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TOXICITY OF CARBOFURAN AND GAMMA-BHC TO THE SPIDERLINGS OF THE WOLF SPIDER, LYCOSA PSEUDOANNULATA BOES. ET STR. (ARANEAE: LYCOSIDAE)[1]

R. M. Lucero and R. S. Raros[2]

LD_{50} values of carbofuran and gamma-BHC on spiderlings of Lycosa pseudoannulata **Boes. et Str. were determined by topical application as follows: 1) per 1-week old spiderling — carbofuran, 1.967 mg/kg; gamma-BHC, 23.621 mg/kg; 2) per 4-week old spiderling — carbofuran, 3.103 mg/kg; gamma-BHC, 33.373 mg/kg.**

Carbofuran was 12.00 and 10.76 times as toxic as gamma-BHC to one- and four-week old spiderlings, respectively. One-week old spiderlings were more susceptible than four-week old spiderlings, two times to carbofuran and four times to gamma-BHC.

The prevailing recommendation of 2.0 kg a.i./ha for carbofuran and 3.0 kg a.i./ha for gamma-BHC, broadcasted in granular form on lowland rice, and the resulting concentrations of these compounds in paddy water did not seem lethal to L. pseudoannulata **spiderlings.**

Insecticides have been primarily recommended for crop protection against insect pests of rice. However, they have been found to have detrimental effects on arthropod parasites and predators. Since beneficial species must be conserved in the field to promote a more stabilized pest and natural enemy balance, establishment of the toxicity of the commonly used insecticides to natural enemies is felt necessary.

The wolf spider, *Lycosa pseudoannulata* Boes. et Str., is an important predator of serious pests of rice such as the green leafhopper, *Nephotettix virescens* (Distant) (Hsieh, 1972) and the brown planthopper, *Nilaparvata lugens* (Stal) (Gavarra and Raros 1975) in the Philippines. This spider is considered one of the the most important biological control agents of insect pests of lowland rice.

Spiders have been observed by several investigators to be promising predators of insect pests of different cultivated crops. Chant (1956) observed that certain spiders particularly small species fed readily on phytophagous mites

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[2] Instructor and Assistant Professor, Department of Forest Biological Sciences, College of Forestry, U.P. at Los Baños, respectively.

while larger ones confined their feeding to orchard insects. In 1964, Whitcomb and Bell found that lycosid spiders fed on the pink bollworm and cabbage looper moths in cotton plants. Similar observations regarding spider predation were made by Harrison (1955) on banana, Hensley *et al.* (1961) on sugarcane, Ito (1965) on rice, Bailey and Chada (1968) on grain sorghum, and Howell (1971) on alfalfa.

Very few attempts have been made to assess the toxicity of insecticides to predatory spiders associated with crops. However, field surveys of some authors indicate hazardous effects of insecticides to spiders (Gaines 1954, Chant 1956, Specht and Dondale 1960, Dondale 1972). One of the early topical treatments on predatory spiders was made by Redmond and Brazzel in 1968. Using fifth and seventh instars of *Oxyopes salticus,* they obtained LD_{50} values of 0.69 to 0.079 ug/ml with toxaphene-DDT and 0.447 to 2.292 ug/ml with methyl parathion.

This study was designed to determine the toxicity of carbofuran and gamma-BHC to spiderlings of *Lycosa pseudoannulata* Boes. et Str., one of the most important biological control agents of the green leafhopper, *Nephotettix virescens* and the brown planthopper, *Nilaparvata lugens* of lowland rice in the Philippines. The work was conducted from December, 1973 to May, 1974 in the Department of Entomology, College of Agriculture, University of the Philippines at Los Baños.

MATERIALS AND METHODS

Spider culture. *L. pseudoannulata* colonies were established from adult spiders collected from IRRI lowland rice fields at Los Baños, Laguna. They were reared continuously in the laboratory in plastic vials containing a small wad of moist cotton. The first- and fourth-instar spiderlings were fed with adults of the fruitfly, *Drosophila melanogaster* Meigen, while fifth- to tenth-instar spiderlings were fed with adults of the housefly, *Musca domestica* L.

Spiderlings were placed in separate glass vials soon after they were separated from their mother. Each vial was provided with a small wad of cotton moistened with water to prevent spiderlings from being dessicated. Standardized feeding was followed by providing 3 *Drosophila* adults as prey for each spiderling every 7 days.

Treatment procedure. Analytical grades of carbofuran and gamma-BHC were dissolved in acetone at 100 mg per ml concentration. Several dilutions were made to obtain four series of concentrations in decreasing order. The first and second dilutions in the series were those dosages which, through pretest exposures, had shown mortalities above 50%. The third and fourth dilutions consisted of dosages that gave mortalities below 50%.

One-week old (mean live weight/spiderling, 0.06 mg) and four-week old (mean live weight/spiderling, .61 mg) spiderlings constituted the experimental group of spiderlings. Initially anesthesized with CO_2, the spiderlings were treated with a dose of 0.08 microliter of acetone-insecticide solution applied to the dorsal surface of the abdomen by means of a pre-calibrated micrometer-actuated syringe. Nine replications of 10 spiderlings per dosage were made. Dosage was calculated in terms of micrograms of test material per test spiderling. As control, 10 spiderlings were treated with plain acetone.

After treatment, the spiderlings were placed in separate glass vials. These vials were kept in an incubator maintained at 30°C.. Mortality counts were taken 24 hours after treatment. All tests were done from 1:00 p.m. to 5:00 p.m. Corrections for natural mortalities were made, using Abbott's formula (Abbott, 1925). Data were subjected to probit analysis to determine LD_{50} values and dosage mortality curves.

RESULTS AND DISCUSSION

Table 1 and Figure 1 present the relative toxicities of carbofuran and gamma-BHC to one- and four-week old spiderlings of *L. pseudoannulata* Boes. et Str. Comparison of both insecticides in terms of dosage which would cause 50% mortality shows that carbofuran is more toxic than gamma-BHC to both sets of spiderlings; the LD_{50} value for carbofuran was 12.00 times lower than gamma-BHC with one-week old spiderlings, and 10.76 times with four-week old spiderlings.

The data also indicate that one-week old spiderlings were more susceptible to both insecticides than four-week old spiderlings: the younger spiderlings were two- and four-times more susceptible to carbofuran and gamma-BHC, respectively, than the older spiderlings.

Since *L. pseudoannulata* Boes. et Str. inhabits areas near the water surface in lowland ricefields, and it may stride over water in pursuit of prey or in moving from one hill to another, it was necessary to determine whether insecticidal concentrations in the irrigation water were toxic or not to this spider. Based on the water analysis made by Aquino (1974), the maximum carbofuran concentration in the irrigation water was 0.206 ppm when carbofuran granules were applied at the rate of 2.0 kg a.i./ha by broadcast method. In a similar study, Pathak *et al.* (1974) found that the maximum gamma-BHC concentration in paddy water was 1.2 ppm after the application of granules at the rate of 3.0 kg a.i./ha. Comparison of these insecticide concentrations in paddy water with those derived from LD_{50} values of the present study (Table 2) indicated that these paddy concentrations of carbofuran and gamma-BHC were significantly lower than those which would cause 50% mortality in the spiderlings.

It appears, therefore, that granular application of either carbofuran or gamma-BHC in lowland fields at rates indicated above poses no direct danger of insecticidal toxicity to the spiderlings because of high dilution factor due to the available paddy water. However, it may be important to point out that the phenomenon of biological magnification along the food chains may eventually affect spider populations, especially with such persistent compounds as gamma-BHC and carbofuran.

TABLE 1. **LD_{50} values and regression lines obtained after topical application of carbofuran and gamma-BHC to the spiderlings of** L. pseudoannulata **Boes. et Str.**

Insecticide	Age of spiderlings	LD_{50} (mg./kg. body wt.)	Regression line
Gamma-BHC	one-week old	1.967	$Y = 4.294474 + 2.400852X$
	four-week old	3.103	$Y = 3.588391 + 2.869851X$
Carbofuran	one-week old	23.621	$Y = 2.213934 + 2.028591X$
	four-week old	33.373	$Y = -2.833720 + 5.142104X$

TABLE 2. **Concentrations of carbofuran and gamma-BHC in LD_{50} values and in paddy water.**

Insecticide	LD_{50} concentration (ppm)	Maximum insecticide concentration in paddy water (ppm)
Carbofuran	1.512	0.206[a]
	6.175	
Gamma-BHC	17.812	1.200[b]
	66.825	

[a] Aquino, 1974.
[b] Pathak et al., 1974.

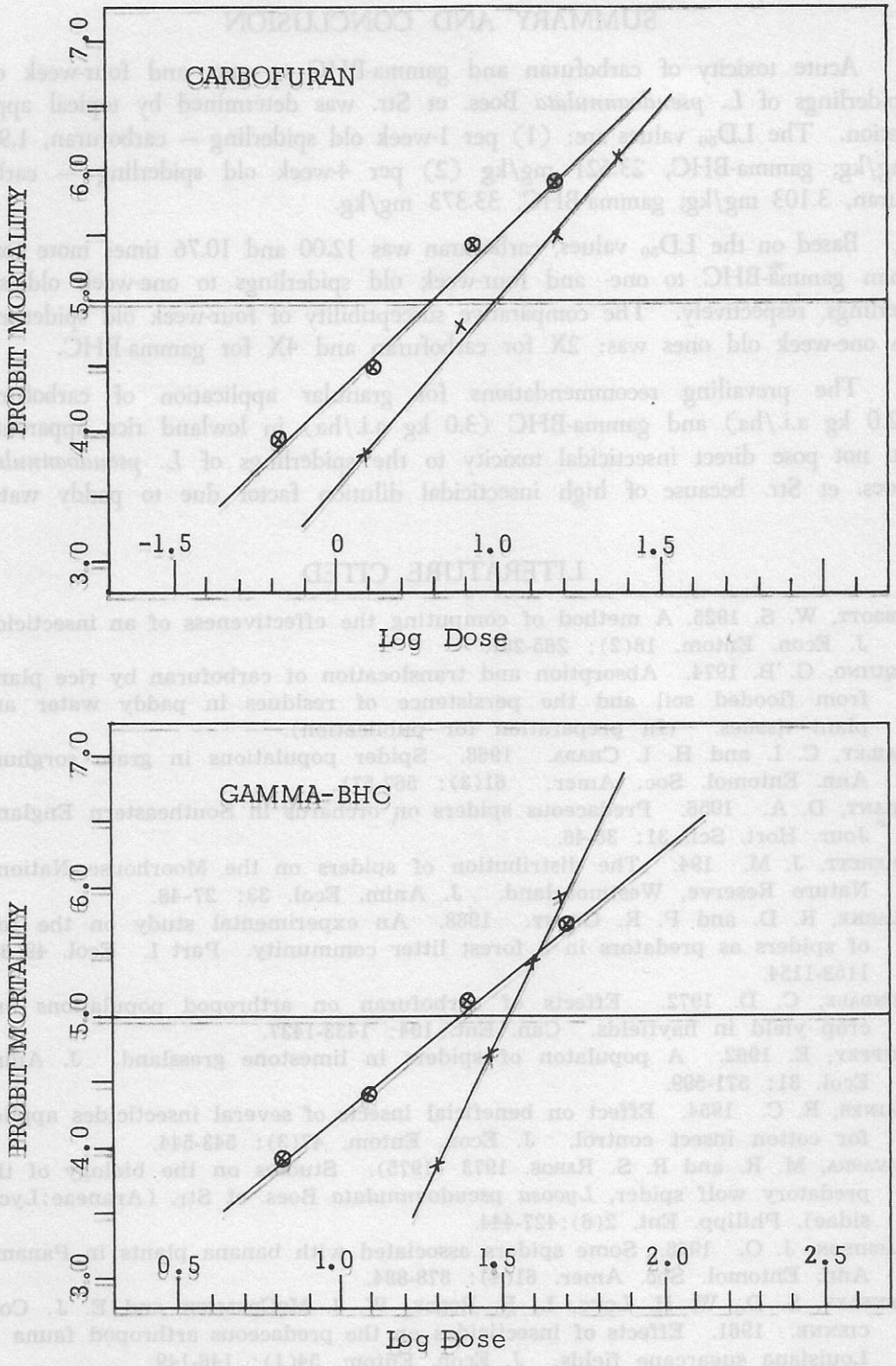

Fig. 1. Dosage-mortality regression lines for contact toxicity of carbofuran and gamma-BHC against one- (⊗) and four- (x) week old spiderlings of *L. pseudoannulata* Boes. et Str. 24 hours after treatment.

SUMMARY AND CONCLUSION

Acute toxicity of carbofuran and gamma-BHC to one- and four-week old spiderlings of *L. pseudoannulata* Boes. et Str. was determined by topical application. The LD_{50} values are: (1) per 1-week old spiderling – carbofuran, 1.967 mg/kg; gamma-BHC, 23.621 mg/kg (2) per 4-week old spiderling – carbofuran, 3.103 mg/kg; gamma-BHC, 33.373 mg/kg.

Based on the LD_{50} values, carbofuran was 12.00 and 10.76 times more toxic than gamma-BHC to one- and four-week old spiderlings to one-week old spiderlings, respectively. The comparative susceptibility of four-week old spiderlings to one-week old ones was: 2X for carbofuran and 4X for gamma-BHC.

The prevailing recommendations for granular application of carbofuran (2.0 kg a.i./ha) and gamma-BHC (3.0 kg a.i./ha) in lowland rice apparently do not pose direct insecticidal toxicity to the spiderlings of *L. pseudoannulata* Boes. et Str. because of high insecticidal dilution factor due to paddy water.

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