

## BIBLIOGRAPHY

LAOYAN, EDEN K. APRIL 2013. Efficacy of Crude Extract of Resurrection Lily (*Kaempferia galanga* Linn.) Against Striped Flea Beetle (*Phyllotreta striloata* Fab.) and Cabbage Butterfly (*Peiris rapae* Linn.) Infesting Crucifers. Benguet State University, La Trinidad, Benguet.

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## ABSTRACT

This research was conducted to determine the efficacy of Resurrection lily (*Kaempferia galanga* Linn.) and Yellow ginger (*Zingiber officinale* R.) against flea beetle (*Phyllotreta striloata* Fab.) and cabbage butterfly (*Peiris rapae* Linn.) with one part of water is to botanical extracts in the dilution ratio of: 1:1, 1:3, 1:5 and 1:7 under laboratory and field conditions.

The crude extracts of both test plants were not effective in causing mortality to flea beetle adults. They showed slight repellent effect at 48 hours with the 1:5 dilution under field condition.

The crude extracts of both test plants caused mortality in cabbage butterfly larvae at 48 hours under laboratory condition and repellent effect to adult stage at 72 hours under field condition. The 1:7 dilution ratio of both botanical extracts showed 10% phytotoxicity in pechay plants in the field.



## RESULTS AND DISCUSSION

### Mortality Effect of Botanical Extracts on Flea Beetle under Laboratory Condition

Table 2 shows that there is no significant difference between Resurrection lily and Yellow ginger in causing mortality to flea beetle, although, the number of dead flea beetle increases in each hour.

The result implies that Resurrection lily and Yellow ginger are not effective against adult flea beetles.

Table 2. Mean number of dead flea beetle treated with the botanical extracts at 24, 48 to 72 hour under laboratory condition

| BOTANICAL EXTRACTS | MEAN              |                   |                   |
|--------------------|-------------------|-------------------|-------------------|
|                    | 24H               | 48H               | 72H               |
| Resurrection lily  | 0.05 <sup>a</sup> | 0.15 <sup>a</sup> | 0.10 <sup>a</sup> |
| Yellow ginger      | 0.00 <sup>a</sup> | 0.45 <sup>a</sup> | 0.40 <sup>a</sup> |

\*Means followed by a common letter in a column are not significantly different at 5% level by DMRT

Table 3 presents the mean number of dead flea beetle after treating them with the different treatments of botanical insecticides. The 1:1 dilution ratio showed a greater effect on flea beetle compared to the higher dilution ratio from 24 hours to 72 hours. The highest mean which is 0.62 was recorded at 48 hours cause by 1:1 dilution ratio.

However, the statistical data show that the differences among treatments are insignificant indicating that the botanical extracts are not effective against adult flea beetle. One reason which might be the cause of their death is the handling of the flea beetle due to



their small size and jumping behavior. Although, all the treated leaves that were provide as their food were damaged showing that they fed.

Table 3. Mean number of dead flea beetle treated with different dilution ratio of botanical extracts at 24, 48 to 72 hours under laboratory condition

| RATIO<br>H <sub>2</sub> O: Botanicals | MEAN              |                   |                   |
|---------------------------------------|-------------------|-------------------|-------------------|
|                                       | 24H               | 48H               | 72H               |
| 1:1                                   | 0.12 <sup>a</sup> | 0.50 <sup>a</sup> | 0.62 <sup>a</sup> |
| 1:3                                   | 0.00 <sup>a</sup> | 0.12 <sup>a</sup> | 0.00 <sup>a</sup> |
| 1:5                                   | 0.00 <sup>a</sup> | 0.37 <sup>a</sup> | 0.37 <sup>a</sup> |
| 1:7                                   | 0.00 <sup>a</sup> | 0.37 <sup>a</sup> | 0.25 <sup>a</sup> |
| Untreated                             | 0.00 <sup>a</sup> | 0.12 <sup>a</sup> | 0.00 <sup>a</sup> |

\*Means followed by a common letter in a column are not significantly different at 5% level by DMRT

Table 4 presents the mean number of dead flea beetle after treating them with Resurrection lily and Yellow ginger treatments, both the Resurrection lily and Yellow ginger treatments did not show any significance in controlling flea beetle, however, dead flea beetle were recorded in 1:1 and 1:7 dilution ratio of Resurrection lily treatments whereas in Yellow ginger all the treatment has shown an effects to flea beetle from 24 hours to 72 hours. The higher mean indicates a greater number of dead flea beetle.

At 72 hours, all the leaves in each replication were severely damaged by the flea beetle both in Resurrection lily and Yellow ginger. It also shows that the effect of 1:1 dilution ratio is similarly with 1:7 dilution ratio.



Table 4. Mean number of the dead flea beetle after treating with Resurrection lily and Yellow ginger treatments at 24, 48 to 72 hours under laboratory condition

| RATIO<br>H <sub>2</sub> O: Botanicals | BOTANICAL EXTRACTS |                   |                   |                   |                   |                   |
|---------------------------------------|--------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
|                                       | RESURRECTION LILY  |                   |                   | YELLOW GINGER     |                   |                   |
|                                       | 24H                | 48H               | 72H               | 24H               | 48H               | 72H               |
| 1:1                                   | 0.05 <sup>a</sup>  | 0.05 <sup>a</sup> | 0.50 <sup>a</sup> | 0.00 <sup>a</sup> | 0.50 <sup>a</sup> | 0.50 <sup>a</sup> |
| 1:3                                   | 0.00 <sup>a</sup>  | 0.00 <sup>a</sup> | 0.00 <sup>a</sup> | 0.00 <sup>a</sup> | 0.25 <sup>a</sup> | 0.25 <sup>a</sup> |
| 1:5                                   | 0.00 <sup>a</sup>  | 0.00 <sup>a</sup> | 0.00 <sup>a</sup> | 0.00 <sup>a</sup> | 0.75 <sup>a</sup> | 0.75 <sup>a</sup> |
| 1:7                                   | 0.00 <sup>a</sup>  | 0.25 <sup>a</sup> | 0.25 <sup>a</sup> | 0.00 <sup>a</sup> | 0.50 <sup>a</sup> | 0.50 <sup>a</sup> |
| Untreated                             | 0.00 <sup>a</sup>  | 0.00 <sup>a</sup> | 0.00 <sup>a</sup> | 0.00 <sup>a</sup> | 0.25 <sup>a</sup> | 0.25 <sup>a</sup> |

\*Means followed by a common letter in a column are not significantly different at 5% level by DMRT

#### Mortality Effect of Botanical Extracts on Cabbage Butterfly Larvae under Laboratory Condition

The results in Table 5 shows that Resurrection lily and Yellow ginger crude extract were not significant in causing mortality on cabbage butterfly larvae. Although the number of dead cabbage butterfly increased at 72 hours both in Resurrection lily and Yellow ginger treatments.

The result implies that the botanical extracts are not effective in causing mortality to the larvae of cabbage butterfly.



Table 5. Mean number of dead cabbage butterfly larvae treated with botanical extracts at 24, 48 to 72 hours under laboratory condition

| BOTANICAL EXTRACTS | MEAN              |                   |                   |
|--------------------|-------------------|-------------------|-------------------|
|                    | 24H               | 48H               | 72H               |
| Resurrection lily  | 0.20 <sup>a</sup> | 1.00 <sup>a</sup> | 1.75 <sup>a</sup> |
| Yellow ginger      | 0.00 <sup>a</sup> | 0.85 <sup>a</sup> | 1.05 <sup>a</sup> |

\*Means followed by a common letter in a column are not significantly different at 5% level by DMRT

Table 6 shows that all the treatments were significant in causing mortality to cabbage butterfly at 48 hours. The 1:7 dilution ratios obtained the highest mean which is 1.75, this was followed by 1:5 dilution ratio with a mean of 1.25. The higher mean indicates greater number of dead cabbage butterfly larvae.

The data at 24 hours and at 72 hours however showed insignificant difference which imply that the botanical extracts are not effective against cabbage butterfly larvae. The significant difference at 48 hours maybe attributed to the different size of larvae that were used and maybe cause by the treated leaves that they had consumed at 24 hours.

Table 6. Mean number of dead cabbage butterfly larvae treated with different dilution ratio of botanical extracts at 24, 48 to 72 hours under laboratory condition

| RATIO<br>H <sub>2</sub> O: Botanicals | MEAN              |                   |                   |
|---------------------------------------|-------------------|-------------------|-------------------|
|                                       | 24H               | 48H               | 72H               |
| 1:1                                   | 0.00 <sup>a</sup> | 0.75 <sup>c</sup> | 1.00 <sup>a</sup> |
| 1:3                                   | 0.12 <sup>a</sup> | 0.62 <sup>d</sup> | 1.37 <sup>a</sup> |
| 1:5                                   | 0.37 <sup>a</sup> | 1.25 <sup>b</sup> | 1.75 <sup>a</sup> |
| 1:7                                   | 0.00 <sup>a</sup> | 1.75 <sup>a</sup> | 2.12 <sup>a</sup> |
| Untreated                             | 0.00 <sup>a</sup> | 0.25 <sup>e</sup> | 0.75 <sup>a</sup> |

\*Means followed by a common letter in a column are not significantly different at 5% level by DMRT



Table 7 presents the mean number of dead cabbage butterfly larvae after treating them with Resurrection lily and Yellow ginger treatments. The highest number of dead cabbage butterfly larvae was recorded in 1:5 dilution ratio of Resurrection lily as shown by its mean which is 2.75 at 72 hours. The higher the mean indicated higher number of dead cabbage butterfly. In Resurrection lily, 1:3 and 1:5 dilution ratio showed an effect from 24 hours while in Yellow ginger, treatments showed an effect at 48 hours, the 1:1 dilution ratio obtained the highest mean which is 1.00 at 72 hours.

Based on the statistical data, the differences among treatments were insignificant indicating further that the botanical extracts are not effective against cabbage butterfly larvae.

Table 7. Mean number of dead cabbage butterfly larvae after treating with the different treatments of Resurrection lily and Yellow ginger at 24, 48, and 72 hours under laboratory condition

| RATIO<br>H <sub>2</sub> O: Botanicals | BOTANICAL EXTRACTS |                   |                   |                   |                   |                   |
|---------------------------------------|--------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
|                                       | RESURRECTION LILY  |                   |                   | YELLOW GINGER     |                   |                   |
|                                       | 24H                | 48H               | 72H               | 24H               | 48H               | 72H               |
| 1:1                                   | 0.00 <sup>a</sup>  | 0.75 <sup>a</sup> | 1.00 <sup>a</sup> | 0.00 <sup>a</sup> | 0.75 <sup>a</sup> | 1.00 <sup>a</sup> |
| 1:3                                   | 0.25 <sup>a</sup>  | 0.50 <sup>a</sup> | 2.00 <sup>a</sup> | 0.00 <sup>a</sup> | 0.75 <sup>a</sup> | 0.75 <sup>a</sup> |
| 1:5                                   | 0.75 <sup>a</sup>  | 1.75 <sup>a</sup> | 2.75 <sup>a</sup> | 0.00 <sup>a</sup> | 0.75 <sup>a</sup> | 0.75 <sup>a</sup> |
| 1:7                                   | 0.00 <sup>a</sup>  | 1.75 <sup>a</sup> | 2.00 <sup>a</sup> | 0.00 <sup>a</sup> | 0.75 <sup>a</sup> | 0.25 <sup>a</sup> |
| Untreated                             | 0.00 <sup>a</sup>  | 0.25 <sup>a</sup> | 1.00 <sup>a</sup> | 0.00 <sup>a</sup> | 0.25 <sup>a</sup> | 0.50 <sup>a</sup> |

\*Means followed by a common letter in a column are not significantly different at 5% level by DMRT



Repellent Efficacy of the Botanical Extracts against Adult Cabbage Butterfly under Field Condition

The results in Table 8 shows that Resurrection lily and Yellow ginger extracts are highly significant in repelling adult cabbage butterfly to lay eggs on the leaves expand at 24 hours to 72 hours. The Resurrection lily shows greater repellent efficacy as shown by its lower mean from 24 to 72 hours compared to Yellow ginger. The lower mean indicates that Resurrection lily was able to prevent the adult cabbage butterfly to lay eggs on the pechay leaves.

Table 8. Mean number of cabbage butterfly eggs laid on pechay leaves sprayed with the botanical extracts at 24, 48 and 72 hours under field condition

| BOTANICAL EXTRACTS | MEAN              |                   |                    |
|--------------------|-------------------|-------------------|--------------------|
|                    | 24H               | 48H               | 72H                |
| Resurrection lily  | 1.35 <sup>b</sup> | 2.10 <sup>b</sup> | 5.80 <sup>b</sup>  |
| Yellow ginger      | 4.70 <sup>a</sup> | 8.50 <sup>a</sup> | 17.50 <sup>a</sup> |

\*Means followed by a common letter in a column are not significantly different at 5% level by DMRT

The Table 9 shows that all the treatments used were highly significant in repelling the adult cabbage butterfly. The 1:7 dilution ratio showed the greatest effect as shown by its obtained mean which is the lowest from 24 hours to 72 hours. The lowest mean indicates the lowest number of cabbage butterfly eggs. Figures 18 and 19 show cabbage butterfly eggs monitored in the plants sprayed with Resurrection lily and Yellow ginger extracts.



Table 9. Mean number of cabbage butterfly eggs laid on pechay leaves after treating with different dilution ratio of botanical extracts at 24, 48 and 72 hours

| RATIO<br>H <sub>2</sub> O: Botanicals | MEAN               |                    |                    |
|---------------------------------------|--------------------|--------------------|--------------------|
|                                       | 24H                | 48H                | 72H                |
| 1:1                                   | 3.87 <sup>b</sup>  | 5.65 <sup>b</sup>  | 11.00 <sup>b</sup> |
| 1:3                                   | 1.62 <sup>bc</sup> | 3.25 <sup>bc</sup> | 7.12 <sup>b</sup>  |
| 1:5                                   | 2.12 <sup>bc</sup> | 4.00 <sup>bc</sup> | 10.00 <sup>b</sup> |
| 1:7                                   | 0.87 <sup>c</sup>  | 1.62 <sup>c</sup>  | 6.75 <sup>b</sup>  |
| Untreated                             | 6.62 <sup>a</sup>  | 12.00 <sup>a</sup> | 23.37 <sup>a</sup> |

\*Means followed by a common letter in a column are not significantly different at 5% level by DMRT



Figure 18. Plants with cabbage butterfly eggs treated with Yellow ginger

Figure 19. Plants with cabbage butterfly treated with Resurrection lily

The Table 10 shows that at 24 hours, both the treatments of Resurrection lily and Yellow ginger were significant in repelling adult cabbage butterfly. However, small difference of mean was observed from the untreated, but at 48 hours to 72 hours, the mean in each treatment shows higher difference. The mean from 24 hours to 72 hours were increasing, it indicates that, repellent efficacy of the treatments is highly effective from 24 to 72 hours.



Table 10. Mean number of cabbage butterfly eggs laid on pechay leaves after treating with different treatment of Resurrection lily and Yellow ginger at 24, 48, 72 hours under field condition

| RATIO<br>H <sub>2</sub> O: Botanicals | BOTANICAL EXTRACTS |                   |                    |                    |                    |                    |
|---------------------------------------|--------------------|-------------------|--------------------|--------------------|--------------------|--------------------|
|                                       | RESURRECTION LILY  |                   |                    | YELLOW GINGER      |                    |                    |
|                                       | 24H                | 48H               | 72H                | 24H                | 48H                | 72H                |
| 1:1                                   | 1.25 <sub>c</sub>  | 1.50 <sup>a</sup> | 3.75 <sup>a</sup>  | 6.50 <sup>b</sup>  | 9.75 <sup>a</sup>  | 18.25 <sup>a</sup> |
| 1:3                                   | 1.00 <sub>c</sub>  | 1.00 <sup>a</sup> | 2.25 <sup>a</sup>  | 2.25 <sup>c</sup>  | 5.50 <sup>a</sup>  | 12.00 <sup>a</sup> |
| 1:5                                   | 1.75 <sub>c</sub>  | 1.75 <sup>a</sup> | 6.00 <sup>a</sup>  | 2.50 <sup>c</sup>  | 6.250 <sup>a</sup> | 14.00 <sup>a</sup> |
| 1:7                                   | 0.00 <sub>c</sub>  | 0.00 <sup>a</sup> | 2.25 <sup>a</sup>  | 1.75 <sup>c</sup>  | 3.25 <sup>a</sup>  | 11.25 <sup>a</sup> |
| Untreated                             | 2.75 <sub>c</sub>  | 6.25 <sup>a</sup> | 14.75 <sup>a</sup> | 10.50 <sup>a</sup> | 17.75 <sup>a</sup> | 32.00 <sup>a</sup> |

\*Means followed by a common letter in a column are not significantly different at 5% level by DMRT

Degree of Flea Beetle Damage on Pechay Plants after Treating with Botanical Extracts under Field Condition

Table 11 shows that the degree of damage caused by the flea beetle on pechay plants sprayed with Resurrection lily and Yellow ginger were not significantly different from each other. It shows that there is no significant difference between the botanical extracts. The heavy damaged pechay plants are shown in Figure 20 characterized by most leaves with 7-10 holes.



Table 11. Mean damage of flea beetle on pechay plants sprayed with botanical extracts at 24, 48 and 72 hours under field condition

| BOTANICAL EXTRACTS | MEAN              |                   |                   |
|--------------------|-------------------|-------------------|-------------------|
|                    | 24H               | 48H               | 72H               |
| Resurrection lily  | 1.95 <sup>a</sup> | 2.55 <sup>a</sup> | 3.00 <sup>a</sup> |
| Yellow ginger      | 1.60 <sup>a</sup> | 2.45 <sup>a</sup> | 3.35 <sup>a</sup> |

\*Means followed by a common letter in a column are not significantly different at 5% level by DMRT

Rating scale: 1- slight (1 to 3 holes per leaves), 2- moderate (4 to 6 holes per leaves);  
3- heavy, most of the leaves with 7- 10 holes , 4- severe, all the leaves with holes



Figure 20. Showing the heavy damaged pechay plants caused by flea beetle

Table 12 shows that all the treatments were highly significant in repelling the flea beetle under field condition from 24 to 48 hours however, the treatments were not significantly different. The 1:7 dilution ratio showed the highest effect since it has the lowest mean from 24 hours to 72 hours followed by 1:5 dilution ratio having a mean of 2.25. The lower the mean indicates lesser injury on the pechay plants.

Table 12. Mean damage of flea beetle on pechay plants after treating with different dilution ratio of the botanical extracts at 24, 48, and 72 hours under field condition

| RATIO<br>H <sub>2</sub> O: Botanicals | MEAN              |                    |                   |
|---------------------------------------|-------------------|--------------------|-------------------|
|                                       | 24H               | 48H                | 72H               |
| 1:1                                   | 1.62 <sup>b</sup> | 2.50 <sup>b</sup>  | 3.00 <sup>a</sup> |
| 1:3                                   | 1.50 <sup>b</sup> | 2.62 <sup>b</sup>  | 3.00 <sup>a</sup> |
| 1:5                                   | 1.75 <sup>b</sup> | 2.25 <sup>bc</sup> | 3.12 <sup>a</sup> |
| 1:7                                   | 1.00 <sup>b</sup> | 1.62 <sup>c</sup>  | 2.87 <sup>a</sup> |
| Untreated                             | 3.00 <sup>a</sup> | 3.50 <sup>a</sup>  | 3.87 <sup>a</sup> |

\*Means followed by a common letter in a column are not significantly different at 5% level by DMRT

Rating scale: 1- slight (1 to 3 holes per leaves), 2- moderate (4 to 6 holes per leaves);  
3- heavy, most of the leaves with 7- 10 holes , 4- severe, all the leaves with holes

Table 13 presents the mean damage of flea beetle on pechay plants, at 24 hours there was slight damaged on the pechay plants both in treatments of Resurrection lily and Yellow ginger as shown by their mean compared to the untreated. However, at 48 to 72 hours except for 1:7 dilution ratio, the plants treated with lower dilution ratios were considered heavy damaged similar to the untreated.

The results showed that the botanical extracts were not effective in repelling the flea beetle under field condition.



Table 13. Mean damage of flea beetle on pechay plants after treating with different treatment of Resurrection lily and Yellow ginger at 24, 48, and 72 hours under field condition

| RATIO<br>H <sub>2</sub> O: botanicals | BOTANICAL EXTRACTS |                   |                   |                   |                   |                   |
|---------------------------------------|--------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
|                                       | RESURRECTION LILY  |                   |                   | YELLOW GINGER     |                   |                   |
|                                       | 24H                | 48H               | 72H               | 24H               | 48H               | 72H               |
| 1:1                                   | 1.75 <sup>a</sup>  | 2.75 <sup>a</sup> | 3.00 <sup>a</sup> | 1.50 <sup>a</sup> | 2.25 <sup>a</sup> | 3.00 <sup>a</sup> |
| 1:3                                   | 2.25 <sup>a</sup>  | 2.50 <sup>a</sup> | 2.50 <sup>a</sup> | 0.75 <sup>a</sup> | 2.75 <sup>a</sup> | 3.50 <sup>a</sup> |
| 1:5                                   | 1.75 <sup>a</sup>  | 2.25 <sup>a</sup> | 3.00 <sup>a</sup> | 1.75 <sup>a</sup> | 2.25 <sup>a</sup> | 3.25 <sup>a</sup> |
| 1:7                                   | 1.00 <sup>a</sup>  | 1.75 <sup>a</sup> | 2.75 <sup>a</sup> | 0.75 <sup>a</sup> | 1.50 <sup>a</sup> | 3.00 <sup>a</sup> |
| Untreated                             | 3.00 <sup>a</sup>  | 3.50 <sup>a</sup> | 3.75 <sup>a</sup> | 3.25 <sup>a</sup> | 3.50 <sup>a</sup> | 4.00 <sup>a</sup> |

\*Means followed by a common letter in a column are not significantly different at 5% level by DMRT

Rating scale: 1- slight (1 to 3 leaves with holes), 2- moderate (4 to 6 leaves with holes);  
3- heavy, most of the leaves with holes , 4- severe, all the leaves with holes

#### Degree of Cabbage Butterfly Larvae Damage on Pechay Plants Sprayed with Botanical Extracts under Field Condition

The results in Table 14 showed that, both the plants treated with Resurrection lily and Yellow ginger were heavily damaged as shown by their mean, at 48 hours, Yellow ginger showed lesser damage but at 72 hours, both plants were severely damaged as shown in Figure 21 where in all leaves were damaged.

Table 14. Mean damage of cabbage butterfly larvae on pechay plants after treating with botanical extracts at 24, 48, and 72 hours under field condition

| BOTANICAL EXTRACTS | MEAN              |                   |                   |
|--------------------|-------------------|-------------------|-------------------|
|                    | 24H               | 48H               | 72H               |
| Resurrection lily  | 3.35 <sup>a</sup> | 4.00 <sup>a</sup> | 4.00 <sup>a</sup> |
| Yellow ginger      | 3.35 <sup>a</sup> | 3.75 <sup>b</sup> | 4.00 <sup>a</sup> |

\*Means followed by a common letter in a column are not significantly different at 5% level by DMRT

Rating scale: 1- slight (1 to 3 holes per leaves), 2- moderate (4 to 6 holes per leaves);  
3- heavy, most of the leaves with 7- 10 holes , 4- severe, all the leaves with holes

*Efficacy of Crude Extract of Resurrection Lily (Kaempferia galanga Linn.) Against Striped Flea Beetle (Phyllotreta striloata Fab.) and Cabbage Butterfly (Peiris rapae Linn.) Infesting Crucifers / LAOYAN, EDEN K. APRIL 2013*





Figure 21. The severely damaged pechay plants caused by cabbage butterfly larvae

The results in Table 15 shows that at 24 hours, the treatments shows significant differences from the untreated. The 1:7 dilution ratio has the lowest mean which is 3.00 indicating that it has lesser damage. The injury of cabbage butterfly larvae was rated as severe damage because all the leaves were damaged. The severe damage indicates that the botanical extracts were not effective in repelling the cabbage butterfly larvae.

Table 15. Mean damage of cabbage butterfly larvae on pechay plants after treating with different dilution ratio of the botanical extracts at 24, 48, and 72 hours under field condition

| RATIO<br>H <sub>2</sub> O: Botanicals | MEAN               |                   |                   |
|---------------------------------------|--------------------|-------------------|-------------------|
|                                       | 24H                | 48H               | 72H               |
| 1:1                                   | 3.35 <sup>c</sup>  | 3.87 <sup>a</sup> | 4.00 <sup>a</sup> |
| 1:3                                   | 3.75 <sup>ab</sup> | 4.00 <sup>a</sup> | 4.00 <sup>a</sup> |
| 1:5                                   | 3.37 <sup>bc</sup> | 3.75 <sup>a</sup> | 3.75 <sup>a</sup> |
| 1:7                                   | 3.00 <sup>c</sup>  | 3.75 <sup>a</sup> | 3.75 <sup>a</sup> |
| Untreated                             | 3.87 <sup>a</sup>  | 4.00 <sup>a</sup> | 4.00 <sup>a</sup> |

\*Means followed by a common letter in a column are not significantly different at 5% level by DMRT

Rating scale: 1- slight (1 to 3 holes per leaves), 2- moderate (4 to 6 holes per leaves); 3- heavy, most of the leaves with 7- 10 holes , 4- severe, all the leaves with holes



Table 16 shows that at 24 hours, both the plants treated with Resurrection lily and Yellow ginger treatments were heavily damaged by the cabbage butterfly larvae as shown by their means ranging between 3.00 to 3.75, however, it became severely damaged at 48 to 72 hours. The result shows that the botanical extracts were not effective in repelling the cabbage butterfly larvae under field condition. However, dead cabbage butterfly larvae were observed on the treated plants. One dead cabbage butterfly larvae in 1:5 ratio and two dead in 1:7 dilution ratio of Resurrection lily while in Yellow ginger one dead in 1:5 ratio and one dead in 1:7 dilution ratio shown in Figure 22 and Figure 23.

Table 16. Mean damage of cabbage butterfly larvae on pechay plants after treating with different treatments of Resurrection lily and Yellow ginger at 24, 48, and 72 hours under field condition

| RATIO<br>H <sub>2</sub> O: botanicals | BOTANICAL EXTRACTS |                   |                   |                   |                   |                   |
|---------------------------------------|--------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
|                                       | RESURRECTION LILY  |                   |                   | YELLOW GINGER     |                   |                   |
|                                       | 24H                | 48H               | 72H               | 24H               | 48H               | 72H               |
| 1:1                                   | 3.00 <sup>a</sup>  | 4.00 <sup>a</sup> | 4.00 <sup>a</sup> | 3.50 <sup>a</sup> | 3.75 <sup>a</sup> | 3.75 <sup>a</sup> |
| 1:3                                   | 3.50 <sup>a</sup>  | 4.00 <sup>a</sup> | 4.00 <sup>a</sup> | 4.00 <sup>a</sup> | 4.00 <sup>a</sup> | 4.00 <sup>a</sup> |
| 1:5                                   | 3.50 <sup>a</sup>  | 4.00 <sup>a</sup> | 4.00 <sup>a</sup> | 3.25 <sup>a</sup> | 3.50 <sup>a</sup> | 4.05 <sup>a</sup> |
| 1:7                                   | 3.00 <sup>a</sup>  | 4.00 <sup>a</sup> | 4.00 <sup>a</sup> | 3.00 <sup>a</sup> | 3.50 <sup>a</sup> | 3.50 <sup>a</sup> |
| Untreated                             | 3.75 <sup>a</sup>  | 4.00 <sup>a</sup> | 4.00 <sup>a</sup> | 4.00 <sup>a</sup> | 4.00 <sup>a</sup> | 4.00 <sup>a</sup> |

\*Means followed by a common letter in a column are not significantly different at 5% level by DMRT

Rating scale: 1- slight (1 to 3 holes per leaves), 2- moderate (4 to 6 holes per leaves);  
3- heavy, most of the leaves with 7- 10 holes , 4- severe, all the leaves with holes







Figure 22. Dead cabbage butterfly larvae in plants treated with resurrection lily



Figure 23. Dead cabbage butterfly larvae in plants treated with yellow ginger

### Phytotoxicity of Resurrection Lily and Yellow Ginger

The degree of phytotoxicity on pechay plants as affected by the application of the botanical extracts is presented in Table 17. Based on the statistical data, both the resurrection lily and yellow ginger treatments has a slight injury effect on pechay plants as shown by their mean.

Table 17. Degree of phytotoxicity on pechay plants as affected by the application of the botanical extracts

| BOTANICAL INSECTICIDES | MEAN              |
|------------------------|-------------------|
| Resurrection lily      | 0.95 <sup>a</sup> |
| Yellow ginger          | 0.70 <sup>a</sup> |

\*Means followed by a common letter in a column are not significantly different at 5% level by DMRT

Rating scale: 1-no crop injury, 3- 4-10% crop injury, 5- 11-20% crop injury, 7- 21-30% crop injury, 9-above 30% crop injury

The result shows that the 1:7 dilution ratio has the highest phytotoxicity effect as shown by its mean which is 3.00 or 10% phytotoxicity on pechay plants while the 1:3 and 1:5 dilution ratio has lower phytotoxicity effect. The 1:1 dilution did not show any phytotoxicity effect. The higher the mean indicates higher phytotoxicity effect on the pechay plants.

Table 18. Degree of phytotoxicity on pechay plants as affected by the application of the different dilution ratio of botanical extracts

| RATIO<br>H <sub>2</sub> O: Botanicals | MEAN              |
|---------------------------------------|-------------------|
| 1:1                                   | 0.00 <sup>c</sup> |
| 1:3                                   | 0.37 <sup>c</sup> |
| 1:5                                   | 1.25 <sup>b</sup> |
| 1:7                                   | 3.00 <sup>a</sup> |
| Untreated                             | 0.00 <sup>c</sup> |

\*Means followed by a common letter in a column are not significantly different at 5% level by DMRT  
 Rating scale: 1-no crop injury, 3- 4-10% crop injury, 5- 11-20% crop injury, 7- 21-30% crop injury, 9-above 30% crop injury

As shown in Table 18, the Resurrection lily and Yellow ginger treatments were not significantly difference from each other. A rating of three was recorded in both 1:7 dilution ratio of Resurrection lily and Yellow ginger indicating they have 10% phytotoxicity on pechay plants. However a rating of 28% and 30% was recorded in the plants treated with 1:7 dilution of both Resurrection lily and Yellow ginger. It was described by having a scattered burn on the surface of the leaves as shown in Figure 24 and Figure 25.





Table 18. Degree of phytotoxicity on pechay plants as affected by the application of the different treatments of Resurrection lily and Yellow ginger

| RATIO<br>H <sub>2</sub> O: Botanicals | BOTANICAL EXTRACTS |                   |
|---------------------------------------|--------------------|-------------------|
|                                       | RESURRECTION LILY  | YELLOW GINGER     |
| 1:1                                   | 0.00 <sup>a</sup>  | 0.00 <sup>a</sup> |
| 1:3                                   | 0.75 <sup>a</sup>  | 0.00 <sup>a</sup> |
| 1:5                                   | 1.50 <sup>a</sup>  | 1.00 <sup>a</sup> |
| 1:7                                   | 3.00 <sup>a</sup>  | 3.00 <sup>a</sup> |
| Untreated                             | 0.00 <sup>a</sup>  | 0.00 <sup>a</sup> |

\*Means followed by a common letter in a column are not significantly different at 5% level by DMRT

Rating scale: 1-no crop injury, 3- 4-10% crop injury, 5- 11-20% crop injury, 7- 21-30% crop injury, 9-above 30% crop injury



Figure 24. The phytotoxicity effect of Yellow ginger on pechay plants rated as 28% injury



Figure 25. The phytotoxicity effect of Resurrection lily on pechay plants rated as 30% injury

#### Evaluation on Mortality of Test Insect

The dead flea beetle due to Resurrection lily and Yellow ginger were normally the same in size and color, however, it was observed that there three pairs of legs were stretch upward.

Dead cabbage butterfly caused by resurrection lily is characterized with a black color on the insect body. The color became dark and it has a soft body. It was also observed that their dead body positioned like a letter U shaped (Figure 26).

The dead cabbage butterfly due to Yellow ginger was similarly characterized with a black color and soft body however dead body of insect were straight (Figure 27).



Figure 26. Appearance of dead cabbage butterfly larvae caused by Resurrection lily



Figure 27. Appearance of dead cabbage butterfly larvae caused by Yellow ginger





Figure 28. Healthy cabbage butterfly larvae

#### Mode of Action of Resurrection Lily and Yellow Ginger

The mode of action of Resurrection lily and Yellow ginger is either dual mode or a single type of action and these are the stomach or repellent.

The mode of action of Resurrection lily and Yellow ginger crude extracts against flea beetle and cabbage butterfly could not be determined due to small number of recorded mortality. However, in adult cabbage butterfly, the mode of action was evaluated as repellent.

## SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

### Summary

The flea beetles and cabbage butterfly are one of the most insect pest problems of farmers due to their heavy infestation on crucifers. The study was conducted to find out if Resurrection lily and Yellow ginger extracts can cause mortality or repel the flea beetle and cabbage butterfly. It also aimed to identify the degree of damage of this insect pest to pechay plants; the mode of action and phytotoxicity effect of Resurrection lily and Yellow ginger extracts to pechay plants. Mortality effect was conducted under laboratory condition while repellent efficacy test was under field condition.

The efficacy of the Resurrection lily and Yellow ginger were determined using the extract at different dilution ratio as follows: 1:1, 1:3, 1:5 and 1:7.

Based on the results, the botanical extracts were not significant in causing mortality in flea beetle. The Resurrection lily and Yellow ginger treatments has slight repellent efficacy against flea beetle in field condition expand from 24 to 48 hours. In terms of cabbage butterfly, both Resurrection lily and Yellow ginger has slight killing effect against cabbage butterfly larvae with 1:5 and 1:7 dilution ratio under laboratory condition. In terms of repellent efficacy, both Resurrection lily and Yellow ginger treatments are highly significant in repelling the adult cabbage butterfly from 24 to 72 hours with 1:1 dilution ratio.

The mode of action of the botanical extracts was evaluated as repellent in adult cabbage butterfly. The degree of flea beetle on pechay plants was heavy damage while severely damage on cabbage butterfly larvae. The 1:7 dilution ratio of the botanical insecticides shows 10% phytotoxicity on pechay plants.



## Conclusions

The Resurrection lily and Yellow ginger extracts are not effective in causing mortality and repelling adult flea beetle. The botanical insecticides were slightly effective in killing cabbage butterfly larvae using 1:5 dilution ratio under laboratory condition. The Resurrection lily and Yellow ginger treatments are highly significant in repelling adult cabbage butterfly using the dilution ratio of 1:1 dilution ratio from 24 to 72 hours under field condition.

## Recommendations

The Resurrection lily and Yellow ginger extracts are recommended to repel the adult cabbage butterfly at 1:1 dilution ratio. Further study maybe conducted by using other dilution rate or on other insect pest. The efficacy of the stored plants extracts at different duration may also be conducted.



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