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Proceeding Paper

Potential of *Achyrocline satureioides* Ethanolic Extract in the Control of *Spodoptera littoralis* †

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Abstract: The species *Spodoptera littoralis* is one of the most destructive agricultural pests in tropical and subtropical areas, causing significant losses to farmers; alternative forms of control are therefore necessary. This study aims to evaluate ethanolic extracts from leaves and inflorescences of *Achyrocline satureioides* as a potential control agent for *Spodoptera littoralis*. The ethanolic extract was prepared via maceration and a bioassay was carried out in five replications with sixth instar *S. littoralis* larvae, using the Food Deterrence methodology; the larvae continued to feed until they had eaten 75% of the control or sample. The results demonstrated that the extracts from *A. satureioides* leaves and inflorescences at a concentration of 10 mg/mL inhibited 37.23% and 22.72% of *S. littoralis* feeding, respectively, indicating that the extracts have an inhibitory effect.

Keywords: pests; *A. satureioides*; *S. littoralis*

1. Introduction

With the global population on the rise, there is an increasing need to bolster food production. According to a 2021 study conducted by the FAO [1], it is projected that a 70% increase in production will be necessary by 2050. This push for expanded production brings with it concerns about conserving natural resources, which in turn drives the exploration of more ecologically sound production methods and the reduction in agrochemical usage. In this context, organic agriculture gains prominence as a promising alternative [2]. In the realm of organic agriculture, alternative methods of pest control have been used. This approach involves utilizing organisms like entomopathogenic fungi, bacteria, nematodes, and plant extracts to combat pests. The use of plant extracts for pest control carries several advantages, including low financial cost, biodegradability, and the absence of the side effects associated with traditional pesticides [3]. An example of a high-impact agricultural pest is the species *Spodoptera littoralis*, commonly known as the cotton leafworm. This pest is particularly destructive in tropical and subtropical regions, feeding on at least 87 types of plants, including vital crops like tomatoes, bell peppers, cotton, and corn [4,5]. However, controlling this pest has often been achieved through the use of synthetic chemical insecticides with broad-spectrum activity, resulting in low selectivity. The continuous and exclusive application of these compounds has led to the emergence of resistant populations, compromising control efficacy [6,7]. Given this scenario, the present study focused on evaluating the potential of the extract from *Achyrocline satureioides*, a species belonging to the Asteraceae family found in various regions of South America. This plant is recognized for its acaricidal and nematicidal potential [8]. This study aimed to investigate the effectiveness of this extract against *Spodoptera littoralis* larvae through a choice assay. The evaluation of this extract holds significant relevance in the pursuit of more effective and sustainable approaches to agricultural pest control.

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2. Methodology

2.1. Plant Material

Inflorescences and leaves of *Achyrocline satureioides* were obtained through a collaborative agreement between the Faculty of Pharmaceutical Sciences of Araraquara (FCFAR-UNESP) and the Multidisciplinary Center for Chemical, Biological, and Agronomic Research (CPQBA UNICAMP). The extracts were prepared for maceration using the methodology developed by Fantatto et al., 2022 [9], by allowing them to remain in contact with pure ethanol at a ratio of 1:10 for 7 days. After this period, the extract was filtered, concentrated through rotary evaporation, and stored in amber vials until use.

2.2. S. littoralis Larvae Obtention

S. littoralis larvae were reared on an artificial diet containing bell pepper plants (Capsicum annuum) and maintained at a temperature of 22 ± 1 °C, relative humidity > 70%, and a photoperiod of 16:8 h (light–dark) in a growth chamber.

2.3. Choice Feeding Assay

For the choice feeding assay, the extract was utilized at a concentration of 10 mg/mL, and 5 replicates were conducted for both the extract and control. Petri dishes were coated with agar culture medium at a concentration of $10\times g/1000$ mL of water. After solidification, four holes were created in the agar, and parts of Capsicum annuum with approximately 1 cm in diameter were positioned to be affixed but not submerged. Ten microliters of the 10 mg/mL extract were applied to two leaves on each plate, while two leaves remained untreated as controls. Additionally, two *Spodoptera littoralis* larvae were placed on each plate in the same positions. The assay continued until the larvae consumed 75% of either the control or the treatments. Percent feeding reduction (% FR) was determined for the equation % FR = [1 − (treatment consumption/control consumption)] 100 [10,11].

3. Results and Discussion

After the larvae had eaten 75% of the control group, they were removed from the plates, and the leftover leaves were removed and pasted onto a sheet of white paper, separating them into treatment and control (Figure 1). The sheet was scanned and measurements were taken following the methodology of Reina et. al., 2001 [11].

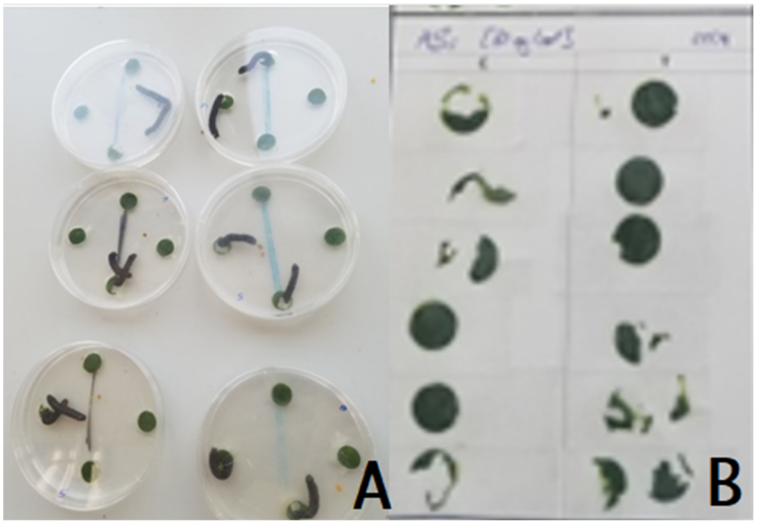

Figure 1. (**A**) Choice feeding assay. (**B**) Leaves considered for inhibition calculation.

The results revealed that a concentration of 10 mg/mL of extracts from the leaves and inflorescences of *A. satureioides* inhibited 37.23% and 22.72% of *S. littoralis* feeding, respectively. A similar outcome was observed in a study conducted by Hussein et al. in

2023 [12], where the methanolic extract of *S. terebinthifolius* exhibited a feed deterrent activity of 21.9% at a concentration of 5 mg/mL. *S. terebinthifolius* contains a substantial amount of tannins that deactivate the digestive enzymes in its leaves, forming a tannin–protein complex that is challenging to digest and adversely affects the growth and survival of insects. In the results obtained in the current study using *A. satureioides* extracts, the observed effect can be attributed to the presence of phenolic compounds, specifically quercetin, isoquercetin, and caffeic acid, which are the predominant molecules in this species [9,13]. Caffeic acid aids plants in defending themselves against predators, pests, and diseases by inhibiting the growth of insects, fungi, and bacteria [14]. Quercetin, on the other hand, is a flavonoid known for its significance in the production of bioinsecticides. Its role in plant metabolism has been associated with a defense mechanism that alters the palatability and nutritional value of the plant, reducing its attractiveness to insects [15,16]. This suggests that the extracts possess an inhibitory effect on the feeding behavior of this caterpillar.

4. Conclusions

The results presented are promising and new trials will be carried out to promote the use of the species *A. satureioides* in the control of agricultural pests.

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