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Efficacy of selected plant extracts in the okra pest, *Zonabris pustulata* (Thunberg)

Jeyaparvathi S.* and Umayal Parvathi M.

Department of Zoology, Ayya Nadar Janaki Ammal College, Sivakasi – 626 124, Tamil Nadu, India.

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The mortality of *Zonabris pustulata* with varied concentration of plant extracts was analyzed. For instance, high pesticidal activity was recorded from the crude extracts of *Azadirachta indica*, *Ocimum sanctum*, *Cynodon dactylon*, *Calotropis gigantea* and *Acalphya indica*. The mortality of *Z. pustulata* which occurred in the *A. indica* extract increased with increased concentration of plant extracts at 48 and 72 h. During 24 h, at 2.0% concentration, there was no mortality and highest mortality was occurring during 10.0% concentration. In 4.0 and 6.0% concentrations, there were no changes in the mortality of beetle. In 72 h, highest mortality was occurring at 2.0, 10.0 and crude extracts. There was no mortality occur in the control. The highest mortality occurred during 48 h (1.71 ± 1.28), and the lowest mortality occur during 72 h (1.29 ± 0.7). The highest mortality of *Z. pustulata* occurs at 2.0 and 4.0% from 24 to 72 h in the *C. gigantea* extract treatment. The highest mortality occurred at 24 h (2 ± 1.31) followed by 48 h (1.86 ± 1.55) and the lowest mortality occurs at 72 h (1.28 ± 0.88). At 24 and 48 h, there was no mortality at 2.0, 4.0, 6.0, 8.0 and 10.0%. At 24 h the mortality occurs at 4.0 and 10.0%. The highest mortality occurs at crude extract treatment. At 48 h, the death rate increased at 8.0% concentration. The highest mortality occurs at 72 h (2±1.31) followed by 48 h (1.14 ± 1.25) and the lowest mortality occurs at 24 h (0.57 ± 0.73).

Key words: Botanicals, pesticide, insecticides, pests, plant extracts.

INTRODUCTION

Plant based insecticides (PBI) have been used for many centuries (Jacobson, 1958, 1975) among limited resource farmers in developing countries to control insect pests of both field crops and stored produce, but their potential was initially limited and ignored. Some of these plant species possess one or more useful properties such as repellence, antifeedant, fast knock down, flushing action, biodegradability, broad-spectrum of activity and ability to reduce insect resistance (Olaifa et al., 1987; Stoll, 1988). However, most of them are either weak insecticidal or may require other plant species with different mode of action to increase their potency (Singh and Singh, 1991; Oparaeke, 2004). Many insect pests have developed resistance to chemical pesticides, and a number of beneficial insects that are natural enemies of the pests have disappeared. Subsistence farming is predominant in the rural areas of the developing world where it directly employs 50 to 70% of the population. Its' contribution to local and regional food security is crucial since they produce most of the stable food crops (Altieri, 1993; MacKay et al., 1993; Tefera, 2004). However, it experiences several crop production and protection challenges such as diseases, insect Pests, poverty, access to credit, and education level among others (Saxena et al., 1990; Altieri, 1993).

*Corresponding author. E-mail: sjpwomenscientist@gmail.com.

MATERIALS AND METHODS

Plant materials

The plant materials used in the trials including leaves of *Azadirachta indica*, *Ocimum sanctum*, *Cynodon dactylon* (L.), *Calotropis gigantea* and *Acalphya indica* (L.) were collected from different areas of Sivakasi, Virudhunagar district, Tamil Nadu, India and stored in plastic containers at a storehouse. The leaves were placed in a shady place (30 ± 5°C) and left to dry. The leaves were then crushed into a fine powder and stored in an air-tight container until use. Five different extracts were prepared by using Soxhlet apparatus. The extracts of *A*. *indica*, *O*. *sanctum*, *C*. *dactylon*, *C*. *gigantea* and *A*. *indica* were prepared by weighing 50 g each of the leaf powders.

Preparation of plant extraction

The leaves were shadow dried at room temperature and powdered by using a preeti mixie. Then the powered material has been extracted by using the soxlet apparatus with acetone solvent. After the completion of the extraction, one gram of residual extract were weighed and dissolved with little amount of acetone.

Soxhlet extraction

In this method, 50 g of leaves were extracted in 500 ml acetone by soxhlet extraction technique for 8 h. The extracts were filtered and filtrate was evaporated under reduced pressure to obtain crude.

Preparation of different concentration of test solution

Different concentration of test solution were prepared by taking required amount of the test solution and diluted with required volume of tap water to get the required test concentrations botanicals (2, 4, 6, 8 and 10%).

Insect collection

The adults of *Z*. *pustulata* (L.) (Plate 6) were also collected from the okra plants of Sivakasi, Virudhunagar district, Tamil Nadu, India and they were reared in one litre glass jars in laboratory. To allow air passage, a whole 2 cm in diameter was opened in the centre of each jar lid, and a sterile cloth was glued to the underside of each lid. Throughout the experiments insect cultures were maintained at constant temperature (32 ± 1°C), photoperiod (13L: 11D) and relative humidity (60 ± 5%).

Insecticidal activity

In order to test the toxicity of botanicals on the adults (< 24 h) of *Z*. *pustulata*, ten adults were put into the one litre plastic containers. Botanicals were applied on flowers surface at different concentrations. The same procedure was applied for the adults (< 48 h and < 72 h) of *Z*. *pustulata*. All the insecticidal activity experiments were conducted at constant temperature (32°C), photoperiod (13L: 11D) and relative humidity (60%). The adults of *Z*. *pustulata* were exposed to botanicals (2; 4; 6; 8 and 10%) for 24, 48 and 72 h. However, because of high tolerance of *Z*. *pustulata* adults were treated with crude extract also. A dose-mortality line depending on the exposure time(s) was developed. Ten replicates were set up for each dose and exposure time. A complete set of controls was maintained and replicated ten times for each treatment. All replicates ran simultaneously during the experiments.

The number of dead insect in each concentration was noted. The mean value ± SD were calculated by using statistical methods and the results were tabulated. The data obtained were subjected to statistical analysis:

Standard deviation (σ) = $\sqrt{\Sigma d^2}$

Where, Σ = sum of total deviation; d = deviation from actual mean; n = total number of analysis

RESULTS AND DISCUSSION

The results of the total mortality of *Z. pustulata* were treated with different plant extracts like *A*. *indica*, *O*. *sanctum*, *C. dactylon*, *C*. *gigantea* and *A. indica* presented in Figures 1 to 6. The concentration of the plant extracts such as 2.0, 4.0, 6.0, 8.0 and 10.0% were used. The results showed that, the mortality of *Z. pustulata varied* with varied concentration of plant extract. For instance, high pesticidal activity was recorded from the crude extracts of *A*. *indica*, *O*. *sanctum*, *C. dactylon*, *C*. *gigantea* and *A. indica*. The mortality of *Z. pustulata* occurs in the *A*. *indica* extract increased with increased concentration of plant extracts at 48 and 72 h. During 24 h, at 2.0% concentration, there was no mortality and highest mortality was occurring during 10.0% concentration. In 48 h, at 4.0% concentration, there was no mortality but after that the mortality of insect beetle were gradually increased during 6.0, 8.0, 10.0% and crude extract treatment (Figure 1). The mortality different depends on time to time and hours to hours. The highest mortality occurs at 24 h (2 ± 1.31) followed by 48 h (1.86 ± 1.55) and the lowest mortality occurs at 72 h (1.28 ± 0.88) (Table 1). The insecticidal constituents of many plant extracts and essential oils are monoterpenoids. Due to their high volatility they have fumigant activity that might be of importance for controlling stored-product insects (Konstantopoulou et al., 1992; Regnault-Roger and Hamraoui, 1995; Ahn et al., 1998). In my result also, the botanical pesticides reduced the population of *Z*. *pustulata* at different concentration levels of 2.0, 4.0, 6.0, 8.0 and10.0%. In related experiments, Roy et al. (2005) demonstrated the effectiveness of a botanical leaf extract of Blumea lacera Dc. against the lesser grain borer, obtaining the highest repellency percentage of 57.41 at 3% extract concentration. Earlier, Reddy et al. (1990) reported that petroleum ether (1%) extracts of *Azadirachta indica* A. Juss and *Annona squamosa* L., reduced the number of *H*. *vigintiocto punctata* larvae infesting brinjal. Similarly, Rao et al. (1990) recorded that extracts of *Annona squamosa* L., *Argemone mexicana* L., *Calotropis gigantea* Ait., *Datura stramonium* L., *Ecalyptus globulus* Labill, *Pongamia glabra* Vent and *Ricinus communis* L. (0.5%) gave cent percent protection against second instar larvae of *H*. *vigintioctopunctata* indicating high anti-feedant effect. The mortality of *Z*. *pustulata* occurs, when treated with the neem (*A*. *indica*) extract.

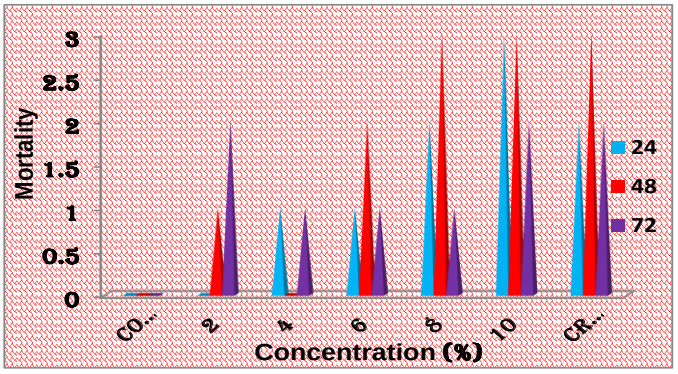

Figure 1. Mortality (%) of *Z. pustulata* treated with *A. indica.*

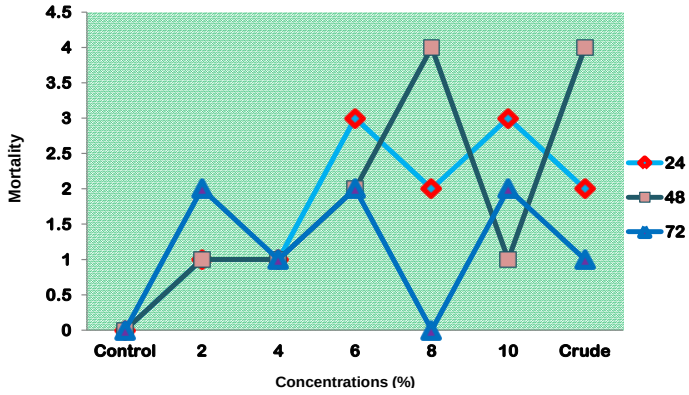

Figure 2. Mortality (%) of *Z. pustulata* treated with *O. sanctum.*

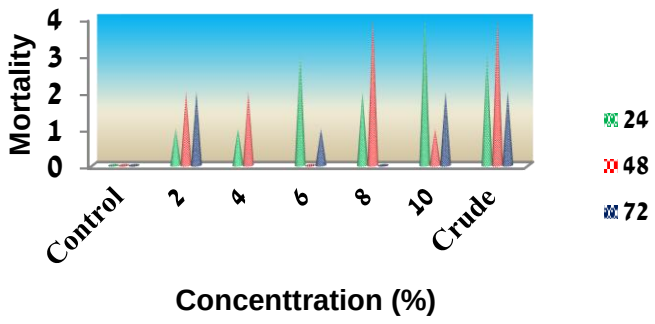

Figure 3. Mortality (%) of *Z. pustulata* treated with *C. gigantiga.*

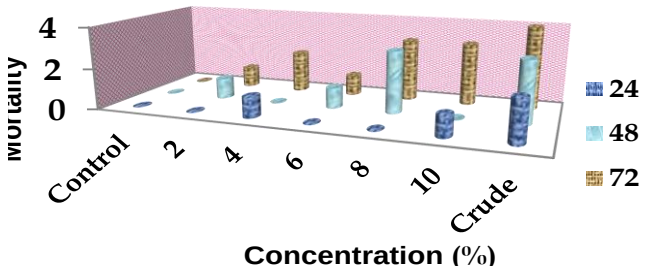

Figure 4. Mortality (%) of *Z. pustulata* treated with *A. indica.*

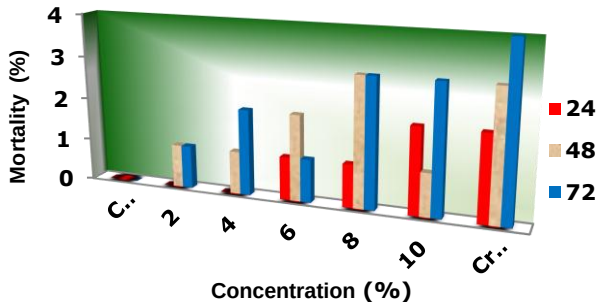

Figure 5. Mortality (%) of *Z. pustulata* treated with *C. dactylon.*

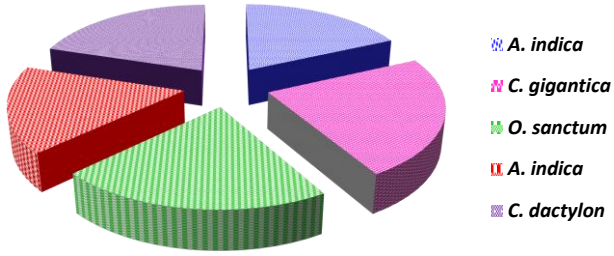

Figure 6. Mortality (%) of *Z. pustulata* treated with selected botanicals.

Table 1. Mortality of Z. *pustulata* adults (Mean ± S. D) treated with selected plant products

Botanicals	Leaf feeding in hours		
	24	48	72
A. indica	1.29 ± 1.03	1.71 ± 1.28	1.29 ± 0.7
C. gigantica	2 ± 1.31	1.86 ± 1.55	1.28 ± 0.88
O. sanctum	1.71 ± 1.30	1.86 ± 1.46	1.14 ± 0.83
A. indica	0.57 ± 0.728	1.14 ± 1.25	2 ± 1.31
C. dactylon	0.86 ± 0.83	1.57 ± 1.04	2 ± 1.31

According to Markandeya et al. (2001) studying the anti-feedant activity and mortality of *H. vigintiocto punctata* on aubergine leaves treated with biotox (*B. thuringiensis*) observed that the average leaf area consumed after 48 h by each grub was only 5.05 cm^2. We also observed that the mortality of *Z. pustulata* occurs, when treated with Tulsi (*O. sanctum*) extract. The death rate increased with different concentration levels. The same result was observed by Sevastopulo (1956a). Similarly, Rao et al. (1990) recorded that extracts of *A. squamosa*, *Argemone mexicana* L., *C. gigantea*, *Datura stramonium* L., *Ecalyptus globulus* Labill, *Pongamia glabra* Vent and *Ricinus communis* L. (0.5%) gave cent percent protection against second instar larvae of *H. vigintiocto punctata* indicating high anti-feedant effect. The higher mortality of *Z. pustulata* observed when treated with *C. dactylon*

extract. Neem products have shown activity on a wide range of insect pests of many crops worldwide, and its derivatives are known to have distinct antifeedant and growth inhibitory effects (Schmutterer et al., 1980; Schmutterer, 1981; 1985; 1990; Jacobson, 1986; Saxena, 1989; NRC, 1992; Kleeberg and Zebitz, 2000). In Africa, there have been more investigations with neem on postharvest pests than on any other group, but there are a few exceptions. Field pests of arable crops have been researched more recently, especially in the tropics where the tree grows naturally (Schmutterer, 1985; Saxena, 1987). Botanical pesticides from neem tree (*A. indica*) have good potential for widespread application and can be applied either as a farmers' recipe (crude extract) or as a standardized industrial formulation (Bruan, 2000). The mortality of *Z. pustulata* occurs when treated with the extract of *A. indica* at different concentration level. Difference of percent yield of extraction product among different extractions might be due to difference in solvents used and the solubility of various ingredients and method and type of extraction used (Debela, 2002). Chemical evaluation of different extracts of all four plants was conducted by various chemical tests to know the active principal present in different extracts (Paech and Tracy, 1955). In *Calotropis procera* (leaves) methanolic extract alkaloids, flavonoids, and tannins were identified in methanolic extract while in case of methanolic extract of *Chenopodium album* (seeds) alkaloids, saponins, glycosides, fixed oils and tannins were present (Mahour et al., 2008).

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