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Efficiency of Ametryn Herbicide Irradiated on different Weeds in an Orchard of Avocado

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ABSTRACT

In the Brazil weeds are a great problem due its competition with crops causing losses, the use of herbicides as ametryn is widely used in plantations of sugar cane, corn, pineapple, among others, is selective and can also be applied to control weeds in the pre and post emergence, But over time, the evolution of the population of herbicide-resistant weeds has become a growing problem in many countries. Due this the objective was develop a new alternative method of control in orchard of avocado with occurrence of weeds, evaluate the efficiency of ametryn herbicide irradiated on different weeds in the experimental area. To experiment the ametryn herbicide was used at concentrations of 3.0 and 6.0 L/ha^{-1} during the entire experiment. The gamma radiation doses were: 250, 500, 750 and 1000 Gy, except in the treatments (T1-control + water) without irradiation and herbicide (T2- ametryn + 3.0 L/ha^{-1}) recommended dose (T3- ametryn + 6.0 L/ha^{-1}) but with a 3 times higher dose than recommended product, after irradiated treatments were: T4- ametryn + 250Gy, T5- ametryn + 500Gy, T6- ametryn + 750Gy, and T7- ametryn + 1000Gy (all of these treatments the concentration 3.0 L/ha^{1}). The infestant communities founded in the experimental area were: 153 plants in 7 different families and 12 species. The families more abundant were *Compositae* (Asteraceae), *Graminae* (Poaceae), *Euphorbiaceae.* The results permited concluded that *D. horizontalis* was more abundant species and the treatments ametryn + 6.0 L/ha^{-1} and ametryn + 750 Gy were the best control on most weeds species in orchard avocado.

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INTRODUCTION

The Brazil is one major of the largest food producers in the world, due its vast cultivated area and productivity of avocado. Due the increasing global demand by food, the pesticides are used as an essential tool to ensure the crops production, Graham (2006) noted that 26-40% of global losses in a culture are due to competition with weeds.

In Brazil the information related to production losses caused by weeds, are concentrated and compared a few cultures especially in soybean, authors such as Blanco (1985), Barros *et al*. (1992), Carvalho (1993) showed that yield losses in soybeans due to competition with weeds in Brazil can vary between 42-95%.

According to (Pitelli, 1985) among the factors that cause yield losses by weeds in crops are: competition for light, nutrients and water, the crops with allelopathic effects and also act as hosts for pests and diseases. The degree of interference caused by weeds depends on season and duration of coexistence with crops.

According to Araújo (2002) the herbicides are the most commonly used pesticides in the world and can act in contact with the plant or translocated inside the same, these being more important to control weeds.

Among these the ametryn belonging to the s-triazines group is widely used in plantations of sugar cane, corn, pineapple, among others, is selective and can also be applied to control weeds in the pre and post emergence This herbicide shows the ability to inhibit the photosynthesis and other enzymatic processes, being absorbed by the leaves and roots with translocation in the xylem and accumulation in

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the apical meristems and in chloroplasts (USEPA, 2006).

But over time, the evolution of the population of herbicide-resistant weeds has become a growing problem in many countries. The number of cases of resistance to herbicide-resistant weeds is recent, while the selective herbicides are used for over 40 years. However, since the first report by Ryan (1970), who observed resistant biotypes of *Senecio vulgaris* to herbicides belonging to the chemical group of triazines, has observed an increasing number of weed species with biotypes resistant not only to triazines, but also and other classes of herbicides.

Lately the discovery of a great number of new molecules site-of-action herbicide no is introduced into the marketplace by about 20 years; the capture of a large fraction of the herbicide market by glyphosate with the commercialization of glyphosate-resistant crops beginning in 1996 contributed to significantly diminished herbicide discovery efforts worldwide (Duke, 2011). Concomitantly, stricter pesticide registration requirements and environmental regulations in a number of jurisdictions have resulted in a drastic decline in available pesticides.

This way, the development of new techniques that minimize the excessive use of herbicides that decreased its concentration in the agriculture and do not cause resistance generating new biotypes should be encouraged. The use of gamma radiation is an alternative method that leaves no residues and will not cause resistance after application, this technique has been used successfully in other segments such as effluent treatment, pesticide degradation, water and soil decontaminations, foods conservation, and ins pest control as phytosanitary treatments among others (Arthur, 1997; Cantinha, 2008; Pestana, 2010, Machi, Ferrari and Arthur, (2014).

Thus the recommended doses of some herbicides can be reduced without affecting crop yield and weed control the decrease of application rates are the most important to increase the efficiency of a herbicide factors, that way may be the most environmentally correct and economically viable (Fleck *et al*., 1997; Pires *et al*., 2001).

The main effects of gamma radiation on the herbicide may be the formation of reactive molecules that interact or not, may be form other compounds such as ions, electrons aqueous, hydrogen atoms, molecular and gaseous products and thus prolong its effects or modify the present compounds the herbicide, stimulating or decreasing its efficiency according to the dose of gamma radiation applied (Campos, 2004).

With the objective of develop a new alternative method of control in orchard of avocado with occurrence of weeds, evaluate the efficiency of ametryn herbicide irradiated on different weeds in the experimental area.

MATERIAL AND METHODS

The experiment was conducted at School of Agriculture "Luiz de Queiroz" - ESALQ/USP in vegetable production department in Piracicaba-SP., and Center for Nuclear Energy in Agriculture - CENA/USP in the Radiobiology and Environment department in Piracicaba-SP. For the study, an area of 8 x 5 m, the experiment consisted of 6 treatments with 3 replicates each, this area was used to application of irradiated herbicide, and the evaluation was made during 3 months. In an experimental area without herbicide application.

Step irradiation herbicide:

For irradiation, flasks involved with aluminum foil containing 40 mL of pure product were taken to a gamma irradiator of Cobalt-60 Gammacell-220, under a dose rate of 0.312 kGy/hour, installed at CENA / USP. The ametryn herbicide was used in the concentrations of 3.0 and 6.0 L/ha^{-1} during the all experiment. The gamma radiation doses were: 250, 500, 750 and 1000 Gy, except in the treatments (T1-control + water) without irradiation and herbicide (T2- ametryn + 3.0 L/ha^{-1}) recommended dose (T3-ametryn + 6.0 L/ha^{-1}) but with a 3 times higher dose than recommended product, after irradiated treatments were: T4- ametryn + 250Gy, T5- ametryn + 500Gy, T6- ametryn + 750Gy, and T7- ametryn + 1000Gy (these treatments in the concentration 1.0 L/ha^{1}).

Application of Ametryn herbicide pre-emergence after the irradiation process:

After 24 hours of the irradiation process, the experimental area was pulverized by compressed air with a pressure of 30 $lbs/inches^2$ using a tip fan type (TeeJet 80.02) and average flow rate of 300L / ha, height of 0.50 m of the target surface (soil/plants). The application was made immediately after irradiation of the herbicide, after application, waiting by 30 days to first evaluation seedlings reached the phonological stage 3 or 4 leaves/seedling, pots with plants treated were kept under ambient conditions in the greenhouse irrigation area without by the period of 24 hours for adequate absorption foliar herbicide. After this period, the plants received daily automated irrigation spraying with water.

The weeds Evaluation period:

For the evaluations, we used a damage scale variations from 0 to 100% where 0 meant that there was no damage to the plant and 100% death of the plant. From the evaluation after herbicide application was evaluated the percentage of weed control, dry weight per period of 60 days. The statistical experimental was the randomized complete block with seven treatments and four replications. The treatments were composed of different periods of coexistence weed area avocado. The Statistical analysis was done using SAS program, data were analyzed using the F test and verification of means by Tukey test at 5% probability.

RESULTS AND DISCUSSION

The infestant community founded in the experimental area were: 153 plants in 7 different families and 12 species. The families more abundant were *Compositae* (Asteraceae), *Graminae* (Poaceae), *Euphorbiaceae* with four, three and two respectively (Table 1). The species that predominance in the experiment were: *Digitaria horizontalis* (32.3), *Brachiaria plantaginea* (6.7), *Alternanthera tenella* (6.6), *Ageratum conyzoides* (5.3), *Emilia sonchifolia* (5.3), *Richardia brasiliensis* (5.0), *Chamaesyce hyssopifolia* (4.6), (Figure 1).

Table 1: Weeds diversity present in the experimental area.

Popular name	Species	Family botanical
Capim colchão	*Digitaria horizontalis*	*Graminae*
Erva de santa Luzia	*Chamaesyce hyssopifolia*	*Euphorbiaceae*
Corda de Viola	*Ipomoea grandifolia*	*Convulvolaceae*
Amendoim bravo	*Euphorbia heterophylla*	*Euphorbiaceae*
Apaga fogo	*Alternanthera tenella*	*Amaranthaceae*
Mentrasto	*Ageratum conyzoides*	*Compositae*
Poaia branca	*Richardia brasiliensis*	*Rubiaceae*
Capim marmelada	*Brachiaria plantaginea*	*Graminae*
Falsa serralha	*Emilia sonchifolia*	*Compositae*
Losna branca	*Parthenium hysterophorus*	*Compositae*
Capim carrapicho	*Cenchrus echinatus*	*Graminae*
Picão branco	*Galinsoga parviflora*	*Compositae*

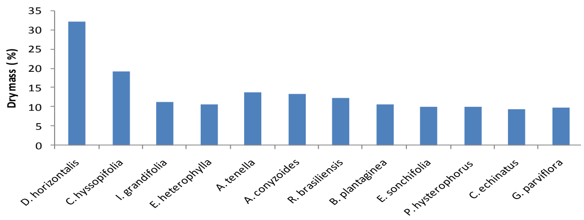

Fig. 1: Ocurrence mean of weeds species predominant.

Among of the species found, some not present great percentage, perhaps because of this seeds not germinated, waiting for the best conditions of temperature and relative humidity ccording to Carvalho (2000). According to Hidalgo *et al*.,(1990); Weber *et al*., (1995); Stevenson *et al*., (1997); Carvalho (2000) these weed species are most frequent founded in different Brazilian regions, besides of these families, others are also of common occurrence, such as: Leguminosae, Rubiaceae, Malvaceae, Convolvulaceae, Portulaceae, Amaranthaceae, Commelinaceae, Cyperaceae e Molluginaceae.

Some of the weed species that occur in the culture of avocado can be considered as local or regional problems, as each region has its peculiarity as the predominant weeds, many of them are found in different producing regions in Brazil avocado.

The annual specie *D. horizontalis* presented after 60 days the major dry matter productions with 32.1% The high viability and dominance of seeds of this species in the soil in comparison with the others, according to Kissmann, (1997) is due its high aggressive as infestant plant, this is reported as a problem in 60 countries, infecting more than 30 crops of economic importance. In Brazil, constitute a serious problem in many cultures spring and summer. These species are particularly adept in the competition process with others weeds, causing damage to annual crops and nurseries. Also have the advantages in relation to crops presenting allelopathic effects on various cultivated plants. We can observe in this case that this effect mightily can occur in the experiment.

Reports of the occurrence of this genus interfering negatively occupying high levels of density, frequency and abundance are frequent in Brazil, as in beans (Silva *et al*., 2005), maize (Duarte *et al*., 2007), soybean (Fialho, 2011).

The distribution of weeds in the experimental area did not occurred in a homogeneous way in all periods. The species that were observed in this first evaluation, not returned in the second evaluation, except for *D. horizontalis* that was less frequent.

The high density in the two evaluations this weed may be due its high tolerance to herbicide ametryn (Figure 2.), cases of tolerance to this herbicide on *D. horizontalis* have been reported in other crops such as sugar cane (Dias *et al.*, 2003).

The herbicide had an excellent control in pre–emergence application obtained 0% percentage of emergence on some weeds. The species *D. horizontalis* and *P. hysterophorus* were tolerance in both treatments without irradiation (ametryn + 3.0

and 6.0 L/ha^{-1}) being statistically different (Table 2). The species *E. heterophylla, A. conyzoides, R. brasiliensis*, *B. plantaginea* and *E. sonchifolia* not presented tolerance in the treatment with ametryn + 3.0 L/ha^{-1} being totally controlled. In the treatment with the concentration dose high than the recommended dose (ametryn + 6.0 L/ha^{-1}) the results showed that most of the plants reached levels of zero percent of mergence, only the species *E. sonchifolia* and *C. echinatus* showed tolerance in this treatment even this did not occur in the treatment with ametryn + 3.0 L/ha^{-1}.

In relation the irradiated treatments (Table 3) ametryn + 750 Gy controlled the most species in comparison with others treatments obtained the levels of zero percent, except for two species: *B. plantaginea* and *P. hysterophorus*. For others treatments only (3) and (5) species not had zero percent of control to ametryn + 1000 Gy, ametryn + 250 and 500 Gy respectively.

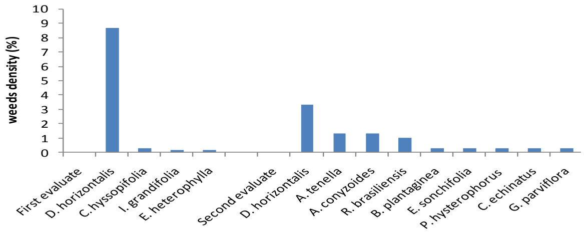

Fig. 2: Weeds species diversity founded in experimental area.

Table 2: Mean number (±SD) of species controlling without irradiation application.

Species	Control	*Am + 3.0 L/ha^{-1}	*Am + 6.0 L/ha^{-1}
D. horizontalis	12.0±1.0aA	3.0±1.1bB	1.33±1.2cC
C. hyssopifolia	0.33±1.3bB	0.33±1.3cB	0.0±1.1dC
I. grandifolia	1.00±1.2bB	0.45±1.2cB	0.0±1.1dC
E. heterophylla	1.43±1.4bB	0.0±0.0dC	0.0±0.0dC
A. tenella	1.33±1.3bB	0.33±1.4cB	0.0±1.1dC
A. conyzoides	1.33±1.5bB	0.0±0.1dC	0.0±0.0dC
R. brasiliensis	1.00±1.3bB	0.0±0.0dC	0.0±0.0dC
B. plantaginea	0.33±1.2bB	0.0±0.0dC	0.0±0.0dC
E. sonchifolia	0.33±1.1bB	0.0±0.0dC	0.33±1.1bB
P. hysterophorus	0.33±1.0bB	2.66±1.3bA	1.33±1.3bA
C. echinatus	1.00±1.2bB	0.0±0.0dC	0.33±1.2bB
G. parviflora	0.33±1.0bB	0.0±0.0dC	0.0±0.0dC

*Means followed by different letters differ statistically (bifatorial, $p < 0.05$ and p value = 71). Uppercase letters compare means in the same line; comparing means lowercase letters in the same column.
*Am - Ametryn

Table 3: Mean number (±SD) of species controlling with irradiation application.

Species	Control	*Am + 250 Gy	*Am + 500 Gy	*Am + 750 Gy	*Am + 1000 Gy
D. horizontalis	12.0±1.0aA	2.66±1.2bA	2.0±1.4bA	0.0±0.0cC	1.33±1.1bA
C. hyssopifolia	0.3±1.1bB	0.33±1.3bB	0.0±0.0cC	0.0±0.0cC	0.0±0.0cC
I. grandifolia	1.0±1.2bB	0.0±0.0cC	0.33±1.1aB	0.0±0.0cC	0.0±0.0cC
E. heterophylla	1.4±1.2bB	0.0±0.0cC	0.0±0.0cC	0.0±0.0cC	0.33±1.0bB
A. tenella	1.3±1.4bB	0.0±0.0cC	0.0±0.0cC	0.0±0.0cC	0.0±0.0cC
A. conyzoides	1.3±1.3bB	0.33±1.3bB	0.0±0.0cC	0.0±0.0cC	0.33±0.0bB
R. brasiliensis	1.0±1.2bB	0.0±0.0cC	0.0±0.0cC	0.0±0.0cC	0.0±0.0cC
B. plantaginea	0.3±1.4bB	0.33±1.2bB	0.66±1.4aB	0.33±1.3aB	0.0±0.0cC
E. sonchifolia	0.3±1.3bB	0.33±1.3bB	0.33±1.2aB	0.0±0.0cC	0.0±0.0cC
P. hysterophorus	0.3±1.3bC	0.0±0.0cC	1.33±1.4bA	3.0±2.1aA	0.0±0.0cC
C. echinatus	1.0±1.2bB	0.0±0.0cC	0.0±0.0cC	0.0±0.0cC	0.0±0.0cC
G. parviflora	0.3±1.2bC	0.0±0.0cC	0.0±0.0cC	0.0±0.0cC	0.0±0.0cC

*Means followed by different letters differ statistically (bifatorial, $p < 0.05$ and p value = 71). Uppercase letters compare means in the same line; comparing means lowercase letters in the same column.
*Am – ametryn

In comparison general the treatments with and without irradiation, we can observed that the treatments with major species number controlled during the experiment were: ametryn + 6.0 L/ha^{-1} and ametryn + 750 Gy, the treatments that less controlling were ametryn + 3.0 L/ha^{-1}, ametryn + 250 and 500 Gy all with (7) species controlled. But some species were more sensible to effects of herbicides and were totally eliminated of all treatment. But the species: *A. tenella*, *R. brasiliensis* and *G. parviflora* were more sensible and with the treatment of ametryn + 3.0 L/ha^{-1}, not emergence.

The species that need of treatments more elevated to be eliminated totally were: *B. plantaginea* and *P. hysterophorus* with ametryn + 1000 Gy, to treatments without irradiation *C. hyssopifolia*, *I.*

grandifolia E. heterophylla, *A. tenella*, *A. conyzoides*, *R. brasiliensis*, *B. plantaginea* with ametryn + 6.0 L/ha^{-1}.

In comparison with the best treatment without irradiation process ametryn + 6.0 L/ha^{-1} with ametryn + 750 Gy in the concentration of 1.0L/ha^{-1}, proved the occurrence of synergetic effect in this treatment using the irradiation process to control.

When we observe the experience as a whole, it was verified that the families of species more abundant that obtained the best control (graminae and compositae) are commonly families weeds founded in fruit trees areas in regions diverse of the Brazil (Stevenson *et al.*, 1997; Carvalho, 2000).

Conclusion:

By results obtained we can conclude that *D. horizontalis* was more abundant species. The treatments with ametryn + 6.0 L/ha^{-1} and ametryn + 750 Gy showed that the best efficiency in control on most of the weeds species in orchard avocado.

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