Benha University
Faculty of Agriculture

Institute for Agricultural Technology

REPORT

INTRODUCED FROM

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EGYPT

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CONTENTNS

1. GENERAL

This report will be introduced to Benha University about the research visit to Germany from March to September, 2014. The research proposal accepted from the German side to do it during summer 2014. The full financial support for this research visit (six months) covered by the Egyptian Academy of Scientific Research and Technology.

2. NOMINATED SCIENTIST INFORMATION

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4. SUBJECT OF STUDY

The idea of this study is to solve some problems that hinder the expansion of the use of drip irrigation and its advantages in the provision of water and energy. These problems include high annual costs especially for the retrieval and maintenance of drip laterals. Another goal is to protect the environment from some of the problems resulting from the use of drip laterals made from petroleum products. Some, such as limited fossil resources (crude oil), take more than 50 years to degrade and when burned release the carbon dioxide into the atmosphere, leading to global warming. According to the new environmental regulations and a growing environmental awareness throughout the world, which have triggered the search for new products and processes that are compatible with the environment, laboratory and field experiments were done to study the suitability of some bioplastic materials already used in agriculture for use as biodegradable drip tubes.

5. INTRIDUCTION

Since the underlying purpose of this study is to use the laterals access for one season only and since these laterals may hinder the machine during harvesting or during the soil preparation for the next season, it is better to find a suitable method to use as a preliminary degradation method between the last irrigation time and before the harvesting at “2-3 weeks.”

From the previous experiments and results (Mostafa, 2010), it was observed that some bioplastic materials can be used as degradable drip laterals for drip irrigation systems. Also from biological degradation results, it was found that the use of enzymes is not appropriate as a degradation way under field conditions with the limited time. Therefore, the suggestion is to use some chemical methods like acids to achieve the objective of the study, which is to find a quick way as a preliminary degradation method under field conditions.

Treatments with acids are mainly needed to dissolve precipitates of calcium carbonate and calcium residue from fertilizer applied in the drip irrigation system. It might be used to clean the drippers’ water passages from other mineral deposits like ferric oxides. Acids can be applied through the drip-irrigation system by a fertilizer pump.

In many cases, bioplastic materials are attacked chemically by acids that can attack the long chain hydrocarbon molecules, and broken down to small pieces. Further microbial degradation must then occur for true biodegradation to be achieved in the soil (Shah et al., 2008 and Auras et al., 2005). Acids can be injected into the system within limited time after the system has reached maximum operation pressure (usually at the end of the last irrigation time).

The aim of this experiment was to evaluate the suitability of the chemical methods for assaying the degradability of bioplastic materials. The idea is to use a degradation method at the end of the last irrigation by pumping a degrading substance into the lateral network allowing enough time for them to deteriorate.

6. SCENARIO OF EXPERIMENTS

6.1 Bioplastic Materials under the Study

The biodegradability of different types of commercial bioplastics available on the market as agricultural mulch film was assessed per DIN EN 13432:2000 and ASTM

D5988:2003. Some of bioplastics were used to test its suitability to produce biodegradable drip tubes. The materials under study were:

1. Ecoflex® F Blend C1200, biodegradable aliphatic-aromatic copolyester based on the monomers 1,4-butanediol, adipic acid and terephthalic acid for film extrusion. It has been developed for conversion to flexible films using a blown film or cast film process. Typical applications are packaging films, agricultural films and compost bags (BASF, 2012).
2. Bi-OPL is biodegradable film mulching and produced from polylactic acid (PLA is made of degradable materials (corn) and compostable in accordance with DIN EN 13432 (Oerlemansplastics, 2012).
3. Ecovio®, 2203 Biodegradable polyester for compostable film with 32 % of renewable (BASF, 2013).
4. Ecovio® 2332, Biodegradable polyester for compostable film with 18 % of renewable resources (BASF, 2013).
5. Ecovio®,FS biodegradable plastic bag (BASF, 2011).

6.2 Experimental Procedures

Monitoring of the different types of commercial bioplastics was assessed under acid conditions to study the material brake down.

According to Netafim (2008) the suitable acids to be injected throw the irrigation system without any hazard or bad affects are nitric acid (HNO_3), phosphoric acid (H_3PO_4), Hydrochloric acid (HCL), and Sulphuric acid (H_2SO_4) with 0.6 % concentration. Also Hydrogen Peroxide (H_2O_2) can be used. Laboratory and filed experiments were done.

For the laboratory experiments, two treatments were used for all acids with 0,5 and 1 % concentration.

The bioplastic strips (6 x 6 cm) of all films were placed in 0,5 and 1 % concentration of each acid for 20 minutes before placed in plastic griddles (60 x 60 cm) filled with 5 cm soil (Fig. 1). Two bioplastic strips were placed separately on the soil surface. All of the plastic griddles were kept in lab and each of them was irrigated every 5 days. The bioplastic strips were retrieved each 5 days of incubation, and were photographed to measure the breakdown.

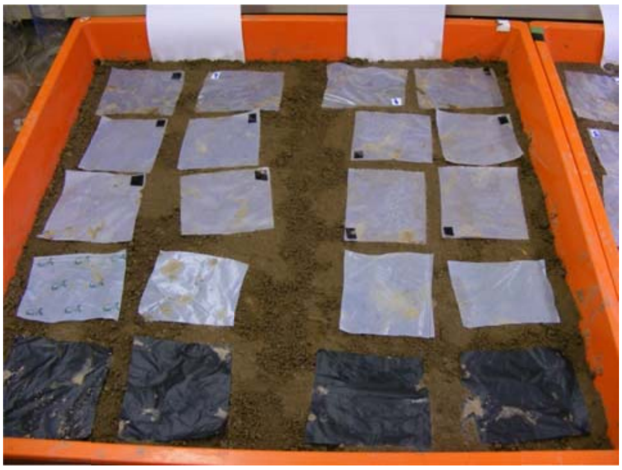

Fig. 1: Bioplastic strips are placed on the soil surface in plastic griddle.

For the filed experiments, a heat paste machine “Polystar 100 G” (Fig. 2) was used to produce the lateral prototypes from the biomaterials with 0.2 m long and 20 mm diameter.

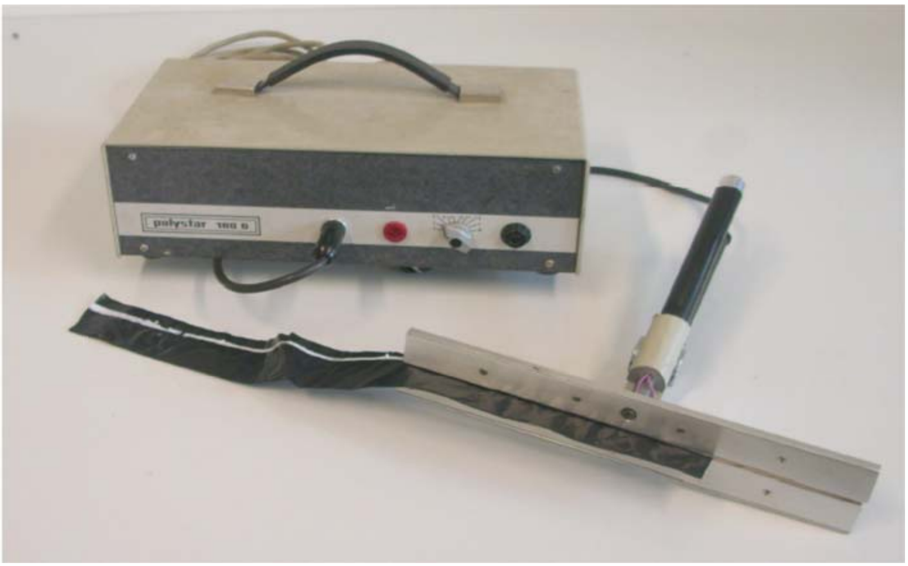

Fig. 2: A heat paste machine “Polystar 100 G” used for producing biodegradable laterals

A 1 % concentration was used for all acids which injected into lateral samples. All treatments were placed in maize field (Fig. 3)

Fig. 3: Bioplastic tubes at the field

7. RESULTS

7.1 Lab Results

Results of the laboratory experiments indicate that all replicates show minimal to no degradation at the time of incubation. Furthermore, no significant increase in degradation is obtained by increasing the exposure time to 30 days (Fig. 4). This was probably due to the absence of sun light and low temperature.

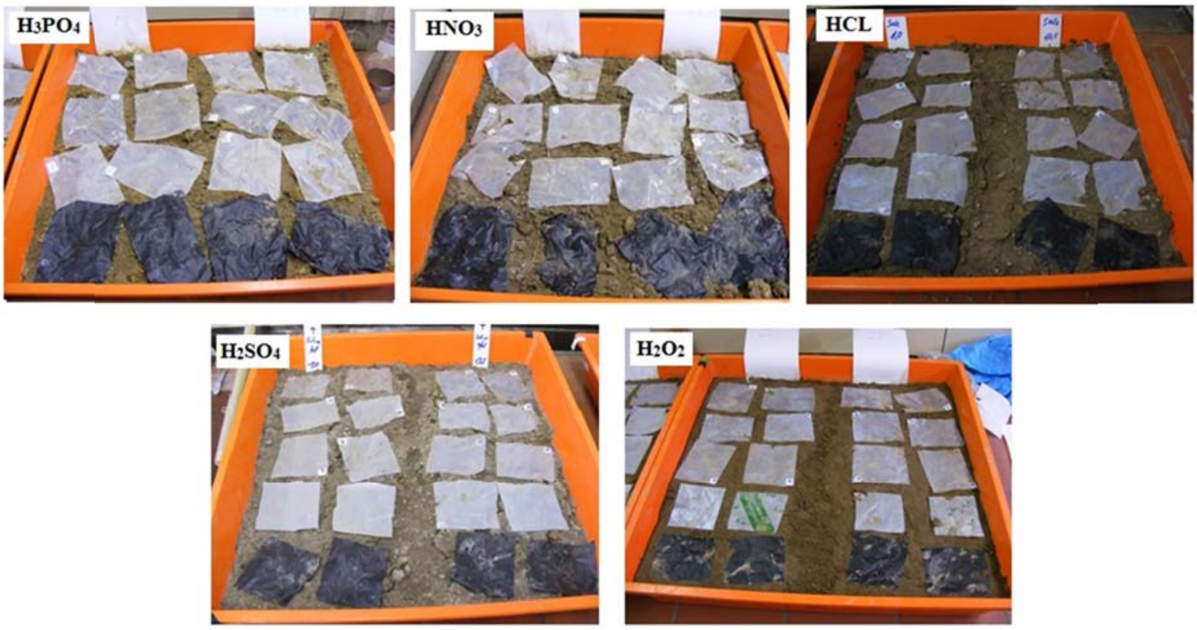

Fig. 4: The bioplastics degradation after the exposure time at laboratory.

7.2 Field Results

The results obtained in this study have indicated that both Bi-OPL and Ecoflex samples have the similar degradation rate at various acids levels (Sulphuric and nitric acids) and times (Fig. 5). They degrade significantly faster in a high acidic than in low concentration. Overall, the three Ecovio bioplastics studied exhibit slow to moderate degradability in acidic conditions. However, Bi-OPL and Ecoflex reveal higher degradability in the high acidic conditions.

Fig. 5: *The bioplastics degradation after the exposure time at field*

8. CONCLUSIONS

It can be recommended that the use of 1 % concentration of nitric or sulphuric acid can achieve the objective of the study under field conditions with the limited time for some bioplastic materials as Bi-OPL and Ecoflex. To save money, concentrated and inexpensive technical acids should be used, such as concentrated technical nitric or sulphuric acid which applied through the drip system.

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Signature

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