

# SOIL QUALITY IMPROVEMENT THROUGH PROPER COMBINATION OF TILLAGE, NITROGEN FERTILIZATION AND COVER CROPPING SYSTEMS

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## ABSTRACT

No-tillage, N fertilization and cover crops can be properly combined for enhancing soil quality and farm productivity. We investigated the combined effect of 15-yr of tillage systems, N fertilization and cover crops on selected soil properties in the sandy loam soil of central Italy. The soil in no-tillage (NT) system had 50% more organic matter and 3 folds higher aggregate stability than the soil in conventional tillage (CT) system. The NT system significantly increased soil moisture and decreased bulk density in upper 10 cm layer than in CT system but the effect was not significant in the soil below 10 cm. Similarly, the NT system significantly increased number and diversity of micro-arthropods groups than CT system, thereby improving soil biological quality measured as QBS (*Qualita biologica del suolo*). N fertilization and use of cover crops significantly increased soil organic matter and aggregate stability under the NT system but not under the CT system. Use of cover crops, particularly hairy vetch, also improved soil moisture content, bulk density and QBS value of soil compared with no cover crops. Our results on major physical, chemical and biological properties of soil suggests that combination of NT, cover crops and moderate rate of N fertilization could be a good strategy for enhancing long-term soil quality in the sandy loam soil of the Mediterranean region. Reducing the amount of nitrogen fertilizer through proper combination of tillage and cover cropping system will reduce the cost of production in one hand and minimize the risk of nutrient pollution on the other.

**key words:** Soil organic matter, Aggregate stability, Micro-arthropod diversity, soil biological quality (QBS), tillage system

## INTRODUCTION

Tillage system, cover cropping and N fertilization interact in a complex way to affect soil quality thereby affecting the productivity of the system. For example, legume cover crops, such as hairy vetch, have been known to enrich soil N and therefore can reduce the amount of N fertilizer needed for the succeeding crop. This effect, however, will be different under different tillage systems due to their differential effects on mineralization of soil nutrients. Here, we present the combined effect of tillage, N fertilization and cover crops on some selected soil properties and on soil micro-arthropods after 15 years of experimentation in central Italy. The treatments were two tillage systems (CT: conventional tillage and NT: No tillage), two N fertilization rates (N0: no nitrogen, N2: medium nitrogen) and three cover crops (C: no cover crops, Vv: *Vicia villosa*, BJ: *Brassica juncea*) combined factorially.

## RESULTS AND DISCUSSIONS

As expected, NT, N fertilization and use of leguminous cover crops improved all studied soil properties than CT, no N fertilization and no cover crops, respectively. Soil organic matter increased significantly with N fertilization and use of leguminous cover crops under NT system but the effect of N fertilization was not observed under CT system (Figure 1). Same trend was observed on soil aggregate stability. The micro-arthropod diversity and QBS value was significantly higher in NT system and in the system planted to cover crops than in conventional tillage system and the system without cover crop, respectively. Positive correlation of soil organic matter with other soil properties including diversity of micro-arthropod communities suggests that the combined effect of treatments on soil quality is probably through improved soil organic matter.

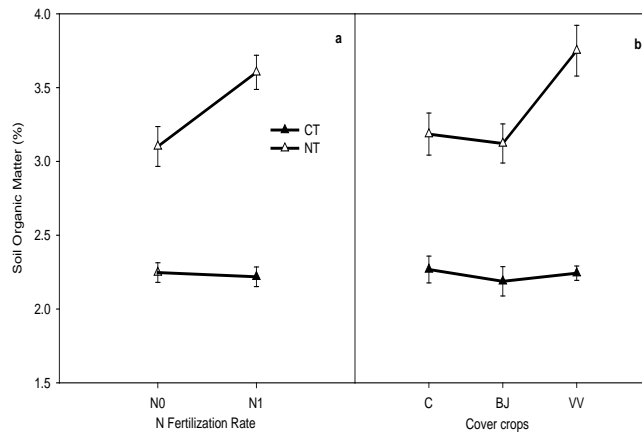


Figure 1. Effect of N fertilization (a) and cover crops (b) on percent soil organic matter under two tillage

## CONCLUSION

NT systems increased soil organic matter, water stable soil aggregates, moisture content, and the soil micro-arthropod groups and decreased bulk density than CT system. N fertilization and cover cropping also improved these soil properties but their effects were more evident in the NT than in the CT system. The NT system with *Vicia villosa* as cover crop and optimum rate of N fertilization can conserve and improve soil organic matter in long term thus sustaining the agro-ecosystem productivity.