Research Update on the Effects of Acid Rain on Corn

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There has been some concern that acid deposition alone or in combination with other air pollutants may be decreasing agricultural production in some parts of the country. Corn, Zea mays L., is one of the major agronomic crops in Massachusetts as well as other areas of the Northeast which experience episodes of acid precipitation. Seed development in corn requires the movement of pollen from the tassels to the silks, through the ambient environment during this period both the male and female reproductive organs are open to extended contact with acid precipitation. Interruption of the fertilization process following acid precipitation through failure of pollen to germinate and grow or through changes in the silk that create a hostile environment for pollen would reduce corn yields.

Beginning in 1984, commercially available field corn hybrids Agway 265x, Agway 380x and Pioneer 3747 were studied in both the field and under greenhouse conditions to determine the susceptibility, if any, of the reproductive process in corn to simulated acid precipitation. These hybrids were used because they represent the three maturity groups that have performed well in Massachusetts corn variety trials. During the 1985 growing season a fourth corn hybrid, Pioneer 3377, was added to the experiment. This was done so that data generated in Massachusetts corn/acid rain can be compared to congruent work being conducted at the University of Illinois, Illinois.

In the field studies, plants were seeded by May 16th, under current commercial production techniques. All varieties were planted at the University of Massachusetts Experimental Farm in South Deerfield, on a Hadley silt loam. This location represents an area known to be subjected to acid precipitation episodes (Table 1).

Table 1: Mean pH of precipitation at University of Mass. Experimental Farm

	1983	1984	1985
July	4.11	4.31	4.26
August	3.80	3.64	3.84

Although one year of Field and laboratory work has been completed; other experiments and the second year of field trials will not be finished until May of 1986. Our work to date indicated that of the three corn varieties selected in 1984 only Pioneer 2747 showed any reduction in the number of kernels per ear when silks and tassels were treated with simulated acid rain at a pH of 3.6 (Figure 1). It is not, however clear as to why there was an increase in seed set when simulated acid rain of pH 4.6 was used. Variation in seed set may have been due to differences in silkage during treatment application and pollination. This potential source of variability was corrected in the second field season by allowing only silks of 3 to 5 days in age to be used in all treatments.

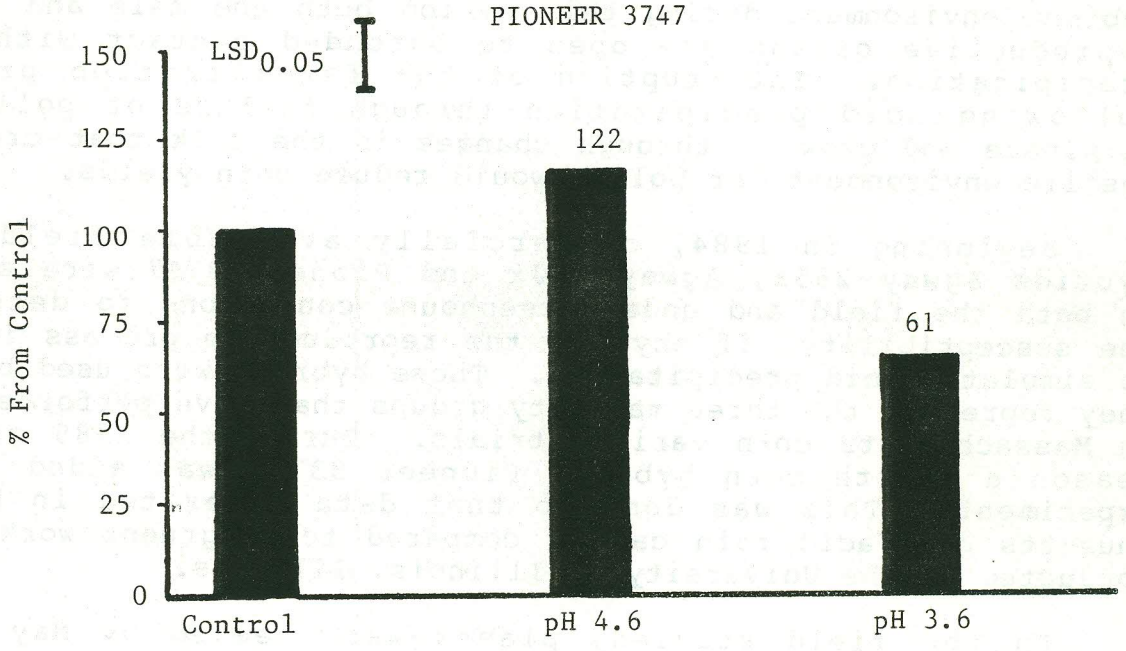

Figure 1. Comparison of tassels and silks treated with simulated acid rain pH 4.6, pH 3.6 and protected tassels and silks (control) on kernel number per ear.

Under laboratory conditions, pollen growing on artificial media, in place of silks, were exposed to varying concentrations of sulfuric and nitric acids, the two major acidifying components in acid rain. These experiments showed corn pollen to have a limited tolerance to growth media which was at a pH below 5.6 as measured by percent germination and tube elongation (Tables 2-3). No growth was found at a pH of 3.6 for either of the two acids.

Table 2: Comparison of sulfuric and nitric simulated acid rain on corn pollen germination.

	pH			
Acid	5.6	4.6	3.6	2.6
	(% germination)			
$H_2S\emptyset_4$	22	24	Ø	Ø
$HN\emptyset_3$	25	18	Ø	Ø

Table 3: Comparison of sulfuric and nitric simulated acid rain on corn pollen tube elongation.

	pH			
Acid	5.6	4.6	3.6	2.6
	(length in mm)			
$H_2S\emptyset_4$	Ø.38	Ø.2Ø	Ø.ØØ	Ø.ØØ
HBO_3	Ø.38	Ø.21	Ø.ØØ	Ø.ØØ

It is interesting to note that the pH found to limit and inhibit pollen growth both are in the range of current acid rain deposition at the University of Massachusetts experimental Farm in South Deerfield. Even so, we have not experienced significant decreases in corn yields which would indicate that under field conditions corn pollen exposed to ambient or simulated acid rain is considerably less sensitive. Confirmation of the above awaits replication from the second seasons field work.