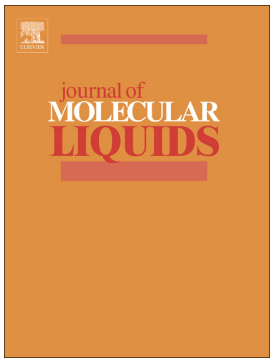

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SOIL CULTURE: INFLUENCE OF DIFFERENT NATURAL FILLERS INCORPORATED IN BIODEGRADABLE MULCHING FILM

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Abstract: The present paper focuses on the study of the incorporation of low levels of natural fillers in mulching films to understand how the fillers can change the mulching degradation capability in soil. This work prepared, biodegraded, and evaluated biodegradable mulching films composed of poly (butylene adipate-co-terephthalate) (PBAT), poly (lactic acid) (PLA), and three natural fillers (carbon black, organic fertilizer, and silica rice ash) prepared by double-screw extrusion. The films were characterized by wettability, sorption of water, biodegradation in simulated soil and ecotoxicity in bean cultivation. The results show that the addition of natural fillers can increase or decrease wettability, and this behavior is depending on the polarity of the fillers. However, all samples show sorption and biodegradation superior to pure blend, as expected. The fertilizer has contributed more for the accumulation of biomass and SiO_2 to the structural growth of the bean. The least satisfactory performance for germination, growth and biomass of the crop was presented by the blends without addition compatibilizers of these natural fillers.

Keywords: Biodegradation, Mulching, PLA/PBAT, Toxicity.

1. Introduction

During the past two decades there has been great scientific and commercial progress in the area of biodegradable polymers and its composites. The agricultural potential of land crops for food and commodities has been growing with the development of researches in the area. Nevertheless, it is necessary a high volume of inputs, organics fertilizers, and materials applied to supply the current market demand. Cover film technology, mulching, is a viable alternative and has been improved to reduce the amount of plastic waste after its application (ROCCA-SMITH et al., 2017).

Biodegradable mulching films can replace conventional ones when they meet the same required properties. In addition, the researches include the use of biodegradable blends or ecologically correct fillers to achieve these requirements (PANKOVA et al., 2010; WALCZAK et al., 2015; ZHOU; ZHANG; CHENG, 2015; ROCCA-SMITH et al., 2017). However, biodegradable polymers have limitations such as: lower processing range, greater brittleness, high moisture absorption, low gas barrier, and low thermal and mechanical resistance. One of the most investigated biodegradable polymers, PLA, which is a relatively rigid polymer, can be applied in blends with the poly (butylene adipate co-terephthalate), PBAT, which is flexible. It promotes the obtainment of a biodegradable blend, stable, tenacious and applicable to mulching cultivation (DE MACEDO; DOS SANTOS ROSA, 2015; SWARNAVALLI et al., 2015; ROCCA-SMITH et al., 2017).

However, few studies investigate the effect of the added fillers in these films as providing an increase in the toxicological quality potential in the soil. In species important for nutrition, such as rice and wheat, there is a need for millimolar concentrations of ions that relieve toxicity to the crop. In dicotyledonous leguminous species, such as beans, the same effect may increase the biosynthesis of organic compounds, which may intensify crop growth (RENGEL et al., 2015). Thus, small contents of additives or fillers can be included in the processing of these films and this impact has positively or negatively the performance of the soil for the crop. Fillers such as carbon black, CB, are already processed with these materials and it is known that their effect increases the fraction of total carbon available and accelerate the biodegradation of the plastic cover (HARADA