SPATIAL VARIABILITY OF SOIL TEST PHOSPHORUS IN A NORTHERN CORN BELT FIELD

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INTRODUCTION

For some time, an increasing number of fertilizer dealers, crop consultants, and farmers have reported substantial year-to-year variability in soil test values for phosphorus (P) and potassium (K). Frequently, this variation could be explained by such factors as extremes in soil moisture content at the time of sample collection. In many situations, however, this variation was due to the fact that soil samples were not collected from the same location in the field in two consecutive years.

The introduction of the concept of variable rate fertilizer application and the associated use of grid sampling has also documented the variability in soil test values across fields. Several new questions have surfaced as a result of the increased interest in grid sampling.

Some of the more important ones are:

1) Is the use of variable rate technology and grid sampling economical?

2) Is there an ideal or recommended size for grid cells when sampling for P and K?

3) What is the recommended technique for sampling individual grid cells?

4) Does time of sampling affect soil test values for P and K?

EXPERIMENTAL PROCEDURE

In order to provide answers to these questions, a study was established in Sibley County in central Minnesota in June of 1993. Previously, this field had been divided into 4.5 acre grid cells and sampled by a crop consultant. Results of this sampling showed substantial variability in soil pH, P (Bray Procedure), and K (ammonium acetate).

In June of 1993, a portion of the field measuring 360 ft. x 1320 ft. was divided into 60 ft. x 60 ft. grid cells. The field was planted to soybeans in 1993. Each row of cells, measuring 60 ft. x 1320 ft., was further divided into 15 ft. x 1320 ft. strips with each strip designated to receive a different application of

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phosphate following the fall harvest of soybeans. The phosphate rates were 0, 30, 60, and 90 lb P_2O_5 per acre. Each rate of phosphate was replicated six times in the study area.

Beginning in June of 1993, soil samples (0-6 inches) were collected from the six strips that would not receive phosphate fertilizer. The samples were collected at 60 ft. intervals, dried, ground, and analyzed for pH, organic matter content, P (Bray and (Olsen procedures) and K by routine soil testing analytical procedures. Collection of the samples from the same sites was repeated in October 1993 and June of 1994. Each sample consisted of a composite of nine cores.

RESULTS AND DISCUSSION

The results of the analyses of 22 samples collected in each of six strips were krilged and the results are shown in Figures 1-4. Soil pH varied from approximately 8.0 to 6.3 (Figure 1). A higher percentage of samples had pH values near 8.0 when samples were taken in June of 1993. In general, there were no major differences with time of sampling. There is no major reason to anticipate a change in soil pH over time and these results support that expectation.

The organic matter percentages were divided into six categories (Figure 2). As was true with soil pH, there were no substantial differences in organic matter content from June of 1993 to June of 1994. The range of organic matter content in the study area, however, was substantial.

Soil test P, as measured by the Bray and Kurtz No. 1 procedure, varied from very low to very high in the study area (Figure 3). As would be expected, the very low soil test values were associated with soil pH values that were calcareous. There were no substantial changes in soil test P as measured by the Bray and Kurtz procedure with time. A rather steep gradient in soil test P was found near the west end of the study area.

Soil test P, as measured by the Olsen procedure, ranged from low to very high (Figure 4). The lowest values were found where the soil pH was in excess of 7.5. In general, there were no major changes in soil test P as measured by the Olsen procedure with time.

The results from the study site in Sibley County document the variability in soil test P that can be found in one part of an individual field. This variability also exists on a larger scale. In 1993, one consulting firm used grid sampling on 53,000 acres in the Minnesota River Valley Watershed. The size of individual grid cells was approximately 4.4 acres. The distribution of soil test values for P is summarized in Table 1.

Table 1. The distribution of soil test P for soil samples from 53,000 acres in the Minnesota River Valley Watershed.

Soil Test Category	Percentage of* Samples
VL	5
L	19
M	25
H	17
VH	34

* Information supplied by Tom McGraw of Minnesota Crop Monitors and Randall Hemb of Minnesota Valley Soil Testing Laboratories.

SUMMARY

Results of this study, at one site in Sibley County Minnesota, show that variability in soil test P can be substantial. This variability was evident when samples were analyzed by both the Bray and Kurtz, and the Olsen procedures.

The information gathered to date is also important for crop consultants and fertilizer dealers who collect a large number of soil samples. If grid sampling is to become a common practice, it will be necessary to collect samples throughout the early part of the growing season in a corn-soybean rotation. The results of this study indicate that soil samples can be collected in either June or October and have no major effect on fertilizer recommendations for phosphate use.

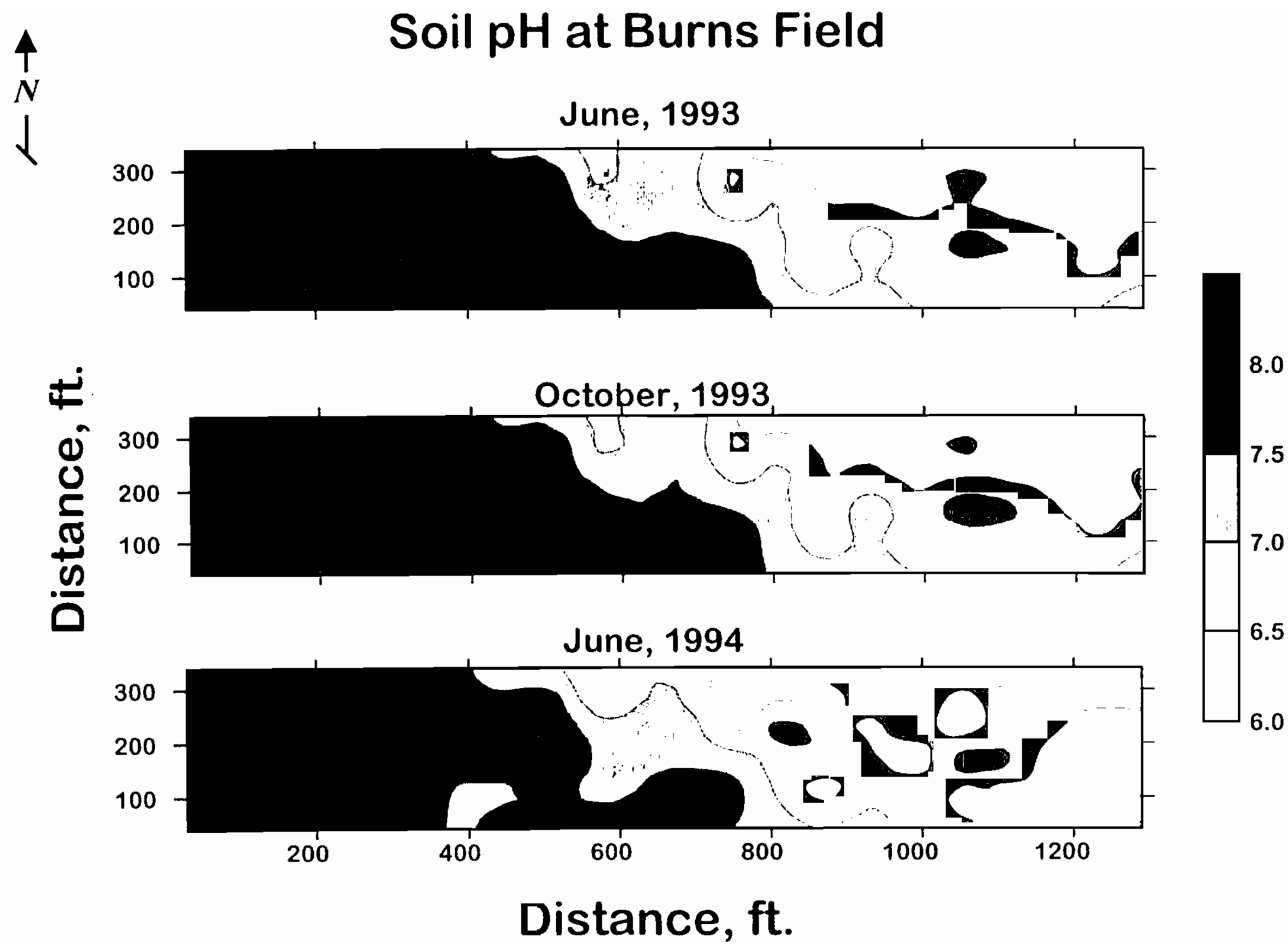

Figure 1. Soil pH as affected by time of sample collection in Sibley County Minnesota.

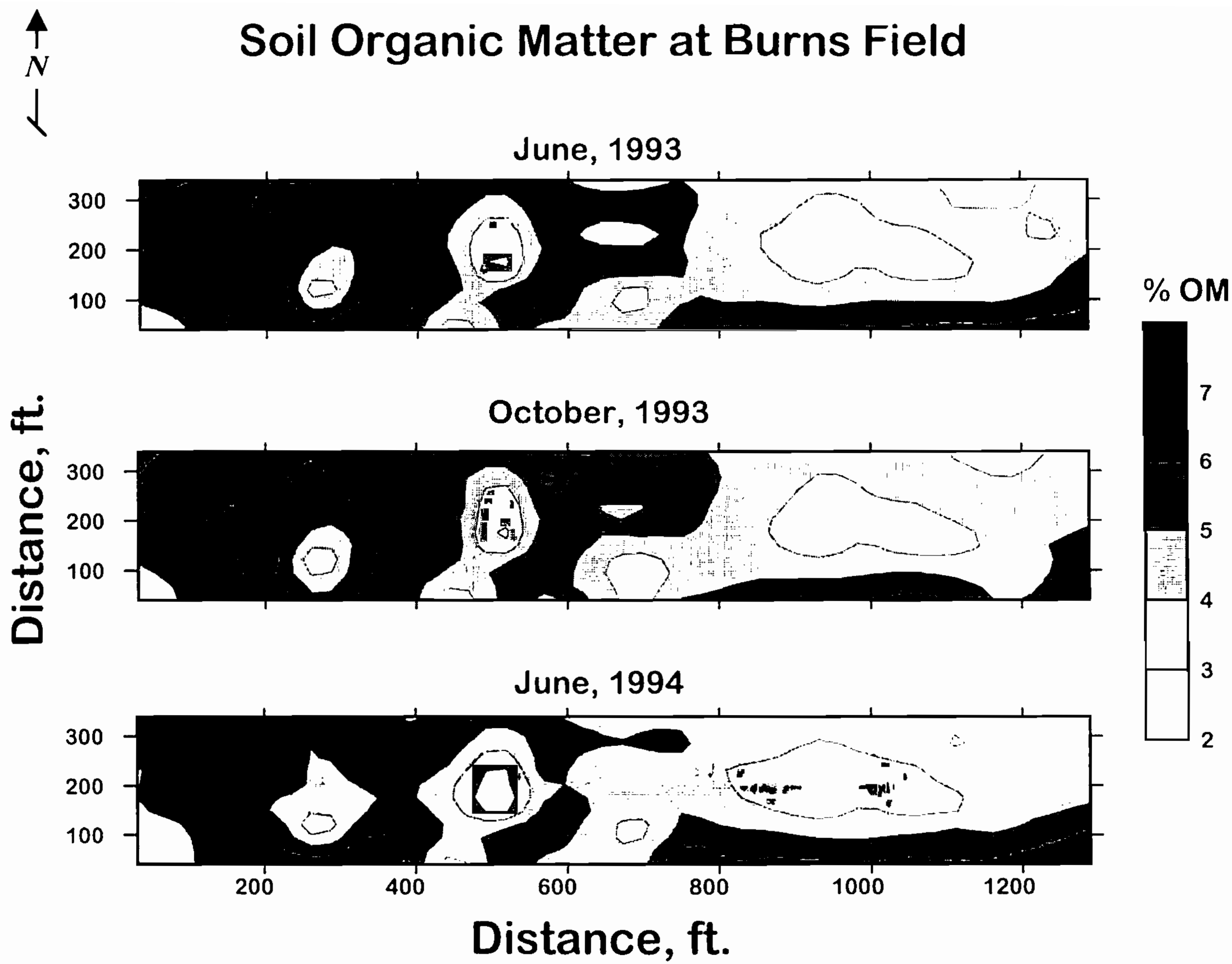

Figure 2. Soil organic matter content (%) as affected by time of sample collection in Sibley County Minnesota.

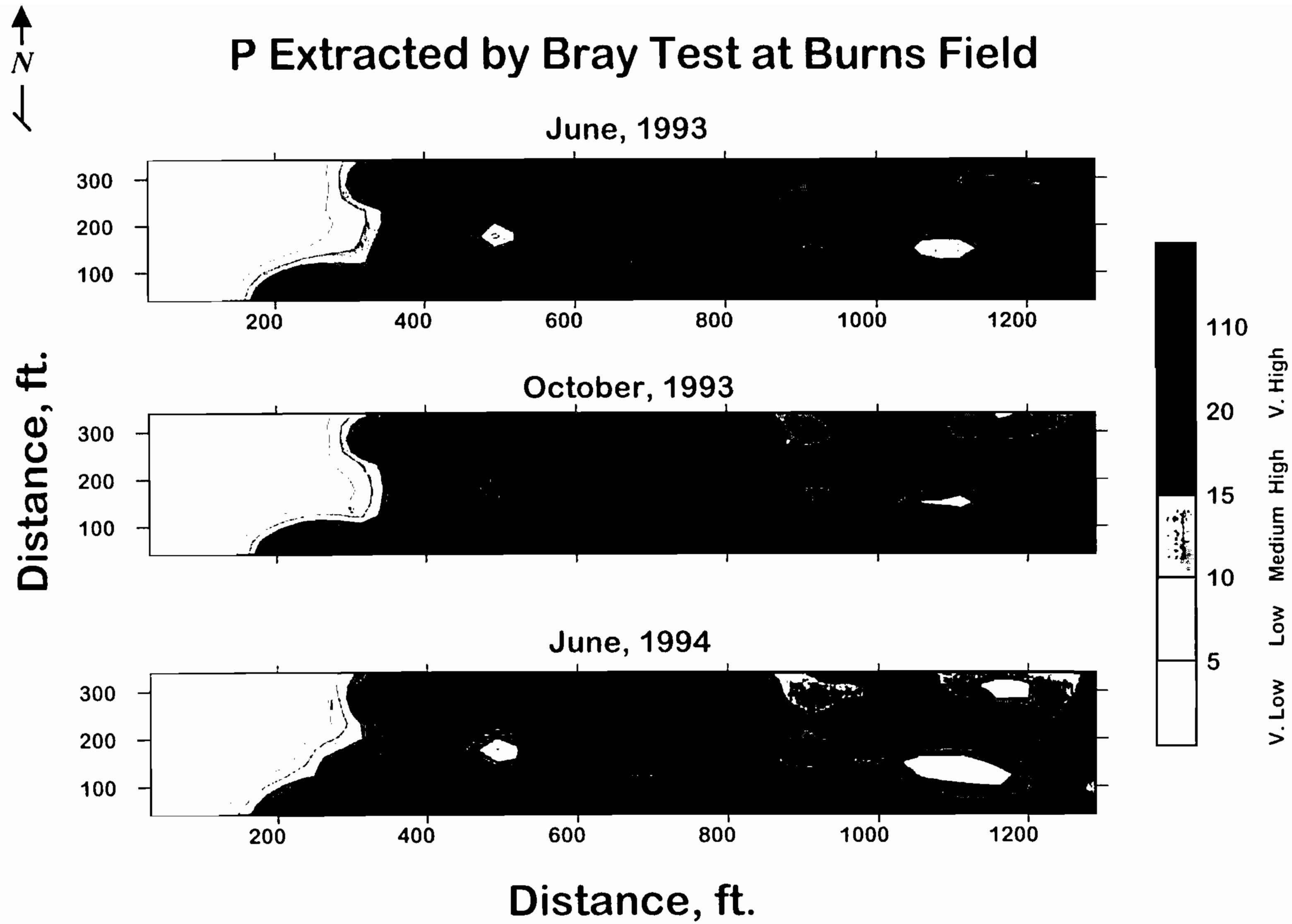

Figure 3. Soil test P (ppm) measured by the Bray and Kurtz procedure as affected by time of sample collection in Sibley County Minnesota.

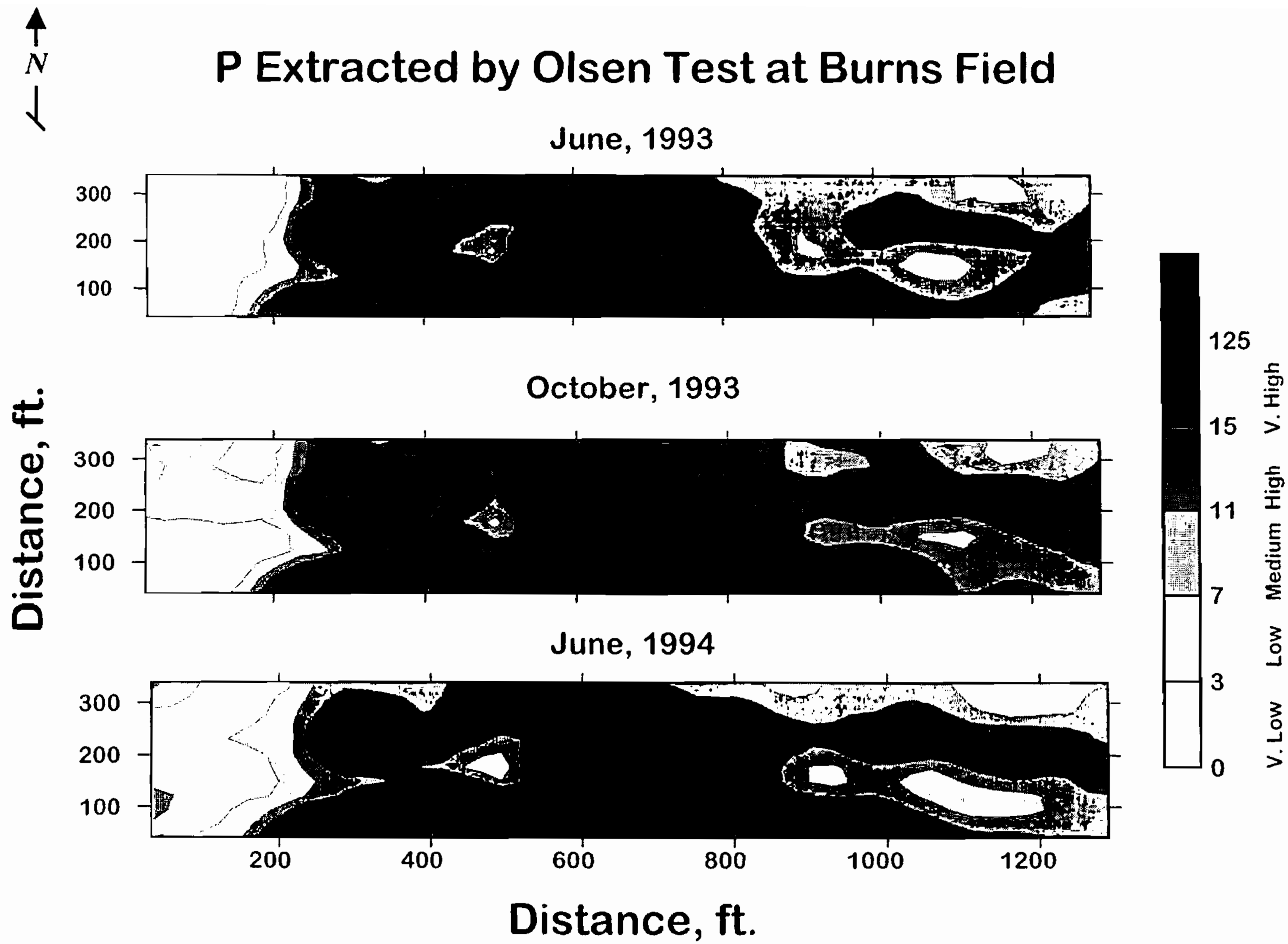

Figure 4. Soil test P (ppm) measured by the Olsen procedure as affected by time of sample collection in Sibley County Minnesota.

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