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Effect of different mulches on soil microbiological properties in processing tomato

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For decades, vegetable growers have used non-degradable plastic mulches in open fields, mainly for spring-summer vegetable crops, for a variety of reasons widely studied. In relation to soil quality, microorganisms play a leading role in regulating soil fertility and transforming organic matter.
In order to assess the effect of mulch composition on soil microbiological properties, a field experiment was conducted in a processing tomato crop in Central Spain (4º2' W, 38º59' N). A randomised complete block design was chosen with nine mulch treatments: black polyethylene mulch (PE, 15μm), two black starch-based biodegradable mulches (Mater-Bi®, Novamont, 15μ; Biofilm®, Barbier, 17μm), one black oxo-biodegradable mulch (Enviroplast®, Genplast, 15μm), two paper mulches (black Mimgreen®, Mimcord, 85 g/m2, with fungicides incorporated; brown Saikraft®, Saica, 125 g/m2), one barley straw mulch and two check treatments (manual and no weed control). Soil samples (5-10 cm depth) were taken at three dates: 1) prior to establishment of the mulches (April 2006), 2) once the crop cycle was finished and the biodegradable mulch materials were completely degraded (May 2007), 3) July 2008. Samples corresponded to soil previously covered by mulches and also bare soil with no crop.
The soil microbiological attributes analysed were: (i) Soil microbial biomass C (SMBC), measured as the ATP content. (ii) Soil organic matter mineralization (SOMM). (iii) CO2 production-to-ATP ratio, similar to the metabolic quotient (qCO2) and related to the availability of nutrients.
At the first sampling, the soil presented a medium level of microorganisms (ATP) and certain equilibrium between the microorganisms responsible for mineralization and humification of the soil organic matter (qCO2). At the second sampling, treatments could be classified in: 1) Bare soils, with low SMBC and normal qCO2. In relation to the first date, a quantitative decrease of the SMBC was observed, although its quality was not affected (similar qCO2). No weed control presented an ATP content slightly higher than the other two variants (rhizospheric effect). 2) Polyethylene and Saikraft® paper, with a biological behaviour similar to group (1), but with higher SMBC. The quality of the biomass in both groups was similar, indicating an indirect stimulation of the cover. 3) Enviroplast®, Biofilm®, Mater-Bi® and barley straw, characterized for SMBC higher that previous groups and lower qCO2, which would suggest, unlike in the group (2), that the cover as such influenced directly on the biological functioning of the soil due to the incorporation and mineralization of exogenous organic matter. Straw treatment had the highest biomass and mineralization. 4) Mimgreen® paper, with low quantitative and qualitative microbial attributes, probably due to the fungicides of the film (toxic effect). At the third sampling, treatments could be classified in: 1) Bare soils, with a similar trend that noticed in the previous date, but with qCO2 slightly higher. 2) Plastic films and papers, with lower SMBC in relation to the second date. With the exception of Mater-Bi®, the microbial properties were similar to those obtained in bare soils, indicating that, after two years, the stimulation effect of the mulches had disappeared. 3) Barley straw, with the highest SMBC and mineralization activity and a low qCO2. This was the only cover whose effect on the soil properties remained after two years.
As conclusion, in general terms and during the first year, mulches affected the soil microbiological properties, especially increasing the microbial biomass, although the effect on the mineralization activity and the quality of the biomass depended on the material employed. This effect of the cover only remained at least two years when straw was used as mulch.
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