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Effect of Sublethal Dietary Exposure of Monosodium Methanearsonate Herbicide on the Nest-Building Behavior of the White-Footed Mouse, *Peromyscus leucopus*

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Monosodium methanearsonate (MSMA) is a pentavalent, water-soluble arsenical that is used extensively as a selective post-emergent herbicide in cotton and non-crop areas. DICKINSON (1972) found that a total dose of 100 mg/Kg administered at a rate of 10 mg/Kg/day resulted in death due to renal failure in 4 of 5 cattle treated. EXON (1974) reported that rats fed 50 ppm MSMA in the feed developed toxic hepatitis after 7 weeks' exposure. There is considerable variation in acute toxicity among mammalian species with LD 50's ranging from about 100 mg/Kg to 1,800 mg/Kg (DICKINSON 1972, EXON 1974, JUDD In Press). JUDD (In Press) showed that white-footed mice, Peromyscus leucopus, voluntarily consume lethal concentrations. Consumption of a sublethal concentration of MSMA herbicide (477 ppm MSMA) resulted in a significant decrease in hematocrit and blood glucose concentration after 30 days elapsed time. The purpose of this study was to determine whether or not this same sublethal concentration affected the behavior of P. leucopus. Nest-building was selected as the behavior for study because it can be easily quantified and because considerable information is available on the nest-building behavior of mice of the genus Peromyscus (SEALANDER 1952, KING et al. 1964, LAYNE 1969, WOLFE 1970, JASLOVE and McMANUS 1972, LYNCH 1973, GARTEN 1976).

MATERIALS AND METHODS

Peromyscus leucopus used in the study were trapped at various localities in Hidalgo County, Texas or they were the F_1 offspring of field-caught mice. Field animals were maintained in the laboratory on ad libitum rations of water and Purina Lab Chow for at least 21 days to ascertain their health and to eliminate pregnant females. Mice were housed individually in plastic cages, 26 cm l x 21 cm w x 11 cm d, floored with wood shavings and topped with a perforated metal cover. Room temperature was 22° C $\pm$ 1° C and photoperiod was 10D:14L.

MSMA (in Ansar® 529 HC) was delivered in the drinking water to 13 males and 13 females. Previous work (JUDD In Press) has shown that a solution of 1,000 ppm herbicide (477 ppm MSMA) is sublethal and that mice can maintain body weight for at least 60 days on this regimen; thus the 26 P. leucopus were given 1,000 ppm herbicide. A control group of 13 males and 10 females received tapwater. All

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mice were adults weighing 20 g or greater and all received Purina Lab Chow *ad libitum* throughout the experiment. Body weights were taken weekly to the nearest 0.1 g.

A 10 g roll of non-absorbent cotton was placed in the food hopper and the amount remaining after 24 h was determined by weighing to the nearest .01 g. Food was placed in a dish on the cage floor. Nests were removed daily and the experiment was continued for 14 consecutive days.

Statistical procedures are those of SOKAL and ROHLF (1969). Probability value less than .05 is considered significant.

RESULTS

Table 1 provides comparisons between sexes and treatments for mean weight of cotton used in nest construction. Control females pulled significantly more cotton than control males ($t = 2.723$, 21 df, $P < .02$). Conversely, males receiving herbicide in their drinking water pulled more cotton than did herbicide treated females, but the difference was not significant. The mean weight of cotton used by males in the two treatments was similar, but females on the herbicide regimen pulled significantly less cotton than control females ($t = 3.186$, 21 df, $P < .01$).

TABLE 1

Comparison of grams of cotton used in nest construction between sexes of *Peromyscus leucopus* receiving tapwater and 477 ppm MSMA for drinking.

Regimen	N	$\bar{X}$	SD	N	$\bar{X}$	SD
Tapwater	13	3.25	2.15	10	5.64	2.00
MSMA	13	3.67	1.61	13	2.96	2.00

DISCUSSION

SEALANDER (1952) pointed out that the degree of protection afforded by nests during winter is an important factor influencing the survival of small mammals during periods of extreme cold. He showed that nesting substantially increased survival of *Peromyscus leucopus* at low temperatures. Thus, an important function of nest size is to aid in thermoregulation.

Because control females pulled more cotton for nest construction than did control males, it was expected that the same relationship would prevail among mice on the herbicide regimen. However, this relationship was not observed (there was no significant difference in weight of cotton used between the sexes). Thus, the results indicate that the herbicide affected the nest-building behavior of females but did not affect males. This suggests that the mechanism of action involves hormonal mediated behavior rather than general activity level. An alternative explanation of our findings is that there were no treatment effects; rather, the data simply reflect individual variation among females.

Previous studies provide conflicting data on sexual differences in nest-building behavior among Peromyscus species. KING et al. (1964), LAYNE (1969), and WOLFE (1970) found no significant differences between the sexes in nest-building behavior. Conversely, JASLOVE and McMANUS (1972) reported that female P. leucopus consistently shredded more paper and built larger nests than males. Our sample sizes are respectable and means for weight of cotton used in nest construction are based on 14 replications for each individual. Therefore, we think that the difference in weight of cotton used for nest-building between the sexes among the control mice is real and not an artifact of sampling. Furthermore, we suggest that selection should favor females building larger nests because of the thermoregulatory importance of the nest for young mice (SEALANDER 1952). Thus, we also think that the difference in weight of cotton pulled between females on the two treatments is real and not a result of small sample size or sample bias. However, to resolve the issue, measures of nest-building behavior before and after herbicide exposure are needed.

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REFERENCES

DICKINSON, J. O.: Am. J. Vet. Res. 33, 1889 (1972).

EXON, J. H., J. R. HARR and R. R. CLAEYS: Nutrition Rpts. International 9, 351 (1974).

GARTEN, C. T., JR.: J. Mamm. 57, 412 (1976).

JASLOVE, S. W. and J. J. McMANUS: Bull. New Jersey Acad. Science 17, 1 (1972).

JUDD, F. W.: Bull. Environ. Contam. Toxicol. 22, (In Press).

KING, J. A., D. MAAS, and R. G. WEISMAN: Evolution 18, 230 (1964).

LAYNE, J. N.: Behavior 35, 288 (1969).

LYNCH, C. B.: Anim. Behav. 22, 405 (1973).

SEALANDER, J. A.: Ecology 33, 63 (1952).

SOKAL, R. R. and F. J. ROHLF: Biometry, the principles and practice of statistics in biological research. 1st ed. San Francisco: W. H. Freeman and Co. 1969.

WOLFE, J. L.: Anim. Behav. 18, 613 (1970).