Earthworms in Agriculture

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Compiled by:
Mary V. Gold
Alternative Farming Systems Information Center
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1. NAL Call No.: RA1270.P35A1
32P-postlabeling determination of DNA adducts in the earthworm Lumbricus terrestris exposed to PAH-contaminated soils.
Includes references.
Descriptors: lumbricus-terrestris; earthworms-; aromatic-hydrocarbons; polluted-soils; toxicity-; dna-; phosphorus-; isotope-labeling; quebec-; polycyclic-aromatic-hydrocarbons; genotoxicity-

2. NAL Call No.: QH84.8.B46
Ability of the earthworms Aporrectodea rosea and Aporrectodea trapezoides to increase plant growth and the foliar concentration of elements in wheat (Triticum aestivum cv. Spear) in a sandy loam soil.
Includes references.
Descriptors: triticum-aestivum; aporrectodea-caliginosa; aporrectodea-; population-density; growth-; foliage-; concentration-; trace-elements; foliar- nutrition; roots-; weight-; sandy-loam-soils

3. NAL Call No.: RA1270.P35A1
Acute toxicity studies with earthworms, Lumbricus terrestris.
Includes references.
Descriptors: pesticides-; fuels-; earthworms-; lumbricus-terrestris; nontarget-organisms; toxicity-; nigeria-

4. NAL Call No.: 56.9-S03
Aggregate stability under oak and pine after four decades of soil development.
Includes references.
Descriptors: quercus-dumosa; pinus-coulteri; forest-soils; comparisons-; aggregates-; stability-; soil-formation; soil-organic-matter; horizons-; earthworms-; worm-casts; water-stable-aggregates; soil-aggregation

Abstract: The development of water-stable aggregates is an important soil genesis process because it strongly influences important soil characteristics, including infiltration, aeration, and erodibility. We studied a 41-yr-old biosequence of lysimeter soils at the San Dimas Experimental Forest in southern California to assess water-stable aggregates as a function of the imposed scrub oak (Quercus dumosa Nutt.) and Coulter pine (Pinus coulteri B. Don) communities. Significantly different aggregate stabilities developed in these initially identical and homogeneous soils. Earthworms under the oak produced a 7-cm-thick A horizon composed almost entirely of worm casts. Casts were also deposited within the litter of the Oi horizon. The A horizon and the Oi horizon worm casts had aggregate stabilities near 90%, approximately 35 g kg-1 organic C, and abundant fungal hyphae, as observed by scanning electron microscopy. The 1-cm-thick A horizon under pine contained no worm casts and had 78% water-stable aggregates, 12.9 g kg-1 organic C, and abundant very fine roots and fungal hyphae. Subsoils under both oak and pine had 43 to 51% water-stable aggregates, attributable to inorganic binding mechanisms since organic C contents were less than or equal to 4 g kg-1, roots were relatively few, and no fungal hyphae were observed. After 41 yr of soil formation, aggregate stability was approximately 15% greater and the volume of stable aggregates was seven times larger under scrub oak than under Coulter pine.
Almond growers reduce pesticide use in Merced County field trials.


Descriptors: orchards-; pest-management; prunus-dulcis; insecticides-; insect-pests; beneficial-insects; soil-organic-matter; soil-fertility; oligochaeta-; parasites-of-insect-pests; crop-yield; california-

Alterations in polyamine levels of nematode, earthworm, leech and planarian during regeneration, temperature and osmotic stresses.


Includes references.

Descriptors: nematodes-; earthworms-; planaria-; hirudo-; regeneration-; polyamines-; biosynthesis-; ornithine-decarboxylase; cold-stress; heat-shock; temperature-; osmotic-pressure

Abstract: Free-living nematodes, Caenorhabditis elegans and Dorylaimus fodorii, contain putrescine and spermidine. Putrescine, spermidine and spermine occur in the parasitic Nematoda, Ascaris suum, Anisakis simplex and Diofilaria immitis. Earthworms, Eisenia fetida, Tubifex hattai and Pheretima communissima and the leech, Hirudo nipponia (belonging to Annelida) and the planarian, Dugesia japonica (belonging to Platyhelminthes) contain homospermidine and spermine in addition to putrescine and spermidine. Regenerated heads of E. fetida and D. japonica are rich in putrescine indicating the stimulation of its synthesis during regeneration. Putrescine and spermidine levels temporarily increase after heat shock in C. elegans, E. fetida and D. japonica and cold shock and hypertonic osmotic shock treatments in D. japonica.

An oxytocin-related peptide isolated from the earthworm, Eisenia fetida.


Includes references.

Descriptors: eisenia-fetida; earthworms-; peptides-; isolation-; characterization-; oxytocin-; vasopressin-; osmoregulation-

Abstract: An oxytocin-vasopressin-related peptide, Cys-Phe-Val-Arg-Cys-Pro-Trp-Gly-NH2, was isolated from the lumbricid earthworm, Eisenia fetida and termed annetocin. Annetocin potentiated not only spontaneous contractions of the gut but also pulsatory contractions and bladder-shaking movement of the nephridia. Annetocin may be involved in osmoregulation of the animal through nephridial function.

As the worm turns.


Descriptors: forest-damage; forest-soils; fungi-; earthworms-; oligochaeta-; forests-; forest-litter

Bins enter the schools.


Descriptors: vermicomposting-; earthworms-; educational-programs

Bioconcentration and Biokinetics of heavy metals in the earthworm.


Includes references.

Descriptors: earthworms-; aporrectodea-caliginosa; lumbricus-rubellus; heavy-metals; cadmium-; copper-; lead-; nickel-; zinc-; concentration-; kinetics-; polluted-soils


Descriptors: Earthworms-

Biotic manipulation effects on soil carbohydrates and microbial biomass in a cultivated soil.


Includes references.

Descriptors: ultisols-; soil-types-cultural; soil-organic-matter; cycling-; roots-; soil-fungi; soil-arthropods; earthworms-; carbohydrates-; soil-flora; biomass-; carbon-; nitrogen-; microarthropods-; soil-organic-matter-dynamics

Abstract: Plant roots, fungi and soil fauna are important soil ecological constituents, which have
substantial influences on soil C dynamics and nutrient cycling. Four biotic treatments (root exclusion, earthworm addition, fungicide and insecticide applications) were designed to investigate the influences of plant roots, fungi, microarthropods and earthworms on soil C dynamics and nutrient cycling in the field. Soils under these four treatments and their untreated controls in a 40 year old mixed meadow in the Georgia piedmont were analyzed for total organic C, soil N, microbial biomass C and N, and carbohydrates for 2 years. Root exclusion significantly reduced the concentrations of soil carbohydrates (P < 0.05) as determined by gas chromatography, with only slight differences in total C between the treatments and the controls. Microbial biomass C and N were significantly lower under root exclusion and fungicide treatment than under the control. Root exclusion and inhibition of soil fungi significantly reduced soil N content, suggesting that both roots and fungi contribute to the retention of soil organic N or contribute as a source of N in cultivated soils. Microbial biomass determined in this study was strongly related to total carbohydrates (P < 0.01). Mannose, a sugar mainly of microbial origin, significantly decreased in the surface 5 cm soils under fungicide treatment, while little effects of the arthropod repellent naphthalene were found in any of the measurements. Significant reductions in xylose and glucose but not in mannose after earthworm additions suggested that earthworms accelerated the turnover of plant materials in soils. The results confirmed that the short-term effects of soil biota on SOM dynamics. Derived carbohydrates are relatively dominant in the total carbohydrate pool. When combined with information on microbial biomass, soil carbohydrate ratios may be a useful indicator of changes in SOM status as a function of biotic and management regimes in cultivated soils.

13. NAL Call No.: S592.7.A1S6
Breakdown of plant residues with contrasting chemical compositions under humid tropical conditions: effects of earthworms and millipedes.
Includes references.
Descriptors: tropical-soils; humid-tropics; soil-fauna; diplodia-; oligochaeta-; biological-activity-in-soil; pruning-trash; maize-stover; rice-straw; decomposition-; mineralization-; plant-composition; carbon-nitrogen-ratio; lignin-; polyphenols-; chrysobalanaceae-; gliricidia-sepium; leucaena-leucocephala; zea-mays; oryza-sativa; nigeria-; spirostreptidae-; eudrilus-eugeniae; daityadenia-barteri
Abstract: The effects of tropical earthworms (Eudrilus eugeniae) and millipedes (Spirostreptidae) on the breakdown of plant residues [Acioa  (presently, Dactyladenia) barteri, Gliricidia sepium and Leucaena leucocephala prunings, maize (Zea mays) stover and rice (Oryza sativa) straw], with contrasting chemical compositions, were studied in the field under humid tropical circumstances. Addition of earthworms significantly increased the breakdown of maize stover. Addition of millipedes significantly increased the breakdown of maize stover and rice straw. Combined addition of earthworms and millipedes generally resulted in greater plant residue breakdown, compared to that of a single group of fauna. During 10 weeks of exposure, earthworms and millipedes, on average, accounted for the breakdown of all plant residues by 10.4 and 28.4%, respectively. Millipedes and earthworms contributed more to the breakdown of plant residues with low quality (high C-to-N ratio, lignin and polyphenol contents) than to the degradation of those with high quality. It is concluded that fauna-enhanced breakdown of plant residues will have different effects on soil nutrient supply, depending on residue quality.

14. NAL Call No.: QH84.8.B46
Burial of soil-surface artifacts in the presence of lumbricid earthworms.
Includes references.
Descriptors: earthworms-; lumbricidae-; wire-; topsoil-; soil-movement; worm-casts; biological-activity-in-soil; grassland-soils; forest-soils; pastures-; new-zealand; soil-bioturbation; burial-by-worm-casts; topsoll-mixing; wire-rings; surface-casting
15. NAL Call No.: QH545.A1E29
Cadmium-induced mRNA encoding a nonmetallothionein 33-kDa protein in Enchytraeus buchholzi (Oligochaeta).
Includes references.
Descriptors: enchytraeus-; cadmium-; dosage-effects; messenger-rna; induction-; uptake-; concentration-; survival-; mortality-; reproduction-; toxicity-; biological-indicators; pollution-; bioconcentration-
16. NAL Call No.: 1-F766F1
Can earthworms survive fire retardants.
Includes references.
Descriptors: forest-fires; fire-retardants; oligochaeta-; earthworms-; toxicity-
17. NAL Call No.: 381-3824
cDNA cloning of a cadmium-inducible mRNA encoding a novel cysteine-rich, non-metallothionein 25-kDa protein in an enchytraeid earthworm.
Includes references.
Abstract: Cadmium accumulation and its effect on gene expression have been investigated at sublethal cadmium concentrations in the soil oligochaete Enchytraeus buchholzi. This worm is capable of accumulating cadmium to large amounts, which coincides with the induction of a mRNA isolated as a cDNA clone by differential screening of a cDNA library constructed from cadmium-treated enchytraeids. The cDNA-clone designated CRP1 is 1474 base pairs in length and contains a 753-base pair open reading frame, encoding a novel Cys-rich non-metallothionein protein. In vitro translation of the in vitro transcribed CRP1 results in a protein with a molecular mass of 25 kDa and an pI of approximately 7.5. These values are consistent with those predicted from the deduced amino acid sequence. The CRP protein contains 27% Cys, most of them arranged in Cys-X-Cys and Cys-Cys segments. The sequence is also characterized by a 31-amino-acid motif, which is tandemly repeated along the sequence. Northern blot analysis reveals that the CRP gene is not constitutively expressed in untreated worms, but rather it is rapidly induced by cadmium. The CRP gene may be a promising candidate gene for monitoring bioavailable cadmium at subtoxic levels in terrestrial environments.

18. NAL Call No.: QH84.8.B46
Changes in potassium availability and other soil properties due to soil ingestion by earthworms.
Includes references.
Descriptors: aporrectodea-caliginosa; lumbricus-rubellus; potassium-; bioavailability-; soil-texture; soil-types; cation-exchange-capacity; cations-; ph-; biological-activity-in-soil

19. NAL Call No.: QH84.8.B46
Changes in the composition of sugarcane harvest residues during decomposition as a surface mulch.
Includes references.
Descriptors: sugarcane-; harvesting-; plant-residues; decomposition-; mulches-; chemical-composition; change-; earthworms-; queensland-

20. NAL Call No.: 500-N484
Chemical toxicity and host defense in earthworms: an invertebrate model.
Descriptors: lumbricus-terrestris; immune-system; toxicity-; defense-mechanisms; chemicals-; pollutants-; immunoassay-; lysozyme-; enzyme-activity; toxicology-; risk-; animal-models; immunotoxicity-; risk-assessment

21. NAL Call No.: QH545.A1E29
CO2 production in three earthworm species exposed to terbuthylazine and carbofuran in food.
Includes references.
Descriptors: terbuthylazine-; carbofuran-; toxicity-; lumbricus-rubellus; lumbricus-terrestris; eisenia-; oral-administration; exposure-; duration-; carbon- dioxide; gas-production; respiration-; nontarget-organisms; eisenia-andrei

22. NAL Call No.: QL461.E532
Colonization and degradation of cattle dung: aspects of sampling, fecal composition, and artificially formed pats.
Includes references.
Descriptors: cattle-dung; staphylinidae-; coleoptera-; scarabaeidae-; diptera-; lumbricidae-; degradation-; germany-

Abstract: Many biotic and abiotic factors influence colonization and degradation of cattle dung pats. Thus, studies using the pat as an experimental unit require precise methodology to prevent misinterpretation of results. This paper reports trials in which impact of methodological procedures on dung fauna and dung degradation was investigated. Factors investigated were pat position on pasture, sampling techniques, influence of various diets, and a comparison between naturally voided versus artificially formed pats. Parameters used to measure these factors included quantitative and qualitative monitoring of dung fauna, including Coleoptera, Diptera, bacteria, nematodes, and Lumbricidae, and assays of pH, moisture content, and organic matter content of dung. An influence of pat position on colonization was seen, with Staphylinidae occurring more frequently in pats located toward the center of a pasture compared with pats located close to a road. Coleoptera larvae preferred the northern parts of the pats. Pat composition influenced colonization of coleoptera. Staphylinidae and Scarabaeidae preferred pats from cattle fed with grass, but Hydrophilidae preferred pats from cattle fed corn silage. More Coleoptera larvae were collected from pats produced by grazing cattle compared with pats from cattle fed hay or corn silage. There were no significant differences between artificial and natural pats as to the total number of Coleoptera, Diptera, or bacteria collected. However, development of Diptera larvae was accelerated in the artificial pats.
Degradation of pats measured by content of organic substance and pat area was similar in artificial and natural pats.

23. NAL Call No.: 448.3-Ap5
Comparative assessment of the aerobic and anaerobic microfloras of earthworm guts and forest soils.
Includes references.
Descriptors: lumbricus-rubellus; oligochaeta-; earthworms-; intestinal-microorganisms; aerobes-; anaerobes-; bacterial-count; carbohydrate-metabolism; glucose-; cellobiose-; ferulic-acid; metabolism-; comparisons-; forest-soils; broadleaved-deciduous-forests; octolasium-lacteum

Abstract: Aerobic and anaerobic microbial potentials of guts from earthworms (Lumbricus rubellus Hoffmeister and Octolasium lacteum (Oerl.)) collected from a beech forest were evaluated. On the basis of enumeration studies, microbes capable of growth under both aerobic and anaerobic conditions were more numerous in the earthworm intestine than in the beech forest soil from which the worms were obtained. The intestine of worms displayed nearly equivalent aerobic and anaerobic microbial growth potentials; in comparison, soils displayed greater aerobic than anaerobic microbial growth potentials. Hence, the ratio of microbes capable of growth under obligately anaerobic conditions to those capable of growth under aerobic conditions was higher with the worm intestine than with the soil. Process level studies corroborated these population differentials: (i) under anaerobic conditions, worm gut homogenates consumed glucose, cellobiose, or ferulate more readily than did soil homogenates; and (ii) under aerobic conditions, worm gut homogenates consumed cellobiose or oxygen more readily than did soil homogenates. Collectively, these results reinforce the general concept that the earthworm gut is not microbiologically equivalent to soil and also suggest that the earthworm gut might constitute a microhabitat enriched in microbes capable of anaerobic growth and activity.

24. NAL Call No.: S590.C63
Comparison of buried bag and PVC core methods for in situ measurement of nitrogen mineralization rates in an agricultural soil.
Includes references.
Descriptors: agricultural-soils; nitrogen-; mineralization-; determination-; measurement-; analytical-methods; comparisons-; nitrogen-; nutrient-sources; earthworms-; populations-

Abstract: We compared estimates of soil nitrogen (N) mineralization rates using the buried bag and PVC core methods in an ongoing investigation of the effects of earthworms and N fertilizer sources on agroecosystem N dynamics. Over a seven-month period, we paired monthly buried bag and PVC core soil incubations within research plots receiving one of three N treatments (inorganic, legume, or manure fertilizers) and with manipulated earthworm populations (reduced, ambient, or increased numbers). Soil moisture within both the buried bags and the PVC cores fluctuated in response to changes in the surrounding soil, violating assumptions of the buried bag method that soil moisture remains constant during incubation. For both methods, overall CV's for net ammonification, nitrification, and N mineralization rates were very high (104-628%). Overall, results for the two methods were significantly correlated for net ammonification (r = 0.89), net nitrification (r = 0.58), and net N mineralization (r = 0.24). In general, the two methods yielded similar seasonal estimates of net N mineralization and nitrification. However, on one occasion in the plots with the inorganic N treatment, buried bag estimates of net N mineralization were significantly higher than the PVC core estimates (1.5 versus -0.4 mg N.kg-1 soil.d-1, respectively). Under some conditions, the two methods may lead to quite different interpretations of soil N mineralization processes.

25. NAL Call No.: QH545.A1E29
Comparison of forest soil microcosm and acute toxicity studies for determining effects of fenitrothion on earthworms.
Includes references.
Descriptors: fenitrothion-; toxicity-; eisenia-fetida; dendrobaena-; sublethal-effects; susceptibility-; mortality-; burrowing-; forest-litter; soil-organic- matter; growth-; reproduction-; species-differences; dendrobaena-octaedra

26. NAL Call No.: QH450.J6
Comparison of water movement and quality in earthworm burrows and pan lysimeters.
Includes references.
Descriptors: lumbricus-terrestris; animal-burrows; water-flow; nitrate-nitrogen; water-flow; nitrate-nitrogen; ammonium-nitrogen; pollutants-; macropore-flow; no-tillage-; tillage-; continuous-cropping; zea-mays; conventional-tillage

Abstract: Although a number of investigators have suggested that earthworm burrows can affect water movement and quality, little attempt has been made to directly measure their effect in the field. Using individual samplers, we monitored flow in Lumbricus terrestris L. burrows for 11 mo in adjacent no-till and conventionally tilled watersheds used for the continuous production of corn (Zea mays L.). Tension-free pan lysimeters were used to assess the composition and amount of bulk subsurface flow in
Abstract: The complete primary structure of a 40-kDa actin-modulating protein from the earthworm Lumbricus terrestris is presented. A muscle-specific cDNA library of the earthworm was constructed and screened with a specific DNA probe obtained by polymerase chain reaction considering information from peptide sequencing. A full-length clone with a coding region of 1098 bp was isolated. The deduced polypeptide sequence of 366 amino acids (41457 Da) reveals the segmental structure typical of both the 40-kDa and 80-kDa actin-modulating proteins. Prominent similarities to the 80-kDa protein gelsolin especially exist with respect to the first segment and to the C-terminal segment. The comparatively high nucleation efficiency of the earthworm actin modulator is probably determined by its third segment which seems to enable the earthworm actin modulator to bind a second G-actin molecule more tightly than other previously described 40-kDa modulators.
Dietary uptake of superlipophilic compounds by earthworms (Eisenia andrei).
Includes references.
Descriptors: eisenia-; organic-compounds; polychlorinated-biphenyls; pollutants-; uptake-; diet-; concentration-; excretion-; pharmacokinetics-; toxicology-; hexabromobenzene-; octachloronaphthalene-.

32. NAL Call No.:  442.8-An72
Distribution and prevalence of the predatory planarian Artioposthia triangulata (Dendy) (Tricladida: Terricola) in Scotland.
Includes references.
Descriptors: planaria-; predators-; earthworms-; agricultural-land; population-distribution; scotland-.

33. NAL Call No.:  TD172.C54
Distribution and transport of atrazine as influenced by surface cultivation, earthworm population and rainfall pattern.
Includes references.
Descriptors: atrazine-; herbicide-residues; leaching-; tillage-; no-tillage-; population-density; rain-; saturated-hydraulic-conductivity; macropores-.

34. NAL Call No.:  QH545.A1E29
Earthworm and food interactions on bioaccumulation and disappearance in soil of polycyclic aromatic hydrocarbons: studies on phenanthrene and fluoranthene.
Includes references.
Descriptors: polycyclic-hydrocarbons; contaminants-; lumbricus-rubellus; earthworms-; lipids-; concentration-; exposure-; duration-; degradation-; polluted-soils; food-limitation.

35. NAL Call No.:  QH84.8.B46
Earthworm biomass response to soil management in semi-arid tropical Alfisol agroecosystems.
Special Issue: Microbial and faunal biomass in soils. II.
Descriptors: earthworms-; lampito-mauritii; farmyard-manure; rice-straw; tillage-; no-tillage-; biomass-; spatial-variation; temporal-variation; dry- season; rainy-season; india-; octochaetona-phillotti; octonochaeta-rosea.

36. NAL Call No.:  SF597.E3L35--1994
Earthworm breeding for profit : practical production and marketing of earthworms in Australia and New Zealand. 2nd ed.
Descriptors: Earthworm-culture; Earthworms-Marketing.

37. NAL Call No.:  QH545.A1E52
Earthworm communities along a gradient of urbanization.
Includes references.
Descriptors: earthworms-; population-density; biomass-production; cadmium-; magnesium-; lead-; copper-; zinc-; concentration-; soil-pollution; urban- areas; belgium-.

38. NAL Call No.:  QL391.A6E22--1995
Earthworm ecology and biogeography in North America.
Hendrix, P. F. 244 : ill., mapsp. ( Lewis Publishers, Boca Raton FL:. 1995)
Descriptors: Earthworms-Ecology-North-America; Earthworms-North-America-Geographical-distribution.

39. NAL Call No.:  Q592.7.A156
Earthworm effects on N dynamics and soil respiration in microcosms receiving organic and inorganic nutrients.
Includes references.
Descriptors: lumbricus-terrestris; porrectodea-caliginosa; biological-activity-in-soil; nitrogen-cycle; nutrient-sources; nitrogen-fertilizers; cattle- manure; vicia-villosa; crop-residues; respiration-; nitrate-nitrogen; ammonium-nitrogen; nutrient-availability; soil-flora; biomass-; nitrogen-; mineralization-.
Abstract: We designed a microcosm experiment to investigate the effects of earthworms on N cycling processes and microbial activity in soil receiving organic or inorganic nutrient amendments. Cylindrical microcosms contained 161. of field-collected soil that received 1 of 3 nutrient amendments, added to the upper 5 cm of soil at a rate of 150 kg N ha⁻¹: (I) granular NH₄NO₃. fertilizer; (2) straw-packed dairy cow manure; and (3) air-dried hairy vetch (Vicia villosa) legume residue. There were 4 replicates of each nutrient treatment without earthworms, and 4 replicates with a total of 21 earthworms added per microcosm (a mixed community of Lumbricus terrestris and Aporrectodea tuberculata). The microcosms were incubated for 112 days. Soil respiration was measured continuously and extractable NO₃⁻ and NH₄⁺ in mineralization and temperature, in contrast, followed a logistic curve. Significant main effects of A. caliginosa were confined to 12C mineralization, reflecting an increase in 12CO₂-C production in the earthworm treatments. The earthworm effects on 12CO₂-C production and on 14C incorporation of the microbial biomass were not linear. The effect of A. caliginosa on 12CO₂-C production and on 14C incorporation of the microbial biomass was most pronounced at intermediate temperatures. It is concluded that temperature alterations affect the microbial use of different C sources in different ways and that the temperature effects can be significantly modified by endogeic earthworms. Earthworm effects on the use of C sources by microorganisms: non-linear response to temperature alteration. Wolters, V.; Ekschmitt, K. Biol-fertil-soils v.19(2/3): p.109-114. (1995 Feb.) Special Issue: Microbial and faunal biomass in soils. 1. Descriptors: aporrectodea-caliginosa; soil-flora; biomass--; litter-plant; fagus-sylvatica; air-temperature; carbon--; mineralization--; forest-soils; calcareous-soils; climatic-change

Abstract: A microcosm was used to study the effect of the endogeic earthworm Aporrectodea caliginosa (Savigny) on the use of C by microorganisms in a calcareous beech forest soil and its dependence on temperature (5-25 degrees C). Inclusion of 14C-labelled beech leaf litter made it possible to differentiate between C use by litter-colonizing microflora and by autochthonous soil microflora. The effect of temperature on the soil microbial biomass 12C was confined to a significant increase at 15 and 20 degrees C. The size of the 14C-labelled microbial biomass, in contrast, was positively correlated with temperature. The 12C mineralization increased exponentially with temperature. The relationship between 14C mineralization and temperature, in contrast, followed a logistic curve. Significant main effects of A. caliginosa were confined to 12C mineralization, reflecting an increase in 12CO₂-C production in the earthworm treatments. The earthworm effects on 12CO₂-C production and on 14C incorporation of the microflora were not linear. The effect of A. caliginosa on 12CO₂-C production was most pronounced at intermediate temperatures. It is concluded that temperature alterations affect the microbial use of different C sources in different ways and that the temperature effects can be significantly modified by endogeic earthworms.
as shown by a 15.5-fold increase in 14C enrichment in the surface litter by the end of the experiment. This translocation of soil C into the litter was significantly reduced by earthworm activities (155.43, 121.11, and 240.58 kBq kg(-1) litter for L. rubellus, A. caliginosa, and the control, respectively), possibly due to disruption by earthworms of fungal-hyphal connections between litter and soil. These interactions between earthworms and soil microbial processes have important implications for soil C turnover.

43. NAL Call No.: TD365.C54-1995
Earthworm macropores and preferential transport as influenced by management.

Includes references.
Descriptors: earthworm-channels; macropores-; macropore-flow; porosity-; liquid-manures; cattle-manure; application-to-land; no-tillage-; chiselling-; lumbricus-terrestris; lumbricus-rubellus; aporrectodea-; minnesota-; aporrectodea-tuberculata; macroporosity-.

44. NAL Call No.: QH84.8.B46
Earthworm macropores and preferential transport in a long-term manure applied typic hapludalf.

Includes references.
Descriptors: dairy-effluent; inorganic-compounds; fertilizers-; application-to-land; earthworms-; macropores-; pore-size; spatial-distribution; soil-depth; soil-water-movement; hapludalfs-; minnesota-

Abstract: Deep burrowing earthworm species have been found to be present in soils with a history of manure application. This study was designed to quantify the effects of long-term application of liquid dairy manure and inorganic fertilizer on the distribution of earthworm macropores and in turn on the preferential transport of water and tracer through a typical soil of the karst area of the upper mid-western USA. Large (approximately 30 cm diam. by 90 cm long) undisturbed soil columns were taken from plots where liquid dairy manure or inorganic fertilizers had been applied continuously for 8 yr. The number and size distribution of macropores in soil columns were nearly the same for both inorganic and manure treatments, however, visible surface macropores were continuous to much deeper depth in soil columns taken from manure than from the inorganic fertilizer plot. Identification of the earthworms a year later showed the presence of Aporrectodea tuberculata, A. trapezoïdes, and Lumbricus rubellus, subsurface burrowers, as well as, L. terrestris, a deeper burrowing species in the manure applied plot. Aporrectodea tuberculata was the only species present in the inorganic fertilizer plot. Number of macropores and macroporosity varied with soil depth. The maximum macroporosity was <2.5% and it occurred at 2-cm depth. The predominant macropore sizes were between 1- and 2-mm radii for both treatments. During breakthrough experiments, Cl appeared earlier in soil columns taken from the manure plot thereby indicating a greater continuity of macropores in the manure compared with the inorganic fertilizer treatment. The early appearance of Cl in the manure treatment, however, was much. The intrusive serial sectioning and image analysis techniques probably overestimate the continuity of macropores possibly due to vacuuming of the earthworm casts and other debris that plugs the macropores channels. Based on the observations of soil columns taken from manure than from the inorganic fertilizer plot. The macropore size distribution with depth and related breakthrough curves, it is likely that most existing models of water and contaminant transport that simulate macropore flow, will not accurately predict the transport of water and contaminant because of their assumption that surface visible macropores are continuous to deeper soil depths. Data from this study showed that macropore size distribution could be described by a normal or log-normal distribution function. These functions in combination with information on continuity and tortuosity of macropores may be sufficient, when used in some current models, to adequately describe the conducting efficiency of macropores in soils.

45. NAL Call No.: QH84.8.B46
The earthworm population of a winter cereal field and its effects on soil and nitrogen turnover.

Special Issue: Microbial and faunal biomass in soils. 1.
Descriptors: earthworms-; population-density; nitrogen-cycle; biomass-production; worm-casts; tillage-; rotations-; cattle-slurry; arable-land; biological- activity-in-soil; northern-ireland

Abstract: The earthworm population in a winter cereal field in Ireland was studied over a 3-year-period and its effects on soil and N turnover were assessed. The mean annual population density was 346-471 individuals m-2 and the mean biomass was 56.9-61.2 g m-2. Twelve species were recorded, the most abundant being Allolobophora chlorotica followed by Aporrectodea caliginosa. Relative cast production (mg dry soil egested g-1 fresh mass day-1) in the laboratory ranged from 362 mg at 5 degrees C to 2553 mg at 15 degrees C in the case of Aporrectodea caliginosa, and 242 mg at 5 degrees C to 713 mg at 10 degrees C in the case of juvenile Lumbricus terrestris. Gut contents (dry mass of soil) comprised 6.7-15.5% of the A. caliginosa live mass, and 9.7-14.7% of the Lumbricus terrestris mass. Annual soil egestion by the field population was estimated as 18-22 kg m-2. Tissue production ranged from 81.7 to 6.7-15.5% of the A. caliginosa live mass, and 9.7-14.7% of the Lumbricus terrestris mass. Annual soil mineralization of 3.4-4.1 g N m-2 year -1.
46. NAL Call No.: SF597.E3G99--1994
Earthworms : a full circle.
Descriptors: Earthworm-culture; Earthworms-; Earthworm-culture-Economic-aspects

47. NAL Call No.: TD172.C54
Earthworms and assessment of ecological impact of soil xenobiotics.
Includes references.
Descriptors: earthworms-; pollutants-; organic-compounds; metabolism-; mineralization-; polluted-soils; soil-pollution

48. NAL Call No.: QH84.8.S6315-1994
Earthworms and other fauna in the soil.
Includes references.
Descriptors: earthworms-; soil-arthropods; animal-burrows; habitats-; population-density; soil-properties; residues-; decomposition-; research-needs

49. NAL Call No.: QH545.A1E52
Earthworms and radionuclides, with experimental investigations on the uptake and exchangeability of radiocaesium.
Includes references.
Descriptors: aporrectodea-longa; cesium-; radionuclides-; uptake-; bioavailability-; spatial-distribution; biological-activity-in-soil; soil-; litter-plant

50. NAL Call No.: QH84.8.B46
Earthworms disseminate a soil-borne plant pathogen, Fusarium oxysporum f.sp. raphani.
Includes references.
Descriptors: earthworms-; pheretima-; fusarium-oxysporum; plant-pathogenic-fungi; dispersal-; fungal-spores; survival-; digestive-system; worm-casts; propagules-

51. NAL Call No.: SF597.E3B76--1994
Earthworms unlimited : backyard earthworm breeding.
Brown, A. 80p. (Kangaroo Press, Dural Delivery Centre, NSW , 1994)
Includes bibliographical references (p. 77-78) and index.
Descriptors: Earthworm-culture; Earthworms-

52. NAL Call No.: QH84.8.B46
Effect of agroforestry woody species on earthworm activity and physicochemical properties of worm casts.
Includes references.
Descriptors: woody-plants; gliricidia-; gliricidia-sepium; leucaena-leucocephala; treculia-africana; earthworms-; biological-activity-in-soil; worm-casts; chemical-composition; physicochemical-properties; microclimate-; phosphorus-; sorption-; zea-mays; growth-; npk-fertilizers; nutrient-uptake; dactyladenia-barteri; senna-siamea; hyperiodrilus-africanus

53. NAL Call No.: QH84.8.B46
Effect of blood type and placement on earthworm (Aporrectodea tuberculata) burrowing and soil turnover.
Includes references.
Descriptors: aporrectodea-caliginosa; earthworms-; biological-activity-in-soil; burrowing-; pedoturbation-; crop-residues; spatial-distribution; food-; sources-; patterns-; macropores-; macropore-flow; transport-processes; bioturbation-; preferential-transport; burrowing-patterns

Abstract: Subsurface-dwelling Aporrectodea tuberculata a common earthworm in Upper-Midwest (USA) agricultural fields, may be a significant component of agroecosystems with regard to soil mixing and preferential transport of water and chemicals. In this study we looked at effects of food residue placement and food type on A. tuberculata burrowing and soil turnover in two-dimensional Evans box microcosms. Four food residue placements mimicked patterns induced by primary tillage and two food types, readily available and natural food sources, with no food as a control. An average earthworm population of 100 earthworms m-2 was calculated to generate 1058 km ha-1 of new burrows and turnover 7.9 Mg ha-1 of soil in 1 week of activity at 20 degrees C. Burrowing was random until food sources were encountered, at which time burrowing appeared to center around the food source.

54. NAL Call No.: QH84.8.B46
Effect of diet on cast production by the megascolecid earthworm Amythas alexandri in laboratory culture.
Includes references.
Abstract: The effects of environmental quantity (moderate soil moisture vs. low soil moisture) and quality (low soil moisture vs. low temperature) on multilocus heterozygosity (MLH)-growth relationships were tested in the earthworm Eisenia fetida. The control treatment was high soil moisture and high temperature. Fresh weight was measured weekly for 4 weeks; MLH was computed for eight polymorphic loci. Moderate moisture limited growth (change in fresh weight) to 50 per cent of control growth; both low moisture and low temperature limited growth to 25 per cent of control growth. MLH was not correlated with growth at any time in the control treatment. MLH was strongly correlated with growth \( (P < 0.01) \) in three out of four weekly intervals in the moderate moisture treatment; MLH was weakly correlated with growth \( (P < 0.05) \) in two out of four weekly intervals in the low moisture treatment. MLH was not correlated with growth at any time in the low temperature treatment. Moderate soil moisture produced significantly stronger MLH-growth relationships than high moisture or low temperature. Even though low soil moisture and low temperature depressed growth to the same extent, the former produced MLH-growth relationships whereas the latter did not. Thus both environmental quantity and quality affected the existence and recurrence of MLH-growth relationships.

Abstract: Permeability problems on irrigated soils may be alleviated by root systems that increase water flow by creating macropores. Infiltration rates have been shown to increase where plant roots decay and serve as preferential flow paths. For low-organic-matter swelling soil, there is a question whether macropores are able to resist the lateral swelling forces of the soil. The objective of this study was to observe preferential water flow paths in a swelling soil under two cropping systems. A Holtville silty clay loam soil was observed in situ. Two crops, alfalfa (Medicago sativa, L.) and wheat (Triticum turgidum, L.) provided sharply contrasting root systems, with wheat possessing fine, fibrous roots; alfalfa on the other hand, has a taproot system. Macropores were observed after applying soil-adsorbing methylene blue dye to irrigation water. Shrinkage cracks failed to conduct dye after 10 minutes into a flood irrigation. Earthworm (Lubricus terrestris) channels were also observed in situ. Alfalfa on the other hand, produced stable macropores, while wheat produced no such macropores. The influence of alfalfa-root-induced macropores was demonstrated by the increase in final infiltration rate during alfalfa cropping which agreed with Meek et al.'s (1989, 1990) findings on sandy loam soils.

Abstract: Earthworm egg capsules of five species were compared with regard to survival and water relations upon exposure to controlled dehydration at 20 degrees C. Cocoons of the investigated species all contained about 3.5 g water g-1 dry weight when fully hydrated. Approximately 18% of this does not readily freeze upon cooling to -40 degrees C and is referred to as osmotically inactive water. Cocoons exposed to desiccation lose a large proportion of the osmotically active water over 1-4 days until water in...
the cocoon fluids has equilibrated with surrounding water vapour. The amount of osmotically inactive water, on the other hand, is only reduced by 10-20%. Dendrobaena octaedra was the species most tolerant to drought, its tolerance limit coinciding with loss of practically all osmotically active water. For the five species investigated, there seemed not to be any clear correlation between drought tolerance and microhabitat. Previous investigations have suggested a very close relation between tolerance to dehydration and to subzero temperatures in overwintering earthworm cocoons. Survival at a given level of dehydration at room temperature is less than at temperatures below 0 degrees C, and the tolerance of room temperature dehydration is not closely correlated with cold hardiness across the range of the species studied.

59. NAL Call No.: QH545.A1E58
The effects of dieldrin on the sperm ultrastructure of the earthworm Eudrilus eugeniae (Oligochaeta).
Includes references.
Descriptors: dieldrin-; toxicity-; sublethal-effects; oligochaeta-; spermatozoa-; ultrastructure-; nontarget-effects; nontarget-organisms

Abstract: Earthworms of the species Eudrilus eugeniae were exposed to dieldrin, using the contact filter paper method, to study the sublethal effects of the pesticide, which is still widely used in many parts of Africa, on the ultrastructure of spermatozoa. The concentrations ranged from 0.154 to 1.54 microgram/cm2 and exposures lasted 48 h. The spermathecae were dissected out and prepared for electron microscopy. Dieldrin was extracted from the worms by steam distillation and analysed by ECD-gas chromatography. A description of the sperm ultrastructure is presented. This study showed that dieldrin at relatively low concentrations caused structural damage, especially to the nucleus of the sperm. It is argued that this finding could contribute toward the development of a model for predicting environmental quality, based on sperm morphology, sperm motility, and sperm density. The sublethal effects of dieldrin on sperm morphology could provide a subanimal test for ecotoxicity since its effects will most probably be manifested at the population level.

60. NAL Call No.: 56.8-So3
The effects of direct drilling and stubble retention on water and bromide movement and earthworm species in a duplex soil.
Includes references.
Descriptors: duplex-soils; conservation-tillage; drilling-; tillage-; soil-pore-system; macropore-flow; infiltration-; earthworms-; oligochaeta-; populations-; population-dynamics; species-diversity; australia-; conventional-versus-conservation-tillage; preferential-flow

61. NAL Call No.: QL391.N4J62
Effects of earthworms on the dispersal of Steinernema spp.
Includes references.
Descriptors: steinernema-; neoaplectana-feltiae; neoaplectana-glaseri; lumbricus-terrestris; dispersal-; earthworm-channels; spatial-distribution; species- differences; entomophilic-nematodes; soil-biology; biological-control-agents; steinernema-carpocapsae

Abstract: Previous studies indicated that dispersal of S. carpocapsae may be enhanced in soil with earthworms. The objective of this research was to determine and compare the effects of earthworms on dispersal of other Steinerennema spp. Vertical dispersal of Steinerennema carpocapsae, S. feltiae, and S. glaseri was tested in soil columns in the presence and absence of earthworms (Lumbricus terrestris). Dispersal was evaluated by a bioassay and by direct extraction of nematodes from soil. Upward dispersal of S. carpocapsae and S. feltiae increased in the presence of earthworms, whereas upward dispersal of S. glaseri was not affected by earthworms. No significant differences were detected in downward dispersal of S. carpocapsae and S. feltiae in soil with earthworms compared to soil without earthworms. Downward dispersal of S. glaseri, however, was greater in soil without earthworms relative to soil with earthworms. In soil void of earthworms, dispersal of S. glaseri was greatest followed by dispersal of S. carpocapsae. The presence of earthworm burrows in soil did not influence nematode dispersal. Nematodes were recovered from the surface, interior, and casts of earthworms. Therefore, nematodes may have a phoretic association with earthworms.

62. NAL Call No.: 410-Ec7
Effects of invasion of an aspen forest (Canada) by Dendrobaena octaedra (Lumbricidae) on plant growth.
Includes references.
Descriptors: dendrobaena-; invasion-; forest-soils; populus-; forests-; elymus-trachycalus; growth-; biomass-production; shoots-; roots-; root-shoot- ratio; nutrients-; mineralization-; soil-flora; respiration-; ammonium-nitrogen; nitrate-nitrogen; phosphates-; soil-water-regimes; exposure-; duration-; phosphate-phosphorus

63. NAL Call No.: QH84.8.B46
Effects of lumbricids and enchytraeids on nematodes in limed and unlimed coniferous mor humus.
Includes references.
64. NAL Call No.: QB84.8.B46
Effects of pasture improvement and intensive cultivation on microbial biomass, enzyme activities, and composition and size of earthworm populations.
Includes references.
Descriptors: pastures-; superphosphate-; application-rates; microorganisms-; biomass-; enzyme-activity; earthworms-; new-zealand

65. NAL Call No.: S592.7.A1S6
Efficacy of methods for manipulating earthworm populations in large-scale field experiments in agroecosystems.
Includes references.
Descriptors: oligochaeta-; earthworms-; populations-; population-change; field-experimentation; cycling-; biological-activity-in-soil; soil-analysis; analytical-methods; efficacy-; zea-mays; agricultural-soils; ohio-

Abstract: We established a long-term field experiment in 1991 to investigate the influence of earthworms on C and N cycling processes in agroecosystems. In a replicated field experiment we decreased earthworm populations using electroshocking, increased them by adding field-collected worms or left them unmanipulated. Population manipulations and sampling were done twice per year in 20 m2 field enclosures that were made from sheets of PVC buried 45 cm deep and extending 15 cm above the soil surface. The experiment was established in maize (Zea mays) agroecosystems in which N was provided in the form of NH4NO3-N, cow-manure-N or legume-cover-crop-N. The two dominant earthworm species at the site were Lumbricus terrestris and Aporrectodea tuberculata. Electroshocking was effective at reducing earthworm populations to about 25% of their natural abundance. In the autumn of 1993, electroshocked enclosures had 75% fewer earthworms and 65% less earthworm biomass than plots with unmodified populations. Electroshocking was equally effective at reducing populations of all earthworm species and did not alter the relative species abundance. The addition of field-collected worms was not as effective as at increasing earthworm populations as electroshocking was at reducing populations. Enclosures with added earthworms had 1.17-fold more earthworms and 2.18-fold greater earthworm biomass than control enclosures. The biomass of L. terrestris was significantly greater in enclosures with increased earthworm populations than in enclosures with reduced or unmodified populations; the biomass of A. tuberculata was not increased. Total earthworm biomass at the site declined from nearly 90 g m-2 in the summers of 1991 and 1993 and a period of excessive rain in the summer of 1992; and (2) the conversion of the field from perennial alfalfa (Medicago sativa) to cultivated maize. The manipulation of earthworm populations in large-scale, replicated field experiments provides a unique and successful approach for investigating the effects of earthworms on soil structure and nutrient cycling processes.

66. NAL Call No.: QB84.8.B46
Enhanced root nodulation of subterranean clover (Trifolium subterraneum) by Rhizobium leguminosarum biovar trifolii in the presence of the earthworm Apporrectodea trapezoides (Lumbricidae).
Includes references.
Descriptors: trifolium-subterraneum; seedlings-; rhizobium-leguminosarum; nodulation-; root-nodules; spatial-distribution; apporrectodea-caliginosa; dispersal-; sheep-dung; growth-; foliar-diagnosis; leaves-; nitrogen-content

67. NAL Call No.: TD172.C54
Includes references.
Descriptors: surfactants-; microbial-degradation; soil-flora; toxicity-; bioassays-; eisenia-fetida; algae-; avena-sativa; luctua-sativa; waste-water- treatment; biological-treatment; seleastrum-capricornutum

68. NAL Call No.: TD172.C54
Experimental accumulation of lead from soil through earthworms to common shrews.
Includes references.
Descriptors: lead-; polluted-soils; earthworms-; lumbricidae-; sorex-araneus; trophic-levels; food-chains; toxicity-

69. NAL Call No.: SB998.E4E76--1995
The farmer's earthworm handbook : managing your underground money-makers. 1st ed.
Descriptors: Zoology, Economic; Tillage-; Earthworms-
Field evidence for reduced severity of Rhizoctonia bare-patch disease of wheat, due to the presence of the earthworms Aporrectodea rosea and Aporrectodea trapezoides.


Abstract: A study demonstrated the ability of the earthworms Aporrectodea rosea and Aporrectodea trapezoides (added at an equivalent density of 100 or 300 m\(^{-2}\)) to reduce the disease severity of Rhizoctonia solani Kuhn on wheat in the field. In a calcareous sandy loam artificially infested with R. solani, the addition of these earthworms caused a significant (P = 0.02) reduction of the Rhizoctonia root disease rating and had a significant (P = 0.01) positive effect on shoot weight. Neither earthworm number or earthworm species had a significant (P < 0.05) effect on root disease rating or shoot weight. In a red-brown earth soil artificially infested with R. solani, neither the presence of these earthworms, earthworm species nor earthworm number influenced root disease rating. However, under these conditions the addition of earthworms (P = 0.01) had a significant positive effect upon shoot weight. To our knowledge these results demonstrate for the first time, the potential of earthworms to contribute to the disease suppression of a cropping soil in a field situation.
34. Abstract: The predation of earthworms by the New Zealand flatworm is an environmental threat that may have consequences beyond the scope of merely reducing earthworm populations in the UK. The role of structural degradation on hydrological-factors; uk-Descriptors: tricladida-; introduced-species; predation-; earthworms-; environmental-impact; Includes references.

77. NAL Call No.: S7.8-C734
Historical overview of vermicomposting.
Includes references.
Descriptors: vermicomposting-; organic-wastes; waste-utilization; earthworms-

80. NAL Call No.: QH84.8.B46
Impact of pasture contamination by copper, chromium, arsenic timber preservative of soil biological activity.
Includes references.
Descriptors: grassland-soils; contamination-; copper-; chromium-; arsenic-; wood-preservatives; polluted-soils; soil-depth; biological-activity-in-soil; lumbricus-rubellus; aporrectodea-; enchytraeidae-; free-living-nematodes; population-density; species-diversity; respiration-; nitrate-nitrogen;
Influence of barley straw and the lumbricid earthworm Aporrectodea trapezoides on Rhizobium meliloti L5-30R, previously inoculated separately into soil, was examined. The addition of barley straw (0.62% w/w), significantly increased the numbers of both introduced bacteria ca. 1000- to 3000-fold after 29 d incubation and ca. 105, 315 or 525 m-2) and the numbers of both introduced bacteria after 29 d, but not after 63 d incubation. In contrast, in the presence of barley straw, there was a significant negative linear relationship between the number of A. trapezoides (at densities equivalent to 0, 50, 150, or 300 m-2) and the numbers of both introduced bacteria after 29 and 63 d incubation. By combining data from both sampling times, there was a significant linear relationship between the number of A. trapezoides and the numbers of both introduced bacteria after 29 and 63 d incubation. In situ analysis of the bacterial community in the gut of the earthworm Lumbricus terrestris L. by whole-cell hybridization. In situ analysis of the bacterial community in the gut of the earthworm Lumbricus terrestris L. by whole-cell hybridization. 

Abstract: In greenhouse experiments, the ability of barley straw and the earthworm Aporrectodea trapezoides to influence the persistence of Pseudomonas corrugata 2140R and Rhizobium meliloti L5-30R, previously inoculated separately into soil, was examined. The addition of barley straw (0.62% w/w), significantly increased the numbers of both introduced bacteria ca. 1000- to 3000-fold after 29 d incubation and cat 25-to 100-fold after 63 d incubation in soil. In the absence of barley straw, there was a significant positive linear relationship between the number of A. trapezoides and the numbers of both introduced bacteria after 29 d, but not after 63 d incubation. In contrast, in the presence of barley straw, there was a significant negative linear relationship between the number of A. trapezoides and the numbers of both introduced bacteria after 29 and 63 d incubation. By combining data from both sampling times, there was a significant linear relationship between the persistence of both introduced bacteria and changes in microbial biomass only in the presence of added barley straw. This would suggest that A. trapezoides had a selective effect upon the persistence of both introduced bacteria in the absence of barley straw, which was not manifest upon the whole microbial community.
85. NAL Call No.: QH84.8.B46

86. NAL Call No.: S592.7.A1S6

87. NAL Call No.: S592.7.A1S6

Abstract: The geophagous earthworm Octolasion cyaneum was maintained in microcosms for up to 14 d in the presence of a genetically-modified microorganism (GEMMO). Pseudomonas fluorescens KTG. The GEMMO contained a marker cassette, which was inserted into the chromosome, consisting of the genes coding for kanamycin and gentamycin resistance and also a cryIVB sequence. Plate counts of P. fluorescens KTG were higher in the burrow wall on day 2, and lower on days 7 and 14 than those in the unworked bulk soil. Numbers of P. fluorescens KTG were consistently significantly lower in cast material than in the unworked soil. Counts for total bacteria revealed no significant differences between bulk soil, burrow wall and casts. When earthworms were fed on soil containing P. fluorescens KTG, the population size of the GEMMO declined progressively on passage from the foregut to the hindgut, then increased slightly in the casts relative to the hindgut. However counts in fresh casts were still significantly lower than the corresponding uningested soil. Populations of P. fluorescens KTG in casts increased by up to 10-fold over the first 2 d of the ageing period. Thereafter, plate counts of the GEMMO were slightly lower than the corresponding soil kept under the same conditions, showing a similar rate of decline over the 50-d period. Total bacterial plate counts in the aged casts increased by approximately 25-fold during the first 2 d of incubation, subsequently declining whilst remaining significantly higher than the total bacterial plate counts in the corresponding soil which remained relatively constant throughout the experiment. Following a single exposure of the earthworms to the GEMMO, counts of the potential for dispersal of GEMMOs by soil invertebrates.

88. NAL Call No.: QDS01.M63

Abstract: Our interest in detecting genotoxic exposure in earthworms led us to isolate high quality DNA from the Eisenia fetida species. For that, we compared a modification of the conventional phenol-chloroform extraction procedure, usually referred to as the Maniatis procedure, to two commercially available kits reportedly eliminating multiple partitions in phenol and chloroform, namely the Qiagen and Nucleon protocols. From the 260 nm optical density values, the commercial kits extracts hinted toward higher DNA recovery with those procedures. However, the 260/280 nm ratios indicated that the quality of the DNA isolated with the modified Maniatis procedure was purer than that isolated with the commercial kits, the latter being most probably contaminated by proteins and/or RNA. The Maniatis procedure was slightly modified by the introduction of a potassium acetate step for protein precipitation and by shortening the proteinase K treatment from 12-18 h to only 2 h. The higher quality of the DNA isolated by phenol-chloroform extraction was confirmed by quantification with the fluorescent 3,5-diaminobenzoic acid assay. Preliminary results suggest that the modified Maniatis procedure herein described is not only applicable for DNA adducts studies using 32P-postlabelling techniques but is also suitable for DNA extraction from other earthworm species such as Lumbricus terrestris.

89. NAL Call No.: S1.M57

90. NAL Call No.: S592.7.A1S6
Lumbricus terrestris in a soil core experiment: nutrient-enrichment processes (NEP) and gut-associated processes (GAP) and their effect on microbial biomass and microbial activity.
Includes references.
Descriptors: soil-flora; populations-; biomass-; microbial-activities; nitrification-; respiration-; lumbricus-terrestris; earthworms-; biological-activity-in-soil; interactions-; organic-matter; incorporation-; metabolism-; enrichment-; nutrient-availability; microbial-ecology; metabolic-activity

Abstract: For 5 weeks, lettuce was supplied to the surface of three types of soil cores. In the first treatment, Lumbricus terrestris (L) was added before the lettuce supply. The average specific growth rate of L. terrestris was 0.01 d-1 with an average feeding rate of 47 mg lettuce dw g-1 earthworm dw d-1 (2.1 mg lettuce Kjeldahl(Kj)-N g-1 earthworm dw d-1). In the second treatment, no worms were added but the lettuce was mixed with the soil. Relative to this "Mixed control", microbial biomass, nitrifying activity and respiration rate were significantly reduced in the presence of L. terrestris by 20, 25 and 49%, respectively. Proteolytic bacteria were significantly stimulated, but the inverse was noticed for fluorescent pseudomonads. Total plate counts, siderophore-producing bacteria and fungi were similar in both treatments. In the third treatment, no worms were added but the lettuce was left unmixed on the soil surface. The "Earthworm treatment" scored significantly higher for most values relative to this "Unmixed control". Nutrient-enrichment processes (NEP) associated with the organic matter incorporation were distinguished from gut-associated processes (GAP) associated with the transit of soil and organic matter through the earthworm gut. It was concluded that the NEP rather than the GAP are responsible for the increased numbers of microorganisms reported in the presence of earthworms. On the other hand, the specific metabolic activity (gC02) of the microbial biomass was decreased by 35% due to the GAP. The lower gC02 indicated a better energy to biomass conversion and an alteration in the microbial community in favour of a higher proportion of K-strategists.

91. NAL Call No.: QH545.A1E58
Lysozyme activity in earthworm (Lumbricus terrestris) coelomic fluid and coelomocytes: enzyme assay for immunotoxicity of xenobiotics.
Includes references.
Descriptors: lumbricus-terrestris; toxicity-; immune-system; copper-; sublethal-effects; lysozyme-; enzyme-activity; body-fluids; mortality-; temperature-; immunotoxicity-

92. NAL Call No.: QH545.A1E58
A method for assessing sublethal effects of contaminants in soils to the earthworm, Eisenia fetida.
Descriptors: eisenia-fetida; toxicity-; contaminants-; growth-; biomass-production; reproduction-; survival-; sublethal-effects; biological-indicators; monitoring-; soil-pollution

Abstract: We developed and tested a procedure that allows quantification of the effects of soil contaminants on earthworm (Eisenia fetida) growth and reproduction. The procedure monitors isolated pairs of earthworms and generates a higher ratio of data per organism than other commonly used procedures. It also incorporates an accurate technique for measuring adult growth, has high sensitivity compared to the Organization for Economic Cooperation and Development (OECD) 14-d acute toxicity test, and is cost effective. We applied the method to a variety of soil-testing problems. A food-and-substrate trial using artificial soil demonstrated the sensitivity of the method and the need for food supplementation to stimulate earthworm reproduction. Application of the procedure to assess efficacy of a soil bioremediation technology revealed the advantage of measuring both growth and reproduction and highlighted the usefulness of a single integrated measure of these two responses. The method also was used as a fast-screening analysis for field soils in a large-scale ecological risk assessment. Finally, a reference toxicant, used in dilution series, demonstrated that responses of E. fetida using our method were similar to their responses in the OECD artificial-soil test method. The results of this study indicate that this procedure can be used both for regulatory and compliance needs within the framework of ecological risk assessment.

93. NAL Call No.: S592.7.A156
Method for caging earthworms for use in field experiments.
Includes references.
Descriptors: aaporrectodea-longa; megascolecidae-; earthworms-; populations-; establishment-; biomass-; survival-; biological-activity-in-soil; lime-; sheep-dung; surface-treatment; incorporation-; species-differences; grassland-soils; permanent-grasslands; dry-matter-accumulation; soil-ph; soil-depth; land-productivity; field-experimentation; methodology-; south-australia; spenceriella-

Abstract: A method is described for caging earthworms in undisturbed soil in field experiments. The method is applicable to sites which are seasonally dry (e.g. summer in southern Australia). Cages were made from sections of PVC pipe (20 cm long X 30 cm dia) which were driven vertically into the soil beneath a permanent pasture in South Australia during spring when the soil was moist and resident earthworms were active near the surface. During the following summer, when most resident earthworms
had burrowed below the depth of the pipes to escape surface aridity, the pipes and the soil within them were lifted from the surrounding soil. Fine curtain mesh was strapped across the bottom edges of the pipes and the resultant "cages" were then replaced in their holes. The mesh isolated the soil within the cages and prevented escape or invasion of earthworms during the subsequent wet season when the desired earthworm species were added. The method was used to compare: (1) the influences of surface-applied lime and sheep dung on the establishment of two earthworm species, Aporrectodea longa (Lumbricidae) and Spenceriella sp. (Megascolecidae); (2) the abilities of the same two earthworm species to bury lime and dung; and (3) the relative influences of A. caliginosa, A. longa, A. rosea, A. trapezoides and Spenceriella sp. on pasture production. The earthworms were caged for 5 months. Survivorship of all species was good (greater than or equal to 50%). Contamination in the cages by undesired species was small (< 28%). The addition of sheep dung enhanced the establishment of A. longa (greater numbers and biomass) but not the establishment of Spenceriella sp. The addition of lime did not influence the establishment of either A. longa or A. longa and dung than in other treatments.

94. NAL Call No.: QH84.8.B46
Microbial biomass in agricultural topsoils after 6 years of bare fallow.
Special Issue: Microbial and faunal biomass in soils.1.
Descriptors: soil-flora; biomass-; Fallow-; catalase-; enzyme-activity; earthworms-; soil-properties; topsoil-; agricultural-soils

Abstract: Inherent soil properties have an influence on microbial activity. These effects were measured in a field trial at Weihenstephan with 30 agricultural and 2 vineyard soils from different sites in Bavaria which had been kept under bare fallow for 6 years. The soils represented a wide range of arable soils from a temperate climate. Unaffected by recent differences in climatic conditions or cropping managements, they were used to assess the relationship between microbial biomass C and a broad spectrum of soil physical and chemical properties (clay content 5-63%, pH 4.5-7.5, organic C 0.55-2.93%). Microbial C was measured using the substrate-induced respiration method. In addition, soil catalase activity and the abundance of microbial biomass of earthworms were determined. Among the soil properties, microbial C was most strongly correlated with organic C (r = 0.86, n = 29). In a comparison of linear regressions between microbial biomass C and organic C for different cropping managements, the slope under bare fallow was lowest, followed by monoculture and crop rotation. The microbial:organic C ratio ranged from 1.1 to 4.3% and was significantly correlated with soil pH (r = 0.66). A positive relationship between microbial C and the clay content (r = 0.66) was significantly improved when soils with more than 25% clay were excluded (r = 0.88). Partial correlation analysis indicated that clay had a direct influence, hardly affected by an intercorrelation with organic C. Catalase activity was highly correlated with microbial C (r = 0.95) and, because a rapid and sensitive method of determination is available, was considered suitable for estimating relative amounts of active microbial mesofauna.

95. NAL Call No.: 442.8.B523
Mitochondrial mass and membrane potential in coelomocytes from the earthworm Eisenia fetida: studies with fluorescent probes in single intact cells.
Includes references.
Descriptors: eisenia-fetida; earthworms-; cells-; mitochondria-; cell-membranes; membrane-potential; fluorescence-microscopy; coelom-

Abstract: Earthworm coelomocytes exist in two forms, i.e., small (SC) and large (LC) cells, as demonstrated by velocity sedimentation, electron microscopy, and FCM. However, we know little concerning the functional activities of various, important organelles, such as mitochondria. In comparison with SC, LC from Eisenia fetida have a higher number of mitochondria, and, accordingly, showed a greater fluorescence intensity when mitochondrial mass was measured by nonyl acridine orange and FCM. To measure MMP we used both the lipophilic cationic probe JC-1 and Rh123. The intracellular localization of JC-1 in SC and LC was observed by fluorescence microscopy. Using JC-1, MMP was analyzed separately on SC and LC by FCM, and significant percentages of coelomocytes (>95% of SC and about 90% of LC) displayed a high MMP. Adding 0.1 micromolar VAL caused most SC to depolarize, while this occurred in only a few LC. Rh123 gave different results: no effects of VAL were observed in either in SC or in LC. In coelomocytes there may be several energy-independent Rh123-binding sites whose role must still be elucidated. On the whole, these data indicate that it is possible to analyze mitochondrial parameters by FCM in intact invertebrate coelomocytes, and that the type of cell and the probe used have a critical importance.

96. NAL Call No.: TD172.A7
Modelling and monitoring organochlorine and heavy metal accumulation in soils, earthworms, and shrews in Rhine-delta floodplains.
Includes references.
Descriptors: organochlorine-compounds; heavy-metals; polluted-soils; lumbricus-rubellus; crocidura-russula; sorex-araneus; concentration-; animal- tissues; liver-; kidneys-; lipids-; residues-; pollution-; monitoring-; biological-indicators; species-differences; floodplains-; biconcentration-
Abstract: Dendrobaena veneta, an earthworm species from Europe, has been reported to have the potential to combat organic waste problems and to be a producer of protein. This study was concerned with the effect of moisture on growth, maturation and cocoon production of this species. Moisture preferences of clitellate worms were studied with the aid of cylindrical moisture towers filled with cattle manure, ground to a particle size of between 500 and 1000 micrometers and moistened. A moisture gradient was allowed to develop in the towers and after the worms were added they were kept at a temperature of 15 degrees C and a relative humidity of 47.7%. Juvenile worms were exposed to different moisture contents in glass flasks filled with cattle manure medium and kept at 15 degrees C. The highest frequency for clitellate worms was between 77.9 and 78.7% while their moisture preference ranged between 67.4 and 84.3%. For cocoon production the highest frequency was between 73.1 and 79.9%. The optimum moisture content for growth and maturation of juvenile worms was 75%. From the results it appears that this earthworm species could be utilized in organic waste with a relatively high moisture content. However, comparing the reproductive capacity and maturation time with that of other vermicomposting species, D. veneta seems to be a less successful earthworm species for vermicomposting.

Abstract: The role of monovalent and divalent cations on the structure-function relationships operative in the large extracellular hemoglobin, isolated from the earthworm, Lumbricus terrestris, has been investigated. This study includes the effects of these cations on the rates of autoxidation, resistance to thermal unfolding, and the conversion of the methemoglobin form to the hemichrome state. At pH 7.0, the divalent cations, Mg(II), Ca(II), Sr(II), and Ba(II), were found to be more effective in reducing the rate of Lumbricus hemoglobin autoxidation than any of the monovalent cations studied. The order of effectiveness in decreasing the rate of autoxidation was Ba(II) > Ca(II) > Sr(II) > Mg(II). Resistance to thermal unfolding (25-60 degrees C) for Lumbricus hemoglobin is increased in the presence of Ca(II) or Ba(II) ions. All of the monovalent cations appear to enhance thermal unfolding above 55 degrees C. Reduced hemichrome formation is evident in the presence of Ca(II) or Ba(II) ions. Increased effectiveness of several of the divalent cations in reducing autoxidation, increasing resistance to thermal unfolding, and stabilization of the methemoglobin state is consistent with other investigations showing these cations prevent subunit dissociation of the Lumbricus hemoglobin molecule.
Abstract: Earthworms are intimately involved in the cycling of C and N in soil. Earthworm casts are enriched in mineral N; however, there have been few studies of the dynamics of microbial N transformations associated with earthworm casts. We evaluated the N-transformations in earthworm casts as affected by organic residues used as a food source by earthworms. Denitrification rate, nitrification potential and mineral N content of the casts of two earthworm species (Octolasian tyrtaeum Savigny and Aporrectodea tuberculata Eisen) were assessed in laboratory trials. Trials were made in plastic chambers (600 g soil) with three organic-c treatments: 20 g fresh hairy vetch (Vicia villosa Roth), 5.5 g air-dried hairy vetch or 5.5 g air-dried horse (Equus caballus) manure. Earthworm casts were enriched in mineral N, relative to surrounding soil, and that the amount of N accumulated in earthworm casts was a reflection of the N content of the organic matter used as a food source by the earthworms. Casts had elevated denitrification rates, compared to soil, however, rates were low relative to the elevated NO₃- concentrations in the casts (80-100 microgram NO₃(-)N g⁻¹ dry wt). Observed denitrification rates appeared to be related to the quality of organic matter available to the earthworms, but were not significantly affected by species of worm.
Abstract: Phosphatase and beta-glucosidase, which are hydrolases bound to humic substances, were determined in the extracts of humic substances and in their fractions (F) of varying molecular weight (F1<10(3) low, F2<10(3)-10(4) intermediate and F3>10(4) high) obtained from cow and sheep manure and their corresponding vermicomposted products (casting). In both of these products F2 was the fraction with the highest C and N content, while the F1 fraction lost the greatest proportion of C during vermicomposting. Phosphatase and beta-glucosidase could be detected in all the fractions studied, whether these were from the extracts of the manure or from the casting. However, the enzymatic activity found in the extracts was less than the total activity of all the fractions summed, which demonstrated that an increase in activity was obtained as a consequence of the ultrafiltration. IEF spectra pointed to bands of humic substances with higher isoelectric points (Ip) in the castings than in the corresponding manures. Most of the beta-glucosidase in cow manure (as determined in humic bands appearing in the polyacrylamide gel after IEF) corresponded to humic bands which focused at Ip between 4.1 and 4.7, while in cow manure casting most of the activity was in bands with Ip between 5.1 and 6. In sheep manure and casting the bands which showed beta-glucosidase activity also showed phosphatase activity. Both in the extract and in its different fractions beta-glucosidase and phosphatase activity increased with IEF. IEF spectra showed that humic substances of the casting had higher enzymatic activity than those of the corresponding manures.

110. NAL Call No.: QP33.J681
Physiology of cold hardiness in cocoons of five earthworm taxa (Lumbricidae: Oligochaeta).
Includes references.
Descriptors: lumbricidae; cocoons; cold-resistance; cold-injury; freezing; dehydration-physiological
Abstract: Earthworm cocoons are mostly found in the uppermost soil layers and are therefore often exposed to low temperatures during winter. In the present study, cocoons of five taxa of earthworms were investigated for their tolerance to freezing, melting points of cocoon fluids and dehydration of cocoons when exposed to a frozen environment. Embryos of the taxa investigated were freeze intolerant. The melting points of fully hydrated cocoon fluids were high (above -0.3 degrees C) and thermal hysteresis factors were absent. Exposure to a frozen environment caused the cocoons to dehydrate drastically and dehydrated cocoons showed significantly lower supercooling points than fully hydrated cocoons, reducing the risk of freezing for dehydrated cocoons. It is proposed therefore that the cold-hardiness strategy of the earthworm cocoons is based on dehydration upon exposure to subzero temperatures in the frozen environment. Cocoons of three surface-dwelling taxa, Dendrobaena octaedra, Dendrodrilus rubidus tenuis and Dendrodrilus rubidus norvegicus had lower supercooling points and survived frost exposure better than cocoons of two deeper-dwelling taxa, Aporrectodea caliginosa and Alolobophora chlorotica. One of the investigated taxa, D.r. norvegicus, was collected from a cold alpine habitat. However, it was not more cold hardy than the closely related D.r. tenuis collected from a lowland temperate habitat. D. octaedra was the most cold hardy taxon, its cocoons being able to withstand -8 degrees C for 3 months and -13.5 degrees C for 2 weeks in frozen soil.

111. NAL Call No.: QH545.A1E58
Polychlorinated biphenyls (PCBs) depress allogeneic natural cytotoxicity by earthworm coelomocytes.
Includes references.
Descriptors: polychlorinated-biphenyls; pollutants; lumbricus-terrestris; cell-mediated-immunity; cytotoxicity; cells; in-vitro; bioassays; comparisons; natural-killer-cell-like-activity
Abstract: Coelomocytes of the earthworm Lumbricus terrestris caused significant spontaneous allogeneic cytotoxicity in a 24-h trypan blue assay, but not in an assay using lactate dehydrogenase (LDH) release. Allogeneic cytotoxicity assays using cells from worms exposed to polychlorinated biphenyls (PCBs) suggest that PCBs can suppress a natural killing (NK-like) reaction. The implications of this work are
Abstract: Earthworm egg capsules (“cocoons”) of five species were shown to accumulate polyol, probably sorbitol, when dehydrated at -3 and 20 degrees C. Low temperature (0 degrees C) did not induce polyol accumulation if cocoons were not dehydrated. The polyol accumulation was restricted to the embryos of the cocoons. Accumulated polyol will reduce water loss of the embryo and thus increase the chances for survival in cocoons exposed to cold or drought.

114. NAL Call No.: QH84.8.B46
Includes references.
Descriptors: megascolecidae-; earthworms-; grassland-soils; population-dynamics; seasonal-variation; india-

115. NAL Call No.: QH545.A1E29
Population level consequences of toxicological influences on individual growth and reproduction in Lumbricus rubellus (Lumbricidae, Oligochaeta).
Includes references.
Descriptors: lumbricus-rubellus; toxicity-; copper-; pollutants-; sublethal-effects; exposure-; duration-; population-structure; survival-; growth-; reproduction-; mathematical-models; ecotoxicity-

116. NAL Call No.: QH84.8.B46
Potential of earthworms, ants, millipeds, and termites for dissemination of vesicular-arbuscular mycorrhizal fungi in soil.
Includes references.
Descriptors: vesicular-arbuscular-mycorrhizas; dispersal-; fungal-spores; survival-; viability-; lumbricus-terrestris; arthropods-; feces-; propagules-; camptonotus-; camponotus-compressus; phylogenostreps-nigrolabiatus

117. NAL Call No.: 442.8-An72
The potential spread of terrestrial planarians Artiopeothia triangulata and Australoplana sanguinea var. alba to continental Europe.
Includes references.
Descriptors: planaria-; earthworms-; spread-; prediction-; geographical-distribution; climatic-factors; computer-software; scotland-; europe-; climex-model

118. NAL Call No.: 421-En895
Prey preference and egg production of the carabid beetle Agonum dorsale.
Includes references.
Descriptors: agonum-dorsale; rhopalosiphum-padi; drosophila-melanogaster; lumbricus-terrestris; predatory-insects; feeding- preferences; prey-; predator-prey-relationships; fecundity-; biological-control-agents; prey-quality

119. NAL Call No.: S37.F72
Proliferative gill disease of catfish.
Includes references.
Descriptors: ictalurus-punctatus; fish-diseases; gills-; symptoms-; myxozoa-; oligochaeta-; intermediate-hosts; life-cycle; fish-ponds; disease-control; aurantiactinomyxon-ictaluri; dero-digitata

120. NAL Call No.: QL750.03
Protozoa, nematoda and lumbricidae in the rhizosphere of Hordelymus europaeus (Poaceae): faunal interactions, response of microorganisms and effects on plant growth.
Includes references.
Descriptors: gramineae-; soil-flora; protozoa-; free-living-nematodes; earthworms-; aporrectodea-caliginosa; population-density; shoots-; roots-; biomass-production; nutrient-availability; nitrogen-; phosphorus-; forest-soils; fagus-sylvatica; respiration-; pellioditis-pellio; nutrient-leaching

121. NAL Call No.: QP501.C6
Purification and characterization of a poly-L-lysine-activated serine endoprotease from Lumbricus rubellus.
Includes references.
Descriptors: lumbricus-rubellus; serine-proteinases; purification-; physicochemical-properties;
enzyme-activity; ph-; inhibition-; enzyme-inhibitors; lysine-; coelomomyces-

Abstract: An endoprotease in earthworm (Lumbricus rubellus) is purified to apparent homogeneity using
125-I-lactalbumin as a substrate. The protease has a molecular mass of 27 kDa and is markedly activated
by poly-L-lysine or poly-L-arginine. It is a chymotrypsin-like serine protease. Its activity is distributed to
coeionic fluid but relatively little to coelomocytes.

122. NAL Call No.: TD930.A32
Recycling of cattle dung, biogas plant-effluent and water hyacinth in vermiculture.
Includes references.
Descriptors: cattle-dung; eichhornia-crassipes; plant-residues; vermiculture-; earthworms-; organic-matter;
crude-protein; growth-rate; waste-utilization

Abstract: The efficiency of recycling cattle dung, anaerobically digested cattle dung (biogas plant-effluent)
and water hyacinth (Eichhornia crassipes) by culture of the earthworm Megascolex sp. was studied. The
growth of the earthworms was increased by 156, 148 and 119% in soil supplemented with water hyacinth,
cattle dung and biogas plant-effluent, respectively. The growth rate of the earthworms was increased
significantly by raw cattle dung and water hyacinth over that by biodigested slurry.

123. NAL Call No.: QH84.8.B46
Relationships between casts of geophagous earthworms (Lumbricidae, Oligochaeta) and matric potential. I .
Cast production, water content, and bulk density.
(1994)
Includes references.
Descriptors: aporrectodea-caliginosa; aporrectodea-; worm-casts; matric-potential; water-content;
water-balance; biological-production; bulk-density; species-differences; biological-activity-in-soil;
aporrectodea-rosea; cast-production

124. NAL Call No.: QH84.8.B46
Relationships between casts of geophagous earthworms (Lumbricidae, Oligochaeta) and matric potential. II.
Clay dispersion from casts.
(1994)
Includes references.
Descriptors: aporrectodea-caliginosa; aporrectodea-; worm-casts; matric-potential; dispersion-; clay-;
aggregates-; stability-; aporrectodea-rosea; mechanical-dispersion

125. NAL Call No.: SF995.A1A9
Resistance of chicks and poults fed vermicompost to caecal colonization by Salmonella.
Includes references.
Descriptors: chicks-; poults-; composts-; feces-; eisenia-fetida; earthworms-; disease-resistance; cecum-;
colonization-; salmonella-typhimurium; salmonella-enteritidis; disease-prevention

126. NAL Call No.: 421-J822
Response of plant-feeding, predatory, and soil-inhabiting invertebrates to Acremonium endophyte and
nitrogen fertilization in tall fescue turf.
Includes references.
Descriptors: festuca-arundinacea; acremonium-coenophialum; endophytes-; urea-; soil-fertility;
spadoptera-frugiperda; schizaphis-graminum; rhopalosiphum-padi; predatory-arthropods; insects-;
scheloribates-; earthworms-; population-density; soil-fauna; kentucky-; herbivorous-insects

Abstract: The endophytic fungus Acremonium coenophialum Morgan-Jones & Gams conveys resistance
to herbivory in tall fescue, Festuca arundinacea Schreber. In contrast, nitrogen fertilization generally
enhances plant quality for herbivores. We studied the main effects and interaction of A. coenophialum and
nitrogen fertilization on plant-feeding, predatory, and soil-dwelling invertebrates in tall fescue turf. Fall
armyworms, Spodoptera frugiperda (J. E. Smith), developed faster when reared on foliage from plots
treated with medium or high rates of urea than on unfertilized tall fescue, but development rates were not
affected by A. coenophialum. Greenbugs, Schizaphis graminum Rondani, preferred fertilized,
endophyte-free feces over nonfertilized, endophyte-free grass. Similarly, bird cherry-oat aphids,
Rhopalosiphum padi (L.), developed fastest on fertilized, endophyte-free tall fescue. Fertilization,
however, did not override the strong, adverse effects of A. coenophialum on both aphid species. In field
plots, densities of leafhoppers, flea beetles, and Staphylinidae were generally higher in fertilized than in
nonfertilized turf. Flea beetles and two of the five most abundant species of leafhoppers were less
numerous in endophyte-infected plots. Predatory arthropods, earthworms, oribatid mites, and Japanese
beetle grubs were equally abundant in endophyte-infected and endophyte-free plots. Fertilization did not
affect the densities of oribatids or P. japonica, but earthworms were more abundant in fertilized plots on some dates. Results showed variable main effects, and an absence of interactive effects of A. coenophialum and fertilization on invertebrates in tall fescue. Fertilization of tall fescue probably will not nullify the.

127. NAL Call No.: QL461.E582
Includes references.
Descriptors: earthworms-; snails-; sarcophagidae-; heavy-metals; determination-; environmental-impact

128. NAL Call No.: HC79.E5E5
Includes references.
Descriptors: worm-casts; rock-phosphate; cellulose-; solubilization-; nutrient-availability; nitrogen-; carbon-

129. NAL Call No.: 57.8-C734
Descriptors: vermicomposting-; waste-utilization; projects-

130. NAL Call No.: QH75.A1B562
Secondary succession, soil formation and development of a diverse community of oribatids and saprophagous soil macro-invertebrates.
Special issue: Biodiversity of soil organisms: community concepts and ecosystem function.
Descriptors: soil-invertebrates; lumbricidae-; diplopoda-; isopoda-; species-diversity; plant-succession; secondary-forests; colonization; soil-fertility; carbon-; nitrogen-content; soil-density; soil-depth; temporal-variation; germany-; species-composition; species-abundance

131. NAL Call No.: QH540.F85
Seeds in soil and worm casts from a neutral grassland.
Includes references.
Descriptors: seed-banks; botanical-composition; seed-size; worm-casts; buried-seeds; grasslands-; south-west-england

132. NAL Call No.: SS92.7.A1S6
Selective consumption of decomposing wheat straw by earthworms.
Includes references.
Descriptors: lumbricus-terrestris; aporrectodea-longa; allobophora-chlorotica; earthworms-; feeding-preferences; soil-fungi; species-; wheat-straw; crop-residues; decay-fungi; plant-pathogenic-fungi; microbial-grazing

Abstract: Three species of earthworm, Lumbricus terrestris L., Aporrectodea longa (Ude) and Allobophora chlorotica (Savigny), were offered a choice of mixtures of soil and small wheat straw fragments which had been inoculated individually with six saprotrophic fungi. All earthworm species showed preferences between the six fungal species offered. Early straw decomposers, capable of utilizing water-soluble sugars and cellulose, were preferred in most cases to the lignin-decomposing fungi characteristic of the later stages of decomposition. The removal of fungal-inoculated straw pieces from the soil surface by L. terrestris followed the same pattern. The palatability of two wheat pathogens to L. terrestris was found to be similar to that of the preferred saprotroph. The implications of these findings for fungal abundance and dispersal in wheat fields are discussed.

133. NAL Call No.: 23-Au783
Short-term effects of tillage and stubble management on earthworm populations in cropping systems in southern New South Wales.
Includes references.
Descriptors: triticum-aestivum; brassica-; minimum-tillage; direct-sowing; fallow-; stubble-cultivation; earthworms-; aporrectodea-caliginosa; oligochaeta-; population-density; waterlogging-; red-soils; red-brown-earths; new-south-wales; microscolex-dubius; microscolex-phosphoreus

134. NAL Call No.: RA1270.P35A1
Abstract: Modifications of soil microbiological activity by the addition of municipal solid-waste compost were studied in laboratory incubations. Three composts were compared, one lumbricompomst and two classical composts with different maturation times. Organic C mineralization and nine enzyme activities (dehydrogenase, peroxidase, cellulase, beta-glucosidase, beta-galactosidase, N-acetyl-beta-glucosaminidase, protease, amidase, and urease) were determined in the composts and the amended soil. Initial enzyme activities varied in the soil according to the sampling date (winter or summer) and were greater in the composts than in the soil, except for urease. Generally, the youngest compost exhibited greater activity than the oldest one. In the amended soil, the composts did not increase enzyme activity in an additive way. Dehydrogenase, the only strictly endocellular enzyme, was the only one for which the activity in the amended soil increased significantly in proportion to the addition of compost. During the incubations, C mineralization and dehydrogenase activity were significantly correlated, indicating that dehydrogenase was a reliable indicator of global microbial activity. Peroxidase activity in the soil remained constant, but increased in the composts and amended soil. Addition of the oldest compost had no effect on the activity of the C cycle enzymes, but the youngest compost increased soil activity at the higher application rate. Enzymes of the N cycle were stimulated by all compost amendments, but the increase was only transient for amidase and urease. Lumbricompompositing had no marked effect on compost enzyme activity, either before or during the incubation.

Includes references.
Descriptors: refuse-compost; soil-flora; biological-activity-in-soil; soil-enzymes; enzyme-activity; mineralization; organic-matter; organic-compounds; decomposition; vermiculture; loam-soils; carbon-mineralization

Abstract: Selective breeding of invertebrates has been suggested by many but studied by few. The possibilities of improving characters like biomass, maturation time, cocoon production rate, and hatching success of cocoons for the earthworm Eisenia fetida were examined in the present study. The results showed that biomass, maturation time, and number of hatchlings could be successfully improved by selective breeding, although a concomitant tendency to a lower reproductive rate, as found in vertebrates, was observed. Other characters like cocoon production rate, hatching success, and number of hatchlings per cocoon also showed promising results.

Includes references.
Descriptors: eisenia-fetida; animal-breeding; selective-breeding; traits; growth-rate; maturity; fecundity

Sorption and retention of herbicides in vertically oriented earthworm and artificial burrows.
Includes references.
Descriptors: atrazine; metolachlor; dicamba; sulfonylurea-herbicides; earthworm-channels; sorption; retention; transport-processes; leaching; flow; sorption-isotherms; soil-depth; worm-casts; soil-organic-matter; preferential-flow

Abstract: In many temperate region no-tillage agro-ecosystems, the vertically oriented burrows of the nightcrawler earthworm (Lumbricus terrestris L.) function as preferential flow paths and may promote the rapid downward transport of surface-applied chemicals. The burrows of nightcrawlers, however, are lined with a material that is enriched in organic C relative to the surrounding soil matrix that may affect transport of organic chemicals. We investigated the effect of this lining on the sorption and retention of four herbicides: atrazine [6-chloro-N-ethyl-N‘-(1-methylethyl)-1,3,5-triazine 2,4-diamine], metolachlor [2-chloro-N-(2-ethyl-6-methylphenyl)-N(2-methoxy-1-methylethyl) acetamide], dicamba (3,6-dichloro-2-methoxybenzoic acid), and primisulfuron [3-[4,6-bis(difluoromethoxy)-pyrimidin-2-yl]-1-(2-methoxy carbonylphenyl sulfonfonyl) urea]. Batch sorption isotherms were determined using burrow lining and bulk soil collected from seven depth intervals from 0 to 50 cm. Sorption of the more strongly sorbed herbicides (atrazine and metolachlor) was enhanced by a factor of up to three on burrow lining relative to bulk soil, while there was little or no enhancement of the weakly sorbed herbicides (dicamba and primisulfuron). Transport and retention of these herbicides was measured in intact burrows in undisturbed soil blocks. Concentrations of the two strongly sorbed herbicides decreased during flow through nightcrawler and artificial (unlined) burrows, with the largest decreases occurring in earthworm burrows. Concentrations of the two weakly sorbed herbicides decreased very little during flow through either type of burrow. Retained herbicide concentrations were greater in nightcrawler than in artificial burrow walls. These results indicate the material lining nightcrawler burrows may significantly retard herbicide transport during lateral flow into and out of burrows.

Includes references.
Descriptors: atrazine; metolachlor; dicamba; sulfonylurea-herbicides; earthworm-channels; sorption; retention; transport-processes; leaching; flow; sorption-isotherms; soil-depth; worm-casts; soil-organic-matter; preferential-flow

Abstract: Modifications of soil microbiological activity by the addition of municipal solid-waste compost were studied in laboratory incubations. Three composts were compared, one lumbricompomst and two classical composts with different maturation times. Organic C mineralization and nine enzyme activities (dehydrogenase, peroxidase, cellulase, beta-glucosidase, beta-galactosidase, N-acetyl-beta-glucosaminidase, protease, amidase, and urease) were determined in the composts and the amended soil. Initial enzyme activities varied in the soil according to the sampling date (winter or summer) and were greater in the composts than in the soil, except for urease. Generally, the youngest compost exhibited greater activity than the oldest one. In the amended soil, the composts did not increase enzyme activity in an additive way. Dehydrogenase, the only strictly endocellular enzyme, was the only one for which the activity in the amended soil increased significantly in proportion to the addition of compost. During the incubations, C mineralization and dehydrogenase activity were significantly correlated, indicating that dehydrogenase was a reliable indicator of global microbial activity. Peroxidase activity in the soil remained constant, but increased in the composts and amended soil. Addition of the oldest compost had no effect on the activity of the C cycle enzymes, but the youngest compost increased soil activity at the higher application rate. Enzymes of the N cycle were stimulated by all compost amendments, but the increase was only transient for amidase and urease. Lumbricompompositing had no marked effect on compost enzyme activity, either before or during the incubation.

Survival of bacteria introduced into soil by means of transport by Lumbricus rubellus.
Includes references.
Descriptors: lumbricus-rubellus; rhizobium-leguminosarum; pseudomonas-fluorescens; pseudomonas-cepacia; digestive-tract; worm-casts; survival-; population-dynamics; transport-processes; biological-activity-in-soil; introduced-species; risk-; genetically-engineered-microorganisms

Abstract: Four strains of bacteria, Rhizobium leguminosarum biovar trifolii, Pseudomonas fluorescens, Pseudomonas cepacia, and Flavobacterium sp., were introduced into loamy sand and then transported by earthworms of the species Lumbricus rubellus to uninoculated soil. Cell densities recovered from the earthworm gut and casts (both expressed per gram dry material) were significantly lower (up to 3 log units) than cell densities recovered from the inoculated soil. Total bacterial counts in casts were similar to those in the inoculated soil. In casts excreted into a sterile environment numbers of colony-forming units (CFU) increased, suggesting a favourable environment for growth. In casts excreted in a non-sterile environment, cell densities of introduced strains decreased. Casts therefore did not offer the introduced bacteria a protective microenvironment for survival in the bulk soil. Transport by worms of R. leguminosarum biovar trifolii and of P. fluorescens appeared to occur mostly by means of cast production; with the Flavobacterium sp. and P. cepacia a large proportion of the cells was possibly transported on the skin of earthworms.

139. NAL Call No.: QH84.8.B46
Terbuthylazine and carbofuran effects on growth and reproduction within three generations of Eisenia andrei (Oligochaeta).
Includes references.
Descriptors: eisenia-; terbuthylazine-; carbofuran-; sublethal-effects; growth-rate; reproduction-; developmental-stages; weight-; biomass-production; hatchlings-; cocoons-production

140. NAL Call No.: 56.9-S03
Tillage, residue, and rainfall effects on movement of an organic tracer in earthworm-affected soils.
Includes references.
Descriptors: agricultural-soils; solutes-; pesticides-; transport-processes; adsorption-; desorption-; movement-in-soil; macropore-flow; earthworms-; biological-activity-in-soil; aporrectodea-caliginosa; lumbricus-terrestris; lumbricus-rubellus; no-tillage-; tillage-; crop-residues; rain-; macropores-; fluorescent-dyes; fluorescent-tracers; minnesota-; preferential-flow; conventional-versus-conservation-tillage; rain-intensity; single-rain-versus-multiple-rain-events

Abstract: A field study was conducted to determine the effects of tillage, residue, and rainfall on the movement of rhodamine WT (C29H29N2O5- Na2Cl), a strongly adsorbed organic dye, in earthworm-affected soils. Rhodamine WT was uniformly applied to the surface of two separate, 0.063-m2 areas within either no-till or conventionally tilled treatments in the presence or absence of residues. One area was exposed to a high intensity rainfall of 12 mm, whereas the second area received 193 mm of rainfall in 13 events during a 28-d period. Following rainfall, soils were excavated in layers to a depth of 40 cm and dye concentrations were determined. For the single rain event, dye concentration at the 28- to 40-cm depth was 1.20 and 0.63 mg kg-1 in the no-till and conventionally tilled treatments containing residues, respectively, compared with concentrations near the detection limit (0.10 mg kg-1) in treatments without residues. For multiple-rain plots, dye concentrations of 1.80 and 0.93 mg kg-1 were detected at the 28- to 40-cm depth in the no-till and conventionally tilled treatments containing residues, respectively, compared with concentrations near the detection limit (0.10 mg kg-1) in treatments without residues. Staining patterns indicated that earthworm channels were responsible for dye movement below 20 cm. The differences in dye movement for single and multiple-rain events suggests that properties of the macro pore system, such as continuity and surface position, control preferential flow under differing tillage, residue, and rainfall conditions.

141. NAL Call No.: RA1270.P35A1; LNSU RA1270.P35A1
Toxicity of pesticides to earthworms in Kentucky bluegrass turf.
Includes references.
Descriptors: pesticides-; plant-growth-regulators; application-rates; formulations-; lumbricidae-; nontarget-effects; nontarget-organisms; kentucky-
Transport of nitrate in soils as affected by earthworm activities.


Abstract: Earthworm (Lumbricus sp.) boles have long been recognized as an important conduit for water and solute transport in field soils. In this study we investigated preferential movement of NO$_3$ through artificially induced earthworm boles and compared three commonly used solute transport models with respect to their ability to describe NO$_3$ transport through the earthworm macropore system. Earthworms boles were created by introducing earthworms into uniformly packed soil columns of 20-cm i.d. and 30- or 60 cm long. After 8 wk of incubation, the columns were leached at a range of fluxes and NO$_3$ breakthrough curves (BTCs) were determined. The columns also were traced with dyes to visualize the spatial distribution of the earthworm boles. The results showed that the earthworms completely altered the uniformity of the packed soil cores. The average saturated hydraulic conductivities of the earthworm hole columns (Ksm) increased 17.9- to 22.3-folds as compared with the control columns. Significant preferential movement of NO$_3$ occurred in these columns even at relative fluxes as low as 0.014 Ksm. A nonlinear least squares program, CXTFIT, was used to fit three solute transport models to all BTCs. The physical nonequilibrium model (MIM) fitted the experimental data better than the convection-dispersion equation (CDE) and the stochastic model (SM), while none of them was adequate to describe the data well.

Uptake, bioavailability and elimination of hydrophobic compounds in earthworms (Eisenia andrei) in field-contaminated soil.


Abstract: Cationic or anionic dyes adsorbed onto cellulose granulate were transported across the gut wall, bound to blood proteins, and accumulated by the chloragocytes. Solubility in water promoted accumulation. The dyes ended up mainly in the chloragosomes. Down to 20 micromoles dye per litre soil water resulted in visible accumulation. Worms which after dye-exposure were kept dye-free for 5 months retained substantial amounts of dye in the chloragosomes. In vitro experiments indicate that the binding to chloragosomes of synthetic and natural phenolics is by ion exchange with calcium phosphate and with an uncharacterized matrix-bound calcium chelator, aided by hydrophobic interactions between the dye and constituents of the chloragosome matrix. The findings are relevant for the evaluation of the effects of constant or periodic soil contamination with industrial or agricultural organochemicals.

Uptake, bioavailability and elimination of hydrophobic compounds in earthworms (Eisenia andrei) in field-contaminated soil.

Uptake, accumulation, and elimination of hydrophobic organic chemicals in earthworms (Eisenia andrei) exposed to field-contaminated Volgermeerpolder soil was studied. Earthworms were able to take up chlorobenzenes, and polychlorobiphenyls (PCBs), but body burdens did not exceed concentrations measured in the soil. For the chlorobenzenes, steady-state concentrations in the worms and biota-to-soil accumulation factor (BSAF) values were much smaller than expected based on earlier experiments, suggesting a decreased bioavailability in the Volgermeerpolder soil. Comparison of the PCB accumulation pattern in worms to the pattern in soil showed that biotransformation of the studied PCBs is of minor importance in this species. Elimination of all chemicals studied was monophasic, with the exception of hexachlorobenzene, which showed a biphasic elimination. The elimination half-life for the initial fast phase of this compound is comparable to the elimination measured in previous studies. Elimination rate constants decreased with increasing log Kow.

147. NAL Call No.: QH545.A1E58
Uptake, metabolism and toxicity of terbufos in the earthworm (Lumbricus terrestris) exposed to counter-15G in artificial soils.
Includes references.
Descriptors: terbufos-; lumbricus-terrestris; uptake-; concentration-; metabolism-; toxicity-; mortality-; metabolites-; nontarget-organisms; nontarget-effects

148. NAL Call No.: QH545.A1E58
Uptake of cesium-134 by the earthworm species Eisenia fetida and Lumbricus rubellus.
Includes references.
Descriptors: eisenia-fetida; lumbricus-rubellus; cesium-; pollutants-; uptake-; concentration-; half-life; temperature-; ph-; electrical-conductivity; species-differences

Abstract: The uptake processes of 134Cs in two earthworm species were investigated as well as the effect of temperature on these processes. The results show that equilibrium concentrations in the two species differ by 1.5 to fivefold. Equilibrium concentrations range from 367 to 963 Bq g-1 in Lumbricus rubellus and from 920 to 1,893 Bq g-1 in Eisenia fetida; biological half-lives range from 56 to 119 h and 52 to 64 h, respectively. Assimilation was two to four times higher in E. fetida and elimination rate one to two times higher in E. fetida than in L. rubellus. Further, the results show that temperature may affect the 134Cs concentration in these earthworms by a factor of 1.4 to 2.1 between 10 and 20 degrees C, depending on the species. The maximum difference found within one species was a factor of 2.6. Our results show no clear effect of temperature on the assimilation, but a small negative effect on elimination, resulting in an increasing biological half-life and concentration factor with higher temperatures.

149. NAL Call No.: TD172.A7
Uptake of hydrophobic halogenated aromatic hydrocarbons from food by earthworms (Eisenia andrei).
Includes references.
Descriptors: eisenia-; species-; uptake-; hydrophobicity-; halogenated-hydrocarbons; aromatic-hydrocarbons; soil-pollution; intestinal-uptake; uptake-efficiency

150. NAL Call No.: QH84.8.B46
The use of resource patches by earthworms.
Includes references.
Descriptors: soil-organic-matter; sheep-manure; formulations-; spatial-distribution; aporrectodea-caliginosa; aporrectodea-; earthworms-; soil-depth; population-density; biomass-production; aporrectodea-rosea; microscolex-dubius

151. NAL Call No.: 57.8-C734
Vermicomposting for the paper pulp industry.
Descriptors: vermicomposting-; pulp-and-paper-industry; paper-mill-sludge; waste-utilization

152. NAL Call No.: 57.8-C734
Vermicomposting in Australia and New Zealand.
Descriptors: vermicomposting-; food-wastes; sewage-sludge; waste-paper; litter-plant; waste-utilization; projects-; australia-; new-zealand

153. NAL Call No.: 57.8-C734
Vermiculture in Cuba.

Descriptors: vermiculture-; earthworms-; worm-casts; application-to-land; organic-fertilizers; cuba-

154. NAL Call No.: SB321.G85
Vermiculture (worm) composting.
Descriptors: lumbricus-rubellus; eisenia-fetida; vermicomposting-

155. NAL Call No.: QH84.8.B46
Volume density of earthworm burrows in compacted cores of soil as estimated by direct and indirect methods.
Includes references.
Descriptors: aporrectodea-caliginosa; aporrectodea-; earthworms-; earthworm-channels; volume-;

density-; determination-; measurement-; methodology-; comparisons-; imagery-; worm-casts;
aminal-burrows; computer-techniques; aporrectodea-rosea; stereology-; air-filled-burrows;
cast-filled-burrows

Abstract: After earthworms of the species Aporrectodea caliginosa and A. rosea had burrowed in compacted cores of soil for 68 days the cores were sectioned horizontally. The upper surface of each sectioned layer of soil was photographed before it was dissected and the dimensions of all burrows within the layer measured. Volume densities calculated from the direct measurement of burrows were compared with the values calculated by stereology; from data obtained from two image analysis methods, computerised image analysis and point counting with a systematic lattice. The assumption implicit in all stereology calculations was satisfied for this experiment in that the burrows of both species showed no preferred orientation in the compacted soil. Computerised image analysis could not measure the density of all burrows in the photographs because of the lack of contrast between cast-filled burrows and the soil and the complex shapes of the burrows. Although the volume densities of A. caliginosa burrows calculated from point counts were correlated with the values calculated from direct measurement, point counting over-estimated volume densities by two to three times. In the experiment, A. rosea produced too few air-filled burrows for the lattice to detect. The relative ratios of air-filled to cast-filled burrows calculated from the point counts suggested that approximately two-thirds and eight-ninths of the burrows of A. caliginosa and A. rosea, respectively, were filled with casts.

156. NAL Call No.: 57.8-C734
Worldwide progress in vermicomposting.
Descriptors: vermicomposting-; earthworms-; waste-utilization

157. NAL Call No.: 57.8-C734
Worm composters in school programs.
Descriptors: vermicomposting-; technical-training; educational-programs

158. NAL Call No.: S544.3.N6662
Worms can recycle your garbage.
In subseries: Water Quality & Waste Management.
Descriptors: vermicomposting-; food-wastes; eisenia-fetida; refuse-compost; waste-utilization

159. NAL Call No.: 57.8-C734
Young composters learn with worms.
Descriptors: vermicomposting-; agricultural-education; elementary-education

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