BRIEFING NOTE

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FIELD DEMONSTRATION OF BIODEGRADABLE MULCH FILMS IN SOUTH AFRICA

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KEY FINDINGS

The aim of the project was to conduct field demonstrate CSIR's formulated biodegradable mulch films (BDM) in South African. The BDMs are designed to fully biodegrade in soil, and don't have to be removed from farms at the end of crop season. Hence, they give the farmer the benefits of conventional mulches–such as crop earliness, but with a favourable end-of-life scenario of full biodegradability. Due to limited awareness among the key stakeholders, it is imperative to demonstrate use cases, to not only create awareness, but also derisk the commercialisation of the technology. Firstly, industrial manufacturability of the formulated BDMs was demonstrated at two different companies, underscoring the robustness of the formulations. The mulches were subsequently deployed at three sites in Gauteng and Eastern Cape, to assess their suitability and compare performance with conventional plastic mulches. It was observed that the BDMs perform same as conventional mulches. In one scenario, it was demonstrated that, like conventional mulches, BDMs enhanced early root formation for pineapple crops due to raised soil temperature.

INTRODUCTION

Agricultural plastic mulches present many benefits. These include conservation of moisture, raising the soil temperature, weed suppression, reduction of nutrients runoff and reduction of certain pests. Generally, these factors consequently lead to increased crop yield, crop earliness, expansion of growing season, reduction of fertilizer and weedicide usage and reduction of irrigation water. Due to these benefits, plastic mulching is on the rise. However, despite the many benefits, several studies are beginning to show adverse effects associated with long-term usage of conventional plastics. In its report, FAO (2021), identifies mulches as second only to polymer coated slow-release fertilizer, as top priority product for intervention, due to high risk profile. This is as result of ease of extent of its usage, potential for leakage into the environment, extent of direct contact with receptor environment, and potential to cause harm, particularly in its microplastic form.

As an alternative to conventional plastic mulches, biodegradable mulch films are gaining traction in usage within the agricultural sector. Unlike the conventional mulches, properly designed biodegradable mulches should be able to fully mineralize through the action of microbes into carbon dioxide and water, without leaving any toxic residue. BDMs do not contribute to the visible pollution often associated with used conventional plastic mulches, which tend to be discarded by the farm side, burnt on the farm, or landfilled. Any microplastic formed from BDMs is also eventually fully biodegraded, without leaving toxic residue. The project objectives were to demonstrate the manufacturability of the BDMs at industry scale and showcase usage in mulching short- and long-term crops in South Africa.

METHODOLOGY

To achieve the project objectives, two product lines, CSIRP2006 and CSIRP20036 were formulated and produced at a pilot-scale facility at the CSIR, before being sent to two film manufacturers for industrial production of the final prototypes. The prototype films were then deployed at three sites: (a) to test a re-use model on short term crops under greenhouse tunnel; and (b) to test performance in the open field for pineapple, as a representative for long-term crops (Figure 1).

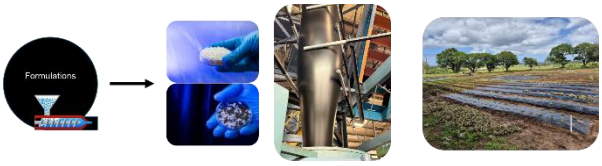

Figure 1: Steps followed in demonstration of BDMs

MAIN RESULTS

The manufacturability of the two formulations was successfully demonstrated at two different industrial scale facilities. This shows the robustness of the formulations as they could be processed with film blowing equipment, typically used for conventional plastics (Figure 2). Key parameters optimized included the profile temperature, screw speed, draw-down rations and blow-up ratios. Wastage rate was notably high, due to change over from conventional to BDMs.

Figure 2: Industrial-scale manufacture of CSIR BDMs (CSIRP20036

Even though the BDMs need to fully biodegrade in soil, testing takes long. An accelerated industrial composting test shows that the BDM fully biodegrades in 250 days, while ~83% mineralization occurs by 180 days (Figure 4). The mechanical properties both in machine direction and transverse directions were also in conformance with EN17033 standard.

For the short-term crops mulched under a greenhouse tunnel, the growth rates and observable quality of the green beans were similar for the sections mulched with CSIRP20036 and those mulched with the white conventional plastic films. However, perforations because of thinner films (45µm) and accelerated disintegration action by fungal pre-treatment applied on the farm meant that the mechanical properties were not sufficient to allow for a re-use model test.

An interesting observation was made for pineapple mulched with BDMs compared to un-mulched and those mulched with conventional black polyethylene mulches. Like the conventional mulches, the BDMs enhanced early root establishment and growth, leading to potential crop earliness (Figure 4).

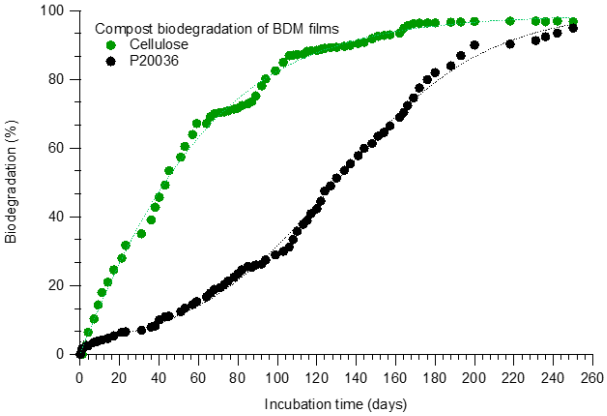

Figure 3: Biodegradability profile for CSIRP20036 under industrial compost conditions

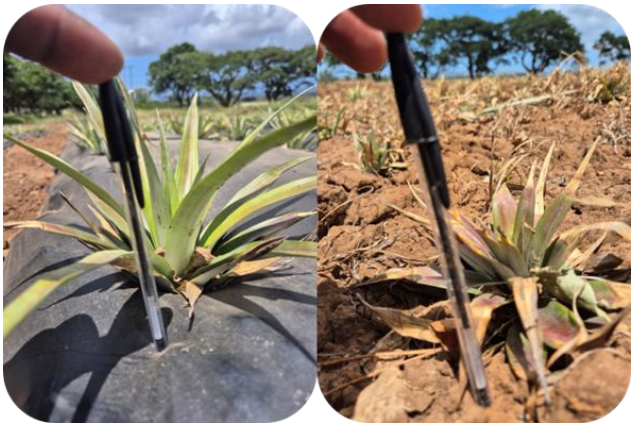

Figure 4: Mulched treatments (both BDMs and Conventional Plastics films showing faster early growth compared to the un-mulched treatment

References

FAO. (2021). Assessment of agricultural plastics and their sustainability – A call for action Retrieved from Rome: https://doi.org/10.4060/cb7856en

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