MÉTODOS TRADICIONAIS DE COMBATE A ERVAS DANINHAS E OS DESAFIOS E PROGRESSO COM O USO DE MICROONDAS.

TRADITIONAL METHODS OF COMBATTING WEEDS AND THE CHALLENGES AND PROGRESS WITH THE USE OF MICROWAVES.

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Abstract: A produção agrícola em grande escala passou a receber uma visão global quando no auge da pandemia (2020/2021), os grandes países produtores de alimentos, precisaram responder a demanda mundial, somado com a paralização de outras indústrias, para suprir a redução global das atividades devido a aplicação do lockdown, em quase toda a cadeia produtiva de todas as regiões do planeta.

O aumento na produção de alimentos sempre foi uma busca incansável na indústria agrícola, porém nas últimas décadas a preservação Ambiental vem sendo atrelada a esse fator. Diante dos desafios, estudos sobre o uso de micro-ondas tem se intensificado com resultados tanto no uso de combate a ervas daninhas como a erradicação de fungos e bactérias, frente a outros processos já aplicados em larga escala.

1. INTRODUCTION

Currently, governments and environmental institutes are creating restrictions and increasing inspections for agricultural techniques and practices to be aligned with the best actions to preserve the environment. Given the above, the question remains: How to increase production in agrobusiness reducing environmental impact?

In various stages of agricultural production there are possibilities to apply control methods with environmental responsibility, but one of these that is often overlooked is the fight against pests and weeds before planting, that is, in preparing the area to receive the new culture.

The action of avoiding weeds in agricultural production has been fought since the beginning of the activity in the community, that is, for centuries, through removal, isolation, burning, chemical action, among others. The ideal from an environmental point of view is removal, but for great properties, the high cost and low efficiency make methods for mass application as a chemical action the most applied method worldwide.

One of the methods that has been seeking application on a commercial scale is the use of microwaves, where there is evidence of its effectiveness in specific applications, but without a study that signals a process ready for application on an industrial scale. This article aims to bring to light the method, the advances, the barriers and the next steps.

2. WEED CONTROL METHODS

There are several control methods for weed infestations, where they are subdivided into groups by method adopted. They are:

Preventive management, cultural control, mechanical actions, physical actions, biological actions, and finally chemical actions.

2.1 Preventive Management

It is a package of actions to be applied with the aim of preventing the entry of weeds into the production area, therefore it is a process that depends on the cultural changes of the employees. Example of actions that can be taken:

- control weeds during the off season.
- hygiene of agricultural machinery and implements.
- avoid the use of manure, straw or compost containing weed propagation.
- quarantine animals in an isolated area soon after they are purchased.
- to buy certified seeds and seedlings.
- cleaning of irrigation channels and carriers.

With the application of a set of control measures, a certain degree of protection can be achieved. For comparison, making a parallel to a sanitary barrier. [1]

2.2 Cultural Control

The method consists of using the diversification of cultivars, along with best agricultural practices, which cause weed suppression and at the same time enhance the main plant production. Example of actions that can be taken:

- physical and chemical preparation of the soil.
- plant rotation(diversity).
- the consortium of cultures.
- adopt types of plant adapted to the region.
- the correct sowing time.
- correct spacing between plants.

The application of this method has proven to be efficient, but when including different cultures, greater controls, a higher level of technical knowledge and a higher cost are required, due to this diversification. [1]

2.3 Mechanical Actions

It is the oldest method applied by society, which simply consists of removing weeds from the production area. Types and equipment that can be adopted:

- Manual removal.
- Hoe removal.
- Cutter.
- Roll of knives.
- Rotary cutter.
- Soil tillage.
- Articulated brush cutter.

Mechanical action is a simple method, but effectively applied in urban areas, due to the law that prohibits the use of chemical defenders in this region. Another factor is that removal is more effective before planting the main crop, due to the ease of transit of implements, but after planting the effectiveness decreases, as implements with large capacity do not have access to these areas. [1]

2.4 Physical Actions

It consists of applying techniques that use physical influence on unwanted plants. Examples of methods:

- the flood,
- the fire,
- to cover,
- the solarization,
- The thermal control (microwave),
- the electricity

They are different methods, with application systems that vary greatly, such as flooding and fire, for example, but thermal control using microwaves is currently the most unknown, mainly because it is not being applied on a large scale. [1]

2.5 Biological Actions

Method that uses as source of control other organisms (natural predator insects) or microorganisms (fungi, viruses and bacteria) in the fight against weeds.

This control consists of finding a highly specific host agent for the weed and confirming its safety and effectiveness through rigorous experimental evaluation. After validations on smaller scales, introduce the control agent in the region where the weed is manifested. (Charudattan & Chapter 1 Weed Control Methods 25 Dionoor, 2000).

This method is not indicated when you want a quick solution response, as it will take time for the proliferation and adaptation of the agent that will fight the weed, that is, the fungus, insect or bacteria. [1]

2.6 Chemical Actions

Large scale control method that provided unprecedented volumes of agricultural production. The discovery of herbicides and their intensive use quickly led to the abandonment of the application of other methods, such as mechanical, handling, etc.

Together with the increase in production, the results of the excessive use of herbicides caused side effects throughout the environment, such as: contamination of rivers and soil, occupational diseases in collaborators who handle the management, increased resistance of weeds, causing a potentializing of the herbicides.

The choice to apply chemical control in weed management has both advantages and disadvantages; although essential in contemporary production systems, it must always be adopted in an integrated scheme with other control methods. It is currently the most applied method in the world. [1]

3 PHYSICAL MICROWAVE METHOD

The study of the use of microwaves is not recent, at least there are almost 40 years of research and advances to prove its effectiveness in eradicating weeds after application. With the objective of making, it effective on a production scale, an addition, the continuous use of herbicides has increased the resistance of weed, making it necessary to increase the toxic dosage every day to have the same effect. Increased resistance of herbs to memos creates greater challenges as society becomes aware of the need to have pesticide-free processes throughout the food process. [2]

“Interest in the effects of high frequency electromagnetic waves on materials dates to the late 19th century while interest in the effect of high frequency waves on plant material began in the 1920s (Arca and Parry 1940). Davis et al. (1971 and 1973) was

among the first to study the lethal effect of microwave heating on seeds. They treated the seeds, with and without soil, in a microwave oven and showed that seed damage was mainly influenced by a combination of seed moisture and absorbed energy." [2]

"One of the biggest challenges of advancement are the variables involved in the method. The experiments must consider the variables of the grasses, their age (days of planting, the soil, the humidity, the time of exposure to the microwave, etc." [3]

"Laboratory tests are similar. Several herb seedlings are prepared, with different varieties, where they are placed in pots, covered with soil of different composition (nutrients) and these are exposed to microwaves at times varying in (2, 5, 10, 30 and 120) seconds through a cylindrical emitter." [3]

Microwave heating is governed by Maxwell's equations and the heat transfer equation. [4]

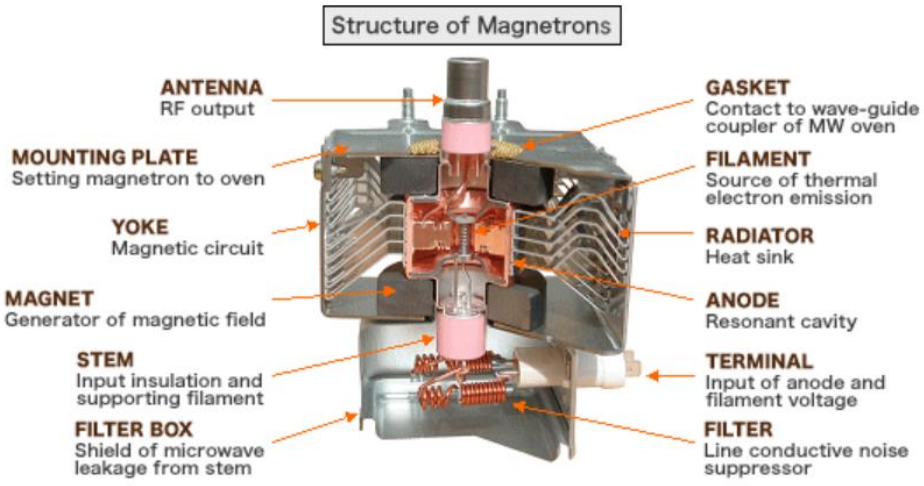
$$P\ (1)\ diss = \frac{\omega \varepsilon 0 \varepsilon''\ |\vec{E}|\ 2}{2}$$

The above equations lead to the conclusion that the hottest place in the heating pattern is along the wave emitter centerline (antenna) temperature is gradually degraded moving away from this centerline. [4]

To expose the soil and weed to a high-power electromagnetic field, it is necessary to use powers above 1 kW. The main component is the wave generator, technically called a magnetron. [4]

Figure 1. Magnetron

(http://www.hokuto.co.jp/hokuto/eng/products/magnetron/index.htm)



"There are several challenges and dangers of using high power microwave sources in an outdoor farming field, some of which relate to issues arising from external electromagnetic wave radiation. First and foremost is the safety of the device's human users. The energy leaked from such a device must meet the safety limits defined by standards and related recommendations such as ICNIRP [21] and IEEE [22] limiting the Specific Absorption Rate (SAR) of these devices. Another important point is related

to biological and environmental issues, which are under research and are not addressed here. What is the impact of microwaves on fauna and flora over time?" [4]

And finally, for industrial use, a series of controls must be applied to avoid exposure to microwaves by the operators involved.

The application of this method has two aspects: the use in grains and seeds with the objective of eliminating fungi, bacteria and microorganisms and the direct application in the soil for the eradication of weeds.

Microwave soil treatment has been proven to kill weeds and their seeds. Experiments have shown that raising soil temperature above 80 °C kills seeds of: wheat [7], ryegrass [8], rubber vine (Cryptostegia grandiflora R.Br.), partenium (Parthenium hysterophorous L.), pain-of-the-mud bush belly (Jatropha gossypiifolia L.) [9], Prickly Paddy melon (Cucumis myriocarpus) [10], wild oat (Avena fatua L.).

Companies such as Microwave Weed Control System have developed equipment that uses microwaves to control weeds in different types of crops. The system is mounted on farm vehicles or implements and directs microwaves at weeds, resulting in the desiccation and destruction of unwanted plants. This method can be applied at different stages of weed growth and in different agricultural crops. The Microwaves Weed Control Robot consists of an autonomous agricultural robot equipped with a microwave generator. The robot autonomously walks through the plantations, identifies weeds and directs microwaves to eliminate invasive plants. The Microwaves Weed Control Robot is designed for localized weed control in narrow rows of crops such as vines, vegetables, and greenhouse crops.

Figure 2. Microwave Weeding Machine

4. CONCLUSION

It is important mentioning that microwave weed control technology is still under development and isn´t being adopted in the agricultural market, as more traditional methods. The effectiveness of this method can vary according to the type of weed and environmental conditions. However, microwave control shows great potential to reduce reliance on chemical herbicides and offer more sustainable and environmentally friendly alternatives for controlling weeds in crops.

There are two aspects being studied regarding the effect of microwaves on plants, one segment mentions that the plant dies and stops reproducing because of the dehydration caused by the heat, but another line of research mentions that the death of the plant occurs due to a breakdown in its DNA structure, preventing its reproduction.

As with any control method used, there will always be the opportunity to apply not just one type of control, but to combine the different techniques developed with the aim of complementing the gaps.

5. REFERENCES

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