The Activity of Chinese Jatropha Stem Extract (*Jatropha multifida* L.) Against Mortality and Fitness of FAW (*Spodoptera frugiperda* J.E. Smith) Larvae in Corn Plants (*Zea mays* L.)

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Abstract*--The activity of Chinese jatropha stem extract (J. multifida L.) was tested on S. frugiperda larvae to determine the percentage of mortality and fitness. The research was carried out in the pest and disease laboratory of the Faculty of Agriculture, Tadulako University from January to May 2020. The research used a completely randomized (CRD) design with six treatments and four replications. Chinese jatropha stem extract was fed through the leaf sandwich method. The variables observed were larval mortality and fitness of larvae and pupae of S. frugiperda. The results showed that the concentration of Chinese jatropha stem extract J. multifida was effective in causing mortality of S. frugiperda larvae ranging from 0% (P0) to 88.75% (P5). Moreover, effectively suppress the fitness of larvae into pupae and pupae into imago S. frugiperda. The highest fitness of larvae into pupae (100%) and pupae into imago (85%) at treatment concentration P0. The lowest fitness of larvae into pupae (11.25%) and pupae into imago (7.50%) in P5. Treatment.

Keywords*--Corn, Jatropha multifida, Spodoptera frugiperda, Vegetable Pesticide.

I. INTRODUCTION

Corn (*Zea mays* L.) is one of the most important sources of human food, in addition to wheat and rice [1]. In Indonesia, corn is the second food commodity that deserves to be developed into the main commodity after rice which is prioritized in increasing food security [2]. Corn can also be grown in almost all types of fertile, loose (nest) soil, and is also rich in humus as well as good drainage, aeration, and management [3] and can be planted in the lowlands to mountainous areas of the plains. high [4].

In Indonesia, especially in the province of Central Sulawesi one of the food-producing areas, especially corn, has a very important role in the economy after rice and wheat to increase the income of farming communities [5].

Corn production in Central Sulawesi in 2014 reached 170,202 tons. In 2015 corn production decreased to 131,123 tons and in 2016 increased again to 317,717 tons, in 2017 corn production increased to 374,323 tons, and in 2018 it reached 380,650 per ton [6] In 2020 the average corn production nationally amounted to 54.74 kg/ha and the percentage of land attacked by pests was 75.03% [7].

Many factors can damage corn plants to reduce corn production, including plant pest organisms (OPT) in the form of pests, diseases, and weeds. One of the important pests that attack corn today is Fall Armyworm (FAW) or armyworm (*Spodoptera frugiperda* J.E. Smith) which is an invasive pest [8] that attacks plants by causing severe damage [9] and incidence of damage 22.13–46.83% [10].

The pest *S. frugiperda* originating from tropical and subtropical America has a high migratory capacity, distributed in Africa in 2016, India in 2018, in East Asian countries in 2019, and in Korea was first found in the cornfields of Jeju Island, [11], [12]. The first *S. frugiperda* attacks in Indonesia were in March 2019 in Pasaman, West Sumatra [9] and West Java, in June 2019 in Bandung, Sumedang, Garut, and Tasikmalaya [13], [14]. *S. frugiperda* attack on maize can cause yield losses of 20-50% [15]. Larval nests in Kenya, caused 83% of maize farmers to suffer losses of 33%, as well as 1 million tonnes [16].

The use of chemical insecticides to control corn pests is still being used, but the use of these insecticides has caused many negative impacts such as the killing of non-target organisms. So farmers are now starting to be directed to switch to using vegetable pesticides as an alternative to maintaining the balance of the environmental ecosystem. [9]

Vegetable pesticide is one of the pesticides of plant origin that contains active ingredients of secondary metabolites that function as a natural defense tool against intruders, protects plants by causing the death of pests or acting as pest repellents, changing insect behavior during oviposition and mating and inhibiting the emergence of offspring. on pests [17].

It is hoped that the effort to develop vegetable pesticides can be used by farmers as pest controllers that are environmentally friendly and safe for humans. One of the plants that can be used as a vegetable pesticide is the

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Chinese Jatropha (*Jatropha multifida* L.). This plant is a plant found in various regions of Indonesia and is better known as tintir distance (Java), octopus distance (Sunda), balacai (Ternate), or iodine tree. The stems of the Chinese Jatropha plant contain alkaloids, saponins, flavonoids, and tannins [18], [19]. Therefore, the authors are interested in researching the effectiveness of Chinese jatropha stem extract (*J. multifida*) on the larval motility of FAW *S. frugiperda*.

II. RESEARCH METHODOLOGY

A. Place and Time of Research

This research was carried out at the Pest Laboratory of the Faculty of Agriculture, Tadulako University, this research was carried out from January 2020 to March 2020

B. Tools and Materials

The tools used in this study were a blender, bucket, analytical scale, Erlenmeyer, rotary evaporator, filter, stirring spoon, dropper, label paper, catheter, tissue, gauze, jar, cotton, and markers.

The materials used were 96% ethanol, Chinese jatropha stalk, *S. frugiperda* larvae, and corn leaves.

C. Research Methods

This study was arranged according to a completely randomized design, consisting of six treatments and four replications, so the total observation units obtained were 24 (6x4) observation units. In each treatment using Chinese Jatropha stem extract (*J. multifida* L.) as a vegetable pesticide on test larvae, namely 3rd instar larvae of *S. frugiperda* with a concentration of Chinese Jatropha stem extract, namely P0 (0%), P1 (5%), P2 (10%), P3 (15%), P4 (20%) and P5 (25%).

The first step is to prepare Chinese jatropha rods which are cut into small pieces then baked at 40o C for 3 days then blended and sifted until smooth into flour with a sieve size of 85 micrometers and weighed with an analytical balance of as much as 250 grams and put in an Erlenmeyer then add 1 liter of 95% ethanol solution was then shaken using a plug for 24 hours. Furthermore, the extract was filtered using filter paper to separate the residue and the filtrate, the filtrate from the filtering was then evaporated with an evaporator at low pressure to separate the Chinese jatropha stem extract with ethanol solvent so that a concentrated extract was obtained, then diluted according to the treatment concentration of the Chinese jatropha stem extract. used.

S. frugiperda larvae taken from corn plantations in Pesaku village, West Dolo District were reared until they reached 3 instar larvae. Before application, the test larvae were fasted for ± 3 hours. The test was carried out using the corn leaf sandwich method. Corn leaf feed is dipped in Chinese castor stalk extract, for 5 minutes, then air-dried for 2-3 minutes. Then the feed leaves were put into the test container, using 20 *S. frugiperda* larvae per treatment and one fish was added to each container. Observations were made one day after application on mortality and fitness of larvae and pupae of *S. frugiperda* to become imago

D. Observation Variable

The things observed in this study were the percentage mortality of *S. frugiperda* test larvae and observations of the fitness of *S. frugiperda* larvae to become pupae and the fitness of *S. frugiperda* pupae to become imago.

The percentage of larval mortality was calculated using the formula.

$$P = a/b \times 100\%$$

Information :
P = Mortality percentage.
a = Number of dead *S. frugiperda* larvae.
b = Number of observed *S. frugiperda* larvae.

Observation of the fitness of larvae and pupae was carried out by observing the fitness of the number of larvae to become pupae and observing the fitness of the number of pupae to become imago.

D. Data Analysis

Analysis of the observational data using ANOVA analysis and if the treatment has a significant effect then continue with the 5% level BNJ test.

III. RESULTS AND DISCUSSION

A. Larval Mortality of S. frugiperda

Observation of the treatment of Chinese jatropha stem extract on *S. frugiperda* larvae showed that stem extract could cause mortality of *S. frugiperda* larvae. The results of the analysis of the effectiveness of the Chinese jatropha stem extract on the mortality percentage of *S. frugiperda* larvae can be seen in Table 1.

Table 1. Mortality percentage of *S. frugiperda* larvae at various concentrations of Chinese jatropha stem extract.

Treatment	Larval Mortality (%)
P0	0^{a}
P1	62.5^{b}
P2	65^{bc}
P3	67.5^{c}
P4	77.5^{d}
P5	88.75^{e}
BNJ 5%	4.88

Note: The numbers followed by the same letter in the same column show no significant difference in the 5% BNJ test

The results of the ANOVA test showed that the application of Chinese jatropha stem extract had a significant effect on the mortality of *S. frugiperda* larvae. Based on the results of the BNJ test at a 5% level that the P0 treatment was different from other treatments, this showed that the Chinese jatropha stem extract was effective in causing mortality of *S. frugiperda* larvae because it contained toxic compounds that could affect pests by causing toxicity (Gupta et al., 2021)

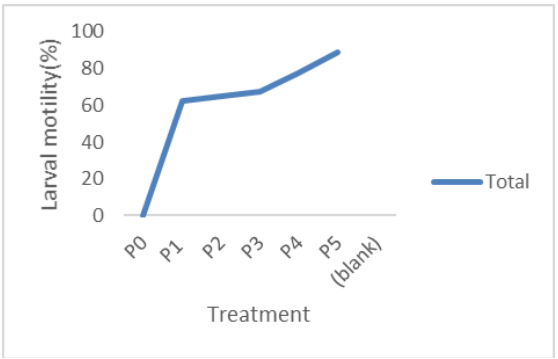

Fig 1. Graph of mortality percentage of *S. frugiperda* larvae at various concentrations of Chinese Jatropha stem extract

Based on Figure 1. It can be seen that the higher the concentration level of Chinese Jatropha stem extract, the higher the mortality percentage of *S. frugiperda* larvae. In treatment P0 all test larvae were still alive, and no larvae died, this happened because treatment P0 did not contain Chinese Jatropha extract so no larvae died, P0 treatment without Chinese Jatropha curcas extract did not affect the physical condition of *S. frugiperda* larvae, whereas in the P1, P2, P3, P4, and P5 treatments there were concentrations of Chinese Jatropha extract which could cause death in *S. frugiperda* larvae because the Chinese Jatropha extract contains a toxin which can cause death according to the concentration level of the treatment used. given. This is following [17] that plant extracts contain secondary metabolites which protect plants against pests by causing pest death.

B. Fitness of S. frugiperda larvae to become pupae

The application of the Chinese jatropha stem extract of *J. multifida* significantly affected the number of larvae in the pupae of *S. frugiperda*. Based on the observations of larval fitness in Table 2.

Table 2. Percentage of fitness of *S. frugiperda* larvae at various concentrations of Chinese jatropha stem extract.

Treatment	Larvae Fitness	
	Larvae become pupae	Percentage of larvae become pupae
P0	20.00^{e}	100.00
P1	7.25^{d}	36.25
P2	6.75^{cd}	33.75
P3	6.50^{c}	32.50
P4	4.50^{b}	22.50
P5	2.25^{a}	11.25
BNJ 0,05%	0.83	

it shows that the P0 treatment resulted in high larval fitness because the treatment did not contain Chinese jatropha stem extract so the larvae remained fit and did not experience disturbances. The percentage of larvae becoming pupae in the P0 treatment achieved the best fitness of 100%. In treatment P1 to treatment P5, the percentage of *S. frugiperda* larvae turning into imago decreased from 36.25% to 11.25%

The results of the 5% BNJ test In Table 2. show that the P0 treatment, namely the treatment that does not contain Chinese jatropha stem extract is different from all treatments containing Chinese jatropha stem extract. In the treatment containing Chinese jatropha stem extract, the fitness differed depending on the content of the Chinese jatropha stem extract except between treatments P1 and P2 and between treatments P2 and P3 did not differ. Treatment containing Chinese jatropha stem extract can cause decreased larval fitness. The higher the concentration of Chinese jatropha stem extract, the lower the larval fitness.

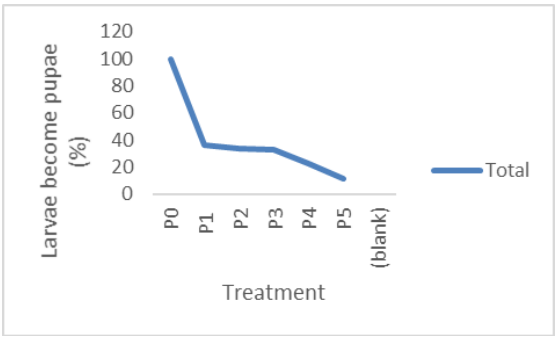

Figure 2. Graph of fitness percentage of larvae to pupae of *S. frugiperda* at various concentrations of Chinese jatropha stem extract

The decrease in fitness was due to the increasing concentration of Chinese jatropha stem extract in corn leaf feed so that the content of toxic substances also increased, causing larval fitness to decrease so that the number of larvae that became pupae was lower according to treatments P1, P2, P3, P4, and P5.

C. Fitness of S. frugiperda pupae to become imago

Application of Chinese jatropha stem extract J. multifida had a significant effect on the number of *S. frugiperda* pupae in imago (Table 3).

Table 3. Percentage of fitness of *S. frugiperda* pupae into imago at various concentrations of Chinese jatropha stem extract

Treatment	Pupae Fitness	
	Pupae become imago	Percentage of pupae become imago
P0	17.00^{e}	85.00
P1	6.00^{d}	30.00
P2	4.50^{bc}	22.50
P3	5.25^{cd}	26.25
P4	4.50^{ab}	22.50
P5	1.50^{a}	7.50
BNJ 0,05%	4.31	

Note: The numbers followed by the same letter in the same column show no significant difference in the 5% BNJ test

The results of the 5% BNJ test in Table 3. show that the P0 treatment (without extract) was different from the treatment containing Chinese jatropha stem extract, namely treatments P1, P2, P3, P4, and P5. The level of pupal fitness in the

treatment containing Chinese jatropha stem extract varied depending on the content of the Chinese jatropha stem extract except between treatments P2 and P3, treatments P2 and P4, treatments P4 and P5, treatments P1 and P3. The higher the concentration of Chinese jatropha stem extract in the pupa, the lower the pupa fitness. The decrease in fitness was due to the increasing concentration of Chinese jatropha stem extract in corn leaf feed so the content of toxic substances also increased, this caused the pupa fitness to decrease, causing the pupae to become imago to lower (Figure 3).

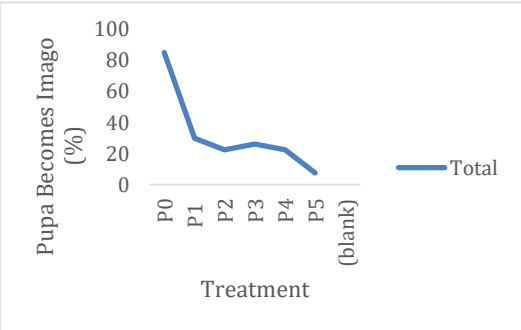

Figure 3. Graph of fitness of Pupae of imago *S. frugiperda* at various concentrations of Chinese jatropha stem extract

Figure 3 shows that the higher the concentration of Chinese castor stem extract, the lower the percentage of pupae of S. frugiperda becoming imago.

The decrease in the fitness of *S. frugiperda* pupae to imago was caused by the increasing concentration of Chinese Jatropha stem extract in corn leaf feed so that the content of toxic substances in the feed increased causing the fitness of the pupae to decrease so that the number of pupae that became imago decreased

Conclusion:

Chinese jatropha stem extract (*J. multifida*) is toxic and effective in causing the mortality of *S. frugiperda* larvae.

Chinese jatropha stem extract is effective in suppressing the fitness of larvae into pupae and pupae into imago *S. frugiperda*

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