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Original Research Article

Study the Pest Repellant Action of *Abelmoschus esculentus* (Okra) and *Solanum melongena* (Egg-Plant) as Affected by Application of Different Concentration of Wood Vinegar / Pyroligneous Acid Produced by Using Different Wood Species

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ABSTRACT

Natural extracts like pyroligneous acid (wood vinegar) is evaluated for pest repellant action of *Abelmoschus esculentus* and *Solanum melongena*. Wood species as *Gliricidia sepium*, *Cinnamomum zeylanicum*, *Acacia leucophloea*, and *Azadirachta indica* used for preparation of pyroligneous acids from different concentrations such as 0%, 0.25%, 0.50%, 0.75%, 1.0% for the experiment. Pyroligneous acid applied as foliar spray with one week intervals when the plant is having four to five leaves per each plant. Pyroligneous acids from different wood species were not significant but *Azadirachta indica* wood species showed lower mean values of pest attacks as 1st week 1.05 ± 0.11 , 2nd week 2.05 ± 0.16 , 3rd week 2.75 ± 0.18 and 4th week 3.25 ± 0.17 for the *Abelmoschus esculentus* plant. Pyroligneous acids from different concentrations were significant except the 1st week. Mean values for the pest attacks explain as 1st week 0.81 ± 0.03, 2nd week 1.50 ± 0.07, 3rd week 2.12 ± 0.09 and 4th week 2.31 ± 0.11 for the *Abelmoschus esculentus* plant. Interaction effect was not significant in all weeks. Also for the *Solanum melongena*, pyroligneous acids from different wood species were not significant but the pyroligneous acids from *Azadirachta indica* wood species were having lower mean value of pest attacks. It can described as 1st week 0.70 ± 0.10, 2nd week 1.50 ± 0.12, 3rd week 2.05 ± 0.16 and 4th week 2.40 ± 0.17. *Solanum melongena* plants also showed same actions for the different concentrations of pyroligneous acids were significant.

Keywords: Pyroligneous acid, Pest repellant, Wood species, Concentrations, Synthetic, Chemicals

INTRODUCTION

Okra (*Abelmoschus esculentus* L.*:* Malvaceae) and egg-plant (Brinjal: *Solanum melongena* L.: Solanaceous) are important vegetable crops grown in Sri Lanka. These crops are damaged by a number of insect, mite pests and several fungal pathogens. As such, farmers rely heavily on synthetic pesticides for the control of these pests and diseases. [1] Farmer surveys have revealed that an average of 15 -20 insecticide applications are done only for the control shoot and fruit borer (*Leucinodes orbonalis*) in egg-plants within one crop cycle. [2] By using the pesticides in vegetable cultivations especially on okra plant will affect human health in adversely manner. [3] Therefore, efforts are been made to develop farmer, consumer and environment friendly alternate strategies to manage these pests and diseases. Pyroligneous acid (Wood vinegar) is known to have pest repellent and

disinfectant properties that can be used in protecting crops from pest and disease causing organisms. [4]

According to the Tiilikkala, he supposed that risks arising from leaching pesticide to groundwater and water ways should minimize globally and it encourages using the wood vinegar as a biocide and pesticide. [5] Extraction of Pyroligneous acids can be done through pyrolysis of woody plant material even at household level. In 2004, herbicides accounted for 45.4% of the agrochemical market, followed by insecticides 27.5%, fungicides 21.7% and other products 5.4%. [6] Latest reports indicate that the use of natural product and natural product-derived insecticides continue to increase, vise-versa sales of organophosphates are declining. It was proved by most commonly used insecticides classes such as neonicotinoids and pyrethroids are natural product or natural product-driven products which is accounting for 19.5%, 15.7%, and other natural insecticides accounting for 7.6% of the combined worldwide sales. [6]

MATERIALS AND METHODS

The experiments were carried at the University of Colombo Institute for Agro technology and Rural Sciences, Weligatta, Hambanthota, Southern Sri Lanka. *Abelmoschus esculentus* (Okra) variety "Shanthi" and *Solanum melongena* (egg-plant) variety "Lena iri" were used for the experiment. Four different wood species namely *Gliricidia sepium* (Gliricidia) *Cinnamomum zeylanicum* (Cinnamon), *Acacia leucopholea* (Katuandara) and *Azadirachta indica* (Kohomba) were selected as sources of pyroligneous acids. Purified pyroligneous acids were diluted with water to obtain 0.25%, 0.50%, 0.75% and 1% concentrations as treatments. Pyroligneous acid treatments were applied to the surface of the leaves with one week intervals when the *Abelmoschus esculentus* and *Solanum melongena* is having four to five leaves per each plant.

Extraction of pyroligneous acids

A 200L capacity metal barrel was used as improvised equipment for thermal decomposition of the selected plant material under inert atmosphere and the resulting volatiles were passed through a condenser to collect pyroligneous acids of the plants.

Test plants of Abelmoschus esculentus and Solanum melongena

Polythene bags were (20cm diameter and 30cm height) were filled Potting media consisting of top soil, sand and compost into 1:1:1 proportion. Twenty bags were seeded with *Abelmoschus esculentus* variety "Shanthi" at the rate of three-seeds per pot. Similarly twenty polysac bags were planted with 3-week-old seedlings of *Solanum melongena* at the rate of three seedlings per pot. The poly sac bags were kept in an open area with a spacing of 60 X 75 cm. All other management practices were carried as per the recommendations of the Department of Agriculture. [7,8]

Experimental design and treatment application

When the plants were 5-leaf stage the extracted pyroligneous acids were sprayed separately to the plants. The treatments were sprayed at the rate of four pots/ each concentration for both crops. Only water was sprayed for the un-treated control pots. The spraying was done once a week until the completion of fruiting cycle.

Data collection

Data was collected with one week interval after application of treatments. Pest repellant action was measured by the mean number of pest attacks to the both type of crops. All plants were subjected to the data collection.

Data analysis/Statistical method

The statistical packages of SAS used for analysis of data. Data analyzed using ANOVA and DMRT for the mean separations.

RESULTS AND DISCUSSION

Impact of wood vinegar from different wood species and different concentrations on pest repellant action of Abelmoschus esculentus plant

Table 1. Mean values for the all treatment combinations for number of pest attacks of *Abelmoschus esculentus* plants after application of treatment in weeks

Treatments	Mean number of pest attacks of *Abelmoschus esculentus* plant				Total
	1st week	2nd week	3rd week	4th week	
C_1	2.55 ± 0.10 a	2.40 ± 0.16 ab	2.95 ± 0.16 a	3.35 ± 0.19 a	2.81
C_2	1.45 ± 0.10 a	2.60 ± 0.15 ab	3.35 ± 0.17 a	3.80 ± 0.21 a	2.80
C_3	1.75 ± 0.10 a	2.85 ± 0.16 a	3.45 ± 0.16 a	3.85 ± 0.16 a	2.97
C_4	1.05 ± 0.11 a	2.05 ± 0.16 b	2.75 ± 0.18 a	3.25 ± 0.17 a	2.27
L_1	2.50 ± 0.08 a	4.19 ± 0.10 a	4.75 ± 0.13 a	5.25 ± 0.12 a	4.17
L_2	1.44 ± 0.06 a	2.31 ± 0.11 b	3.19 ± 0.13 b	3.69 ± 0.16 b	2.65
L_3	2.62 ± 0.09 a	2.25 ± 0.14 b	2.87 ± 0.15 bc	3.50 ± 0.18 b	2.81
L_4	1.12 ± 0.08 a	2.12 ± 0.13 b	2.68 ± 0.14 bc	3.06 ± 0.16 bc	2.24
L_5	0.81 ± 0.03 a	1.50 ± 0.07 b	2.12 ± 0.09 c	2.31 ± 0.11 c	1.68
c	ns	ns	ns	ns	
l	ns	s	s	s	
c*l	ns	ns	ns	ns	

** Means with the same letter(S) are not significantly different from each other according to DMRT at 5% significant level*
** The values are the means ± standard error of 80 plants in four replications.*
** s/significant , ns/not significant*
** Where; C_1- Gliricidia sepium, C_2- Cinnamomum zeylanicum, C_3- Acacia leucophloea, C_4- Azadirachta indica, L_1-0% WV, L_2-0.25% WV, L_3-0.5% WV, L_4-0.75% WV, L_5-1% WV.*

Table from the above revealed that number of pest attacks increasing with the time when plant is growing with many number of leaves and others. Pyroligneous acids from *Azadirachta indica* species have shown a great reduction of pest attacks when compared to the other wood species. Data from overhead table discovered that pyroligneous acid from different wood species are not significant (P value>0.05) in every week after application of treatments. But for the concentrations it gave totally opposite results when compared with different wood species. It is revealed that pyroligneous acids from different concentrations are significant (P value<0.05) in every week after treatment application. Moreover Hangner confirmed that wood vinegar (WV) exhibited a clear repellent effect against mollusks. [9] Also Rahmat declared that mixing and fuming application of 5ml wood vinegar as a pest insect repellent on 200g of maize on storage could increase the number of dead maize weevil and reduce the damage maize kernel. [10] When consider the treatment combinations of pyroligneous acids from different wood species and different concentrations are not significant (P value>0.05) in every week.

Impact of wood vinegar from different wood species and different concentrations on pest repellant action of Solanum melongena

Table 2. Mean values for the all treatment combinations for number of pest attacks of *Solanum melongena* plants after application of treatment in weeks

Treatments	Mean number of pest attacks of *Solanum melongena*				Total
	1st week	2nd week	3rd week	4th week	
C_1	0.35 ±0.08 b	1.20 ± 0.12 a	1.85 ± 0.15 a	2.15 ± 0.17 a	1.39
C_2	0.30 ± 0.07 b	1.45 ± 0.12 a	2.20 ± 0.14 a	2.65 ± 0.18 a	1.65
C_3	0.90 ± 0.11 a	1.90 ± 0.12 a	2.15 ± 0.15 a	2.40 ± 0.16 a	1.84
C_4	0.70 ± 0.10 ab	1.50 ± 0.12 a	2.05 ± 0.16 a	2.40 ± 0.17 a	1.66
L_1	1.00 ± 0.06 c	2.25 ± 0.10 a	2.81 ± 0.14 b	3.31 ± 0.14 a	2.34
L_2	0.87 ± 0.11 ab	1.75 ± 0.14 ab	2.56 ± 0.15 ab	3.06 ± 0.16 a	2.06
L_3	0.44 ± 0.07 bc	1.31 ± 0.14 b	1.94 ± 0.16 abc	2.44 ± 0.16 ab	1.53
L_4	0.19 ± 0.04 c	1.19 ± 0.05 b	1.69 ± 0.10 bc	1.81 ± 0.12 bc	1.22
L_5	0.31 ± 0.05 c	1.06 ± 0.10 b	1.31 ± 0.10 c	1.37 ± 0.10 c	1.01
c	ns	ns	ns	ns	
l	s	s	s	s	
c*l	ns	ns	ns	ns	

** Means with the same letter(S) are not significantly different from each other according to DMRT at 5% significant level*
** The values are the means ± standard error of 80 plants in four replications.*
** s/significant , ns/not significant*
** Where; C_1- Gliricidia sepium, C_2- Cinnamomum zeylanicum, C_3- Acacia leucophloea, C_4- Azadirachta indica, L_1-0% WV, L_2-0.25% WV, L_3-0.5% WV, L_4-0.75% WV, L_5-1% WV.*

From above table we can revealed that number of pest attacks increasing with the time when plant is growing with many number of leaves and others. Pyroligneous acids from *Acacia leucophloea* species have shown a great reduction of pest attacks when compared to the other wood species. According to the above table pyroligneous acids from different wood species against the mean number of pest attacks are not significant (P value>0.05) at 2nd, 3rd and 4th weeks. But at the 1st week it is significant (P value<0.05). When consider the pyroligneous acids from different concentrations it is all significant (P value<0.05) in every week. In treatment combinations of pyroligneous acids from different wood species and different concentrations against the mean number of pest attacks are not significant (P value>0.05) in every week.

CONCLUSIONS

It could be concluded that, above mentioned wood species can be used to induce pest repellent characteristic and with the increasing levels of concentrations as same as effects also increased. Even though the application of different types of pyroligneous acids with different concentrations, 1% concentration level showed highest values in pest repellent characteristics.

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REFERENCES

1. Schreinemachers P, Sringarm S, Sirijinda A. The role of synthetic pesticides in the intensification of highland agriculture in Thailand. Crop Protection. 2011; 30(11):1430-1437.
2. Krithika BN, Ananthanarayana SR. Effect of certain plant extracts on the life cycle of leucinodes orbonalis (guenee): a comparative study. International Journal of Current Research. December, 2017; Vol. 9, Issue, 12, pp.62253-62255.
3. Wagan T. A., Khaskheli M. I., Abbasi Q. D., Jiskani M. M., Wagan S. A. Effect of Irrational Use of Pesticides on Insect Pests and Yield of Okra. Journal of Biology, Agriculture and Healthcare. 2014; Vol.4 (No.25).
4. Kim D, Seo H, Lee S, Lee K. Effects of wood vinegar mixted with insecticides on the mortalities of nilaparvata lugensandlaodelphax striatellus(homoptera: Delphacidae). Animal Cells and Systems. 2008; 12(1):47-52.
5. Tiilikkala K, Fagernäs L, Tiilikkala J. History and Use of Wood Pyrolysis Liquids as Biocide and Plant Protection ProductHistory and Use of Wood Pyrolysis Liquids as Biocide and Plant Protection Product. The Open Agriculture Journal. 2010; 4(1):111-118.
6. Dayan F, Cantrell C, Duke S. Natural products in crop protection. 2009; 4022–4034.
7. Okra [Internet]. Doa.gov.lk. 2019 [cited 6 February 2019]. Available from: https://www.doa.gov.lk/HORDI/index.php/en/crop-2/20-okra
8. Brinjal [Internet]. Doa.gov.lk. 2019 [cited 6 February 2019]. Available from: https://www.doa.gov.lk/HORDI/index.php/en/crop-2/14-brinjal
9. Hagner, M. (2013). Potential of the slow pyrolysis products birch tar oil, wood vinegar and biochar in sustainable plant protection: pesticidal effects, soil improvement and environmental risks.
10. Rahmat B, Pangesti D, Natawijaya D, Sufyadi D. Generation of Wood-waste Vinegar and Its Effectiveness as a Plant Growth Regulator and Pest Insect Repellent. BioResources. 2014;9(4) : 6350-6360.

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