night. The six lizards injected with saline alone (experiment B) did not develop any fever and all survived.

Five of the 12 lizards in experiment C developed a fever within 48 hours after injection with live bacteria and sodium salicylate. All five febrile lizards survived, while the seven afebrile lizards died (Fig. 1b). Although the sample sizes are small, these differences are statistically significant ($P < .01$, chi-square test). These data for experiments A and C are summarized in Fig. 2. In experiment D, only one of eight lizards died, which indicates that the dose of sodium salicylate used in these experiments was not toxic.

These data indicate that the administration of sodium salicylate to lizards with bacterial infections is harmful when it results in reduction of body temperature to an afebrile level. When sodium salicylate failed to produce antipyresis, the survival of infected lizards was not affected. It is not known why 5 of the 12 lizards receiving sodium salicylate developed a fever. The dose of sodium salicylate was kept low in order to minimize the toxic effects of this drug (*7*). The most likely explanation for the different responses to the salicylate is individual variability—that is, the dosage is probably on the ascending side of the dose response curve (*5*). In addition, initial results from our laboratory indicate that sodium salicylate is not 100 percent effective in preventing fever in mammals infected with live bacteria.

It is not known whether the results concerning the adaptive value of fever in reptiles can be extrapolated to the higher vertebrates, including man. We have shown that the characteristics of fever in the higher vertebrates (reptiles, birds, and mammals) are similar (*1, 4, 5*). For example, all three classes of vertebrates contain individuals that develop fever in response to injection with dead bacteria (containing endotoxin) or to infection with live bacteria. In all three classes, sodium salicylate is an effective antipyretic drug. Since the characteristics of fever are similar, it is tempting to suggest that the febrile mechanism had a common origin. If this is the case, we suspect that the function of fever in birds and mammals is similar to that in reptiles; that is, fever has evolved as a defense mechanism which substantially increases the likelihood of the infected host surviving that infection.

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7. In an initial study the dosage of sodium salicylate per lizard was 0.2 ml of a 37.5 mg/ml solution. This higher dose of salicylate prevented fever in only five of eight lizards (63 percent); this indicates that even at higher doses, sodium salicylate does not prevent fever in 100 percent of infected animals. Control lizards were injected with bacteria and this high dose of salicylate, and then maintained at a febrile body temperature by artificial means. Those injected with the high dose of salicylate had a statistically higher mortality (7 of 12 or 58 percent) than did controls injected with 0.2 ml of a 20 mg/ml solution as reported in the text (1 of 8 or 13 percent died; $P < .04$, chi-square test); this indicates that the high dose of salicylate is toxic.
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Herbicide (2,4-D) Increases Insect and Pathogen Pests on Corn

Abstract. *Corn leaf aphids, European corn borers, and southern corn leaf blight were more abundant on corn exposed to 2,4-dichlorophenoxyacetic acid (2,4-D) herbicide than they were on unexposed corn. Protein levels were higher in corn plants that were exposed to several dosages of 2,4-D, and this may have favored the growth of pests.*

Since 1945, increased losses due to attack of insects and pathogens have been reported for crops in spite of greater efforts in pest control (*1*). How much if any of this increased loss caused by pests is due to the ecological and biochemical impact of herbicides on crops is unknown, but in a number of instances herbicides have been reported to increase pest problems on various crops (*2*). Our laboratory and field tests were designed to determine what influence the use of 2,4-dichlorophenoxyacetic acid (2,4-D) has on the susceptibility of grain corn to the European corn borer (*Ostrinia nubilalis*), corn leaf aphid, and the southern corn leaf blight (*Helminthosporium maidis*).

In 1973 a preliminary study was made of the impact of 2,4-D (triethanolamine salt) herbicide on corn leaf aphid and European corn borer populations in the corn variety Pennsylvania 290. The three treatments of 2,4-D per hectare were (i) untreated (control), (ii) 0.14 kg, and (iii) 0.55 kg (normal use). The herbicide spray was directed at the base of knee-high corn plants and toward any weeds, and all plots were cultivated for weed control. Aphid counts were made on 60 ears of corn selected systematically from each of these plots during late September. The number of aphids, following the three treatments, were (i) 618, (ii) 1388, and (iii) 1679. Corn borer infestations were measured in late August, and the percentages of plants in these plots that were infested with corn borer larvae were 16 percent after (i), 24 after treatment (ii), and 28 after treatment (iii).

More extensive field tests were made in 1974 on three row plots (70 to 90 plants) 2½ by 7 m in size. Four treatments (i) untreated (control), (ii) 0.14 kg of 2,4-D per hectare, (iii) 0.55 kg of 2,4-D per hectare (normal use dosage), and (iv) 4.4 kg of 2,4-D per hectare were used; techniques were the same as in the 1973 tests. Aphid counts made on the tassels of the corn were significantly (0.01 level) higher in the plots treated with 0.14 and 0.55 kg of 2,4-D per hectare than in the untreated plots. These numbers were for (i) 1420, (ii) 2449, (iii) 3116, and (iv) 2023. The percentages of corn plants attacked by the corn borer were 63 percent after (i), 83 after treatment (ii), 70 after treatment (iii), and 63 after treatment (iv). Differences between treatments of 0.14 and 0.55 kg of 2,4-D per hectare and the control were statistically significant (0.05 level).

In laboratory tests the single hybrid OH 51A × B8 corn was grown in a growth chamber at temperatures of 28° to 29°C. After 4 weeks (when the corn was 40 to 50 cm tall) 90 ml of 2,4-D solution was applied to the soil in each pot at concentrations of 0, 5, 20, 80, and 320 parts per million (ppm). The 20-ppm con-

Table 1. Mean pupal weight and egg production of moths reared from corn borer larvae raised on hybrid corn OH 51A × B8 treated with four dosages of 2,4-D.

Dosages of 2,4-D (ppm)	Mean pupal weight (mg)*	Mean number of egg masses per female
0	92.87 c	18.7
5	98.51 b	26.0
20	113.43 a	25.5
80	103.01 b	32.5
320	91.63 c	19.0

*Significant differences at 0.05 level (Duncan's multiple range test) indicated by letter differences.

Table 2. Duncan's multiple range test (0.01 level) of the means of total protein of 1-g leaf samples of hybrid corn OH 51A × B8 treated with four dosages of 2,4-D; *Rp* is least significant difference.

Rp		1.37	1.43	1.47	1.50
2,4-D treatment	0	320 ppm	80 ppm	20 ppm	5 ppm
Mean (mg)	2.3	2.8	3.9	4.0	4.3

Table 3. Duncan's multiple range test (0.01 level) of the mean number of lesions (greater than 1 cm) of the southern corn leaf blight pathogen on hybrid corn OH 51A × B8 treated with five dosages of 2,4-D; *Rp* is defined in the legend to Table 2.

Rp		5.79	6.08	6.24	6.34	6.44
2,4-D treatment	10 ppm	0	200 ppm	100 ppm	20 ppm	40 ppm
Mean	11.00	12.60	14.00	14.60	17.60	19.20

centration approximated the field dosage of 2,4-D of 0.55 kg/ha. Then 2 weeks after herbicide treatment each experimental corn plant was infected with five first-instar corn borer larvae placed in the whorl of the plant. Mean weights of corn borer pupae obtained from larvae reared on corn treated with 5, 20, and 80 ppm of 2,4-D were significantly (0.05 level) heavier than larvae reared on untreated corn (Table 1). Moths reared on plants receiving 5, 20, and 80 ppm of 2,4-D on the average produced more egg masses per female than those reared on untreated plants (Table 1).

Corn plants from the corn borer experiments were tested for total protein (*3*). Corn plants receiving 5, 20, and 80 ppm of 2,4-D contained significantly (0.01 level) higher levels of protein than the untreated plants and plants receiving 320 ppm of 2,4-D (Table 2). The increased protein of the treated plants probably improved the nutrient content for the corn borers, corn leaf aphids, and the southern corn leaf blight pathogens (*4*).

The impact of 2,4-D on the susceptibility of corn to southern corn leaf blight was studied in other tests. Seven days after planting, the corn was treated with 2,4-D at 10, 20, 40, 100, and 200 ppm, and one group of plants was left untreated. After 6 days the plants were spray-inoculated with 100 ml of a spore suspension standardized to 11,500 spores per milliliter. Pathogen infection was determined by counting all lesions larger than 1 cm in length. Corn plants treated with 20, 40, 100, and 200 ppm of 2,4-D had significantly more lesions (greater than 1 cm in length) than the untreated plants and the plants with the lowest dosage of 2,4-D (10 ppm) (Table 3).

The results of this investigation demonstrate that increased risks of attack by insects and disease on corn may result from herbicide treatments. Additional studies are needed on other crop plants on which herbicides are used to determine the potential impact herbicides are having on plant protection programs.

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Brainstem Neurons Without Spontaneous Unit Discharge

Abstract. *A new class of single neurons showing no spontaneous activity in waking, rapid eye movement sleep, and slow-wave sleep was found in the brainstem of unrestrained cats. Systematic testing showed that these cells discharge only in response to specific stimuli and remain silent for as long as 40 minutes in the absence of stimulation. Silent cells were widely distributed in the pons and midbrain and constituted a major percentage of observed neurons. The economy of discharge shown by these cells contrasts with the spontaneous activity of virtually all other neurons that have been observed in the brains of unrestrained animals and suggests the widespread existence of specialized neural systems that show only phasic activity.*

Single neurons recorded in unanesthetized unrestrained animals have generally been found to exhibit "spontaneous" unit discharge in waking that persists and is frequently augmented during the stages of sleep (*1*). This recurrent discharge occurs in the absence of observable fluctuations in either sensory stimulation or motor activity. The existence of spontaneous activity in the neurons of behaving animals has been assumed in most theoretical formu-

Table 1. Average durations, in seconds, of the longest silent period observed in cells that are not spontaneously active (NSA) and in midbrain raphe and pontine FTG cells, recorded under the same conditions, during waking, slow-wave sleep (SWS), and rapid eye movement (REM) sleep ± the standard error of the means. The fourth line gives the average duration of the waking and sleep states during which the NSA units were observed.

	Cells (No.)	Duration (seconds)		
		Waking	SWS	REM sleep
NSA	27	166.8 ± 19.6	383.4 ± 57.9	321.4 ± 39.4
Midbrain raphe	10	5.8 ± 2.0	16.5 ± 3.3	44.1 ± 7.5
Pontine FTG	10	48.0 ± 8.1	91.2 ± 20.3	21.4 ± 8.7
Duration of state	27	179.4 ± 20.0	428.2 ± 58.7	480.0 ± 40.3