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ORIGINAL PAPER

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Effects of traditional and biodynamic farmyard manure amendment on yields, soil chemical, biochemical and biological properties in a long-term field experiment

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Abstract We studied the effects of applications of traditionally composted farmyard manure (FYM) and two types of biodynamically composted FYM over 9 years on soil chemical properties, microbial biomass and respiration, dehydrogenase and saccharase activities, decomposition rates and root production under grass-clover, activity and biomass of earthworms under wheat, and yields in a grass-clover, potatoes, winter wheat, field beans, spring wheat, winter rye crop rotation. The experiment was conducted near Bonn, on a Fluvisol using a randomised complete block design (n=6). Our results showed that plots which received either prepared or non-prepared FYM (30 Mg ha^{-1} year^{-1}) had significantly increased soil pH, P and K concentrations, microbial biomass, dehydrogenase activity, decomposition (cotton strips), earthworm cast production and altered earthworm community composition than plots without FYM application. Application of FYM did not affect the soil C/N ratio, root length density, saccharase activity, microbial basal respiration, metabolic quotient and crop yields. The biodynamic preparation of FYM with fermented residues of six plant species (6 g Mg^{-1} FYM) significantly decreased soil microbial basal respiration and metabolic quotient compared to non-prepared FYM or FYM prepared with only *Achillea*. The biodynamic preparation did not affect soil microbial biomass, dehydrogenase activity and decomposition during 62 days. However, after 100 days, decomposition was significantly faster in plots which received completely prepared FYM than in plots which received no FYM, FYM without preparations or FYM with the *Achillea* preparation. Furthermore, the application of completely prepared FYM led to significantly higher biomass and abundance of endogeic or anecic earthworms than in plots where non-prepared FYM was applied.

Keywords Cattle manure · Organic farming · Soil quality · Soil ecology · Organic fertiliser

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Introduction

Organic agriculture is a production system which avoids or largely excludes the use of synthetically produced fertilisers, pesticides, growth regulators and livestock feed additives relying instead on crop rotations, crop residues, animal manures, legumes, green manures, and aspects of biological pest control to maintain soil productivity and tilth, to supply plant nutrients and to control insects, weeds and other pests (Lampkin 1990). A growing number of studies show that organic farming leads to higher soil quality and more biological activity in soil than conventional farming (e.g. Reganold 1988; Alföldi et al. 1993; Drinkwater et al. 1995; Droogers and Bouma 1996). These organic systems have also been shown to use fertilisers and energy more efficiently than conventionally managed systems (Mäder et al. 2002) and to be just as economically viable as conventional farms (Reganold et al. 1993; Reganold and Palmer 1995).

Biodynamic agriculture has many similarities to other organic agricultural systems and relies heavily on composted farmyard manure (FYM) as a fertiliser. Additionally, biodynamic farming uses field sprays and compost preparations consisting of specific minerals or plants treated or fermented with animal organs, water and/or soil (Steiner 1924). Since biodynamic preparations are added to composting organic material in very low doses of a few grams per ton of compost material, the primary purpose of these preparations is not to add nutrients, but to stimulate the processes of nutrient and energy cycling, hasten decomposition and to improve soil and crop quality (Koepf 1993). Generally, biodynamic compost additives are made from six different plant species (Steiner 1924):