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EFFICIENCY OF DIFFERENT HERBICIDES IN THE CONTROL OF *Digitaria insularis* L. IN COFFEE CROP

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ABSTRACT

Among the main species of weeds in coffee growing, we highlight the *Digitaria insularis* L., which is increasingly difficult to control, as it has a large number of seeds, high power of dissemination and high germination rate, which may have been some of the factors that contributed to the species showing resistance to some herbicides. The objective of this research was to evaluate the efficiency of different herbicides, in the control of *Digitaria insularis* L. in coffee plantations, being carried out in a plantation of approximately 4 years, variety Catuaí Vermelho IAC 144, experimental design in randomized blocks (DBC), containing 5 treatments and 4 repetitions, totaling 20 experimental plots. The treatments were: Roundup Original (Glyphosate 445 g/L), Select (Cletodim 240 g/L + vegetable oil 930 g /L), Verdict R (Haloxifope-P-methyl 124,7 g/L + vegetable oil 930 g/L), Fusilade (Fluazipofe-P-butyl 250 g/L) and Control (without the addition of herbicides). The percentage of death of the *Digitaria insularis* L. was made visually at 7, 15 and 30 DAA, where 0% represented absence of damage and 100% complete death of the plant. It is concluded that the use of Cletodim 240 g/L (Select) and Haloxifope-p-Butyl 124,7 g/L (Verdict R), associated with vegetable oil 930 g/L in the dosage of 0,5% of the syrup, were the best treatments among those used in this research to control the *Digitaria insularis* L.

Keywords: Coffee, Matology, Weeds, Resistance.

1. INTRODUCTION

Brazil is the largest producer and exporter of coffee in the world, so coffee growing has great economic prominence (FAPEMIG, 2018), generating thousands of direct and indirect jobs in the

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country every year. Being represented by more than 100 species, especially *C. arabica* and *C. canephora*. And according to (CONAB, 2019) in a total area of 2,28 million hectares, with 5,66 billion coffee trees in production and training. In this context, the State of Minas is highlighted as being the main coffee hub in the country, responsible for about 51% of the national coffee production (IBGE, 2016), and responsible for 62% of exports in 2015 (more than 20 million bags) (MDIC, 2016).

Currently, approximately 2,16 million hectares are grown with coffee (arabica and canephora), where 319,72 thousand hectares (14.8%) are crops in the formation stage and 1,84 million hectares (85,2%) are crops in full production (CONAB, 2019), which shows the growth and development of coffee culture throughout the country each year.

Digitaria insularis L., due to its great resistance, its high dissemination power, large number of seeds and height between 50 and 100 cm (KISSMANN and GROTH, 1997), make it difficult to control it in coffee plantations, making it even greater the dispute for nutrients, water and light with coffee crops, causing a reduction of nutrients in the leaves and affecting growth and reduced productivity (RONCHI et al., 2003; FIALHO et al., 2011).

Chemical control through the use of several herbicides, is being increasingly used, obtaining better results in the control of weeds, so success depends frankly on a correct application technology, on the equipment, with the calibration and use of tips correct. Essentially contributing to hit the target thus avoiding drift, and damage to the culture. (LORENZI, 2014).

Glyphosate [N- (phosphonomethyl) glycine], a non-selective, post-emergent and systemic active ingredient, which is absorbed through the leaves, translocating through the phloem to all locations to the meristematic regions where they are responsible for plant growth. This herbicide acts on the various enzymatic systems, specifically inhibiting the enzyme 5-enolpyruvilshikimate3-phosphate synthase (EPSPs), which acts fundamentally in the pathway of shikimic acid. Since this is an explorer of formidable secondary metabolites of the plant, through the inhibition of this enzyme glyphosate obstructs the production of these compounds, causing a metabolic imbalance (YAMADA and Castro, 2007). It is necessary to highlight that glyphosate is indicated for the control of invasive monocotyledonous and dicotyledonous herbs, in cultures such as: rice, plum, banana, sugar cane, coffee, citrus, tobacco, apple, corn, pasture, soy, grape and sugar cane, cocoa, nectarine, pear, peach, rubber and no-till cotton (AMARANTE JÚNIOR and Santos, 2002), being the most used in Brazil and world.

The herbicide Cletodim acts as an ACCase inhibitor, which belongs to the group of Cyclohexanediones, being used for the control of post-emergence grasses, acting as a selective product for dicot crops (MONTEIRO et al., 2017), in addition to said Clethodim inhibits the

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synthesis of lipids, acting in mono and dicotyledonia achieving good control results in isolation, in mixture or in sequential application (LICORINI et al., 2015), causing paralysis of the plant's growth system, affecting the meristem and the consequent death of the plant in a few weeks.

According to Stephenson et al. (2006) the herbicide Haloxifope-P-methyl belonging to the chemical group aryloxyphenoxypropionic acid, inhibits the synthesis of lipids, or ACCase inhibitors, in this way if the production of lipids does not occur, there is no production of cell membranes and plant growth is halted.

Fluazifope-P-butyl, an herbicide belonging to the chemical families aryloxyphenoxypropionates and cyclohexanediones, inhibits the enzymes acetyl CoA-carboxylase (ACCase), being the first biosynthetic enzyme of fatty acids. ACCase catalyzes the carboxylation of acetyl-CoA, being dependent on ATP to form malonyl-CoA, which is also used in lipid elongation and synthesis of secondary metabolites (SASAKI and NAGANO, 2004).

Thus, the study aimed to evaluate the efficiency of different herbicides in controlling *Digitaria insularis* in coffee crops.

2. MATERIAL AND METHODS

The survey was carried out from 09/04/2020 to 05/09/2020 at the Serrinha site, municipality of Campestre, South of Minas Gerais, located at the geographical coordinates Latitude 21°43'43"S and Longitude 46°16' 44"W, with an attitude of 1.290 meters. The predominant climate is oceanic. (Climate-data.org, 2020).

The selected area was an Arabica coffee plantar cultivar Catuai Vermelho 144 in production, with 4 years, spacing of 3,2 m by 1,0 m, totaling 3,125 plants/ha^{-1}.

The experimental plots were composed of 1 m^2 between the lines of the coffee tree, where they were with an average of 100 plants of *Digitaria isularis* per m2, with an average height of 10 cm, in the initial vegetative stage.

The treatments were: Roundup Original (Glyphosate 445 g/L - 5L/ha^{-1}), Select (Cletodim 240 g/L + vegetable oil 930 g/L- according to package insert specification – 0,5L/ha^{-1} + 1L/ha^{-1}), Verdict R (Haloxifope-P-methyl 124,7 g/L + vegetable oil 930 g/L- according to package insert specification – 0,5L/ha^{-1} + 1L/ha^{-1}), Fusilade (Fluazifope-P-butyl 250 g/L – 0,75L/ha^{-1}) and control (without adding herbicide).

The application was carried out with a backpack sprayer, volume of 100L of syrup/ha^{-1}, type Teejet 11002.

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The evaluation of the percentage of death of *Digitaria insularis* L. was performed visually, according to the methodology adopted by the EWRC (1964), where 0% is absence of death and 100% complete death of the plant (VILELA et al., 2004), and the first evaluation was performed at 7 days after application, the second was performed at 15 days and the last evaluation was performed at 30 days after application.

Plagiotropic branches were also marked in the middle third of the coffee plants, to assess the number of internodes developed at 90 days after herbicide application. (ALFONSI, 2008), in addition to the visual analysis of toxicity.

According to (MAGALHÃES et al., 2012) the toxicity caused by herbicides to coffee was evaluated at 7,15, 30,45, 60 and 90 days after application (DAA), by assigning phytotoxicity percentage scores in relation to to the control (without application), with zero absence of symptoms and 100, complete senescence of the plant.

The chosen design was randomized blocks, consisting of 5 treatments with 4 replications, totaling 20 experimental plots.

The surveyed results were subjected to analysis of variance and the comparison of the averages made by the Scott-Knott test, at 5% probability, both using the SISVAR® software (FERREIRA, 2014).

3. RESULTS AND DISCUSSION

The results obtained after the application of the herbicides at 7, 15 and 30 days after application (Table 1), where the average percentage values of death of *Digitaria insularis* L. are described, according to the methodology adopted by EWRC (1964).

Table 1: Average percentage of death of *Digitaria insularis* L. 7, 15 and 30 days after herbicide application.

TREATMENTS	7 DAA	15 DAA	30 DAA*
Glyphosate	52,0 A	45,0 B	35,0 C
Cletodim	55,0 A	70,0 A	85,0 A
Haloxifop-P-methyl	40,0 B	70,0 A	84,0 A
Fluazifop-P-butyl	20,0 C	35,0 B	58,0 B
Control	0,00 D	0,00 D	0,00 D

Different letters in the column, differ statistically by the Scott-Knott test, at 5% probability. *DAA (day after application).

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In analyzing the effects of herbicides in relation to the control of *Digitaria insularis*, at 7 days after application of the herbicides, the treatment that showed the best statistical results in relation to the control were Cletodim 240 g/L (Select) with the use of vegetable oil and Glyphosate 445g/L (Original Roundup).

According to Moreira et al. (2007) Glyphosate control was better at 7 DAA, with a reduction in efficiency at 15 and 30 DAA, due to plant recovery.

At 15 DAA of the herbicides, Cletodim 240 g/L (Select) and Haloxifope-P-methyl 124,7 g/L (Verdict R) presented the best results in relation to weed death (*Digitaria insularis* L.), both recommended in the package insert use associated with vegetable oil.

Jordan et al. (1996) tested the influence of adjuvants on the effectiveness of Cletodim 240g/L, in the control of weeds (*Digitaria insularis* L.) in different species of chemicals. The result shows a greater level of control when associated with oily adjuvants.

At 30 DAA the herbicides Cletodim 240 g/L (Select) and Haloxifope-P-methyl 124,7 g/L (Verdict R) showed that they obtained efficiency in the control of *Digitaria insularis* L. with Fluazifope-P-butyl 250 g/L (Fusilade) having an improvement in efficiency but was not able to do the control.

The use of a single mechanism of action to control *Digitaria insularis* in areas where glyphosate resistance already occurs can result in a selection pressure source for resistance to ACCase-inhibiting herbicides (GEMELLI et al., 2012).

Adegas et al. (2010) using the herbicides Clethodim, Fluazifope-P-buthyl, Tepraloxydim, haloxyfope-methyl and Paraquat, obtained controls above 90%. However, when the plant grows, it sprouts, and this control drops to an average of 50%, confirming that the control of perennial plants is more difficult (FORNAROLLI et al., 2011).

It presents positive results of the herbicides used as Cletodim and Haloxifope-P-butylíco, controlling *Digitaria insularis* L. and with an improvement 30 DAA of Fluazifope-P-methylíco.

Still, for the Ministry of Agriculture, Livestock and Supply (MAPA, 2018) the average control that a herbicide must promote to be considered viable and request a registration with the mentioned agency is 80%. Thus, from the treatments used, it is concluded that all are effective, with the exception of the use of Glyphosate isolated in the management of resistant plants of *Digitaria insularis*, however the control must be done in early stages of plant development.

Glyphosate is a post-emergent herbicide that acts on the blockade of the enzyme enolpiruvil-shikimato-phosphate (EPSP), which is responsible for the synthesis of aromatic amino acids

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(tyrosine, tryptophan and phenylalanine), which perform several functions in the plant. Blocking EPSP synthesis generates shikimate accumulation and loss of amino acids responsible for proteins essential for plant growth. The symptoms caused from the third to the fifth day after application are visible. (MARCHI et al., 2008).

The herbicides Cletodim, Haloxifope-P-methylíque and Fluazifope-P-butilíco are responsible for the first reaction in the metabolic route of lipid synthesis involving the paralysis of the enzyme Acetyl-CoA carboxylase (ACCase), which is responsible for the components of phospholipids and triacylglycerols that combined form double lipid layers that serve as a cell membrane. The paralysis of the ACCase enzyme interrupts the formation of new cell membranes, and without new cell membranes the growth of the plant is paralyzed.

The symptoms take several days after the treatment to be evident, but the plants stop their growth right after the application of the herbicide. (MARCHI et al., 2008).

Table 2: Average number of internodes developed at 90 DAA.

TREATMENTS	NUMBER OF INTERNATIONALS DEVELOPED
Glyphosate	3 C
Cletodim	5 A
Haloxifop-P-methyl	5 A
Fluazifop-P-butyl	4 B
Control	3 C

Different letters in the column, differ statistically by the Scott-Knott test, at 5% probability.

There were statistical differences between treatments A, B, C in relation to the number of internodes developed, thus showing the importance of making the correct management of the control of *Digitaria insularis* L. being observed a difference in the growth of the plant in the plots referring to Glyphosate and to the witnesses, where *Digitaria insularis* L. was not controlled (Table 2). No leaves with signs of intoxication were found in the plagiotropic branches of the coffee tree, thus obtaining positive results regarding the use of herbicides in the chemical control of weeds, highlighting that the control plots met 100% of live digitalis plants, competing in water , light and nutrients with the coffee tree.

Coffee plants grow slowly when they are associated with weeds, allowing them to make better use of the available resources than the crop. The interference imposed by these plants results in a decrease in the nutrient content in the leaves (RONCHI et al., 2003), less growth (RONCHI and Silva, 2006), and, consequently, less coffee production.

According to the results, there were no signs of toxicity in low leaves of the plagiotropic branches of the coffee tree caused by the use of herbicides.

4. CONCLUSION

It is concluded that the use of Cletodim 240 g/L (Select) and Haloxifope-P-butyl 124,7 g/L (Verdict R), associated with vegetable oil 930 g/L in the dosage of 0,5% of the syrup , were the best treatments among those used in this research to control *Digitaria insularis* L. in coffee plantation, after 30 days of application, and in relation to the development of plagiotropic branches, we can highlight that the inefficient control of bittergrass plants, affected the development of plagiotropic branches.

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