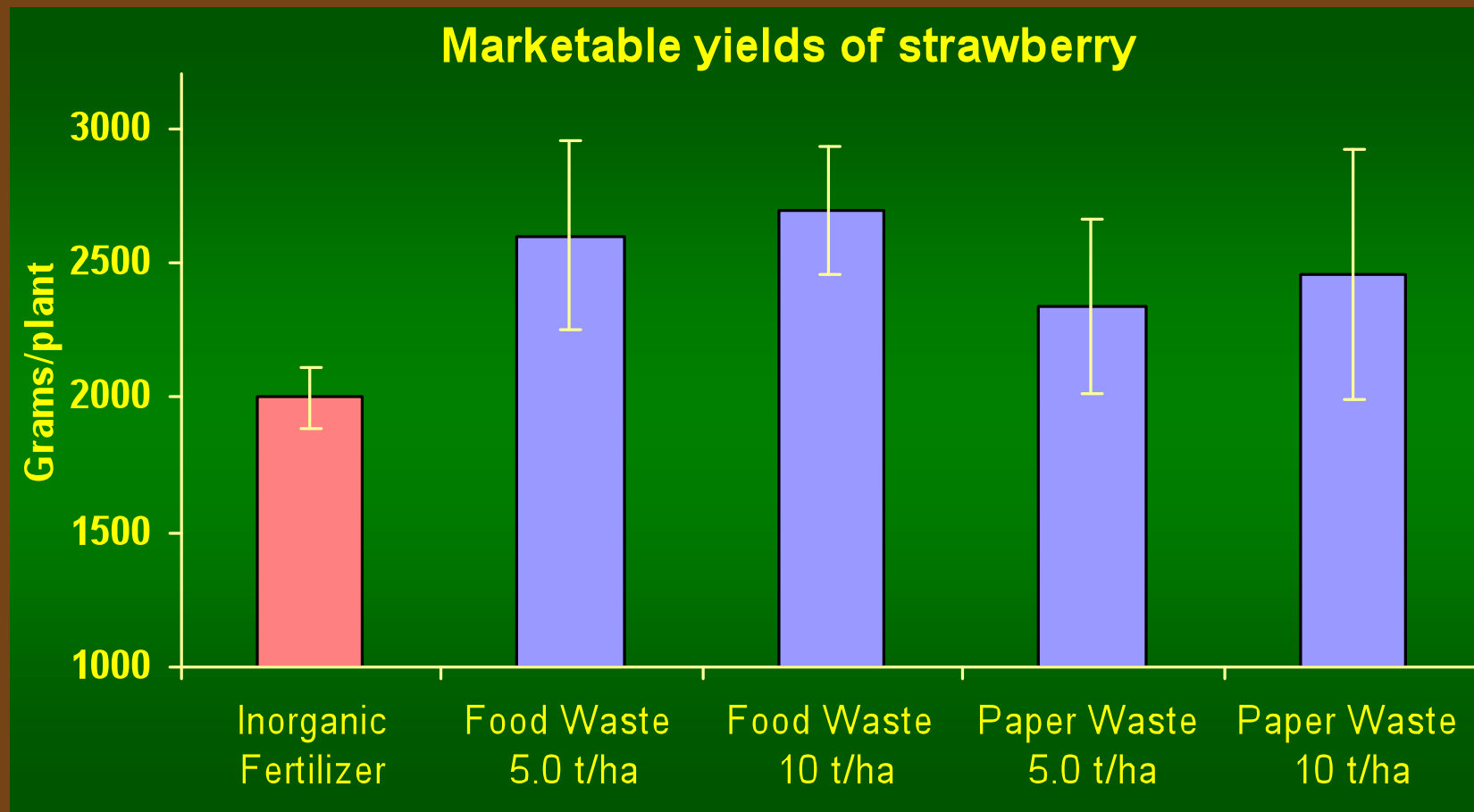
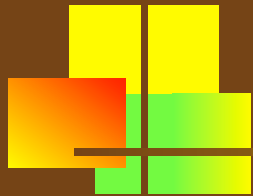
# EFFECTS OF VERMICOMPOSTS ON TOMATO SEEDLING GROWTH



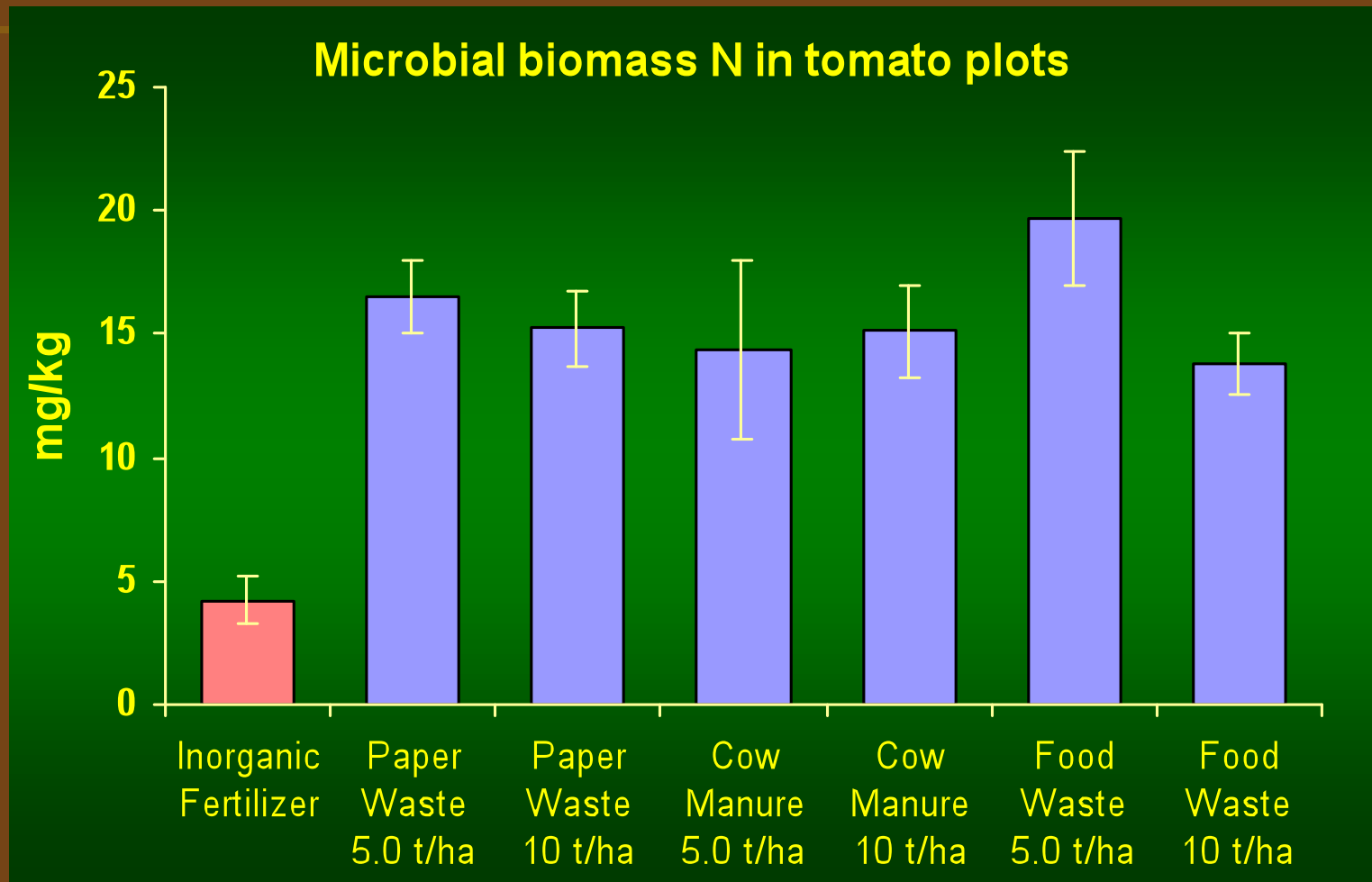
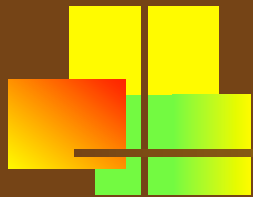
# MARKETABLE YIELDS OF TOMATOES IN THE FIELD



# MARKETABLE YIELDS OF STRAWBERRIES



# MICROBIAL BIOMASS-N IN TOMATO FIELD EXPERIMENT





# EVIDENCE FOR PLANT GROWTH REGULATORS IN VERMICOMPOSTS

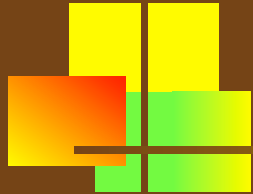


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- **SMALL SUBSTITUTIONS OF VERMICOMPOSTS INTO GROWTH MEDIA INCREASE PLANT GROWTH INDEPENDENT OF NUTRIENT SUPPLY**
- **VERMICOMPOSTS ARE EXTREMELY MICROBIAALLY ACTIVE AND MICROORGANISMS PRODUCE PLANT GROWTH HORMONES**
- **AQUEOUS EXTRACTS OF VERMICOMPOSTS CAN INCREASE GROWTH INDEPENDENT OF NUTRIENTS**
- **BASE EXTRACTS OF HUMATES FROM VERMICOMPOSTS CAN INCREASE PLANT GROWTH INDEPENDENT OF NUTRIENTS**
- **GROWTH REGULATORS ADSORBED ONTO HUMATES IN VERMICOMPOSTS**
- **PLANT GROWTH PATTERNS E.G. STEM ELONGATION, ROOT GROWTH, FLOWERING PATTERNS ARE OFTEN CHANGED BY VERMICOMPOSTS**

# EFFECTS OF VERMICOMPOSTS AND VERMICOMPOST 'TEAS' ON PLANT DISEASES

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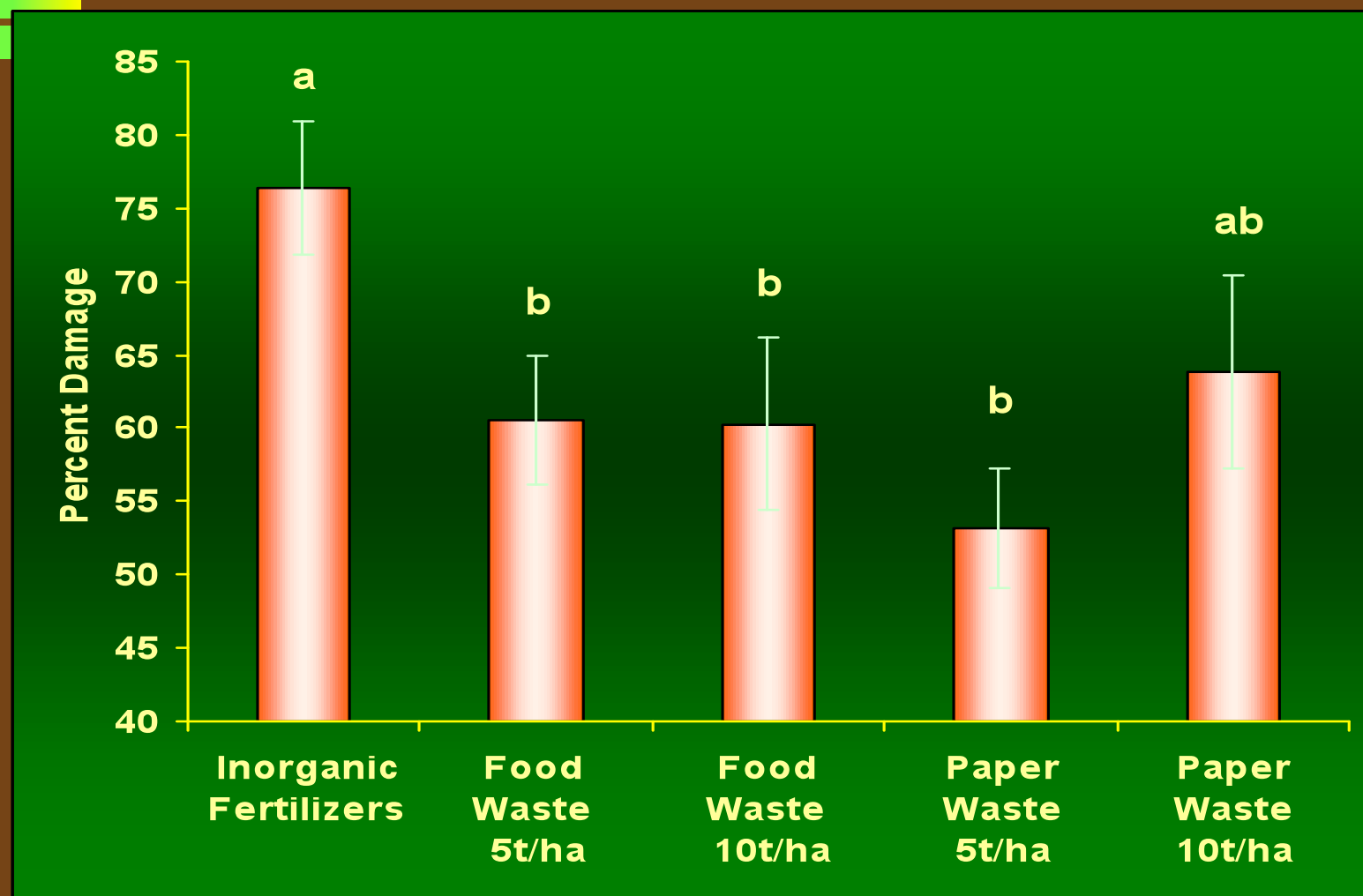
## •Laboratory

- Pythium*
- Rhizoctonia*
- Plectosporium*
- Phytophthora*
- Fusarium*

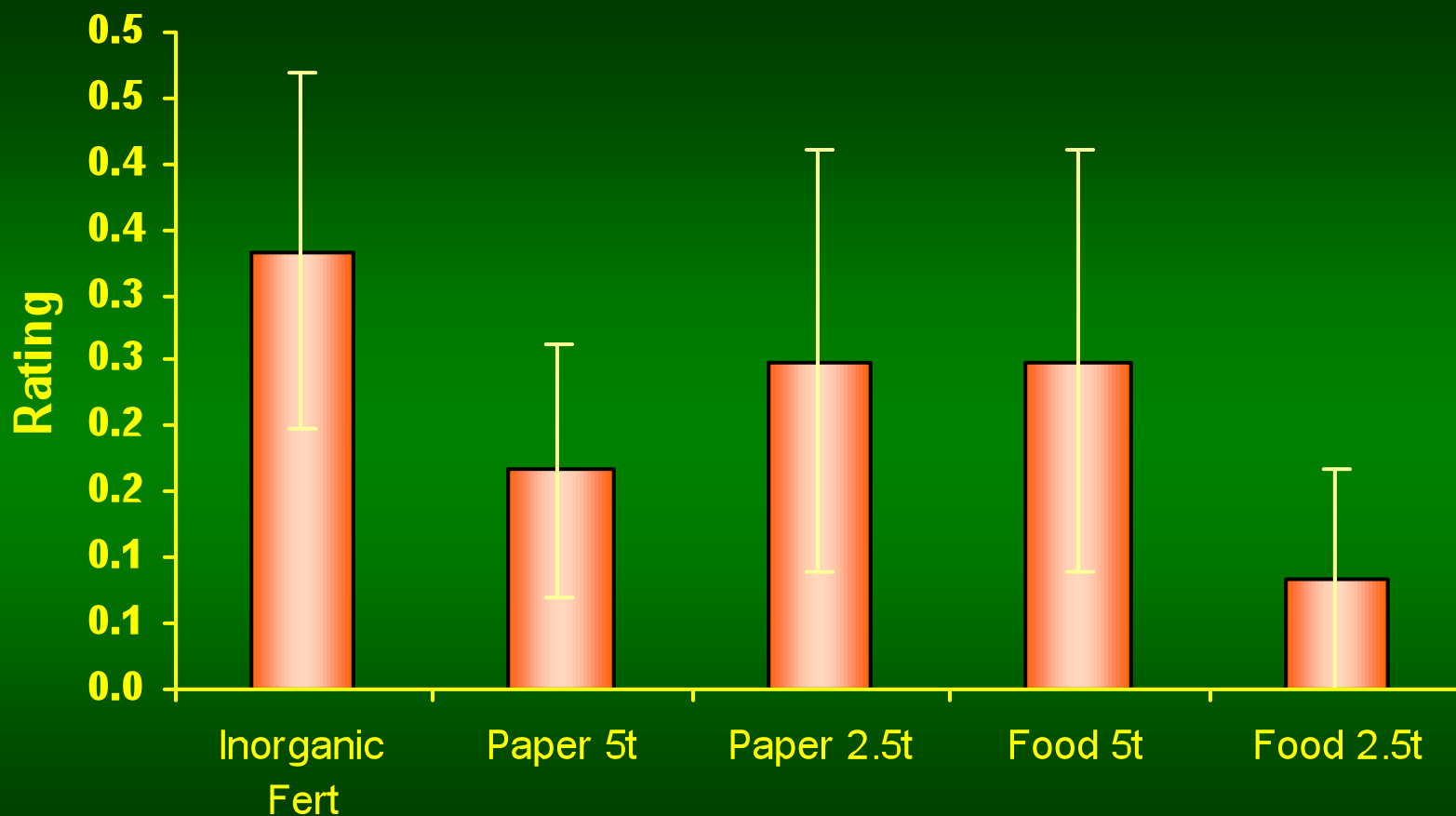
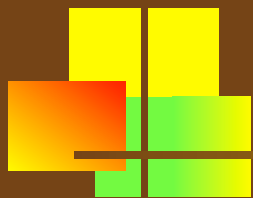
## Field

- Verticillium*
- Phomopsis*
- Sphaerotheca*
- Uncinula necator*

# SUPPRESSION OF *VERTICILLIUM* ON STRAWBERRY BY VERMICOMPOSTS

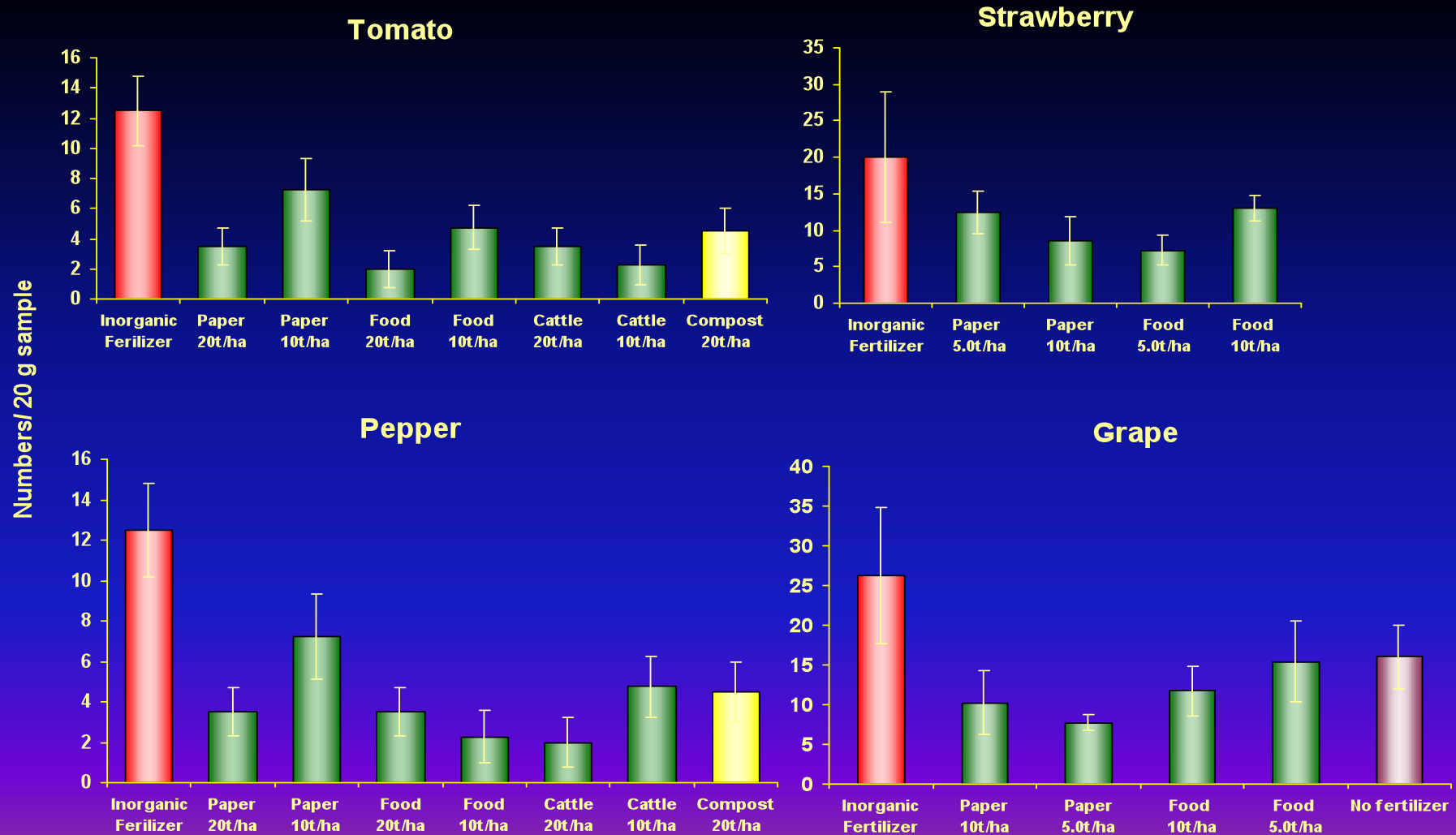


# SUPPRESSION OF POWDERY MILDEW ON FIELD GRAPES BY VERMICOMPOSTS

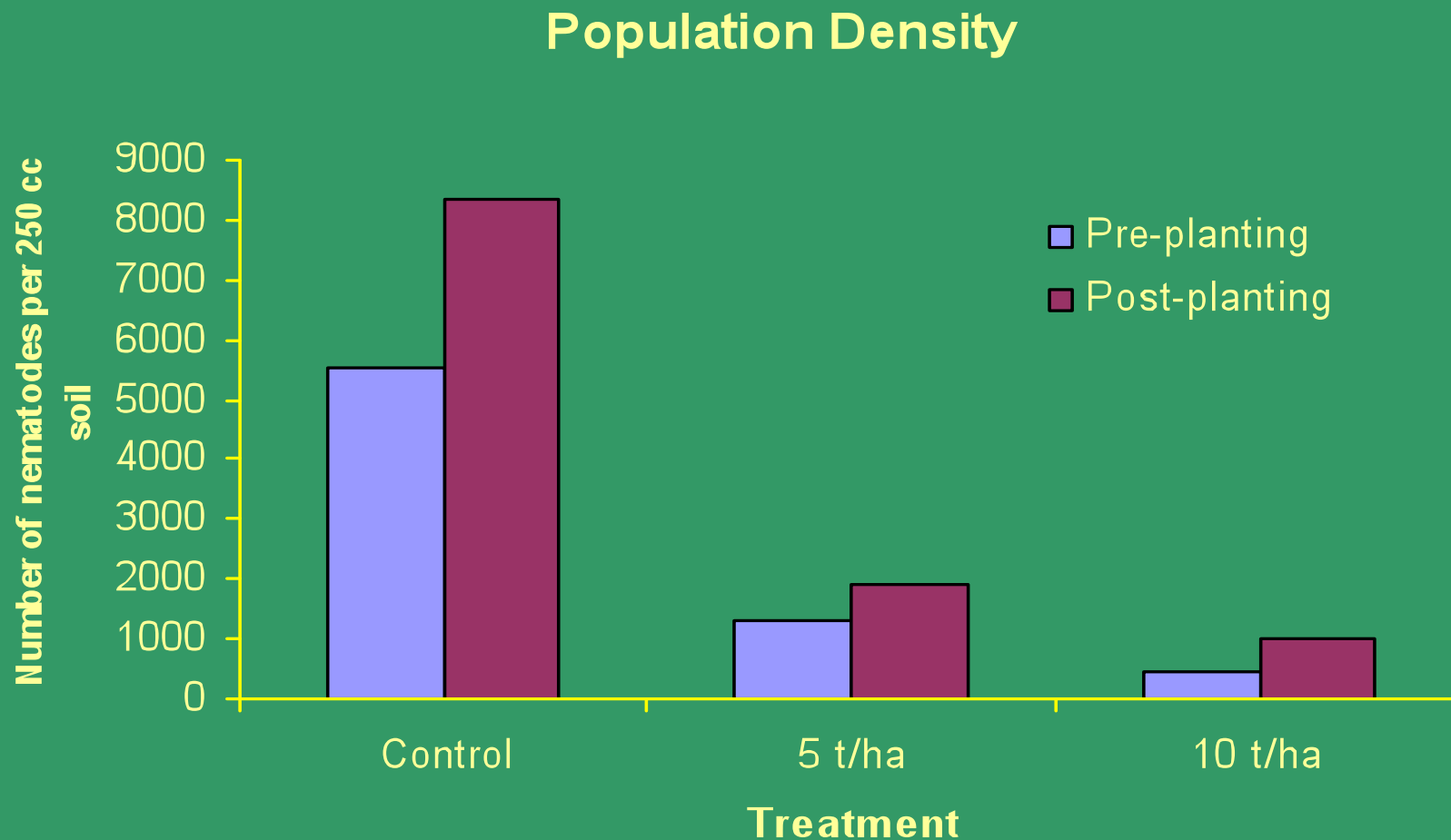




# PLANT PARASITIC NEMATODE POPULATIONS



# SUPPRESSION OF *MELOIDOGYNE* BY FOOD WASTE ON TOMATOES BY VERMICOMPOST



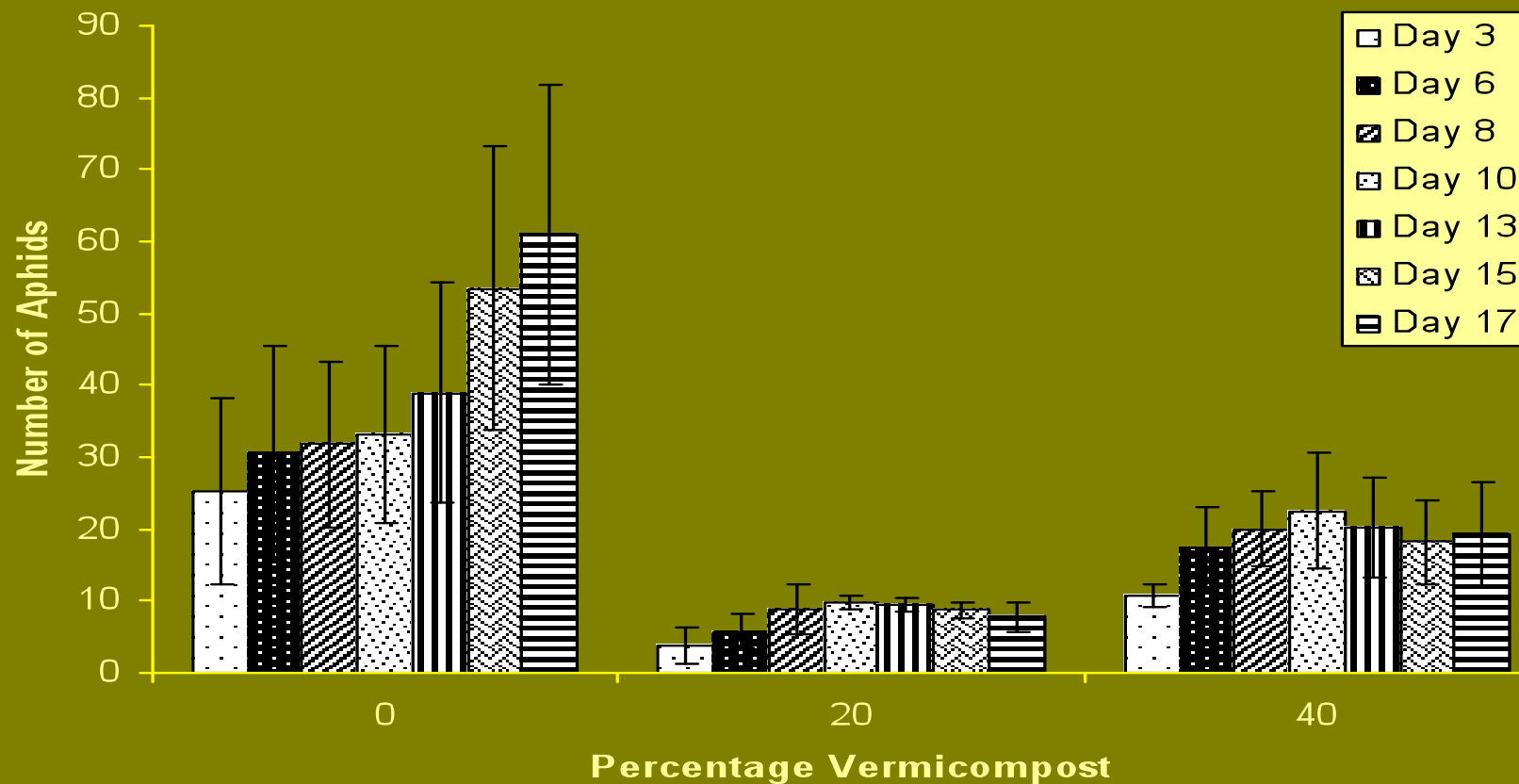


# EFFECTS OF VERMICOMPOSTS ON ARTHROPOD PESTS

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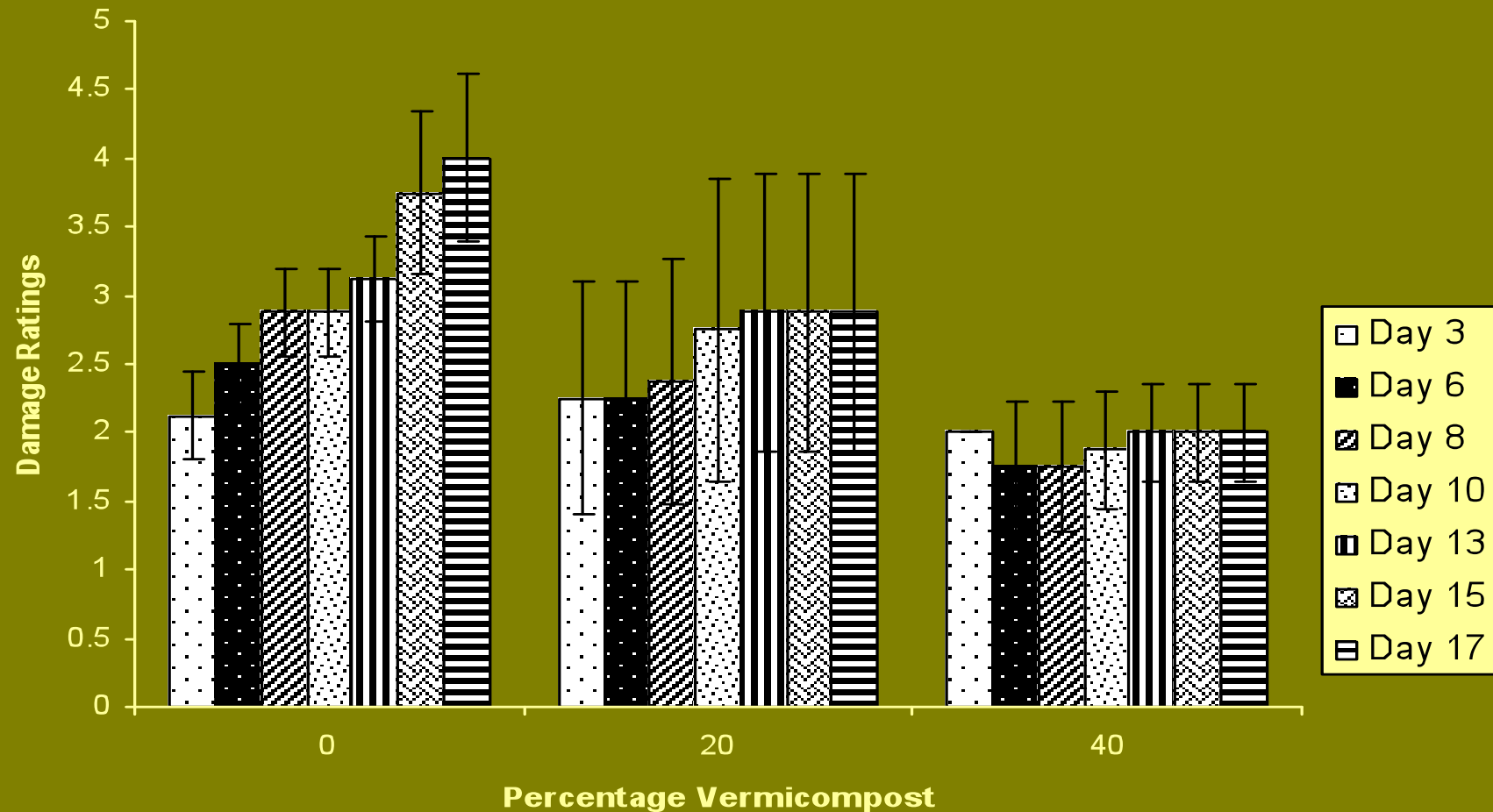
- SUCKING INSECTS
  - APHIDS
  - MEALY BUGS
  - TWO-SPOTTED SPIDER MITES
- CHEWING INSECTS
  - CABBAGE WHITE CATERPILLARS
  - CUCUMBER BEETLES
  - TOMATO HORNWORMS

# EFFECTS OF VERMICOMPOSTS ON DEVELOPMENT OF APHID INFESTATIONS ON CABBAGE





# EFFECTS OF VERMICOMPOSTS ON DAMAGE RATINGS OF TWO-SPOTTED SPIDER MITES INFESTATIONS ON EGGPLANTS





# CONCLUSIONS ON ROLE OF VERMICOMPOSTS IN SUSTAINABLE AGRICULTURE

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- Vermicomposts have great potential in horticulture and agriculture crop production due to production of plant growth regulators by the greatly increased microbial populations. These accelerate the germination, growth, flowering and yields of plants independent of nutrient supply.
- Vermicomposts also have potential, as solids or aqueous vermicompost extracts, in integrated pest management programs, since one application suppresses soil-borne plant pathogens, plant parasitic nematodes as well as numbers and reproduction of arthropod pests such as aphids, beetles and caterpillars.



# CONCLUSIONS ON THE ROLE OF SOIL ECOLOGY IN SUSTAINABLE AGRICULTURE

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- Sustainable agriculture depends on inputs from biological organisms instead of chemicals. This makes the soil ecology principles and inputs to sustainable agricultural systems a critical component.