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USE OF TOBACCO EXTRACT AS PESTICIDE TO FIGHT CABBAGE CATERPILLARS AND APHIA: CASE STUDY FROM THE ADMINISTRATIVE POST OF MATSINHO

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SUMMARY
The present study is the result of experimental research that aims to evaluate the effectiveness of tobacco extract as a pesticide to combat cabbage caterpillars and aphids in the Administrative Post of Matsinho. To understand the research data, the methodology consisted of bibliographical research and field work, with a sample made up of seven cabbage beds, each treated differently. Based on direct observation, it was possible to conclude that tobacco extracts prepared at 0.1 kg/l undiluted and diluted by half are efficient in combating cabbage caterpillars and aphids, causing collateral damage to cabbage, while those diluted at 25% despite the delayed action, proved to be equally efficient and more suitable for use as a pesticide to combat aphids and cabbage caterpillars as they do not cause embarrassment to this crop. Given the relevance of the study, it is suggested that research be carried out on the effectiveness of tobacco extract in combating other pests from different agricultural crops.
Key words: Cabbage. Aphids. Cabbage caterpillars. Pesticide. Nicotine

ABSTRACT
The present study is the result of an experimental research that aims to evaluate the effectiveness of tobacco extract as a pesticide to combat cabbage caterpillars and aphids in the Administrative Post of Matsinho. In order to understand the research data, the methodology consisted of bibliographical research and field work, with a sample made of seven cabbage beds, treated in turn in a different way. Based on direct observation, it was possible to conclude that tobacco extracts prepared at 0.1 kg/l undiluted and diluted by half are efficient in combating cabbage caterpillars and aphids causing collateral damage to cabbage, while those diluted up to 25% despite the slow action, were equally and efficient more suitable to be used as a pesticide to combat aphids and cabbage caterpillars as they do not cause constraints to this crop. Given the relevance of the study, it is suggested that research be carried out on the effectiveness of tobacco extract in combating other pests of various agricultural crops.

Keywords: Cabbage. Aphids. Cabbage caterpillars. Pesticide. Nicotine

INTRODUCTION

Cabbages are important sources of vitamins, minerals and as a source of income for small farmers in rural and suburban areas, constituting one of the largest bases in the diet. However, production is often constrained by a diversity of pests and diseases (FILGUEIRA, 2008).

In particular, family farmers in the administrative post of Matsinho survive basically from horticulture, where cabbage cultivation is the main source of income. This cabbage is attacked by colonies of cabbage caterpillars and aphids during cultivation.

Due to the high cost of purchasing and conserving synthetic pesticides available on the market, most family income farmers in this administrative post do not use such pesticides. With this, more than half of production is devastated by pests, causing low crop yields throughout the year. On the other hand, in the city of Chimoio (Mozambique) and the surrounding area of this Administrative Post, immense quantities of tobacco of different types and with different properties are sold. At points of sale, the ribs and tobacco leaf powder are separated, which are not used in the manufacture of cigarettes. These tobacco residues or remains are dumped in the open. According to Yildz (2004), the nicotine in tobacco acts as a pesticide. Therefore, the question that arises is:*How effective is tobacco extract for use as a pesticide in combating*The*Cabbage caterpillars and aphids?*

Furthermore, the study carried out by Jacomini et al (2016), entitled "*Tobacco extract in the control of*

*poultry beetle",*aimed to evaluate the effect of tobacco extract on the control of the mealybug beetle [*Alphitobius diaperinus*(Coleoptera: Tenebrionidae)] from avian. The experiment was conducted in a completely randomized design, with four contact times (21/2, 5, 71/2 and 10 min) and four concentrations of tobacco extract (0, 25, 50 and 75% dilution). Contact time and extract dilutions were independent; however, contact time had a greater influence on insect mortality. Tobacco extract has insecticidal potential in poultry management, but toxicity tests must be carried out on birds.

In view of the above, the present study aims to evaluate the effectiveness of tobacco extract as a pesticide against cabbage caterpillars and aphids. The specific objective was to prepare seven cabbage beds; spraying, except for one, all beds using a tobacco extract-based pesticide; compare the results in terms of plant development in the beds with and without pesticide applied, and determine the dose of tobacco extract suitable for use in combating pests based on the toxicity results controls of the different tobacco extracts in six beds. To this end, the sample consisted of seven beds, of which 6 were prepared from tobacco ribs in 3 different concentrations, and 1 without the previous conditions.

However, the study is limited to improving cabbage production by controlling the cabbage caterpillar and aphid pest, in order to improve the quality of life of the population of the Administrative Post of Matsinho, city of Chimoio.

Cabbage aphids and caterpillars on plants

Cabbage aphids, also known as cabbage aphids (NYAMBO & SEIF, 2013), appeared 280 million years ago (HOLTZ*et al.,*2015). They are distributed worldwide in regions with temperate and tropical climates, causing damage to various crops (AHMAD & AKHTAR, 2013). They appear in dense colonies on cabbage leaves between late spring and autumn (BOOKS & HALSTEAD, 1999) and are vectors of viruses that cause diseases. Reproduction is by parthenogenesis, that is, without egg production (NYAMBO & SEIF, 2013) and without male participation, originating only female offspring (HOLTZ*et al.,*2015).

Cabbage aphids are small, pyriform insects with a soft and fragile body and a color that varies from yellow to dark green, where the head and thorax are darker. They present a serous secretion covering the body and infested leaves. They prefer young leaves and are generally found on their adaxial surface and at the point of growth, causing profound atrophy (BOOKS & HALSTEAD, 1999).

Aphids develop rapidly and under unfavorable conditions, such as low food quality, high density, high temperature and photoperiod, winged individuals emerge (HOLTZ*et al.,*2015).

Damage is caused by the way of feeding and the transmission of viruses. Direct feeding causes leaf curling, delayed growth, reduced seed production and even death of infested plants (NYAMBO & SEIF, 2013).

When aphids bite a diseased plant, they acquire the virus, which in another bite contaminates healthy plants, causing deformation of leaf tissues, the formation of galls, and in some cases, can lead to the death of young plants. These aphids excrete a sugary substance that serves as a food substrate for the development of a black fungus, known as sooty mold, which blocks sunlight, reducing photosynthesis and crop yield. Distortion of the plant also aggravates control problems, as aphids are protected from products with contact action inside the curled leaves (HOLTZ*et al.*, 2015).

For Souza (2010), cabbage caterpillars include three most common genera that feed on brassicas: the caterpillars of the great white butterfly (*Pieris brassicae*), the caterpillars of the small white butterfly (*Pieris rapae*) and cabbage moth caterpillars (*Mamestra brassicae*).

The caterpillars of the great white butterfly are yellow, with black dots; the caterpillars of the small white butterfly are light green with a velvety appearance; Cabbage moth caterpillars are green or brown, without a hairy covering. All these types of caterpillars have two generations during the summer and damage to the plant occurs between April and October. These eat the cabbage leaves, producing irregularly shaped holes, and piercing the cabbage head (BOOKS & HALSTEAD, 1999).

Cabbage caterpillars undergo complete metamorphosis, having egg, larval (caterpillar), pulp (chrysalis) and adult stages. Adults do not cause damage, however, their larvae can attack every part of the plant, causing enormous damage (SOUZA, 2010). These caterpillars have chewing-type mouthparts (FILGUEIRA, 2008) that allow them to cut different parts of the plant or open galleries in the stem, interrupting the

the circulation of sap. They prefer younger, more tender tissues (COLEY & BARONE, 1996).

When the caterpillars finish their development, they stop feeding on the culture and look for a suitable place for transformation into pulp, from where the adult later emerges, insects with wings covered in scales (FILGUEIRA, 2008).

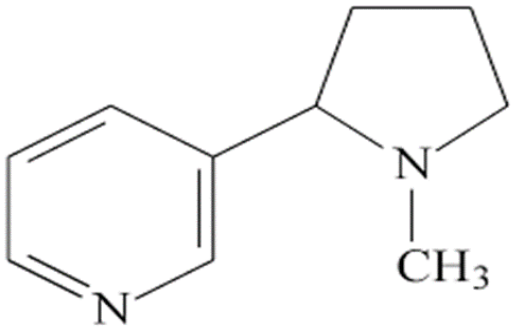
Pesticide action based on tobacco extract (nicotine)

Nicotine is a plant alkaloid synthesized in the roots of the tobacco plant, rising up the stem to the leaves and storing the highest concentrations in the highest areas close to the stem. However, the nicotine content varies depending on the types of plant (ROSEMBERG, 2004). Its main metabolites are cotinine and cotinine-N-oxide (ADNAN, 2009).

Nicotine is the most important of the alkaloids in the leaves of the tobacco plant, where it is found in the malate and citrate state in varying percentages from 0.6 to 12%. It is used in agriculture, in the fight against incest harmful to cultivated plants, either as an ingestion or contact insecticide, or as a fumigant. In the second case, the more general one is advisable against plant aphids, although it is not equally effective for all species" (GRANDE ENCICLOPÉDIA PORTUGUESA E BRAZILEIRA MOURA-NU-CK, S/A, p. 726).

Nicotine is a tertiary amine with the molecular formula CHN_{10}, its structure is composed of pyridine and $_{14}$ $_{2}$ pyrolidine rings (ADNAN, 2009). There are stereoisomeric racemic forms with a three-dimensional structure. In tobacco, two are permanently present: *l*-nicotine and *d*-nicotine. The first is 100 times more pharmacologically active, constituting 90% of the total (ROSEMBERG, 2004).

Figure 1: Chemical structure of nicotine



Source: http://www.adicciones.org/articulos/articulo002.html

Its pesticidal action is carried out by the paralysis of the nervous centers linked to the locomotor and nutritional organs; it also has abortive action on the eggs of various pests" (GRANDE ENCICLOPÉDIA PORTUGUESA E BRAZILEIRA, MOURA-NUCK S/A, p. 726).

Nicotine is neurotoxic, being a substance with a structure similar to acetylcholine, the essential neurotransmitter in the central nervous system of insects. Nicotine is, therefore, an analogue of acetylcholine, and thus, imitates its action, competing with acetylcholine for its receptors present on the postsynaptic membrane. The captivation of acetylcholine receptors by nicotine is, therefore, abnormally prolonged, causing hyperexcitability of the central nervous system due to continuous and uncontrolled transmission of nerve impulses, causing tremors and paralysis (MATSUMURA, 1976; KATHRINA & ANTONIO, 2004).

The nicotine products most used to prepare the respective formulations are: pure nicotine (98 to 99%), nicotine sulfate (40%), tobacco extracts (7 to 10%) and tobacco extracts prepared in House. Both nicotine and its derivatives can be added to sulfonic insecticides, Bordeaux, lead arsenate syrup and soap in the following proportions for 100 liters of solvent: pure nicotine (98 to 99%), 50g, nicotine sulfate (40%), 125g, tobacco extracts (7 to 10%), 1000g.

You can prepare homemade tobacco extract as long as you have leftover tobacco preparation or tobacco leaves. To be able to use this extract, however, you must know the percentage so as not to apply it in percentages so low that they have no effect on pests or so high that they burn the foliage. For this purpose, the Baumé densimeter is used, and the extract have more than 12 °Bé. Nicotine formulations sometimes produce brown spots or burns on leaves and fruits under the action of

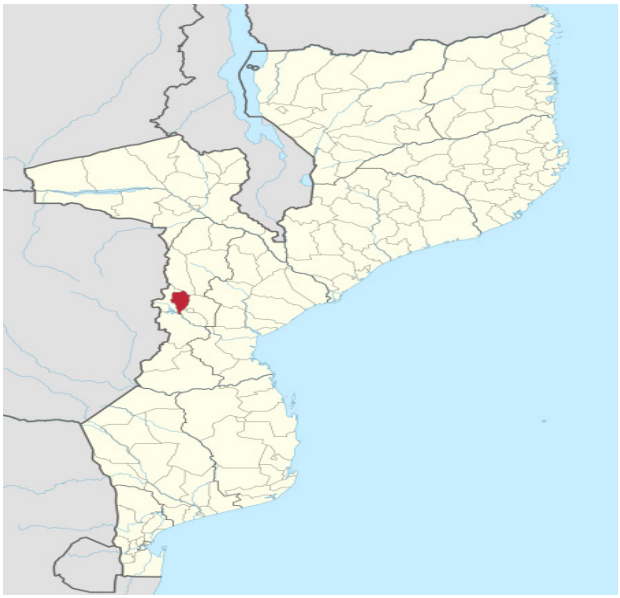
sun rays and to avoid it, treatments should only be carried out on days without sun (GRANDE ENCICLOPÉDIA PORTUGUESA E BRASILEIRA MOURA-NUCK S/A, p. 726).

After applying nicotine extracts to edible plants, a period of 3 to 4 days of biological degradation of the product must be expected (BUSS & PARK-BROWN, 2002; KATHRINA & ANTONIO, 2004; WIESBROOK, 2004).

MATERIAL AND METHOD

Study area

Administrative Post of Matsinho, belongs to the District of Vanduzi and is located to the east of this District (MAE, 2005). The district of Vanduzi is located in the center of the province of Manica in Mozambique. It is limited to the north by the district of Bárue, to the east by the districts of Gondola and Macate, to the south by the district of Sussundenga and to the west by the district of Manica.



Source: https://upload.wikimedia.org/wikipedia/commons/thumb/4/46/Vanduzi

Procedures

To give theoretical support to the work, priority was given to bibliographical research, which consisted of collecting information from books, documents, articles, monographs and the internet related to cabbage cultivation, pesticides, the tobacco plant, nicotine, cabbage aphids, cabbage caterpillars and guidelines for preparing the extract.

The study is of a quantitative experimental type, as it seeks to quantify the dose of tobacco extract ideal for use as a pesticide, seeking to validate the variables and the construction of the hypothesis through field experimentation.

To carry it out, the sample consisted of 7 cabbage beds, 3 of which were sprayed with extracts prepared from tobacco ribs in 3 different concentrations; another 3 paved beds verified with extracts prepared from the tobacco leaf also in 3 different concentrations, and an unsprayed seedbed.

Field research began with soil preparation, which was carried out by clearing the land, which allowed the breaking of the clods and homogenization of the soil to facilitate the planting of cabbage cuttings and seedlings. Seven beds were then formed, approximately 1 m wide and 6 m long, approximately 1 m apart. Each bed had two rows of planting holes, one row consisting of 14 and the other of 15 holes. To improve soil fertility and respond to the nutritional conditions of plants, animal manure was used. Furthermore, fertilization was carried out in two periods: in the first, after the

transplanting and planting cabbage, and in the second period, 28 days after the first fertilization. In each bed, in a row of holes, the leafy cabbage cuttings were planted and in another row, the large cabbage seedlings were planted. Each pit included two cuttings in the leafy cabbage rows and two seedlings in the beefy cabbage rows. The cuttings and seedlings (after 4 weeks of germination) were removed from the seedbeds.

Irrigation was initially done in empty holes before the planting process, then it was done on Mondays, Tuesdays, Thursdays and Saturdays during the first 45 days, and when it did not rain. After this phase, irrigation began to be carried out on Tuesdays and Saturdays for the rest of the research field's working days.

For the ecological dam, stakes from local plants were used for support, and natural wires and ropes were used to secure the stakes. Furthermore, local elephant grass was used to create insulation to prevent the transfer of air masses between the different beds. To characterize the beds, 7 different plates were made using plywood and acrylic paints. If so, on the first plate “rib 1 100%” was drawn, on the second “rib 2 50%”, on the third “rib 3 25%”, on the fourth “limbo 1 100%”, on the fifth “limbo 2 50% ”, in the sixth “limbo 3 25%” and in the seventh “zero site 0%”, attributed to the first to the seventh site.

The preparation of the tobacco extract occurred in a phased manner based on the following reagents: tobacco rib, tobacco limb and well water. In the first phase: 1- 2 kg of previously crushed dry tobacco ribs were weighed and placed in a 20 l bucket; 2- Add 5 l of hot water, bring to 20 l and cover tightly; 3 - Let it rest for fifteen hours (until the next day) in a dark place; 5 - The extract was filtered with the help of an old mosquito net, squeezing the pomace well. The volume obtained was up to 20. For spraying based on the extract obtained, 10 l of the undiluted extract was used in a 16 l sprayer and the first bed was sprayed for 100% rib base extract (N 100 %); 5 l of the extract diluted with 5 l of water and the second bed was sprayed for extract based on the vein at 50% (N 50%); and 2.5 l of the extract diluted with 7.5 l of water and the third bed was sprayed for extract based on the vein at 25% (N 25%). Procedures 1 to 4 were used to prepare the extract based on the tobacco leaf, which was already in powder form. In the same way, 10 l of the undiluted extract was used from the latter preparation and the fourth bed was pulverized for 100% leaf-based extract (L 100%); 5 l of the extract diluted with 5 l of water and the fifth bed was sprayed for 50% leaf-based extract (L 50%); and 2.5 l of the extract diluted with 7.5 l of water and the sixth bed was sprayed with 25% leaf extract (L 25%). In the seventh plot, the null 0% plot (CN 0%) was not sprayed.

In the second phase: 1 - 1 kg of previously crushed dry tobacco rib was weighed and placed in a 10 l bucket; 2 - Add 5 l of hot water, bring to 10 l and cover tightly; 3- Let it rest for fifteen hours (until the next day) in a dark place; 4 - The extract was filtered with the help of a mosquito net, squeezing the bagasse well. The volume obtained was increased to 10 l of extract. For spraying based on the obtained extract, 4 l of the undiluted extract was used in a 16 l sprayer and 100% N was sprayed; 2 l of the extract diluted with 2 l of water and 50% N was sprayed; and 1 l of the extract diluted with 3 l of water and 25% N was sprayed. Procedures 1 to 4 were used to prepare the tobacco leaf-based extract. In the same way, 4 l of the undiluted extract was used from the latter preparation and 100% L was sprayed; 2 l of the extract diluted with 2 l of water and 50% L was sprayed; and 1 l of the extract diluted with 3 l of water and 25% L was sprayed. In CN 0% it was not sprayed.

In the third phase, all the procedures from the second phase were repeated, both in preparing and spraying the extract. In the fourth and final phase, the extract was prepared with the same amount of reagents as in the third phase, however, for spraying, the proportions of sprayed volumes decreased according to the small amount of pests on the foliage due to previous spraying. Thus, 2 l of the undiluted extract was used and 100% N was sprayed; 1 l of the extract diluted with 1 l of water and sprayed with 50% N; and 0.5 l of the extract diluted with 1.5 l of water and 25% N was sprayed. Respectively the same proportions were used for L 100%, L 50% and L 25%, maintaining as always CN 0% unsprayed. This was the last time the extract was sprayed on the vegetable.

Table 1 summarizes the preparation and spraying phases of the different extracts and their respective proportions (for extract and solvent):

Table 1: Relationship between the proportions of extract and water used in dilution

Extract from:	Preparation date	Spray date rization	Volume of extract	Volume of water
100% rib	01.10.2017	02.10.2017	10 l	0 l
50% rib			5 l	5l
25% rib			2.5 l	7.5 l
100% limbo			10 l	0 l
Limbo at 50%			5 l	5l
Limbo at 25%			2.5 l	7.5 l
100% rib	08.10.2017	09.10.2017	4 l	0 l
50% rib			2 l	2 l
25% rib			1 l	3 l
100% limbo			4 l	0 l
Limbo at 50%			2 l	2 l
Limbo at 25%			1 l	3 l
100% rib	15.10.2017	16.10.2017	4 l	0 l
50% rib			2 l	2 l
25% rib			1 l	3 l
100% limbo			4 l	0 l
Limbo at 50%			2 l	2 l
Limbo at 25%			1 l	3 l
100% rib	08.11.2017	09.11.2017	2 l	0l
50% rib			1 l	1 l
5% rib			0.5 l	1.5 l
100% limbo			2 l	0l
Limbo at 50%			1 l	1 l
And 25% L			0.5 l	1.5 l

Source: Authors, 2023

RESULTS AND DISCUSSION

The amounts of extract in the sprayer varied according to the crop's needs in each of the 4 spraying phases, as pest colonies gradually reduced from one phase to another, as shown in table 2.

Table 2: Amount of extract sprayed in each phase

Pulve phases rization	Extract used to 100%	50% powdered extract	25% powdered extract
1st	10 l of extract	5 l of extract + 5 liters of water	2.5 l of extract + 7.5 of water
2nd	4 l of extract	2 liters of extract + 2 liters of water	1 liter of extract + 3 liters of water
3rd	4 l of extract	2 liters of extract + 2 liters of water	1 liter of extract + 3 liters of water
4th	2 extract	1 liter of extract + 1 liter of water	0.5 l of extract + 1.5 of water

Source: Authors, 2023

In the first phase, three hours after spraying, it was noted that in the first bed sprayed at 100% (N 100%) and in the fifth bed sprayed at 100% (L 100%) most of the aphids were dead and dissected, but some part of the aphid colonies on the innermost leaves were still alive and immobile. In the remaining beds, there was no immediate change in the behavior of aphids. As for the caterpillars, three hours after spraying, they were immobile or moving quickly and disorganized. This fact was also notable in the second bed sprayed at 50% (N 50%) and in the fifth bed sprayed at 50% (L 50%), while in the third bed sprayed at 25% (N 25%) and in the sixth bed sprayed at 25% (L 25%) the caterpillars moved slowly for a long period. By the second day, the caterpillars were dead.

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On this second day, in all sprayed beds, aphid colonies drastically reduced. Certainly, some fell to the ground and the caterpillars adhered to the surface of the cabbage, changing the color of the body, changing from green to brown and a small number of them were on the ground and curled up in the ground. Seven days after spraying at 100% N and 100% L, the outermost leaves withered following the formation made by aphids and the shade of the leaves was soft brown. At N 50% and L 50%, the foliage took on faint brown drops. In N 25% and L 25% there was no notable damage, but the number of aphids was relatively higher than in other beds.

In the second phase, in all beds 100% and 50%, 1 and 3 days after spraying respectively, most of the aphid colonies had died and dissected, becoming a characteristic gray powder, leaving only part of the population that had formed the most dense leaves. young people. The caterpillars were almost no longer identified in the culture. In the 25% beds, there were still certain individuals of aphids even on some external leaves. Only 7 days after the second spraying was it possible to notice that almost in all the beds, there were no more colonies and only in the 25% beds there were some adult aphids right on the casing of some young leaves.

In the 50% and 25% beds, there could be one immobile adult caterpillar in every 3 or 4 cabbages in each bed. Here the foliage did not acquire an intense brown color at N 50% and L 50% as it was in the first phase. At this stage, the poor development of the large cabbage was notable in terms of height, leaf diameter and physical aspect of color in the seventh null bed (CN 0%). Kale was a little more adaptable to aphid infestation.

In the third phase, 3 days after spraying, in all beds there was no longer a considerable offensive number of aphids or any caterpillars. It was uncommon to identify 3 aphids on a leaf of the same cabbage from N 25% and L 25%. After 7 days it was difficult to identify 3 aphids on the same cabbage and 10 days later, it was difficult to identify aphids on the entire cabbage crop. Here, the poor development of cabbage in CN 0%

It was already quite remarkable.

Source: Authors, 2023

23 days after the first spray, some of the previously wilted foliage of N 100% and L 100% had dried out and could be crushed with your fingertips. After 21 days of this third phase of spraying, some populations of aphids reappeared in all beds, mostly young. In the fourth and final phase spraying, after the activity, on the same day, at 100% N and 100% L approximately 2 hours later, the aphid population was extinct. At N 50% and L 50% about 3 hours later, the population was extinct. In N 25% and L 25% around 3 hours later, only the youngest ones were eliminated and it was only the following day that all the foliage was clean (see Appendix N).

In the sprayed beds, the cabbage reached maturity with free and smooth leaves, a healthy and long stem, abundant flowers and seeds, except in the N 100% and L 100% which had partially dry leaves. In CN 0%, the cabbages that resisted death had very small, yellow and stunted leaves; the stem is less elongated, some with galleries and rot on the side and at the growing point; The cabbage that managed to reach maturity had a reduced number of flowers and fruits.

In the experiments carried out, tobacco extracts proved to be: More toxic than previously verified you by Jacomini *et al.*(2016) during experimental poisoning against poultry beetles. These authors extracted 50 ml of the extract from 500g of fresh tobacco leaves whereas in this research the author used 0.1 kg/l of dry tobacco residue; toxic as verified by Sohail *et al.*(2012) during aphid control *Toxoptera aurantii* of tea. These authors used an industrially prepared extract at 2% and compared it with extracts from other plants also at 2%, while the author used extracts from the rib and stem of tobacco, comparing their effectiveness at different concentrations. Therefore, tobacco extract was effective in this research, as concluded by Sohail *et al.*(2012). Less toxic than verified by Mhazo *et al.*(2011) during experimental poisoning on aphid mortality on turnip greens. These authors compared tobacco extract with other botanical extracts. It took the tobacco extract 12 days to cause mortality in just one spray. The extracts prepared by the author took 21 days to cause significant aphid mortality in 3 sprays. The smaller quantity of target pests by these authors may have been the reason for the discrepancy with the results of this research.

In the first phase of spraying the extracts, a certain part of the aphid colonies on the innermost leaves were still alive because the extract did not reach the inner surface of the leaves with the same radius that it reached the outermost foliage due to the distortion of the leaves. Holtz (2015) reports that the distortion of the plant also worsens control problems, as aphids are protected from products with contact action inside the curled leaves.

As for the caterpillars, they did not move due to paralysis and moved quickly and disorganized due to hyperexcitability in the nervous system. Kathrina & Antonio (2004) maintain that nicotine in insects causes hyperexcitability of the central nervous system due to continuous and uncontrolled transmission of nerve impulses, causing tremors and paralysis. In the remaining beds sprayed at 25%, mobility was slow due to the delayed action of lower concentrations of nicotine with nicotinic receptors, leaving the reaction slow. Feltre (2004) states that the highest concentration of reactants increases the reaction speed and lower concentrations influence the slower reaction speed.

In N_1 100% and L_4 100%, the outermost leaves partially dried due to the higher nicotine concentration in E_N 100% and E_L 100% respectively. These damages are warned in the GRANDE ENCICLOPÉDIA PORTUGUESA E BRASILEIRA MOURA-NUCK (S/A, p. 726) when stating: “to be able to use this extract one must, however, know the percentage so as not to apply it in such low percentages that have no action on incest or are so high that they burn the foliage.”

The foliage turned brown drops in the 50% beds due to the oxidation of enough nicotine in the extract to react with oxygen in the air or undergo photolysis, agreeing with Mofatt (2005) in pointing out that nicotine when exposed to light or air gradually turns brown. . In N 25% and L 25% there was no notable damage or noticeable brown color due to the greater dilution of the solute (extract) over water (solvent).

In N_1 100% and L_4 100% L, the death of aphids was extremely fast (about 3 hours) after the first spraying because the non-dilution of these extracts favored them as a strong contact insecticide as stated by Kathrina & Antonio (2004, p. 92) when highlighting that “nicotine has rapid contact action when sprayed against sucking insects, especially soft-bodied ones, such as aphids”.

At CN_7 0%, leaf development of cabbage was greatly reduced due to atrophy of plant organs. Books and Halstead (1999) maintain that cabbage aphids suck the sap, which causes profound atrophy of the vegetable. On the other hand, the rot of the stem and the yellowing of the leaves were due to the illness of the plant caused by aphids, as stated by Holtz. *et al.*(2013) when mentioning that one of the symptoms of cabbage becoming ill is the yellowing of the leaves.

Regarding the disease responsible for cabbage rot, Segeren *et al.*(1994, p. 149) state: “the affected tissues transform into a soft, viscous mass, with a nauseating smell, due to the presence of secondary microorganisms. In the stem, the vascular ring acquires a brownish color.” These microorganisms secondary nisms are transmitted by aphids according to Holtz *et al.*(2015) when maintaining that the When aphids bite a diseased plant, they acquire the virus, which in another bite releases viral particles, contaminating healthy plants.

CONCLUSION

The purpose of the present study was to evaluate the effectiveness of tobacco extract as a pesticide against cabbage caterpillars and aphids. However, once the study was completed it was concluded that:

All extracts are effective against cabbage caterpillars in a single spray. Against aphids: undiluted extracts (100%) are effective after two sprays (on the eighth day); extracts diluted by half (50%) are effective after two sprays (on the tenth day); extracts diluted by a third (25%) are effective in three sprays every 7 days (at 21 days). Comparing the rib-based extracts with the limbus-based extracts, each with the equivalent dilution, they are equally effective; extracts based on veins cause less color on the foliage and have a more pronounced odor than those from limbus.

The 7 beds are compared: in CN 0%, the plants do not develop; in N 100% and L_1 100% the cabbage grows, however, it does not develop at the leaf level as it partially burns; at N 50% and L_{two} 50%, the cabbage develops, however, the color of the foliage tends to brown drops; in N 25% and L_3 25% they show good development and no collateral damage.

Prepared the extract at 0.1 kg/l and diluting it by a third (25% of the extract) is efficient to combat cabbage caterpillars causing mortality in 1 day in a single spray and in aphids for 21 days when sprayed three times at an interval of 7 days. In this case, this dose does not cause side effects to kale.

The 25% extracts are the most suitable for use as a pesticide against cabbage caterpillars and aphids.

Given the relevance of the study, it is suggested that research be carried out on the effectiveness of tobacco extract in combating other pests of various agricultural crops.

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