Phasing out Highly Hazardous Pesticides in Costa Rica

Workshop presentation 1: Agroecological alternatives to paraquat for management of pineapple foliage waste

Adapted by PAN UK from the presentation by **Oscar Acuña, Centre for Agronomic Research at the University of Costa Rica** (UCR), for the workshop on ***Phasing out Highly Hazardous Pesticides in pineapple****,* held 3rd May 2017 in San Carlos, Costa Rica.

For background information on the issue of paraquat use in pineapple, see the project *Technical Briefing no.1 Alternatives to paraquat for pineapple foliage treatment* (Aug. 2016).

In a nutshell: Earlier experiences with commercial products for speeding up pineapple crop waste decomposition for stable fly control were disappointing because the products did not contain the right microbes for digesting cellulose-lignin.

More recent work has developed an effective strategy based on:

a. Breaking up foliage into smaller pieces using chopping or harrowing equipment
b. Application of carefully selected lignin-digesting decomposer microbes
c. Incorporating into the soil foliage pieces in decomposition along with the beneficial microbes

Problems with pineapple crop waste

Costa Rican researchers began looking for alternatives to paraquat for pineapple foliage destruction from 2004 in the country's northern production zone. It is the slow and inefficient rotting of the huge volumes of pineapple waste after harvest that makes fields highly prone to stable fly infestation, as the rotting material can become an attractive breeding site for this economically harmful pest of livestock. There is a narrow window of intermediate moisture levels when the foliage becomes the perfect substrate for egg-laying. However, if the foliage is too wet or too dry, it will not attract egg-laying females of the stable fly.

Poor foliage decomposition practices can not only encourage major breeding of stable flies but also trigger higher populations of crop-harmful *Phytophthora* fungi. Until 2005 it was common practice for most pineapple producers to avoid this by destroying (desiccating) foliage with paraquat herbicide and then burning the dried out material to get rid of their waste foliage problem. This practice, however, leads to serious environmental contamination and problems of soil erosion. In 2010, Costa Rica recorded its worst stable fly outbreaks.

The need for suitable decomposition processes and microbes

The size and diversity of the saprophytic decomposer community in the soil is very important with respect to the speed by which any plant material rots. Rotting speed also depends on the physico-chemical properties of the soil and on the quality of the waste, i.e. what kind of microbial and meso-fauna it can support. If suitable decomposer species, which are able to tackle the tough and juicy pineapple leaves, are lacking, then the rotting process will be slow. Fermenter fungi are the first group to start attacking cellulose-lignin substrates and begin the decomposition process. This then allows bacteria to come in and work on secondary breakdown substances.

UCR studies in 2009 found very little decomposer activity in much pineapple waste which had been treated with certain commercial biodegradation products – this was because the products did not contain the right microbes for decomposing pineapple foliage! Some earlier products only contained lactic acid consuming bacteria and these products failed totally to decompose lignin in the pineapple leaves.

The so-called 'forest microorganisms' [microorganismos de montaña, MM, in Spanish but usually known as 'effective microorganisms', EM, in English] are a great source of suitable fungal decomposer species- these are accessible for free for small producers [in leaf litter from natural vegetation under shade] or can be purchased in commercial products. NB: it's important to check carefully before buying a commercial product that they contain suitable species for pineapple foliage.

An agroecological strategy for dealing with pineapple foliage

200 tons per hectare of foliage residue is a valuable resource of nitrogen and other nutrients so it makes little sense to waste this by herbicide application and burning! UCR has developed alternative strategies to speed up the decomposition and mineralization rate by:

Step 1 Mechanical chopping: fragment the waste using chopping equipment or harrowing

Step 2 Add decomposer microbes: make sure to get maximum coverage of the surface area of the fragmented waste to maximise the microbial action

Step 3 Incorporation: the aim is to return the biologically active mixture of rotting waste + beneficial microbes back to the soil

Experiences to date

Experience shows that one month after incorporation, the material is well decomposed, with no smell and is no longer suitable for stable fly egg-laying. The land can be replanted at this stage. However, you may increase the incidence of some soil-borne diseases if you haven't achieved a good rotting process or you replant too early. The recommended practice is therefore to leave plots for two months before replanting.

In a 2012 study of 50 farms by the Socio-Environmental Commission for Pineapple (COSAP) of the National Chamber of Pineapple Producers and Exporters (CANAPEP), only two had stable fly at problematic levels. These were the only two farms that were still using conventional methods for foliage destruction (i.e. paraquat application followed by burning). The other 48 were following some form of the UCR recommended strategy.

These recommended practices also benefit the producers via delivering a soil habitat which encourages strong and healthy root development of pineapple suckers. This will help growers to achieve one of the key IPM principles, namely 'growing a healthy crop', resulting in young plants better able to withstand soil-borne pests or diseases.

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(IRET) at the National University of Costa Rica (UNA), activities in 2015-2017 identified HHPs in use and trialled safer IPM alternatives in coffee and pineapple systems.