Comparison of plastic film, biodegradable paper and bio-based film mulching for summer tomato production: Soil properties, plant growth, fruit yield and fruit quality

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## Abstract

Plastic film (PF) is a common soil mulching material used worldwide in crop production. In recent years there is an increasing demand for reducing the use of PF because of potential environmental- and ecological-risks. Although biodegradable paper (BP) and bio-based film (BB) have been used as alternatives to PF, little information is available regarding their efficiency in summer crop production, which is often restricted by the combination of heat stress and drought stress. To meet this need, PF (silver-gray plastic film made from polyethylene), BP (biodegradable paper made from plant straw) and BB (bio-based film made from plant straw combined with decomposed coal) were used as soil mulching materials to investigate their influence on soil properties (temperature, moisture, pH, electricity conductivity (EC), nutrients and enzymes), plant growth (root morphology, the relative growth rate (RGR), plant biomass and the root/shoot ratio), fruit yield and fruit quality. The un-mulched soil served as control. The trial was conducted in a five-year-old commercial greenhouse located in Helan county, Ningxia, China, with the mean air temperatures of about 32 °C and 31 °C during the summer season in 2016 and 2017, respectively. In general, although PF mulching increased soil moisture, it increased soil temperature, pH and EC and decreased available P, resulting in the reduction of plant growth (root length and diameter, the RGRs of plant height and leaf area, and shoot and root biomass) and fruit yield. The BB mulching decreased soil temperature, however, it decreased soil moisture and invertase and increased soil EC, leading to reduced root growth (root diameter and biomass, and the root/shoot ratio). The BP mulching not only decreased soil temperature, but also increased soil moisture. As a result, it showed several advantages such as decreasing soil EC, increasing soil enzyme activities, improving plant growth (root length, the RGRs of plant height

and leaf area, plant biomass and the root/shoot ratio) and increasing fruit yield. Moreover, the fruit quality was partly improved by BP mulching due to reduced nitrate but increased vitamin C. Our results infer that BP was a potential mulching material that could be used for summer tomato production.