



Soil inorganic N contents and maize yield following winter-hardy vs. freeze-killed cover crop mixtures on an organic farm in Eastern Austria

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Cover crop mixtures of legumes and non-legumes have multiple advantages compared to bare soil like reducing erosion by covering the soil, fixing nitrogen from the air and reducing nitrate leaching, adding organic matter to the soil, increasing soil biological activity and improving soil structure. The advantages and disadvantages of a winter-hardy vs. a freeze-killed cover crop (CC) mixture were studied on an organic farm in Raipoltenbach in Lower Austria (10.5 °C, 760 mm) with non-inverting soil cultivation since 2008. Effects on soil inorganic nitrogen contents and the yield of a following maize crop were assessed. On an orthic Luvisol with a silty clay to silty loam texture, two field experiments (FE1 and FE2) were laid out in a randomized complete block design in four replicates in two consecutive years. The winter-hardy CC mixture was "Landsberger Gemenge" consisting of winter vetch, crimson clover and Italian ryegrass. The freeze-killed CC mixture consisted of fodder pea, common vetch, chickling vetch, buckwheat, phacelia and fodder radish. The winter-hardy catch crop mixture was terminated with a rotary cultivator and the freeze-killed CC was worked into the soil with a chisel on 4 April 2017 / 19 April 2018. After chiseling the soil (only in FE1), maize, cv "Connexxion RZ 340", was sown on 4 May 2017 / 7 May 2018. In both treatments, soil was harrowed once in May and hoed twice in June. Soil inorganic nitrogen (N_{in}) was analysed in 0.0125 M $CaCl_2$ extracts. The winter-hardy CC had a biomass of 2.8 t ha⁻¹ on average when terminated in April, the freeze-killed CC reached on average 3.1 t ha⁻¹ in November. The N_{in} values in 0-90 cm soil depth in spring (2017 FE1 / 2018 FE2) were almost doubled in the freeze-killed CC treatment compared to the winter-hardy CC treatment. The winter-hardy CC mixture took up soil nitrogen until termination in April, thus reducing N_{in} contents after winter and the risk of nitrate leaching during winter, saving nitrogen for the following main crop. An assessment in June (FE1) and May (FE2) showed no differences in the number of maize plants per m². Maize grain dry matter yield was 7.8 t ha⁻¹ in FE1 and 7.0 t ha⁻¹ in FE2 on average and did not differ between treatments. Also maize nitrogen yield did not differ. Sowing maize without inverting soil cultivation was more difficult in the winter-hardy CC treatment than in the treatment where the CC mixture was freeze-killed. But mainly due to the effective CC termination with the rotary cultivator, weed density was not higher in this treatment (except for one assessment date in July 2018 in FE2). In our study, both freeze-killed and winter-hardy CC mixtures consisted of a legume-dominated legume-non-legume mixture. This resulted in a narrow C-to-N ratio (10 to 13) in the CC

biomass as a basis for a swift N mineralization from the CC residues in both treatments. Accordingly, maize grain DM yield and maize grain N yield did not differ between the CC treatments.