adjacent pyramidal neurons with similar dendritic branching patterns and apical dendrites in the same plane showed different degrees of spine loss and spine abnormality. In general, there was no obvious relation between the degree of dendritic spine abnormality in these elements and dendritic length or branching patterns. Dendritic spine abnormalities seemed to be more closely correlated with the severity of retardation and age of the subject than were changes in basic dendritic geometry. Apropos of this is a recent report that dendritic branching is somewhat reduced in preparations from young, but not older, retarded patients (*6*).

This study demonstrates two types of dendritic spine abnormalities in retarded children with normal karyotypes: dendritic spine loss and the presence of very long, thin spines that resemble the developing spines of primitive neurons (*2*). The functional significance of these abnormalities is not known. However, it is reasonable to expect that spine loss and alterations in dendritic spine geometry (*7*) exert significant effects on integrative operations of dendritic systems as receptor surfaces for synaptic inputs to cortical neurons (*1, 8*). The emphasis here on dendritic spine "dysgenesis," which implies defective development, as a common feature of the microstructural pathology in profound mental retardation affirms the importance of axodendritic synaptic dysfunction in many developmental disorders of infancy and childhood (*2, 9*).

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Synergism of Insecticides by Herbicides: Effect of Environmental Factors

Abstract. *The synergism of parathion and* p,p′-*DDT* [*1,1,1-trichloro-2,2-bis-*(p-*chlorophenyl)ethane*] *by atrazine was investigated as a function of soil type, age of pesticide soil residues, and the presence of soils in quiet or turbulent water. Compared to previous tests in which the pesticides were applied on glass surfaces, a significant reduction of the toxicity of the insecticides to fruit flies and of the synergistic effects of atrazine was observed with soils, particularly a silt loam. The effects of atrazine as a synergist in soil declined rapidly within 4 days. The toxicity of parathion in water and its synergism by atrazine were significantly reduced by soil sediments, depending on the type and amount of soil present. Soils were highly effective in turbulent water: in water containing the relatively high parathion concentration of 0.3 part per million, 93 percent of the mosquito larvae present died within 24 hours, yet this solution was rendered nontoxic by being mixed with 5 grams of a loam soil. With atrazine present in the latter system, however, 38 percent of the mosquito larvae died. Thus, insecticides can be more or less toxic, depending on their concentrations, the presence of synergists, and the environmental conditions.*

Synergism of insecticides by herbicides, resulting in enhancement of the toxicity of selected insecticides to three insect species, was reported by Lichtenstein *et al.* (*1*). This publication was picked up by a number of newspapers, one of which (*2*), under the heading "Warning given on insecticides," reported that "farmers who use both insecticides and herbicides on their crops may be applying more insecticides than they need." While this may be true, it was not reported that the experiments with pesticides were conducted on glass surfaces or with tap water. We have now investigated the synergism of insecticides by herbicides under more realistic conditions to determine the effects of some environmental factors. We report here the effects of soil type, age of pesticide soil residues, and the presence of soils in quiet and turbulent water on the synergism of parathion and *p,p*′-DDT [1,1,1-trichloro-2,2-bis(*p*-chlorophenyl)ethane] by atrazine.

Table 1. Effect of soils and water turbulence on the synergism of parathion toxicity to mosquito larvae (*Aeddes aegypti* L.) by atrazine in water solutions. Amounts and concentrations used were: water, 20 ml; soil, 5 g; atrazine, 10 ppm; parathion, 0.015 ppm. Results are means of three replicated tests.

Pesticide	24-Hour mortality (%) of larvae in water with		
	No soil	Sand	Loam
Atrazine			
No mixing	0	0	0
Mixing		0	0
Parathion			
No mixing	20 ± 7*	18 ± 4	5 ± 4
Mixing		5 ± 4	0 ± 0
Atrazine + parathion			
No mixing	73 ± 18*	71 ± 14†	64 ± 4‡
Mixing		18 ± 4†	0‡

* Difference significant at $P = .01$ by Student's *t*-test. † Difference significant at $P = .01$. ‡ Difference significant at $P = .001$.

To determine the toxicity of the insecticides in soils, fruit flies (*Drosophila melanogaster* Meigen) were exposed directly to pesticide-treated soil. For this purpose, 10-g portions of air-dried soil were placed into 4-ounce (~ 120-ml) test jars and treated with chloroform solutions of parathion, *p,p*′-DDT, atrazine, or combinations thereof. After evaporation of the solvent (*3*), 50 fruit flies were introduced into each jar and held for 24 hours, when mortality counts were made. Each treatment was replicated three times. To determine the persistence or decline of pesticides in soils, some of the soils were treated with parathion or atrazine and then incubated at room temperature for 4 days. At intervals, soil samples were extracted and analyzed for parathion by gas-liquid chromatography with a flame photometric detector, as described in (*4*). Soil samples containing atrazine residues were similarly extracted, but the final partition was made into ethyl ether instead of benzene. The ether solutions were used for analyses with a flame-ionization detector in a Tracor model 550 gas chromatograph; the chromatograph employed a glass column 1.83 m long with a 4-mm inner diameter, filled with 10 percent Dow Corning DC-200 on 80/100 mesh Gas-Chrom Q and maintained at 200°C.

The effect of soil type on the synergism of parathion by atrazine was studied with a Plainfield sand (percentage of organic matter, 1.2; sand, 89.8; silt, 8; and clay, 1) and a Plano silt loam (percentage of organic matter, 4.7; sand, 4.3; silt, 69; and clay, 22). Fruit flies were exposed to 10 g of each soil, previously treated with parathion (2.3 μg per 10 g of soil) or DDT (30 μg per 10 g of soil). To ascertain the dose-response relation of the synergistic effects of the herbicide, insects were also exposed to soils treated with constant dosages of insecticides to which increasing amounts of atrazine (40 to 1000 μg per 10 g of soil) had been added. In the experiments with glass surfaces (*1*), exposure of fruit flies for 24 hours to 0.35 μg of parathion resulted in 9 percent mortality, and similar exposure to 2 μg of DDT resulted in 17 percent mortality. With 10 g of soil, however, 2.3 μg of parathion or 30 μg of DDT had to be added to obtain comparable mortalities (Fig. 1). As shown in Fig. 1, identical concentrations of the insecticide resulted in lower insect mortalities with the loam soil than with the Plainfield sand, which is less sorptive. The addition of increasing amounts of atrazine with constant insecticide doses resulted in increased mortalities, yielding typical dosage-mortality curves (Fig. 1). With glass surfaces, 18-hour exposures, and 0.35 μg of parathion, the quantity of atrazine required to obtain 50 percent insect mortality was only 6 μg (*1*); with 10 g of soil, 24-hour exposures, and 2.3 μg of parathion, the amount of atrazine required to obtain 50 percent insect mortality was 62 μg in sand and 920 μg in loam. For DDT, the corresponding figures were 40 μg (glass), 85 μg (sand), and 680 μg (loam). It appears that soil of increased sorptive capacity reduces the toxicity of an insecticide and the effectiveness of atrazine as a synergist.

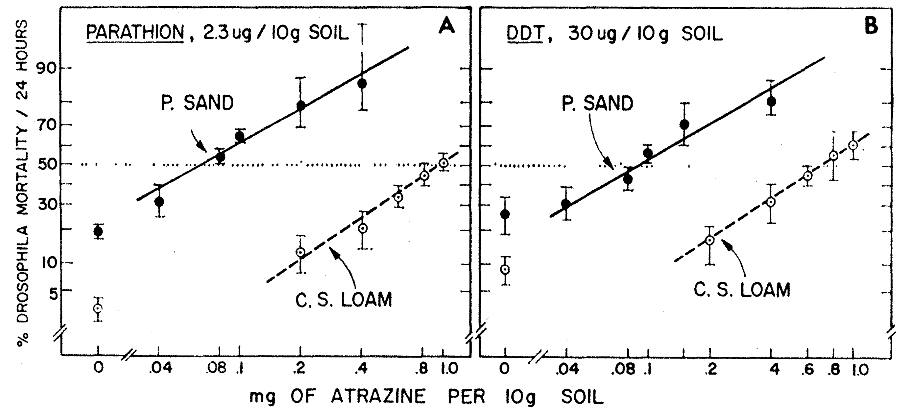

Fig. 1. Effect of soil type and concentration of atrazine (4 to 100 ppm) on synergism of the toxicity of constant dosages of (A) parathion and (B) DDT to fruit flies (*Drosophila melanogaster* Meigen).

The effectiveness of atrazine as a synergist in the loam soil was investigated over a 4-day period. The soil was treated with the herbicide [50 parts per million (ppm)] and then incubated for 4 days in the dark at 22° ± 2°C. Initially and on each of the following 4 days, three 10-g portions of the soil were placed in test jars, to which first parathion (3.5 μg per 10 g of soil) and then 50 fruit flies were added. The jars for the 4 days contained increasingly aged atrazine soil residues. Control jars prepared in the same way, but with atrazine-free soil, were used for comparison. Portions of the herbicide-treated soil were extracted and analyzed as described above. Aging of atrazine soil residues decreased their effectiveness as synergists (Fig. 2A) and after 4 days they were no longer effective (43.3 ± 8 percent mortality with atrazine and 36 ± 11 percent without it; percentages are standard deviations). At that time the concentration of atrazine in the soil had declined to 19 ppm, which was barely enough to synergize the insecticide in the loam soil (Fig. 1). The ratio of mortalities of insects exposed to atrazine-treated and atrazine-free loam soil was 2.67 initially; it declined to 2.3, 1.92, and 1.41 after 1, 2, and 3 days, respectively.

In another experiment, the synergistic effects of atrazine were tested with aged residues of parathion in the silt loam (Fig. 2B). Soil was treated with the insecticide (0.35 ppm) and incubated for 4 days at 22° ± 2°C in the dark. Initially and on each of the following 4 days, three 10-g portions of this soil were placed in test jars, to which first atrazine (500 μg per 10 g of soil) and then 50 fruit flies were added. For comparison, flies were exposed daily to the increasingly aged parathion soil residues, but no atrazine was added. For gas chromatographic analyses, portions of insecticide-treated soil were removed daily and extracted (*4*). As shown in Fig. 2B, the toxicity of the parathion

Fig. 2. (A) Toxicity to fruit flies of parathion, alone and with increasingly aged atrazine residues, in a loam soil. Parathion (3.5 μg per 10 g of soil) was added daily. (B) Toxicity to fruit flies of increasingly aged parathion residues in a loam soil. Atrazine (500 μg per 10 g of soil) was added daily.

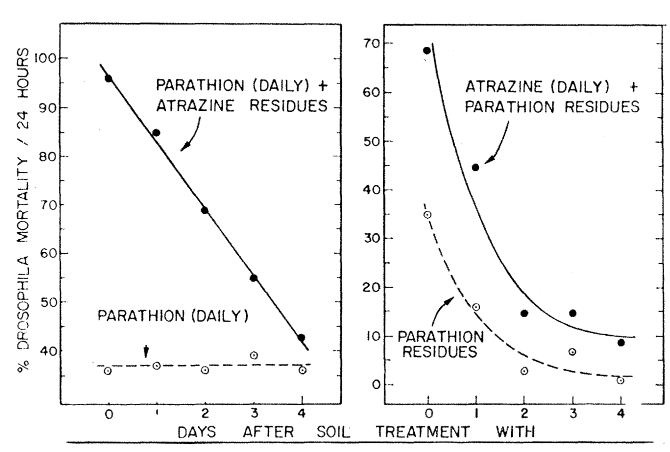

Table 2. Effects of type and amount of soil on the synergism of parathion toxicity to mosquito larvae (*Aedes aegypti* L.) by atrazine in 20-ml water solutions. After the soils were added to the pesticide solutions the samples were shaken vigorously before the larvae were added. Results are means of three replicated tests.

Pesticide and concentration (ppm)	24-Hour mortality (%) of larvae in water with				
	No soil	Sand		Loam	
		1 g	5 g	1 g	5 g
Atrazine (10)	0	0	0	0	0
Parathion (0.015)	24 ± 7	16 ± 7	2 ± 2	7 ± 0	0
Atrazine (10) + parathion (0.015)	62 ± 8	42 ± 10	2 ± 2	22 ± 4	0
Atrazine (20)	0		0		0
Parathion (0.30)	93 ± 6		62 ± 8		0
Atrazine (20) + parathion (0.30)	98 ± 4		76 ± 4		38 ± 10

residues declined rapidly; while the toxicity was higher in the presence of atrazine, the curve obtained with atrazine present drops off parallel to the curve for parathion alone. The concentration of the insecticide in the soil after 4 days was 0.24 ppm, which is the lower margin of the killing range of parathion in the loam soil.

Although the toxicity of parathion reached a low point on the second day after it was added to the soil (Fig. 2B), gas chromatographic analyses of the soils indicated that the parathion concentration did not change during the first 3 days (0.35 ± 0.015 ppm), and it was only on the fourth day that the low concentration of 0.24 ppm was determined. This suggests that by the second day enough insecticide had been bound to the soil particles to reduce its toxicity and prevent it from being as effectively synergized as freshly deposited residues. Extraction of these soils and exposure of fruit flies to dry residues of the extracts confirmed these results. Extracts of the soil samples for the first 3 days caused high insect mortalities (83 to 98 percent after exposure for 20 hours to dry residues representing 1.14 g of soil), while the extract from soil incubated for 4 days caused considerably lower insect mortality (46 percent).

The synergistic effects of atrazine with parathion in water or in water with soil were measured with mosquito larvae (*Aedes aegypti* L.). In all experiments, 15 third-instar larvae were placed in 20 ml of tap water, previously treated with parathion, atrazine, or both in water solutions. To study the effects of soils in water, 1-g or 5-g portions of the sand or the silt loam were poured into the pesticide-treated water in vials; the vials were centrifuged at 100*g* for 5 minutes, and then mosquito larvae were introduced. To study the effects of water turbulency, tubes containing water and soil were shaken and vigorously swirled for 1 minute, then centrifuged at 100*g* for 5 minutes, and mosquito larvae were introduced. Mortality counts were made after 24 hours.

Table 1 summarizes the results obtained after exposure of the larvae to water (with and without soils) treated with atrazine (10 ppm), parathion (0.015 ppm), or both. Under these conditions soil reduced the effectiveness of the insecticide. Atrazine, which is not toxic by itself, significantly increased the toxicity of the insecticide. Shaking and mixing the soil and water significantly reduced the toxicity of the insecticide with both sand and loam, apparently by increasing the binding of the insecticide by soil particles. The synergistic effect of atrazine in water was not affected by soil under nonturbulent conditions, but was significantly reduced under turbulent conditions. In nature, soil is mixed with water in the runoff into lakes and streams, whereas bottom mud in deepwater lakes is not likely to be mixed with the upper water layers, even after surface turbulency. Therefore, both conditions simulated in these experiments could prevail in nature and affect the biological activity of pesticides.

Table 2 shows the results obtained with different amounts of soil in the water. In these experiments, 1 or 5 g of the sand or the silt loam was added to 20 ml of pesticide-treated water and the mixture was shaken. With the larger amount of soil, the biological activity of parathion as an insecticide and of atrazine as a synergist was significantly reduced. In solutions with no soil and the relatively high parathion concentration of 0.3 ppm, 93 percent of the mosquito larvae died within 24 hours, yet these solutions were rendered nontoxic by being shaken with 5 g of the loam soil. With atrazine added to this system, however, 38 percent of the mosquito larvae died. Insecticides, therefore, can be more or less toxic, depending on their concentrations, the presence of insecticide synergists, and the environmental conditions.

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Target Structure and Echo Spectral Discrimination by Echolocating Bats

Abstract. *Echolocating bats can use sonar to discriminate among targets which reflect echoes differing in spectral distribution of energy but not in overall intensity. They can detect differences smaller than 1 millimeter in fine target structure. Bats may be capable of classifying targets from echo spectral signatures and might thus be able to distinguish among flying insect prey by sonar.*

Microchiropteran bats use a biological sonar system, echolocation, as a partial substitute for vision in their nocturnal lives (*1*). With echolocation bats can detect, locate, and track flying insects (*1*, *2*) and discriminate among mealworms and plastic spheres or disks propelled into the air (*1*, *3*). Echoes from such airborne targets differ in spectral composition (*3*, *4*), and there is evidence that bats may be able to perceive target features from echo spectral cues (*5*). This report describes an experimental study of discrimination