NITRATE TEST CLINICS IN MICHIGAN[1]

M. L. Vitosh, B. P. Darling and D. B. Campbell
Department of Crop and Soil Sciences
Michigan State University

ABSTRACT

Nitrate contamination of groundwater in Michigan is becoming an increasing public concern. Fertilizer N, animal manures and rural septic systems have been implicated as possible nonpoint sources of contamination. A state wide program of monitoring nitrate N in soil and well water was initiated. In the spring of 1989 and 1990, 74 nitrate testing clinics were conducted. Over 3,600 soil samples and 1,900 water samples were analyzed for nitrate N using the nitrate ion-specific electrode. More soil nitrate N was found in 1990 than in 1989. Adjustment in N fertilizer recommendations were based on the amount of nitrate N found in the 60 cm profile samples. The average adjustment for these fields was 37 lb N/A in 1989 and 70 lb N/A in 1990.

Fifteen to 20 percent of the farm wells sampled in these clinics exceeded the Public Health Department drinking water standard of 10 ppm nitrate N. Wells less than 50 feet deep had more nitrates than those greater than 50 feet deep. Wells located less than 50 feet from livestock facilities had more nitrate than wells further away. No correlation was found between nitrates in water and distance from septic systems.

OBJECTIVES

The objectives of the program were to: (1) offer soil and water nitrate N analysis to farmers and rural residents, (2) provide a quick turn-around time and interpretation of the analysis and (3) provide farmers with reduced N fertilizer recommendations based on the nitrate N found in two foot soil profile samples.

METHODS

A mobile nitrate testing van was equipped with an electrical generator, a nitrate ion-specific electrode, a soil grinder for grinding, mixing and screening dry soil samples, an electronic balance for weighing soil samples, a mechanical sample shaker, a computer and a printer for printing the report.

Farmers were asked to bring in two dry soil samples, 0-10 and 10-24 inches deep, from each field representing no more than 20 acres. They were instructed to air dry the samples before bringing them to the clinic.

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Water samples were collected the day of the clinic or refrigerated if taken before the clinic.

The nitrate extraction and analysis procedure for soil samples is described by North Central Regional Publication No. 221, "Recommended Chemical Soil Test Procedures for the North Central Region" (Bulletin No. 499 October 1988). Sulfamic acid was not used in the soil extract because no interference problems with chlorides or nitrites were anticipated. Nitrate analysis of the soil extract was made on the decanted but unfiltered soil-water slurry. Nitrate analysis of water was made on a 50 ml sample after adding 0.5 ml of 2M ammonium sulfate to obtain a constant ionic strength in all samples. A Hach Agri-Trak nitrate ion-specific electrode was used to determine the nitrate N in both soil and water samples.

RESULTS AND DISCUSSION

In the spring of 1989, 38 nitrate testing clinics were held in 36 counties. Over 2,200 soil samples and 1,500 water samples were analyzed for nitrate N. In 1990, 36 spring clinics were conducted where a total of 1,492 soil samples and 349 water samples were analyzed.

Soil Nitrate Analysis

The frequency of distribution for nitrate N in soil samples is shown in Fig. 1 and 2. In 1989, more than 50 percent of the samples contained less than 30 lb/A-2ft of nitrate N (4 ppm). No credit was given for samples that contained less than 30 lb N/A-2ft. Thus, only 35 percent of the 1,100 fields sampled in 1989 were given a N credit. The average adjustment for these fields was 37 lb N/A.

In 1990, a much larger number of fields (79%) contained greater than 30 lb N/A-2ft. Nearly 50 fields had more than 150 lb N/A-2ft. Nitrogen credit in 1990 was based on all of the nitrate N found in the 2 foot profile samples. More than 50 percent of the fields received an adjustment of greater than 55 lb N/A.

Manured fields in both years contained significantly more nitrate than non-manured fields (Fig. 3). In 1989, significantly more nitrate N was found in those fields where manure was spring applied compared to fall applied (Fig. 4). No differences were observed in the 1990 data. The difference between 1989 and 1990 is probably due to the wet fall of 1988 compared to a relatively dry fall and mild winter of 1989-90.

Information on the amount of N fertilizer used in the previous year was obtained for each field tested. There was a poor relationship in both years between the amount of N applied in the previous year and the amount of soil nitrate found in the spring.

Water Nitrate Analysis

The data for water samples is shown graphically in Fig. 5-10. In 1989, 20 percent of the samples exceeded the 10 ppm U. S. Public Health

Department standard. In 1990, 15 percent of the wells were above the 10 ppm standard. These percentages are probably biased upward because those people who suspect nitrates to be a problem or those who have previously found nitrates in their water, continue to test. Those people who have tested and found little or no nitrates, do not retest their wells.

Information on well depth was obtained for 567 wells in 1989 and 290 in 1990. The effect of well depth on nitrate content of water is shown graphically in Fig. 7 and 8. Higher levels of nitrate contamination were found in shallow wells (less than 50 feet deep).

In 1989, there were 407 wells associated with livestock farms. The number in 1990 was 204. The location of livestock facilities in proximity to the well head and the associated levels of nitrate in the water is shown graphically in Fig. 9 and 10. Wells located less than 50 feet from a livestock facility contain more nitrate than those wells located more than 50 feet from a livestock facility.

Well distance from septic systems was also obtained in this study, but there was no significant correlation between nitrate N concentration and distance from septic systems.

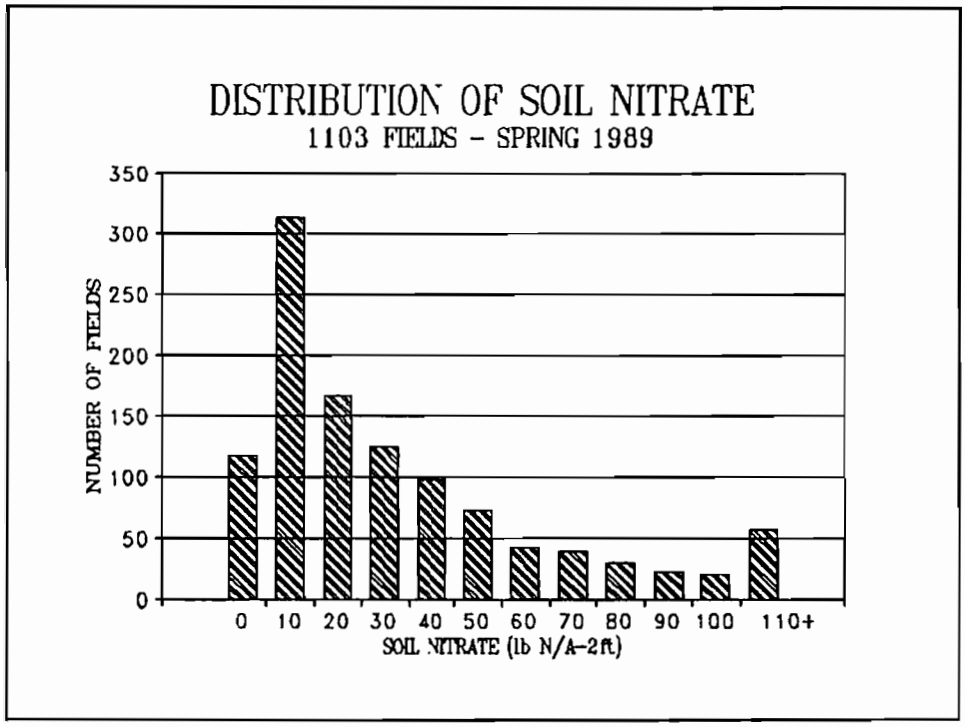

Figure 1. Distribution of soil nitrate in 1103 fields tested in the spring of 1989.

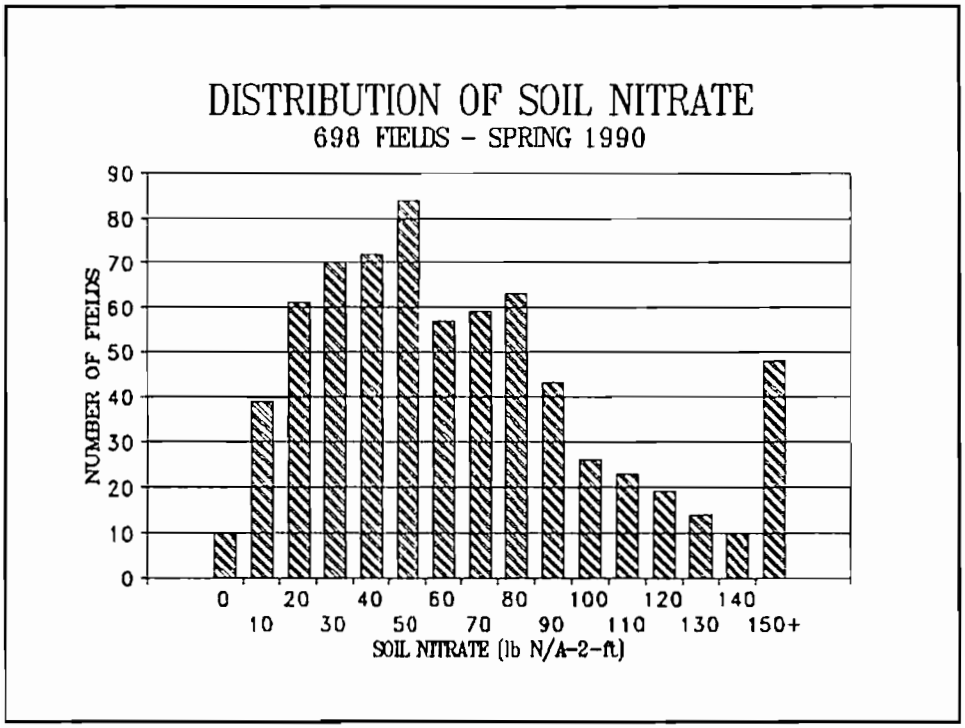

Figure 2. Distribution of soil nitrate in 698 fields tested in the spring of 1990.

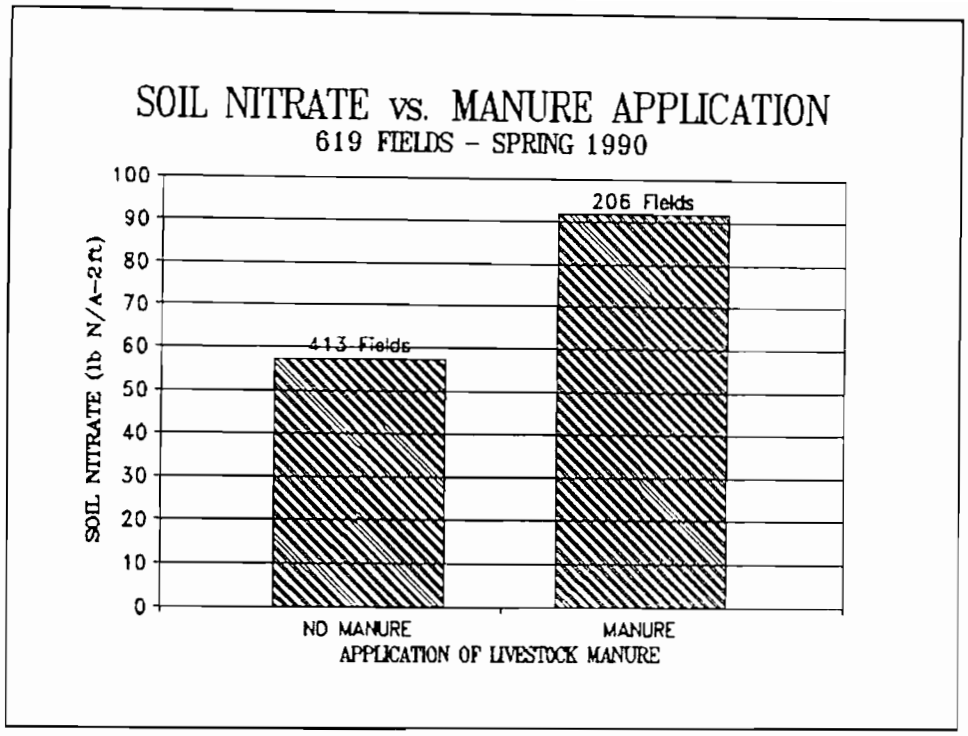

Figure 3. Soil nitrate content of manured and non-manured fields tested in the spring of 1990.

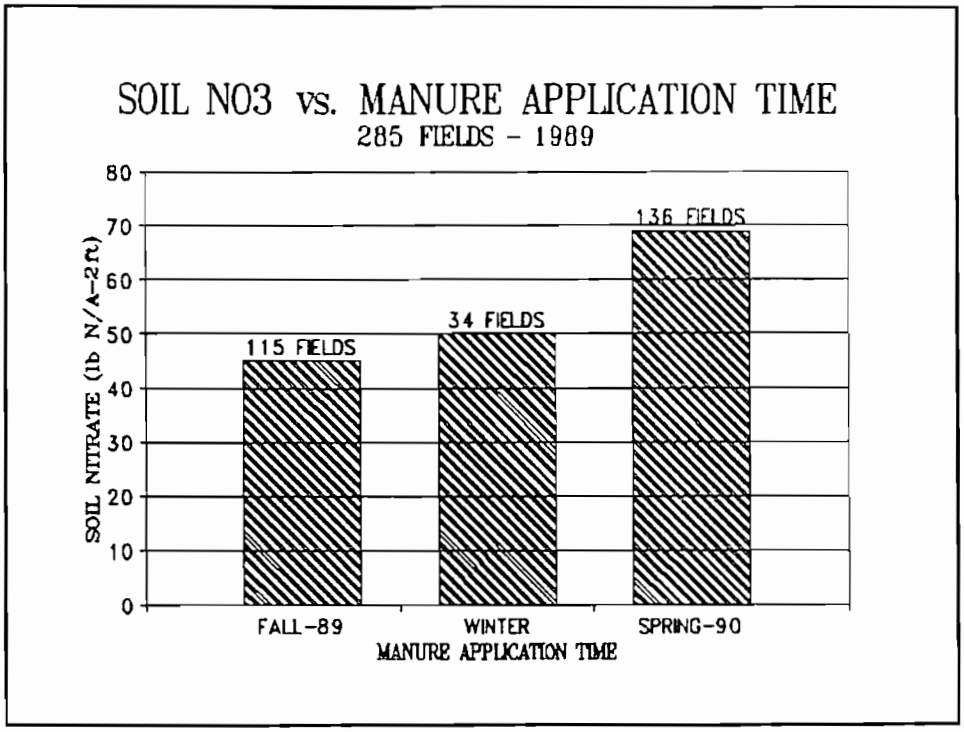

Figure 4. Soil nitrate content of 285 manured fields tested in the spring of 1989 as affected by time of manure application.

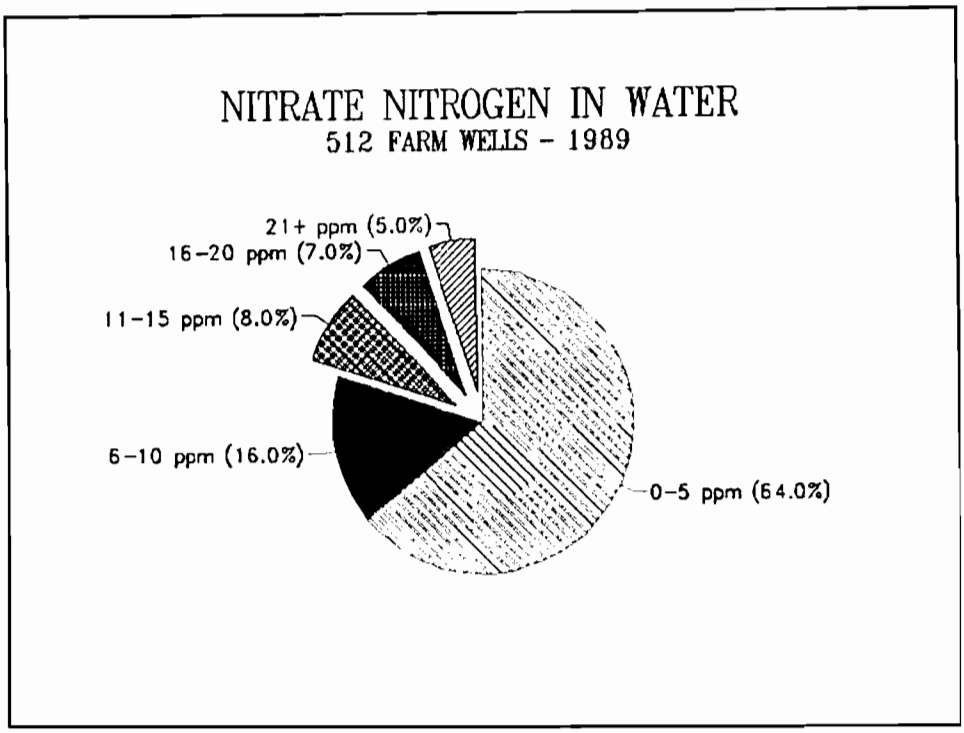

Figure 5. Percentage of farm wells tested in 1989 with various levels of nitrate N.

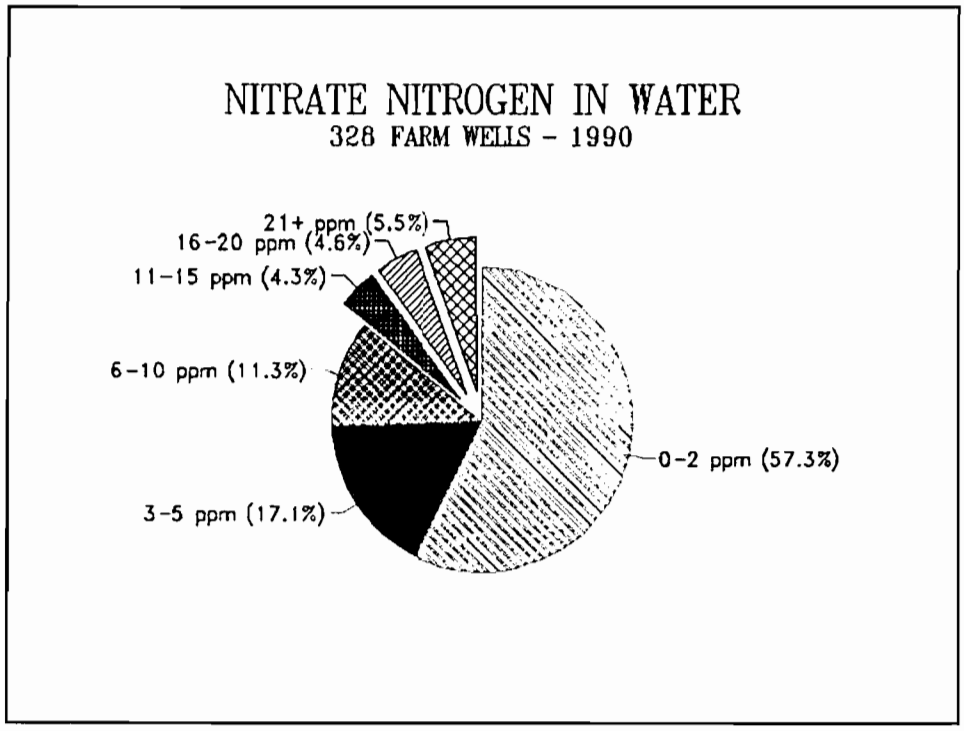

Figure 6. Percentage of farm wells tested in 1990 with various levels of nitrate N.

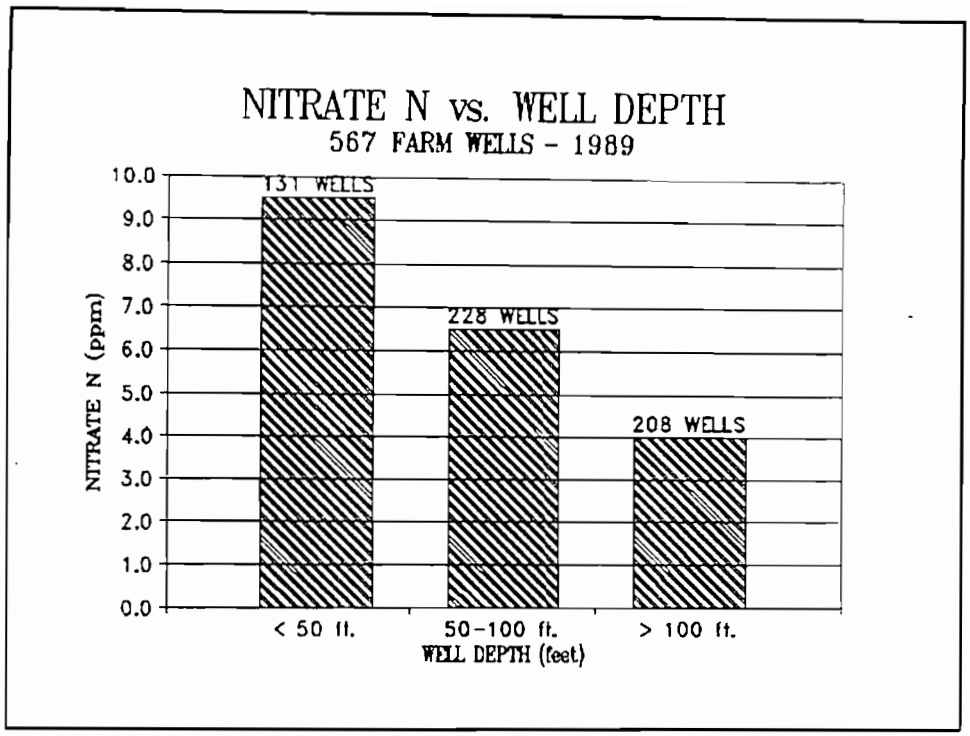

Figure 7. Nitrate N content of 567 farm wells tested in 1989 as related to well depth.

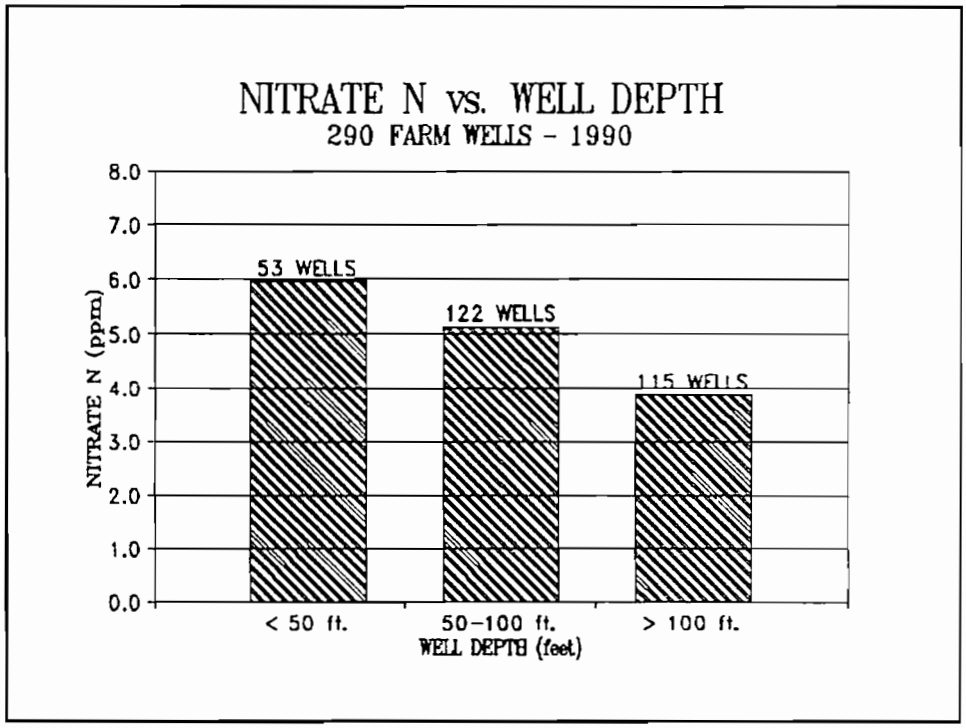

Figure 8. Nitrate N content of 290 farm wells tested in 1990 as related to well depth.

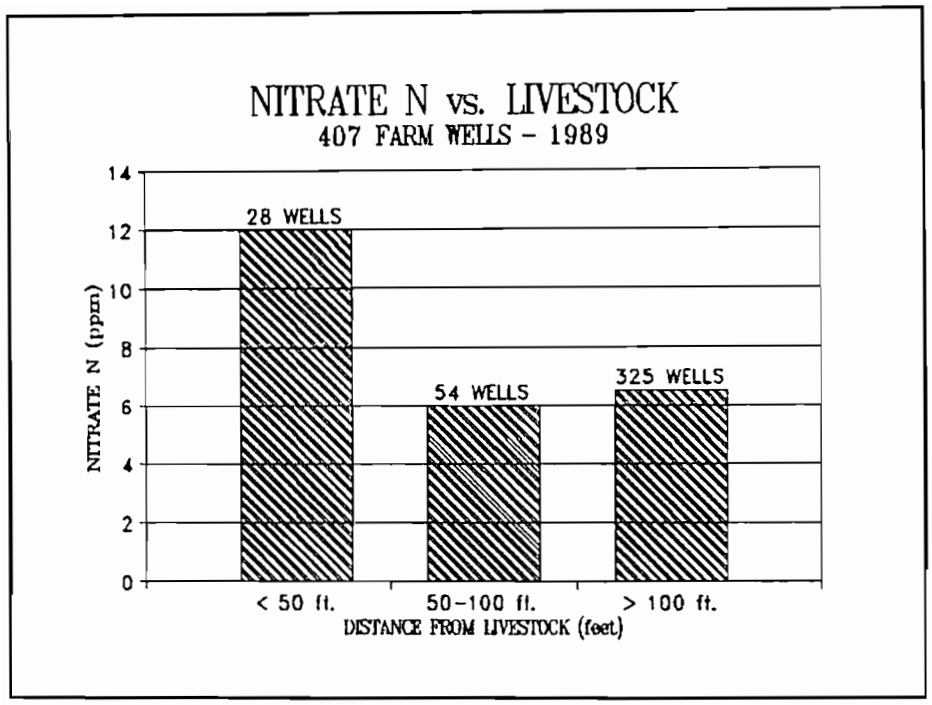

Figure 9. Nitrate N content of 407 farm wells tested in 1989 as related to distance from livestock facilities.

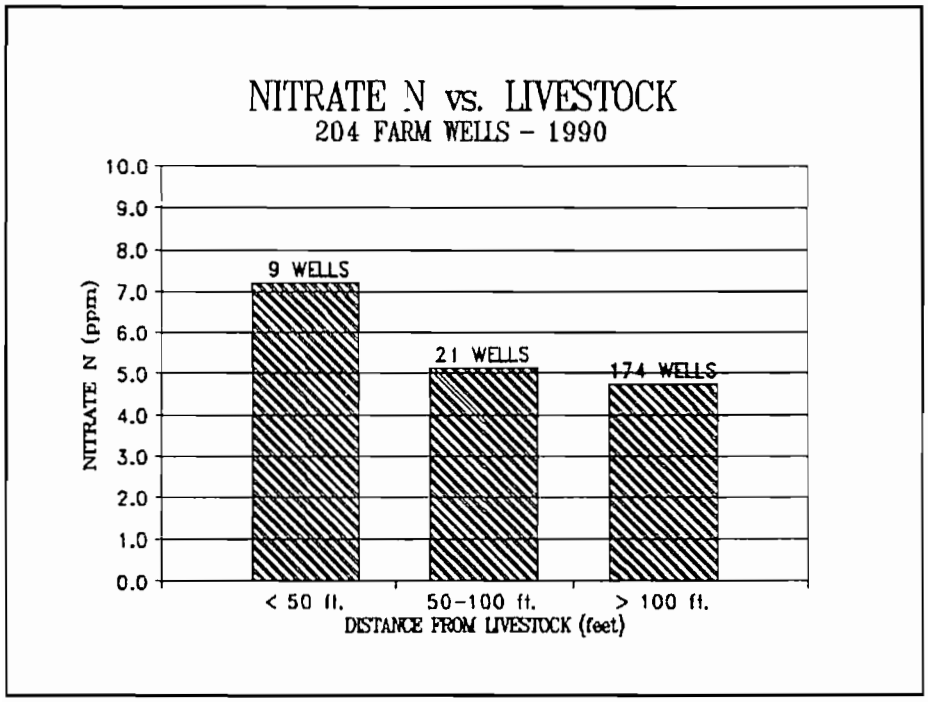

Figure 10. Nitrate N content of 204 farm wells tested in 1990 as related to distance from livestock facilities.

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Department of Agronomy
Purdue University
Lilly Hall of Life Sciences
West Lafayette, IN 47907-7899