GLOBAL SCIENCE AND TECHNOLOGY (ISSN 1984 - 3801)

EFFICIENCY OF CHEMICAL CONTROL OF *Bemisia tabaci* BIOTYPE "B" (Hemiptera: Aleyrodidae) IN CUCUMBER CROP[1]

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ABSTRACT - The research was carried out at the experimental field of Agronomy / UFG School in Goiânia - GO to evaluate insecticides in the control whitefly (*Bemisia tabaci* biotype "B") in cucumber crop. The experimental design was a randomized blocks with six treatments and four replications. Each inseticide application was made by using interval of seven days. The treatments were: control, diafenthiuron 500 SC at doses of 40, 60, 80 and 100 ml p.c./100 L of water and pyriproxyfen EC 100 at a dose of 75 ml p.c./100 L of water. The crop evaluations were realized at 7, 14, 21 and 28 days after germination. The live nymphs in 25 leaves / plot were ramdomized and evaluated in upper third plant leaves with the aid of a magnifying glass of 20 fold increase pocket. Control nymphs of *B. tabaciraça* biotype "B" after three sequential inseticide applications with seven day intervals is considered an acceptable efficiency obtained by using doses of 80 and p.c.100 ml of diafentiuron 500 SC Polo/ 100 L of water and 75 ml p.c. of piriproxifen Cordial 100 EC/100 L of water.

Keywords: *Cucumis sativus*. Whitefly, Chemical control. Insect atack

EFICIÊNCIA DO CONTROLE QUÍMICO DE *Bemisia tabaci* BIOTIPO "B" (Emiptera: Aleyrodidae) NA CULTURA DO PEPINO

RESUMO - O estudo foi instalado no campo experimental da Escola de Agronomia/UFG em Goiânia/GO para avaliar inseticidas no controle de mosca-branca (*Bemisia tabaci* raça "B") na cultura do pepino. O delineamento experimental foi em blocos ao acaso com seis tratamentos e quatro repetições. Foram realizadas quatro aplicações em intervalos de sete dias, aos 7, 14, 21 e 28 dias após a germinação. Os tratamentos utilizados foram: testemunha, diafentiuron 500 SC, nas doses de 40, 60, 80 e 100 ml de p.c./100 L de água e piriproxifen 100 EC, na dose de 75 ml de p.c./100 L de água. Avaliou-se em campo o número de ninfas vivas em 25 folhas/parcela, ao acaso, no terço superior das plantas com auxílio de uma lupa de bolso de 20 vezes de aumento. O controle de ninfas de *B. tabaci*raça raça"B" foi obtido após três aplicações sequenciais em intervalos de sete dias, podendo considerar a eficiência aceitável quando utilizadas as doses de 80 e 100 ml de p.c./100 L de água do inseticida POLO 500 SC e também também com a aplicação do inseticida Cordial 100 EC, na dose de 75 ml de p.c./100 L de água.

Palavras chave: Controle químico *Cucumis sativus*, mosca-branca

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Recebido em: 08/06/2016. Aprovado em: 29/11/2016.

INTRODUCTION

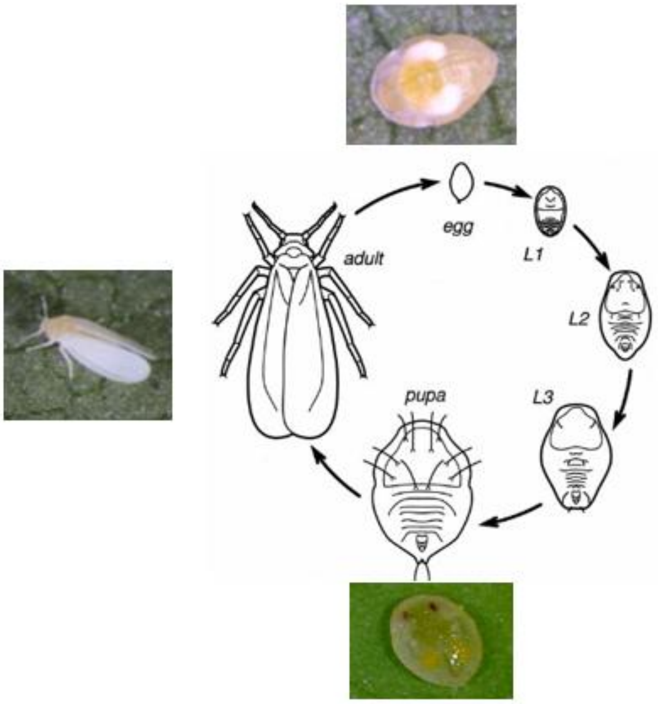
Area used with horticulture has been reduced in recent years but the volume of cucumber (*Cucumis sativus*) offered by the market is still growing, but at the same time higher yield has been observed by using the efficiency of cultivation techniques. On the other hand the market has demanded products of good quality and appearance. Environmental factors such as varying temperatures, heavy rains and frosts are factors that result in low quantitative and qualitative vegetables. Under these conditions can occur up to 100% in depreciation and production losses. Therefore, the intensive increase in greenhouse cultivation has been justified by the plant adptation way easier to achieve adjustment response and also sustainable income.

World production of cucumbers in 2011 was about 6,507,971,500 million ton. Asia is considerated the largest producer. Especially distak can be sent for China that obtained in 2011 a production of 4,736,052,100 million tons, about 72.49% of all world production (FAO, 2013) .The Brazilian annual production of cucumber exceeds 200,000 tons, the Southeast accounts for over 50% of the total Brazilian production (EMBRAPA HORTALIÇAS, 2010).

To succeed in driving the culture there must be a correct management, mainly phytosanitary questions. The cucumber crop is attacked by many pests, among these we have the whitefly, *Bemisia tabaci* (Genn.) (Hemiptera: Aleyrodidae) considered by many researchers as the plague of the century. In agriculture, the complex *Bemisia tabaci* cause devastating impact, causing losses of more than $ 10 billion worldwide, disregarding the degradation of environmental, due to the excessive use of insecticides in the whitefly control (OLIVEIRA and FARIAS, 2000; OLIVEIRA , 2001).

Periods dry and warm favor the development and spread of the pest, and therefore observed the highest population peaks in the dry season. Severe attacks of *Bemisia tabaci* were found in various crops such as alfalfa, zucchini, broccoli, cabbage - flower, cotton, beans, pod beans, soybeans, peanuts, tomatoes, pepper, peppers, potatoes, eggplant, chayote, tobacco, watermelon, melon, cucumber, grape and ornamental plants, causing huge losses of financial order (PERRING et al., 1993; LOURENÇÃO and NAGAI, 1994; FRANCE et al., 1996). It has also been detected in weeds as blackjack, nicandra, wild poinsettia and datura. No tomato can compromise the production up to 100% (BALDIN et al., 2007). loss estimates caused by this plague reached $ 5 billion, especially in bean crops, tomatoes, melons and some vegetables (LIMAET al., 2000; OLIVEIRA et al., 2001).

However, cucumber culture adapts to varying regions with a climate mild hot, ie, temperatures between 20 and 30 ° C. Very low temperatures, such as most vegetables, restrain the development, especially in young plants, i.e. below 35 days after germination, and decrease productivity. The cucumber culture does not tolerate frost due to climate limitation, cucumber plantations are concentrated in the spring-summer period, however, planting can be done in the winter time in places where frost does not occur. Planting in areas of high altitude and latitude above 22º South, or in areas prone to frost can be ameliorated with cultivation in greenhouse. Under these conditions, the greenhouse effect generated within this environment makes low temperatures, especially night, are not limiting to the culture. The cucumber can also be grown (Figure 1) in a protected environment in the summer time, with the advantage to improve product quality and efficiency in the control of pests and diseases due to the "umbrella effect". For cucumber grown in greenhouses in the warmer seasons of the year is necessary to maintain the sides open to avoid high temperatures.



Note: adult = adulto, egg = ovo, L1 = first instar = primeiro instar, L2 second instar= segundo instar, L3 = Third instar = terceiro instar. The fourth instar is indicated by several authors, pupa = pupa. L1L2L3 - linfais stages = estágios da linfa. **Source:** Biobest Biological System and Adptation of Vigato (2014)

Figure 1 -. Biological cycle of *Bemisia tabaci*.

Another precaution in cucumber cultivation in a greenhouse is the choice of suitable cultivars, since they require pollinators to produce can be impaired in completely closed environment. One way around this problem is the choice of ginoico-parthenocarpic genotypes.

In relation to photoperiod in high latitude regions above 22 º both temperature and photoperiod can influence the yield of cucumber crop. Most cultivars tend to have a higher proportion of male flowers under conditions of long days. Regarding insulation, high light intensity favors high productivity, however, the direct sunlight on the fruits can bring injuries to the same, such as white or beige necrosis. Temperature also affects the relationship between the formation of male and female flowers, where high temperatures favor the production of male flowers and temperature (CARVALHO et al. 2013).

The *Bemisia tabaci* when it feeds on sap sucking and during the nutritional process introduces toxins that cause symptoms of changes in vegetative and reproductive development of the plant, with irregular ripening of the fruit, making it difficult to recognize the point of harvest, reduçãoda production and pulp quality after processing (NAGAI et al.1992). It also causes indirect damage, such as the secretion of sugary substances, sticky and shiny, the "honeydew" that attracts ants and contributes to the development of Capnodium by fungi known as sooty mold (MATTHEWS, 1989; SANTOS, 1999) that damage respiration and photosynthesis leaves (HAJI et al., 1996; LOURENÇÃO et al., 1999;. GALLO et al, 2002), and transmit viral diseases (ZUCCHI et al., 1993).

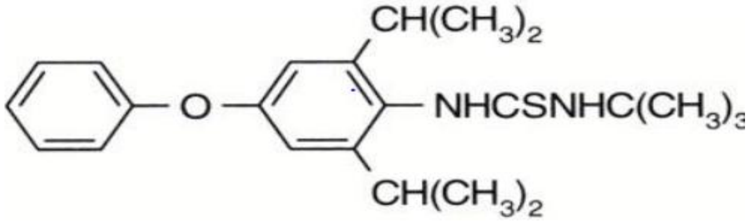
Although chemical methods, ie the control of whitefly with the use of pesticides produced by agrochemical industries around the world, to be combated, when the plague strikes a culture, a high degree of intensity, these methods are used to prevent lost production or quality of the crop product. To prevent damage to human health and the environment, these products should be used with technique and with caution as the advantages and disadvantages are well discussed in scientific papers. The control with the use of pesticides, commonly used method in combating the whitefly, may result in the establishment of genetic resistance of insects to these substances, which, through natural selection, the surviving insects originate more powerful pests (FERNANDES, 2011). This results in long-term science in control, in addition to multiple risks generated by the misuse of these products, making it essential to develop less aggressive control methods and can be used in any cropping system.

As a way to control B*emisia. tabaci* biotype "B", the main management strategy adopted by the producers is the chemical method. The main groups of insecticides for control are those of the neonicotinoid group include acetamiprid, clothianidin, imidacloprid, thiacloprid and thiamethoxam. In the category of growth regulators insecticides has the active ingredient buprofezim, which acts on chitin synthesis and pyriproxyfen an analogue of the juvenile hormone. As last option has the spiromesifen that acts as an inhibitor of lipid biosynthesis (CZEPAK al., 2009). Currently, in Brazil there are only six commercial products registered for control of *Bemisia tabaci* biotype "B" in cucumber cultivation, 50% of those belonging to the chemical group of neonicotinoids, and 33.3% are framing as growth regulators insects (AGROFIT, 2013). Thus it is commonly observed foliar applications of systemic insecticides, and many of those without the expected control efficiency. This situation can be explained by several factors, among them not monitoring the pest in the area, and the loss of the ideal application time, investments in undesirable weather conditions, insect resistance to active ingredient, with tank mixtures, etc. In this way the improper use of chemical control tool, has caused increase in the cost of production, pollution of soil, air and water, in addition to not control the pest (PICANÇO and GUEDES, 1999; PICANÇO et al., 2001). Thus, the aim of this study was to seek effective alternatives to chemical control of B. tabaci biotype "B" in cucumber crop.

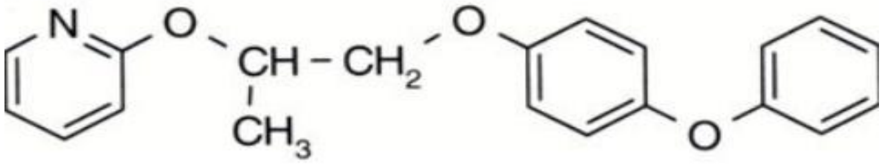
MATERIAL AND METHODS

The experiment was conducted in the experimental area of the School of Agronomy / UFG - Campus Samambaia, the city of Goiânia / GO, with geographic coordinates 16°36'19" S latitude, 49°15'48" W longitude, average elevation of 610 meters. The cucumber seedlings of the variety Sapphire were transplanted after 15 days of seeded polypropylene trays (20/01). 5 cm deep holes were made, spaced 0.5 meters from each other, and row spacing of one meter. Each pit received 2 seedlings. Fertilization was done at planting with 700 kg / ha of trades 04-14-08 formulation, and later in cover 200 kg / ha of urea 30 days after transplanting.

The culture was conducted tutored way irrigated area in drip form. The experimental design was a randomized blocks with six treatments and four replications. As plots were 2.5 meters wide and five meters in length and spaced of 1.0 m. It was considered as a useful area the two central rows of each plot, with an average of ten plantas.As applications of insecticides were held on 10/02, 17/02 and 24/02, when the plants were five leaves, about 20 days after transplantation of culture, which were performed weekly. Were used for this a knapsack sprayer bar, with constant pressure (CO_2) of 40 psi, nozzle array equipped with 11004, and spray volume of 1000 L / ha.



Source: Omoto, 2016. Anvisa 2014
Figure 2 - Structural formula of diafentiuran



Source::Anvisa 2008.
Figure 3: - Structural formula of piriproxyfen.

The treatments were: control, diafenthiuron 500 SC at doses of 40, 60, 80 and 100 ml of p.c./100 L of water (Figure2) and pyriproxyfen EC 100 at a dose of 75 ml p.c./100 L of water (Figure 3) a preliminary assessment was carried out on 10/02/09 assessment to the seven days of the second application 24/02/09, and at seven and 14 days of the third application in the days 03/03 and 10/03.

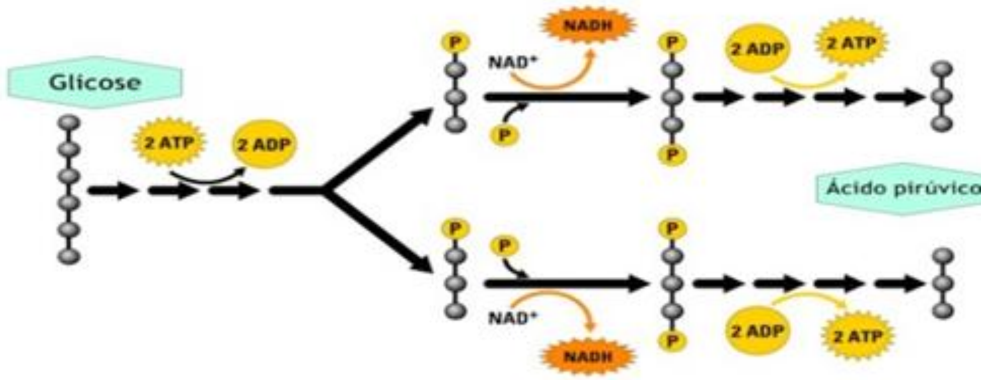
The assessment methodology consisted in counting the number of whitefly nymphs in the field, with the help of a loupe with increase of 20 X 25 leaves selected at random in the upper third of each plant / plot. The data on number of live nymphs present were subjected to analysis of variance as proposed design and the averages compared by Tukey test at 5% probability. The efficiency percentages of different treatments was calculated by the formula Abbott (1925). Therefore, the mortality data (%) of the treatments and control was used to calculate the insecticidal efficiency by Abbott's formula wherein Ma = (Mt - Mc) / (100 - MC) x 100 wherein Ma = mortality corrected for the control treatment; Mt = mortality observed in the treatment with insecticide and Mc = mortality observed in the control treatment.

RESULTS AND DISCUSSION

The number of nymphs in the preliminary assessment was the same for all treatments, showing that the area had a population of whitefly nymphs evenly distributed . This fact probably occurred up to the time the crop is free of any type of insecticide application, which has an attractive and led to the establishment of the pest. A week after the second application was observed differences between treatments with insecticides in the control. However, the control efficiency was above 80% only for doses of POLO 80 and 100 ml / PC 100 L of water insecticidal diafenthiuron 500 SC and the insecticide pyriproxyfen 100 EC in a dose of 75 ml / PC 100 L water. Seven days after the third application still remained reduced the number of nymphs (Figure 4) in the plots treated with insecticide compared to untreated plots. As for efficiency, pesticide diafenthiuron 500 SC at doses of 80 and 100 ml of PC / 100 L of water and pesticide pyriproxyfen 100 EC at a dose of 75 ml of PC / 100 L of water had control percentages above 80% for said pest. After fourteen days of the third were also observed statistically lower numbers of nymphs in plots treated with insecticide compared with the control, however, the most effective insecticides were diafenthiuron 500 SC at a dose 100 ml of PC / 100 L of insecticide water, and pyriproxyfen 100 EC in a dose of 75 ml / pC 100 L of the insecticide water.

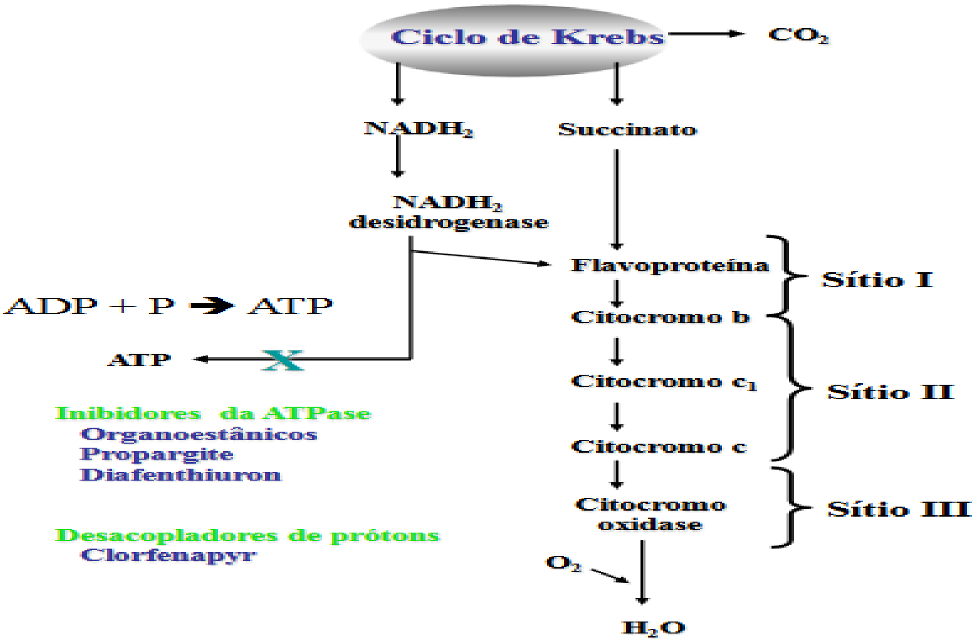
Figure 4:- Whitefly nymphs (*Bemisia tabaci*).

These doses may vary due to different environmental factors field populations are generally more heterogeneous and present complex and diverse responses to insecticide pressure, and the results obtained in the laboratory should be applied with care. Field environment interactions, population structure and selection intensity affect the response in the field. Often the evolution of insecticide resistance in field conditions can be decreased due to immigration of susceptible people from other cultures and places where there is rotation of insecticides and correct cultural practices (SETHI et al., 2008).



Observation: glicose = glucose, Ácido pirúvico = piruvic acid, DNA = ácido desoxyribonucleico (ADN) deoxyribonucleic acid, ADNH = ácido desoxyribonucleico reduzido = (NADH) reduced deoxyribonucleic acid, ATP = adenosina trifosfatada = (TPA) tri-phosphate adenosine, ADP adenosina di-fosfatada = (DPA) di-phosphate adenosine. NAD = substance that acts as coenzyme receiving electrons and hydrogen being reduced to NADH.

Figure 5 - Glycolysis, one breath step.



Source: Omoto, 2016.

Figure 6. Inhibition of ATP formation.

Insecticides diafenthiuron base hás bee reported as na interferent in cellular respiration, compromising mitochondrial electron transport by inhibiting the ATPase enzyme (Figure 5), and concomitantly the production of ATP (Figure 6), energy by the insect (DEKEYSER, 2005). Thus can be explained the lowest average of nymphs per leaf during evaluations when compared to higher dose diafenthiuron with other treatments.

Further disclose that ATPases are insecticides target (PING et al., 2004) and characterization of these enzymes in insects can be of great importance since identification of distinct properties between ATPases insects and mammals could develop more specific drugs and which consequently are less harmful to humans and other organisms. The north, northeast and center of the country, cultivate and exploit the babassu palm for subsistence and beetle control P. nucleorum has economic importance in their lives (CARRAZAN et al., 2012), this because the fruit of the palm can be availed 100% if they do not show any deformation caused by insects. The maggot of other beetles may have also been studied reporting that the characterization of Ca-ATPase some of them also be important to control this pest (DIAS and COELHO, 2007).

There growth regulator insecticides by inhibiting the synthesis of chitin. where the benzoilfenilureias the group include novaluron, lufenuron, flufenoxuron, triflumuron among others. A second group of Juvenóides where hormôniojuvenil agonists such as methoprenefenoxy are included. Carbpyriproxifen i.e. There are still the ecdysteroids agonists where the tebufenoside and methoxyfenozide.

The action of insecticides to pyriproxyfen base mimics the action of insect juvenile hormone, interfering vital physiological processes, including the moulting and reproduction of the insect (IRAC, 2013) and therefore the efficiency of these insecticides is higher in development stages insect nymphal, where the rate of juvenile hormone is low in insect hemolymph, or in the last instar or early pupal stage.

The juvenile hormone, its derivatives and analogs have been thoroughly tested as growth regulators of *Bombyx mori, Bombyx mori* L. The first works with analogues of juvenile hormone in *Bombix mori* were performed using topical applications in the insect. Later, other studies have sought the practical application of hormones by spraying or soaking the leaves in the products. They reported increased from 20% to 40% in weight cocoons and pupal weight, formation of giant cocoons where the larvae were treated with a derivative of methylene-dioxy-phenyl with the use of juvenile hormone SJ-42-F. Test the effects of topical application of methoprene, found increases of 12.4%, 12.3%, 16.3%, 2.7% and 11.0% of larval weight, cocoon weight, empty cocoon weight, content silk and wire length, respectively, compared to the control. juvenile, derivatives and analogues hormones positively influence the development of the silk gland, resulting in increased silk production. The effects of analogues of juvenile hormone (AHJ) may vary with the product, the line and the time of application.

Table 1 - Average number of nymphs / leaf (N) and percentage efficiency (% E) after application of different treatments to control *B. tabaci* biotype "B" in cucumber crop. Goiânia / GO, 2009

Treatments	Dose ml de c.p.c/100 L water	*Previous	Days after aplication					
			07DA2ªA		07DA3ªA		14DA3ªA	
			N*	%E	N*	%E	N*	%E
Check	-	9,7a	18,2a	-	31,5a	-	33,5a	-
diafentiuron 500 SC	40	10,7a	10,5b	42,4	17,7b	43,6	19,2b	38,8
diafentiuron 500 SC	60	8,7a	6,0c	67,1	8,0c	74,6	11,0c	65,0
diafentiuron 500 SC	80	8,7a	3,2cd	82,1	4,5cd	85,7	8,0cd	74,6
diafentiuron 500 SC	100	9,7a	1,2d	93,1	1,2d	96,0	2,5e	92,0
piriproxifen 100 EC	75	10,2a	1,5d	91,7	0,7d	97,6	3,2de	89,6
CV%	-	16,1	18,6	-	16,5	-	17,7	-

* Numbers followed by the same letter in the columns do not differ statistically at 5% probability according to Tukey's test. 5% ; E = percent efficiency calculated by using Abbott's formula; DAG = days after germination.

Exoskeleton is a rigid structure that covers the body of these animals full or partially, conferring protection to internal organs and supporting musculature. As the insect grows throughout its life cycle, this exoskeleton is changed, a process which is called molting or changes. This exchange can occur several times in the life of an insect, unlimited number varies from species to species. The mechanism is dictated by the performance of two hormones: the ecdisonio, which performs the function of stimulating epithelial cells to initiate the moulting process; and changes inhibitory hormone (MIH, English, Inhibitor Moulting Hormone), which, as its name makes clear, acts contrary to ecdisonio deforms.

The entire molting cycle occurs in four stages named 1st. Pro-molt - step before the change, in which the animal is preparing to release a exosesqueleto, replacing it with another. At this stage, the animal's body retains water and air, which facilitates its support during the exchange and exerts a pressure which helps in breaking the old shell, 2nd. Molt - effective exchange of exoskeletons, that is, the stage in which the old skeleton is discarded, replaced by a new, 3rd. Post-molt - later stage to changes in the animal increases in size and has its new exoskeleton hardened gradativamente and 4th. Intermolt - covers the period between a change and another, in which the animal stores nutrients to prepare for the resumption of the entire cycle. Effective animal growth occurs in this phase. There are basically two environmental factors that greatly affect this cycle: temperature and nutrient availability. The temperature change alters the metabolism of the animal, which can advance or delay the cycle. As the insect, if the insect needs a lot of energy to make the changes, there must be also a good nutrient availability. If the amount of food available is insufficient, the change is delayed, because, that way, the insect can not meet the costs of energy after the process.

With the insect age and the extent of their reproductive activity, its ability to make shell exchange ceases. This is because, prior to the adult stage, the insect uses energy from food for growth, whereas sexual age, this energy is required to produce reproductive organs and cells.

In a significant aspect of the development of arthropods, ecdysis is also an important adaptative value, since it allows adaptation of the insect to various different environments. On the other hand, this property can be harmful to the living being, since, after molting, the insect is vulnerable for a certain period due to the high energy expenditure which facilitates insecticidal effect.

Thus, it is concluded that for the control of whitefly nymphs *(Bemisia tabaci* biotype "B", Figure) after three sequential applications at intervals of seven days, doses of 80 and 100 ml /PC 100 L of water pesticide diafenthiuron 500 SC (POLO) and pesticide pyriproxyfen EC 100 (Cordial) at a dose of 75 ml of pC/100 L of water (Table 1) showed 80% control efficiency.

CONCLUSION

The control of *Bemisia tabaci* byotype "B" nymphs, when performed three applications sequentially at weekly intervals by using doses of POLO 80 and 100 ml / PC 100 L of water POLO 500 SC insecticide and Cordial 100 EC, at a dose of 75 ml / p.c. 100 L of water inseticide is an effective alternative to cucumber crop.

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