Acid Rains: Implications for Agriculture

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ABSTRACT—Acid rains have fallen in Minnesota and may pose a serious threat in the future as emissions of the oxides of sulfur and nitrogen continue to increase and the net flux of the emissions continues from the south to the north. The acid rains would ultimately cause drastic changes in the soil pH, seriously endangering crops such as alfalfa and clover. That, in turn, would jeopardize the livestock industry. A statewide plan of taking corrective measures such as liming coupled with monitoring the pH of farms through soil testing on a massive scale needs to be prepared.

Acid rains fell in Northern Minnesota and other regions of the United States and Canada in the year 1979, bringing down substantial quantities of sulfuric and nitric acids. The ancient scriptures foretell the falling of brimstone from the sky in the days to come, and the falling of acid rains of modern times almost seems to fulfill the prophesy, for brimstone is the ancient name for sulfur; and emissions of the oxides of sulfur and nitrogen cause the acid rains. The automobile, power plants, and burning of high-sulfur coal are primarily responsible for these emissions.

The problem of acid rain had become so alarming that President Carter created in August 1979 an Acid Rain Coordination Committee with Rupert Cutler of the Department of Agriculture and Stephen Gage of the Environmental Protection Agency as co-chairmen. The President also called for an acid rain research program. In a report released by the United States-Canada Bilateral Research Group in October 1979, the following two important facts emerge:

a) Emissions of the oxides of sulfur in the United States alone total 26 million tons and those of the oxides of nitrogen total 22 million tons.

b) The net flux of these acid-causing substances is from the south to the north.

These findings should be a matter of great concern for a northern state such as Minnesota. The consequences of acid rains in Minnesota assume greater seriousness because the eastern half of the state already has acidic soil. While the Acid Rain Coordination Committee is looking into the possible ways of reducing the amounts of the emissions, Minnesota may have to gear up to rectify the consequences of acid rains on a crash basis. The question of relevance for Minnesota is not how to reduce the emissions, but how to save Minnesota agriculture from the possible devastating effects of continual acid rains.

Acid rains are bound to cause significant change in the soil and ground water pH which is the index of acidity or alkalinity. A pH of 7 is neutral, a pH above 7 is alkaline and a pH below 7 is acidic. Lower the pH value, greater the acidity.

The optimum soil pH ranges for crops vary. Alfalfa and sweet clover thrive at a pH range of 6.5 - 7.5 which is the near-neutral slightly-alkaline range. The optimum soil pH range for corn, soybeans and oats is 5.5 - 7 and that for potatoes is 5 - 5.5. Potatoes can withstand the most acidity whereas alfalfa would be the hardest hit if soil acidity increases and the pH falls. When acid rains hit the ground, initially there may be no change in the soil pH due to the buffering action of lime, phosphates and organic matter present in the soil. But once the buffering capacity is exhausted, a sudden drop in the pH would be inevitable. A drastic fall in the soil pH due to increased acidity if unreversed is bound to force a change in the cropping pattern. Alfalfa and red clover would be the first victims of such a change and may induce a complete change over to the growing of potatoes as that is the crop that can withstand high acidity. Present statistics indicate that yearly alfalfa production is a little above 7 million tons in Minnesota, and if there is drastic reduction in the production of this crop, it is bound to have adverse effects on the livestock industry. Corn and soybean may help initially to tide over the shock but the effect may be short-lived. The choice is obvious -- change the cropping pattern and risk upsetting the long established land management process or take correctional measures for the acidity.

The most effective correctional measure for soil acidity is the liming of soil. Limestone of the dolomitic type and marl are available in Minnesota and are quite effective. There is no way of predicting precisely how much of the total quantity of the oxides of sulfur and nitrogen would fall on the Minnesota soil. One may reasonably assume it to be a tenth of the total for the entire country, which would put the quantity at 2.6 million tons of the oxides of sulfur and 2.2 million tons of the oxides of nitrogen. The limestone required to neutralize the resulting acidity would be about 7 million tons. This is a huge quantity which would have to be quarried and transported over and above the current supplies.

A cheaper source which has not been used to any significant extent is the egg shell, consisting mostly of calcium carbonate, the same material that is in limestone. Minnesota produces 2.2 billion eggs annually, which has a potential for producing an equivalent of 10,000 tons of calcium carbonate from the egg shells. It is time this source is tapped.

Any corrective measures for soil acidity resulting from acid rains would involve careful soil testing and monitoring of soil pH on a massive scale state wide. The testing facilities now available in the private and public laboratories may well prove inadequate. This calls for a survey of existing testing facilities in the state to ascertain the potential to operate on an emergent basis and the preparation of a statewide plan to augment or create new facilities.

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