

**STUDIES ON THE EFFICACY OF SOME RHIZOME
POWDERS IN PROTECTING STORED MUNG BEAN
PHASEOLUS RADIATUS AGAINST PULSE BEETLE
CALLOSOBRUCHUS CHINENSIS (COLEOPTERA:
BRUCHIDAE)**

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ABSTRACT

The study was conducted to determine the efficacy of some rhizome powders of *Zingiber officinale* var *amarum* and *Zingiber officinale* var. *officinale*, *Curcuma xanthorrhiza*, *Alpinia galanga* and *Kaempferia galanga* against *Callosobruchus chinensis* in protecting mung bean *Phaseolus radiatus*. The rhizome powders were admixed with the seed at 1% (w/w). The result showed all of rhizomes powder caused adult mortality 80 to 90% at 5 days after treatment, but powder of *Alpinia galanga* rhizome showed the fastest mortality (43.75% at 1 day after treatment). The rhizome powder of, *Alpinia galanga* and *Kaempferia galanga* provided good protection for mung bean *Phaseolus radiatus* by reducing

number of egg laid, F1 adult emergence, seed damaged and seed weight loss.

Key words: Efficacy, rhizome powder, *Zingiber officinale*, *Curcuma xanthorrhiza*, *Alpinia galanga* and *Kaempferia galanga*, *Callosobruchus chinensis*, *Phaseolus radiatus*

ABSTRAK

Kajian ini dijalankan untuk menentukan keberkesanan beberapa serbuk rizom *Zingiber officinale var amarum* dan *Zingiber officinale var. officinale*, *Curcuma xanthorrhiza*, *Alpinia galanga* dan *Kaempferia galanga* terhadap *Callosobruchus chinensis* untuk melindungi kacang hijau *Phaseolus radiatus*. Serbuk rizom telah dicampur dengan benih pada 1% (w / w). Hasilnya menunjukkan semua serbuk rizom menyebabkan kematian pada 80 hingga 90 % pada 5 hari selepas rawatan, tetapi serbuk rizom *Alpinia galanga* menunjukkan kadar kematian yang paling cepat (43.75% pada 1 hari selepas rawatan). Serbuk rizom, *Alpinia galanga* dan *Kaempferia galanga* menyediakan perlindungan baik untuk kacang hijau *Phaseolus radiatus* dengan mengurangkan bilangan telur, kelahiran F1 dewasa, benih rosak dan penurunan berat benih.

Kata kunci: keberkesanan, serbuk rizom, *Zingiber officinale*, *Curcuma xanthorrhiza*, *Alpinia galanga* dan *Kaempferia galanga*, *Callosobruchus chinensis*, *Phaseolus radiatus*

INTRODUCTION

The pulse beetle, *Callosobruchus chinensis* (Coleoptera: Bruchidae) is one of the most destructive pest world-wide. The beetle is serious insect pests, initially in the field and later in stores (Hill, 2002). It attacks mainly on the pulses, cereals, and different type of grain. The damage due to this insect affects the germination ability and nutritive value of the seed. The beetle

feed on the seed and the weight loss caused the beetle was about 70%. Synthetic insecticides have been used for many years to control insect pests including those that damaged food crops in storage (Arthur 1996; Daglish, 1998). A considerable problem may arise from the continued application of insecticides among those are insecticide resistance, environment and hazards when handling the toxic compounds (Golob *et al.*, 1982). It need an alternative method to synthetic insecticides to overcome the negative effects of synthetic insecticides. Hence, there is a need to search the alternative method of control such as using plant materials as botanical insecticides which is locally available in the area. The material acts as grain protectants in small-scale storage system and practically proper for farmer. The present study was undertaken to evaluate the efficacy of five dry rhizome powder (medicinal and spices plants) against *C. chinensis*.

MATERIALS AND METHODS

Insects cultures

The initial population of *C. chinensis* was obtained from mung bean *P. radiatus* in the open market. The insect culture was maintained on mung bean as growth medium. The *C. chinensis* was cultured for 3th generations before used in the experiment to avoid external factors and to acclimatize the stock with the laboratory condition. A total of 30 adults were fed on 50 g mung bean filled up in a transparent plastic cup (7 cm high, 9.5 top and 8.5 cm bottom diameter, respectively) for 1 week. After 5 days, they were then removed and the mung bean were incubated at 30±2°C and 80±10% R.H. until adult emergence (ca.3 weeks).

Plant materials

The rhizome of *Zingiber officinale* var *amarum* and *Zingiber officinale* var. *officinale*, *Curcuma xanthorrhiza*, *Alpinia galanga* and *Kaempferia galangal* were obtained from in the

open marked around of Medan city in March 2015. The rhizome were cut into 5 mm thickness to make it dry and fine and then ground with electric grinding machine and finally passed through a 40-mesh sieve to obtain the powder.

Bioassay

The application of rhizome powder on mung bean *P. radiatus* following Belmain *et al.* (2001). A total 50 g mung bean was put into plastic cup (7 cm high, 9.5 top and 8.5 cm bottom diameter, respectively) then 0.5 g rhizome powder was added to the cup and then shaken manually for 30 sec. Ten pairs of 5-7 days old insect (after emergence) were placed into similar plastic cup and covered with a piece of muslin cloth held by rubber band to prevent adult from escaping. Untreated mung bean seed was provided to the adults as control. Number of dead adults was recorded everyday for 1 to 14 days after treatment. Number of egg laid counted by sampling 5 g of mung bean at 5 days after treatment. Number of adult emerged (progeny production) was counted everyday which was started at 21 days after treatment until no adult emerged anymore. The weight loss and seed damaged were taken if no more adult emerged.

Data analysis

The experiment was replicated 4 times arranged following CRD. Data of *C. chinensis* mortality were transformed using $\arcsin \sqrt{x}$, number of egg laid using $\log x$ and progeny production was normalized using $\log x+1$, while $\sqrt{x+0.5}$ for weight loss and seed damaged (Gomez & Gomez, 1984). Data were subjected to analysis of variance and where significant differences existed, treatments means were compared at 0.05 significant level using LSD Test. All statistical analysis were run on the MINITAB Statistical Package (Minitab Vol. 16, 2010)

RESULTS AND DISCUSSIONS

There was a significant effect between rhizome powders tested on the percent *C. chinensis* mortality ($F=17.88$, $df=5,18$, $P<0.05$), number of egg laid ($F=14.17$, $df=5,18$, $P<0.05$), F1 progeny production ($F=65.79$, $df=5,18$, $P<0.05$), percent seed damage ($F=33.64$, $df=5,18$, $P<0.05$), and percent weight loss ($F=26.10$, $df=5,18$, $P<0.05$). The effect of different rhizome powder on percentage of *C. chinensis* adult mortality, number of egg laid, F1 progeny production, percent seed damaged and percent weight loss as presented in Table 1.

All the rhizome powder tested showed certain degree of ability to control *C. chinensis*. Mung bean tested with rhizome powder showed adult mortality about 80-90%. *Curcuma xanthorrhiza* showed the highest mortality on *C. chinensis* (96.25%). It contains curcumin, a volatile compound acts as repellent. Whilst *K. galanga* contains chemical compounds such as essential oils derived oxygenated monoterpene hydrocarbons. It was also found to control cucumber fruit fly, *Spodoptera litura* and *Plutella xylostella* (Martono, 1991; Sukari et al., 2008). This indicates this rhizome is potential to control *C. chinensis*. *Alpinia galanga* in this study showed 92.50% mortality. According to Prijono (1999), an isolated kavikol from *A. galanga* caused mortality on *C. chinensis*. Rhizome powder of *Z. officinale* has been tested by some researchers. Mathur et al. (1985) reported that rhizome powder of *Z. officinale* showed toxicity to the *C. chinensis* and it protected stored blackgram. Whilst, Ahamed and Ahmed (1991) found the rhizome powder admixed with stored grain at 3% w/w showed 100% mortality to *Corcyra cephalonica* and *Sitophilus oryzae*.

Table 1 Percent *C. chinensis* adult mortality, number of egg laid, F1 progeny production, percent seed damaged and percent weight loss as affected some rhizome powders treated on mung bean *Phaseolus radiatus*

Treatment	Percent Mortality (Mean \pm SEM)	Number of egg laid (Mean \pm SEM)	Number of progeny (Mean \pm SEM)	Percent Seed damaged (Mean \pm SEM)	Percent Weight loss (Mean \pm SEM)
Control	5.00 \pm 2.04b	54.50 \pm 4.36a	342.00 \pm 49.91a	44.83 \pm 6.19a	2.76 \pm 0.33a
<i>Z. officinale</i> var <i>amarum</i>	85.00 \pm 7.35a	36.50 \pm 1.19b	129.50 \pm 15.52b	14.96 \pm 3.35bc	0.75 \pm 0.12c
<i>Z. officinale</i> var <i>officinale</i>	86.25 \pm 8.48a	38.50 \pm 3.06b	191.00 \pm 45.32ab	22.93 \pm 10.01b	1.61 \pm 0.39b
<i>Curcuma xanthorrhiza</i>	96.25 \pm 2.39a	25.00 \pm 2.34c	106.50 \pm 17.48b	13.33 \pm 4.49c	0.7 \pm 0.16c
<i>Alpinia galanga</i>	92.50 \pm 1.44a	20.25 \pm 2.95c	57.75 \pm 24.33c	6.93 \pm 6.05d	0.23 \pm 0.05d
<i>Kaempferia galanga</i>	93.75 \pm 3.14a	25.75 \pm 2.28c	0.75 \pm 0.47d	0.10 \pm 0.20e	0.01 \pm 0.01d

Means in a column followed by different letters are significantly different at P=0.05 by LSD Test.

The cumulative percent mortality of *C. chinensis* adult over 1 weeks caused by rizome powder as shows at Figure 1.

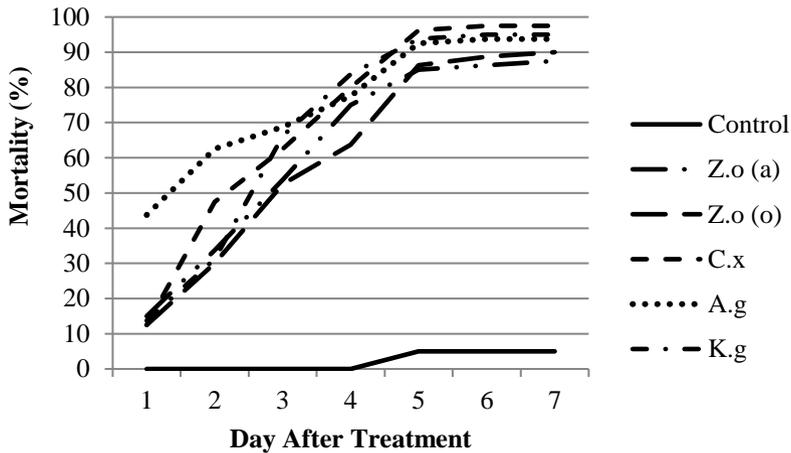


Figure 1 Mortality of *C. chinensis* adult over 1 weeks caused by rizome powder

Result showed that the rhizome powder of *A. galanga* presented rapid effect of adult mortality, because 1 day after treatment it showed 43.75% adult mortality, whilst, the other treatment showed 0-15% of mortality. The antifeedant effect from *A. galanga* could cause the rapid action.

The result showed that *C. xanthorrhiza*, *A. galanga* and *K. galanga* triggered number egg laid by adult *C. chinensis* about 20-25. Whilst *Z. officinale* caused *C. chinensis* laid the egg was about 36-38. Although, there were some egg laid by *C.chinensis* when mung bean treated with *K. galanga*, but there was the lowest of progeny production (0.75). *K. galanga* contain a volatile oil, derivate oxygenated monoterpens and hydrocarbons. It could caused inhibition egg hatched and development larva to adult (Sukari et al., 2008). The result

showed both *A. galanga* and *K. galanga* effectively reduced seed damaged and weight loss. This result can be attributed to the least progeny production.

CONCLUSIONS

The rhizome powder of, *Alpinia galanga* and *Kaempferia galanga* provided good protection for mung bean *Phaseolus radiatus* by reducing number of egg laid, F1 adult emergence, seed damaged and seed weight loss.

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