

Appendix 1

Table A1. Studies used in meta-analysis (full citations follow table), and information on experimental design: source of soil and country of origin, manipulated grazers, manipulated predators (if applicable), and plant species.

Study	Soil origin (habitat)	Country	Experiment type	Manipulated grazers	Manipulated predators	Plant
Alpei et al. (1996)	Beechwood	Germany	Micro/mesocosm	Extracted soil protozoa (amoebae, flagellates, ciliates); bacterivorous nematode <i>Pellioditis pellio</i>	n/ a	<i>Hordeum europaeus</i> (grass)
(Bååth et al. (1981)	Pine heath	Sweden	Micro/mesocosm	Bacterivorous nematode <i>Acrobeloides nanus</i> ; fungivorous nematode <i>Aphelenchoides</i> sp.; fungivorous mite <i>Tectocephus velatus</i>	n/ a	<i>Pinus sylvestris</i> (conifer)
Bardgett and Chan (1999)	Grassland	UK	Micro/mesocosm	Extracted soil nematodes (dominated by bacterivorous); fungivorous collembolan <i>Onychiurus procampatus</i>	n/ a	<i>Nardus stricta</i> (grass)
Bonkowski et al. (2000)	Garden soil	UK	Micro/mesocosm	Extracted soil protozoa (amoebae, flagellates, ciliates), soil nematodes (mainly bacterivorous <i>Coactadera cystilarva</i> and <i>Panagrolaimus</i> spp.)	n/ a	<i>Lolium perenne</i> (grass)
Bonkowski et al. (2001a)	Garden soil	UK	Micro/mesocosm	Extracted soil protozoa (amoebae, flagellates, ciliates)	n/ a	<i>Triticum aestivum</i> (grass)
Bonkowski et al. (2001b)	Spruce forest	Germany	Micro/mesocosm	Amoebae	n/ a	<i>Picea abies</i> (conifer)
Bradford et al. (2002)	Grassland	UK	Micro/mesocosm	Soil fauna: size exclusion (control: 100 µm, treatment: 2 mm)	Predatory soil fauna	Grassland spp.
Clarholm (1985)	Agricultural field	Sweden	Micro/mesocosm	Extracted soil protozoa (amoebae, flagellates, ciliates)	n/ a	<i>Triticum aestivum</i> (grass)
Cole et al. (2004)	Grassland	UK	Micro/mesocosm	Collembolans <i>Isotoma anglicana</i> , <i>Protaphorura armata</i> , <i>Folsomia quadrioculata</i> , <i>Pseudosinella alba</i> , <i>Ceratophysella denticulata</i> , <i>Mesaphorura macrochaeta</i> ; mites <i>Platynothrus peltifer</i> , <i>Scheloribates laevigatus</i>	Mite <i>Hypoaspis aculeifer</i>	<i>Agrostis capillaris</i> (grass)
Djigal et al. (2004a)	Agricultural field	Senegal	Micro/mesocosm	Bacterivorous nematodes <i>Cephalobus pseudoparvus</i> , <i>Acrobeloides nanus</i> , <i>Zeldia punctata</i>	n/ a	<i>Zea mays</i> (grass)
Djigal et al. (2004b)	Agricultural field	Senegal	Micro/mesocosm	Bacterivorous nematode <i>Zeldia punctata</i>	n/ a	<i>Zea mays</i> (grass)
Ek et al. (1994)	Pine forest soil	Sweden	Micro/mesocosm	Collembolan <i>Onychiurus armatus</i>	n/ a	<i>Pinus contorta</i> (conifer)
Elliot et al. (1979)	n/ a	n/ a	Micro/mesocosm	Amoeba <i>Acanthamoeba polyphaga</i>	n/ a	<i>Bouteloua gracilis</i> (grass)
Endlweber and Scheu (2007)	Field	Germany	Micro/mesocosm	Collembolan <i>Protaphorura fimata</i>	n/ a	<i>Lolium perenne</i> (grass), <i>Trifolium repens</i> (legume)

Study	Soil origin (habitat)	Country	Experiment type	Manipulated grazers	Manipulated predators	Plant
Haase et al. (2008)	Grassland	Germany	Micro/ mesocosm	Collembolan <i>Folsomia candida</i>	n/ a	<i>Poa annua</i> (grass); <i>Plantago lanceolata</i> , <i>Sanguisorba minor</i> (deciduous herbs); <i>Trifolium repens</i> (legume)
Herdler et al. (2008)	Field	Germany	Micro/ mesocosm	Amoeba <i>Acanthamoeba castellanii</i>	n/ a	<i>Oryza sativa</i> (grass)
Ingham et al. (1985)	Grassland	USA	Micro/ mesocosm	Bacterivorous nematodes <i>Pelodera</i> sp. and <i>Acrobeloides</i> sp.; fungivorous nematode <i>Aphelenchus avenae</i>	n/ a	<i>Bouteloua gracilis</i> (grass)
Jentschke et al. (1995)	Sand with forest soil extracts	Germany	Micro/ mesocosm	Extracted soil protozoa (amoebae, flagellates, ciliates)	n/ a	<i>Picea abies</i> (conifer)
Kaiser and Lussenhop (1991)	Potting mix	n/ a	Micro/ mesocosm	Collembolan <i>Folsomia candida</i>	n/ a	<i>Glycine max</i> (legume)
Ke and Scheu (2008)	Agricultural field	Germany	Micro/ mesocosm	Collembolan <i>Protaphorura armata</i>	n/ a	<i>Triticum aestivum</i> (grass)
Klironomos and Kendrick (1995)	Potting mix	n/ a	Micro/ mesocosm	Collembolans <i>Folsomia candida</i> , <i>F. penicula</i> , <i>Tullbergia clavata</i> ; mites <i>Lasiobelba rigida</i> , <i>Ceratozetes gracilis</i> , <i>Nothrus anaunensis</i>	n/ a	<i>Acer saccharum</i> (deciduous tree)
Kreuzer et al. (2004)	Field	Germany	Micro/ mesocosm	Collembolans <i>Heteromurus nitidus</i> , <i>Protaphorura fimata</i> , <i>Folsomia candida</i>	n/ a	<i>Lolium perenne</i> (grass); <i>Trifolium repens</i> (legume)
Kuikman and van Veen (1989)	Agricultural field	Netherlands	Micro/ mesocosm	Extracted soil protozoa (amoebae, flagellates, ciliates)	n/ a	<i>Triticum aestivum</i> (grass)
Kuikman et al. (1990)	Agricultural field	Netherlands	Micro/ mesocosm	Amoeba <i>Acanthamoeba</i> sp., flagellate <i>Cercomonas</i> sp.	n/ a	<i>Triticum aestivum</i> (grass)
Laakso and Setälä (1999a)	Mixed forest	Finland	Micro/ mesocosm	Bacterivorous nematodes <i>Acrobeloides tricornis</i> , <i>Caenorhabditis elegans</i> , <i>Panagrolaimus subelongatus</i> ; Fungivorous nematodes <i>Aphelenchoides</i> sp., <i>A. saprophilus</i> , <i>Aphelenchus avenae</i>	Predatory mites <i>Parazercon radiatus</i> , <i>Lysigamasus lapponicus</i>	<i>Betula pendula</i> (deciduous tree)
Laakso and Setälä (1999b)	Mixed forest	Finland	Micro/ mesocosm	Mites <i>Conchogneta trågårdhii</i> , <i>Medioppia subpectinata</i> , <i>Oppiella nova</i> , <i>Nothrus silvestris</i> , <i>Heminothrus peltifer</i> , <i>Carabodes subarcticus</i> ; Collembolan <i>Isotomiella minor</i> , <i>Isotoma hiemalis</i> , Enchytraeid <i>Cognettia sphagnetorum</i> , Dipteran <i>Bradysia fungicola</i>	Extracted predatory soil fauna	<i>Betula pendula</i> (deciduous tree)
Laakso et al. (2000)	Mixed forest	Finland	Micro/ mesocosm	Bacterivorous nematodes <i>Acrobeloides nanus</i> , <i>Plectus</i> sp., <i>Panagrellus</i> sp.; Fungivorous nematode <i>Aphelenchoides</i> sp.; Enchytraeid <i>Cognettia sphagnetorum</i> , Dipterans <i>Bradysia</i> sp., <i>B. fungicola</i>	Predatory mites <i>Parazercon radiatus</i> , <i>Vulgarogamasus kraepelini</i> , <i>Pergamasus brevicornis</i> ; predatory nematode <i>Prionchulus punctatus</i>	<i>Betula pendula</i> (deciduous tree)

Study	Soil origin (habitat)	Country	Experiment type	Manipulated grazers	Manipulated predators	Plant
Larsen and Jakobsen (1996)	n/ a	n/ a	Micro/ mesocosm	Collembolan <i>Folsomia candida</i>	n/ a	<i>Trifolium subterraneum</i> (legume)
Liiri et al. (2002)	Pine forest soil	Finland	Micro/ mesocosm	Soil fauna: size exclusion (control: 45 µm, treatment: 1 mm)	n/ a	<i>Pinus sylvestris</i> L. (conifer)
Lussenhop and BassiriRad (2005)	Potting mix	n/ a	Micro/ mesocosm	Collembolan <i>Folsomia candida</i>	n/ a	<i>Fraxinus pennsylvanica</i> (deciduous tree)
Partsch et al. (2006)	Grassland	Germany	Micro/ mesocosm	Collembolans <i>Protaphorura fimata</i> , <i>Heteromurus nitidus</i> , <i>Folsomia candida</i>	n/ a	64 grassland spp. (legumes, grasses, herbs)
Scheu et al. (1999)	Fallow field	Germany	Micro/ mesocosm	Collembolans <i>Heteromurus nitidus</i> , <i>Onychiurus scotarius</i>	n/ a	<i>Poa annua</i> (grass), <i>Trifolium repens</i> (legume)
Schreiner and Bethlenfalvay (2003)	Field	USA	Micro/ mesocosm	Extracted soil collembolans (mainly <i>Isotoma</i> spp.)	n/ a	<i>Pisum sativum</i> (legume)
Schütz et al. (2008)	Fallow field	Germany	Micro/ mesocosm	Collembolans <i>Protaphorura fimata</i> , <i>Heteromurus nitidus</i> , <i>Folsomia candida</i>	n/ a	<i>Triticum aestivum</i> (grass)
Setälä (1995)	Forest	Finland	Micro/ mesocosm	Extracted soil fauna: nematodes, enchytraids, collembolans, mites	Extracted predatory soil mites	<i>Betula pendula</i> (deciduous tree), <i>Pinus sylvestris</i> (conifer)
Setälä (2000)	Coniferous forest	Finland	Micro/ mesocosm	Mites <i>Oppiella nova</i> , <i>Medioppia subpectinata</i> , <i>Conchogneta traegardhi</i> ; collembolan <i>Hypogastrura assimilis</i> ; enchytraid <i>Cognettia sphagnetorum</i>	n/ a	<i>Pinus sylvestris</i> (conifer)
Setälä and Huhta (1991)	Coniferous forest	Finland	Micro/ mesocosm	Extracted soil nematodes, microarthropods (collembolans, mites); enchytraeid <i>Cognettia sphagnetorum</i>	Extracted predatory soil fauna	<i>Betula pendula</i> (deciduous tree)
Setälä et al. (1996)	Forest soil	Canada	Micro/ mesocosm	Soil fauna: size exclusion (control: 45 µm, treatments: 0.5, 5 mm)	Predatory soil fauna	<i>Populus trichocarpa</i> (deciduous tree)
Setälä et al. (1997)	Coniferous forest	Finland	Micro/ mesocosm	Extracted soil fauna (collembolans, mites); enchytraeid <i>Cognettia sphagnetorum</i>	Extracted predatory soil fauna	<i>Pinus sylvestris</i> (conifer)
Setälä et al. (1999)	Coniferous forest	Finland	Micro/ mesocosm	Bacterivorous nematodes <i>Acrobeloides tricornus</i> , <i>Caenorhabditis elegans</i> ; fungivorous nematodes <i>Aphelenchoides saprophilus</i> , <i>Aphelenchus avenae</i>	Predatory nematode <i>Prionchulus punctatus</i>	<i>Pinus sylvestris</i> (conifer)
Sulkava et al. (2001)	Coniferous forest	Finland	Micro/ mesocosm	Extracted soil fauna (collembolans, mites); enchytraeid <i>Cognettia sphagnetorum</i>	Extracted predatory soil fauna	<i>Betula pendula</i> (deciduous tree)
Wright and Coleman (1988)	Field	USA	Micro/ mesocosm	Soil fauna: nematicide and insecticide used on control plots	Predatory soil fauna	<i>Sorghum bicolor</i> (grass)

Studies used in meta-analysis:

- Alphei, J. et al. 1996. Protozoa, Nematoda and Lumbricidae in the rhizosphere of *Hordeleymus europaeus* (Poaceae): faunal interactions, response of microorganisms and effects on plant growth. – *Oecologia* 106: 111–126.
- Bååth, E. et al. 1981. Impact of microbial-feeding animals on total soil activity and nitrogen dynamics: a soil microcosm experiment. – *Oikos* 37: 257–264.
- Bardgett, R. D. and Chan, K. F. 1999. Experimental evidence that soil fauna enhance nutrient mineralization and plant nutrient uptake in montane grassland ecosystems. – *Soil Biol. Biochem.* 31: 1007–1014.
- Bonkowski, M. et al. 2001a. Effects of soil decomposer invertebrates (protozoa and earthworms) on an above-ground phytophagous insect (cereal aphid) mediated through changes in the host plant. – *Oikos* 95: 441–450.
- Bonkowski, M. et al. 2000. Substrate heterogeneity and microfauna in soil organic 'hotspots' as determinants of nitrogen capture and growth of ryegrass. – *Appl. Soil Ecol.* 14: 37–53.
- Bonkowski, M. et al. 2001b. Contrasting effects of microbial partners in the rhizosphere: interactions between Norway spruce seedlings (*Picea abies* Karst.), mycorrhiza (*Paxillus involutus* (Batsch) Fr.) and naked amoebae (protozoa). – *Appl. Soil Ecol.* 18: 193–204.
- Bradford, M. A. et al. 2002. Impacts of soil faunal community composition on model grassland ecosystems. – *Science* 298: 615–618.
- Clarholm, M. 1985. Interactions of bacteria, protozoa and plants leading to mineralization of soil nitrogen. – *Soil Biol. Biochem.* 17: 181–187.
- Cole, L. et al. 2004. Soil animals influence microbial abundance, but not plant-microbial competition for soil organic nitrogen. – *Funct. Ecol.* 18: 631–640.
- Dijgal, D. et al. 2004a. Influence of bacterial-feeding nematodes (Cephalobidae) on soil microbial communities during maize growth. – *Soil Biol. Biochem.* 36: 323–331.
- Dijgal, D. et al. 2004b. Interactions between *Zeldia punctata* (Cephalobidae) and bacteria in the presence or absence of maize plants. – *Plant Soil* 262: 33–44.
- Ek, H. et al. 1994. Extramatrical mycelial growth, biomass allocation and nitrogen uptake in ectomycorrhizal systems in response to collembolan grazing. – *Appl. Soil Ecol.* 1: 155–169.
- Elliott, E. T. et al. 1979. The influence of amoebae on the uptake of nitrogen by plants in gnotobiotic soil. – In: Harley, J. L. and Russell, R. S. (eds), *The soil-root interface*. Academic Press, pp. 221–229.
- Endlweber, K. and Scheu, S. 2007. Interactions between mycorrhizal fungi and Collembola: effects on root structure of competing plant species. – *Biol. Fertil. Soils* 43: 741–749.
- Haase, J. et al. 2008. Above- and belowground interactions are mediated by nutrient availability. – *Ecology* 89: 3072–3081.
- Herdler, S. et al. 2008. Interactions between arbuscular mycorrhizal fungi (*Glomus intraradices*, Glomeromycota) and amoebae (*Acanthamoeba castellanii*, Protozoa) in the rhizosphere of rice (*Oryza sativa*). – *Soil Biol. Biochem.* 40: 660–668.
- Ingham, R. E. et al. 1985. Interactions of bacteria, fungi, and their nematode grazers: effects on nutrient cycling and plant-growth. – *Ecol. Monogr.* 55: 119–140.
- Jentschke, G. et al. 1995. Soil protozoa and forest tree growth: non-nutritional effects and interaction with mycorrhizae. – *Biol. Fertil. Soils* 20: 263–269.
- Kaiser, P. A. and Lussenhop, J. 1991. Collembolan effects on establishment of vesicular-arbuscular mycorrhizae in soybean (*Glycine max*). – *Soil Biol. Biochem.* 23: 307–308.
- Ke, X. and Scheu, S. 2008. Earthworms, Collembola and residue management change wheat (*Triticum aestivum*) and herbivore pest performance (Aphidina: *Rhopalosiphum padi*). – *Oecologia* 157: 603–617.
- Klironomos, J. N. and Kendrick, W. B. 1995. Stimulative effects of arthropods on endomycorrhizas of sugar maple in the presence of decaying litter. – *Funct. Ecol.* 9: 528–536.
- Kreuzer, K. et al. 2004. Decomposer animals (Lumbricidae, Collembola) and organic matter distribution affect the performance of *Lolium perenne* (Poaceae) and *Trifolium repens* (Fabaceae). – *Soil Biol. Biochem.* 36: 2005–2011.
- Kuikman, P. J. et al. 1990. Protozoan predation and the turnover of soil organic carbon and nitrogen in the presence of plants. – *Biol. Fertil. Soils* 10: 22–28.
- Kuikman, P. J. and van Veen, J. A. 1989. The impact of protozoa on the availability of bacterial nitrogen to plants. – *Biol. Fertil. Soils* 8: 13–18.
- Laakso, J. and Setälä, H. 1999a. Population- and ecosystem-level effects of predation on microbial-feeding nematodes. – *Oecologia* 120: 279–286.
- Laakso, J. and Setälä, H. 1999b. Sensitivity of primary production to changes in the architecture of belowground food webs. – *Oikos* 87: 57–64.
- Laakso, J. et al. 2000. Influence of decomposer food web structure and nitrogen availability on plant growth. – *Plant Soil* 225: 153–165.
- Larsen, J. and Jakobsen, I. 1996. Effects of a mycophagous Collembola on the symbioses between *Trifolium subterraneum* and three arbuscular mycorrhizal fungi. – *New Phytol.* 133: 295–302.
- Liiri, M. et al. 2002. Soil processes are not influenced by the functional complexity of soil decomposer food webs under disturbance. – *Soil Biol. Biochem.* 34: 1009–1020.
- Lussenhop, J. and BassiriRad, H. 2005. Collembola effects on plant mass and nitrogen acquisition by ash seedlings (*Fraxinus pennsylvanica*). – *Soil Biol. Biochem.* 37: 645–650.
- Partsch, S. et al. 2006. Decomposers (Lumbricidae, Collembola) affect plant performance in model grasslands of different diversity. – *Ecology* 87: 2548–2558.
- Scheu, S. et al. 1999. Links between the detritivore and the herbivore system: effects of earthworms and Collembola on plant growth and aphid development. – *Oecologia* 119: 541–551.
- Schreiner, R. P. and Bethlenfalvay, G. J. 2003. Crop residue and Collembola interact to determine the growth of mycorrhizal pea plants. – *Biol. Fertil. Soils* 39: 1–8.
- Schütz, K. et al. 2008. Effects of Collembola and fertilizers on plant performance (*Triticum aestivum*) and aphid reproduction (*Rhopalosiphum padi*). – *Basic Appl. Ecol.* 9: 182–188.
- Setälä, H. 1995. Growth of birch and pine seedlings in relation to grazing by soil fauna on ectomycorrhizal fungi. – *Ecology* 76: 1844–1851.
- Setälä, H. 2000. Reciprocal interactions between Scots pine and soil food web structure in the presence and absence of ectomycorrhiza. – *Oecologia* 125: 109–118.
- Setälä, H. and Huhta, V. 1991. Soil fauna increase *Betula pendula* growth: laboratory experiments with coniferous forest floor. – *Ecology* 72: 665–671.
- Setälä, H. et al. 1999. Influence of ectomycorrhiza on the structure of detrital food webs in pine rhizosphere. – *Oikos* 87: 113–122.
- Setälä, H. et al. 1996. Influence of body size of soil fauna on litter decomposition and ¹⁵N uptake by poplar in a pot trial. – *Soil Biol. Biochem.* 28: 1661–1675.
- Setälä, H. et al. 1997. Conditional outcomes in the relationship between pine and ectomycorrhizal fungi in relation to biotic and abiotic environment. – *Oikos* 80: 112–122.
- Sulkava, P. et al. 2001. Influence of soil fauna and habitat patchiness on plant (*Betula pendula*) growth and carbon dynamics in a microcosm experiment. – *Oecologia* 129: 133–138.
- Wright, D. H. and Coleman, D. C. 1988. Soil faunal vs. fertilization effects on plant nutrition: results of a biocide experiment. – *Biol. Fertil. Soils* 7: 46–52.

Table A2. Regressions of effect size versus sample size (funnel plots) to test for publication bias, and regression of effect size versus length of experiment to test for influence of experimental duration.

Response Variable	Regression results – funnel plots	Regression results – length of experiment
Shoot biomass	$F_{(1,120)} = 0.013$ $P=0.91$	$Q_{(1,120)} = 1.2$ $P=0.27$
Root biomass	$F_{(1,103)} = 0.77$ $P=0.38$	$Q_{(1,103)} = 0.49$ $P=0.49$
Microbial biomass	$F_{(1,73)} = 0.37$ $P=0.55$	$F_{(1,73)} = 0.45$ $P=0.50$
Shoot nitrogen	$F_{(1,70)} = 0.039$ $P=0.84$	$F_{(1,70)} = 0.57$ $P=0.45$
Root nitrogen	$F_{(1,23)} = 0.10$ $P=0.75$	$F_{(1,23)} = 1.3$ $P=0.27$