EFFECTIVENESS OF MIST-BLOWER APPLICATIONS OF MALATHION AND PERMETHRIN TO FOLIAGE AS BARRIER SPRAYS FOR SALT MARSH MOSQUITOES[1]

ALICE L. ANDERSON,[2] CHARLES S. APPERSON[3] AND RICHARD KNAKE[4]

ABSTRACT. Permethrin and malathion were applied as salt marsh mosquito barrier sprays by mist-blower to the shrub border of a park. At one and 24 h after treatment, mosquito landing counts in both insecticide treated areas declined by 80–90% relative to counts in an untreated control area. After 48 h, in the malathion-treated area, mosquito activity returned to levels observed in the control area. From 2 to 8 days post-treatment, mosquito landing counts in the permethrin-treated area remained depressed and significantly ($P<0.01$) different from the malathion-treated and control areas. On days 9 and 10 post-treatment, mosquito landing rates returned to high levels in the insecticide-treated and control areas.

The biting activity of salt marsh mosquitoes, *Aedes sollicitans* (Walker) and *Ae. taeniorhynchus* (Wied.), cause severe nuisance problems in coastal areas of North Carolina. These mosquitoes often interfere with outdoor recreational activities in rural areas where the lack of a network of roads and the presence of dense vegetation reduce the effectiveness of ultra low volume insecticide sprays. To provide temporary relief from salt marsh mosquitoes in public-use areas, mosquito control agencies often use mist-blower applications of insecticides, such as malathion, to vegetation bordering parks. Permethrin has been shown to provide prolonged residual activity against mosquitoes when applied to foliage (Helson and Surgeoner 1983). Consequently, we evaluated permethrin and malathion treatments of foliage as barrier sprays to reduce the activity of salt marsh mosquitoes in a rural park.

The field trial was conducted near the community of Williston in Mariner's Park, Carteret County, NC from August 12 to 22, 1989. Salt marsh mosquitoes were produced in irregularly flooded salt marsh in Jarret Bay estuary, which is located ca. 1 km south of the park. The park was surrounded by a dense shrub/annual/vine border that was approximately 3–4 m high.

One-minute counts of mosquitoes landing on an observer from the waist down were taken to assess mosquito activity 1 h before and at various time intervals after insecticide applications. Collections of female mosquitoes made before the insecticide applications were comprised of *Ae. sollicitans* and *Ae. taeniorhynchus*. In each of the 2 treated areas and in the untreated (control) area, landing counts were taken at 5 stations located ca. 50 m apart along the shrub border. At each station, landing counts were taken 1 m and then 25 m from the shrub border between 1100 and 1300 h EST. When landing counts were made, maximum wind speed was ca. 3–6 km/h and air temperature varied from 27 to 35°C. Generally, the weather was sunny but rain showers occurred several times during the 10 days of the trial.

Permethrin (10% emulsifiable concentrate, 0.1 kg AI/liter) and malathion (57% emulsifiable concentrate, 0.7 kg AI/liter), mixed 19:1 with water, were applied to some of the park's shrub border with a Buffalo Turbine mist-blower at rates of 0.3 and 1.7 kg AI/ha, respectively. Application rates were calculated using a swath width of 15 m because of the dense vegetation. When insecticide treatments were made, the vehicle was 10 m from the hedgerow and traveling at a speed of 6.2 km/h. Chemical applications were made to vegetation that encompassed a softball field and tennis courts. Permethrin was sprayed on vegetation adjacent to the center and left field sides of the ball park, and malathion was applied to vegetation that paralleled the first base and right field side of the ball field and the tennis courts. Hedgerows bordering the entrance of the park were not treated. This area was used as a control to evaluate effects of the insecticide treatments on mosquito activity.

Differences between landing counts recorded on each sampling date in the treated and untreated areas were tested for statistical significance ($P \leq 0.01$) by analysis of variance (ANOVA). Initially, insecticide and landing count site (1 m vs. 25 m) were the independent variables tested. The site variable was eliminated when differences between landing counts taken 1 and 25 m from the shrub borders were

[1] The evaluation of materials described in this publication does not imply endorsement by the N.C. Department of Environment, Health and Natural Resources or the N.C. Agricultural Research Service of the chemicals mentioned nor criticism of similar ones not mentioned.

[2] Public Health Pest Management, Department of Environment, Health and Natural Resources, 205 Country Aire Suites, Morehead City, NC 28557.

[3] Department of Entomology, Box 7613, N.C. State University, Raleigh, NC 27695-7613.

[4] Carteret County Mosquito Control Program, Courthouse Square, Beaufort, NC 28516.

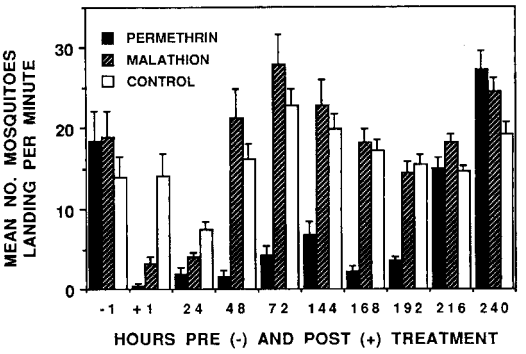

Fig. 1. Salt marsh mosquito landing counts in Mariner's Park, Carteret County, NC, just before and after application of mist-blower sprays of permethrin and malathion as barrier sprays to shrub borders on August 22, 1989. Bars are standard error of mean values ($n = 10$).

not found to be significant ($P > 0.05$). Hence there were 10 replicate landing counts for each chemical on each sampling date used in each ANOVA. Data were not transformed before analysis because no statistically significant relationship (Kendall's tau-*b*, $P > 0.05$, d.f. = 7) was found between means and variances of the landing counts for each chemical treatment or the untreated control. Significantly different mean values were separated using Tukey's Studentized range test (SAS Institute 1985).

Results of the insecticide treatments are presented in Fig. 1. Just before the insecticide treatments, landing counts averaged about 18 and 14 females per minute in the treated and untreated areas, respectively. These counts were not significantly different. Mosquito activity had declined by 80–90% at the one and 24-h post-treatment observations in the malathion and permethrin treated areas, but no change was observed in mosquito landing rates in the untreated area. Mosquito activity was significantly different in all 3 areas. At the 48-h post-treatment count, landing rates in the permethrin treated area remained depressed whereas mosquito counts made in the malathion treated area increased substantially. Salt marsh mosquito activity in the permethrin treated area remained depressed and significantly different from the malathion treated and control areas until 9–10 days after the insecticides were applied. At these observation times, mean landing counts were not significantly dissimilar in all 3 areas.

Aqueous sprays of permethrin applied to foliage by a mist-blower provided control of salt marsh mosquito adults for 8 days. We did not determine whether the decline in mosquito activity in the permethrin treated area resulted from residual repellency or toxicity or a combination of both. However, permethrin was shown in a previous study (Helson and Surgeoner 1983) to have greater residual toxicity against mosquitoes than some other insecticides, including malathion, when applied to lawns. In addition to its effectiveness in reducing nuisance populations of mosquitoes, application of permethrin as a barrier spray in public use areas would help minimize selection of resistant mosquitoes by limiting the amount of insecticide used since it has a prolonged residual activity.

REFERENCES CITED

Helson, B. V. and G. A. Surgeoner. 1983. Permethrin as a residual lawn spray for adult mosquito control. Mosq. News 43:164–169.

SAS Institute, Inc. 1985. SAS user's guide: statistics, version 5th edition. Cary, NC.