

Effectiveness of Babadotan Leaf Extract as a Botanical Pesticide for Fall Armyworm on Corn Plants (*Zea mays* L.)

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Abstract. Corn is the second main source of carbohydrates and protein after rice. Corn production decreased by 2,816 quintals due to the attack of armyworm pests. This study aims to determine the effectiveness of babadotan leaf extract as an insecticide to control armyworms in corn plants. This research was conducted in Pau Village, Langke Rembong District, Manggarai Regency, from February to May 2024. This research was an experimental design and this research was block randomizes design (RAK) by using four times repeats by using variant doses of babadotan leaf extract in the control treatment, 300 gr/L, 450 gr/L, 600 gr/L and 750 gr/L. The data were analyzed by using one-way ANOVA. The results of the study showed that administering a dose of babadotan leaf extract had a significant effect in reducing the intensity of armyworm attacks by 52% and increasing armyworm mortality by 100%.

Keywords: Armyworm; babadotan leaf; corn; insecticide

1 Introduction

Corn (*Zea mays* L.) is one of the important food ingredients in Indonesia because corn is the second main source of carbohydrates and protein after rice. In addition, corn is widely developed because of its position as an industrial raw material and animal feed. [1] stated that the national corn requirement as a food ingredient in 2022 was 12.27 million tons and increased by 38.41% to 16.98 million tons in 2023. The increase in national corn demand in recent years has not been in line with the increase in domestic production. [2] stated that corn production in Manggarai Regency in 2022 was 4,979 tons and decreased by 58.91% to 2,045 tons in 2023. The main problem of low corn production in the Manggarai region is the increasing number of armyworm pest attacks due to excessive use of chemical pesticides. The armyworm pest (*Spodoptera litura* F) is a pest that has appeared since the corn planting season in April-May 2019 and has been quite disturbing for corn farmers, because many of their plants have been destroyed and the harvest has failed [3]. Corn yield losses due to armyworm attacks can reach 15 - 73% with the population of plants attacked ranging from 55 - 100% [4].

Farmers usually use chemical pesticides available on the market with quite high frequency and dosage. Improper application of chemical pesticides results in an explosion of pest populations, increased pest immunity and affects human health [5]. The next impact is a decrease in soil fertility, which can disrupt the agricultural sector, resulting in a decrease in crop production [6]. An environmentally friendly way to control pests is to use botanical pesticides

that contain active compounds for plant maintenance and are made simply with the results in the form of solutions, yields and extracts [7]. One of the plants that has the potential as a botanical pesticide is babadotan. Babadotan (*Ageratum conyzoides* L) is a weed that is easily found in rice fields, gardens, yards and roadsides.

Babadotan leaves can be used as botanical pesticides because they contain bioactive compounds in the form of saponins, flavonoids, polyphenols, and essential oils which can prevent pests from approaching plants (repellent) and inhibit larvae from becoming pupae [8]. The babadotan leaf botanical pesticide is a contact poison by stopping the egg hatching process, a nerve poison and killing armyworms [9]. According to [10], 750 g/l of babadotan leaf extract can reduce the intensity of armyworm attacks by 0.75% at 25 Days After Planting (DAP) on pak choy mustard plants. In addition, babadotan leaves have bioactive properties as an insecticide against *Spodoptera litura* at a concentration of 3% [11].

In this regard, it is necessary to study the potential of the babadotan plant to be developed as a botanical pesticide to control armyworm pests in corn plants. The aims of this research are as follows: (1) To determine the effectiveness of babadotan leaf extract as a botanical pesticide in controlling armyworms in corn plants, (2) Obtaining the right dose of babadotan leaf extract to reduce armyworm pest attacks on corn plants.

2 Method and Materials

This research was conducted from February to May 2024 at the Pau Ngawe experimental land, Langke Rembong District, Manggarai Regency, Nusa Tenggara Timur Province. The materials used in this study were hoes, sickles, buckets, measuring cups, bottles, knives, stirrers, blenders, sieves, meters, scales, handsprayers. armyworm pests, BWX33 variety corn seeds, babadotan leaves, soap, pig manure and water. This study used a non-factorial Randomized Block Design (RAK) with 5 treatment levels and 4 replications, so that there were 20 experimental units in this study. Each experimental unit contained three third instar *S. frugiperda* larvae invested in corn plants aged 21 Days After Planting (DAP). The treatment given was the addition of a dose of babadotan leaf extract as a botanical pesticide with the following doses: B0 (control or 0 g/l), B1 (300 g/l), B2 (450 g/l), B3 (600 g/l) and B4 (750 g/l). The application of botanical pesticides was carried out starting 22 days after planting with an interval of 5 days until nearing harvest, and was carried out by mixing the babadotan leaf extract according to the treatment into 1 liter of water, then spraying it on each plant. Observation parameters consisted of the attack intensity of armyworm, mortality of armyworm, number of cob, cob weight and cob length. The data obtained during the study were analyzed using Analysis Of Variance (ANOVA). If the ANOVA results show significant, it is continued with Duncan's Multiple Range Test (DMRT) at the 5% level.

3 Results and Discussion

3.1 Attack Intensity of Armyworm

The results of the analysis of variance showed that the treatment of the babadotan leaf extract dose had a significant effect on the attack intensity of armyworm on corn plants (**Table 1**).

Table 1. Intensity of armyworm attacks on various doses of babadotan leaf extract on corn plants

Babadotan leaf extract treatment	Attack intensity (%) of armyworm
B0 (0 g/l)	100.00 c
B1 (300 g/l)	70.75 b
B2 (450 g/l)	66.75 ab
B3 (600 g/l)	62.50 ab
B4 (750 g/l)	52.00 a

Note: Numbers followed by the same letter and same column indicate an insignificant difference based on the DMRT test for Difference at 5%.

The dose of 750 g/l babadotan leaf extract resulted in a lower intensity of armyworm attacks by 52.00% compared to the control of 100.00%. This dose is the highest dose among other treatments. The low intensity of armyworm attacks is caused by the content of toxic substances in the form of secondary metabolite compounds in babadotan leaves which can affect the digestive system and death of armyworm. According to [12], the botanical pesticide babadotan leaves sprayed on armyworm pests contain secondary metabolites that cause the pests to slowly lose body fluids, so that the pests begin to stiffen and die. Babadotan leaves have secondary metabolite compounds in the form of flavonoids and saponins that can reduce the attack intensity of armyworm. Flavonoid compounds can block cell membranes in obtaining molecules or nutrients by binding to proteins, so that pests will lack protein for their cell development [13]. According to [14] saponin compounds in botanical pesticides from babadotan leaves can inhibit enzymatic reactions in the digestive system, usually referred to as stomach poisoning, which results in the absorption of nutrients in the pest's body not being optimal and causing death in the pest. The higher the dose of botanical pesticides applied to plants, the lower the intensity of armyworm attacks [15].

3.2 Mortality of Armyworm

The results of the analysis of variance showed that the treatment of the babadotan leaf extract dose had a significant effect on the mortality of armyworm on corn plants (**Table 2**).

Table 2. Mortality of armyworm on various doses of babadotan leaf extract on corn plants

Babadotan leaf extract treatment	Mortality (%) of armyworm
B0 (0 g/l)	8.32 a
B1 (300 g/l)	68.70 b
B2 (450 g/l)	93.75 c
B3 (600 g/l)	93.75 c
B4 (750 g/l)	100.00 c

Note: Numbers followed by the same letter and same column indicate an insignificant difference based on the DMRT test for Difference at 5%.

The dose of babadotan leaf extract of 750 g/l as the highest treatment in increasing the mortality of corn armyworms by 100.00%, while the lowest mortality of armyworm pests of 8.32% was found in the control treatment (without application of babadotan leaf extract). According to [16] babadotan leaves contain secondary metabolite compounds in the form of alkaloids and flavonoids which can increase mortality in insect organisms and microorganisms. Flavonoid compounds in babadotan leaves can work as respiratory poisons. The way flavonoid compounds work is by entering the caterpillar's body through the respiratory system which can cause decreased nerve function and damage to the respiratory system, and cause the caterpillar

to be unable to breathe and not eat the leaves that have been applied with pesticides, causing the pest to die and dry out [17]. The content of secondary metabolite compounds in babadotan in the form of alkaloids works orally with the nature of bitter compounds and makes insects or larvae not want to eat plants [18], so that insects do not get energy to be active because of starvation in insects and causes death in insects. According to [19] stated that increasing the dose of botanical pesticides is directly proportional to the increase in the toxic material, so that can increasing the killing power of armyworms.

3.3 Number of Cob

The results of the analysis of variance showed that the treatment of the babadotan leaf extract dose had no significant effect on the number of corn cob (**Figure 1**).

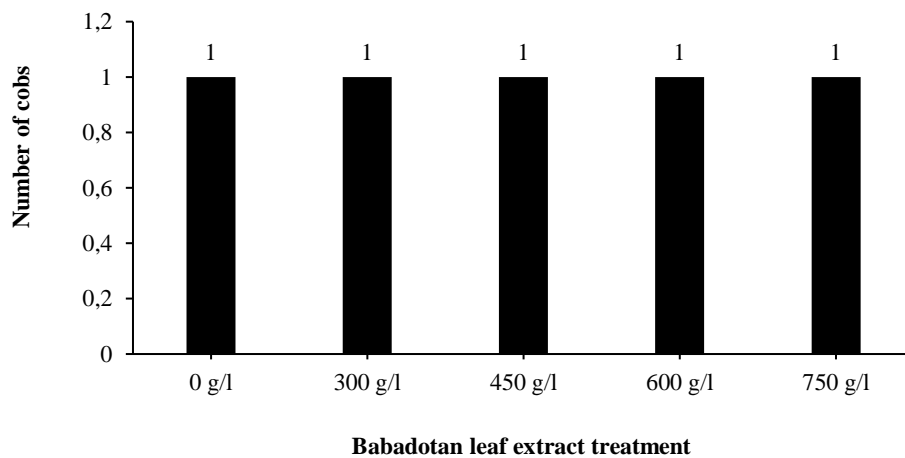


Fig. 1. Number of corn cobs at various doses of babadotan leaf extract.

The corn cob yield in all treatments averaged 1 cob (**Figure 1**). The application of the babadotan leaf botanical pesticide did not affect the number of corn cob, because the treatment of the babadotan leaf botanical pesticide did not play a role in stimulating the growth or initiation of corn plant organs to be more rapid. The applied plant pesticide of babadotan leaves aims to overcome the problem of armyworm pest attacks on corn plants [20]. The corn yield component is measured based on the number of cob that can be obtained from the addition of nutrients, if the number of cob is greater, it will increase the corn yield more [21].

3.4 Cob Weight

The results of the analysis of variance showed that the treatment dose of babadotan leaf extract had a significant effect on the weight of corn cob (**Table 3**).

Table 3. Corn cob weight at various doses of babadotan leaf extract

Babadotan leaf extract treatment	Cob weight (g)
B0 (0 g/l)	61.42 a
B1 (300 g/l)	84.75 b
B2 (450 g/l)	79.25 ab
B3 (600 g/l)	81.25 ab
B4 (750 g/l)	108.42 c

Note: Numbers followed by the same letter and same column indicate an insignificant difference based on the DMRT test for Difference at 5%.

The dose of babadotan leaf extract of 750 g/l produced the highest corn cob weight of 108.42 g. This is because the dose of babadotan leaf extract of 750 g/l is also the best dose in reducing the attack intensity of armyworm, so that cell growth and development continue to increase without any interference from attack of armyworm. The increase in corn cob weight is also caused by the content of babadotan leaf extract in the form of alkaloid compounds that can inhibit the appetite of armyworms. Alkaloid compounds inhibit taste receptors in the mouth area of the larvae. This results in the larvae failing to receive taste stimuli, so they are unable to recognize their food and cause the larvae not to eat the developing plant parts [22]. In addition, the plant pesticide of babadotan leaves is able to support cell development, especially in increasing the weight of the cob because the babadotan leaves contain nutrients in the form of K nutrients [23]. The availability of K elements as a material for the formation of proteins and carbohydrates, and improves the quality of plant yields [24], such as fruit weight, cob weight and number of seeds.

3.5 Cob Length

The results of the analysis of variance showed that the treatment dose of babadotan leaf extract had a significant effect on the length of corn cob (**Table 4**).

Table 4. Corn cob length at various doses of babadotan leaf extract

Babadotan leaf extract treatment	Cob length (cm)
B0 (0 g/l)	11.57 a
B1 (300 g/l)	12.59 ab
B2 (450 g/l)	13.00 ab
B3 (600 g/l)	13.62 bc
B4 (750 g/l)	15.00 c

Note: Numbers followed by the same letter and same column indicate an insignificant difference based on the DMRT test for Difference at 5%.

The dose of babadotan leaf extract of 750 g/l as the highest treatment in producing corn cob length of 15.00 cm. This is because the dose is the highest dose of botanical pesticide among other treatments, so that it is able to produce poison for pests that attack corn plants, and cause the intensity of attacks to decrease. The low intensity of pest attacks results in no part of the plant being attacked, so that it can maintain the growth and development conditions of the plant. According to [25], babadotan leaves contain secondary metabolite compounds that can repel pests and inhibit the growth of larvae into pupae. The content of secondary metabolite compounds in babadotan leaves in the form of saponin compounds acts as a contact poison that enters through the body wall of the larvae and then damages and causes hemolysis of blood cells so that it can inhibit breathing and cause death in the larvae [26]. In addition, saponins also have

a bitter taste that can reduce the appetite of larvae, then the larvae will die due to starvation and reduced nutrition in the body of the larvae [27]. The death of the larvae causes no pest attacks on plants, so that plants can grow and develop optimally.

4 Conclusion

Botanical pesticides of babadotan leaves have a significant effect in controlling armyworms in corn plants. The dose of babadotan leaf extract of 750 g/l is the most effective treatment in controlling armyworms, because it can increase armyworm mortality by 100.00% and reduce the attack intensity of armyworm by 52.00%.

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