

Bio-pesticide

iGEM Lanzhou

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What is pesticide?

1. Definition

Pesticides is a kind of chemical used to prevent harmful organisms (pests, mites, nematodes, pathogens, weeds and rodents) which can destroy agriculture, forestry, live stock industry in that the remaining chemicals may cause potential harm to the growth of plants.

2. Classification

(1) Based on the materials of pesticide, they can be divided into organic pesticides, inorganic pesticides, plant pesticides, microbial pesticides and insect hormones.

(2) **Based on the processing methods**, they can be divided into powder, soluble powder, emulsion, concentrated emulsion, cream, paste, colloid, aerosol, oil and particle agent etc.

(3) **Based on the object of prevention and control**, they can be divided into pesticides, fungicides, fungicides, fungicides, fungicides, herbicides, leaf removal agents, plant growth regulators.

How does the common pesticide function?

1. Primary herbicide

(1) **Selective herbicides** (killing crops selectively): 2,4-D and trifluralin.

(2) **Destructive herbicide** (are toxic to all plants): Sodium pentachlorophenol, Sodium chlorate, gramoxone, glyphosate.

(3) **Contact-killing herbicides** (can only kill the parts of plants which contact with

herbicides): 2,4-dichloro-1-(4-nitrophenoxy)benzene.

(4) **Conductive herbicide** (can be absorbed by certain regions of plants and transported to the whole plant through the conduction tissue): Chipton.

The principles of selective herbicides

(1) **Space selection:** Select depending on position of soil or whether a certain space in between crops or weeds.

(2) **Time selection:** Select according to weeds' growth period..

(3) **Morphological selection:** Select on the basis of weeds' different shapes or sizes..

(4) **Physiological selection:** Select on account of the weeds' ability to absorb herbicide.

(5) **Biochemical selection;** Select basing on biochemical reactions starting in weeds.

Mixing principles are frequently used when applying herbicide in the field..

Different kinds of herbicide with various selective ranges are mixed up when there is no precipitation. So that most of the advantages will be made full use of while most disadvantages will be overcome. However, from the data we collected from those surveys showed that most farmers use one herbicide only so that most of the herbicide residue will left on the crops and weeds.

Glyphosate is one of the most widely-used herbicides in our country. Because of its high efficiency, low toxicity and wide herbicide controlling spectra, glyphosate becomes extremely popular in agriculture and forestry. Glyphosate mainly inhibit the Enol Acetyl Shikimate Phosphoric Synthetase of plants, so that Shikimate can not transform into phenylalanine, tyrosine and tryptophan. Then the synthesis of protein will be repressed thus leading to death of plants. Although glyphosate is a low-resistant herbicide, its abuse has already led to excessive selecting pressure and the number of glyphosate-resistance weeds increase year by year.



Glyphosate

2.The harm of herbicide

(1) Residue

It is known that the residual herbicide is harmful to the crops, by the soil PH, temperature etc, even after 2-3 years the herbicide still produces harm. The destructive herbicide, for example, Sodium pentachlorophenol, will cause potential phytotoxicity in a large area of and result in decrease in total amount of yield. The content of glyphosate in the commonest 14 kinds of beer in Germany is $0.46\text{-}29.74 \mu\text{g/L}^{-1}$. But the standards of Germany drinking water required that the highest of the content of glyphosate is $0.1 \mu\text{g/L}^{-1}$.

(2) Pathogenicity

Because of bio-accumulation and being attached to the herbicide, human body becomes a heavy container of herbicide. Then it causes mucosal congestion, gene mutation and various inflammatory reactions. With the toxicant being absorbed into the blood circulation, it not only results in the mononuclear phagocyte, lymphocyte, and liver losing the function of defense and synthesis but also causes the pathological process of tissue diffusion, humoral diffusion even nerve diffusion.

International Agency for Research on Cancer(IARC) lists more than 10 kinds of pesticide such as glyphosate and sodium chlorate in “probably carcinogenic”. And epidemiological studies have found that glyphosate harbors mutagenicity,

genotoxicity, developmental toxicity, cytotoxicity and reproductive toxicity.

(3) Drifting phytotoxicity

Gramoxone and 2,4-D etc are both highly toxic pesticides. But they are easy to volatilize. There are some data show that spraying partial can drift for nearly 800 meters, which can cause broad crops damaged and make leaves narrower and smaller.

(4) Producing resistant weeds

The paper shows that weeds' resistance to pesticides has dramatically increased in recent years, because of the shift of farming system, the abuse of herbicides, the use of various kinds of herbicides and genetically modified crops in the field.

Why you should choose iGEM Lanzhou bio-pesticide?

iGEM Lanzhou bio-pesticide is water-soluble and is able to killing both weeds and pests that are two main problems to farmers around the world.

Main constituents:

- (1) The dsRNA which can silence the expression of the malic lyase of *Setaria* .
- (2) The dsRNA which can silence the expression of the citrate (Si)-synthase of *Setaria* .
- (3) The dsRNA which can silence the expression of the salivary sheath protein of *Aphidoidea*.
- (4) The dsRNA which can silence the expression of the ecdysteroid receptor of *Aphidoidea* .

Main functions:

The dsRNA (double stranded RNA) in iGEM Lanzhou bio-pesticide will lead to RNA Interference effect when it is absorbed by the weeds. The dsRNA could silence the essential gene which is necessary for weeds' and *Aphidoidea*'s growth. Thus the weeds and *Aphidoidea* couldn't grow normally and crops will be protected.

Main principle : iGEM Lanzhou bio-pesticide utilizes RNAi technology (RNAi

mediate the mRNA degradation through the input of endogenous or exogenous dsRNA. Ultimately, it will lead to post-transcriptional gene silencing) to kill weeds and Aphidoidea.

	iGEM Lanzhou bio-pesticide	Monsanto bio-pesticide	General pesticide
Principle	Silence the necessary gene of weeds and Aphidoidea	Silence the resistance gene of weeds and Aphidoidea	Use chemicals to destroy the protein in the weeds and Aphidoidea
Method	Used alone	With other pesticide	According to the sensitivity of crops to adjust the dose
Function	One can kill both weeds and Aphidoidea	One can kill the weeds, need the other one to kill the Aphidoidea	One can kill the weeds, need the other one to kill the Aphidoidea
Advantage	1.Hardly produce resistance 2.High targetability and less pollution 3.multifunction	The technology is more mature	Cheap
Disadvantage	1.Expensive 2.The technology is not yet mature	Just remove the resistance of weeds and Aphidoidea. The	1.Pollute the environment 2.It is harmful to human' s health

		pesticide is still needed	3.It is easy to make weeds and Aphidoidea produce resistance
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