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STUDY OF THE POTENTIAL FOR BIOACCUMULATION OF CYPROCONAZOLE, IN THE FRUIT AND STEM OF THE PHYSALIS PERUVIANA

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ABSTRACT

As part of the way of life, human beings have been growing in massive form different foods with le designed to meet the needs of the population, with the passage of time has arisen various problems that affect this system, as what they are pests or diseases that attack the crops without any discrimination. For this has been developing a series of pesticides or chemical agents against these infections, which have been effective in almost all the occasions, but at a high cost, which was add to basic food to the population, potentially toxic chemical agents and with consequences to health. That is why in this work proposes a study of the potential for bioaccumulation of the compound cyproconazole, in a tropical fruit as is the Physalis peruviana to delete a fungus known as Phoma sp. And all this with the purpose of establishing early on the potential damage present of this compound in the crop.

Keywords: bioaccumulation, cyproconazole,, physalis peruviana, phoma sp, cape gooseberry.

1. INTRODUCTION

Agriculture, one of the most ancient and basic processes of humanity, for several centuries has been altered including different chemical agents for the control and elimination of pests around the crops, reducing losses that may be caused. On the other hand pesticides are commonly known by the toxic effects that occur in health, it is for this reason that have developed different studies and have generated measures to curb this, but even so there are multiple factors that make it difficult to proper disposal of these before they are harmful to the health, as are the processes of bioaccumulation and biomagnification. [1]

The bioaccumulation as described in [2] is the sum continues or discontinuous with chemical agents persevering in living organisms in such a way that these with the passage of time reach levels higher than concentrations in the environment and/or in the food, affecting many times in affections to human health.

In [3] There is evidence that in spite of the measures of control that the government and the Ministry of Health have post, are fruits with chemical residues of pesticides (chlorpyrifos) that exceed the limit allowed (MRLS) and which as reflected in [4] Has adverse effects of neurological in children and in the fetus and is highly toxic in small doses, so it is classified as a class II by the EPA.

On the other hand [5], pesticide residues were evidenced as lindane, aldrin, dieldrin, endrin, among others with values well above the maximum allowable limit in a product of common use as is the pasteurized milk. This strengthened with as described in [6], establishes that there is a pattern in the use of pesticides and their presence in food, once they have been processed and treated. This coupled with the fact that pesticides are toxic to a greater or lesser degree for the human being, sets a precedent that the food they normally consume can cause problems in health.

In general you can define that any pesticide independent of its origin has a potential for bioaccumulation, which in addition to the fact that each compound used in these is divided into different metabolites, many times more toxic than the same compounds, makes it necessary to carry out a more thorough study of each of the pesticides used in food, where through different techniques as shown in [7] And [8] It is possible to determine the concentrations of pesticides in food before applying them. Therefore, this work presents the study of bioaccumulation of the active ingredient Cyproconazole, a culture of cape gooseberries in where it will be analyzed in depth the effect of this pesticide in the Physalis peruviana and waste of this in the fruit and in the plant for a time of study of 20 days exposed to the fungus Phoma sp. That as shown in [9], [10], [11] And [12] Several studies have been conducted of bioaccumulation on the plant Physalis peruviana and the various effects of cyproconazole, in different foods, but even so there is not a specific study of the potential for bioaccumulation of the compound in the plant and fruit.

2. METHODOLOGY

In order to establish the study in mention is necessary to demarcate the area and the mode of operation of the crop and the pesticide as shown in Figure-1.

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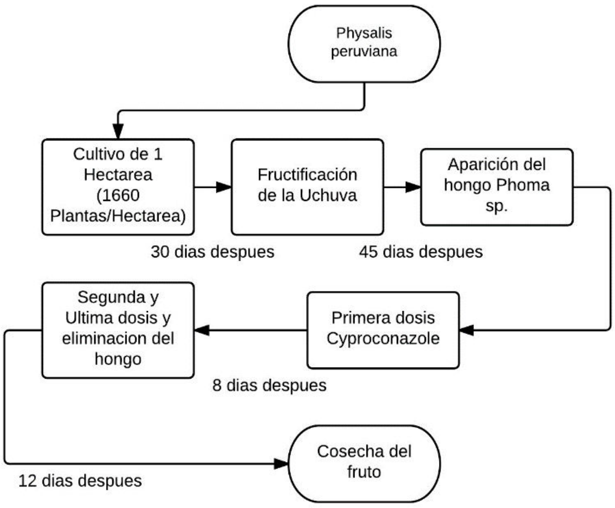

Figure-1. Study methodology.

According to Figure-1 the plant Physalis peruviana is affected with the fungus Phoma sp also known as death descending, which usually attacks coffee crop, but according to the humidity and temperature conditions adequate, also occurs in crops of cape gooseberry as explained in [13] And [14], already in [15] Sets out the guidelines of the fungus in physiological yes.

As part of a basic food for the population, the cape gooseberry is subjected to 2 doses of cyproconazole,, the first with the aim of eliminating the scourge and the second to prevent sprouts as explained in [16] And the recommended concentration is 100 g/L in each one of the dose. Additionally necessary adicionarla just at the time of the appearance of the fungus in the shell and leaves of the plant, due to the fact that once a time elapses and the fruit is concerned this is lost.

To conduct the study of bioaccumulation in the plant, took 3 reparse points that correspond to the start of each application and the result of these, with this order was determined a model of bioaccumulation and elimination of the compound in the plant and in the fruit.

$$\frac{dx}{dt} = Entrada - Eliminacion \quad (1)$$

Where there is the entrance of the pesticide or of the compound by dermal or external, plus the speed of elimination of this compound by natural action of the body, it becomes in the equation 2.

$$\frac{dx}{dt} = K_i X_o - K_e X \quad (2)$$

Where K_i is the rate of incorporationof the compound (Cyproconazole,), K_e the rate of removal of the compound in the organism, X is the chemical concentration of the compound and X_o is the chemical concentration of the compound in the pesticide.

To resolve this equation is necessary to take into account that both K_i and K_e are constant and K_e is invariant in time, with resulting equation 3.

$$X = \frac{K_i * X_o}{K_e * V} * (1 - e^{-K_e t}) + X_i * e^{-K_e t} \quad (3)$$

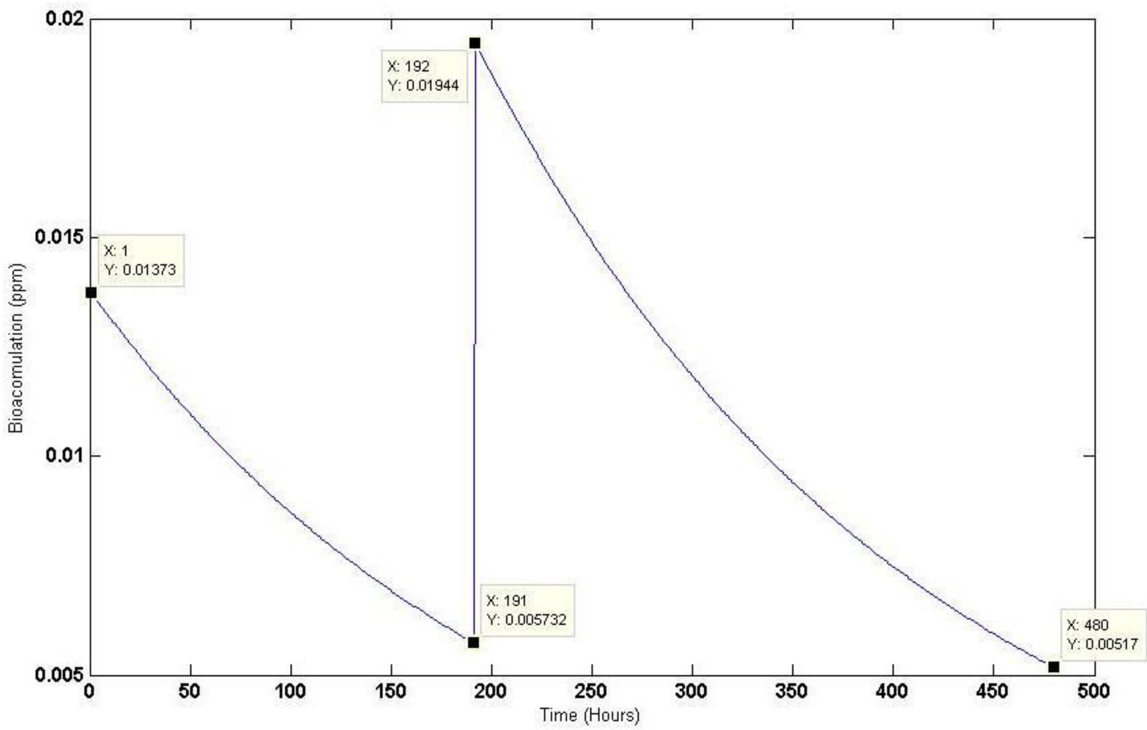

Figure-2. Bioaccumulation and elimination of Cyproconaloze in the Physalis peruviana.

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In this model is taken into account t as the exposure time of the compound in the body, X_i such as the initial concentration of the compound in the body and V as the volume of the plant and the cape gooseberry.

The next step is to find the constants, for K_i it must be borne in mind that depends on 2 moments in time and correspond to the application of the pesticide on the crop, so to apply the model of equation 3, it is necessary to define a period of study, which according to the model in Figure-1 corresponds to 20 days, where the first application is done by day 1 and the second to day 8, according to what is established in [17] The grace period is 7 days. By which the value of the constant is defined in equation (4)

$$K_i = 0.4\frac{Litros}{Hectarea} * \frac{1\,Hectarea}{1660\,plantas} = 0.2409\frac{mL}{planta} \quad (4)$$

of the equation (4) defines the application rate of the pesticide per hectare as $0.4\frac{Litros}{Hectarea}$, for a crop in a single hectare defined with a density of cultivation of 1660 plants as indicated in [18], so that the individual concentration total for each plant and fruit is $0.2409\frac{mL}{planta}$.

On the other hand, X_o is the concentration of the compound in the pesticide which was established in $100\frac{g}{L}$, t for iste case was established in 1 hour and K_e was found in the equation 5 from the fact that the average life span $t_{\frac{1}{2}}$ of cyproconazole, is 6.28 days in plants such as indicated in [19].

$$K_e = \frac{\ln 2}{t_{\frac{1}{2}}} = 4.59x10^{-3}h^{-1} \quad (5)$$

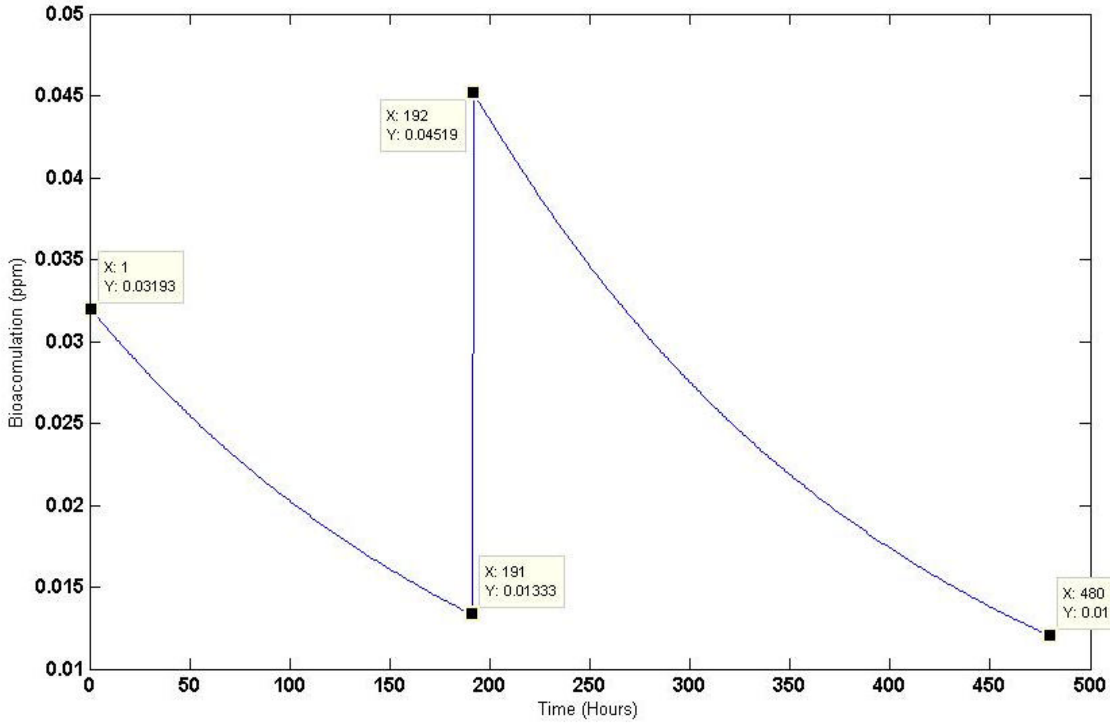

Figure-3. Bioaccumulation and elimination of Cyproconaloze in the fruit of the Physalis peruviana.

The volume of the plant was defined based on the sum of each one of the parts that compose as shown in equation 6.

$$V_{planta} = V_{tallo} + V_{ramificaciones} + V_{hojas} + V_{frutos} \quad (6)$$

The volume of the stem approached this to a cylindrical Figure that according to [20] And [21] Was 198.83 cm3. In the case of the branches are took into account the volume of the primaries more than the secondary and therefore the number of both that which according to [22] approximates a volume of 47.92 cm^3.

In the case of the volume of the leaves as established by [21] And [23] It has an area of 15000 cm2 per plant with an average thickness of 0.05 cm, with which the approximate volume serious of 750 cm3. Finally to the volume of the fruit stipulates that each fruit has an average volume of 2.51 cm3 as studied in [24] And by culture there are approximately 300 fruits according to studies [22] And [25] So the average volume is 753 cm3. Finally Applying equation (6) the total volume of the plant is 1749 m3. Table-1 shows the values of the variables found along this methodology.

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Table-1. Compilation of the variables found.

Variable	Value
K_i	$0.2409\,\frac{mL}{planta}$
K_e	$4.59x10^{-3}h^{-1}$
X_o	$100\,\frac{g}{L}$
V_{planta}	$1.749\ m^3$
t	$1\ h$
$t_{estudio}$	$480\ h$

3. RESULTS

To apply the model described in equation 3 with the constants of Table-1 in Matlab taking into account a study time of 20 days and that the model used is based on the principles of absorption and elimination of chemical compounds as explained in [26] The result is the Figure-2.

In Figure-2 we find different points of study, which as explained earlier, correspond to the dosage of the pesticide in the plant, with which starts with a concentration of 0.01 ppm to decline 50% in the course of 8 days, for then with the second dose, increase up to 0.02 ppm, which after 15 additional days, this reaches the same value of 0.05 ppm, indicating a potential for bioaccumulation of 46% for periods of life less than 20 days. Additionally, it was observed that the concentration values found in all stages do not exceed the MRL, which was established in 0.05 ppm by the EU as is set to [27].

In the same way we conducted a follow-up to the individual to the fruit of the plant, taking into account that the density of fruits per each one is of 300 and that the values of Ki and the volume change, Figure-3 shows the results obtained.

In Figure-3 is displayed as the behavior is the same, even the potential for bioaccumulation is set to 46%, with the difference that in the specific case of the fruit the values obtained of concentration are closest to the MRLS being this 0.05 and for the harvest times the concentration shown in 0.01. Due to the above two studies were carried out more, with the purpose of finding the minimum and maximum values with which this pesticide can work to this fruit. The second study, was to increase the concentration of the pesticide progressively as shown in Figure-4.

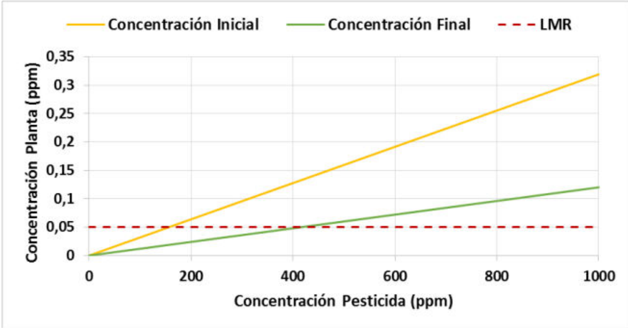

Figure-4. Concentration of the pesticide vs concentration in the fruit.

In Figure-4, is displayed as from the increase of the concentration of the pesticide, after the 400 ppm is exceeds both for the initial value of concentration, as for the final value in the fruit, giving by defined that the nominal concentrations must have in a bottom margin to 200 ppm. Figure-5 shows the concentration in the fruit with regard to entering time of this same.

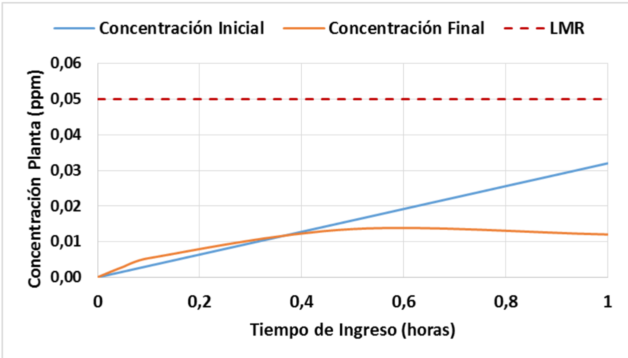

Figure-5. Concentration of fruit vs time of entry of the compound.

In this case it is established that for shorter times of 30 minutes, the fruit is greater degrees of concentration of pesticide, after this period the concentration in the fruit increases more slowly and it defined a maximum concentration of 0.013 ppm, taking a decreasing exponential behavior.

4. CONCLUSIONS

Taking into account the Figures 2 and 3 establishes that in the fruit the degree of pesticide is greater than in the whole plant, so that for the purposes of crop must be borne in mind that the actual concentrations are handled in values close to the maximum level permitted by the EU, and that for this study took 5 additional days of waiting for the recommended, it can be established that the actual concentrations are greater in a fruit of common use as is the cape gooseberry and of a fungus of easy appearance as it is the Phoma sp, without the controls of temperature and humidity required.

In Figure-4 establishes that the concentrations in the fruit increase proportionately to the concentration of

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the compound in the pesticide and with an average life span of 6.28 days, the use of this pesticide in times close to the harvest should be regulated taking into account different variables such as other pests and/or climate changes that increase the exposure times of the pesticide.

In general throughout the study in this work is denoted that despite working with pesticides with indices of toxicology and low risk (Level III) and work under ideal conditions and lengthening the harvest times for 5 more days (which in reality is not profitable) is that many of the compounds used in the present to curb pests and fungi in the fruits, endanger human health, because for this case is only worked with an infection, that for massive crops and more hectares can be two or even more than three, which would in the fruit over a toxic compound.

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