



## TECHNICAL REPORT INSECT PRODUCTION

The potential to recover nutrient from fruit and vegetable residues through insect production

### SHORT SUMMARY FOR PRACTITIONERS

EN version

Plant waste produced in agriculture is abundant and, if treated adequately, can be an important source of nutrients to nourish the soil. One way to recover those nutrients is by using insects which could be fed with the plant material, and in a period of just 14 days convert this highly fermentable and unstable waste in nutrient and carbon rich fertiliser (also known as insect frass). Furthermore, the insects produced in the process can be used to fertilise the soil, with the amino acids and chitin, or simply commercialised in other applications, making the process more sustainable, circular and with virtually no waste produced.

Black soldier fly has shown to be the most efficient insect species tested. To use the larvae as a waste converter, the substrate is first prepared. The plant material must be grinded and reduced in other to make the nutrients accessible to the insects. Moisture of the substrate should be kept above 65%, while maintaining warm temperatures during the insect bio-digestion. Insects are added to the prepared substrate when they are still small. If all goes smoothly, we can expect, for every ton of plant material, mainly fruit smash and leaves, a production of ca. 90kg of frass and 43kg of insect biomass. At the end of the insect bio-digestion, larvae (already grown) can be separated from the frass by sieving. The frass is usable as fertiliser while the insect biomass can be used to extract other components.

### SHORT SUMMARY FOR PRACTITIONERS

NATIVE version

Los residuos agrícolas son abundantes y si se tratan de forma adecuada pueden ser un recurso importante para nutrir el suelo. Una de las formas para recuperar dichos nutrientes es por medio de insectos que pueden ser alimentados con el material vegetal y en un periodo de tan solo 14 días convertir este residuo fermentable e inestable, en un fertilizante rico en nutrientes y carbono (también conocido como frass). Además, los insectos producidos en el proceso pueden fertilizar el suelo con aminoácidos y quitina o simplemente comercializados en otras aplicaciones, haciendo el proceso más sostenible, circular y virtualmente exento de residuos.

La mosca soldado negra ha mostrado ser el insecto más eficiente probado. Para usar las larvas como conversores de residuo, el sustrato tiene que ser preparado. El material vegetal tiene que ser triturado y reducido para que los nutrientes queden accesibles al insecto. La humedad del sustrato tiene que ser superior al 65% y además se tiene que mantener el sustrato cálido durante todo el proceso de bio-digestión. Los insectos se añaden al sustrato cuando aún son pequeños. Si todo el proceso ocurre correctamente, podemos esperar, por cada tonelada de material vegetal, principalmente frutas trituradas y hojas, una producción de aproximadamente 90kg de frass y 43 kg de biomasa larvaria. Al final de la bio-digestión con insectos, las larvas (ya crecidas) pueden ser separadas del frass mediante cribado. El frass se puede usar como fertilizante mientras que la biomasa larvaria se puede utilizar para extraer otros componentes.



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### CONTEXT

Agricultural organic waste is a nutrient rich source widely available in many places. In Almería (Spain) ca.1.5 million tons of greenhouse organic waste are produced every year. Those nutrients could be returned to the soil, to fertilise the plants, if they are treated properly. One way is by using insects that feed on the plant waste material, and in the same time, producing a by-product called "frass" (equivalent to manure but from insects) to fertilise the soil.

### PROBLEM

Many insect species could feed on plant material, specially on decomposing plant material, as it is the main constituent of the agricultural waste in Almeria. But, in order to achieve an efficient waste treatment with insects, to be implemented at large scale, it is necessary to select an insect species that is easily and steadily produced using plant waste, and produces good quantities of frass to nourish the soil.

### APPROACH

To know which insect is the best to produce frass, experiments were done with 6 different insect species (beetles, flies, crickets, and roaches, which are known for their ease in reproduction/breeding) that were fed with 16 different agricultural waste (fruits, leaves, stems from greenhouse crops, plus other waste like olive pomace or broccoli or mushrooms). Evaluation was on which insect grew faster, ate a certain food, and produced more frass to be used as fertiliser, and had more insect biomass for product extraction.

### OUTCOME

1. From all the insects used in the experiment, black soldier fly stood out for its fast development, the ability to feed on all kinds of materials, and producing a good amount of frass rich in cellulose.
2. The best source of food for the insect was fruits and vegetables puree, while for frass production, plant leaves gave the best results..
3. Per tonne of plant material treated, ca. 90 kg of frass and 43 kg of insect biomass can be produced

### PRACTICAL RECOMMENDATIONS

- Insects are good to treat plant waste, passing in a period of 14 days from a fermentable plant material high in moisture, to a low moisture and stabilized frass.
- Best plant material to produce frass are plant leaves, but if it is desired to give the insect a boost, best is to add fruits to the mix having as a result, more frass and more insect biomass.
- Pesticides are detrimental to the insect, so the best choice is to use organic plant material, or allowing a security period after spraying with pesticides.