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NITROGEN TRANSFORMATION PROCESSES IN AGRICULTURAL WATERSHED SOILS

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IN AGRICULTURAL WATERSHED SOILS

FINAL REPORT on PROJECT 11

AGRICULTURAL WATERSHED STUDIES

Task C (Canadian Section) - Activity 1
International Reference Group on Great Lakes
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G.C. Kowalenko

Soil Research Institute
Agriculture Canada
Ottawa, Ontario

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SUMMARY

Soils were characterized with respect to the rates of biological processes important to N leaching considerations. Nitrification was shown to be a relatively fast process which was related to temperature and moisture content conditions. The cross product of temperature X water content was particularly important. A regression equation including these environmental factors was derived for several groups of soils, depending largely on textural differences.

Mineralization was particularly influenced by environmental factors (temperature and moisture content) when soil (%C, %N, pH, etc.) and environmental factors were considered. An estimate of the amount of N produced by mineralization under field conditions suggested considerable N released, depending on the soil type. More precise calculations would need detailed knowledge of field conditions of moisture and temperature and applying the relationships derived in this study to these conditions. Incorporation of plant residues alters the mineralization-immobilization pattern in soils considerably and is dependent on the content of the plant material. Material with a low percentage N results in net immobilization of N. Organic amendments must be considered in the long term for N considerations because of changing mineralization-immobilization relationships.

Denitrification can progress very quickly if warm anaerobic conditions are met. The rates suggest that short but quantitatively large bursts of denitrification may be important in NO_3^- losses and these may occur during or immediately after rains. Calculation of field significance will depend on detailed knowledge of field moisture and temperature conditions.

Asymbiotic N fixation does not appear to be an important source of N in these soils.

Mineralization and denitrification appear to be two key processes to consider in addition to soil N leaching.

INTRODUCTION

The objective of this study was to characterize N transformation rates in a variety of soil types and horizons using laboratory incubation conditions and to evaluate how these conditions influence the rates. Biological transformations influence the sources and sinks of NO_3^--N to the ground water. These rates are viewed as providing information for a mathematical model of N transport and transformation in the unsaturated soil zone in order to contribute to an understanding of the N storage and release characteristics of selected agricultural soils in the watersheds.

DATA COLLECTION METHODS

Soils

Soils were from three (3) watersheds (#1, #5 and #13) and comprised thirty-one (31) samples. The soils from watersheds 1 and 13 correspond to plot areas of Project 13 (Cameron et al., 1977. Nitrogen Movement in Tile-Drained Clay and Sandy Agricultural Watersheds. Final Report on Project 13, Agricultural Watershed Studies, Task C (Canadian Section) Activity 1, International Reference Group on Great Lakes Pollution from Land Use Activities. I.J.C.) and included surface and subsurface samples, as well as samples from a similar area taken at two different times (spring *vs.* fall). The soils from watershed #1 are Brookston clay and from watershed #13 are Berrien sand and were sampled in the spring and fall of 1975. Only surface soils were sampled from watershed #5, and they represent five (5) distinct soils (Table 1). All were sampled on September 9, 1975. Some characterizing analyses are given for all the samples (Table 2).

Sample Code Designation

Samples are identified by numbers and/or letters and can be categorized into two main groups. Those with a 2 number code (eg. 1-1, 2-1, 1-3, etc.) designate samples from plot studies (Cameron - Project 13). The first digit designates the plot number (i.e. there are six (6) plots numbered 1, 2, ... 6). The second digit designates the horizon depths which are as follows:

1	0-10 cm
2	10-20 cm
3	20-30 cm
4	30-45 cm
5	45-60 cm
6	60-75 cm
7	75-90 cm

In four cases, the 2 number code is followed by a letter (eg. 2-1-b) and this letter (b) designates a second sampling date, to evaluate how sampling time affects the results.

Samples designated by N-5 are samples from watershed 5. All samples are surface samples to a depth of 25 cm (except N-5/1 which is to 20 cm). The third digit denotes the soil within the watershed.

Incubation Systems

1) "Aerobic" incubations for:

a) Nitrification and Mineralization

Soil samples were incubated using combinations of addition and no addition of $(NH_4^+)_2SO_4$ for twenty-one (21) days at 30% and 75% to field capacity water content at 4^o, 15^o and 30^oC temperatures. The level of $(NH_4^+)_2SO_4$ addition was 80μg NH_4^+-N/g soil. Field capacity moisture content was taken to be 100 cm water tension, performed on a water tension table apparatus. Extraction of inorganic N was done using a sequential extraction using first 0.005 M $CaCl_2$ then 2N KCl (1:4 soil weight to extractant volume) for ½ hr., centrifuged, and solution filtered and analysed for NH_4^+-N and NO_3^--N using autoanalyser. By operational definition, the $CaCl_2$ extracts all the NO_3^--N plus all the soluble NH_4-N. The KCl extracts the exchangeable NH_4^+-N. Corrections for carry-over of soluble NH_4^+-N and NO_3^--N were made using a weighing technique. The samples were extracted immediately after addition of solution (to bring the soil to required water content and N addition) and after 5, 14 and 21 days of incubation. Sufficient 5 g samples were prepared to allow incubation and extraction, in duplicate, at each time and with each combination of temperature, water content, and $(NH_4^+)_2SO_4$ addition. The incubation vessels were closed but aerated every two (2) to three (3) days throughout the incubation period to restrict water loss and maintain aerated conditions. After preliminary trials, some of the incubations were simplified by eliminating the analysis on the fifth day of the incubation, since it was too close to the initial burst of activity after wetting the air dry samples. Also only a KCl extraction was used, eliminating the $CaCl_2$ extraction, resulting in bulking soluble and exchangeable NH_4^+-N into a single extractable fraction.

b) Mineralization of Plant Material

Plant material (finely ground) was added to Berrien and Brookston soil samples (equal mixtures of 2-1 and 2-2, and 5-1 and 5-2, respectively) taken to field capacity moisture content and incubated at 30C. Incubation was in beakers, covered with parafilm, having small aeration holes, and moisture maintained by weighing and water additions. The soil was sampled at days 0, 15, 30 and 60 for inorganic nitrogen analyses.

Plant materials added to the soils were from the field plots and were added at a rate corresponding to harvest of dry matter (i.e. 320, 1430, 1790 and 5370 mg/100 g. soil, using rye, soybean, wheat and corn respectively). Nitrogen content of these materials were 2.32, 2.58, 1.18 and 0.99% for rye, soybean, wheat and corn respectively.

2) "Anaerobic" incubations for:

a) Denitrification

Soil samples were incubated using combination of, addition and no addition of NH_4NO_3 for five (5) days at 75%, 100% and 120% of saturation water contents at 4^o, 15^o and 30^o temperatures (C). The level of NH_4NO_3 addition was 80μg NO_3^--N/g soil and 80μg NH_4^+-N/g soil. No other amendments were made so the denitrification process was dependent on nutrients and energy sources inherent in the soil sample. Saturation water content was determined by adding water in small measured increments to a know weight of soil to a point just before free water was evident. Extraction of inorganic N was with 2N KCl (1:4 soil weight to extractant volume) for ½ hour, filtered and analysed for NH_4^+-N and NO_3^--N using autoanalyser. The samples were extracted immediately after addition of solution (to bring the soil to required water content and level of N added) and after two (2) and five (5) days incubation. Sufficient 5 g samples were prepared to allow incubation and extraction in duplicate at each time and with each combination of temperature, water content and NH_4NO_3 addition. Incubation vessels were closed through the period to restrict water loss. Laboratory tests showed that closing or leaving the vessels open made no difference on the N analysis, therefore for convenience the closed system was used. No other control of the gas phase was made. After several trials, the incubations were streamlined by including only one moisture content (saturation).

b) Asymbiotic N fixation

The incubation system was similar to the denitrification experiments, except that no N treatments were included and only one combination of moisture content (saturation) and temperature (30C) was used. Inorganic nitrogen and N fixation was measured by the ability of the system to convert acetylene to ethylene over a three-day period.

Inorganic N analyses: NH_4^+-N and NO_3^--N were analysed by autoanalyser using a distillation step (Keay, J. and P.M.A. Menage, 1970, Analyst 95:279-382; Quinn J.R., J.G.A. Boisvert and I. Wood, 1974, Anal. Biochem. 58:609-614). Presence or absence of NO_2^- was first determined by spot test and if present, quantitative analysis was determined by modified Greiss-Ilosvay color reaction (Bremner, J.M., 1965, Inorganic forms of nitrogen IN Methods of Soil Analysis Part 2 Chemical and Microbiological Properties, Agronomy Series No. 9 Amer. Soc. Agron. Madison pp. 1219-1224).

EXPERIMENTAL RESULTS

The results of the incubation experiments designed to examine rates of mineralization and nitrification in watershed soils are shown in Table 3. Besides giving information on rates, the results provide some information on other processes such as adsorption and fixation of NH_4^+-N. Plotting soluble and exchangeable NH_4^+-N values on a log-log scale, a straight line relationship was perceived. Distinct relationships were evident for the clay and sandy loam soils from watersheds #1 and #13. The following relationships were derived for soil 2-1 (sandy loam) and soil 4-1 (clay) respectively:

$$(NH_4^+\text{-N})_{\text{exch.}} = 6.8\left[(NH_4^+\text{-N})_{\text{sol}}\right]^{0.58} \qquad (1)$$

$$(NH_4^+\text{-N})_{\text{exch.}} = 1.6\left[(NH_4^+\text{-N})_{\text{sol}}\right]^{0.76} \qquad (2)$$

The relationship shows that a much larger proportion of the NH_4^+-N goes on to the exchange sites in the clay than in the sandy loam soils. This reflects the available cation exchange sites. This means a much greater potential of leaching NH_4^+-N in sandy loam soils than in clay soils or more precisely in soils of low cation exchange than with high cation exchange.

The Brookston clay soils contain a large quantity of fixed NH_4^+-N and the Berrien sandy loam soils contain smaller but measureable amounts (Table 2). Since NH_4^+-N was added to the soils in the mineralization-nitrification incubations and extracted immediately, the ability of the samples to fixed NH_4^+-N can be assessed. Table 4 shows that negligible amounts of NH_4^+-N was fixed in the Berrien sandy loam, whereas the Brookston clay showed some fixation in the subsoils. Small to negligible amounts were fixed in the surface, possibly showing that the fixation sites are almost completely saturated by fertilization, etc. Soils from watershed #5 showed low to negligible ability to fix NH_4^+-N.

Nitrification

Nitrification is the oxidation of NH_4^+-N to NO_3^--N, which in soils, is mediated by micro-organisms. Although it has long been recognized that this is a two step process ($NH_4^+ \rightarrow NO_2^- \rightarrow NO_3^-$) with each step being done by a particular genus of autotrophic bacteria, the oxidation is often viewed as a single process. The initial step ($NH_4^+ \rightarrow NO_2$) is usually the rate limiting step and hence NO_2^- rarely accumulates in normal soils due to nitrification. For purposes of this study, the oxidation of NH_4^+-N will be discussed as a single process.

Nitrification was measured in these soils by adding a know quantity of NH_4^+-N (80µg N/g soil) and monitoring changes in extractable inorganic N. Simultaneous to nitrification, mineralization of organic N also occurs. The end product is NH_4^+-N, which in turn, is nitrified. NH_4^+-N rarely accumulates in a mineralizing soil, (i.e.) all NH_4^+-N resulting from mineralization is nitrified immediately. The nitrification rate calculated in this experiment utilizes information from the NH_4^+-N treated plots. NH_4^+-N was added only at the beginning of the incubations, hence as the experiment progressed, the NH_4^+-N may decrease to a point where it becomes limiting. The rate of nitrification can be calculated many ways, but considering the probability of NH_4^+-N becoming limiting, a rate coefficient involving loss of NH_4^+-N and gain of NO_3^--N was used. The actual calculation assumed a first order relationship (Cameron, D.R. and C.G. Kowalenko, 1976, Can. J. Soil Sci., 56: 71-78).

$$k_n = -\ln(N_t/N_o)/t$$

where k_n = rate coefficient of nitrification (day^{-1}); N_o = original control NH_4-N concentration and

$$N_t = \frac{N_t^{1} + N_t^{11}}{2}$$

N_t^{1} = net loss of fertilizer NH_4^+-N over time t and N_t^{11} = net gain of NO_3^--N due to the fertilizer NH_4^+-N added. By including both the NO_3^--N gain and NH_4^+-N loss results more of the anlytical data was used, thus increasing the reliability of the calculation. These rate coefficients were then calculated for 0-14 and 14-21 day intervals and the average of these two gives the accepted rate coefficient.

The rate coefficients calculated in this way are presented in Table 5. Each soil has six (6) rate coefficents from combinations of three (3) temperatures (4, 15, 30C) and two (2) moisture contents (30 and 75% of field capacity). The rate coefficient changes considerably within a single soil, depending on the moisture and temperature combination. In a few cases, the rate could not be calculated because there was more inorganic N than could be accounted for by fertilizer N (i.e. mineralization was higher in fertilized than control samples). The nature of the soil also influences the coefficient considerably. The surface layers (0-10 and 10-20) of Berrien sandy loam samples (numbers 1, 2 and 3) had an average coefficient of 0.010 day^{-1}, with a range of -0.002 to 0.033 day^{-1} and the corresponding layers of Brookston clay samples (numbers 4, 5 and 6) had an average coefficient of 0.073 day^{-1}, with a range of 0.027 to 0.141 day^{-1} for 15C and 75% of field capacity moisture content, as an example. Comparison of samples (at 15C and 75% of field capacity) taken.

at two (2) different times (2-1 and 2-1b, 2-2 and 2-2b, 5-1 and 5-2b) show considerable variation. Rate coefficients for subsurface horizons are lower than surface horizons.

Correlation coefficients of nitrification rate coefficients with temperature and moisture show that the interaction between temperature (T) and moisture content (θ) is the highest in all the surface samples and that a multiple correlation of all factors was not very much higher than the simple correlations. Correlations among factors for the Berrien sandy loam are the lowest of the three (3) groupings of soils. This relationsip among the environmental variables and the rate coefficient was similar to previous work (Cameron, D.R. and C.G. Kowalenko, 1976, Can. J. Soil Sci., 56, 71-78). The regression equation relating the nitrification rate coefficient to environmental variables of this study are as follows:

Brookston clay: $$k_n = 10^{-3}(9.913 + 0.3845T\theta - 3.443T - 1.06030\theta \qquad (4)$$

Berrien sandy Loam: $$k_n = 10^{-3}(1.569 + 0.209T\theta - 0.5684T - 0.6769\theta \qquad (4)$$

N-5 $$k_n = 10^{-3}(-4.515 + 0.4993T\theta - 4.3837T + 0.4811\theta \qquad (6)$$

These relationships are, in general, similar to the previous study (Cameron and Kowalenko, 1976) of an Ottawa area soil which was derived in a slightly different way. That relationship was

$$k_n = 10^{-3}(9.537 + 0.374T\theta - 0.545T - 0.2903\theta) \qquad (7)$$

Mineralization

Although in the strictest sense, mineralization is the conversion of organic N to NH_4^+-N, nitrification is so rapid that it appears as NO_3^--N instead. To measure mineralization in these samples, the accumulation of organic N in a moistened soil (no N added) is taken as the net mineralization. "Net" mineralization is used since both mineralization and immobilization occur simultaneously, and only the net result can be measured. As with nitrification, mineralization rates can be calculated from the results in a number of ways. It was finally decided to use a weighted average daily rate. A rate coefficient was not attempted since one must measure or assume a decline in organic N. Organic N in a soil is a complex component, with fractions having variable degrees of availability toward mineralization, making meaningful measurements virtually impossible with present knowledge. The weighted average rate was calculated as follows:

$$r = .5(N_{14} + N_{21} - 2N_o)/17.5$$

where r = weighted daily rate of mineralization (μgN/g soil/day), N_o = initial inorganic concentration (μgN/g), N_{14} = inorganic N concentration at day 14 (μgN/g), N_{21} = inorganic N concentration at day 21 (μgN/g) and 17.5 is the average of 14 and 21 days. The average rate was weighted in such manner to emphasize results of the later part of the incubation period since early in the incubation, there may have been a flush of activity due to wetting an air dry soil.

Table 7 shows the calculated weighted average daily rate of mineralization. As with nitrification, the rate of mineralization is higher in the Brookston clay than in the Berrien sandy loam, and in both soils, it decreases with depth. Unlike nitrification, the amount of the source material (organic N) is difficult to quantify and is not considered in the rate calculation of mineralization (i.e. for nitrification NH_4^+-N is incorporated into the rate coefficient calculation). For this reason, correlations were extended beyond just environmental factors, but also soil characterization values (Table 8). It is evident that correlations are poor to non existant with characterizing analyses, but better with environmental factors, particularly with moisture content and moisture content x temperature.

A generalization that 1 to 3% of soil N is mineralized yearly, has often been made (see Appendix 1 p. xix). Using this approach, the rate of mineralization can be calculated for watershed soils (Table 9). Assuming that the soil actively mineralized during 150 days (late spring to early fall) then average daily rates would range from 0.06 to 0.25 μgN/g/day. Table 9 also shows the very large pool of N in the surface 15 cm of the soils and small changes in daily rate of mineralization can be a very significant inorganic N source on a yearly basis.

The results from the soil-plant residue incubation show the influence of plant residue N concentration on the net mineralization-immobilization (Table 10). In the Brookston clay, only the soybean residue treatment resulted in net mineralization of N relative to the control, but in the Berrien sandy loam soil, both rye and soybean. Corn and wheat residue treatments resulted in about the same or less extractable inorganic N at 60 days compared with initial amounts. The soybean and rye material had the highest N concentrations and the wheat and corn residue had the lowest. Addition of plant residue appears to encourage net immobilization of N when the residue N concentration is relatively low. The N in the residue would probably be mineralized after longer incubations as the C/N ratio is narrowed.

Denitrification

Table 11 shows the results of the denitrification incubation study. The decrease in NO_3^--N was taken to be denitrification; immobilization was considered to be minimal particularly in the N amended samples since NH_4^+ was added to take care of this process. Increases in control NH_4^+-N indicates that immobilization is not important even where additional NH_4^+-N was not added. There was a fairly definite temperature effect, with cool temperatures retarding the NO_3^--N decrease considerably. NO_2^--N was measurable on occasion and was assumed to be a transient intermediate of denitrification. The moisture contents that were used initially were shown to have a very small effect and in subsequent incubations of soils, only one moisture content (saturation) was used. The surface Brookston clay samples had higher denitrification activity as compared with the sandier samples.

First order rate coefficients for denitrification (see Stanford et al 1975, S.S.S.A.P., 39, 284-289) were calculated as follows:

$$RD_t = -\ln(N_t/N_o)/t \qquad (9)$$

where RD_t = denitrification rate coefficient at a given time, t = time, N_t and N_o = NO_3^- + NO_2^- concentrations at times t and zero, respectively. The rate coefficients are shown in Table 12. In several instances, a value could not be recorded since no NO_3^- nor NO_2^--N was present resulting in equation (9) becoming ∞ which is unrealistic. These occur only in the control incubations where original NO_3^--N available for denitrification was low.

Correlations of denitrification rate coefficients of fertilized surface samples with the temperature of incubation were 0.51, 0.77 and 0.91 for Berrien sandy loam, Brookston clay and N-5 soils, respectively. Similar correlations with the water content were very low (i.e. 0.07 to 0.30). This suggests that temperature has a definite influence on the rate coefficient, but the water content does not. The low correlation with water content was expected, since the water content would be adequate for microbial activity and functions more as an agent to encourage anaerobic conditions. Correlations of rate coefficient with %C, %N and glucose -C were low (less than 0.24). Glucose -C has been related to denitrification rates in other studies (Burford, J.R. and J.M. Bremner, 1975. Soil Biol. Biochem. 7, 389-394; Stanford, G., R.A. Vander Pol and S. Dzienia, 1975. Soil Sci. Soc. Am. Proc. 39, 284-289) and this difference may be due to the range of samples used in the study and/or including a wide range of temperature conditions in the rate coefficient calculation making environmental variables the overriding factors.

<u>Nitrogen Fixation</u>

Asymbiotic N fixation is one possible mechanism for N gain to the soil and it was not known how important the process is. The process requires anaerobic conditions, therefore, the water saturated conditions of denitrification incubations were employed to explore a maximum potential rate. It is known that excess inorganic N often retards the process, hence the incubation study for N fixation was extended such that denitrification could "strip away" any NO_3^--N and subsequently encourage N fixation. Table 13 shows that representative soils and depths of these soils have very low asymbiotic N fixation potential. N fixation rate is shown as g ethylene produced /g soil/day and to convert this to N_2 fixation, the theoretical C_2H_2/N_2 conversion is around 3 (Hardy, R.W.F., R.C. Burns and R.D. Holsten, 1973. Soil Biol. Biochem. 5, 47-81), therefore, N_2 fixation appears to be rather minor input of N. Denitrification effectively reduced the NO_3^--N content, but this reduction did not appear to increase the rate of N fixation. Time of original field sampling (eg. 2-1 <u>vs</u>. 2-1-b and 5-1 <u>vs</u>. 5-1-b) did not significantly affect the results.

DATA ANALYSIS AND INTERPRETATION

Although in the Berrien sandy loam samples, there is potential for NH_4^+-N leaching because of a relatively high proportion of soluble NH_4^+-N, the relatively low rate of nitrification would limit movement to the NO_3^--N form. Fixation of added NH_4^+-N occured only in subsurface samples of the Brookston clay, this process would not be particularly important in N leaching considerations. Nitrification was relatively high in most surface samples studied, which would result in NH_4^+-N being present in negligible quantities in these soils except for short periods after large NH_4^+-N additions.

The very large pool of organic N contained in the surface horizon of the soils (see Table 9) is a potential source for N leaching to the ground water. Mineralization is the process that releases the N, which is quickly nitrified to NO_3^--N (which is very mobile). Environmental factors are particularly important in influencing the rate of this process. The average daily rates of net mineralization measured at 15°C and 75% of field capacity moisture content were 0.1043, 0.7645 and 1.3309 μgN/g for Berrien sandy loam, Brookston clay and N-5 surface samples, respectively. If these environmental conditions on average prevailed for 150 days in the field, approximately 36, 258 and 448 kg N/ha would be released over the summer season (i.e. entire year). This calculation of N release over a year is much higher than using the 1% of the total N in the soil. Incorporation of plant residues will alter the rate of mineral N release depending to a large degree on the nature of the residue. Material relatively high %N (e.g. legume residues or green manure materials) would encourage higher amounts of mineralization. The rate of this process must be put into context of other processes (eg. plant uptake and denitrification) and probably more detail of rates of these processes considered over seasonal changing environmental conditions are needed to determine the fate of the N in the soil. A literature review of rates of process is presented (Appendix) to enable comparison of rates with other studies.

Denitrification is much harder to assess over a period of a year because of the rather special conditions required for this process to proceed. Anaerobic conditions (whether in general or in microsites), warmth and NO_3^--N are needed. An intimate consideration of field environmental conditions are required to apply the rate coefficients of this process to a weather conditions of field season. The quick initiation of the process upon saturation and fast rate of the process suggests sudden but large bursts of N loss during and immediately after a rain, rather than a small but continuous release over the entire season.

Asymbiotic N fixation does not appear to be a quantitatively important process in potential nitrogen leaching/pollution consideration in these soils.

Mineralization and denitrification appear to be the two most important N cycle processes to consider in N leaching potential in soils. Mineralization of the large pool of organic N contained in surface soils has great potential as a NO_3^--N source and only a small change in the rate can have a profound effect on the amount of N released over a period of a year. It is know that fallowing will accelerate the process, whereas, incorporation of low N content plant residues would encourage immobilization. Addition of N containing materials should be considered over a relatively long time period (eg. several years) because of changing mineralization/immobilization rates as carbon is evolved. Nitrification appears to be a relatively fast process, so any additions of NH_4^+-N fertilizers would quickly be converted to NO_3^--N which is then vulnerable to leaching. Denitrification is one process of depleting excess NO_3^--N but requires rather specific environmental conditions.

RELATIONSHIP OF PROJECT RESULTS TO PLUARG OBJECTIVES

This project, of itself, does not answer the questions - From what sources and from what causes are pollutants contributed to ground water? Its contribution is an input that is to be used in relation to field plot studies, in order to assist the mathematical simulation of N transport and movement. The results do show the potential importance of biological transformations in the soil in leaching NO_3^--N to the ground water. All soils studied have a high potential to convert NH_4^+-N into NO_3^--N, hence, any fertilizer without a nitrification inhibitor will quickly be converted into the mobile form. The rates of net mineralization, denitrification and plant uptake relative to one another over the entire biologically active season (spring, summer, fall) are important in controlling the amount of NO_3^--N present in surface soils that can be moved downward. The very large pool of N in the organic fraction of surface soils is potentially vulnerable to leaching after mineralization-nitrification and any management practice (eg. fallowing, type of cultivation, etc.) that increases the rate of mineralization enhances the NO_3^--N pollution potential. Fertilizer and soil mineralized N are two sources of N for plant growth and N fertilization must consider the amount of N that will be made available from soil organic N due to mineralization. Mineralizable N is generally higher in fine-textured, high organic matter soils, hence fertilization should be lower. Uptake of N by plants appears to change over the season (i.e. high initially, then lower, then increasing as flowering and seed set progress) but N mineralization could remain constant, hence the match of rate of these processes are important in potential NO_3^--N loss. Incorporation of N containing organic amendments (straw residue, manure, sewage sludge) must be viewed in the long term (several years) since initially they may increase the soil org. N pool, and later be released by mineralization. Management practices should be viewed in the long term using these amendments. Denitrification is potentially a source of NO_3^--N loss but specific environmental conditions are required. This process can be beneficial to strip away excess NO_3^--N, but must also be considered in terms of the economics to plant production.

The remaining questions i.e. contribution to seasonal loadings and transmission to boundary waters, can not be addressed without knowledge of other projects, e.g. plot experiments and ground water studies.

SUPPLEMENTARY INFORMATION

If farm cultivation practices contribute to N pollution, one must be careful to isolate the exact cause. One must evaluate whether cultivation or fertilizer application is the culprit. Cultivation may accelerate N mineralization of the large soil N pool. Organic amendments must be considered in the long term, since immobilization may be important in the first year, but mineralization may be important in the next few years. A soil test, based on objective measurements, would be very beneficial to restrict NO_3^--N leaching by encouraging efficient fertilizer use. More must be known about basic processes of N transformations and transport under Ontario environmental conditions to enable application of an objective, measurement based N soil test.

An area that may require further consideration is whether or not cultivation has depleted the organic matter content of the soils in the watershed areas. If the organic matter has been depleted, then a considerable amount of N will have been released over the years. If this N had not been taken up by plants and if it was not denitrified, then a large amount of N could have been moved into the ground water over the cultivation period. This N would have to be quantified, to enable separation of cultivation from fertilization contributing NO_3^--N to ground water.

Table 1. Description of surface soil samples from watershed 5 (IJC - PLUARG Task C - Canada)

Code	Soil Name	Land Use	Drainage	Slope	Location UTM	Location Sheet
N-5/1	Crombie or Maplewood	Pasture	Poor	1%	008/817	40P/2e
N-5/2	Honeywood or Guelph	Corn	Good	3%	031/755	40P/2e
N-5/3	Embro	Corn (with grassy weeds)	Imperfect	1%	028/805	40P/2e
N-5/4	Travistock	Corn	Imperfect	1%	014/773	
N-5/5	Unnamed	Oats	Good	2 %	002/797	

Table 2 Some characterization analyses of soil samples from watersheds 1, 5 and 13 (IJC- PLUARG Task C - Canada)

Watershed	Sample	pH	%N	%C	C/N	% Moisture at Field Capacity	% Moisture at Saturation	Glucose Equivalent (org.C/g)	Fixed NH_4-N (μg/g)
13	1-1	5.8	0.09	1.09	12.1	7.6	35	141	37
	1-2	5.8	0.08	0.96	11.9	8.6	36	119	30
	2-1-b	5.2	0.11	1.27	11.5	9.8	36	172	30
	2-2-b	5.5	0.11	1.29	12.9	9.7	39	163	28
	2-3	5.6	0.10	1.23	12.3	9.4	37	149	46
	2-4	6.1	0.06	0.76	12.7	7.5	37	43	32
	2-5	6.3	0.02	0.30	15.0	4.8	33	23	36
	2-5	6.2	0.03	0.24	8.0	4.2	33	27	29
	2-7	6.0	0.02	0.19	9.5	4.1	33	10	24
	2-1	5.6	0.12	1.87	15.4	11.5	36	149	18
	2-2	5.5	0.12	1.62	15.5	11.4	36	138	31
	3-1	7.7	0.07	0.94	13.4	9.6	35	116	79
	3-2	7.6	0.07	0.94	13.4	10.2	36	85	49
1	4-1	6.8	0.32	3.34	10.4	32.0	74	450	329
	4-2	6.8	0.30	2.99	10.0	32.2	72	307	340
	5-1-b	7.0	0.28	2.91	10.4	30.8	73	272	352
	5-2-b	7.1	0.30	3.21	10.7	32.3	77	260	274
	5-3	7.2	0.17	1.90	11.2	29.4	74	131	282
	5-4	7.6	0.08	0.85	10.6	28.0	70	50	333
	5-5	7.7	0.08	0.61	7.6	27.8	67	28	306
	5-6	7.6	0.06	0.57	9.5	27.2	66	26	343
	5-7	7.8	0.07	0.53	7.6	27.9	64	9	357
	5-1	7.0	0.28	2.90	10.4	29.2	66	269	294
	5-2	7.1	0.25	2.86	11.4	29.0	67	254	280
	6-1	7.8	0.21	2.05	9.8	30.4	72	187	411
	6-2	7.7	0.20	1.94	9.7	31.5	69	187	342
5	N-5/1	7.1	0.37	3.83	10.4	32.0	70	712	108
	N-5/2	7.3	0.24	2.50	10.4	27.0	63	338	99
	N-5/3	7.0	0.30	3.06	10.2	30.0	67	338	73
	N-5/4	6.5	0.33	3.41	10.3	31.8	69	422	159
	N-5/5	5.5	0.13	1.50	11.5	23.4	55	215	61

Meaning of computer abbreviations for Tables 3, 5, 7, 11 and 12

•

PL = plot number

DP = depth number (see p. 2 - Sample Code Designation)

SOL = abbreviated description of soil type: S = sand, C = clay

TMP = temperature in ^{o}C

WC = water content in % oven dry weight (30% and 75% of field capacity, (see p. 6)

TRT = treatment of N (see description of Incubation Systems for details pp 3-4)

AVER = average

SOL NH_4 = dilute $CaCl_2$ extractable NH_4-N

EX NH_4 = exchangeable NH_4-N (see p. 3)

TOTAL N = total extractable inorganic N

RN-14 = nitrification rate coefficient to day 14

RN-21 = nitrification rate coefficient to day 21

RN-AVE = nitrification rate coefficient averaged for 0-14 and 14-21 day periods (see p. 6)

MIN RATE = mineralization rate

RD-2 = denitrification rate coefficient to day 2

RD-5 = denitrification rate coefficient to day 5

RD-AVE = denitrification rate coefficients averaged

Table 3 Inorganic N analyses (μgN/g/soil) during incubation experiments examining nitrification and mineralization of watershed soils under combinations of temperature and moisture contents.

							NO3		NO2		SOL NH4		EX NH4		
PL	DP	SOL	TMP	WC	TRT	DAY	RANGE	AVER	RANGE	AVER	RANGE	AVER	RANGE	AVER	TOTALN
1	1	S	4	2.87	0	0	4.6	14.3	0.0	0.0	0.6	1.3	0.0	1.8	17.4
1	1	S	4	2.87	0	5	1.4	20.0	0.0	0.0	0.1	0.8	0.8	2.3	23.0
1	1	S	4	2.87	0	14	0.6	18.8	0.0	0.0	0.1	0.5	1.1	1.6	20.9
1	1	S	4	2.87	0	21	0.1	19.6	0.0	0.0	1.1	0.8	0.0	1.1	21.5
1	1	S	4	2.87	80	0	1.5	23.8	0.0	0.0	1.1	56.4	4.0	23.6	103.8
1	1	S	4	2.87	80	5	2.3	22.3	0.0	0.0	0.5	61.4	3.[illegible]	26.8	110.4
1	1	S	4	2.87	80	14	0.2	22.5	0.0	0.0	2.1	61.8	0.4	24.5	108.8
1	1	S	4	2.87	80	21	0.6	23.8	0.0	0.0	2.1	58.6	0.6	26.8	109.2
1	1	S	4	7.19	0	0	0.8	15.5	0.0	0.0	0.4	0.6	0.7	2.8	18.8
1	1	S	4	7.19	0	5	0.5	21.9	0.0	0.0	0.1	0.6	0.0	2.5	25.1
1	1	S	4	7.19	0	14	10.5	16.4	0.0	0.0	1.1	0.8	1.2	1.6	18.9
1	1	S	4	7.19	0	21	1.6	20.4	0.0	0.0	1.6	2.5	0.8	2.0	24.9
1	1	S	4	7.19	80	0	3.3	27.9	0.0	0.0	3.4	58.6	0.6	25.0	111.5
1	1	S	4	7.19	80	5	0.9	19.8	0.0	0.0	1.1	66.1	0.6	25.3	111.3
1	1	S	4	7.19	80	14	0.5	28.4	0.0	0.0	0.6	58.4	0.8	25.2	111.9
1	1	S	4	7.19	80	21	0.9	25.9	0.0	0.0	0.5	59.4	1.6	25.0	110.4
1	1	S	15	2.87	0	0	4.6	14.3	0.0	0.0	0.6	1.3	0.8	1.8	17.4
1	1	S	15	2.87	0	5	0.2	21.6	0.0	0.0	0.6	0.8	1.8	2.6	25.0
1	1	S	15	2.87	0	14	0.1	17.8	0.0	0.0	0.7	0.8	0.7	1.1	19.7
1	1	S	15	2.87	0	21	1.7	19.3	0.0	0.0	0.0	0.3	0.1	2.1	21.8
1	1	S	15	2.87	80	0	1.5	23.8	0.0	0.0	1.1	56.4	4.0	23.6	103.8
1	1	S	15	2.87	80	5	1.9	23.9	0.0	0.0	5.7	59.9	1.3	26.3	110.1
1	1	S	15	2.87	80	14	0.8	24.4	0.0	0.0	1.5	57.3	0.7	26.3	108.0
1	1	S	15	2.87	80	21	0.1	23.3	0.0	0.0	3.7	54.6	1.2	26.3	104.2
1	1	S	15	7.19	0	0	0.8	15.5	0.0	0.0	0.4	0.6	0.7	2.8	18.8
1	1	S	15	7.19	0	5	0.8	24.8	0.0	0.0	1.2	1.3	0.2	2.0	28.1
1	1	S	15	7.19	0	14	13.1	16.6	7.0	3.5	0.3	0.5	0.5	1.3	21.8
1	1	S	15	7.19	0	21	4.1	14.8	0.0	0.0	0.9	1.6	0.1	2.4	18.8
1	1	S	15	7.19	80	0	3.3	27.9	0.0	0.0	3.4	58.6	0.6	25.0	111.5
1	1	S	15	7.19	80	5	4.3	26.3	0.0	0.0	5.9	62.1	1.5	26.4	114.8
1	1	S	15	7.19	80	14	3.0	29.6	0.0	0.0	0.0	57.1	1.3	25.8	112.6
1	1	S	15	7.19	80	21	5.2	31.9	0.0	0.0	6.2	49.1	1.4	25.2	106.2
1	1	S	30	2.87	0	0	4.6	14.3	0.0	0.0	0.6	1.3	0.6	1.8	17.4
1	1	S	30	2.87	0	5	3.2	17.1	0.0	0.0	0.1	0.8	0.6	2.0	19.9
1	1	S	30	2.87	0	14	0.2	15.2	0.0	0.0	0.1	0.3	0.1	2.3	17.8
1	1	S	30	2.87	0	21	2.5	10.8	0.0	0.0	0.1	0.4	0.1	2.1	13.3
1	1	S	30	2.87	80	0	1.5	23.8	0.0	0.0	1.1	56.4	4.0	23.6	103.8
1	1	S	30	2.87	80	5	3.1	26.6	0.0	0.0	5.3	54.3	5.2	28.5	109.5
1	1	S	30	2.87	80	14	0.0	23.8	0.0	0.0	0.0	50.9	0.9	27.3	102.0
1	1	S	30	2.87	80	21	0.2	24.4	0.0	0.0	3.1	45.9	2.4	25.9	96.2
1	1	S	30	7.19	0	0	0.8	15.5	0.0	0.0	0.4	0.6	0.7	2.8	18.8
1	1	S	30	7.19	0	5	1.0	24.6	0.0	0.0	0.3	1.0	0.5	2.6	28.2
1	1	S	30	7.19	0	14	1.9	24.8	4.0	2.0	0.0	0.3	0.7	2.0	29.1
1	1	S	30	7.19	0	21	1.9	18.8	0.0	0.0	0.0	0.3	0.1	3.3	22.3
1	1	S	30	7.19	80	0	3.3	27.9	0.0	0.0	3.4	58.6	0.6	25.0	111.5
1	1	S	30	7.19	80	5	1.0	36.2	0.0	0.0	2.3	54.3	0.5	24.3	114.8
1	1		30	7.19	80	14	8.6	51.7	0.0	0.0	4.8	37.1	1.0	22.0	110.8
1	1	S	30	7.19	80	21	0.9	66.8	0.0	0.0	2.0	19.8	0.6	15.4	101.9
1	2	S	4	2.60	0	0	4.9	[illegible]	0.0	0.0	3.5	11.1	0.0	0.0	36.9
1	2	S	4	2.60	0	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	2	S	4	2.60	0	14	1.6	18.9	0.0	0.0	0.5	10.5	0.0	0.0	29.4
1	2	S	4	2.60	0	21	1.1	21.3	0.0	0.0	0.2	6.0	0.0	0.0	27.3
1	2	S	4	2.60	80	0	0.4	25.3	0.0	0.0	4.0	88.4	0.0	0.0	113.7
1	2	S	4	2.60	80	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	2	S	4	2.60	80	14	2.0	34.8	0.0	0.0	0.3	84.1	0.0	0.0	118.9
1	2	S	4	2.60	80	21	8.2	37.7	0.0	0.0	0.6	75.5	0.0	0.0	113.2
1	2	S	4	6.50	0	0	1.7	24.8	0.0	0.0	0.4	6.2	0.0	0.0	31.0
1	2	S	4	6.50	0	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	2	S	4	6.50	0	14	0.3	17.9	0.0	0.0	0.9	13.9	0.0	0.0	31.9
1	2	S	4	6.50	0	21	0.1	21.4	0.0	0.0	0.2	10.5	0.0	0.0	31.9
1	2	S	4	6.50	80	0	7.8	22.0	0.0	0.0	10.2	94.1	0.0	0.0	116.1
1	2	S	4	6.50	80	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	2	S	4	6.50	80	14	6.0	34.0	0.0	0.0	5.2	89.1	0.0	0.0	123.1
1	2	S	4	6.50	80	21	4.7	33.5	0.0	0.0	3.1	83.8	0.0	0.0	117.3

Table 3 cont'd.

PL	DP	SOL	TMP	WC	TRT	DAY	NO3 RANGE	NO3 AVER	NO2 RANGE	NO2 AVER	SOL NH4 RANGE	SOL NH4 AVER	EX NH4 RANGE	EX NH4 AVER	TOTALN
1	2	S	15	2.60	0	0	4.9	25.8	0.0	0.0	3.5	11.1	0.0	0.0	36.9
1	2	S	15	2.60	0	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	2	S	15	2.60	0	14	0.1	18.4	0.0	0.0	0.0	9.0	0.0	0.0	27.4
1	2	S	15	2.60	0	21	0.6	20.9	0.0	0.0	0.2	6.0	0.0	0.0	26.9
1	2	S	15	2.60	80	0	0.4	25.3	0.0	0.0	4.0	88.4	0.0	0.0	113.7
1	2	S	15	2.60	80	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	2	S	15	2.60	80	14	3.2	29.7	0.0	0.0	0.6	80.9	0.0	0.0	110.6
1	2	S	15	2.60	80	21	1.0	29.3	0.0	0.0	1.6	77.5	0.0	0.0	106.8
1	2	S	15	6.50	0	0	1.7	24.8	0.0	0.0	0.4	6.2	0.0	0.0	31.0
1	2	S	15	6.50	0	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	2	S	15	6.50	0	14	6.2	15.3	0.0	0.0	0.9	15.7	0.0	0.0	30.9
1	2	S	15	6.50	0	21	1.7	19.9	0.0	0.0	0.4	12.9	0.0	0.0	32.8
1	2	S	15	6.50	80	0	7.8	22.0	0.0	0.0	10.2	94.1	0.0	0.0	116.1
1	2	S	15	6.50	80	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	2	S	15	6.50	80	14	3.4	33.5	0.0	0.0	1.1	85.3	0.0	0.0	118.8
1	2	S	15	6.50	80	21	6.6	38.1	0.0	0.0	7.4	91.0	0.0	0.0	129.1
1	2	S	30	2.60	0	0	4.9	25.8	0.0	0.0	3.5	11.1	0.0	0.0	36.9
1	2	S	30	2.60	0	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	2	S	30	2.60	0	14	2.0	19.2	0.0	0.0	0.2	11.1	0.0	0.0	30.3
1	2	S	30	2.60	0	21	0.9	20.6	0.0	0.0	0.4	7.2	0.0	0.0	27.8
1	2	S	30	2.60	80	0	0.4	25.3	0.0	0.0	4.0	88.4	0.0	0.0	113.7
1	2	S	30	2.60	80	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	2	S	30	2.60	80	14	5.1	29.8	0.0	0.0	1.7	83.1	0.0	0.0	112.9
1	2	S	30	2.60	80	21	7.6	31.4	0.0	0.0	2.3	81.4	0.0	0.0	112.8
1	2	S	30	6.50	0	0	1.7	24.8	0.0	0.0	0.4	6.2	0.0	0.0	31.0
1	2	S	30	6.50	0	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	2	S	30	6.50	0	14	0.3	16.6	0.0	0.0	0.3	22.5	0.0	0.0	39.2
1	2	S	30	6.50	0	21	2.2	21.3	0.0	0.0	0.1	20.3	0.0	0.0	41.6
1	2	S	30	6.50	80	0	7.8	22.0	0.0	0.0	10.2	94.1	0.0	0.0	116.1
1	2	S	30	6.50	80	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	2	S	30	6.50	80	14	4.2	35.3	0.0	0.0	1.0	99.5	0.0	0.0	134.8
1	2	S	30	6.50	80	21	1.1	38.6	0.0	0.0	1.1	96.8	0.0	0.0	135.3
2	1	S	4	3.45	0	0	1.1	7.6	0.0	0.0	0.1	0.1	0.6	2.9	10.7
2	1	S	4	3.45	0	5	1.4	10.9	0.0	0.0	0.1	1.9	0.7	3.1	16.0
2	1	S	4	3.45	0	14	0.6	9.8	0.0	0.0	0.5	1.3	0.2	2.6	13.6
2	1	S	4	3.45	0	21	0.3	10.0	0.0	0.0	0.6	1.9	0.4	2.4	14.3
2	1	S	4	3.45	80	0	6.2	15.2	0.0	0.0	1.6	55.5	0.6	25.6	96.3
2	1	S	4	3.45	80	5	3.2	17.7	0.0	0.0	4.2	58.9	0.2	27.4	104.0
2	1	S	4	3.45	80	14	6.4	15.2	0.0	0.0	0.0	56.8	0.9	25.6	97.6
2	1	S	4	3.45	80	21	5.8	22.9	0.0	0.0	9.0	63.4	1.8	29.1	115.4
2	1	S	4	8.63	0	0	1.0	11.7	0.0	0.0	0.1	0.6	0.2	3.1	15.4
2	1	S	4	8.63	0	5	0.2	10.9	0.0	0.0	0.3	0.3	0.2	3.2	14.3
2	1	S	4	8.63	0	14	0.0	12.5	0.0	0.0	0.1	0.8	0.3	2.5	15.9
2	1	S	4	8.63	0	21	0.3	14.5	0.0	0.0	0.3	0.9	0.1	1.3	16.8
2	1	S	4	8.63	80	0	3.4	12.2	0.0	0.0	3.8	56.2	4.2	27.9	96.3
2	1	S	4	8.63	80	5	1.2	18.2	0.0	0.0	2.2	58.6	0.3	27.3	104.0
2	1	S	4	8.63	80	14	0.2	22.5	0.0	0.0	0.0	57.5	0.5	25.9	105.9
2	1	S	4	8.63	80	21	7.2	20.8	0.0	0.0	17.1	65.6	5.3	26.6	115.0
2	1	S	15	3.45	0	0	1.1	7.6	0.0	0.0	0.1	0.1	0.6	2.9	10.7
2	1	S	15	3.45	0	5	3.1	9.3	0.0	0.0	1.4	0.8	0.3	2.5	12.6
2	1	S	15	3.45	0	14	0.5	9.8	0.0	0.0	0.3	1.4	0.0	2.6	13.8
2	1	S	15	3.45	0	21	0.3	9.6	0.0	0.0	0.1	1.6	0.3	2.6	13.9
2	1	S	15	3.45	80	0	6.2	15.2	0.0	0.0	1.6	55.5	0.6	25.6	96.3
2	1	S	15	3.45	80	5	6.1	17.1	0.0	0.0	2.6	55.0	1.3	28.8	100.9
2	1	S	15	3.45	80	14	0.6	17.9	0.0	0.0	0.5	55.6	0.9	27.3	100.7
2	1	S	15	3.45	80	21	3.1	17.6	0.0	0.0	0.0	54.7	1.1	26.8	99.2
2	1	S	15	8.63	0	0	1.0	11.7	0.0	0.0	0.1	0.6	0.2	3.1	15.4
2	1	S	15	8.63	0	5	2.8	12.5	0.0	0.0	1.2	0.7	0.1	1.4	14.6
2	1	S	15	8.63	0	14	0.5	13.6	0.0	0.0	0.0	0.1	0.1	0.8	14.6
2	1	S	15	8.63	0	21	0.4	14.6	0.0	0.0	0.2	0.2	0.0	0.5	15.3
2	1	S	15	8.63	80	0	3.4	12.2	0.0	0.0	3.8	56.2	4.2	27.9	96.3
2	1	S	15	8.63	80	5	2.5	22.9	0.0	0.0	1.6	55.1	1.1	26.4	104.5
2	1	S	15	8.63	80	14	6.7	32.5	0.0	0.0	4.4	46.8	2.1	23.3	102.6
2	1	S	15	8.63	80	21	9.0	42.0	0.0	0.0	2.1	37.6	0.3	19.8	99.6
2	1	S	30	3.45	0	0	1.1	7.6	0.0	0.0	0.1	0.1	0.6	2.9	10.7
2	1	S	30	3.45	0	5	2.6	8.8	0.0	0.0	0.9	0.7	1.0	2.3	11.7
2	1	S	30	3.45	0	14	0.8	9.6	0.0	0.0	0.2	0.9	0.0	1.9	12.4
2	1	S	30	3.45	0	21	1.5	10.1	0.0	0.0	0.6	1.4	0.0	1.5	13.0
2	1	S	30	3.45	80	0	6.2	15.2	0.0	0.0	1.6	55.5	0.6	25.6	96.3
2	1	S	30	3.45	80	5	0.8	19.1	0.0	0.0	2.2	50.5	0.8	29.3	98.9
2	1	S	30	3.45	80	14	2.8	19.9	0.0	0.0	3.1	57.3	0.9	29.8	107.1
2	1	S	30	3.45	80	21	2.1	17.3	0.0	0.0	2.6	53.9	0.4	29.7	100.8
2	1	S	30	8.63	0	0	1.0	11.7	0.0	0.0	0.1	0.6	0.2	3.1	15.4
2	1	S	30	8.63	0	5	2.2	13.8	0.0	0.0	1.3	0.7	0.5	1.4	15.9
2	1	S	30	8.63	0	14	0.3	15.3	0.0	0.0	0.1	0.1	0.1	0.6	16.1
2	1	S	30	8.63	0	21	0.2	15.9	0.0	0.0	0.0	0.9	0.2	1.0	17.8
2	1	S	30	8.63	80	0	3.4	12.2	0.0	0.0	3.8	56.2	4.2	27.9	96.3
2	1	S	30	8.63	80	5	0.3	35.0	0.0	0.0	1.9	47.1	0.6	26.0	108.2
2	1	S	30	8.63	80	14	5.5	52.4	0.0	0.0	1.1	29.6	1.2	18.1	100.3
2	1	S	30	8.63	80	21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table 5 cont'd.

PL	DP	SOL	TMP	WC	TRT	DAY	NO3 RANGE	NO3 AVER	NO2 RANGE	NO2 AVER	SOL NH4 RANGE	SOL NH4 AVER	EX NH4 RANGE	EX NH4 AVER	TOTALN
2	2	S	4	3.42	0	0	3.4	17.1	0.0	0.0	0.1	2.1	0.1	4.3	23.5
2	2	S	4	3.42	0	5	0.8	17.2	0.0	0.0	1.8	1.1	0.1	5.1	23.3
2	2	S	4	3.42	0	14	0.6	18.3	0.0	0.0	0.1	2.4	0.3	5.3	26.1
2	2	S	4	3.42	0	21	2.3	16.8	0.0	0.0	0.0	2.9	2.0	5.0	24.7
2	2	S	4	3.42	80	0	1.3	14.9	0.0	0.0	3.2	56.8	2.6	27.2	98.9
2	2	S	4	3.42	80	5	11.2	19.2	0.0	0.0	4.2	57.3	1.2	30.5	107.0
2	2	S	4	3.42	80	14	0.9	18.6	0.0	0.0	1.1	61.6	0.2	28.3	108.4
2	2	S	4	3.42	80	21	14.6	21.4	0.0	0.0	3.2	62.0	1.4	28.8	112.2
2	2	S	4	8.55	0	0	1.3	17.4	0.0	0.0	0.6	0.6	0.1	5.1	23.2
2	2	S	4	8.55	0	5	1.3	17.4	0.0	0.0	1.3	0.8	0.1	6.1	24.3
2	2	S	4	8.55	0	14	2.0	18.3	0.0	0.0	0.1	2.8	0.2	5.1	26.2
2	2	S	4	8.55	0	21	3.1	18.6	0.0	0.0	0.3	2.9	1.0	4.9	26.5
2	2	S	4	8.55	80	0	3.3	20.0	0.0	0.0	1.1	62.8	2.3	27.5	110.4
2	2	S	4	8.55	80	5	0.4	18.4	0.0	0.0	2.6	61.0	1.0	29.7	109.1
2	2	S	4	8.55	80	14	3.7	15.9	0.0	0.0	1.6	63.1	0.2	29.1	108.1
2	2	S	4	8.55	80	21	8.4	22.2	0.0	0.0	1.1	63.4	0.1	28.3	114.0
2	2	S	15	3.42	0	0	3.4	17.1	0.0	0.0	0.1	2.1	0.1	4.3	23.5
2	2	S	15	3.42	0	5	0.7	15.3	0.0	0.0	1.5	0.9	0.2	4.7	21.0
2	2	S	15	3.42	0	14	0.2	14.9	0.0	0.0	0.1	2.6	0.6	4.4	21.9
2	2	S	15	3.42	0	21	1.0	15.4	0.0	0.0	0.7	2.9	0.7	3.5	21.9
2	2	S	15	3.42	80	0	1.3	14.9	0.0	0.0	3.2	56.8	2.6	27.2	98.9
2	2	S	15	3.42	80	5	6.8	23.7	0.0	0.0	0.1	60.6	2.3	30.0	114.3
2	2	S	15	3.42	80	14	0.5	22.9	0.0	0.0	0.5	64.1	0.7	29.6	116.6
2	2	S	15	3.42	80	21	5.4	25.4	0.0	0.0	1.1	61.1	1.3	29.6	116.1
2	2	S	15	8.55	0	0	1.3	17.4	0.0	0.0	0.6	0.6	0.1	5.1	23.2
2	2	S	15	8.55	0	5	0.2	17.4	0.0	0.0	0.5	1.9	0.1	5.1	24.4
2	2	S	15	8.55	0	14	1.4	16.9	0.0	0.0	0.7	2.1	0.5	3.6	22.6
2	2	S	15	8.55	0	21	4.3	21.9	0.0	0.0	1.1	0.9	0.8	2.1	25.0
2	2	S	15	8.55	80	0	3.3	20.0	0.0	0.0	1.1	62.8	2.3	27.5	110.4
2	2	S	15	8.55	80	5	0.4	20.8	0.0	0.0	1.1	64.1	1.3	31.0	115.9
2	2	S	15	8.55	80	14	7.4	30.2	0.0	0.0	1.0	61.3	1.9	28.8	120.3
2	2	S	15	8.55	80	21	12.9	34.6	0.0	0.0	2.2	59.7	0.5	27.8	122.1
2	2	S	30	3.42	0	0	3.4	17.1	0.0	0.0	0.1	2.1	0.1	4.3	23.5
2	2	S	30	3.42	0	5	0.1	16.6	0.0	0.0	1.0	1.8	0.2	3.9	22.2
2	2	S	30	3.42	0	14	0.0	16.0	0.0	0.0	0.0	2.4	0.2	3.2	21.6
2	2	S	30	3.42	0	21	0.1	15.8	0.0	0.0	0.6	3.3	0.4	2.9	21.9
2	2	S	30	3.42	80	0	1.3	14.9	0.0	0.0	3.2	56.8	2.6	27.2	98.9
2	2	S	30	3.42	80	5	5.3	26.0	0.0	0.0	3.3	55.1	2.8	28.6	109.8
2	2	S	30	3.42	80	14	7.4	29.2	0.0	0.0	1.1	56.8	2.4	28.8	114.7
2	2	S	30	3.42	80	21	0.0	28.4	0.0	0.0	2.0	58.5	0.0	30.0	116.9
2	2	S	30	8.55	0	0	1.3	17.4	0.0	0.0	0.6	0.6	0.1	5.1	23.2
2	2	S	30	8.55	0	5	0.4	21.4	0.0	0.0	0.3	1.0	0.3	2.4	24.9
2	2	S	30	8.55	0	14	1.5	24.6	0.0	0.0	0.3	0.3	0.0	0.7	25.6
2	2	S	30	8.55	0	21	1.0	24.8	0.0	0.0	0.2	0.6	0.7	0.8	26.2
2	2	S	30	8.55	80	0	3.3	20.0	0.0	0.0	1.1	62.8	2.3	27.5	110.4
2	2	S	30	8.55	80	5	7.7	37.6	0.0	0.0	1.7	57.8	16.4	29.0	124.4
2	2	S	30	8.55	80	14	11.8	44.3	0.0	0.0	9.8	50.9	5.2	26.8	122.0
2	2	S	30	8.55	80	21	3.2	51.8	0.0	0.0	0.6	42.2	0.2	22.7	116.7
2	1	SB	4	2.94	0	0	1.0	58.6	0.0	0.0	0.1	0.1	0.8	2.7	61.4
2	1	SB	4	2.94	0	5	0.6	56.7	0.0	0.0	0.5	0.5	0.3	3.1	60.4
2	1	SB	4	2.94	0	14	0.3	59.6	0.5	0.3	0.6	0.8	0.6	6.7	67.4
2	1	SB	4	2.94	0	21	1.4	59.2	0.0	0.0	0.1	0.1	0.8	3.6	62.9
2	1	SB	4	2.94	80	0	0.5	69.1	0.0	0.0	3.9	51.8	3.5	23.6	144.4
2	1	SB	4	2.94	80	5	2.6	69.1	0.0	0.0	0.6	53.7	0.4	26.8	149.6
2	1	SB	4	2.94	80	14	0.2	68.3	0.0	0.0	1.8	57.7	3.0	30.2	156.2
2	1	SB	4	2.94	80	21	0.7	66.8	0.0	0.0	1.0	53.9	1.1	28.8	149.5
2	1	SB	4	7.34	0	0	0.2	58.8	0.0	0.0	0.5	0.4	1.1	3.4	62.6
2	1	SB	4	7.34	0	5	1.5	61.3	0.0	0.0	0.0	0.1	0.1	3.8	65.1
2	1	SB	4	7.34	0	14	0.2	60.6	0.0	0.0	0.7	0.5	0.9	3.8	65.0
2	1	SB	4	7.34	0	21	0.8	61.8	0.0	0.0	0.1	0.1	0.9	3.3	65.3
2	1	SB	4	7.34	80	0	0.2	68.2	0.0	0.0	0.9	55.6	0.4	26.6	150.3
2	1	SB	4	7.34	80	5	0.3	69.8	0.0	0.0	1.3	56.5	0.4	27.0	153.3
2	1	SB	4	7.34	80	14	4.3	67.3	0.0	0.0	5.2	59.0	0.2	26.3	152.5
2	1	SB	4	7.34	80	21	23.2	58.0	0.0	0.0	16.3	46.9	10.9	20.7	125.7
2	1	SB	15	2.94	0	0	1.0	58.6	0.0	0.0	0.1	0.1	0.8	2.7	61.4
2	1	SB	15	2.94	0	5	1.6	57.9	0.0	0.0	0.0	0.1	1.2	3.4	61.4
2	1	SB	15	2.94	0	14	1.5	57.6	7.0	6.0	0.7	1.1	0.8	3.2	67.9
2	1	SB	15	2.94	0	21	0.3	61.4	0.0	0.0	0.0	0.1	0.4	2.7	64.2
2	1	SB	15	2.94	80	0	0.5	69.1	0.0	0.0	3.9	51.8	3.5	23.6	144.4
2	1	SB	15	2.94	80	5	0.1	68.6	0.0	0.0	3.9	54.1	2.2	26.6	149.4
2	1	SB	15	2.94	80	14	1.4	68.0	1.0	0.5	7.0	55.7	3.4	27.9	152.1
2	1	SB	15	2.94	80	21	3.0	66.9	0.0	0.0	0.5	51.9	0.6	27.2	145.9
2	1	SB	15	7.34	0	0	0.2	58.8	0.0	0.0	0.5	0.4	1.1	3.4	62.6
2	1	SB	15	7.34	0	5	3.8	58.1	0.0	0.0	1.4	0.8	0.2	2.8	61.7
2	1	SB	15	7.34	0	14	3.4	64.0	1.0	0.5	0.2	0.2	0.2	3.5	68.2
2	1	SB	15	7.34	0	21	0.8	64.2	0.0	0.0	0.0	0.1	1.3	2.9	67.2
2	1	SB	15	7.34	80	0	0.2	68.2	0.0	0.0	0.9	55.6	0.4	26.6	150.3
2	1	SB	15	7.34	80	5	0.8	68.8	0.0	0.0	0.3	55.3	0.4	26.7	150.7
2	1	SB	15	7.34	80	14	0.5	68.6	0.0	0.0	3.3	56.4	0.0	27.8	152.8
2	1	SB	15	7.34	80	21	1.6	67.0	0.0	0.0	3.6	50.4	0.4	26.3	143.7

PL	DP	SOL	TMP	WC	TRT	DAY	NO3 RANGE	NO3 AVER	NO2 RANGE	NO2 AVER	SOL NH4 RANGE	SOL NH4 AVER	EX NH4 RANGE	EX NH4 AVER	TOTALN
2	1	SB	30	2.94	0	0	1.0	58.6	0.0	0.0	0.1	0.1	0.8	2.7	61.4
2	1	SB	30	2.94	0	5	2.2	61.1	0.0	0.0	0.0	0.1	0.5	4.1	65.2
2	1	SB	30	2.94	0	14	0.9	58.6	0.0	0.0	0.6	0.5	0.0	3.6	62.7
2	1	SB	30	2.94	0	21	1.2	61.4	0.0	0.0	0.4	0.3	1.3	4.4	66.1
2	1	SB	30	2.94	80	0	0.5	69.1	0.0	0.0	3.9	51.8	3.5	23.6	144.4
2	1	SB	30	2.94	80	5	2.9	67.1	0.0	0.0	1.7	51.9	3.0	29.3	148.4
2	1	SB	30	2.94	80	14	13.1	57.8	0.5	0.3	0.3	51.1	3.3	31.0	140.3
2	1	SB	30	2.94	80	21	11.5	74.4	0.0	0.0	0.9	51.8	0.2	28.6	154.8
2	1	SB	30	7.34	0	0	0.2	58.8	0.0	0.0	0.5	0.4	1.1	3.4	62.6
2	1	SB	30	7.34	0	5	3.1	63.8	0.0	0.0	0.0	0.2	2.2	4.4	68.3
2	1	SB	30	7.34	0	14	0.1	62.8	0.0	0.0	0.0	0.1	0.3	3.8	66.7
2	1	SB	30	7.34	0	21	0.0	63.9	0.0	0.0	0.1	0.1	1.2	4.5	68.5
2	1	SB	30	7.34	80	0	0.2	68.2	0.0	0.0	0.9	55.6	0.4	26.6	150.3
2	1	SB	30	7.34	80	5	0.6	70.1	0.0	0.0	3.5	53.4	0.2	26.5	150.0
2	1	SB	30	7.34	80	14	2.9	71.3	0.0	0.0	0.3	53.5	7.2	34.5	159.3
2	1	SB	30	7.34	80	21	2.4	69.8	0.0	0.0	0.1	51.3	0.1	29.1	150.2
2	2	SB	4	2.91	0	0	1.0	22.3	0.0	0.0	0.0	0.1	0.1	3.1	25.5
2	2	SB	4	2.91	0	5	2.7	20.5	0.0	0.0	0.0	0.2	1.4	2.2	22.9
2	2	SB	4	2.91	0	14	1.7	22.3	0.0	0.0	0.1	0.1	0.2	1.3	23.8
2	2	SB	4	2.91	0	21	1.8	22.1	0.0	0.0	0.6	0.4	0.0	1.2	23.7
2	2	SB	4	2.91	80	0	0.8	20.1	0.0	0.0	0.5	52.4	0.6	28.1	100.5
2	2	SB	4	2.91	80	5	2.5	23.6	0.0	0.0	3.6	53.9	0.2	26.7	104.1
2	2	SB	4	2.91	80	14	5.1	22.1	0.0	0.0	0.0	52.1	1.4	26.8	101.0
2	2	SB	4	2.91	80	21	2.5	24.9	0.0	0.0	2.0	52.6	0.6	26.2	103.7
2	2	SB	4	7.28	0	0	1.4	21.1	0.0	0.0	3.0	2.0	0.5	2.1	25.1
2	2	SB	4	7.28	0	5	4.0	21.6	0.0	0.0	0.9	0.5	0.2	1.7	23.8
2	2	SB	4	7.28	0	14	1.7	22.8	0.0	1.5	1.2	0.8	1.2	1.3	26.3
2	2	SB	4	7.28	0	21	1.0	24.0	0.0	0.0	0.1	0.3	0.9	1.2	25.6
2	2	SB	4	7.28	80	0	4.3	23.3	0.0	0.0	1.0	53.7	0.2	28.0	104.9
2	2	SB	4	7.28	80	5	1.9	25.1	0.0	0.0	0.3	51.3	1.1	26.8	103.1
2	2	SB	4	7.28	80	14	4.3	24.5	0.5	0.3	2.1	53.1	2.0	26.1	104.0
2	2	SB	4	7.28	80	21	7.1	26.8	0.0	0.0	0.7	50.3	0.0	28.3	105.3
2	2	SB	15	2.91	0	0	1.0	22.3	0.0	0.0	0.0	0.1	0.1	3.1	25.5
2	2	SB	15	2.91	0	5	1.6	21.2	0.0	0.0	0.4	0.3	0.7	1.8	23.2
2	2	SB	15	2.91	0	14	0.5	23.1	0.0	0.0	0.0	0.1	0.1	1.6	24.7
2	2	SB	15	2.91	0	21	0.8	23.8	0.0	0.0	0.1	0.3	0.1	1.6	25.6
2	2	SB	15	2.91	80	0	0.8	20.1	0.0	0.0	0.5	52.4	0.6	28.1	100.5
2	2	SB	15	2.91	80	5	3.2	25.8	0.0	0.0	0.2	50.9	4.6	29.4	106.1
2	2	SB	15	2.91	80	14	7.8	24.1	0.0	0.0	4.3	47.8	2.5	30.4	102.4
2	2	SB	15	2.91	80	21	6.8	20.6	0.0	0.0	0.2	50.6	0.2	28.2	99.4
2	2	SB	15	7.28	0	0	1.4	21.1	0.0	0.0	3.0	2.0	0.5	2.1	25.1
2	2	SB	15	7.28	0	5	0.3	21.9	0.0	0.0	0.4	0.3	0.3	1.3	23.6
2	2	SB	15	7.28	0	14	1.6	24.5	0.0	0.0	0.2	0.2	3.7	4.6	29.3
2	2	SB	15	7.28	0	21	0.3	26.6	0.0	0.0	0.0	0.3	0.2	1.2	28.1
2	2	SB	15	7.28	80	0	4.3	23.3	0.0	0.0	1.0	53.7	0.2	28.0	104.9
2	2	SB	15	7.28	80	5	5.1	27.9	0.0	0.0	0.1	49.9	0.5	27.6	105.5
2	2	SB	15	7.28	80	14	5.6	27.1	0.0	0.0	0.1	49.1	1.1	29.8	106.0
2	2	SB	15	7.28	80	21	4.6	35.6	0.0	0.0	3.6	45.6	1.2	24.6	105.8
2	2	SB	30	2.91	0	0	1.0	22.3	0.0	0.0	0.0	0.1	0.1	3.1	25.5
2	2	SB	30	2.91	0	5	2.1	21.1	0.0	0.0	0.1	0.3	0.1	1.6	22.8
2	2	SB	30	2.91	0	14	1.3	22.1	0.0	0.0	0.0	0.2	0.6	3.3	25.6
2	2	SB	30	2.91	0	21	1.4	22.1	0.0	0.0	0.3	0.3	0.1	1.8	24.2
2	2	SB	30	2.91	80	0	0.8	20.1	0.0	0.0	0.5	52.4	0.6	28.1	100.5
2	2	SB	30	2.91	80	5	3.2	24.5	0.0	0.0	1.9	48.4	1.1	28.3	101.2
2	2	SB	30	2.91	80	14	4.0	22.1	0.0	0.0	3.0	51.1	1.3	26.8	100.1
2	2	SB	30	2.91	80	21	3.0	25.5	0.0	0.0	1.0	49.0	0.8	26.7	101.2
2	2	SB	30	7.28	0	0	1.4	21.1	0.0	0.0	3.0	2.0	0.5	2.1	25.1
2	2	SB	30	7.28	0	5	0.8	25.6	0.0	0.0	0.1	0.1	0.1	2.3	28.0
2	2	SB	30	7.28	0	14	5.0	23.9	0.0	0.0	0.1	0.3	1.2	2.5	26.6
2	2	SB	30	7.28	0	21	1.2	25.4	0.0	0.0	0.0	0.1	0.1	1.9	27.4
2	2	SB	30	7.28	80	0	4.3	23.3	0.0	0.0	1.0	53.7	0.2	28.0	104.9
2	2	SB	30	7.28	80	5	0.9	43.4	0.0	0.0	0.9	47.3	19.5	36.6	127.3
2	2	SB	30	7.28	80	14	7.4	39.3	0.0	0.0	0.0	44.8	0.5	26.3	110.4
2	2	SB	30	7.28	80	21	7.9	44.4	0.0	0.0	1.1	42.8	0.7	23.1	110.3

Table 3 cont'd.

PL	DP	SOL	TMP	WC	TRT	DAY	NO3 RANGE	NO3 AVER	NO2 RANGE	NO2 AVER	SOL NH4 RANGE	SOL NH4 AVER	EX NH4 RANGE	EX NH4 AVER	TOTALN
2	3	S	4	2.81	0	0	1.6	20.4	0.0	0.0	0.1	0.3	0.6	3.4	24.0
2	3	S	4	2.81	0	5	0.2	20.9	0.0	0.0	0.1	0.3	0.0	2.6	23.7
2	3	S	4	2.81	0	14	1.2	19.3	0.0	0.0	0.5	0.8	0.3	1.8	21.8
2	3	S	4	2.81	0	21	0.8	20.6	0.0	0.0	0.0	0.0	0.0	1.4	22.0
2	3	S	4	2.81	80	0	4.9	18.8	0.0	0.0	3.9	51.8	1.3	26.0	96.5
2	3	S	4	2.81	80	5	5.6	17.9	0.0	0.0	4.6	55.8	0.1	25.9	99.6
2	3	S	4	2.81	80	14	8.7	13.4	3.3	1.6	0.4	53.1	2.5	26.3	94.4
2	3	S	4	2.81	80	21	1.4	16.8	0.0	0.0	0.4	56.6	0.3	24.8	98.1
2	3	S	4	7.04	0	0	0.2	20.7	0.0	0.0	0.8	0.6	1.9	3.1	24.3
2	3	S	4	7.04	0	5	2.7	20.4	0.0	0.0	1.3	1.4	1.9	3.1	24.9
2	3	S	4	7.04	0	14	0.1	19.8	0.0	0.0	0.2	0.9	0.0	2.4	23.1
2	3	S	4	7.04	0	21	0.3	21.1	0.0	0.0	0.1	0.6	0.1	1.1	22.9
2	3	S	4	7.04	80	0	2.7	17.9	0.0	0.0	4.5	58.1	1.3	26.0	102.1
2	3	S	4	7.04	80	5	1.6	20.4	0.0	0.0	0.2	55.6	2.3	26.6	102.6
2	3	S	4	7.04	80	14	3.1	19.8	0.0	0.0	1.8	52.8	0.9	24.6	97.2
2	3	S	4	7.04	80	21	5.7	24.4	0.0	0.0	2.5	52.1	0.1	22.8	99.3
2	3	S	15	2.81	0	0	1.6	20.4	0.0	0.0	0.1	0.3	0.6	3.4	24.0
2	3	S	15	2.81	0	5	0.5	20.9	0.0	0.0	0.1	0.1	0.3	2.1	23.1
2	3	S	15	2.81	0	14	0.3	19.3	0.0	0.0	0.5	0.4	0.1	1.8	21.3
2	3	S	15	2.81	0	21	1.4	20.6	0.0	0.0	0.0	0.1	0.6	2.3	23.0
2	3	S	15	2.81	80	0	4.9	18.8	0.0	0.0	3.9	51.8	1.3	26.0	96.5
2	3	S	15	2.81	80	5	1.6	18.4	0.0	0.0	1.9	53.6	7.9	27.8	99.8
2	3	S	15	2.81	80	14	3.1	23.1	0.0	0.0	2.4	49.1	0.6	25.2	97.4
2	3	S	15	2.81	80	21	3.7	19.4	0.0	0.0	2.4	52.5	0.6	25.4	97.3
2	3	S	15	7.04	0	0	0.2	20.7	0.0	0.0	0.8	0.6	1.9	3.1	24.3
2	3	S	15	7.04	0	5	1.2	20.9	0.0	0.0	0.3	0.3	0.7	1.8	23.0
2	3	S	15	7.04	0	14	4.2	19.7	0.0	0.0	0.4	0.3	0.6	1.7	21.7
2	3	S	15	7.04	0	21	0.6	23.5	0.0	0.0	0.1	0.3	0.2	1.9	25.7
2	3	S	15	7.04	80	0	2.7	17.9	0.0	0.0	4.5	58.1	1.3	26.0	102.1
2	3	S	15	7.04	80	5	4.1	23.1	0.0	0.0	1.9	50.1	0.1	24.3	97.5
2	3	S	15	7.04	80	14	3.4	29.4	13.5	6.8	1.6	43.3	0.1	23.4	102.9
2	3	S	15	7.04	80	21	7.9	28.1	0.0	0.0	1.0	45.1	2.7	22.4	95.6
2	3	S	30	2.81	0	0	1.6	20.4	0.0	0.0	0.1	0.3	0.6	3.4	24.0
2	3	S	30	2.81	0	5	0.8	19.4	0.0	0.0	1.2	0.8	0.5	2.3	22.4
2	3	S	30	2.81	0	14	3.3	18.3	0.5	0.3	0.0	0.2	0.2	2.1	20.9
2	3	S	30	2.81	0	21	0.3	21.1	0.0	0.0	0.0	0.2	0.4	2.1	23.4
2	3	S	30	2.81	80	0	4.9	18.8	0.0	0.0	3.9	51.8	1.3	26.0	96.5
2	3	S	30	2.81	80	5	6.5	21.4	0.0	0.0	5.4	49.3	1.1	26.8	97.5
2	3	S	30	2.81	80	14	1.8	24.0	0.5	0.3	1.7	49.3	0.1	31.6	105.1
2	3	S	30	2.81	80	21	10.6	19.0	0.0	0.0	10.0	44.2	9.1	27.3	90.5
2	3	S	30	7.04	0	0	0.2	20.7	0.0	0.0	0.8	0.6	1.9	3.1	24.3
2	3	S	30	7.04	0	5	3.5	21.8	0.0	0.0	0.2	0.2	0.7	2.1	24.1
2	3	S	30	7.04	0	14	0.9	18.6	0.0	0.0	0.0	0.1	1.0	3.0	21.6
2	3	S	30	7.04	0	21	0.4	26.4	0.0	0.0	0.7	0.4	0.1	1.8	28.6
2	3	S	30	7.04	80	0	2.7	17.9	0.0	0.0	4.5	58.1	1.3	26.0	102.1
2	3	S	30	7.04	80	5	2.4	30.1	0.0	0.0	3.1	43.8	0.3	22.8	96.6
2	3	S	30	7.04	80	14	21.4	46.8	0.0	0.0	6.0	33.1	1.7	21.8	101.8
2	3	S	30	7.04	80	21	5.1	56.4	0.0	0.0	0.7	25.9	0.8	17.4	99.8
2	4	S	4	2.26	0	0	6.8	6.2	0.0	0.0	0.0	0.8	0.7	1.3	8.3
2	4	S	4	2.26	0	5	0.4	10.2	0.0	0.0	0.0	0.0	0.1	0.9	11.1
2	4	S	4	2.26	0	14	0.2	9.3	0.0	0.0	0.0	0.0	1.4	3.4	12.7
2	4	S	4	2.26	0	21	1.5	9.4	0.0	0.0	0.0	0.0	0.0	2.9	12.3
2	4	S	4	2.26	80	0	6.4	12.7	0.0	0.0	0.6	62.8	1.4	22.1	97.6
2	4	S	4	2.26	80	5	0.8	11.7	0.0	0.0	2.3	60.3	1.6	23.0	94.9
2	4	S	4	2.26	80	14	1.0	5.6	0.0	0.0	0.0	60.8	4.4	25.5	91.9
2	4	S	4	2.26	80	21	0.9	11.8	0.0	0.0	1.1	59.6	1.8	24.0	95.5
2	4	S	4	5.59	0	0	0.1	10.3	0.0	0.0	0.4	0.2	0.2	1.2	11.7
2	4	S	4	5.59	0	5	1.3	10.5	0.0	0.0	0.0	0.0	0.1	0.9	11.5
2	4	S	4	5.59	0	14	3.9	8.5	0.0	0.0	0.0	0.0	0.1	2.1	10.6
2	4	S	4	5.59	0	21	0.4	10.7	0.0	0.0	0.0	0.0	0.3	2.0	12.7
2	4	S	4	5.59	80	0	1.5	12.4	0.0	0.0	1.7	61.6	0.8	22.3	96.4
2	4	S	4	5.59	80	5	0.2	7.3	0.0	0.0	0.6	65.6	0.1	21.6	94.4
2	4	S	4	5.59	80	14	3.2	12.1	0.0	0.0	1.2	58.5	0.5	22.6	93.1
2	4	S	4	5.59	80	21	0.9	8.9	0.0	0.0	1.7	60.4	0.4	22.2	91.6
2	4	S	15	2.26	0	0	6.8	6.2	0.0	0.0	0.0	0.8	0.7	1.3	8.3
2	4	S	15	2.26	0	5	0.2	9.2	0.0	0.0	0.0	0.0	0.3	1.4	10.6
2	4	S	15	2.26	0	14	0.9	9.8	0.0	0.0	0.1	0.1	0.2	1.8	11.7
2	4	S	15	2.26	0	21	0.7	10.1	0.0	0.0	0.0	0.0	0.1	1.6	11.8
2	4	S	15	2.26	80	0	6.4	12.7	0.0	0.0	0.6	62.8	1.4	22.1	97.6
2	4	S	15	2.26	80	5	2.8	7.1	0.0	0.0	1.7	61.6	0.6	22.1	90.8
2	4	S	15	2.26	80	14	1.9	10.8	0.0	0.0	2.9	61.6	4.5	24.4	96.8
2	4	S	15	2.26	80	21	5.8	11.4	0.0	0.0	1.7	59.9	0.4	23.2	94.5
2	4	S	15	5.59	0	0	0.1	10.3	0.0	0.0	0.4	0.2	0.2	1.2	11.7
2	4	S	15	5.59	0	5	1.4	10.8	0.0	0.0	0.0	0.0	0.6	1.3	12.1
2	4	S	15	5.59	0	14	2.9	10.3	0.0	0.0	0.0	0.0	0.1	1.1	11.4
2	4	S	15	5.59	0	21	0.7	10.9	0.0	0.0	0.1	0.1	0.0	1.0	12.0
2	4	S	15	5.59	80	0	1.5	12.4	0.0	0.0	1.7	61.6	0.8	22.3	96.4
2	4	S	15	5.59	80	5	12.5	10.4	0.0	0.0	1.7	64.4	0.6	21.0	95.9
2	4	S	15	5.59	80	14	1.3	12.3	0.0	0.0	1.7	59.9	0.2	21.7	94.0
2	4	S	15	5.59	80	21	7.7	15.6	0.0	0.0	2.3	56.8	1.6	21.1	93.5

Table 3 cont'd.

PL	DP	SOL	TMP	WC	TRT	DAY	NO3 RANGE	NO3 AVER	NO2 RANGE	NO2 AVER	SOL NH4 RANGE	SOL NH4 AVER	EX NH4 RANGE	EX NH4 AVER	TOTALN
2	4	S	30	2.26	0	0	6.8	6.2	0.0	0.0	0.0	0.8	0.7	1.3	8.3
2	4	S	30	2.26	0	5	0.2	9.5	0.0	0.0	0.0	0.0	0.0	1.0	10.5
2	4	S	30	2.26	0	14	0.2	9.7	0.0	0.0	0.6	0.3	0.1	1.1	11.1
2	4	S	30	2.26	0	21	1.0	9.5	0.0	0.0	0.1	0.1	0.0	1.3	10.9
2	4	S	30	2.26	80	0	6.4	12.7	0.0	0.0	0.6	62.8	1.4	22.1	97.6
2	4	S	30	2.26	80	5	0.6	11.7	0.0	0.0	3.4	59.1	0.1	22.8	93.6
2	4	S	30	2.26	80	14	0.1	12.4	0.0	0.0	0.6	56.6	0.3	24.0	93.1
2	4	S	30	2.26	80	21	7.7	13.0	0.0	0.0	2.8	54.3	1.1	23.3	90.6
2	4	S	30	5.59	0	0	0.1	10.3	0.0	0.0	0.4	0.2	0.2	1.2	11.7
2	4	S	30	5.59	0	5	0.4	10.4	0.0	0.0	0.0	0.0	0.0	0.6	11.0
2	4	S	30	5.59	0	14	1.0	8.9	0.0	0.0	0.1	0.1	0.0	0.9	9.8
2	4	S	30	5.59	0	21	1.8	9.3	0.0	0.0	0.0	0.0	0.5	0.8	10.1
2	4	S	30	5.59	80	0	1.5	12.4	0.0	0.0	1.7	61.6	0.8	22.3	96.4
2	4	S	30	5.59	80	5	1.2	12.0	0.0	0.0	2.3	61.3	0.3	21.8	95.1
2	4	S	30	5.59	80	14	10.5	20.6	0.0	0.0	7.0	52.3	1.7	20.0	93.0
2	4	S	30	5.59	80	21	1.4	19.3	0.0	0.0	3.2	51.7	1.8	22.3	93.3
2	5	S	4	1.44	0	0	0.1	2.3	0.0	0.0	0.0	1.0	0.6	1.0	4.3
2	5	S	4	1.44	0	5	0.0	2.6	0.0	0.0	0.2	0.4	0.1	1.8	4.8
2	5	S	4	1.44	0	14	1.1	1.3	0.0	0.0	0.0	0.2	0.0	0.7	2.1
2	5	S	4	1.44	0	21	0.1	2.6	0.0	0.0	0.1	0.3	0.1	0.8	3.6
2	5	S	4	1.44	80	0	0.3	6.9	0.0	0.0	2.9	67.1	1.2	16.5	90.6
2	5	S	4	1.44	80	5	5.9	3.3	0.0	0.0	2.3	66.8	0.1	16.9	87.1
2	5	S	4	1.44	80	14	4.4	6.6	0.0	0.0	1.1	62.3	2.2	18.6	87.5
2	5	S	4	1.44	80	21	1.3	9.3	0.0	0.0	2.8	63.8	0.6	17.0	90.0
2	5	S	4	3.61	0	0	0.0	2.5	0.0	0.0	0.2	0.2	0.1	0.8	3.5
2	5	S	4	3.61	0	5	0.1	2.6	0.0	0.0	0.1	0.8	0.5	1.4	4.8
2	5	S	4	3.61	0	14	0.3	2.8	0.0	0.0	0.1	0.1	2.0	1.7	4.6
2	5	S	4	3.61	0	21	0.1	2.6	0.0	0.0	0.4	0.3	0.1	0.8	3.7
2	5	S	4	3.61	80	0	7.4	5.6	0.0	0.0	5.0	66.4	0.5	16.4	88.4
2	5	S	4	3.61	80	5	0.4	8.1	0.0	0.0	2.8	64.7	0.6	17.1	89.9
2	5	S	4	3.61	80	14	0.6	5.5	0.0	0.0	1.2	61.6	0.1	17.1	84.1
2	5	S	4	3.61	80	21	3.2	7.9	0.0	0.0	1.1	62.8	0.1	17.1	87.8
2	5	S	15	1.44	0	0	0.1	2.3	0.0	0.0	0.0	1.0	0.6	1.0	4.3
2	5	S	15	1.44	0	5	0.2	2.2	0.0	0.0	0.1	0.4	0.4	1.5	4.1
2	5	S	15	1.44	0	14	0.1	2.3	0.0	0.0	0.3	0.3	0.3	0.8	3.4
2	5	S	15	1.44	0	21	0.4	2.6	0.0	0.0	0.0	0.5	0.0	0.8	3.9
2	5	S	15	1.44	80	0	0.3	6.9	0.0	0.0	2.9	67.1	1.2	16.5	90.6
2	5	S	15	1.44	80	5	10.0	7.5	0.0	0.0	3.4	65.2	0.3	17.8	90.4
2	5	S	15	1.44	80	14	1.9	3.1	0.0	0.0	1.1	65.8	0.3	16.9	85.8
2	5	S	15	1.44	80	21	3.5	8.9	0.0	0.0	1.1	64.1	0.9	18.1	91.1
2	5	S	15	3.61	0	0	0.0	2.5	0.0	0.0	0.2	0.2	0.1	0.8	3.5
2	5	S	15	3.61	0	5	0.1	2.3	0.0	0.0	0.2	0.2	1.3	1.8	4.4
2	5	S	15	3.61	0	14	1.8	0.9	0.0	0.0	0.0	0.0	0.4	1.0	1.9
2	5	S	15	3.61	0	21	0.2	2.6	0.0	0.0	0.1	0.1	0.2	0.7	3.3
2	5	S	15	3.61	80	0	7.4	5.6	0.0	0.0	5.0	66.4	0.5	10.4	88.4
2	5	S	15	3.61	80	5	2.0	7.8	0.0	0.0	0.0	62.7	0.7	17.3	87.7
2	5	S	15	3.61	80	14	5.5	2.9	0.0	0.0	4.0	61.3	0.8	17.8	82.0
2	5	S	15	3.61	80	21	1.5	4.3	0.0	0.0	4.5	65.6	0.3	17.3	87.1
2	5	S	30	1.44	0	0	0.1	2.3	0.0	0.0	0.0	1.0	0.6	1.0	4.3
2	5	S	30	1.44	0	5	0.2	2.7	0.0	0.0	0.0	0.3	0.2	0.9	3.9
2	5	S	30	1.44	0	14	0.2	1.9	0.0	0.0	0.0	0.0	2.5	2.4	4.3
2	5	S	30	1.44	0	21	0.4	2.6	0.0	0.0	0.0	0.5	0.0	0.9	4.0
2	5	S	30	1.44	80	0	0.3	6.9	0.0	0.0	2.9	67.1	1.2	16.5	90.6
2	5	S	30	1.44	80	5	1.8	4.7	0.0	0.0	2.2	65.2	0.4	17.9	87.8
2	5	S	30	1.44	80	14	3.6	2.8	0.0	0.0	0.0	57.3	0.4	18.2	78.3
2	5	S	30	1.44	80	21	0.5	5.1	0.0	0.0	0.0	57.3	0.0	19.7	82.0
2	5	S	30	3.61	0	0	0.0	2.5	0.0	0.0	0.2	0.2	0.1	0.8	3.5
2	5	S	30	3.61	0	5	0.5	2.3	0.0	0.0	0.0	0.0	0.0	0.6	2.8
2	5	S	30	3.61	0	14	2.2	1.4	0.0	0.0	0.3	0.1	0.2	0.7	2.2
2	5	S	30	3.61	0	21	0.3	1.5	0.0	0.0	0.3	0.3	0.2	0.5	2.3
2	5	S	30	3.61	80	0	7.4	5.6	0.0	0.0	5.0	66.4	0.5	16.4	88.4
2	5	S	30	3.61	80	5	1.4	2.9	0.0	0.0	1.7	66.3	0.4	17.8	87.0
2	5	S	30	3.61	80	14	7.0	4.9	0.0	0.0	3.4	61.0	3.1	20.3	86.2
2	5	S	30	3.61	80	21	5.7	6.1	0.0	0.0	4.6	59.9	2.1	19.8	85.8

able 3 cont'd.

							NO3		NO2		SOL NH4		EX NH4		
PL	DP	SOL	TMP	WC	TRT	DAY	RANGE	AVER	RANGE	AVER	RANGE	AVER	RANGE	AVER	TOTALN
2	6	S	4	1.26	0	0	0.3	3.3	0.0	0.0	0.5	0.5	0.0	1.9	5.8
2	6	S	4	1.26	0	5	0.6	3.4	0.0	0.0	0.1	0.5	0.0	0.7	4.6
2	6	S	4	1.26	0	14	0.3	3.3	0.0	0.0	0.5	0.4	0.[illegible]	1.3	5.0
2	6	S	4	1.26	0	21	0.3	3.3	0.0	0.0	0.2	0.6	0.5	2.6	6.4
2	6	S	4	1.26	80	0	3.9	3.8	0.0	0.0	2.0	74.4	1.3	13.0	91.2
2	6	S	4	1.26	80	5	1.8	16.7	0.0	0.0	2.9	65.6	0.[illegible]	16.6	99.0
2	6	S	4	1.26	80	14	5.7	5.3	0.0	0.0	7.7	72.9	4.4	14.1	92.3
2	6	S	4	1.26	80	21	6.7	8.4	0.0	0.0	10.4	73.6	2.5	14.5	96.6
2	6	S	4	3.14	0	0	0.3	3.1	0.0	0.0	0.0	0.3	0.2	1.1	4.5
2	6	S	4	3.14	0	5	0.2	3.7	0.0	0.0	0.1	0.3	0.8	2.1	6.0
2	6	S	4	3.14	0	14	0.3	3.3	0.0	0.0	0.2	0.4	0.1	1.1	4.8
2	6	S	4	3.14	0	21	0.4	3.2	0.0	0.0	0.2	0.7	0.[illegible]	2.6	6.4
2	6	S	4	3.14	80	0	3.0	1.5	0.0	0.0	5.2	74.4	1.8	14.7	90.6
2	6	S	4	3.14	80	5	0.7	17.9	0.0	0.0	1.2	59.7	0.8	16.0	93.6
2	6	S	4	3.14	80	14	1.7	0.8	0.0	0.0	0.5	77.6	0.7	10.3	88.6
2	6	S	4	3.14	80	21	3.3	1.7	0.0	0.0	1.5	74.1	0.8	14.3	90.2
2	6	S	15	1.26	0	0	0.3	3.3	0.0	0.0	0.5	0.5	0.0	1.9	5.8
2	6	S	15	1.26	0	5	0.6	3.3	0.0	0.0	0.3	0.8	0.9	1.2	5.3
2	6	S	15	1.26	0	14	0.0	3.1	0.0	0.0	0.3	0.3	0.8	1.2	4.6
2	6	S	15	1.26	0	21	0.2	3.1	0.0	0.0	0.2	0.6	4.8	4.8	8.5
2	6	S	15	1.26	80	0	3.9	3.8	0.0	0.0	2.0	74.4	1.3	13.0	91.2
2	6	S	15	1.26	80	5	1.1	0.6	0.0	0.0	13.3	78.3	1.5	11.1	89.9
2	6	S	15	1.26	80	14	0.0	0.0	0.0	0.0	3.4	71.9	0.4	11.6	83.5
2	6	S	15	1.26	80	21	0.8	2.1	0.0	0.0	2.5	74.4	0.2	14.6	91.0
2	6	S	15	3.14	0	0	0.3	3.1	0.0	0.0	0.0	0.3	0.2	1.1	4.5
2	6	S	15	3.14	0	5	0.1	3.3	0.0	0.0	0.1	0.1	0.3	1.3	4.6
2	6	S	15	3.14	0	14	0.1	3.6	0.0	0.0	0.1	0.3	0.0	0.6	4.5
2	6	S	15	3.14	0	21	0.7	3.8	0.0	0.0	0.2	0.7	0.3	2.0	6.5
2	6	S	15	3.14	80	0	3.0	1.5	0.0	0.0	5.2	74.4	1.8	14.7	90.6
2	6	S	15	3.14	80	5	2.0	1.0	0.0	0.0	0.3	75.0	0.[illegible]	11.9	88.0
2	6	S	15	3.14	80	14	0.1	5.4	0.0	0.0	1.8	75.2	0.2	11.5	92.1
2	6	S	15	3.14	80	21	1.2	2.6	0.0	0.0	1.4	75.6	5.0	10.4	88.6
2	6	S	30	1.26	0	0	0.3	3.3	0.0	0.0	0.5	0.5	0.0	1.9	5.8
2	6.	S	30	1.26	0	5	0.2	3.1	0.0	0.0	0.4	0.6	0.1	0.8	4.5
2	6	S	30	1.26	0	14	0.1	3.3	0.0	0.0	0.2	0.4	0.0	0.5	4.2
2	6	S	30	1.26	0	21	0.7	3.5	0.0	0.0	0.4	0.8	0.2	1.9	6.2
2	6	S	30	1.26	80	0	3.9	3.8	0.0	0.0	2.0	74.4	1.3	13.0	91.2
2	6	S	30	1.26	80	5	4.9	2.4	0.0	0.0	2.9	73.1	1.3	10.5	86.0
2	6	S	30	1.26	80	14	6.0	3.9	0.0	0.0	1.4	73.5	0.2	10.7	88.1
2	6	S	30	1.26	80	21	3.5	3.3	0.0	0.0	8.4	70.0	1.1	16.3	89.5
2	6	S	30	3.14	0	0	0.3	3.1	0.0	0.0	0.0	0.3	0.2	1.1	4.5
2	6	S	30	3.14	0	5	0.2	3.1	0.0	0.0	0.6	0.5	0.3	0.8	4.3
2	6	S	30	3.14	0	14	0.5	3.1	0.0	0.0	0.1	0.3	0.0	0.5	3.9
2	6	S	30	3.14	0	21	0.0	3.9	0.0	0.0	0.0	0.6	2.9	3.1	7.5
2	6	S	30	3.14	80	0	3.0	1.5	0.0	0.0	5.2	74.4	1.8	14.7	90.6
2	6	S	30	3.14	80	5	0.8	0.4	0.0	0.0	2.6	77.4	1.7	10.4	88.2
2	6		30	3.14	80	14	1.1	2.9	0.0	0.0	4.9	69.3	3.7	13.3	85.4
2	6	S	30	3.14	80	21	0.0	0.0	0.0	0.0	2.1	72.1	1.6	15.8	87.9
2	7	S	4	1.22	0	0	0.4	4.5	0.0	0.0	0.4	0.4	0.[illegible]	1.1	6.0
2	7	S	4	1.22	0	5	0.1	4.1	0.0	0.0	0.4	0.3	0.0	0.8	5.1
2	7	S	4	1.22	0	14	0.1	4.6	0.0	0.0	0.3	0.5	0.[illegible]	0.8	6.0
2	7	S	4	1.22	0	21	0.3	4.8	0.0	0.0	0.1	0.8	0.0	1.7	7.3
2	7	S	4	1.22	80	0	9.0	8.0	0.0	0.0	0.6	77.2	0.5	12.3	97.4
2	7	S	4	1.22	80	5	3.6	2.6	0.0	0.0	5.4	79.3	1.[illegible]	10.6	92.5
2	7	S	4	1.22	80	14	0.0	0.0	0.0	0.0	0.3	76.8	0.4	6.8	83.5
2	7	S	4	1.22	80	21	1.8	5.6	0.0	0.0	1.7	80.0	0.7	10.6	96.3
2	7	S	4	3.05	0	0	0.0	4.4	0.0	0.0	0.0	0.3	0.1	1.1	5.8
2	7	S	4	3.05	0	5	0.3	4.8	0.0	0.0	0.1	0.8	0.2	0.9	6.5
2	7	S	4	3.05	0	14	0.0	4.7	0.0	0.0	0.1	0.3	0.0	0.9	5.9
2	7	S	4	3.05	0	21	0.1	4.6	0.0	0.0	0.1	1.6	2.2	2.5	8.7
2	7	S	4	3.05	80	0	8.0	5.8	0.0	0.0	2.3	69.4	0.1	13.3	88.6
2	7	S	4	3.05	80	5	0.0	0.0	0.0	0.0	0.3	82.8	0.6	11.1	93.9
2	7	S	4	3.05	80	14	2.4	11.6	0.0	0.0	0.6	77.2	1.3	6.5	95.3
2	7	S	4	3.05	80	21	6.9	8.8	0.0	0.0	3.4	79.5	1.5	13.6	102.0
2	7	S	15	1.22	0	0	0.4	4.5	0.0	0.0	0.4	0.4	0.1	1.1	6.0
2	7	S	15	1.22	0	5	0.6	4.4	0.0	0.0	0.2	1.0	0.3	0.8	6.2
2	7	S	15	1.22	0	14	0.3	4.6	0.0	0.0	0.1	0.5	1.0	1.3	6.5
2	7	S	15	1.22	0	21	0.0	4.9	0.0	0.0	0.7	1.6	0.[illegible]	1.3	7.8
2	7	S	15	1.22	80	0	9.0	8.0	0.0	0.0	0.6	77.2	0.5	12.3	97.4
2	7	S	15	1.22	80	5	6.3	3.1	0.0	0.0	3.7	78.4	1.2	11.5	93.1
2	7	S	15	1.22	80	14	0.6	4.8	0.0	0.0	2.3	75.8	0.3	7.0	87.6
2	7	S	15	1.22	80	21	9.8	7.8	0.0	0.0	2.3	76.6	0.5	10.9	95.6
2	7	S	15	3.05	0	0	0.0	4.4	0.0	0.0	0.0	0.3	0.1	1.1	5.8
2	7	S	15	3.05	0	5	0.4	4.6	0.0	0.0	0.2	0.5	0.2	1.1	6.2
2	7	S	15	3.05	0	14	0.7	4.4	0.0	0.0	0.3	0.3	0.1	0.8	5.4
2	7	S	15	3.05	0	21	0.2	4.6	0.0	0.0	0.0	1.9	0.3	1.1	7.6
2	7	S	15	3.05	80	0	8.0	5.8	0.0	0.0	2.3	69.4	0.1	13.3	88.6
2	7	S	15	3.05	80	5	2.9	5.3	0.0	0.0	4.6	80.7	0.4	11.0	97.0
2	7	S	15	3.05	80	14	0.5	9.4	0.0	0.0	2.3	73.8	1.3	7.9	91.1
2	7	S	15	3.05	80	21	1.3	5.0	0.0	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table 3 cont'd.

							NO3		NO2		SOL NH4		EX NH4		
PL	DP	SOL	TMP	WC	TRT	DAY	RANGE	AVER	RANGE	AVER	RANGE	AVER	RANGE	AVER	TOTALN
2	7	S	30	1.22	0	0	0.4	4.5	0.0	0.0	0.4	0.4	0.[illegible]	1.1	6.0
2	7	S	30	1.22	0	5	0.5	4.6	0.0	0.0	0.3	0.9	0.5	1.4	6.9
2	7	S	30	1.22	0	14	0.3	4.3	0.0	0.0	0.1	0.9	0.1	0.8	6.0
2	7	S	30	1.22	0	21	2.3	5.5	0.0	0.0	0.1	2.4	0.9	0.7	8.6
2	7	S	30	1.22	80	0	9.0	8.0	0.0	0.0	0.6	77.2	0.5	12.3	97.4
2	7	S	30	1.22	80	5	3.4	2.8	0.0	0.0	4.0	80.0	1.3	11.8	94.6
2	7	S	30	1.22	80	14	8.2	10.7	0.0	0.0	1.7	72.5	2.1	8.6	91.9
2	7	S	30	1.22	80	21	1.1	6.3	0.0	0.0	1.7	74.3	2.2	12.5	93.0
2	7	S	30	3.05	0	0	0.0	4.4	0.0	0.0	0.0	0.3	0.1	1.1	5.8
2	7	S	30	3.05	0	5	0.5	4.4	0.0	0.0	0.0	0.2	0.[illegible]	1.4	5.9
2	7	S	30	3.05	0	14	0.2	4.8	0.0	0.0	0.0	1.5	0.[illegible]	1.2	7.5
2	7	S	30	3.05	0	21	1.6	4.9	0.0	0.0	0.0	1.6	2.[illegible]	2.0	8.5
2	7	S	30	3.05	80	0	8.0	5.8	0.0	0.0	2.3	69.4	0.1	13.3	88.6
2	7	S	30	3.05	80	5	0.0	0.0	0.0	0.0	1.1	76.3	0.4	12.5	88.8
2	7	S	30	3.05	80	14	8.4	7.1	0.0	0.0	3.8	75.6	4.[illegible]	11.0	93.7
2	7	S	30	3.05	80	21	0.0	6.9	0.0	0.0	0.0	80.1	1.[illegible]	11.4	98.4
3	1	S	4	2.87	0	0	0.7	14.8	3.5	1.8	0.1	0.1	0.0	1.7	18.2
3	1	S	4	2.87	0	5	2.2	19.4	0.0	0.0	0.7	0.8	0.2	1.5	21.7
3	1	S	4	2.87	0	14	2.1	16.3	0.0	0.0	0.0	0.0	0.2	1.8	18.0
3	1	S	4	2.87	0	21	2.5	18.6	0.0	0.0	0.1	0.6	0.3	1.8	21.0
3	1	S	4	2.87	80	0	2.2	20.2	0.0	0.0	3.3	52.8	0.5	24.4	97.5
3	1	S	4	2.87	80	5	3.4	19.0	0.0	0.0	10.2	56.5	3.3	23.6	99.1
3	1	S	4	2.87	80	14	1.9	21.8	0.0	0.0	5.9	58.6	0.1	22.8	103.2
3	1	S	4	2.87	80	21	3.7	13.8	0.0	0.0	3.6	75.5	0.9	24.8	114.1
3	1	S	4	7.17	0	0	2.0	19.9	0.0	0.0	0.9	0.4	3.4	1.8	22.1
3	1	S	4	7.17	0	5	1.8	19.8	0.0	0.0	0.7	0.4	0.6	2.2	22.4
3	1	S	4	7.17	0	14	3.1	19.8	0.0	0.0	0.3	0.3	0.2	2.1	22.2
3	1	S	4	7.17	0	21	2.7	19.9	0.0	0.0	0.2	1.2	0.5	2.4	23.5
3	1	S	4	7.17	80	0	3.2	18.6	0.0	0.0	1.2	56.8	0.7	23.6	99.0
3	1	S	4	7..7	80	5	1.4	21.6	0.0	0.0	1.2	56.8	0.5	22.1	100.5
3	1	S	4	7.17	80	14	1.2	20.7	0.0	0.0	2.3	55.1	0.1	23.1	99.0
3	1	S	4	7.17	80	21	1.7	14.1	0.0	0.0	1.2	62.3	0.5	22.1	98.5
3	1	S	15	2.87	0	0	0.7	14.6	3.5	1.8	0.1	0.1	0.0	1.7	18.2
3	1	S	15	2.87	0	5	3.7	15.4	0.0	0.0	0.2	0.3	0.0	2.2	17.9
3	1	S	15	2.87	0	14	2.6	16.2	0.0	0.0	0.0	0.0	0.6	2.4	18.6
3	1	S	15	2.87	0	21	0.1	17.3	0.0	0.0	0.2	0.6	0.5	1.8	19.6
3	1	S	15	2.87	80	0	2.2	20.2	0.0	0.0	3.3	52.8	0.5	24.4	97.5
3	1	S	15	2.87	80	5	2.7	9.5	0.0	0.0	4.8	62.8	1.2	24.1	96.4
3	1	S	15	2.87	80	14	1.4	13.8	0.0	0.0	2.5	54.4	3.1	22.1	90.3
3	1	S	15	2.87	80	21	0.2	17.8	0.0	0.0	7.8	60.7	0.8	21.7	100.2
3	1	S	15	7.17	0	0	2.0	19.9	0.0	0.0	0.9	0.4	3.4	1.8	22.1
3	1	S	15	7.17	0	5	0.3	18.9	0.0	0.0	0.0	0.0	0.9	1.9	20.9
3	1	S	15	7.17	0	14	2.5	20.4	0.0	0.0	0.7	0.3	0.1	0.8	21.4
3	1	S	15	7.17	0	21	0.2	19.3	0.0	0.0	0.1	0.5	0.1	1.3	21.2
3	1	S	15	7.17	80	0	3.2	18.6	0.0	0.0	1.2	56.8	0.7	23.6	99.0
3	1	S	15	7.17	80	5	4.9	14.7	2.0	1.0	4.1	62.1	1.7	20.3	98.1
3	1	S	15	7.17	80	14	1.6	34.4	0.0	0.0	5.2	49.3	1.5	20.4	104.0
3	1	S	15	7.17	80	21	8.0	39.4	0.0	0.0	0.8	44.3	2.0	17.8	101.5
3	1	S	30	2.87	0	0	0.7	14.8	3.5	1.8	0.1	0.1	0.0	1.7	18.2
3	1	S	30	2.87	0	5	0.2	16.3	0.0	0.0	0.2	0.1	0.4	1.8	18.2
3	1	S	30	2.87	0	14	0.3	17.0	0.0	0.0	0.5	0.4	0.4	3.5	21.0
3	1	S	30	2.87	0	21	1.5	17.4	0.0	0.0	0.1	0.6	0.0	1.8	19.8
3	1	S	30	2.87	80	0	2.2	20.2	0.0	0.0	3.3	52.8	0.5	24.4	97.5
3	1	S	30	2.87	80	5	5.3	19.1	0.0	0.0	5.0	50.6	3.1	22.6	92.3
3	1	S	30	2.87	80	14	4.4	16.9	0.0	0.0	7.9	57.1	0.2	26.0	99.9
3	1	S	30	2.87	80	21	6.0	14.6	0.0	0.0	4.8	60.4	1.0	21.8	96.8
3	1	S	30	7.17	0	0	2.0	19.9	0.0	0.0	0.9	0.4	3.4	1.8	22.1
3	1	S	30	7.17	0	5	0.1	20.8	0.0	0.0	0.3	0.3	0.3	1.3	22.3
3	1	S	30	7.17	0	14	1.0	21.5	0.0	0.0	0.2	1.2	0.4	2.8	25.5
3	1	S	30	7.17	0	21	0.2	23.2	0.0	0.0	0.1	0.3	0.6	1.2	24.6
3	1	S	30	7.17	80	0	3.2	18.6	0.0	0.0	1.2	56.8	0.7	23.6	99.0
3	1	S	30	7.17	80	5	5.4	38.7	11.5	5.8	7.5	43.9	1.8	18.1	106.4
3	1	S	30	7.17	80	14	25.1	76.1	27.0	13.5	10.6	12.7	5.2	7.0	109.3
3	1	[illegible]	30	7.17	80	21	30.2	64.4	0.0	0.0	20.2	22.5	7.7	10.5	97.4

PL	DP	SOL	TMP	WC	TRT	DAY	NO3 RANGE	NO3 AVER	NO2 RANGE	NO2 AVER	SOL NH4 RANGE	SOL NH4 AVER	EX NH4 RANGE	EX NH4 AVER	TOTALN
3	2	S	4	3.06	0	0	3.4	13.9	0.0	0.0	1.0	0.6	0.1	2.1	16.6
3	2	S	4	3.06	0	5	0.6	12.1	0.0	0.0	0.4	0.4	0.2	2.1	14.6
3	2	S	4	3.06	0	14	2.6	11.6	0.0	0.0	0.0	0.1	0.0	1.6	13.3
3	2	S	4	3.06	0	21	1.4	14.1	0.0	0.0	0.3	0.3	0.1	2.1	16.6
3	2	S	4	3.06	80	0	4.4	23.7	0.0	0.0	6.5	57.3	0.6	23.5	104.4
3	2	S	4	3.06	80	5	3.3	21.0	0.0	0.0	4.0	55.5	0.0	22.7	99.2
3	2	S	4	3.06	80	14	4.3	19.5	0.0	0.0	1.5	53.8	0.1	23.3	96.6
3	2	S	4	3.06	80	21	0.1	26.8	0.0	0.0	4.1	54.9	1.0	23.7	105.4
3	2	S	4	7.65	0	0	2.3	14.9	0.0	0.0	0.2	0.9	0.4	2.3	18.1
3	2	S	4	7.65	0	5	1.4	13.7	0.0	0.0	0.2	0.4	0.1	1.8	15.8
3	2	S	4	7.65	0	14	0.9	14.9	0.0	0.0	0.1	0.1	0.2	2.3	17.4
3	2	S	4	7.65	0	21	0.6	17.6	0.0	0.0	0.3	0.3	0.9	1.8	19.7
3	2	S	4	7.65	80	0	2.2	23.6	0.0	0.0	1.5	58.9	0.2	24.7	107.1
3	2	S	4	7.65	80	5	9.9	21.3	0.0	0.0	0.5	56.4	0.0	22.7	100.3
3	2	S	4	7.65	80	14	0.1	27.1	0.5	0.8	1.0	54.6	0.6	22.7	105.1
3	2	S	4	7.65	80	21	3.2	29.5	1.5	0.8	1.5	55.4	0.0	23.4	109.0
3	2	S	15	3.06	0	0	3.4	13.9	0.0	0.0	1.0	0.6	0.1	2.1	16.6
3	2	S	15	3.06	0	5	0.8	12.9	0.0	0.0	1.3	1.5	0.6	1.9	16.3
3	2	S	15	3.06	0	14	2.1	13.9	0.0	0.0	1.2	1.0	0.4	1.8	16.7
3	2	S	15	3.06	0	21	1.3	15.0	0.0	0.0	1.6	0.9	0.1	1.8	17.7
3	2	S	15	3.06	80	0	4.4	23.7	0.0	0.0	6.5	57.3	0.6	23.5	104.4
3	2	S	15	3.06	80	5	11.3	25.9	0.0	0.0	5.5	56.8	0.0	24.2	106.9
3	2	S	15	3.06	80	14	6.2	28.8	0.0	0.0	7.5	57.3	2.6	25.5	111.5
3	2	S	15	3.06	80	21	2.0	23.9	0.0	0.0	1.5	53.8	1.6	23.9	101.5
3	2	S	15	7.65	0	0	2.3	14.9	0.0	0.0	0.2	0.9	0.4	2.3	18.1
3	2	S	15	7.65	0	5	2.3	14.9	0.0	0.0	0.8	0.5	0.4	2.2	17.6
3	2	S	15	7.65	0	14	1.9	21.1	0.0	0.0	0.0	0.1	0.3	0.9	22.2
3	2	S	15	7.65	0	21	3.2	21.6	0.0	0.0	0.0	0.1	0.0	0.7	22.4
3	2	S	15	7.65	80	0	2.2	23.6	0.0	0.0	1.5	58.9	0.2	24.7	107.1
3	2	S	15	7.65	80	5	4.4	28.6	0.0	0.0	1.5	55.9	0.5	22.6	107.1
3	2	S	15	7.65	80	14	3.6	54.9	0.0	0.0	3.9	33.6	4.8	16.4	104.9
3	2	S	15	7.65	80	21	18.4	71.3	0.0	0.0	19.0	24.5	7.6	12.3	108.1
3	2	S	30	3.06	0	0	3.4	13.9	0.0	0.0	1.0	0.6	0.1	2.1	16.6
3	2	S	30	3.06	0	5	0.6	13.2	0.0	0.0	0.0	0.1	0.1	1.6	14.9
3	2	S	30	3.06	0	14	2.2	16.4	0.0	0.0	0.4	0.7	1.8	2.4	19.5
3	2	S	30	3.06	0	21	0.9	15.9	0.0	0.0	0.1	0.6	0.6	2.1	18.7
3	2	S	30	3.06	80	0	4.4	23.7	0.0	0.0	6.5	57.3	0.6	23.5	104.4
3	2	S	30	3.06	80	5	2.6	19.9	0.0	0.0	1.0	49.5	1.3	23.5	92.9
3	2	S	30	3.06	80	14	3.6	19.4	0.0	0.0	4.5	57.3	1.4	24.4	101.0
3	2	S	30	3.06	80	21	5.6	20.7	0.0	0.0	3.0	52.0	4.6	22.7	95.4
3	2	S	30	7.65	0	0	2.3	14.9	0.0	0.0	0.2	0.9	0.4	2.3	18.1
3	2	S	30	7.65	0	5	0.0	20.8	0.0	0.0	0.0	0.8	0.0	1.5	23.1
3	2	S	30	7.65	0	14	0.1	22.6	0.0	0.0	0.3	0.3	0.3	1.0	23.8
3	2	S	30	7.65	0	21	2.4	26.7	0.0	0.0	0.0	0.1	0.0	0.8	27.6
3	2	S	30	7.65	80	0	2.2	23.6	0.0	0.0	1.5	58.9	0.2	24.7	107.1
3	2	S	30	7.65	80	5	3.8	49.1	16.0	12.5	6.0	36.4	1.0	15.7	113.7
3	2	S	30	7.65	80	14	25.2	70.2	0.0	0.0	18.5	24.3	8.3	11.3	105.8
3	2	S	30	7.65	80	21	19.2	72.2	0.0	0.0	0.8	21.6	0.8	11.9	105.7
4	1	C	4	9.60	0	0	1.8	17.0	0.0	0.0	0.6	0.5	2.4	5.3	22.8
4	1	C	4	9.60	0	5	0.2	17.3	0.0	0.0	0.4	0.4	0.3	9.0	26.7
4	1	C	4	9.60	0	14	2.1	17.4	0.0	0.0	0.0	0.1	0.4	7.1	24.6
4	1	C	4	9.60	0	21	0.0	16.5	0.0	0.0	0.0	0.2	0.1	7.1	23.7
4	1	C	4	9.60	80	0	1.2	22.1	0.0	0.0	0.5	23.9	0.5	47.6	93.5
4	1	C	4	9.60	80	5	1.0	20.3	0.0	0.0	3.6	29.1	6.1	53.1	102.5
4	1	C	4	9.60	80	14	0.4	21.0	0.0	0.0	0.4	25.3	0.9	42.6	88.9
4	1	C	4	9.60	80	21	1.4	17.0	0.0	0.0	2.8	23.3	5.6	39.8	80.1
4	1	C	4	24.00	0	0	1.5	19.4	0.0	0.0	0.0	0.2	0.0	8.5	28.1
4	1	C	4	24.00	0	5	0.8	27.6	0.0	0.0	1.0	0.9	0.6	6.7	35.2
4	1	C	4	24.00	0	14	0.8	35.9	0.0	0.0	1.0	0.7	0.7	2.1	38.7
4	1	C	4	24.00	0	21	1.1	43.8	0.0	0.0	0.0	0.1	0.2	1.1	45.0
4	1	C	4	24.00	80	0	0.7	24.6	0.0	0.0	2.1	30.4	1.9	55.3	110.4
4	1	C	4	24.00	80	5	3.3	34.8	0.0	0.0	6.5	25.4	7.4	48.0	108.2
4	1	C	4	24.00	80	14	2.8	45.3	0.0	0.0	6.0	23.3	6.0	39.9	108.5
4	1	C	4	24.00	80	21	5.4	54.8	0.0	0.0	14.5	25.3	14.8	41.3	121.3

Table 3 cont'd.

PL	DP	SOL	TMP	WC	TRT	DAY	NO3 RANGE	NO3 AVER	NO2 RANGE	NO2 AVER	SOL NH4 RANGE	SOL NH4 AVER	EX NH4 RANGE	EX NH4 AVER	TOTALN
4	1	C	15	9.60	0	0	1.8	17.0	0.0	0.0	0.6	0.5	2.4	5.3	22.8
4	1	C	15	9.60	0	5	1.4	15.9	0.0	0.0	0.2	0.3	1.7	6.5	24.7
4	1	C	15	9.60	0	14	0.9	18.8	0.0	0.0	0.0	0.3	5.8	4.4	23.5
4	1	C	15	9.60	0	21	1.0	18.0	0.0	0.0	0.0	0.2	0.9	3.4	21.6
4	1	C	15	9.60	80	0	1.2	22.1	0.0	0.0	0.5	23.9	0.5	47.6	93.5
4	1	C	15	9.60	80	5	1.2	21.0	0.0	0.0	18.1	32.8	14.6	47.2	100.9
4	1	C	15	9.60	80	14	2.8	20.9	0.0	0.0	2.8	26.2	2.2	39.2	86.3
4	1	C	15	9.60	80	21	1.3	20.8	0.0	0.0	6.5	21.4	7.0	38.2	80.4
4	1	C	15	24.00	0	0	1.5	19.4	0.0	0.0	0.0	0.2	0.0	8.5	28.1
4	1	C	15	24.00	0	5	4.7	36.3	0.0	0.0	0.5	0.8	0.4	1.5	38.5
4	1	C	15	24.00	0	14	0.5	40.6	0.0	0.0	0.0	0.2	0.2	0.8	41.5
4	1	C	15	24.00	0	21	6.8	44.8	0.0	0.0	0.1	0.3	0.4	0.3	45.3
4	1	C	15	24.00	80	0	0.7	24.6	0.0	0.0	2.1	30.4	1.9	55.3	110.4
4	1	C	15	24.00	80	5	0.5	51.1	0.0	0.0	2.0	22.7	0.8	38.9	112.6
4	1	C	15	24.00	80	14	8.8	83.7	0.0	0.0	5.5	8.6	6.1	19.6	111.9
4	1	C	15	24.00	80	21	4.0	106.0	0.0	0.0	2.4	2.3	10.2	10.9	119.2
4	1	C	30	9.60	0	0	1.8	17.0	0.0	0.0	0.6	0.5	2.4	5.3	22.8
4	1	C	30	9.60	0	5	1.2	18.6	0.0	0.0	0.0	0.2	0.1	5.1	23.9
4	1	C	30	9.60	0	14	0.7	15.8	0.0	0.0	0.0	0.2	0.1	2.9	18.9
4	1	C	30	9.60	0	21	1.6	15.7	0.0	0.0	1.4	1.0	0.6	2.4	19.1
4	1	C	30	9.60	80	0	1.2	22.1	0.0	0.0	0.5	23.9	0.5	47.6	93.5
4	1	C	30	9.60	80	5	0.1	21.4	0.0	0.0	11.9	28.1	12.8	41.3	90.9
4	1	C	30	9.60	80	14	2.0	21.8	0.0	0.0	5.1	19.9	3.4	40.3	82.1
4	1	C	30	9.60	80	21	2.5	20.1	0.0	0.0	2.0	19.0	3.7	37.9	77.0
4	1	C	30	24.00	0	0	1.5	19.4	0.0	0.0	0.0	0.2	0.0	8.5	28.1
4	1	C	30	24.00	0	5	1.7	45.9	0.0	0.0	0.1	0.3	0.1	0.8	47.0
4	1	C	30	24.00	0	14	2.4	50.5	0.0	0.0	0.1	0.1	0.1	0.3	51.0
4	1	C	30	24.00	0	21	8.1	57.8	0.0	0.0	0.1	0.8	0.1	0.6	59.4
4	1	C	30	24.00	80	0	0.7	24.6	0.0	0.0	2.1	30.4	1.9	55.3	110.4
4	1	C	30	24.00	80	5	1.0	101.5	0.0	0.0	3.5	3.9	6.8	16.0	121.3
4	1	C	30	24.00	80	14	13.0	132.5	0.0	0.0	0.0	0.1	3.2	2.2	134.8
4	1	C	30	24.00	80	21	3.0	131.5	0.0	0.0	0.1	0.8	0.2	0.8	133.0
4	2	C	4	9.66	0	0	0.6	4.2	0.0	0.0	0.0	0.1	0.7	4.1	8.4
4	2	C	4	9.66	0	5	1.5	4.4	0.0	0.0	0.8	0.6	0.3	4.9	10.0
4	2	C	4	9.66	0	14	0.9	4.6	0.0	0.0	0.4	0.3	0.3	5.8	10.7
4	2	C	4	9.66	0	21	0.1	4.3	0.0	0.0	0.2	0.5	0.5	5.1	10.0
4	2	C	4	9.66	80	0	1.7	5.8	0.0	0.0	6.1	26.8	0.4	55.1	87.6
4	2	C	4	9.66	80	5	1.6	5.0	0.0	0.0	3.1	24.6	1.3	54.3	84.0
4	2	C	4	9.66	80	14	1.7	5.3	0.0	0.0	6.5	25.9	9.7	51.3	82.4
4	2	C	4	9.66	80	21	3.1	4.1	0.0	0.0	7.4	24.5	5.5	51.4	80.0
4	2	C	4	24.20	0	0	0.3	6.0	0.0	0.0	0.3	0.3	1.4	5.9	12.3
4	2	C	4	24.20	0	5	5.9	6.9	0.0	0.0	0.1	0.1	0.4	8.3	15.3
4	2	C	4	24.20	0	14	0.3	19.1	0.0	0.0	0.1	0.1	0.1	6.1	25.2
4	2	C	4	24.20	0	21	0.3	21.8	0.0	0.0	0.0	0.1	0.5	3.6	25.6
4	2	C	4	24.20	80	0	0.9	7.3	0.0	0.0	0.0	23.5	2.2	48.3	79.0
4	2	C	4	24.20	80	5	2.7	14.9	0.0	0.0	2.8	26.4	0.7	57.9	99.3
4	2	C	4	24.20	80	14	2.0	20.6	0.0	0.0	0.8	25.0	0.2	56.2	101.8
4	2	C	4	24.20	80	21	0.9	26.8	0.0	0.0	0.0	22.6	2.4	50.1	99.5
4	2	C	15	9.66	0	0	0.6	4.2	0.0	0.0	0.0	0.1	0.7	4.1	8.4
4	2	C	15	9.66	0	5	0.8	4.2	0.0	0.0	0.2	0.7	0.3	4.9	9.8
4	2	C	15	9.66	0	14	0.2	4.2	0.0	0.0	0.2	1.7	0.3	4.3	10.1
4	2	C	15	9.66	0	21	0.7	4.3	0.0	0.0	0.1	1.3	0.4	2.5	8.1
4	2	C	15	9.66	80	0	1.7	5.8	0.0	0.0	6.1	26.8	0.4	55.1	87.6
4	2	C	15	9.66	80	5	2.1	6.3	0.0	0.0	9.7	20.4	14.2	47.7	74.4
4	2	C	15	9.66	80	14	0.7	4.3	0.0	0.0	4.8	19.7	11.6	41.5	65.4
4	2	C	15	9.66	80	21	1.1	7.1	0.0	0.0	13.8	30.0	15.1	53.4	90.6
4	2	C	15	24.20	0	0	0.3	6.0	0.0	0.0	0.3	0.3	1.4	5.9	12.3
4	2	C	15	24.20	0	5	1.1	19.8	0.0	0.0	0.0	0.1	0.2	3.6	23.5
4	2	C	15	24.20	0	14	5.5	28.1	0.0	0.0	0.1	0.1	0.2	0.9	29.0
4	2	C	15	24.20	0	21	0.0	30.8	0.0	0.0	0.0	0.1	0.1	0.6	31.5
4	2	C	15	24.20	80	0	0.9	7.3	0.0	0.0	0.0	23.5	2.6	48.5	79.3
4	2	C	15	24.20	80	5	5.5	25.9	0.0	0.0	0.2	20.4	0.9	48.8	95.1
4	2	C	15	24.20	80	14	2.0	57.6	0.0	0.0	2.1	13.4	2.8	29.2	100.3
4	2	C	15	24.20	80	21	1.5	87.4	0.0	0.0	0.4	3.6	1.4	11.9	102.9
4	2	C	30	9.66	0	0	0.6	4.2	0.0	0.0	0.0	0.1	0.7	4.1	8.4
4	2	C	30	9.66	0	5	0.6	4.4	0.0	0.0	0.2	0.4	0.9	2.5	7.3
4	2	C	30	9.66	0	14	1.1	2.4	0.0	0.0	0.3	1.5	0.1	2.4	6.4
4	2	C	30	9.66	0	21	0.4	1.9	0.0	0.0	1.1	2.6	0.3	1.0	5.5
4	2	C	30	9.66	80	0	1.7	5.8	0.0	0.0	6.1	26.8	0.4	55.1	87.6
4	2	C	30	9.66	80	5	1.9	4.6	0.0	0.0	0.9	18.8	1.3	38.8	62.3
4	2	C	30	9.66	80	14	1.7	5.8	0.0	0.0	0.9	18.9	0.1	38.3	63.1
4	2	C	30	9.66	80	21	1.5	6.9	0.0	0.0	1.6	18.6	9.1	37.3	62.8
4	2	C	30	24.20	0	0	0.3	6.0	0.0	0.0	0.3	0.3	1.4	5.9	12.3
4	2	C	30	24.20	0	5	1.7	30.4	0.0	0.0	0.5	0.4	0.2	0.6	31.4
4	2	C	30	24.20	0	14	0.5	42.8	0.0	0.0	0.0	0.1	0.1	0.8	43.7
4	2	C	30	24.20	0	21	4.5	49.6	0.0	0.0	0.0	0.1	0.1	1.8	51.4
4	2	C	30	24.20	80	0	0.9	7.3	0.0	0.0	0.0	23.5	2.5	48.5	79.3
4	2	C	30	24.20	80	5	2.3	58.8	0.0	0.0	2.3	14.8	6.1	31.1	104.6
4	2	C	30	24.20	80	14	9.9	103.1	0.0	0.0	0.0	0.0	1.1	1.6	104.7
4	2	C	30	24.20	80	21	7.0	113.5	0.0	0.0	0.0	0.0	0.1	1.3	114.8

PL	DP	SOL	TMP	WC	TRT	DAY	NO3 RANGE	NO3 AVER	NO2 RANGE	NO2 AVER	SOL NH4 RANGE	SOL NH4 AVER	EX NH4 RANGE	EX NH4 AVER	TOTALN
5	1	C	4	8.76	0	0	1.3	20.3	0.0	0.0	0.0	0.0	0.3	5.3	25.7
5	1	C	4	8.76	0	5	3.3	22.3	0.0	0.0	0.0	0.1	0.0	5.9	28.2
5	1	C	4	8.76	0	14	2.2	21.3	0.0	0.0	0.1	0.1	0.1	6.8	28.2
5	1	C	4	8.76	0	21	2.1	22.8	0.0	0.0	0.1	0.1	1.0	7.0	30.0
5	1	C	4	8.76	80	0	5.2	23.4	0.0	0.0	4.9	25.4	5.0	47.8	96.6
5	1	C	4	8.76	80	5	7.7	26.4	0.0	0.0	9.9	22.6	14.3	42.6	91.6
5	1	C	4	8.76	80	14	3.1	25.3	0.0	0.0	1.2	29.7	1.0	50.9	105.9
5	1	C	4	8.76	80	21	2.3	26.8	0.0	0.0	0.0	23.0	0.9	42.8	92.6
5	1	C	4	21.90	0	0	2.8	23.0	0.0	0.0	0.1	0.1	0.9	5.4	28.5
5	1	C	4	21.90	0	5	3.8	26.2	0.0	0.0	0.4	0.3	0.3	6.6	33.1
5	1	C	4	21.90	0	14	8.9	32.6	0.0	0.0	0.0	0.1	4.7	5.5	38.3
5	1	C	4	21.90	0	21	0.9	36.3	0.0	0.0	0.1	0.1	2.0	6.8	43.2
5	1	C	4	21.90	80	0	4.6	28.2	0.0	0.5	7.7	27.5	9.1	50.4	106.7
5	1	C	4	21.90	80	5	4.2	36.4	0.0	0.0	4.6	27.3	3.5	50.8	114.4
5	1	C	4	21.90	80	14	1.5	37.4	0.0	0.0	1.6	30.3	1.3	46.3	114.1
5	1	C	4	21.90	80	21	4.1	36.8	0.0	0.0	4.7	30.1	5.0	49.9	116.9
5	1	C	15	8.76	0	0	1.3	20.3	0.0	0.0	0.0	0.0	0.3	5.3	25.7
5	1	C	15	8.76	0	5	2.4	23.5	0.0	0.0	0.2	0.7	2.2	7.4	31.6
5	1	C	15	8.76	0	14	2.7	23.6	0.0	0.0	0.0	0.1	0.1	6.3	30.0
5	1	C	15	8.76	0	21	1.1	23.6	0.0	0.0	0.0	0.2	0.3	5.8	29.7
5	1	C	15	8.76	80	0	5.2	23.4	0.0	0.0	4.9	25.4	5.0	47.8	96.6
5	1	C	15	8.76	80	5	5.8	25.6	0.0	0.0	13.3	26.8	9.5	44.6	97.0
5	1	C	15	8.76	80	14	3.3	25.9	0.0	0.0	8.4	32.7	8.1	51.1	109.8
5	1	C	15	8.76	80	21	1.9	32.4	0.0	0.0	16.4	31.7	4.5	57.7	121.8
5	1	C	15	21.90	0	0	2.8	23.0	0.0	0.0	0.1	0.1	0.9	5.4	28.5
5	1	C	15	21.90	0	5	3.1	29.8	0.0	0.0	0.1	0.1	0.3	6.5	36.5
5	1	C	15	21.90	0	14	5.5	36.4	0.0	0.0	0.0	0.1	2.1	3.1	39.7
5	1	C	15	21.90	0	21	2.7	37.3	0.0	0.0	0.0	0.1	1.7	3.4	40.9
5	1	C	15	21.90	80	0	4.6	28.2	0.0	0.5	7.7	27.5	9.1	50.4	106.7
5	1	C	15	21.90	80	5	22.2	45.6	0.0	0.0	6.3	23.0	6.5	39.9	108.6
5	1	C	15	21.90	80	14	43.2	75.2	0.0	0.0	18.0	12.6	26.3	27.4	115.2
5	1	C	15	21.90	80	21	2.0	52.1	0.0	0.0	1.4	22.4	0.5	40.8	115.2
5	1	C	30	8.76	0	0	1.3	20.3	0.0	0.0	0.0	0.0	0.3	5.3	25.7
5	1	C	30	8.76	0	5	0.8	23.7	0.0	0.0	0.0	0.1	0.3	5.8	29.5
5	1	C	30	8.76	0	14	2.6	23.9	0.0	0.0	0.7	0.8	0.3	7.3	32.0
5	1	C	30	8.76	0	21	0.6	25.2	0.0	0.0	0.2	1.4	0.2	7.2	33.8
5	1	C	30	8.76	80	0	5.2	23.4	0.0	0.0	4.9	25.4	5.0	47.8	96.6
5	1	C	30	8.76	80	5	2.7	26.3	0.0	0.0	1.6	24.2	6.1	41.8	92.4
5	1	C	30	8.76	80	14	7.6	28.0	0.0	0.0	6.3	25.9	9.4	48.7	102.6
5	1	C	30	8.76	80	21	1.5	20.9	0.0	0.0	6.1	32.6	2.0	54.0	107.6
5	1	C	30	21.90	0	0	2.8	23.0	0.0	0.0	0.1	0.1	0.9	5.4	28.5
5	1	C	30	21.90	0	5	4.7	41.4	0.0	0.0	0.4	0.3	4.5	3.4	45.1
5	1	C	30	21.90	0	14	1.6	44.0	0.0	0.0	0.0	0.1	3.2	3.7	47.8
5	1	C	30	21.90	0	21	0.9	47.3	0.0	0.0	0.1	0.3	4.2	2.8	50.4
5	1	C	30	21.90	80	0	4.6	28.2	0.0	0.5	7.7	27.5	9.1	50.4	106.7
5	1	C	30	21.90	80	5	8.4	95.8	0.0	0.0	2.3	2.8	0.7	16.4	115.0
5	1	C	30	21.90	80	14	43.0	107.5	0.0	0.0	1.2	0.7	28.5	15.8	124.0
5	1	C	30	21.90	80	21	9.0	109.5	0.0	0.0	3.4	6.8	7.7	17.8	134.1
5	2	C	4	8.70	0	0	0.5	9.8	0.0	0.0	0.0	0.1	0.5	4.3	14.2
5	2	C	4	8.70	0	5	0.8	10.1	0.0	0.0	0.6	0.6	0.5	4.6	15.2
5	2	C	4	8.70	0	14	0.2	12.0	0.0	0.0	0.0	0.1	0.2	4.1	16.2
5	2	C	4	8.70	0	21	2.2	9.2	0.0	0.0	1.2	1.0	0.1	4.8	15.0
5	2	C	4	8.70	80	0	1.8	7.2	0.0	0.0	4.0	24.9	1.3	44.3	76.4
5	2	C	4	8.70	80	5	3.8	21.5	0.0	0.0	0.3	23.5	3.3	42.0	87.1
5	2	C	4	8.70	80	14	2.0	22.9	0.0	0.0	0.5	22.3	0.4	43.8	88.9
5	2	C	4	8.70	80	21	2.1	9.1	0.0	0.0	2.3	30.3	2.7	49.0	88.4
5	2	C	4	21.80	0	0	1.1	11.1	0.0	0.0	0.1	0.3	0.1	5.1	16.5
5	2	C	4	21.80	0	5	0.4	17.0	0.0	0.0	0.1	0.3	0.1	4.3	21.6
5	2	C	4	21.80	0	14	1.4	23.0	0.0	0.0	0.0	0.1	0.0	1.4	24.5
5	2	C	4	21.80	0	21	0.9	23.1	0.0	0.0	0.1	0.1	2.5	2.6	25.8
5	2	C	4	21.80	80	0	2.3	12.4	0.5	0.3	2.6	26.8	6.8	48.5	88.0
5	2	C	4	21.80	80	5	1.7	19.9	0.5	0.3	1.9	24.8	3.3	45.3	90.2
5	2	C	4	21.80	80	14	2.3	25.8	0.5	0.3	1.4	22.9	0.9	40.3	89.1
5	2	C	4	21.80	80	21	3.7	26.0	0.0	0.0	2.8	26.4	6.0	40.4	92.8
5	2	C	15	8.70	0	0	0.5	9.8	0.0	0.0	0.0	0.1	0.6	4.3	14.2
5	2	C	15	8.70	0	5	0.3	9.8	0.0	0.0	0.0	0.9	0.3	4.4	15.1
5	2	C	15	8.70	0	14	0.2	9.3	0.0	0.0	0.0	0.1	0.1	3.6	13.0
5	2	C	15	8.70	0	21	1.2	9.4	0.0	0.0	0.3	1.0	0.2	3.4	13.8
5	2	C	15	8.70	80	0	1.8	7.2	0.0	0.0	4.0	24.9	1.3	44.3	76.4
5	2	C	15	8.70	80	5	1.4	10.9	0.0	0.0	15.9	35.9	13.4	56.8	103.6
5	2	C	15	8.70	80	14	3.2	11.0	0.0	0.0	1.4	26.9	2.2	51.8	91.7
5	2	C	15	8.70	80	21	6.4	14.4	0.0	0.0	6.5	30.9	4.6	48.1	93.3
5	2	C	15	21.80	0	0	1.1	11.1	0.0	0.0	0.1	0.3	0.1	5.1	16.5
5	2	C	15	21.80	0	5	0.4	22.5	0.0	0.0	0.0	0.1	1.8	2.2	24.8
5	2	C	15	21.80	0	14	2.3	29.6	0.0	0.0	0.0	0.1	0.2	0.7	30.4
5	2	C	15	21.80	0	21	0.6	29.5	0.0	0.0	0.0	0.1	0.1	1.3	30.9
5	2	C	15	21.80	80	0	2.3	12.4	0.5	0.3	2.6	26.8	6.3	48.5	88.0
5	2	C	15	21.80	80	5	6.1	33.9	0.0	0.0	1.7	23.3	1.0	43.0	100.2
5	2	C	15	21.80	80	14	24.8	92.6	0.0	0.0	4.0	2.6	8.1	10.8	106.0

Table 3 cont'd.

							NO3		NO2		SOL NH4		EX NH4		
PL	DP	SOL	TMP	WC	TRT	DAY	RANGE	AVER	RANGE	AVER	RANGE	AVER	RANGE	AVER	TOTALN
5	2	C	30	8.70	0	0	0.5	9.8	0.0	0.0	0.0	0.1	0.6	4.3	14.2
5	2	C	30	8.70	0	5	1.1	9.1	0.0	0.0	0.5	0.5	0.0	4.4	14.1
5	2	C	30	8.70	0	14	0.3	9.4	0.0	0.0	0.1	0.1	0.5	4.9	14.5
5	2	C	30	8.70	0	21	0.4	10.3	0.0	0.0	0.6	1.7	0.5	6.1	18.1
5	2	C	30	8.70	80	0	1.8	7.2	0.0	0.0	4.0	24.9	1.3	44.3	76.4
5	2	C	30	8.70	80	5	6.3	12.1	0.0	0.0	0.8	26.5	4.2	46.1	84.7
5	2	C	30	8.70	80	14	9.1	12.3	0.0	0.0	1.4	24.0	1.7	45.6	82.0
5	2	C	30	8.70	80	21	10.0	14.8	0.0	0.0	3.9	23.6	1.0	41.9	80.3
5	2	C	30	21.80	0	0	1.1	11.1	0.0	0.0	0.1	0.3	0.1	5.1	16.5
5	2	C	30	21.80	0	5	0.6	30.8	0.0	0.0	0.1	0.1	0.1	0.6	31.6
5	2	C	30	21.80	0	14	1.8	35.5	0.0	0.0	0.0	0.1	0.0	0.7	36.3
5	2	C	30	21.80	0	21	4.0	40.1	0.0	0.0	2.1	1.1	7.4	6.0	47.1
5	2	C	30	21.80	80	0	2.3	12.4	0.0	0.0	2.6	26.8	6.8	48.5	87.8
5	2	C	30	21.80	80	5	8.1	77.1	0.0	0.0	0.7	3.6	0.9	13.8	94.5
5	2	C	30	21.80	80	14	6.6	102.7	0.0	0.0	1.1	0.6	7.3	5.0	108.3
5	2	C	30	21.80	80	21	28.8	101.6	0.0	0.0	3.7	2.3	10.5	6.6	110.5
5	1	CB	4	9.24	0	0	0.1	17.1	0.0	0.0	0.0	0.0	0.2	6.2	23.3
5	1	CB	4	9.24	0	5	0.7	18.3	0.0	0.0	0.2	1.2	0.7	6.9	26.4
5	1	CB	4	9.24	0	14	2.1	15.3	2.5	8.8	0.0	0.5	0.1	7.4	31.9
5	1	CB	4	9.24	0	21	1.7	16.4	0.0	0.0	0.7	0.3	0.0	7.6	24.4
5	1	CB	4	9.24	80	0	1.6	15.8	0.0	0.0	2.6	25.9	7.3	50.8	92.5
5	1	CB	4	9.24	80	5	1.6	14.5	0.0	0.0	14.9	31.4	5.3	56.2	102.1
5	1	CB	4	9.24	80	14	1.6	15.9	1.0	8.5	6.1	23.9	4.3	52.4	100.7
5	1	CB	4	9.24	80	21	2.7	16.5	0.0	0.0	7.5	30.3	6.2	55.9	102.7
5	1	CB	4	23.10	0	0	0.4	20.0	0.0	0.0	0.0	0.0	0.3	5.9	25.9
5	1	CB	4	23.10	0	5	0.9	28.9	0.0	0.0	0.0	0.0	0.0	4.5	33.4
5	1	CB	4	23.10	0	14	4.0	21.7	2.0	5.0	0.0	0.0	1.3	4.3	31.0
5	1	CB	4	23.10	0	21	0.6	35.1	0.0	0.0	0.0	0.0	1.0	3.1	38.2
5	1	CB	4	23.10	80	0	4.3	20.4	0.5	0.8	0.9	27.6	0.9	50.6	99.5
5	1	CB	4	23.10	80	5	2.2	30.4	0.5	0.3	1.9	24.3	5.8	50.6	105.6
5	1	CB	4	23.10	80	14	1.3	43.8	0.0	0.0	0.5	16.9	0.9	41.9	102.7
5	1	CB	4	23.10	80	21	2.0	44.4	0.0	0.0	2.8	20.0	0.2	31.0	95.4
5	1	CB	15	9.24	0	0	0.1	17.1	0.0	0.0	0.0	0.0	0.2	6.2	23.3
5	1	CB	15	9.24	0	5	1.2	18.1	0.0	0.0	0.4	0.9	1.8	7.2	26.2
5	1	CB	15	9.24	0	14	0.8	15.8	4.5	7.8	0.3	0.3	0.4	7.5	31.3
5	1	CB	15	9.24	0	21	0.5	16.6	10.0	5.0	0.0	0.5	0.9	8.3	30.3
5	1	CB	15	9.24	80	0	1.6	15.8	0.0	0.0	2.6	25.9	7.8	50.8	92.5
5	1	CB	15	9.24	80	5	2.8	16.7	0.0	0.0	23.4	33.0	33.1	54.4	104.1
5	1	CB	15	9.24	80	14	0.5	14.1	5.5	2.8	3.1	22.3	4.5	45.3	84.4
5	1	CB	15	9.24	80	21	3.7	16.8	0.0	0.0	3.2	28.9	9.3	52.8	98.4
5	1	CB	15	23.10	0	0	0.4	20.0	0.0	0.0	0.0	0.0	0.8	5.9	25.9
5	1	CB	15	23.10	0	5	19.2	40.9	0.0	0.0	2.2	1.1	1.7	0.8	42.8
5	1	CB	15	23.10	0	14	6.5	32.3	2.0	1.0	2.3	1.3	1.3	3.3	37.9
5	1	CB	15	23.10	0	21	0.6	34.8	0.0	0.0	1.4	1.5	3.9	1.9	38.2
5	1	CB	15	23.10	80	0	4.3	20.4	0.5	0.8	0.9	27.6	0.9	50.6	99.5
5	1	CB	15	23.10	80	5	7.1	42.9	0.0	0.0	8.7	17.1	6.3	37.6	97.7
5	1	CB	15	23.10	80	14	36.8	94.6	21.0	10.5	1.9	1.8	4.3	13.3	120.3
5	1	CB	15	23.10	80	21	10.9	92.6	0.0	0.0	0.0	0.0	0.5	3.1	95.7
5	1	CB	30	9.24	0	0	0.1	17.1	0.0	0.0	0.0	0.0	0.2	6.2	23.3
5	1	CB	30	9.24	0	5	0.6	16.8	0.0	0.0	0.9	0.4	0.4	6.2	23.4
5	1	CB	30	9.24	0	14	0.0	17.0	2.5	6.3	0.1	0.3	1.1	7.9	31.4
5	1	CB	30	9.24	0	21	0.7	16.0	0.0	0.0	1.2	1.2	1.2	7.9	25.1
5	1	CB	30	9.24	80	0	1.6	15.8	0.0	0.0	2.6	25.9	7.8	50.8	92.5
5	1	CB	30	9.24	80	5	1.8	17.3	0.0	0.0	0.1	21.8	2.8	41.8	80.8
5	1	CB	30	9.24	80	14	1.9	21.1	0.0	0.0	3.8	23.8	3.5	45.1	90.0
5	1	CB	30	9.24	80	21	4.5	19.6	0.0	0.0	0.0	20.5	8.7	38.8	78.9
5	1	CB	30	23.10	0	0	0.4	20.0	0.0	0.0	0.0	0.0	0.8	5.9	25.9
5	1	CB	30	23.10	0	5	0.8	37.1	0.0	0.0	0.0	0.0	0.8	1.5	38.6
5	1	CB	30	23.10	0	14	3.0	36.2	3.0	1.5	0.0	0.0	0.1	2.1	39.7
5	1	CB	30	23.10	0	21	3.2	42.6	0.0	0.0	0.0	0.0	1.0	2.4	45.0
5	1	CB	30	23.10	80	0	4.3	20.4	0.5	0.8	0.9	27.6	0.9	50.6	99.5
5	1	CB	30	23.10	80	5	5.5	79.6	0.0	0.0	6.4	3.2	7.6	15.1	97.9
5	1	CB	30	23.10	80	14	22.0	114.0	0.0	0.0	4.9	2.7	2.0	7.8	124.5
5	1	CB	30	23.10	80	21	1.0	107.5	0.0	0.0	1.6	2.3	1.9	9.5	119.3
5	2	CB	4	9.69	0	0	1.9	16.6	0.0	0.0	0.0	0.1	0.0	5.4	22.1
5	2	CB	4	9.69	0	5	0.2	13.8	3.0	11.5	0.3	0.6	0.4	8.0	33.9
5	2	CB	4	9.69	0	14	1.8	16.8	2.0	1.0	0.1	0.3	0.0	7.4	25.5
5	2	CB	4	9.69	0	21	1.7	15.9	0.0	0.0	0.4	0.3	1.0	7.2	23.4
5	2	CB	4	9.69	80	0	2.2	20.3	0.0	0.0	11.5	27.4	15.4	48.7	96.4
5	2	CB	4	9.69	80	5	2.9	18.1	11.0	5.5	14.5	30.3	16.5	52.8	106.6
5	2	CB	4	9.69	80	14	1.0	15.5	13.5	6.8	1.2	26.3	3.1	50.8	99.3
5	2	CB	4	9.69	80	21	0.8	17.0	0.0	0.0	4.2	18.9	5.0	42.7	78.6
5	2	CB	4	24.20	0	0	1.5	21.1	0.0	0.0	0.1	0.1	0.0	7.0	28.2
5	2	CB	4	24.20	0	5	8.7	20.5	19.5	9.8	0.0	0.7	1.0	8.9	39.9
5	2	CB	4	24.20	0	14	1.2	29.1	0.0	0.0	0.2	0.1	0.1	6.1	35.3
5	2	CB	4	24.20	0	21	3.0	32.9	0.0	0.0	0.0	0.1	2.6	6.7	39.7
5	2	CB	4	24.20	80	0	3.1	24.4	0.0	0.0	0.1	28.4	0.6	50.4	103.3
5	2	CB	4	24.20	80	5	0.5	16.9	3.0	19.0	3.6	30.9	4.6	52.1	118.9
5	2	CB	4	24.20	80	14	1.9	36.3	0.0	0.0	3.5	22.6	2.6	46.9	105.9
5	2	CB	4	24.20	80	21	1.8	34.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

PL	DP	SOL	TMP	WC	TRT	DAY	NO3 RANGE	NO3 AVER	NO2 RANGE	NO2 AVER	SOL NH4 RANGE	SOL NH4 AVER	EX NH4 RANGE	EX NH4 AVER	TOTALN
5	2	CB	15	9.69	0	0	1.9	16.6	0.0	0.0	0.0	0.1	0.0	5.4	22.1
5	2	CB	15	9.69	0	5	2.6	12.1	12.0	6.0	0.0	0.9	1.8	9.0	23.0
5	2	CB	15	9.69	0	14	2.4	16.1	0.0	21.5	0.2	0.4	0.1	6.8	44.8
5	2	CB	15	9.69	0	21	4.3	19.8	0.0	0.0	0.2	0.4	1.2	9.8	30.0
5	2	CB	15	9.69	80	0	2.2	20.3	0.0	0.0	11.5	27.4	15.4	48.7	96.4
5	2	CB	15	9.69	80	5	0.6	11.7	0.0	0.0	40.4	42.1	1.2	44.1	97.9
5	2	CB	15	9.69	80	14	9.4	17.5	0.0	0.0	1.9	27.6	4.4	54.4	99.5
5	2	CB	15	9.69	80	21	0.3	17.1	0.0	0.0	5.6	25.8	4.2	51.3	94.2
5	2	CB	15	24.20	0	0	1.5	21.1	0.0	0.0	0.1	0.1	0.0	7.0	28.2
5	2	CB	15	24.20	0	5	3.5	26.6	8.5	4.3	0.4	0.2	0.3	6.0	37.1
5	2	CB	15	24.20	0	14	2.9	40.1	0.0	0.0	0.1	0.3	0.2	3.2	43.5
5	2	CB	15	24.20	0	21	0.1	40.8	0.0	0.0	0.1	0.3	0.2	5.5	46.6
5	2	CB	15	24.20	80	0	3.1	24.4	0.0	0.0	0.1	28.4	0.6	50.4	103.3
5	2	CB	15	24.20	80	5	10.1	36.4	0.0	0.0	3.8	17.6	2.0	39.5	93.5
5	2	CB	15	24.20	80	14	3.7	67.3	10.5	5.3	3.7	12.6	7.5	29.4	114.6
5	2	CB	15	24.20	80	21	19.7	85.9	0.0	0.0	5.3	7.5	5.6	23.4	116.9
5	2	CB	30	9.69	0	0	1.9	16.6	0.0	0.0	0.0	0.1	0.0	5.4	22.1
5	2	CB	30	9.69	0	5	2.6	15.7	7.0	3.5	0.1	0.6	0.9	7.8	27.7
5	2	CB	30	9.69	0	14	0.5	18.6	0.0	0.0	0.0	1.1	0.1	8.8	28.5
5	2	CB	30	9.69	0	21	0.4	18.1	0.0	0.0	0.0	0.5	0.7	11.0	29.6
5	2	CB	30	9.69	80	0	2.2	20.3	0.0	0.0	11.5	27.4	15.4	48.7	96.4
5	2	CB	30	9.69	80	5	6.6	11.4	0.0	0.0	11.8	25.0	16.7	48.3	84.6
5	2	CB	30	9.69	80	14	3.1	19.9	0.0	0.0	17.9	30.8	23.7	60.9	111.7
5	2	CB	30	9.69	80	21	1.6	17.1	8.5	4.3	2.6	25.4	1.2	51.0	97.7
5	2	CB	30	24.20	0	0	1.5	21.1	0.0	0.0	0.1	0.1	0.0	7.0	28.2
5	2	CB	30	24.20	0	5	10.9	32.9	11.0	5.5	0.0	0.2	0.5	10.4	49.1
5	2	CB	30	24.20	0	14	3.3	43.9	7.0	13.0	0.1	0.3	1.3	9.5	66.7
5	2	CB	30	24.20	0	21	0.3	51.3	0.0	0.0	0.2	0.3	0.2	10.7	62.2
5	2	CB	30	24.20	80	0	3.1	24.4	0.0	0.0	0.1	28.4	0.6	50.4	103.3
5	2	CB	30	24.20	80	5	4.8	56.2	10.5	5.3	4.4	16.4	3.0	37.3	115.1
5	2	CB	30	24.20	80	14	6.6	89.1	6.0	8.5	1.4	11.5	2.1	32.4	141.5
5	2	CB	30	24.20	80	21	3.5	96.1	0.0	0.0	2.9	7.8	4.9	24.6	128.6
5	3	C	4	8.82	0	0	0.7	7.5	0.0	0.0	0.5	0.4	0.0	3.0	11.0
5	3	C	4	8.82	0	5	6.0	3.0	5.5	2.8	0.1	0.3	0.6	3.8	9.6
5	3	C	4	8.82	0	14	1.4	6.2	0.0	0.0	0.0	0.1	0.0	2.9	9.2
5	3	C	4	8.82	0	21	0.1	7.8	0.0	0.0	0.4	0.4	0.6	3.5	11.6
5	3	C	4	8.82	80	0	0.3	8.3	0.0	0.0	6.2	19.6	9.7	34.9	62.9
5	3	C	4	8.82	80	5	0.5	5.1	4.5	2.3	10.0	21.5	16.1	38.8	67.6
5	3	C	4	8.82	80	14	14.3	13.2	0.0	0.0	2.7	18.8	11.4	28.2	60.3
5	3	C	4	8.82	80	21	1.2	20.0	0.0	0.0	1.7	20.8	19.0	29.8	70.6
5	3	C	4	22.10	0	0	1.1	9.3	0.0	0.0	0.4	0.7	2.1	5.6	15.5
5	3	C	4	22.10	0	5	0.9	11.1	2.0	1.0	0.0	0.1	0.3	4.8	17.0
5	3	C	4	22.10	0	14	0.8	17.0	0.0	0.0	0.0	0.5	0.2	2.4	19.9
5	3	C	4	22.10	0	21	2.2	19.4	0.0	0.0	0.1	0.1	0.1	2.8	22.4
5	3	C	4	22.10	80	0	0.5	10.0	0.0	0.0	3.9	23.6	1.5	40.6	74.2
5	3	C	4	22.10	80	5	0.8	7.4	6.0	6.5	6.7	12.5	2.9	40.1	66.5
5	3	C	4	22.10	80	14	2.7	10.3	0.5	0.3	13.5	15.8	1.2	36.2	62.5
5	3	C	4	22.10	80	21	1.8	7.1	0.0	1.5	18.0	27.7	5.9	36.8	73.1
5	3	C	15	8.82	0	0	0.7	7.5	0.0	0.0	0.5	0.4	0.0	3.0	11.0
5	3	C	15	8.82	0	5	0.9	5.8	6.0	3.0	0.2	0.6	0.2	3.5	12.8
5	3	C	15	8.82	0	14	2.8	5.1	3.0	1.5	0.0	0.1	0.2	3.1	9.8
5	3	C	15	8.82	0	21	0.0	8.1	0.0	0.0	0.0	0.1	0.3	3.1	11.3
5	3	C	15	8.82	80	0	0.3	8.3	0.0	0.0	6.2	19.6	9.7	34.9	62.9
5	3	C	15	8.82	80	5	1.0	6.5	0.0	0.0	17.4	26.9	18.6	44.3	77.7
5	3	C	15	8.82	80	14	0.4	7.4	0.0	0.0	3.1	15.6	2.2	30.9	53.8
5	3	C	15	8.82	80	21	2.2	9.3	0.0	0.0	4.7	12.0	7.0	24.0	45.3
5	3	C	15	22.10	0	0	1.1	9.3	0.0	0.0	0.4	0.7	2.1	5.6	15.5
5	3	C	15	22.10	0	5	1.3	16.8	0.0	0.0	0.2	0.2	0.2	3.2	20.1
5	3	C	15	22.10	0	14	0.6	24.0	0.0	0.0	0.0	0.1	0.2	1.0	25.1
5	3	C	15	22.10	0	21	1.7	30.1	0.0	0.0	0.4	0.3	1.4	2.3	32.7
5	3	C	15	22.10	80	0	0.5	10.0	0.0	0.0	3.9	23.6	1.5	40.6	74.2
5	3	C	15	22.10	80	5	8.2	22.2	8.5	6.8	2.1	19.8	2.4	36.9	85.6
5	3	C	15	22.10	80	14	2.8	48.7	0.0	0.0	3.2	9.7	1.6	22.1	80.5
5	3	C	15	22.10	80	21	1.7	65.9	0.0	0.0	0.7	3.8	2.1	11.8	81.6
5	3	C	30	8.82	0	0	0.7	7.5	0.0	0.0	0.5	0.4	0.0	3.0	11.0
5	3	C	30	8.82	0	5	1.1	7.3	0.0	0.0	0.3	0.3	0.1	3.4	11.1
5	3	C	30	8.82	0	14	0.5	7.1	0.0	0.0	0.0	0.1	0.6	2.9	10.0
5	3	C	30	8.82	0	21	0.1	8.0	0.0	0.0	0.6	1.0	0.6	3.5	12.5
5	3	C	30	8.82	80	0	0.3	8.3	0.0	0.0	6.2	19.6	9.7	34.9	62.9
5	3	C	30	8.82	80	5	4.7	3.4	5.5	2.8	14.8	21.1	18.3	35.8	63.1
5	3	C	30	8.82	80	14	22.4	22.6	0.0	0.0	16.4	8.2	1.9	34.8	65.6
5	3	C	30	8.82	80	21	1.5	9.6	0.0	0.0	2.4	19.8	4.2	31.9	61.3
5	3	C	30	22.10	0	0	1.1	9.3	0.0	0.0	0.4	0.7	2.1	5.6	15.5
5	3	C	30	22.10	0	5	6.4	24.9	0.0	0.0	0.2	0.2	1.7	2.3	27.4
5	3	C	30	22.10	0	14	4.4	40.6	0.0	0.0	0.0	0.1	0.4	0.7	41.4
5	3	C	30	22.10	0	21	1.4	42.8	0.0	0.0	0.1	0.6	0.0	1.0	44.4
5	3	C	30	22.10	80	0	0.5	10.0	0.0	0.0	3.9	23.6	1.5	40.6	74.2
5	3	C	30	22.10	80	5	2.1	47.6	0.0	0.0	0.7	9.4	2.7	27.3	84.3
5	3	C	30	22.10	80	14	0.9	92.3	0.0	0.0	0.5	0.4	1.3	5.1	97.9
5	3	C	30	22.10	80	21	14.1	103.9	0.0	0.0	0.1	0.1	0.1	[illegible]	105.6

PL	DP	SOL	TMP	WC	TRT	DAY	NO3 RANGE	NO3 AVER	NO2 RANGE	NO2 AVER	NH4 RANGE	NH4 AVER	TOTALN
5	4	C	4	8.40	0	0	0.8	4.6	0.0	0.0	0.3	1.5	6.1
5	4	C	4	8.40	0	14	0.4	4.7	0.0	0.0	0.1	1.4	6.1
5	4	C	4	8.40	0	21	0.2	6.8	0.0	0.0	0.1	1.8	8.5
5	4	C	4	8.40	80	0	3.4	1.7	0.0	0.0	5.9	40.6	42.3
5	4	C	4	8.40	80	14	1.7	3.5	0.0	0.0	11.9	35.8	39.4
5	4	C	4	8.40	80	21	9.6	11.1	0.0	0.0	21.1	43.1	54.2
5	4	C	4	21.00	0	0	1.7	4.6	0.0	0.0	0.0	1.6	6.3
5	4	C	4	21.00	0	14	0.1	5.9	0.0	0.0	0.0	3.6	9.6
5	4	C	4	21.00	0	21	0.3	10.8	0.0	0.0	0.7	3.9	14.7
5	4	C	4	21.00	80	0	0.6	5.5	0.0	0.0	13.5	55.1	60.6
5	4	C	4	21.00	80	14	2.8	7.5	0.0	0.0	15.7	62.0	69.5
5	4	C	4	21.00	80	21	0.9	9.8	0.0	0.0	26.5	56.6	66.4
5	4	C	15	8.40	0	0	0.8	4.6	0.0	0.0	0.3	1.5	6.1
5	4	C	15	8.40	0	14	0.6	4.6	0.0	0.0	0.1	1.4	6.0
5	4	C	15	8.40	0	21	0.4	6.3	0.0	0.0	0.4	2.2	8.5
5	4	C	15	8.40	80	0	3.4	1.7	0.0	0.0	5.7	40.8	42.4
5	4	C	15	8.40	80	14	3.5	7.6	0.0	0.0	16.7	43.6	51.3
5	4	C	15	8.40	80	21	10.0	5.0	0.0	0.0	11.5	41.9	46.9
5	4	C	15	21.00	0	0	1.7	4.6	0.0	0.0	0.0	1.6	6.3
5	4	C	15	21.00	0	14	0.5	6.9	0.0	0.0	0.0	5.5	12.4
5	4	C	15	21.00	0	21	0.7	14.4	0.0	0.0	0.0	5.9	20.3
5	4	C	15	21.00	80	0	0.6	5.5	0.0	0.0	13.5	55.1	60.6
5	4	C	15	21.00	80	14	0.3	13.1	0.0	0.0	3.5	51.6	64.7
5	4	C	15	21.00	80	21	13.7	6.8	0.0	0.0	19.0	49.9	56.7
5	4	C	30	8.40	0	0	0.8	4.6	0.0	0.0	0.3	1.5	6.1
5	4	C	30	8.40	0	14	0.0	4.0	0.0	0.0	0.0	1.6	5.6
5	4	C	30	8.40	0	21	0.2	4.3	0.0	0.0	0.2	1.7	6.0
5	4	C	30	8.40	80	0	3.4	1.7	0.0	0.0	5.7	40.8	42.4
5	4	C	30	8.40	80	14	5.6	6.0	0.0	0.0	8.3	36.8	42.8
5	4	C	30	8.40	80	21	2.8	5.3	0.0	0.0	1.0	40.5	45.8
5	4	C	30	21.00	0	0	1.7	4.6	0.0	0.0	0.0	1.6	6.3
5	4	C	30	21.00	0	14	0.6	10.6	0.0	0.0	0.2	5.5	16.1
5	4	C	30	21.00	0	21	0.3	11.5	0.0	0.0	0.8	5.9	17.4
5	4	C	30	21.00	80	0	0.6	5.5	0.0	0.0	13.5	55.1	60.6
5	4	C	30	21.00	80	14	0.5	13.6	0.0	0.0	14.0	60.4	74.0
5	4	C	30	21.00	80	21	7.4	4.1	0.0	0.0	21.9	61.1	65.1
5	5	C	4	8.30	0	0	0.0	5.0	0.0	0.0	0.0	1.1	6.1
5	5	C	4	8.30	0	14	0.3	3.5	0.0	0.0	0.3	1.5	5.1
5	5	C	4	8.30	0	21	0.0	4.4	0.0	0.0	0.4	1.8	6.2
5	5	C	4	8.30	80	0	1.0	2.9	0.0	0.0	9.0	36.2	39.1
5	5	C	4	8.30	80	14	2.7	4.4	0.0	0.0	4.3	31.0	35.5
5	5	C	4	8.30	80	21	0.1	2.4	0.0	0.0	2.4	35.1	37.5
5	5	C	4	20.90	0	0	0.4	4.3	0.0	0.0	0.0	0.9	5.2
5	5	C	4	20.90	0	14	0.2	4.6	0.0	0.0	0.2	1.9	6.5
5	5	C	4	20.90	0	21	0.8	4.3	0.0	0.0	0.1	2.3	6.5
5	5	C	4	20.90	80	0	1.2	4.3	0.0	0.0	12.8	36.6	40.9
5	5	(	4	20.90	80	14	0.9	2.8	0.0	0.0	5.0	44.5	47.3
5	5	C	4	20.90	80	21	0.3	1.8	0.0	0.0	4.2	39.4	41.2
5	5	C	15	8.30	0	0	0.0	5.0	0.0	0.0	0.0	1.1	6.1
5	5	C	15	8.30	0	14	0.4	4.1	0.0	0.0	0.0	1.4	5.5
5	5	C	15	8.30	0	21	0.5	4.3	0.0	0.0	0.2	1.5	5.8
5	5	C	15	8.30	80	0	1.0	2.9	0.0	0.0	9.0	36.2	39.1
5	5	C	15	8.30	80	14	3.0	4.9	0.0	0.0	10.7	43.3	48.2
5	5	C	15	8.30	80	21	2.4	5.1	0.0	0.0	4.9	29.6	34.7
5	5	C	15	20.90	0	0	0.4	4.3	0.0	0.0	0.0	0.9	5.2
5	5	C	15	20.90	0	14	0.4	5.1	0.0	0.0	0.4	2.9	8.0
5	5	C	15	20.90	0	21	0.3	6.0	0.0	0.0	0.4	2.9	8.9
5	5	C	15	20.90	80	0	1.2	4.3	0.0	0.0	12.8	36.6	40.9
5	5	C	15	20.90	80	14	0.8	5.8	0.0	0.0	10.2	46.0	51.8
5	5	C	15	20.90	80	21	1.6	7.0	0.0	0.0	3.9	34.6	41.6
5	5	C	30	8.30	0	0	0.0	5.0	0.0	0.0	0.0	1.1	6.1
5	5	C	30	8.30	0	14	1.1	4.6	0.0	0.0	0.0	1.6	6.2
5	5	C	30	8.30	0	21	0.3	3.9	0.0	0.0	0.2	1.7	5.6
5	5	C	30	8.30	80	0	1.0	2.9	0.0	0.0	9.0	36.2	39.1
5	5	C	30	8.30	80	14	0.1	4.9	0.0	0.0	32.3	49.3	54.2
5	5	C	30	8.30	80	21	1.5	5.9	0.0	0.0	5.8	33.2	39.1
5	5	C	30	20.90	0	0	0.4	4.3	0.0	0.0	0.0	0.9	5.2
5	5	C	30	20.90	0	14	0.2	5.1	0.0	0.0	0.7	2.9	8.0
5	5	C	30	20.90	0	21	0.7	6.3	0.0	0.0	0.1	2.4	8.7
5	5	C	30	20.90	80	0	1.2	4.3	0.0	0.0	12.8	36.6	40.9
5	5	C	30	20.90	80	14	0.7	6.1	0.0	0.0	11.5	38.9	45.0
5	5	C	30	20.90	80	21	8.4	4.3	0.0	0.0	27.7	53.1	57.4

							NO3		NO2		NH4		
PL	DP	SOL	TMP	WC	TRT	DAY	RANGE	AVER	RANGE	AVER	RANGE	AVER	TOTALN
5	6	C	4	8,20	0	0	0.3	4.3	0.0	0.0	0.1	0.8	5.2
5	6	C	4	8,20	0	14	1.0	3.8	0.0	0.0	0.1	1.8	5.6
5	6	C	4	8,20	0	21	0.3	4.5	0.0	0.0	0.3	1.0	5.6
5	6	C	4	8,20	80	0	4.0	3.4	0.0	0.0	7.2	25.8	29.2
5	6	C	4	8,20	80	14	0.7	5.8	0.0	0.0	7.0	29.4	35.1
5	6	C	4	8,20	80	21	0.4	6.6	0.0	0.0	6.4	39.6	46.2
5	6	C	4	20,40	0	0	0.4	4.4	0.0	0.0	0.0	0.6	5.0
5	6	C	4	20,40	0	14	0.5	3.8	0.0	0.0	0.1	1.8	5.6
5	6	C	4	20,40	0	21	0.1	4.4	0.0	0.0	0.0	0.7	5.1
5	6	C	4	20,40	80	0	0.3	1.6	0.0	0.0	1.0	27.8	29.4
5	6	C	4	20,40	80	14	1.2	6.5	0.0	0.0	2.2	29.4	35.9
5	6	C	4	20,40	80	21	0.6	6.0	0.0	0.0	7.4	29.9	35.9
5	6	C	15	8,20	0	0	0.3	4.3	0.0	0.0	0.1	0.8	5.2
5	6	C	15	8,20	0	14	0.4	4.1	0.0	0.0	0.0	1.7	5.8
5	6	C	15	8,20	0	21	0.2	4.3	0.0	0.0	0.4	0.9	5.2
5	6	C	15	8,20	80	0	4.0	3.4	0.0	0.0	7.2	25.8	29.2
5	6	C	15	8,20	80	14	2.1	6.1	0.0	0.0	5.4	31.3	37.3
5	6	C	15	8,20	80	21	1.4	5.8	0.0	0.0	2.7	32.6	38.4
5	6	C	15	20,40	0	0	0.4	4.4	0.0	0.0	0.0	0.6	5.0
5	6	C	15	20,40	0	14	0.1	4.3	0.0	0.0	0.2	1.9	6.2
5	6	C	15	20,40	0	21	0.2	6.0	0.0	0.0	0.2	1.1	7.1
5	6	C	15	20,40	80	0	0.3	1.6	0.0	0.0	1.0	27.8	29.4
5	6	C	15	20,40	80	14	1.0	6.4	0.0	0.0	0.9	30.8	37.2
5	6	C	15	20,40	80	21	1.7	7.4	0.0	0.0	3.3	24.8	32.3
5	6	C	30	8,20	0	0	0.3	4.3	0.0	0.0	0.1	0.8	5.2
5	6	C	30	8,20	0	14	0.3	3.1	0.0	0.0	0.1	1.8	4.9
5	6	C	30	8,20	0	21	0.4	4.4	0.0	0.0	0.7	1.5	5.9
5	6	C	30	8,20	80	0	4.0	3.4	0.0	0.0	7.2	25.8	29.2
5	6	C	30	8,20	80	14	1.0	5.6	0.0	0.0	4.8	27.2	32.8
5	6	C	30	8,20	80	21	0.3	5.0	0.0	0.0	6.8	26.7	31.7
5	6	C	30	20,40	0	0	0.4	4.4	0.0	0.0	0.0	0.6	5.0
5	6	C	30	20,40	0	14	0.2	5.7	0.0	0.0	0.0	2.0	7.7
5	6	C	30	20,40	0	21	1.0	7.4	0.0	0.0	0.6	1.8	9.2
5	6	C	30	20,40	80	0	0.3	1.6	0.0	0.0	1.0	27.8	29.4
5	6	C	30	20,40	80	14	1.6	8.2	0.0	0.0	1.2	27.3	35.5
5	6	C	30	20.40	80	21	0.6	7.8	0.0	0.0	2.8	26.1	33.9
5	7	C	4	8,40	0	0	0.2	3.8	0.0	0.0	0.0	1.2	5.0
5	7	C	4	8,40	0	14	0.2	3.4	0.0	0.0	0.0	0.9	4.3
5	7	C	4	8,40	0	21	0.0	4.0	0.0	0.0	0.1	1.1	5.1
5	7	C	4	8,40	80	0	0.6	4.5	0.0	0.0	13.1	42.6	47.1
5	7	C	4	8,40	80	14	3.2	5.2	0.0	0.0	2.2	32.6	37.8
5	7	C	4	8,40	80	21	0.2	5.8	0.0	0.0	5.2	41.6	47.4
5	7	C	4	20,90	0	0	0.7	4.0	0.0	0.0	0.1	0.6	4.7
5	7	C	4	20,90	0	14	0.6	4.8	0.0	0.0	0.1	0.6	5.4
5	7	C	4	20,90	0	21	1.7	5.6	0.0	0.0	0.0	1.2	6.8
5	7	C	4	20,90	80	0	0.1	4.1	0.0	0.0	5.1	38.1	42.3
5	7	C	4	20,90	80	14	1.0	5.2	0.0	0.0	1.1	31.6	36.8
5	7	C	4	20,90	80	21	0.0	7.3	0.0	0.0	0.0	31.0	38.3
5	7	C	15	8,40	0	0	0.2	3.8	0.0	0.0	0.0	1.2	5.0
5	7	C	15	8,40	0	14	0.7	4.6	0.0	0.0	0.8	0.6	5.2
5	7	C	15	8,40	0	21	0.7	3.6	0.0	0.0	0.8	0.6	4.2
5	7	C	15	8,40	80	0	0.6	4.5	0.0	0.0	13.1	42.6	47.1
5	7	C	15	8,40	80	14	2.3	3.3	0.0	0.0	3.5	28.6	32.0
5	7	C	15	8,40	80	21	3.6	3.2	0.0	0.0	24.7	25.6	28.8
5	7	C	15	20,90	0	0	0.7	4.0	0.0	0.0	0.1	0.6	4.7
5	7	C	15	20,90	0	14	1.6	5.1	0.0	0.0	0.9	0.7	5.8
5	7	C	15	20,90	0	21	1.0	5.3	0.0	0.0	0.3	1.8	7.1
5	7	C	15	20,90	80	0	0.1	4.1	0.0	0.0	5.1	38.1	42.3
5	7	C	15	20,90	80	14	0.7	7.4	0.0	0.0	1.8	25.7	33.1
5	7	C	15	20,90	80	21	2.2	7.9	0.0	0.0	7.0	29.2	37.1
5	7	C	30	8,40	0	0	0.2	3.8	0.0	0.0	0.0	1.2	5.0
5	7	C	30	8,40	0	14	0.6	4.2	0.0	0.0	0.1	1.3	5.4
5	7	C	30	8,40	0	21	0.2	4.1	0.0	0.0	0.1	1.4	5.5
5	7	C	30	8,40	80	0	0.6	4.5	0.0	0.0	13.1	42.6	47.1
5	7	C	30	8,40	80	14	0.4	6.0	0.0	0.0	8.2	33.9	39.9
5	7	C	30	8,40	80	21	1.8	5.0	0.0	0.0	3.3	24.5	29.5
5	7	C	30	20,90	0	0	0.7	4.0	0.0	0.0	0.1	0.6	4.7
5	7	C	30	20,90	0	14	0.7	4.8	0.0	0.0	0.0	2.2	7.0
5	7	C	30	20,90	0	21	1.0	6.9	0.0	0.0	0.5	1.0	7.9
5	7	C	30	20,90	80	0	0.1	4.1	0.0	0.0	5.0	38.2	42.3
5	7	C	30	20,90	80	14	0.3	7.0	0.0	0.0	2.1	21.9	29.0
5	7	C	30	20,90	80	21	1.9	6.4	0.0	0.0	1.3	30.4	36.9

PL	DP	SOL	TMP	WC	TRT	DAY	NO3 RANGE	NO3 AVER	NO2 RANGE	NO2 AVER	SOL NH4 RANGE	SOL NH4 AVER	EX NH4 RANGE	EX NH4 AVER	TOTALN
6	1	C	4	9.12	0	0	0.4	10.4	0.0	0.0	0.0	0.3	0.1	3.6	14.3
6	1	C	4	9.12	0	5	0.2	11.4	0.0	0.0	0.7	1.3	0.9	4.1	16.7
6	1	C	4	9.12	0	14	0.6	10.9	0.0	0.0	0.0	0.2	1.1	5.6	16.7
6	1	C	4	9.12	0	21	2.1	10.8	0.0	0.0	0.9	0.4	0.7	4.3	15.5
6	1	C	4	9.12	80	0	0.2	11.4	0.0	0.0	1.2	17.2	4.9	40.1	68.7
6	1	C	4	9.12	80	5	0.4	10.2	0.0	0.0	4.3	20.8	5.3	43.5	74.5
6	1	C	4	9.12	80	14	0.4	10.7	0.5	0.3	3.5	16.3	1.1	43.6	70.8
6	1	C	4	9.12	80	21	0.7	10.8	0.0	0.0	2.2	13.9	3.9	41.1	65.9
6	1	C	4	22.80	0	0	0.1	13.4	0.5	0.3	0.6	0.5	0.3	2.5	16.7
6	1	C	4	22.80	0	5	0.3	18.4	0.5	0.8	0.1	1.4	1.3	3.1	23.8
6	1	C	4	22.80	0	14	0.3	20.6	0.0	0.0	0.0	0.0	0.5	1.8	22.4
6	1	C	4	22.80	0	21	1.9	23.3	0.0	0.0	0.1	0.1	0.1	1.8	25.1
6	1	C	4	22.80	60	0	0.2	14.6	1.0	1.5	2.0	22.1	1.0	44.6	82.8
6	1	C	4	22.80	80	5	0.2	16.8	0.0	2.0	1.3	19.3	4.1	40.3	78.5
6	1	C	4	22.80	80	14	0.5	22.8	0.0	0.0	3.7	18.8	5.0	41.8	83.4
6	1	C	4	22.80	80	21	1.0	27.2	0.0	0.5	4.2	18.1	4.2	44.6	90.4
6	1	C	15	9.12	0	0	0.4	10.4	0.0	0.0	0.0	0.3	0.1	3.6	14.3
6	1	C	15	9.12	0	5	0.6	10.8	0.0	0.0	0.6	1.2	0.1	4.9	16.9
6	1	C	15	9.12	0	14	0.6	10.5	0.0	0.0	0.1	0.1	0.0	4.8	15.4
6	1	C	15	9.12	0	21	0.2	10.9	0.0	0.0	0.1	0.1	1.7	4.8	15.9
6	1	C	15	9.12	80	0	0.2	11.4	0.0	0.0	1.2	17.2	4.9	40.1	68.7
6	1	C	15	9.12	80	5	0.4	10.3	0.0	0.0	4.0	22.6	5.2	49.9	82.8
6	1	C	15	9.12	80	14	0.0	11.8	0.0	0.0	0.0	16.6	0.0	49.7	78.1
6	1	C	15	9.12	80	21	1.0	12.4	0.0	0.0	0.5	14.3	0.5	38.9	65.6
6	1	C	15	22.80	0	0	0.1	13.4	0.5	0.3	0.6	0.5	0.3	2.5	16.7
6	1	C	15	22.80	0	5	0.5	20.3	0.0	0.0	0.4	0.7	1.1	2.9	23.9
6	1	C	15	22.80	0	14	0.1	19.4	0.0	0.0	0.0	0.0	0.0	1.2	20.6
6	1	C	15	22.80	0	21	0.1	21.6	0.0	0.0	0.2	0.1	0.4	1.5	23.1
6	1	C	15	22.80	80	0	0.2	14.6	1.0	1.5	2.0	22.1	1.0	44.6	82.8
6	1	C	15	22.80	80	5	0.9	26.1	1.5	0.8	1.2	18.1	2.7	42.8	87.6
6	1	C	15	22.80	80	14	11.0	52.1	0.0	0.0	7.3	7.3	15.6	28.6	88.0
6	1	C	15	22.80	80	21	1.4	63.4	0.0	0.0	0.4	3.5	1.9	17.8	84.7
6	1	C	30	9.12	0	0	0.4	10.4	0.0	0.0	0.0	0.3	0.1	3.6	14.3
6	1	C	30	9.12	0	5	0.0	11.3	3.0	1.5	0.2	1.3	1.0	5.7	19.8
6	1	C	30	9.12	0	14	3.1	6.1	0.0	0.0	0.7	0.5	1.6	4.1	10.7
6	1	C	30	9.12	0	21	0.1	10.8	0.0	0.0	0.2	0.3	2.0	1.7	12.8
6	1	C	30	9.12	80	0	0.2	11.4	0.0	0.0	1.2	17.2	4.9	40.1	68.7
6	1	C	30	9.12	80	5	0.8	11.7	0.0	0.0	3.7	19.5	7.8	49.0	80.2
6	1	C	30	9.12	80	14	0.6	10.5	4.5	2.3	1.2	11.4	4.5	36.4	60.6
6	1	C	30	9.12	80	21	0.5	11.8	0.0	0.0	1.3	13.8	0.8	36.6	64.2
6	1	C	30	22.80	0	0	0.1	13.4	0.5	0.3	0.6	0.5	0.3	2.5	16.7
6	1	C	30	22.80	0	5	0.9	21.3	0.0	0.0	0.5	1.6	0.4	4.4	27.4
6	1	C	30	22.80	0	14	0.0	23.7	0.0	0.0	0.0	0.1	0.1	1.1	24.9
6	1	C	30	22.80	0	21	1.4	27.6	0.0	0.0	0.1	0.1	0.4	1.6	29.3
6	1	C	30	22.80	80	0	0.2	14.6	1.0	1.5	2.0	22.1	1.0	44.6	82.8
6	1	C	30	22.80	80	5	0.1	48.6	0.0	0.0	0.1	11.8	1.2	35.6	96.1
6	1	C	30	22.80	80	14	7.5	94.6	0.0	0.0	0.0	0.0	0.1	1.3	95.8
6	1	C	30	22.80	80	21	17.7	108.1	0.0	0.0	0.0	0.2	3.2	2.5	110.8

PL	DP	SOL	TMP	WC	TRT	DAY	NO3 RANGE	NO3 AVER	NO2 RANGE	NO2 AVER	NH4 RANGE	NH4 AVER	TOTALN
N5	1		4	9.60	0	0	0.9	37.6	0.0	0.0	0.1	5.3	43.0
N5	1		4	9.60	0	14	0.2	34.8	0.0	0.0	0.0	7.3	42.1
N5	1		4	9.60	0	21	3.2	37.1	0.0	0.0	0.3	6.6	43.7
N5	1		4	9.60	80	0	1.7	51.4	0.0	0.0	0.6	63.4	114.8
N5	1		4	9.60	80	14	3.8	48.6	0.0	0.0	3.2	66.4	115.0
N5	1		4	9.60	80	21	4.1	51.6	0.0	0.0	0.3	64.9	116.5
N5	1		4	24.00	0	0	0.4	41.8	0.0	0.0	0.1	12.8	54.6
N5	1		4	24.00	0	14	1.1	51.9	0.0	0.0	0.8	17.8	69.7
N5	1		4	24.00	0	21	2.3	64.4	0.5	0.3	0.8	13.2	77.9
N5	1		4	24.00	80	0	8.5	57.6	0.0	0.0	11.6	80.6	138.2
N5	1		4	24.00	80	14	4.2	63.8	0.0	0.0	0.6	80.4	144.2
N5	1		4	24.00	80	21	32.2	70.0	0.5	0.3	5.3	71.5	141.8
N5	1		15	9.60	0	0	0.9	37.6	0.0	0.0	0.1	5.3	43.0
N5	1		15	9.60	0	14	1.4	36.9	0.0	0.0	0.1	6.8	43.7
N5	1		15	9.60	0	21	0.2	39.5	0.0	0.0	0.5	6.6	46.0
N5	1		15	9.60	80	0	1.7	51.4	0.0	0.0	0.6	63.4	114.8
N5	1		15	9.60	80	14	25.2	65.3	0.0	0.0	36.5	84.8	150.0
N5	1		15	9.60	80	21	4.6	59.6	0.0	0.0	0.0	61.9	121.5
N5	1		15	24.00	0	0	0.4	41.8	0.0	0.0	0.1	12.8	54.6
N5	1		15	24.00	0	14	0.0	84.8	0.0	0.0	0.3	1.0	85.8
N5	1		15	24.00	0	21	0.0	88.9	0.0	0.0	0.2	0.6	89.5
N5	1		15	24.00	80	0	8.5	57.6	0.0	0.0	11.6	80.6	138.2
N5	1		15	24.00	80	14	11.0	157.5	0.0	0.0	10.1	10.3	167.8
N5	1		15	24.00	80	21	1.0	172.5	0.0	0.0	0.3	1.3	173.8

PL	DP	SOL	TMP	WC	TRT	DAY	NO3 RANGE	NO3 AVER	NO2 RANGE	NO2 AVER	NH4 RANGE	NH4 AVER	TOTALN
N5	1		30	9.60	0	0	0.9	37.6	0.0	0.0	0.1	5.3	43.0
N5	1		30	9.60	0	14	2.5	37.1	0.0	0.0	0.4	8.7	45.8
N5	1		30	9.60	0	21	3.7	39.6	0.0	0.0	0.7	8.6	48.3
N5	1		30	9.60	80	0	1.7	51.4	0.0	0.0	0.6	63.4	114.8
N5	1		30	9.60	80	14	2.0	49.9	0.0	0.0	2.0	64.7	114.6
N5	1		30	9.60	80	21	3.6	53.8	0.0	0.0	0.3	63.5	117.3
N5	1		30	24.00	0	0	0.4	41.8	0.0	0.0	0.1	12.8	54.6
N5	1		30	24.00	0	14	1.0	101.5	0.0	0.0	0.0	1.4	102.9
N5	1		30	24.00	0	21	4.0	103.0	0.0	0.0	0.1	0.5	103.5
N5	1		30	24.00	80	0	8.5	57.6	0.0	0.0	11.6	80.6	136.2
N5	1		30	24.00	80	14	11.0	182.5	0.0	0.0	0.0	1.5	184.0
N5	1		30	24.00	80	21	7.0	199.5	0.0	0.0	0.3	1.6	201.1
N5	2		4	8.10	0	0	3.1	34.6	0.0	0.0	0.3	4.8	39.5
N5	2		4	8.10	0	14	1.8	35.4	0.0	0.0	0.1	3.8	39.2
N5	2		4	8.10	0	21	1.3	34.8	0.0	0.0	0.8	3.3	38.1
N5	2		4	8.10	80	0	1.0	41.4	2.0	1.0	8.5	82.6	125.0
N5	2		4	8.10	80	14	13.0	40.1	0.0	0.0	1.3	78.0	118.1
N5	2		4	8.10	80	21	7.9	37.8	0.0	0.0	1.3	82.8	120.7
N5	2		4	20.30	0	0	0.9	36.6	0.5	0.8	0.4	7.7	45.0
N5	2		4	20.30	0	14	1.5	47.8	0.1	2.1	0.4	5.1	54.9
N5	2		4	20.30	0	21	1.7	49.8	0.5	0.8	0.1	2.8	53.3
N5	2		4	20.30	80	0	12.4	42.7	2.0	1.0	8.6	86.3	130.0
N5	2		4	20.30	80	14	4.7	59.8	2.0	4.0	8.7	96.6	160.5
N5	2		4	20.30	80	21	1.9	57.6	0.5	4.8	1.0	75.3	137.7
N5	2		15	8.10	0	0	3.1	34.6	0.0	0.0	0.3	4.8	39.5
N5	2		15	8.10	0	14	1.2	37.7	0.0	0.0	0.1	0.6	38.3
N5	2		15	8.10	0	21	1.6	36.4	0.0	0.0	0.2	0.8	37.2
N5	2		15	8.10	80	0	1.0	41.4	2.0	1.0	8.5	82.6	125.0
N5	2		15	8.10	80	14	11.1	41.1	0.0	0.0	3.1	76.1	117.3
N5	2		15	8.10	80	21	3.3	50.8	0.0	0.0	4.1	64.8	115.6
N5	2		15	20.30	0	0	0.9	36.6	0.5	0.8	0.4	7.7	45.0
N5	2		15	20.30	0	14	0.0	57.3	0.0	0.0	0.0	0.6	57.9
N5	2		15	20.30	0	21	0.0	61.3	0.0	0.0	0.0	0.5	61.8
N5	2		15	20.30	80	0	12.4	42.7	2.0	1.0	8.6	86.3	130.0
N5	2		15	20.30	80	14	21.0	128.5	0.0	0.0	2.8	3.5	132.0
N5	2		15	20.30	80	21	22.0	129.0	0.0	0.0	0.4	2.3	131.3
N5	2		30	8.10	0	0	3.1	34.6	0.0	0.0	0.3	4.8	39.5
N5	2		30	8.10	0	14	0.6	40.3	0.0	0.0	0.0	0.5	40.8
N5	2		30	8.10	0	21	1.1	43.3	0.0	0.0	0.1	0.5	43.9
N5	2		30	8.10	80	0	1.0	41.4	2.0	1.0	8.5	82.6	125.0
N5	2		30	8.10	80	14	13.4	44.9	0.0	0.0	0.0	64.4	109.3
N5	2		30	8.10	80	21	0.0	47.6	0.0	0.0	4.4	48.6	96.2
N5	2		30	20.30	0	0	0.9	36.6	0.5	0.8	0.4	7.7	45.0
N5	2		30	20.30	0	14	0.0	70.0	0.0	0.0	0.1	0.5	70.5
N5	2		30	20.30	0	21	1.8	73.4	0.0	0.0	0.0	0.5	73.9
N5	2		30	20.30	80	0	12.4	42.7	2.0	1.0	8.6	86.3	130.0
N5	2		30	20.30	80	14	5.0	137.5	0.0	0.0	0.4	2.3	139.8
N5	2		30	20.30	80	21	3.0	139.5	0.0	0.0	0.4	2.3	141.8
N5	3		4	9.00	0	0	2.0	60.6	0.0	0.0	1.2	6.6	67.2
N5	3		4	9.00	0	14	6.1	63.9	0.0	0.0	0.3	6.3	70.3
N5	3		4	9.00	0	21	1.1	61.6	0.0	0.0	1.1	8.6	70.2
N5	3		4	9.00	80	0	12.9	67.1	0.0	0.0	6.5	89.9	157.1
N5	3		4	9.00	80	14	7.3	69.1	0.0	0.0	2.7	83.3	152.5
N5	3		4	9.00	80	21	0.8	69.6	0.0	0.0	1.7	85.8	155.4
N5	3		4	22.50	0	0	0.3	64.4	0.5	0.3	0.1	10.5	75.2
N5	3		4	22.50	0	14	2.7	79.9	0.0	0.0	0.6	10.4	90.3
N5	3		4	22.50	0	21	3.5	83.9	0.5	0.3	0.0	8.8	92.9
N5	3		4	22.50	80	0	0.8	69.9	0.5	0.8	3.5	95.9	166.6
N5	3		4	22.50	80	14	2.4	89.6	0.0	0.0	4.9	87.8	177.4
N5	3		4	22.50	80	21	4.1	88.1	0.0	0.0	24.4	95.8	183.9
N5	3		15	9.00	0	0	2.0	60.6	0.0	0.0	1.2	6.6	67.2
N5	3		15	9.00	0	14	0.0	67.3	0.0	0.0	0.8	1.9	69.2
N5	3		15	9.00	0	21	2.1	70.1	0.0	0.0	0.6	2.6	72.6
N5	3		15	9.00	80	0	12.9	67.1	0.0	0.0	6.5	89.9	157.1
N5	3		15	9.00	80	14	9.7	68.5	0.0	0.0	3.4	76.2	144.7
N5	3		15	9.00	80	21	11.9	68.1	0.0	0.0	42.3	104.8	172.9
N5	3		15	22.50	0	0	0.3	64.4	0.5	0.3	0.1	10.5	75.2
N5	3		15	22.50	0	14	1.9	95.8	0.0	0.0	0.3	0.8	96.5
N5	3		15	22.50	0	21	32.2	104.9	0.0	0.0	0.6	2.2	107.1
N5	3		15	22.50	80	0	0.8	69.9	0.5	0.8	3.5	95.9	166.6
N5	3		15	22.50	80	14	47.0	167.5	0.0	0.0	26.5	15.8	183.2
N5	3		15	22.50	80	21	6.0	185.0	0.0	0.0	3.6	3.8	188.8

PL	DP	SOL	TMP	WC	TRT	DAY	NO3 RANGE	NO3 AVER	NO2 RANGE	NO2 AVER	NH4 RANGE	NH4 AVER	TOTALN
N5	3		30	9.00	0	0	2.0	60.6	0.0	0.0	1.2	6.6	67.2
N5	3		30	9.00	0	14	1.8	75.9	0.0	0.0	0.1	0.5	76.4
N5	3		30	9.00	0	21	6.0	77.7	0.0	0.0	0.3	2.3	80.0
N5	3		30	9.00	80	0	12.9	67.1	0.0	0.0	6.5	89.9	157.1
N5	3		30	9.00	80	14	9.9	88.6	0.0	0.0	2.7	67.6	156.3
N5	3		30	9.00	80	21	0.1	98.3	0.0	0.0	7.5	67.3	165.5
N5	3		30	22.50	0	0	0.3	64.4	0.5	0.3	0.1	10.5	75.2
N5	3		30	22.50	0	14	2.0	128.0	0.0	0.0	0.2	0.7	128.7
N5	3		30	22.50	0	21	6.0	135.0	0.0	0.0	0.8	2.4	137.4
N5	3		30	22.50	80	0	0.8	69.9	0.5	0.8	3.5	95.9	166.6
N5	3		30	22.50	80	14	2.0	185.0	0.0	0.0	0.7	2.1	187.1
N5	3		30	22.50	80	21	4.0	203.0	0.0	0.0	1.7	4.0	207.0
N5	4		4	9.50	0	0	1.9	44.1	0.0	0.0	0.2	5.9	49.9
N5	4		4	9.50	0	14	5.5	49.1	0.0	0.0	0.1	6.3	55.4
N5	4		4	9.50	0	21	0.0	50.2	0.0	0.0	0.9	8.3	58.4
N5	4		4	9.50	80	0	3.5	40.1	0.0	0.0	9.0	77.6	117.7
N5	4		4	9.50	80	14	11.2	49.9	0.0	0.0	12.8	75.4	125.3
N5	4		4	9.50	80	21	0.0	53.2	0.0	0.0	3.6	80.6	133.3
N5	4		4	23.90	0	0	0.3	46.8	0.0	0.0	0.3	8.1	54.9
N5	4		4	23.90	0	14	1.5	54.4	0.0	0.0	0.2	9.3	63.7
N5	4		4	23.90	0	21	1.6	58.6	0.0	0.0	1.0	10.5	69.1
N5	4		4	23.90	80	0	0.2	37.2	0.0	0.0	39.8	87.1	124.3
N5	4		4	23.90	80	14	5.1	58.9	0.0	0.0	7.9	61.6	120.5
N5	4		4	23.90	80	21	1.6	63.1	0.0	0.0	12.7	73.5	136.[illegible]
N5	4		15	9.50	0	0	1.9	44.1	0.0	0.0	0.2	5.9	49.9
N5	4		15	9.50	0	14	1.4	52.5	0.0	0.0	0.1	5.1	57.6
N5	4		15	9.50	0	21	3.6	52.0	0.0	0.0	0.7	7.1	59.1
N5	4		15	9.50	80	0	3.5	40.1	0.0	0.0	9.0	77.6	117.7
N5	4		15	9.50	80	14	1.0	63.5	0.0	0.0	11.8	82.8	146.3
N5	4		15	9.50	80	21	7.0	58.7	0.0	0.0	24.3	83.6	142.3
N5	4		15	23.90	0	0	0.3	46.8	0.0	0.0	0.3	8.1	54.9
N5	4		15	23.90	0	14	0.1	69.3	0.0	0.0	0.2	0.7	69.9
N5	4		15	23.90	0	21	6.1	68.1	0.0	0.0	0.6	2.2	70.3
N5	4		15	23.90	80	0	0.2	37.2	0.0	0.0	39.8	87.1	124.3
N5	4		15	23.90	80	14	17.5	108.3	0.0	0.0	16.9	40.1	148.3
N5	4		15	23.90	80	21	1.0	119.5	0.0	0.0	0.1	4.8	124.3
N5	4		30	9.50	0	0	1.9	44.1	0.0	0.0	0.2	5.9	49.9
N5	4		30	9.50	0	14	14.4	42.2	0.0	0.0	1.0	4.5	46.7
N5	4		30	9.50	0	21	1.0	42.7	0.0	0.0	0.6	7.6	50.3
N5	4		30	9.50	80	0	3.5	40.1	0.0	0.0	9.0	77.6	117.7
N5	4		30	9.50	80	14	10.3	60.3	0.0	0.0	22.7	71.3	131.6
N5	4		30	9.50	80	21	1.6	64.3	0.0	0.0	11.7	60.1	124.4
N5	4		30	23.90	0	0	0.3	46.8	0.0	0.0	0.3	8.1	54.9
N5	4		30	23.90	0	14	0.8	69.3	0.0	0.0	0.1	0.8	70.0
N5	4		30	23.90	0	21	4.1	78.1	0.0	0.0	0.5	2.4	80.5
N5	4		30	23.90	80	0	0.2	37.2	0.0	0.0	39.8	87.1	124.3
N5	4		30	23.90	80	14	9.0	132.5	0.0	0.0	10.1	7.9	140.4
N5	4		30	23.90	80	21	52.0	154.0	0.0	0.0	3.8	2.3	156.3
N5	5		4	7.00	0	0	2.9	26.3	0.0	0.0	0.0	4.5	30.8
N5	5		4	7.00	0	14	1.8	28.8	0.0	0.0	0.7	7.5	36.3
N5	5		4	7.00	0	21	0.2	28.6	0.0	0.0	0.5	9.3	37.9
N5	5		4	7.00	80	0	2.0	53.6	0.0	0.0	0.3	78.8	132.4
N5	5		4	7.00	80	14	11.2	47.5	0.0	0.0	4.1	73.1	120.5
N5	5		4	7.00	80	21	0.0	50.1	0.0	0.0	0.0	77.5	127.6
N5	5		4	17.60	0	0	0.1	30.3	0.0	0.0	0.0	6.9	37.1
N5	5		4	17.60	0	14	1.0	35.8	0.0	0.0	0.5	14.3	50.1
N5	5		4	17.60	0	21	1.5	32.6	0.0	0.0	0.4	18.3	50.9
N5	5		4	17.60	80	0	0.7	50.6	0.0	0.0	5.3	67.1	117.8
N5	5		4	17.60	80	14	5.8	51.5	0.0	0.0	3.1	77.1	128.6
N5	5		4	17.60	80	21	2.3	42.8	0.0	0.0	19.9	91.1	133.3
N5	5		15	7.00	0	0	2.9	26.3	0.0	0.0	0.0	4.5	30.3
N5	5		15	7.00	0	14	1.8	30.1	0.0	0.0	0.3	8.0	38.1
N5	5		15	7.00	0	21	0.6	26.1	0.0	0.0	0.6	9.8	35.9
N5	5		15	7.00	80	0	2.0	53.6	0.0	0.0	0.3	78.8	132.4
N5	5		15	7.00	80	14	2.3	35.8	0.0	0.0	1.6	74.6	110.4
N5	5		15	7.00	80	21	0.3	32.3	0.0	0.0	15.5	66.4	98.8

							NO3		NO2		NH4		
PL	DP	SOL	TMP	WC	TRT	DAY	RANGE	AVER	RANGE	AVER	RANGE	AVER	TOTALN
N5	5		15	17.60	0	0	0.1	30.3	0.0	0.0	0.0	6.9	37.1
N5	5		15	17.60	0	14	3.3	42.3	0.0	0.0	0.8	19.8	62.1
N5	5		15	17.60	0	21	2.7	44.5	0.0	0.0	2.3	21.1	65.7
N5	5		15	17.60	80	0	0.7	50.6	0.0	0.0	5.3	67.1	117.8
N5	5		15	17.60	80	14	0.5	48.6	0.0	0.0	7.5	79.3	127.9
N5	5		15	17.60	80	21	6.0	46.3	0.0	0.0	4.7	78.1	124.0
N5	5		30	7.00	0	0	2.9	26.3	0.0	0.0	0.0	4.5	30.8
N5	5		30	7.00	0	14	6.2	31.5	0.0	0.0	4.1	15.3	46.8
N5	5		30	7.00	0	21	1.3	28.4	0.0	0.0	0.7	15.1	43.6
N5	5		30	7.00	80	0	2.0	53.6	0.0	0.0	0.3	78.8	132.4
N5	5		30	7.00	80	14	4.4	38.6	0.0	0.0	13.3	94.3	132.9
N5	5		30	7.00	80	21	25.8	49.4	0.0	0.0	5.6	87.7	137.1
N5	5		30	17.60	0	0	0.1	30.3	0.0	0.0	0.0	6.9	37.2
N5	5		30	17.60	0	14	3.5	51.1	0.0	0.0	1.1	17.3	68.5
N5	5		30	17.60	0	21	10.8	51.5	0.0	0.0	1.1	12.8	64.3
N5	5		30	17.60	80	0	0.7	50.6	0.0	0.0	5.3	67.1	117.8
N5	5		30	17.60	80	14	5.0	50.7	0.0	0.0	10.1	86.8	137.5
N5	5		30	17.60	80	21	14.9	73.6	0.0	0.0	1.4	94.5	168.2

Table 4 Recovery of added NH_4^+-N (80 μg N/g) from soil profiles representing watersheds #1, 5 and 13

	% Recovery of original NH_4^+-N applied						
Depth (cm)	Sandy loam (2)	Clay (5)	N-5/1	N-5/2	N-5/3	N-5/4	N-5/5
0-10	94	89	79	98	106	98	84
10-20	98	89					
20-30	98	68					
30-45	103	52					
45-60	102	44					
60-75	108	33					
75-90	106	49					

Table 5 Rate coefficients of nitrification of added NH_4^+-N in soils from 3 watersheds

PL	DP	SOL	TMP	WC	TRT	RN-14	RN-21	RN-AVE
1	1	S	4	2.87	80	-0.006	-0.004	-0.005
1	1	S	4	7.19	80	-0.001	-0.002	-0.001
1	1	S	15	2.87	80	-0.003	-0.002	-0.003
1	1	S	15	7.19	80	-0.002	0.005	0.001
1	1	S	30	2.87	80	0.000	0.004	0.002
1	1	S	30	7.19	80	0.018	0.035	0.027
1	2	S	4	2.60	80	0.010	0.008	0.009
1	2	S	4	6.50	80	0.014	0.009	0.011
1	2	S	15	2.60	80	0.008	0.005	0.007
1	2	S	15	6.50	80	0.018	0.009	0.014
1	2	S	30	2.60	80	0.008	0.005	0.006
1	2	S	30	6.50	80	0.015	0.009	0.012
2	1	S	4	3.45	80	-0.001	-0.001	-0.001
2	1	S	4	8.63	80	0.005	-0.002	0.001
2	1	S	15	3.45	80	-0.000	0.000	0.000
2	1	S	15	8.63	80	0.015	0.018	0.016
2	1	S	30	3.45	80	-0.002	-0.001	-0.001
2	1	S	30	8.63	80	0.041	0.024	0.032
2	2	S	4	3.42	80	-0.001	0.000	-0.000
2	2	S	4	8.55	80	-0.002	0.000	-0.001
2	2	S	15	3.42	80	0.001	0.002	0.001
2	2	S	15	8.55	80	0.005	0.003	0.004
2	2	S	30	3.42	80	0.006	0.003	0.005
2	2	S	30	8.55	80	0.011	0.015	0.013
2	1	SB	4	2.94	80	-0.005	-0.003	-0.004
2	1	SB	4	7.34	80	-0.002	0.000	-0.001
2	1	SB	15	2.94	80	-0.006	-0.003	-0.004
2	1	SB	15	7.34	80	-0.003	-0.001	-0.002
2	1	SB	30	2.94	80	-0.008	-0.000	-0.004
2	1	SB	30	7.34	80	-0.003	-0.000	-0.002
2	2	SB	4	2.91	80	0.001	0.002	0.001
2	2	SB	4	7.28	80	-0.001	0.000	-0.000
2	2	SB	15	2.91	80	0.002	-0.000	0.001
2	2	SB	15	7.28	80	0.002	0.005	0.003
2	2	SB	30	2.91	80	0.002	0.003	0.003
2	2	SB	30	7.28	80	0.011	0.010	0.011
2	3	S	4	2.81	80	-0.002	-0.002	-0.002
2	3	S	4	7.04	80	0.004	0.004	0.004
2	3	S	15	2.81	80	0.004	-0.000	0.002
2	3	S	15	7.04	80	0.017	0.007	0.012
2	3	S	30	2.81	80	0.001	0.001	0.001
2	3	S	30	7.04	80	0.033	0.028	0.031
2	4	S	4	2.26	80	-0.004	-0.001	-0.002
2	4	S	4	5.59	80	0.002	-0.001	0.001
2	4	S	15	2.26	80	-0.003	-0.001	-0.002
2	4	S	15	5.59	80	0.001	0.002	0.002
2	4	S	30	2.26	80	-0.000	0.001	0.000
2	4	S	30	5.59	80	0.010	0.005	0.007
2	5	S	4	1.44	80	0.001	0.001	0.001
2	5	S	4	3.61	80	0.002	0.002	0.002
2	5	S	15	1.44	80	-0.002	0.001	-0.000
2	5	S	15	3.61	80	0.001	-0.001	0.000
2	5	S	30	1.44	80	0.002	0.001	0.002
2	5	S	30	3.61	80	0.001	0.001	0.001
2	6	S	4	1.26	80	0.001	0.001	0.001
2	6	S	4	3.14	80	0.000	0.001	0.000
2	6	S	15	1.26	80	-0.000	0.000	-0.000
2	6	S	15	3.14	80	0.002	0.001	0.002
2	6	S	30	1.26	80	0.001	0.000	0.000
2	6	S	30	3.14	80	0.003	0.000	0.002
2	7	S	4	1.22	80	-0.001	-0.001	-0.001
2	7	S	4	3.05	80	0.002	-0.001	0.000
2	7	S	15	1.22	80	0.001	0.001	0.001
2	7	S	15	3.05	80	0.002	-0.003	-0.000
2	7	S	30	1.22	80	0.005	0.000	0.003
2	7	S	30	3.05	80	-0.001	-0.002	-0.001

PL	DP	SOL	TMP	WC	TRT	RN-14	RN-21	RN-AVE
3	1	S	4	2.87	80	-0.001	-0.009	-0.005
3	1	S	4	7.17	80	0.002	-0.002	-0.000
3	1	S	15	2.87	80	-0.002	-0.002	-0.002
3	1	S	15	7.17	80	0.012	0.014	0.013
3	1	S	30	2.87	80	-0.003	-0.003	-0.003
3	1	S	30	7.17	80	0.132	0.040	0.086
3	2	S	4	3.06	80	0.000	0.002	0.001
3	2	S	4	7.65	80	0.004	0.002	0.003
3	2	S	15	3.06	80	0.001	0.001	0.001
3	2	S	15	7.65	80	0.031	0.036	0.033
3	2	S	30	3.06	80	-0.003	0.000	-0.001
3	2	S	30	7.65	80	0.054	0.036	0.045
4	1	C	4	9.60	80	0.002	0.002	0.002
4	1	C	4	24.00	80	0.010	0.006	0.008
4	1	C	15	9.60	80	0.001	0.003	0.002
4	1	C	15	24.00	80	0.060	0.072	0.066
4	1	C	30	9.60	80	0.005	0.004	0.005
4	1	C	30	24.00	80	0.307	0.136	0.222
4	2	C	4	9.66	80	0.003	0.002	0.002
4	2	C	4	24.20	80	-0.005	0.000	-0.002
4	2	C	15	9.66	80	0.010	-0.000	0.005
4	2	C	15	24.20	80	0.036	0.079	0.057
4	2	C	30	9.66	80	0.013	0.010	0.011
4	2	C	30	24.20	80	0.205	0.185	0.195

Table 5 cont.

PL	DP	SOL	TMP	WC	TRT	RN-14	RN-21	RN-AVE
5	1	C	4	8.76	80	-0.002	0.004	0.001
5	1	C	4	21.90	80	0.000	-0.002	-0.001
5	1	C	15	8.76	80	-0.005	-0.003	-0.004
5	1	C	15	21.90	80	0.046	0.008	0.027
5	1	C	30	8.76	80	0.001	-0.006	-0.002
5	1	C	30	21.90	80	0.119	0.064	0.092
5	2	C	4	8.70	80	0.010	-0.002	0.004
5	2	C	4	21.80	80	0.005	0.003	0.004
5	2	C	15	8.70	80	-0.004	-0.001	-0.002
5	2	C	15	21.80	80	0.135	0.127	0.131
5	2	C	30	8.70	80	0.003	0.006	0.004
5	2	C	30	21.80	80	0.198	0.119	0.158
5	1	CB	4	9.24	80	0.002	-0.002	-0.000
5	1	CB	4	2[illegible].10	80	0.019	0.012	0.016
5	1	CB	15	9.24	80	0.003	-0.002	0.000
5	1	CB	15	23.10	80	0.176	0.106	0.141
5	1	CB	30	9.24	80	0.005	0.009	0.007
5	1	CB	30	23.10	80	0.231	0.099	0.165
5	2	CB	4	9.69	80	0.001	0.005	0.003
5	2	CB	4	24.20	80	0.006	-0.000	0.003
5	2	CB	15	9.69	80	-0.013	-0.001	-0.007
5	2	CB	15	24.20	80	0.041	0.046	0.043
5	2	CB	30	9.69	80	-0.007	0.002	-0.002
5	2	CB	30	24.20	80	0.053	0.049	0.051
5	3	C	4	8.82	80	0.010	0.008	0.009
5	3	C	4	22.10	80	0.001	-0.006	-0.002
5	3	C	15	8.82	80	0.006	0.010	0.008
5	3	C	15	22.10	80	0.042	0.056	0.049
5	3	C	30	8.82	80	0.021	0.002	0.012
5	3	C	30	22.10	80	0.164	******	******
5	4	C	4	8.40	80	0.006	0.003	0.005
5	4	C	4	21.00	80	-0.003	-0.000	-0.002
5	4	C	15	8.40	80	0.003	0.001	0.002
5	4	C	15	21.00	80	0.009	0.000	0.005
5	4	C	30	8.40	80	0.009	0.003	0.006
5	4	C	30	21.00	80	0.000	-0.004	-0.002
5	5	C	4	8.30	80	0.009	0.001	0.005
5	5	C	4	20.90	80	-0.008	-0.003	-0.005
5	5	C	15	8.30	80	-0.004	0.007	0.002
5	5	C	15	20.90	80	-0.006	0.003	-0.001
5	5	C	30	8.30	80	-0.010	0.006	-0.002
5	5	C	30	20.90	80	0.001	-0.010	-0.005
5	6	C	4	8.20	80	0.000	-0.009	-0.004
5	6	C	4	20.40	80	0.007	0.002	0.005
5	6	C	15	8.20	80	-0.002	-0.004	-0.003
5	6	C	15	20.40	80	0.004	0.007	0.006
5	6	C	30	8.20	80	0.004	0.001	0.003
5	6	C	30	20.40	80	0.010	0.006	0.008
5	7	C	4	8.40	80	0.010	0.001	0.006
5	7	C	4	20.90	80	0.007	0.006	0.007
5	7	C	15	8.40	80	0.011	0.010	0.010
5	7	C	15	20.90	80	0.016	0.009	0.012
5	7	C	30	8.40	80	0.009	0.012	0.011
5	7	C	30	20.90	80	0.022	0.005	0.014

PL	DP	SOL	TMP	WC	TRT	RN-14	RN-21	RN-AVE
6	1	C	4	9.12	80	-0.001	0.001	-0.000
6	1	C	4	22.80	80	0.003	0.002	0.002
6	1	C	15	9.12	80	-0.005	0.003	-0.001
6	1	C	15	22.80	80	0.045	0.051	0.048
6	1	C	30	9.12	80	0.012	0.001	0.006
6	1	C	30	22.80	80	******	******	******
NS	1		4	9.60	80	-0.001	0.000	-0.000
NS	1		4	24.00	80	0.001	-0.000	0.000
NS	1		15	9.60	80	-0.003	0.004	0.000
NS	1		15	24.00	80	0.136	0.251	0.193
NS	1		30	9.60	80	0.001	0.001	0.001
NS	1		30	24.00	80	0.280	******	******
NS	2		4	8.10	80	0.000	-0.002	-0.001
NS	2		4	20.30	80	-0.002	0.004	0.001
NS	2		15	8.10	80	-0.001	0.007	0.003
NS	2		15	20.30	80	0.160	0.100	0.130
NS	2		30	8.10	80	0.005	0.009	0.007
NS	2		30	20.30	80	0.150	0.097	0.123
NS	3		4	9.00	80	0.002	0.002	0.002
NS	3		4	22.50	80	0.005	-0.001	0.002
NS	3		15	9.00	80	0.002	-0.007	-0.003
NS	3		15	22.50	80	0.114	0.123	0.119
NS	3		30	9.00	80	0.010	0.010	0.010
NS	3		30	22.50	80	0.112	0.092	0.102
NS	4		4	9.50	80	0.004	0.002	0.003
NS	4		4	23.90	80	0.021	0.010	0.016
NS	4		15	9.50	80	0.005	0.002	0.003
NS	4		15	23.90	80	0.058	0.097	0.078
NS	4		30	9.50	80	0.015	0.018	0.016
NS	4		30	23.90	80	0.177	******	******
NS	5		4	7.00	80	0.000	0.000	0.000
NS	5		4	17.60	80	-0.004	-0.008	-0.006
NS	5		15	7.00	80	-0.006	-0.001	-0.004
NS	5		15	17.60	80	-0.007	-0.006	-0.007
NS	5		30	7.00	80	-0.011	-0.001	-0.006
NS	5		30	17.60	80	-0.016	-0.007	-0.012

Table 6 Correlations of nitrification rate coefficients with temperature and moisture in surface samples of watershed soils

	Correlation coefficients			Non preassigned % reduction in total sum of squares		
Factor	Brookston Clay	Berrien Sandy Loam	N-5	Brookston Clay	Berrien Sandy Loam	N-5
Temp. x H_2O	0.82	0.61	0.73	68.0	37.4	53.6
Temp.	0.45	0.36	0.25	76.9	40.5	75.4
H_2O	0.58	0.40	0.64	77.3	40.8	75.4
Multiple	0.88	0.64	0.87			

Table 7 Weighted average daily rates of mineralization of watershed soils

PL	DP	SOL	TMP	WC	TRT	MIN RATE
1	1	S	4	2,87	0	0,2171
1	1	S	4	7,19	0	0,1743
1	1	S	15	2,87	0	0,1914
1	1	S	15	7,19	0	0,0886
1	1	S	30	2,87	0	-0,1029
1	1	S	30	7,19	0	0,3943
1	2	S	4	2,60	0	-0,4886
1	2	S	4	6,50	0	0,0486
1	2	S	15	2,60	0	-0,5571
1	2	S	15	6,50	0	0,0514
1	2	S	30	2,60	0	-0,4486
1	2	S	30	6,50	0	0,5343
2	1	S	4	3,45	0	0,1914
2	1	S	4	8,63	0	0,0543
2	1	S	15	3,45	0	0,1857
2	1	S	15	8,63	0	-0,0286
2	1	S	30	3,45	0	0,1200
2	1	S	30	8,63	0	0,0914
2	2	S	4	3,42	0	0,1086
2	2	S	4	8,55	0	0,1829
2	2	S	15	3,42	0	-0,0914
2	2	S	15	8,55	0	0,0371
2	2	S	30	3,42	0	-0,0971
2	2	S	30	8,55	0	0,1571
2	1	SB	4	2,94	0	0,2143
2	1	SB	4	7,34	0	0,1457
2	1	SB	15	2,94	0	0,2657
2	1	SB	15	7,34	0	0,2914
2	1	SB	30	2,94	0	0,1714
2	1	SB	30	7,34	0	0,2829
2	2	SB	4	2,91	0	-0,1029
2	2	SB	4	7,28	0	0,0457
2	2	SB	15	2,91	0	-0,0200
2	2	SB	15	7,28	0	0,2000
2	2	SB	30	2,91	0	-0,0343
2	2	SB	30	7,28	0	0,1057
2	3	S	4	2,81	0	-0,1200
2	3	S	4	7,04	0	-0,0743
2	3	S	15	2,81	0	-0,1029
2	3	S	15	7,04	0	-0,0343
2	3	S	30	2,81	0	-0,1057
2	3	S	30	7,04	0	0,0486
2	4	S	4	2,26	0	0,2400
2	4	S	4	5,59	0	-0,0029
2	4	S	15	2,26	0	0,1914
2	4	S	15	5,59	0	-0,0029
2	4	S	30	2,26	0	0,1543
2	4	S	30	5,59	0	-0,1000
2	5	S	4	1,44	0	-0,0800
2	5	S	4	3,61	0	0,0371
2	5	S	15	1,44	0	-0,0371
2	5	S	15	3,61	0	-0,0514
2	5	S	30	1,44	0	-0,0086
2	5	S	30	3,61	0	-0,0714
2	6	S	4	1,26	0	0,0000
2	6	S	4	3,14	0	0,0629
2	6	S	15	1,26	0	0,0457
2	6	S	15	3,14	0	0,0571
2	6	S	30	1,26	0	-0,0286
2	6	S	30	3,14	0	0,0686
2	7	S	4	1,22	0	0,0371
2	7	S	4	3,05	0	0,0857
2	7	S	15	1,22	0	0,0629
2	7	S	15	3,05	0	0,0400
2	7	S	30	1,22	0	0,0743
2	7	S	30	3,05	0	0,1257

PL	DP	SOL	TMP	WC	TRT	MIN RATE
3	1	S	4	2,87	0	0,0771
3	1	S	4	7,17	0	0,0400
3	1	S	15	2,87	0	0,0514
3	1	S	15	7,17	0	-0,0429
3	1	S	30	2,87	0	0,1229
3	1	S	30	7,17	0	0,1686
3	2	S	4	3,06	0	-0,0943
3	2	S	4	7,65	0	0,0229
3	2	S	15	3,06	0	0,0314
3	2	S	15	7,65	0	0,2371
3	2	S	30	3,06	0	0,1400
3	2	S	30	7,65	0	0,4371
4	1	C	4	9,60	0	0,0800
4	1	C	4	24,00	0	0,7857
4	1	C	15	9,60	0	-0,0143
4	1	C	15	24,00	0	0,8800
4	1	C	30	9,60	0	-0,2171
4	1	C	30	24,00	0	1,5486
4	2	C	4	9,66	0	0,1086
4	2	C	4	24,20	0	0,7514
4	2	C	15	9,66	0	0,0400
4	2	C	15	24,20	0	1,0314
4	2	C	30	9,66	0	-0,1400
4	2	C	30	24,20	0	2,0200
NS	1		4	9,60	0	0,0
NS	1		4	24,00	0	1,0971
NS	1		15	9,60	0	0,1143
NS	1		15	24,00	0	1,8686
NS	1		30	9,60	0	0,2343
NS	1		30	24,00	0	2,7771
NS	2		4	8,10	0	-0,0429
NS	2		4	20,30	0	0,5229
NS	2		15	8,10	0	-0,0943
NS	2		15	20,30	0	0,8486
NS	2		30	8,10	0	0,1657
NS	2		30	20,30	0	1,5543
NS	3		4	9,00	0	0,1714
NS	3		4	22.50	0	0,9371
NS	3		15	9,00	0	0,2143
NS	3		15	22,50	0	1,5229
NS	3		30	9,00	0	0,6286
NS	3		30	22,50	0	3,3057
NS	4		4	9,50	0	0,3971
NS	4		4	23,90	0	0,6571
NS	4		15	9,50	0	0,4771
NS	4		15	23,90	0	0,8714
NS	4		30	9,50	0	-0,0857
NS	4		30	23,90	0	1,1657
NS	5		4	7,00	0	0,3600
NS	5		4	17,60	0	0,7600
NS	5		15	7,00	0	0,3543
NS	5		15	17,60	0	1,5229
NS	5		30	7,00	0	0,8200
NS	5		30	17,60	0	1,6657

PL	DP	SOL	TMP	WC	TRT	MIN RATE
5	1	C	4	8,76	0	0,1971
5	1	C	4	21,90	0	0,6943
5	1	C	15	8,76	0	0,2371
5	1	C	15	21,90	0	0,6686
5	1	C	30	8,76	0	0,4171
5	1	C	30	21,90	0	1,1743
5	2	C	4	8,70	0	0,0800
5	2	C	4	21,80	0	0,4971
5	2	C	15	8,70	0	-0,0457
5	2	C	15	21,80	0	0,8086
5	2	C	30	8,70	0	0,1200
5	2	C	30	21,80	0	1,4429
5	1	CB	4	9,24	0	0,2743
5	1	CB	4	23.10	0	0,4971
5	1	CB	15	9,24	0	0,4314
5	1	CB	15	23,10	0	0,6971
5	1	CB	30	9,24	0	0,2857
5	1	CB	30	23,10	0	0,9429
5	2	CB	4	9,69	0	0,1343
5	2	CB	4	24,20	0	0,5371
5	2	CB	15	9,69	0	0,8743
5	2	CB	15	24,20	0	0,9686
5	2	CB	30	9,69	0	0,3971
5	2	CB	30	24,20	0	2,0800
5	3	C	4	8,82	0	-0,0257
5	3	C	4	22,10	0	0,3171
5	3	C	15	8,82	0	-0,0200
5	3	C	15	22,10	0	0,7600
5	3	C	30	8,82	0	0,0229
5	3	C	30	22,10	0	1,5600
5	4	C	4	8,40	0	0,0714
5	4	C	4	21,00	0	0,3371
5	4	C	15	8,40	0	0,0657
5	4	C	15	21,00	0	0,5800
5	4	C	30	8,40	0	-0,0171
5	4	C	30	21,00	0	0,6029
5	5	C	4	8,30	0	-0,0286
5	5	C	4	20,90	0	0,0771
5	5	C	15	8,30	0	-0,0257
5	5	C	15	20,90	0	0,1857
5	5	C	30	8,30	0	-0,0114
5	5	C	30	20,90	0	0,1800
5	6	C	4	8,20	0	0,0257
5	6	C	4	20,40	0	0,0200
5	6	C	15	8,20	0	0,0229
5	6	C	15	20,40	0	0,0943
5	6	C	30	8,20	0	0,0171
5	6	C	30	20,40	0	0,1971
5	7	C	4	8,40	0	-0,0171
5	7	C	4	20,90	0	0,0857
5	7	C	15	8,40	0	-0,0171
5	7	C	15	20,90	0	0,1057
5	7	C	30	8,40	0	0,0286
5	7	C	30	20,90	0	0,1629
6	1	C	4	9,12	0	0,1029
6	1	C	4	22,80	0	0,4057
6	1	C	15	9,12	0	0,0771
6	1	C	15	22,80	0	0,2971
6	1	C	30	9,12	0	-0,1457
6	1	C	30	22,80	0	0,5943

Table 7 cont.

PL	DP	SOL	TMP	WC	TRT	RD-2	RD-S	RD-AVE
2	1	S	4	27.00	0	0.020	-0.020	-0.000
2	1	S	4	27.00	80	-0.010	-0.004	-0.007
2	1	S	4	36.00	0	-0.023	-0.009	-0.016
2	1	S	4	36.00	80	0.034	0.012	0.023
2	1	S	4	44.00	0	-0.044	-0.017	-0.030
2	1	S	4	44.00	80	0.017	0.007	0.012
2	1	S	15	27.00	0	-0.050	-0.037	-0.044
2	1	S	15	27.00	80	0.031	0.015	0.023
2	1	S	15	36.00	0	0.106	0.179	0.142
2	1	S	15	36.00	80	0.008	0.011	0.009
2	1	S	15	44.00	0	0.198	0.166	0.182
2	1	S	15	44.00	80	0.063	0.033	0.048
2	1	S	30	27.00	0	0.503	0.401	0.452
2	1	S	30	27.00	80	0.083	0.025	0.054
2	1	S	30	36.00	0	1.980	0.572	1.276
2	1	S	30	36.00	80	0.171	0.067	0.119
2	1	S	30	44.00	0	********	0.067	********
2	1	S	30	44.00	80	0.144	0.065	0.105
2	2	S	4	27.00	0	-0.027	-0.026	-0.027
2	2	S	4	27.00	80	0.005	0.007	0.006
2	2	S	4	36.00	0	-0.027	-0.021	-0.024
2	2	S	4	36.00	80	0.0	-0.011	-0.006
2	2	S	4	44.00	0	-0.028	-0.022	-0.025
2	2	S	4	44.00	80	-0.058	-0.019	-0.039
2	2	S	15	27.00	0	-0.014	-0.031	-0.022
2	2	S	15	27.00	80	-0.043	-0.010	-0.027
2	2	S	15	36.00	0	0.034	0.065	0.050
2	2	S	15	36.00	80	-0.035	-0.014	-0.025
2	2	S	15	44.00	0	0.029	0.093	0.061
2	2	S	15	44.00	80	-0.074	0.005	-0.035
2	2	S	30	27.00	0	0.182	-0.049	0.067
2	2	S	30	27.00	80	0.138	0.019	0.078
2	2	S	30	36.00	0	1.701	0.717	1.209
2	2	S	30	36.00	80	0.110	0.081	0.095
2	2	S	30	44.00	0	1.889	0.644	1.267
2	2	S	30	44.00	80	0.124	0.056	0.090
2	1	SB	4	36.00	0	-0.017	-0.002	-0.010
2	1	SB	4	36.00	80	0.009	-0.003	0.003
2	1	SB	15	36.00	0	-0.013	0.013	0.000
2	1	SB	15	36.00	80	-0.003	-0.009	-0.006
2	1	SB	30	36.00	0	0.164	0.148	0.156
2	1	SB	30	36.00	80	0.0	0.035	0.018
2	2	SB	4	39.00	0	-0.090	-0.035	-0.063
2	2	SB	4	39.00	80	0.002	-0.009	-0.003
2	2	SB	15	39.00	0	-0.071	0.005	-0.033
2	2	SB	15	39.00	80	-0.016	-0.008	-0.012
2	2	SB	30	39.00	0	0.268	0.310	0.289
2	2	SB	30	39.00	80	0.017	0.032	0.024
2	3	S	4	37.00	0	-0.085	-0.051	-0.068
2	3	S	4	37.00	80	0.002	0.001	0.001
2	3	S	15	37.00	0	0.121	0.022	0.071
2	3	S	15	37.00	80	-0.008	0.002	-0.003
2	3	S	30	37.00	0	0.439	0.293	0.366
2	3	S	30	37.00	80	0.058	0.036	0.047
2	4	S	4	37.00	0	0.048	-0.044	0.002
2	4	S	4	37.00	80	0.023	0.005	0.014
2	4	S	15	37.00	0	-0.110	-0.034	-0.072
2	4	S	15	37.00	80	0.048	0.005	0.026
2	4	S	30	37.00	0	0.307	0.098	0.203
2	4	S	30	37.00	80	0.047	0.035	0.041
2	5	S	4	33.00	0	-0.157	-0.213	-0.185
2	5	S	4	33.00	80	-0.034	-0.012	-0.023
2	5	S	15	33.00	0	-0.228	-0.185	-0.207
2	5	S	15	33.00	80	-0.062	-0.028	-0.045
2	5	S	30	33.00	0	-0.157	-0.189	-0.173
2	5	S	30	33.00	80	-0.086	-0.023	-0.054
2	6	S	4	33.00	0	0.112	0.130	0.121
2	6	S	4	33.00	80	0.036	0.007	0.022
2	6	S	15	33.00	0	0.152	0.168	0.160
2	6	S	15	33.00	80	0.043	0.008	0.025
2	6	S	30	33.00	0	0.152	0.183	0.167
2	6	S	30	33.00	80	0.046	0.021	0.034
2	7	S	4	33.00	0	0.074	0.036	0.055
2	7	S	4	33.00	80	0.032	0.026	0.029
2	7	S	15	33.00	0	0.035	0.039	0.037
2	7	S	15	33.00	80	0.062	-0.021	0.020
2	7	S	30	33.00	0	0.050	0.026	0.038
2	7	S	30	33.00	80	0.018	-0.008	0.005

PL	DP	SOL	TMP	WC	TRT	RD-2	RD-S	RD-AVE
5	1	C	4	50.00	0	-0.054	-0.052	-0.053
5	1	C	4	50.00	80	-0.035	-0.019	-0.027
5	1	C	4	66.00	0	-0.057	0.011	-0.023
5	1	C	4	66.00	80	-0.009	-0.006	-0.007
5	1	C	4	79.00	0	-0.049	0.014	-0.017
5	1	C	4	79.00	80	0.016	0.007	0.012
5	1	C	15	50.00	0	0.175	0.551	0.363
5	1	C	15	50.00	80	0.058	-0.011	0.024
5	1	C	15	66.00	0	0.342	0.560	0.451
5	1	C	15	66.00	80	0.074	0.028	0.051
5	1	C	15	79.00	0	0.678	0.761	0.720
5	1	C	15	79.00	80	0.096	0.054	0.075
5	1	C	30	50.00	0	********	0.054	********
5	1	C	30	50.00	80	0.129	0.006	0.065
5	1	C	30	66.00	0	********	0.006	********
5	1	C	30	66.00	80	0.301	0.134	0.218
5	1	C	30	79.00	0	********	0.134	********
5	1	C	30	79.00	80	0.280	0.116	0.198
5	2	C	4	50.00	0	-0.523	-0.245	-0.384
5	2	C	4	50.00	80	-0.009	-0.015	-0.012
5	2	C	4	67.00	0	-0.280	-0.164	-0.222
5	2	C	4	67.00	80	0.053	0.014	0.034
5	2	C	4	80.00	0	-0.438	-0.190	-0.314
5	2	C	4	80.00	80	0.019	-0.002	0.009
5	2	C	15	50.00	0	-0.765	-0.102	-0.434
5	2	C	15	50.00	80	-0.059	-0.019	-0.039
5	2	C	15	67.00	0	-0.570	-0.199	-0.384
5	2	C	15	67.00	80	0.355	0.103	0.229
5	2	C	15	80.00	0	-0.541	-0.191	-0.366
5	2	C	15	80.00	80	0.144	0.069	0.107
5	2	C	30	50.00	0	-0.363	0.484	0.061
5	2	C	30	50.00	80	0.094	0.261	0.178
5	2	C	30	67.00	0	1.184	0.591	0.887
5	2	C	30	67.00	80	0.563	0.521	0.542
5	2	C	30	80.00	0	1.753	0.599	1.176
5	2	C	30	80.00	80	0.727	0.311	0.519
5	1	CB	4	73.00	0	-0.167	-0.119	-0.143
5	1	CB	4	73.00	80	0.012	0.010	0.011
5	1	CB	15	73.00	0	0.859	0.391	0.625
5	1	CB	15	73.00	80	0.124	0.156	0.140
5	1	CB	30	73.00	0	0.764	0.233	0.499
5	1	CB	30	73.00	80	1.220	0.527	0.874
5	2	CB	4	77.00	0	-0.064	-0.036	-0.050
5	2	CB	4	77.00	80	-0.024	-0.019	-0.022
5	2	CB	15	77.00	0	0.786	0.276	0.531
5	2	CB	15	77.00	80	0.122	0.182	0.152
5	2	CB	30	77.00	0	0.736	0.337	0.536
5	2	CB	30	77.00	80	0.887	0.387	0.637
5	3	C	4	74.00	0	0.156	0.068	0.112
5	3	C	4	74.00	80	0.066	0.012	0.039
5	3	C	15	74.00	0	0.794	0.512	0.653
5	3	C	15	74.00	80	0.108	0.191	0.149
5	3	C	30	74.00	0	0.700	0.325	0.512
5	3	C	30	74.00	80	0.807	0.539	0.673
5	4	C	4	70.00	0	0.073	0.130	0.102
5	4	C	4	70.00	80	-0.021	-0.065	-0.043
5	4	C	15	70.00	0	0.226	0.202	0.214
5	4	C	15	70.00	80	-0.145	-0.019	-0.082
5	4	C	30	70.00	0	0.035	0.168	0.102
5	4	C	30	70.00	80	-0.028	0.055	0.014
5	5	C	4	67.00	0	0.102	0.161	0.131
5	5	C	4	67.00	80	0.090	0.027	0.058
5	5	C	15	67.00	0	0.102	0.312	0.207
5	5	C	15	67.00	80	0.009	0.003	0.006
5	5	C	30	67.00	0	0.102	0.149	0.126
5	5	C	30	67.00	80	-0.010	0.015	0.002
5	6	C	4	66.00	0	-0.321	0.045	-0.138
5	6	C	4	66.00	80	-0.002	-0.008	-0.005
5	6	C	15	66.00	0	0.215	0.160	0.188
5	6	C	15	66.00	80	-0.037	-0.010	-0.023
5	6	C	30	66.00	0	0.399	0.160	0.279
5	6	C	30	66.00	80	-0.101	-0.020	-0.061
5	7	C	4	64.00	0	-0.030	-0.045	-0.037
5	7	C	4	64.00	80	0.052	0.004	0.028
5	7	C	15	64.00	0	0.347	0.094	0.220
5	7	C	15	64.00	80	0.053	0.031	0.042
5	7	C	30	64.00	0	0.490	0.139	0.315
5	7	C	30	64.00	80	0.051	0.025	0.038

Table 8 Correlation of rate of N mineralization values with environmental and soil factors of incubated watershed surface soil samples

Factor	Correlation Coefficient		
	Brookston Clay	Berrien Sandy Loam	N-5
%C	0.25	0.09	0.30
%N	0.24	0.12	0.30
pH	-0.22	0.00	-0.30
Fixed NH_4^+	0.24	0.03	0.30
Glucose-C	0.08	0.15	0.30
Temp.	0.30	0.16	0.37
H_2O	0.73	0.37	0.85
Temp. x H_2O	0.73	0.38	0.83
Multiple	0.90	0.58	---

Table 9 Total surface nitrogen and yearly N mineralized assuming 1% of the total N is mineralized/year

Soil	kgN/ha	N mineralized/year kgN/ha	N mineralized/year µgN/g
Berrien sandy Loam	2,466	25	9.6
Brookston clay	6,726	67	26.5
N-5/1	16,591	166	37.0
N-5/2	10,762	108	24.0
N-5/3	13,452	135	30.0
N-5/4	14,797	148	33.0
N-5/5	5,829	58	13.0

Table 10 Total inorganic N in soil-plant residue incubations

Soil	Plant Material	Day 0 Ave	Day 0 Range	Day 15 Ave	Day 15 Range	Day 30 Ave	Day 30 Range	Day 60 Ave	Day 60 Range
Brookston Clay	Rye	20.3	0.8	11.6	2.5	27.5	1.1	59.3	0.3
	Soybean	18.9	5.0	55.3	7.1	88.8	10.5	133.0	1.1
	Wheat	18.8	4.3	6.5	0.8	7.3	0.7	22.6	0.6
	Corn	11.4	15.5	7.4	2.5	8.3	0.4	9.4	1.3
	Control	19.0	2.0	35.8	3.8	56.6	3.4	76.2	14.5
Berrien Sandy Loam	Rye	19.6	0.4	34.8	3.1	50.2	6.4	61.2	2.2
	Soybean	20.7	2.1	35.2	1.2	73.1	9.7	99.2	0.9
	Wheat	21.7	0.7	1.9	0.1	5.4	0.2	6.7	1.1
	Corn	12.5	0.1	2.6	0.2	6.0	0.9	6.6	0.4
	Control	18.7	1.3	33.6	0.2	44.2	0.1	51.0	0.2

Table   Inorganic N analyses (μgN/g) during incubation experiments examining denitrification under saturated moisture contents and several temperatures of watershed soils

							NO3		NO2		NH4		
PL	DP	SOL	TMP	WC	TRT	DAY	RANGE	AVER	RANGE	AVER	RANGE	AVER	TOTALN
1	1	S	4	35.00	0	0	1.0	15.6	0.0	0.0	0.8	2.8	16.4
1	1	S	4	35.00	0	2	0.7	18.3	0.0	0.0	0.0	2.6	20.8
1	1	S	4	35.00	0	5	1.2	20.9	0.0	0.0	0.6	3.9	24.8
1	1	S	4	35.00	80	0	10.4	78.1	0.0	0.0	8.2	88.0	166.1
1	1	S	4	35.00	80	2	23.2	79.3	0.0	0.0	3.6	85.4	164.7
1	1	S	4	35.00	80	5	3.4	88.1	0.0	0.0	7.4	90.3	178.4
1	1	S	15	35.00	0	0	1.0	15.6	0.0	0.0	0.8	2.8	18.4
1	1	S	15	35.00	0	2	9.5	12.5	0.5	1.8	0.9	5.3	19.6
1	1	S	15	35.00	0	5	4.7	13.5	0.0	0.0	0.4	8.3	21.8
1	1	S	15	35.00	80	0	10.4	78.1	0.0	0.0	8.2	88.0	166.1
1	1	S	15	35.00	80	2	2.0	76.5	2.5	1.3	2.8	88.9	166.6
1	1	S	15	35.00	80	5	2.0	73.7	1.5	0.8	1.3	92.4	166.9
1	1	S	30	35.00	0	0	1.0	15.6	0.0	0.0	0.8	2.8	18.4
1	1	S	30	35.00	0	2	0.6	2.5	0.0	0.0	0.4	8.6	11.1
1	1	S	30	35.00	0	5	0.5	2.1	0.0	0.0	0.6	11.3	13.3
1	1	S	30	35.00	80	0	10.4	78.1	0.0	0.0	8.2	88.0	166.1
1	1	S	30	35.00	80	2	26.0	68.5	0.0	3.0	3.7	91.8	163.3
1	1	S	30	35.00	80	5	3.3	64.6	0.0	0.0	4.0	92.9	157.5
1	2	S	4	36.00	0	0	0.5	24.6	0.0	0.0	0.4	6.0	30.6
1	2	S	4	36.00	0	2	0.1	25.3	0.0	0.0	1.1	5.8	31.1
1	2	S	4	36.00	0	5	0.3	23.5	0.0	0.0	0.1	4.6	28.2
1	2	S	4	36.00	80	0	0.0	133.0	0.0	0.0	6.3	81.4	214.4
1	2	S	4	36.00	80	2	1.0	112.5	0.0	0.0	3.8	81.7	194.2
1	2	S	4	36.00	80	5	1.0	115.5	0.0	0.0	2.0	81.4	196.9
1	2	S	15	36.00	0	0	0.5	24.6	0.0	0.0	0.4	6.0	30.6
1	2	S	15	36.00	0	2	1.3	19.3	0.5	1.8	0.6	7.5	28.5
1	2	S	15	36.00	0	5	0.9	15.7	0.0	0.0	1.0	9.9	25.6
1	2	S	15	36.00	80	0	0.0	133.0	0.0	0.0	6.3	81.4	214.4
1	2	S	15	36.00	80	2	6.0	113.0	0.0	2.0	3.9	85.6	200.6
1	2	S	15	36.00	80	5	0.0	105.0	0.0	0.5	2.8	85.4	190.9
1	2	S	30	36.00	0	0	0.5	24.6	0.0	0.0	0.4	6.0	30.6
1	2	S	30	36.00	0	2	0.0	6.6	0.0	0.0	0.4	11.1	17.7
1	2	S	30	36.00	0	5	0.3	1.8	0.0	0.0	5.1	12.5	14.4
1	2	S	30	36.00	80	0	0.0	133.0	0.0	0.0	6.3	81.4	214.4
1	2	S	30	36.00	80	2	0.2	96.0	0.0	2.5	1.6	90.2	188.7
1	2	S	30	36.00	80	5	7.7	88.8	1.5	3.3	7.9	94.9	186.9
2	1	S	4	27.00	0	0	1.2	10.4	0.0	0.0	0.0	3.0	13.4
2	1	S	4	27.00	0	2	2.0	10.0	0.0	0.0	1.1	4.6	14.6
2	1	S	4	27.00	0	5	1.0	11.5	0.0	0.0	0.7	4.3	15.8
2	1	S	4	27.00	80	0	2.0	99.0	0.0	0.0	4.0	100.0	199.0
2	1	S	4	27.00	80	2	6.0	101.0	0.0	0.0	4.0	100.0	201.0
2	1	S	4	27.00	80	5	10.0	101.0	0.0	0.0	0.0	94.0	195.0
2	1	S	4	36.00	0	0	1.0	10.5	0.0	0.0	0.0	2.0	12.5
2	1	S	4	36.00	0	2	0.0	11.0	0.0	0.0	0.4	4.2	15.2
2	1	S	4	36.00	0	5	0.0	11.0	0.0	0.0	0.0	4.4	15.4
2	1	S	4	36.00	80	0	12.0	107.0	0.0	0.0	2.0	95.0	202.0
2	1	S	4	36.00	80	2	4.0	100.0	0.0	0.0	0.0	94.0	194.0
2	1	S	4	36.00	80	5	10.0	101.0	0.0	0.0	2.0	93.0	194.0
2	1	S	4	44.00	0	0	0.0	11.0	0.0	0.0	2.0	3.0	14.0
2	1	S	4	44.00	0	2	0.0	12.0	0.0	0.0	1.8	4.9	16.9
2	1	S	4	44.00	0	5	0.0	12.0	0.0	0.0	0.0	4.0	16.0
2	1	S	4	44.00	80	0	8.0	106.0	0.0	0.0	6.0	92.0	198.0
2	1	S	4	44.00	80	2	3.0	102.5	0.0	0.0	4.0	91.0	193.5
2	1	S	4	44.00	80	5	1.0	102.5	0.0	0.0	0.0	93.0	195.5
2	1	S	15	27.00	0	0	1.2	10.4	0.0	0.0	0.0	3.0	13.4
2	1	S	15	27.00	0	2	1.0	11.5	0.0	0.0	0.4	4.9	16.8
2	1	S	15	27.00	0	5	3.0	12.5	0.0	0.0	3.0	4.5	17.0
2	1	S	15	27.00	80	0	2.0	99.0	0.0	0.0	4.0	100.0	199.0
2	1	S	15	27.00	80	2	2.0	93.0	0.0	0.0	0.0	90.0	183.0
2	1	S	15	27.00	80	5	4.0	92.0	0.0	0.0	4.0	92.0	184.0
2	1	S	15	36.00	0	0	1.0	10.5	0.0	0.0	0.0	2.0	12.5
2	1	S	15	36.00	0	2	1.3	8.0	0.0	0.5	0.0	4.8	13.3
2	1	S	15	36.00	0	5	2.7	4.3	0.0	0.0	1.3	5.8	10.2
2	1	S	15	36.00	80	0	12.0	107.0	0.0	0.0	2.0	95.0	202.0
2	1	S	15	36.00	80	2	0.0	104.0	0.5	1.3	3.0	90.5	195.7
2	1	S	15	36.00	80	5	7.0	101.5	0.0	0.0	2.0	97.0	198.5
2	1	S	15	44.00	0	0	0.0	11.0	0.0	0.0	2.0	3.0	14.0
2	1	S	15	44.00	0	2	0.0	7.1	0.5	0.3	0.0	4.9	12.3
2	1	S	15	44.00	0	5	0.9	4.8	0.0	0.0	0.5	5.6	10.4
2	1	S	15	44.00	80	0	8.0	106.0	0.0	0.0	6.0	92.0	198.0
2	1	S	15	44.00	80	2	2.0	92.0	0.0	1.5	4.0	93.0	186.5
2	1	S	15	44.00	80	5	2.0	90.0	0.0	0.0	2.0	94.0	184.0
2	1	S	30	27.00	0	0	1.2	10.4	0.0	0.0	0.0	3.0	13.4
2	1	S	30	27.00	0	2	1.7	3.8	0.0	0.0	1.3	9.1	13.0
2	1	S	30	27.00	0	5	1.1	1.4	0.0	0.0	2.6	5.5	6.9
2	1	S	30	27.00	80	0	2.0	99.0	0.0	0.0	4.0	100.0	199.0
2	1	S	30	27.00	80	2	9.0	83.5	0.5	0.3	0.0	92.0	175.7
2	1	S	30	27.00	80	5	9.0	87.5	0.0	0.0	8.0	94.0	181.5
2	1	S	30	36.00	0	0	1.0	10.5	0.0	0.0	0.0	2.0	12.5
2	1	S	30	36.00	0	2	0.4	0.2	0.0	0.0	0.9	7.4	7.6
2	1	S	30	36.00	0	5	0.5	0.6	0.0	0.0	1.6	6.1	6.7
2	1	S	30	36.00	80	0	12.0	107.0	0.0	0.0	2.0	95.0	202.0
2	1	S	30	36.00	80	2	2.0	75.0	0.0	1.0	2.0	93.0	169.0
2	1	S	30	36.00	80	5	5.0	76.5	0.0	0.0	2.0	93.0	169.5
2	1	S	30	44.00	0	0	0.0	11.0	0.0	0.0	2.0	3.0	14.0
2	1	S	30	44.00	0	2	0.0	0.4	0.0	0.0	0.0	7.5	7.9
2	1	S	30	44.00	0	5	0.0	0.0	0.0	0.0	0.9	7.6	7.5
2	1	S	30	44.00	80	0	8.0	106.0	0.0	0.0	6.0	92.0	198.0
2	1	S	30	44.00	80	2	10.0	79.0	0.0	0.5	5.0	95.5	175.[illegible]

PL	DP	SOL	TMP	WC	TRT	DAY	NO3 RANGE	NO3 AVER	NO2 RANGE	NO2 AVER	NH4 RANGE	NH4 AVER	TOTALN
2	2	S	4	27.00	0	0	0.0	18.0	0.0	0.0	0.0	4.3	22.3
2	2	S	4	27.00	0	2	0.0	19.0	0.0	0.0	0.8	6.0	25.0
2	2	S	4	27.00	0	5	1.0	20.5	0.0	0.0	0.0	5.6	26.1
2	2	S	4	27.00	80	0	3.0	106.5	0.0	0.0	6.0	97.0	203.5
2	2	S	4	27.00	80	2	5.0	105.5	0.0	0.0	12.0	96.0	201.5
2	2	S	4	27.00	80	5	2.0	103.0	0.0	0.0	6.0	95.0	198.0
2	2	S	4	36.00	0	0	0.0	18.0	0.0	0.0	0.4	4.6	22.6
2	2	S	4	36.00	0	2	0.0	19.0	0.0	0.0	0.4	5.0	24.0
2	2	S	4	36.00	0	5	0.0	20.0	0.0	0.0	0.4	5.9	25.9
2	2	S	4	36.00	80	0	2.0	104.0	0.0	0.0	4.0	98.0	202.0
2	2	S	4	36.00	80	2	2.0	104.0	0.0	0.0	2.0	95.0	199.0
2	2	S	4	36.00	80	5	2.0	110.0	0.0	0.0	12.0	96.0	206.0
2	2	S	4	44.00	0	0	1.0	17.5	0.0	0.0	0.0	4.4	21.9
2	2	S	4	44.00	0	2	1.0	18.5	0.0	0.0	0.0	4.9	23.4
2	2	S	4	44.00	0	5	1.0	19.5	0.0	0.0	1.3	7.3	26.8
2	2	S	4	44.00	80	0	14.0	98.0	0.0	0.0	6.7	96.3	194.3
2	2	S	4	44.00	80	2	2.0	110.0	0.0	0.0	10.0	98.0	208.0
2	2	S	4	44.00	80	5	4.0	108.0	0.0	0.0	6.0	101.0	209.0
2	2	S	15	27.00	0	0	0.0	18.0	0.0	0.0	0.0	4.3	22.3
2	2	S	15	27.00	0	2	1.0	18.5	0.0	0.0	0.4	7.9	26.4
2	2	S	15	27.00	0	5	0.0	21.0	0.0	0.0	0.5	8.8	29.8
2	2	S	15	27.00	80	0	3.0	106.5	0.0	0.0	6.0	97.0	203.5
2	2	S	15	27.00	80	2	2.0	116.0	0.0	0.0	0.0	96.0	212.0
2	2	S	15	27.00	80	5	14.0	112.0	0.5	0.3	7.0	99.5	211.7
2	2	S	15	36.00	0	0	0.0	18.0	0.0	0.0	0.4	4.6	22.6
2	2	S	15	36.00	0	2	0.0	16.0	0.5	0.8	0.4	7.2	23.9
2	2	S	15	36.00	0	5	0.0	13.0	0.0	0.0	0.4	9.4	22.4
2	2	S	15	36.00	80	0	2.0	104.0	0.0	0.0	4.0	98.0	202.0
2	2	S	15	36.00	80	2	2.0	110.0	0.0	1.5	6.0	101.0	212.5
2	2	S	15	36.00	80	5	7.0	111.5	0.5	0.3	14.0	101.0	212.7
2	2	S	15	44.00	0	0	1.0	17.5	0.0	0.0	0.0	4.4	21.9
2	2	S	15	44.00	0	2	0.0	16.0	0.0	0.5	0.4	7.3	23.8
2	2	S	15	44.00	0	5	2.0	11.0	0.0	0.0	0.2	9.9	20.9
2	2	S	15	44.00	80	0	14.0	98.0	0.0	0.0	6.7	96.3	194.3
2	2	S	15	44.00	80	2	1.0	112.5	0.5	1.3	2.0	92.0	205.7
2	2	S	15	44.00	80	5	5.0	95.5	0.0	0.0	0.0	101.0	196.5
2	2	S	30	27.00	0	0	0.0	18.0	0.0	0.0	0.0	4.3	22.3
2	2	S	30	27.00	0	2	3.0	12.5	0.0	0.0	1.0	12.5	25.0
2	2	S	30	27.00	0	5	6.0	23.0	0.0	0.0	3.0	4.5	27.5
2	2	S	30	27.00	80	0	3.0	106.5	0.0	0.0	6.0	97.0	203.5
2	2	S	30	27.00	80	2	9.0	80.5	0.5	0.3	2.0	109.0	189.7
2	2	S	30	27.00	80	5	10.0	97.0	0.0	0.0	6.0	105.0	202.0
2	2	S	30	36.00	0	0	0.0	18.0	0.0	0.0	0.4	4.6	22.6
2	2	S	30	36.00	0	2	0.5	0.6	0.0	0.0	0.0	12.0	12.6
2	2	S	30	36.00	0	5	1.0	0.5	0.0	0.0	1.0	14.5	15.0
2	2	S	30	36.00	80	0	2.0	104.0	0.0	0.0	4.0	98.0	202.0
2	2	S	30	36.00	80	2	2.0	82.0	0.0	1.5	8.0	106.0	189.5
2	2	S	30	36.00	80	5	9.0	69.5	0.0	0.0	2.0	112.0	181.5
2	2	S	30	44.00	0	0	1.0	17.5	0.0	0.0	0.0	4.4	21.9
2	2	S	30	44.00	0	2	0.0	0.4	0.0	0.0	1.0	12.5	12.9
2	2	S	30	44.00	0	5	0.6	0.7	0.0	0.0	1.0	11.5	12.2
2	2	S	30	44.00	80	0	14.0	98.0	0.0	0.0	6.7	96.3	194.3
2	2	S	30	44.00	80	2	5.0	75.5	0.0	1.0	2.0	107.0	183.5
2	2	S	30	44.00	80	5	2.0	74.0	0.0	0.0	11.0	106.5	180.5

PL	DP	SOL	TMP	WC	TRT	DAY	NO3 RANGE	NO3 AVER	NO2 RANGE	NO2 AVER	NH4 RANGE	NH4 AVER	TOTALN
2	1	SB	4	36.00	0	0	2.0	50.1	0.0	0.0	0.4	4.2	54.3
2	1	SB	4	36.00	0	2	1.7	51.8	0.0	0.0	0.1	3.3	55.0
2	1	SB	4	36.00	0	5	1.2	50.7	0.0	0.0	0.0	4.7	55.4
2	1	SB	4	36.00	80	0	7.0	142.5	0.0	0.0	2.2	85.8	228.3
2	1	SB	4	36.00	80	2	14.0	140.0	0.0	0.0	4.5	85.6	225.6
2	1	SB	4	36.00	80	5	8.0	145.0	0.0	0.0	3.0	84.0	229.0
2	1	SB	15	36.00	0	0	2.0	50.1	0.0	0.0	0.4	4.2	54.3
2	1	SB	15	36.00	0	2	0.0	49.9	1.0	1.5	0.2	4.3	55.7
2	1	SB	15	36.00	0	5	4.5	45.9	0.0	0.0	0.4	7.4	52.3
2	1	SB	15	36.00	80	0	7.0	142.5	0.0	0.0	2.2	85.8	228.3
2	1	SB	15	36.00	80	2	5.0	141.5	1.0	2.0	2.2	83.3	226.8
2	1	SB	15	36.00	80	5	1.0	148.5	1.5	0.8	0.9	86.3	235.5
2	1	SB	30	36.00	0	0	2.0	50.1	0.0	0.0	0.4	4.2	54.3
2	1	SB	30	36.00	0	2	2.0	35.3	0.5	0.8	0.1	6.8	42.8
2	1	SB	30	36.00	0	5	9.6	23.9	0.0	0.0	1.7	12.3	36.1
2	1	SB	30	36.00	80	0	7.0	142.5	0.0	0.0	2.2	85.8	228.3
2	1	SB	30	36.00	80	2	3.0	140.5	0.0	2.0	1.4	87.1	229.6
2	1	SB	30	36.00	80	5	3.0	118.5	1.0	1.0	6.4	87.1	206.6
2	2	SB	4	39.00	0	0	0.6	21.7	0.0	0.0	0.2	3.4	25.1
2	2	SB	4	39.00	0	2	0.0	26.0	0.0	0.0	0.2	2.4	28.4
2	2	SB	4	39.00	0	5	1.0	25.8	0.0	0.0	0.1	2.8	28.6
2	2	SB	4	39.00	80	0	11.0	111.5	0.0	0.0	3.7	83.6	195.2
2	2	SB	4	39.00	80	2	4.0	111.0	0.0	0.0	2.4	83.4	194.4
2	2	SB	4	39.00	80	5	7.0	116.5	0.0	0.0	3.0	85.6	202.3
2	2	SB	15	39.00	0	0	0.6	21.7	0.0	0.0	0.2	3.4	25.1
2	2	SB	15	39.00	0	2	0.2	24.5	1.0	0.5	4.1	5.6	30.5
2	2	SB	15	39.00	0	5	1.4	21.2	0.0	0.0	0.3	4.6	26.0
2	2	SB	15	39.00	80	0	11.0	111.5	0.0	0.0	3.7	83.8	195.2
2	2	SB	15	39.00	80	2	7.0	112.5	2.5	2.8	3.4	86.3	201.6
2	2	SB	15	39.00	80	5	3.0	115.5	0.5	0.8	4.0	86.3	202.6
2	2	SB	30	39.00	0	0	0.6	21.7	0.0	0.0	0.2	3.4	25.1
2	2	SB	30	39.00	0	2	1.8	12.7	0.0	0.0	0.2	6.0	18.7
2	2	SB	30	39.00	0	5	2.8	4.6	0.0	0.0	2.0	7.4	12.0
2	2	SB	30	39.00	80	0	11.0	111.5	0.0	0.0	3.7	83.8	195.2
2	2	SB	30	39.00	80	2	4.0	106.0	0.5	1.8	0.3	86.4	192.2
2	2	SB	30	39.00	80	5	0.8	95.1	0.0	0.0	3.0	87.5	182.6
2	3	S	4	37.00	0	0	1.6	19.5	0.0	0.0	0.5	4.1	23.5
2	3	S	4	37.00	0	2	0.7	23.1	0.0	0.0	0.0	2.3	25.4
2	3	S	4	37.00	0	5	1.6	25.2	0.0	0.0	0.3	3.1	28.3
2	3	S	4	37.00	80	0	8.4	96.8	0.0	0.0	0.6	85.3	182.1
2	3	S	4	37.00	80	2	13.0	96.5	0.0	0.0	3.1	85.9	182.4
2	3	S	4	37.00	80	5	0.6	96.4	0.0	0.0	0.4	90.8	187.2
2	3	S	15	37.00	0	0	1.6	19.5	0.0	0.0	0.5	4.1	23.5
2	3	S	15	37.00	0	2	4.5	13.8	0.0	1.5	3.4	5.6	20.9
2	3	S	15	37.00	0	5	3.0	17.5	0.0	0.0	0.9	5.1	22.5
2	3	S	15	37.00	80	0	8.4	96.8	0.0	0.0	0.6	85.3	182.1
2	3	S	15	37.00	80	2	0.7	96.1	2.5	2.3	2.7	91.5	189.9
2	3	S	15	37.00	80	5	1.3	94.0	1.0	1.0	0.7	91.5	187.7
2	3	S	30	37.00	0	0	1.6	19.5	0.0	0.0	0.5	4.1	23.5
2	3	S	30	37.00	0	2	0.1	8.1	0.0	0.0	0.3	7.8	15.9
2	3	S	30	37.00	0	5	2.7	4.5	0.0	0.0	1.2	7.1	11.6
2	3	S	30	37.00	80	0	8.4	96.8	0.0	0.0	0.6	85.3	182.1
2	3	S	30	37.00	80	2	2.3	84.4	0.5	1.8	0.8	95.6	181.8
2	3	S	30	37.00	80	5	9.9	80.9	0.0	0.0	2.7	[illegible]	[illegible]

Table 11 cont.

PL	DP	SOL	TMP	WC	TRT	DAY	NO3 RANGE	NO3 AVER	NO2 RANGE	NO2 AVER	NH4 RANGE	NH4 AVER	TOTALN
2	4	S	4	37.00	0	0	1.2	9.8	0.0	0.0	0.5	4.1	13.9
2	4	S	4	37.00	0	2	0.7	8.9	0.0	0.0	3.3	6.5	15.5
2	4	S	4	37.00	0	5	0.8	12.2	0.0	0.0	0.0	2.1	14.3
2	4	S	4	37.00	80	0	7.6	95.9	0.0	0.0	3.4	87.7	183.6
2	4	S	4	37.00	80	2	6.9	91.6	0.0	0.0	0.8	91.0	182.6
2	4	S	4	37.00	80	5	2.9	93.3	0.0	0.0	1.9	82.6	175.9
2	4	S	15	37.00	0	0	1.2	9.8	0.0	0.0	0.5	4.1	13.9
2	4	S	15	37.00	0	2	2.5	10.4	2.5	1.8	0.9	4.8	17.0
2	4	S	15	37.00	0	5	0.7	11.6	0.0	0.0	0.0	3.7	15.3
2	4	S	15	37.00	80	0	7.6	95.9	0.0	0.0	3.4	87.7	183.6
2	4	S	15	37.00	80	2	3.4	86.4	0.5	0.8	0.0	88.6	175.7
2	4	S	15	37.00	80	5	1.4	93.4	0.5	0.3	0.4	87.7	181.3
2	4	S	30	37.00	0	0	1.2	9.8	0.0	0.0	0.5	4.1	13.9
2	4	S	30	37.00	0	2	1.9	5.3	0.0	0.0	0.1	5.8	11.1
2	4	S	30	37.00	0	5	0.7	6.0	0.0	0.0	0.0	6.0	12.0
2	4	S	30	37.00	80	0	7.6	95.9	0.0	0.0	3.4	87.7	183.6
2	4	S	30	37.00	80	2	15.9	84.3	0.0	3.0	16.9	88.6	175.9
2	4	S	30	37.00	80	5	12.8	80.4	0.0	0.0	0.3	96.5	176.9
2	5	S	4	33.00	0	0	1.5	1.9	0.0	0.0	1.8	5.0	6.9
2	5	S	4	33.00	0	2	0.7	2.6	0.0	0.0	0.3	7.4	10.1
2	5	S	4	33.00	0	5	2.0	5.5	0.0	0.0	0.7	1.3	6.8
2	5	S	4	33.00	80	0	3.3	81.6	0.0	0.0	2.3	88.6	170.3
2	5	S	4	33.00	80	2	5.5	87.4	0.0	0.0	1.2	89.2	176.6
2	5	S	4	33.00	80	5	1.7	86.8	0.0	0.0	5.7	84.9	171.8
2	5	S	15	33.00	0	0	1.5	1.9	0.0	0.0	1.8	5.0	6.9
2	5	S	15	33.00	0	2	0.4	3.0	0.0	0.0	0.0	2.0	5.0
2	5	S	15	33.00	0	5	0.3	4.8	0.0	0.0	0.2	0.9	5.6
2	5	S	15	33.00	80	0	3.3	81.6	0.0	0.0	2.3	88.6	170.3
2	5	S	15	33.00	80	2	4.7	92.3	0.0	0.0	3.5	89.6	181.9
2	5	S	15	33.00	80	5	9.1	93.8	0.0	0.0	3.1	85.1	178.9
2	5	S	30	33.00	0	0	1.5	1.9	0.0	0.0	1.8	5.0	6.9
2	5	S	30	33.00	0	2	0.2	2.6	0.0	0.0	0.2	2.6	5.2
2	5	S	30	33.00	0	5	0.5	4.9	0.0	0.0	0.0	1.3	6.2
2	5	S	30	33.00	80	0	3.3	81.6	0.0	0.0	2.3	88.6	170.3
2	5	S	30	33.00	80	2	8.2	96.9	0.0	0.0	2.7	88.4	185.3
2	5	S	30	33.00	80	5	2.5	91.4	0.0	0.0	1.5	84.1	175.4
2	6	S	4	33.00	0	0	1.7	6.5	0.0	0.0	0.0	0.6	7.1
2	6	S	4	33.00	0	2	0.0	5.2	0.0	0.0	0.0	0.5	5.7
2	6	S	4	33.00	0	5	1.3	3.4	0.0	0.0	0.2	2.3	5.7
2	6	S	4	33.00	80	0	3.0	94.2	0.0	0.0	1.5	85.9	180.1
2	6	S	4	33.00	80	2	5.8	87.6	0.0	0.0	2.8	83.5	171.1
2	6	S	4	33.00	80	5	2.1	91.1	0.0	0.0	2.9	82.6	173.8
2	6	S	15	33.00	0	0	1.7	6.5	0.0	0.0	0.0	0.6	7.1
2	6	S	15	33.00	0	2	0.2	4.8	0.0	0.0	0.0	0.5	5.3
2	6	S	15	33.00	0	5	0.3	2.8	0.0	0.0	0.1	2.1	4.9
2	6	S	15	33.00	80	0	3.0	94.2	0.0	0.0	1.5	85.9	180.1
2	6	S	15	33.00	80	2	2.6	86.5	0.0	0.0	0.0	80.7	167.2
2	6	S	15	33.00	80	5	1.0	90.4	0.0	0.0	3.2	83.4	173.8
2	6	S	30	33.00	0	0	1.7	6.5	0.0	0.0	0.0	0.6	7.1
2	6	S	30	33.00	0	2	0.6	4.8	0.0	0.0	0.1	0.4	5.3
2	6	S	30	33.00	0	5	0.7	2.6	0.0	0.0	0.4	2.1	4.7
2	6	S	30	33.00	80	0	3.0	94.2	0.0	0.0	1.5	85.9	180.1
2	6	S	30	33.00	80	2	5.3	85.9	0.0	0.0	0.6	81.2	167.1
2	6	S	30	33.00	80	5	4.9	84.8	0.0	0.0	3.2	82.0	166.7
2	7	S	4	33.00	0	0	1.4	7.3	0.0	0.0	0.2	0.7	8.0
2	7	S	4	33.00	0	2	0.5	6.3	0.0	0.0	0.1	0.5	6.8
2	7	S	4	33.00	0	5	0.3	6.1	0.0	0.0	0.0	0.5	6.6
2	7	S	4	33.00	80	0	3.1	88.4	0.0	0.0	0.3	81.6	170.1
2	7	S	4	33.00	80	2	3.4	83.0	0.0	0.0	0.8	80.8	163.8
2	7	S	4	33.00	80	5	10.2	77.6	0.0	0.0	3.4	82.4	160.0
2	7	S	15	33.00	0	0	1.4	7.3	0.0	0.0	0.2	0.7	8.0
2	7	S	15	33.00	0	2	0.5	6.8	0.0	0.0	0.0	0.2	6.9
2	7	S	15	33.00	0	5	0.4	6.0	0.0	0.0	0.0	0.2	6.2
2	7	S	15	33.00	80	0	3.1	88.4	0.0	0.0	0.3	81.6	170.1
2	7	S	15	33.00	80	2	4.0	78.1	0.0	0.0	2.3	85.3	163.4
2	7	S	15	33.00	80	5	7.6	98.2	0.0	0.0	0.6	83.0	181.2
2	7	S	30	33.00	0	0	1.4	7.3	0.0	0.0	0.2	0.7	8.0
2	7	S	30	33.00	0	2	0.6	6.6	0.0	0.0	0.1	0.1	6.7
2	7	S	30	33.00	0	5	0.2	6.4	0.0	0.0	0.0	0.4	6.8
2	7	S	30	33.00	80	0	3.1	88.4	0.0	0.0	0.3	81.6	170.1
2	7	S	30	33.00	80	2	5.4	85.3	0.0	0.0	4.6	78.9	164.2
2	7	S	30	33.00	80	5	1.0	92.2	0.0	0.0	3.2	81.7	173.9
6	1	C	4	72.00	0	0	0.1	9.8	0.0	0.0	0.5	3.6	13.4
6	1	C	4	72.00	0	2	1.3	13.8	1.0	1.0	0.3	5.5	20.3
6	1	C	4	72.00	0	5	2.4	12.1	1.0	4.0	0.2	8.7	24.8
6	1	C	4	72.00	80	0	3.4	98.3	0.0	0.0	3.7	70.1	168.4
6	1	C	4	72.00	80	2	7.0	110.5	0.0	0.0	1.8	67.8	178.3
6	1	C	4	72.00	80	5	3.0	106.5	0.0	0.0	4.8	71.8	178.3
6	1	C	15	72.00	0	0	0.1	9.8	0.0	0.0	0.5	3.6	13.4
6	1	C	15	72.00	0	2	2.2	5.3	0.0	0.0	0.7	11.8	17.0
6	1	C	15	72.00	0	5	0.7	4.5	0.0	0.0	0.0	16.2	20.7
6	1	C	15	72.00	80	0	3.4	98.3	0.0	0.0	3.7	70.1	168.4
6	1	C	15	72.00	80	2	0.5	78.1	2.0	17.5	1.5	74.6	170.2
6	1	C	15	72.00	80	5	8.2	54.1	0.5	4.3	1.1	78.1	136.4
6	1	C	30	72.00	0	0	0.1	9.8	0.0	0.0	0.5	3.6	13.4
6	1	C	30	72.00	0	2	0.3	5.9	0.0	0.0	0.1	18.6	24.5
6	1	C	30	72.00	0	5	0.8	5.5	0.0	0.0	0.9	27.6	33.1
6	1	C	30	72.00	80	0	3.4	98.3	0.0	0.0	3.7	70.1	168.4
6	1	C	30	72.00	80	2	0.6	22.5	1.0	0.5	1.4	79.3	102.3
6	1	C	30	72.00	80	5	0.7	7.1	0.0	0.0	0.8	83.3	90.4
6	2	C	4	69.00	0	0	0.4	9.5	0.0	0.0	0.4	4.6	14.1
6	2	C	4	69.00	0	2	0.3	10.3	0.0	0.0	0.3	7.0	17.3
6	2	C	4	69.00	0	5	0.2	8.3	0.5	1.8	0.6	8.2	18.2
6	2	C	4	69.00	80	0	6.9	94.1	0.0	0.0	0.7	71.3	165.5
6	2	C	4	69.00	80	2	0.3	94.1	0.0	0.0	3.5	71.4	165.5
6	2	C	4	69.00	80	5	6.4	91.7	0.5	2.3	1.7	70.4	164.4
6	2	C	15	69.00	0	0	0.4	9.5	0.0	0.0	0.4	4.6	14.1
6	2	C	15	69.00	0	2	0.1	1.4	0.0	0.0	0.4	11.7	13.1
6	2	C	15	69.00	0	5	1.1	1.1	0.0	0.0	0.6	14.2	15.3
6	2	C	15	69.00	80	0	6.9	94.1	0.0	0.0	0.7	71.3	165.5
6	2	C	15	69.00	80	2	0.6	76.9	3.0	13.5	0.3	74.9	165.3
6	2	C	15	69.00	80	5	0.4	45.4	0.0	0.0	1.3	78.3	123.6
6	2	C	30	69.00	0	0	0.4	9.5	0.0	0.0	0.4	4.6	14.1
6	2	C	30	69.00	0	2	0.3	1.3	0.0	0.0	1.7	16.1	17.5
6	2	C	30	69.00	0	5	0.5	1.9	0.0	0.0	2.8	22.5	24.4
6	2	C	30	69.00	80	0	6.9	94.1	0.0	0.0	0.7	71.3	165.5
6	2	C	30	69.00	80	2	10.5	22.4	0.0	0.0	2.0	82.4	104.8
6	2	C	30	69.00	80	5	5.1	8.6	0.0	0.0	1.4	80.7	89.3

PL	DP	SOL	TMP	WC	TRT	DAY	NO3 RANGE	NO3 AVER	NO2 RANGE	NO2 AVER	NH4 RANGE	NH4 AVER	TOTALN
3	1	S	4	26.00	0	0	1.0	19.5	0.0	0.0	0.0	1.0	20.5
3	1	S	4	26.00	0	2	2.0	21.0	0.0	0.0	1.0	1.5	22.5
3	1	S	4	26.00	0	5	1.0	15.5	0.0	0.0	0.0	2.0	17.5
3	1	S	4	26.00	80	0	2.9	98.1	0.0	0.0	2.0	88.0	186.1
3	1	S	4	26.00	80	2	3.0	103.5	0.0	0.0	0.0	89.0	192.5
3	1	S	4	26.00	80	5	4.0	105.0	0.0	0.0	0.0	87.0	192.0
3	1	S	4	35.00	0	0	1.0	19.5	0.0	0.0	0.0	1.0	20.5
3	1	S	4	35.00	0	2	1.0	19.5	0.0	0.0	0.0	2.0	21.5
3	1	S	4	35.00	0	5	1.0	19.5	0.0	0.0	0.0	2.0	21.5
3	1	S	4	35.00	80	0	1.0	105.5	0.0	0.0	4.0	89.0	194.5
3	1	S	4	35.00	80	2	12.0	109.0	0.0	0.0	9.0	91.5	200.5
3	1	S	4	35.00	80	5	5.0	103.5	0.0	0.0	0.0	85.0	188.5
3	1	S	4	42.00	0	0	2.0	16.0	0.0	0.0	0.0	2.0	18.0
3	1	S	4	42.00	0	2	2.0	18.0	0.0	0.0	0.0	2.0	20.0
3	1	S	4	42.00	0	5	1.0	17.5	0.0	0.0	0.0	1.0	18.5
3	1	S	4	42.00	80	0	15.0	93.5	0.0	0.0	14.0	84.0	177.5
3	1	S	4	42.00	80	2	9.0	92.5	0.0	0.0	3.0	80.5	173.0
3	1	S	4	42.00	80	5	5.0	105.5	0.0	0.0	0.0	79.0	184.5
3	1	S	15	26.00	0	0	1.0	19.5	0.0	0.0	0.0	1.0	20.5
3	1	S	15	26.00	0	2	2.0	19.0	0.0	0.0	0.0	3.0	22.0
3	1	S	15	26.00	0	5	1.0	20.5	0.0	0.0	2.0	2.0	22.5
3	1	S	15	26.00	80	0	2.9	98.1	0.0	0.0	2.0	88.0	186.1
3	1	S	15	26.00	80	2	8.0	105.0	0.5	0.3	2.0	84.0	189.2
3	1	S	15	26.00	80	5	9.0	104.5	0.5	0.3	2.0	80.0	184.7
3	1	S	15	35.00	0	0	1.0	19.5	0.0	0.0	0.0	1.0	20.5
3	1	S	15	35.00	0	2	1.0	16.5	0.0	0.0	1.0	2.5	19.0
3	1	S	15	35.00	0	5	0.0	17.0	0.0	0.0	1.6	1.2	18.2
3	1	S	15	35.00	80	0	1.0	105.5	0.0	0.0	4.0	89.0	194.5
3	1	S	15	35.00	80	2	13.0	95.5	1.0	0.5	9.0	82.5	178.5
3	1	S	15	35.00	80	5	8.0	102.0	3.5	1.8	9.0	82.5	186.2
3	1	S	15	42.00	0	0	2.0	16.0	0.0	0.0	0.0	2.0	18.0
3	1	S	15	42.00	0	2	1.0	16.5	0.0	0.0	1.0	2.5	19.0
3	1	S	15	42.00	0	5	0.0	17.0	0.0	0.0	0.5	0.8	17.8
3	1	S	15	42.00	80	0	15.0	93.5	0.0	0.0	14.0	84.0	177.5
3	1	S	15	42.00	80	2	10.7	91.3	0.0	0.0	2.0	78.0	169.3
3	1	S	15	42.00	80	5	2.8	96.4	2.5	1.8	5.0	79.5	177.6
3	1	S	30	26.00	0	0	1.0	19.5	0.0	0.0	0.0	1.0	20.5
3	1	S	30	26.00	0	2	5.0	13.5	0.0	0.0	1.0	3.5	17.0
3	1	S	30	26.00	0	5	8.0	22.0	0.0	0.0	0.4	0.2	22.2
3	1	S	30	26.00	80	0	2.9	98.1	0.0	0.0	2.0	88.0	186.1
3	1	S	30	26.00	80	2	11.0	92.5	2.0	2.0	4.0	83.0	177.5
3	1	S	30	26.00	80	5	0.0	101.0	0.0	0.0	3.0	73.5	174.5
3	1	S	30	35.00	0	0	1.0	19.5	0.0	0.0	0.0	1.0	20.5
3	1	S	30	35.00	0	2	5.5	9.3	0.0	0.0	2.8	3.4	12.6
3	1	S	30	35.00	0	5	3.4	11.3	0.0	0.0	0.4	0.2	11.5
3	1	S	30	35.00	80	0	1.0	105.5	0.0	0.0	4.0	89.0	194.5
3	1	S	30	35.00	80	2	11.0	96.5	1.5	0.8	0.0	85.0	182.2
3	1	S	30	35.00	80	5	12.0	95.0	0.5	0.3	4.0	85.0	180.2
3	1	S	30	42.00	0	0	2.0	16.0	0.0	0.0	0.0	2.0	18.0
3	1	S	30	42.00	0	2	0.0	7.5	0.0	0.0	0.0	4.0	11.5
3	1	S	30	42.00	0	5	0.4	9.5	0.0	0.0	1.0	3.5	13.0
3	1	S	30	42.00	80	0	15.0	93.5	0.0	0.0	14.0	84.0	177.5
3	1	S	30	42.00	80	2	4.0	93.0	1.0	1.0	0.0	84.0	178.0
3	1	S	30	42.00	80	5	6.0	100.0	2.0	5.5	11.0	71.5	177.0
3	2	S	4	27.00	0	0	0.1	13.8	0.0	0.0	0.6	2.1	15.9
3	2	S	4	27.00	0	2	0.5	15.0	0.0	0.0	0.3	2.4	17.5
3	2	S	4	27.00	0	5	0.7	16.1	0.0	0.0	0.2	2.2	18.3
3	2	S	4	27.00	80	0	10.0	107.0	0.0	0.0	3.4	85.0	192.0
3	2	S	4	27.00	80	2	7.9	103.1	0.0	0.0	0.4	85.2	188.2
3	2	S	4	27.00	80	5	10.3	97.8	0.5	0.3	2.1	83.1	181.1
3	2	S	4	36.00	0	0	0.0	14.4	0.0	0.0	0.1	2.1	16.4
3	2	S	4	36.00	0	2	0.0	15.0	0.0	0.0	0.5	2.3	17.3
3	2	S	4	36.00	0	5	0.4	15.9	0.0	0.0	0.3	2.1	18.0
3	2	S	4	36.00	80	0	14.9	105.6	0.0	0.0	1.4	84.8	190.4
3	2	S	4	36.00	80	2	15.8	102.1	5.5	2.8	1.4	84.8	189.6
3	2	S	4	36.00	80	5	6.1	98.9	0.0	0.5	0.0	81.5	180.9
3	2	S	4	43.00	0	0	0.2	14.2	0.0	0.0	0.0	2.0	16.2
3	2	S	4	43.00	0	2	0.4	15.5	0.0	0.0	0.3	2.3	17.8
3	2	S	4	43.00	0	5	0.1	16.1	0.0	0.0	0.1	1.9	18.0
3	2	S	4	43.00	80	0	12.0	104.0	0.0	0.0	1.8	86.0	190.0
3	2	S	4	43.00	80	2	10.0	99.0	0.0	0.0	4.5	86.4	185.4
3	2	S	4	43.00	80	5	8.8	100.6	0.5	0.8	3.6	81.6	182.9
3	2	S	15	27.00	0	0	0.1	13.8	0.0	0.0	0.6	2.1	15.9
3	2	S	15	27.00	0	2	1.4	16.3	0.0	0.0	0.5	3.6	19.8
3	2	S	15	27.00	0	5	1.9	14.0	0.0	0.0	1.2	1.8	15.8
3	2	S	15	27.00	80	0	10.0	107.0	0.0	0.0	3.4	85.0	192.0
3	2	S	15	27.00	80	2	4.0	106.0	0.5	0.8	3.9	82.6	189.4
3	2	S	15	27.00	80	5	14.6	101.7	1.0	0.5	6.8	79.0	181.2
3	2	S	15	36.00	0	0	0.0	14.4	0.0	0.0	0.1	2.1	16.4
3	2	S	15	36.00	0	2	0.2	11.6	0.0	0.0	0.4	4.3	15.9
3	2	S	15	36.00	0	5	2.0	11.9	0.0	0.0	0.7	3.0	14.9
3	2	S	15	36.00	80	0	14.9	105.6	0.0	0.0	1.4	84.8	190.4
3	2	S	15	36.00	80	2	16.0	108.0	0.5	0.3	0.9	84.6	192.8
3	2	S	15	36.00	80	5	9.6	101.2	0.2	2.6	2.6	77.6	181.4
3	2	S	15	43.00	0	0	0.2	14.2	0.0	0.0	0.0	2.0	16.2
3	2	S	15	43.00	0	2	0.5	11.3	0.0	0.0	0.1	4.1	15.4
3	2	S	15	43.00	0	5	0.5	11.4	0.0	0.0	0.8	3.0	14.4
3	2	S	15	43.00	80	0	12.0	104.0	0.0	0.0	1.8	86.0	190.0
3	2	S	15	43.00	80	2	9.5	102.3	0.5	0.3	1.3	82.6	185.1
3	2	S	15	43.00	80	5	7.8	100.1	0.5	0.3	0.0	80.7	181.0
3	2	S	30	27.00	0	0	0.1	13.8	0.0	0.0	0.6	2.1	15.9
3	2	S	30	27.00	0	2	0.0	7.2	0.0	0.0	1.3	5.5	12.7
3	2	S	30	27.00	0	5	4.3	10.9	0.0	0.0	0.0	2.4	13.3
3	2	S	30	27.00	80	0	10.0	107.0	0.0	0.0	3.4	85.0	192.0
3	2	S	30	27.00	80	2	9.0	101.5	1.0	1.0	3.9	89.1	191.6
3	2	S	30	27.00	80	5	2.0	111.0	0.0	0.0	3.1	75.4	186.4
3	2	S	30	36.00	0	0	0.0	14.4	0.0	0.0	0.1	2.1	16.4
3	2	S	30	36.00	0	2	0.4	2.3	0.0	0.0	0.2	6.7	9.0
3	2	S	30	36.00	0	5	1.6	4.4	0.0	0.0	1.6	3.6	8.0
3	2	S	30	36.00	80	0	14.9	105.6	0.0	0.0	1.4	84.8	190.4
3	2	S	30	36.00	80	2	4.2	101.9	2.0	1.5	0.8	87.2	190.6
3	2	S	30	36.00	80	5	27.1	109.4	11.5	6.3	0.5	58.6	174.3
3	2	S	30	43.00	0	0	0.2	14.2	0.0	0.0	0.0	2.0	16.2
3	2	S	30	43.00	0	2	1.6	1.9	0.0	0.0	1.5	6.6	8.5
3	2	S	30	43.00	0	5	2.0	3.8	0.0	0.0	1.5	2.1	5.9
3	2	S	30	43.00	80	0	12.0	104.0	0.0	0.0	1.8	86.0	190.0
3	2	S	30	43.00	80	2	3.1	96.4	0.5	2.3	0.4	81.8	180.5
3	2	S	30	43.00	80	5	0.0	114.0	13.5	6.8	15.1	63.8	184.6

Table 11 cont.

PL	DP	SOL	TMP	WC	TRT	DAY	NO3 RANGE	NO3 AVER	NO2 RANGE	NO2 AVER	NH4 RANGE	NH4 AVER	TOTALN
4	1	C	4	55.00	0	0	0.5	19.1	0.0	0.0	0.5	5.1	24.1
4	1	C	4	55.00	0	2	6.8	18.3	0.0	3.0	0.5	9.4	30.7
4	1	C	4	55.00	0	5	20.2	22.5	2.5	1.3	6.9	6.8	30.6
4	1	C	4	55.00	80	0	14.0	114.0	0.0	0.0	0.5	81.3	195.[illegible]
4	1	C	4	55.00	80	2	1.0	121.5	0.5	0.8	6.3	86.9	209.2
4	1	C	4	55.00	80	5	36.8	107.6	5.0	2.5	11.4	84.9	195.0
4	1	C	4	74.00	0	0	0.3	19.3	0.0	0.0	0.0	5.6	24.9
4	1	C	4	74.00	0	2	0.7	15.3	0.0	4.5	0.5	9.3	29.2
4	1	C	4	74.00	0	5	0.8	12.0	0.0	1.0	0.0	9.9	22.9
4	1	C	4	74.00	80	0	12.0	111.0	0.0	0.0	3.4	86.9	197.9
4	1	C	4	74.00	80	2	17.3	104.3	0.0	5.0	1.0	86.2	195.5
4	1	C	4	74.00	80	5	16.1	98.9	1.0	4.0	1.0	90.0	192.9
4	1	C	4	88.00	0	0	1.9	19.6	0.0	0.0	0.0	5.7	25.3
4	1	C	4	88.00	0	2	0.6	15.9	0.5	4.3	1.1	9.8	29.9
4	1	C	4	88.00	0	5	1.1	4.6	0.5	1.3	1.1	12.1	18.0
4	1	C	4	88.00	80	0	12.0	115.0	0.0	0.0	0.0	85.4	200.4
4	1	C	4	88.00	80	2	3.0	107.5	0.5	4.6	0.5	89.6	201.6
4	1	C	4	88.00	80	5	9.8	98.1	1.9	4.1	4.3	89.0	191.2
4	1	C	15	55.00	0	0	0.5	19.1	0.0	0.0	0.5	5.1	24.1
4	1	C	15	55.00	0	2	23.4	14.0	0.0	0.0	5.3	11.5	25.5
4	1	C	15	55.00	0	5	1.0	27.7	0.0	0.0	0.0	0.9	28.6
4	1	C	15	55.00	80	0	14.0	114.0	0.0	0.0	0.5	81.3	195.2
4	1	C	15	55.00	80	2	38.0	100.0	0.0	0.0	12.3	84.8	184.8
4	1	C	15	55.00	80	5	19.5	91.3	0.0	0.0	4.5	79.6	170.9
4	1	C	15	74.00	0	0	0.3	19.3	0.0	0.0	0.0	5.6	24.9
4	1	C	15	74.00	0	2	0.0	2.9	0.0	0.0	0.5	15.3	18.2
4	1	C	15	74.00	0	5	0.8	2.4	0.0	0.0	0.5	13.9	16.3
4	1	C	15	74.00	80	0	12.0	111.0	0.0	0.0	3.4	86.9	197.9
4	1	C	15	74.00	80	2	6.6	70.1	0.0	0.0	1.9	95.1	165.2
4	1	C	15	74.00	80	5	9.0	49.5	0.0	0.0	4.3	91.6	141.1
4	1	C	15	88.00	0	0	1.9	19.6	0.0	0.0	0.0	5.7	25.3
4	1	C	15	88.00	0	2	0.1	2.3	0.0	0.0	1.0	15.7	18.0
4	1	C	15	88.00	0	5	1.0	1.3	0.0	0.0	0.5	14.3	15.6
4	1	C	15	88.00	80	0	12.0	115.0	0.0	0.0	0.0	85.4	200.4
4	1	C	15	88.00	80	2	10.3	74.4	0.0	0.0	3.5	95.4	169.9
4	1	C	15	88.00	80	5	3.9	62.4	0.0	0.0	3.9	68.3	150.8
4	1	C	30	55.00	0	0	0.5	19.1	0.0	0.0	0.5	5.1	24.1
4	1	C	30	55.00	0	2	1.4	3.3	0.0	0.0	4.0	19.6	22.9
4	1	C	30	55.00	0	5	0.7	1.8	0.0	0.0	2.1	3.6	5.4
4	1	C	30	55.00	80	0	14.0	114.0	0.0	0.0	0.5	81.3	195.2
4	1	C	30	55.00	80	2	45.9	28.4	0.0	0.0	9.1	97.4	125.9
4	1	C	30	55.00	80	5	12.0	39.0	0.0	0.0	17.7	76.3	115.2
4	1	C	30	74.00	0	0	0.3	19.3	0.0	0.0	0.0	5.6	24.9
4	1	C	30	74.00	0	2	0.0	0.0	0.0	0.0	0.6	22.5	22.5
4	1	C	30	74.00	0	5	1.8	0.9	0.0	0.0	6.6	29.5	30.4
4	1	C	30	74.00	80	0	12.0	111.0	0.0	0.0	3.4	86.9	197.9
4	1	C	30	74.00	80	2	6.5	12.8	0.0	0.0	21.8	87.1	99.8
4	1	C	30	74.00	80	5	4.2	7.8	0.0	0.0	11.5	95.3	103.0
4	1	C	30	88.00	0	0	1.9	19.6	0.0	0.0	0.0	5.7	25.3
4	1	C	30	88.00	0	2	1.5	1.6	0.0	0.0	0.0	26.6	28.3
4	1	C	30	88.00	0	5	1.4	1.9	0.0	0.0	5.5	29.9	31.8
4	1	C	30	88.00	80	0	12.0	115.0	0.0	0.0	0.0	85.4	200.4
4	1	C	30	88.00	80	2	0.0	16.0	0.0	0.0	0.0	100.0	116.0
4	1	C	30	88.00	80	5	5.4	5.1	0.0	0.0	8.3	92.5	97.6

PL	DP	SOL	TMP	WC	TRT	DAY	NO3 RANGE	NO3 AVER	NO2 RANGE	NO2 AVER	NH4 RANGE	NH4 AVER	TOTALN
4	2	C	4	54.00	0	0	0.5	5.3	0.0	0.0	1.0	3.5	8.8
4	2	C	4	54.00	0	2	0.4	7.5	0.0	0.0	0.5	7.9	15.4
4	2	C	4	54.00	0	5	2.0	14.0	0.0	0.0	0.5	7.9	21.9
4	2	C	4	54.00	80	0	2.3	85.1	0.0	0.0	2.2	82.9	168.0
4	2	C	4	54.00	80	2	22.7	79.4	0.0	0.0	15.8	78.3	157.7
4	2	C	4	54.00	80	5	22.5	90.8	1.5	1.3	0.0	79.5	171.5
4	2	C	4	72.00	0	0	0.5	4.9	0.0	0.0	0.0	4.0	8.9
4	2	C	4	72.00	0	2	1.0	3.5	0.0	2.5	0.9	8.0	14.0
4	2	C	4	72.00	0	5	0.0	2.0	0.5	0.3	0.0	11.0	13.3
4	2	C	4	72.00	80	0	7.1	81.4	0.0	0.0	2.4	86.2	167.6
4	2	C	4	72.00	80	2	16.5	81.4	0.5	3.8	2.4	79.1	164.3
4	2	C	4	72.00	80	5	9.4	77.9	0.5	5.3	2.4	83.8	166.9
4	2	C	4	87.00	0	0	0.5	5.1	0.0	0.0	0.0	4.0	9.1
4	2	C	4	87.00	0	2	3.0	1.5	0.0	2.5	0.5	8.5	12.5
4	2	C	4	87.00	0	5	10.0	6.0	0.0	0.0	7.0	7.5	13.5
4	2	C	4	87.00	80	0	7.3	86.3	0.0	0.0	2.4	81.5	167.8
4	2	C	4	87.00	80	2	0.0	85.2	0.5	3.8	4.9	77.8	166.8
4	2	C	4	87.00	80	5	5.7	79.8	2.0	7.0	2.4	81.5	168.3
4	2	C	15	54.00	0	0	0.5	5.3	0.0	0.0	1.0	3.5	8.8
4	2	C	15	54.00	0	2	1.0	1.5	0.0	0.0	2.0	16.0	17.5
4	2	C	15	54.00	0	5	16.0	12.0	0.0	0.0	6.1	8.9	20.9
4	2	C	15	54.00	80	0	2.3	85.1	0.0	0.0	2.2	82.9	168.0
4	2	C	15	54.00	80	2	13.7	74.9	0.5	1.3	2.3	87.4	163.6
4	2	C	15	54.00	80	5	13.9	100.1	0.0	0.0	6.8	71.5	171.6
4	2	C	15	72.00	0	0	0.5	4.9	0.0	0.0	0.0	4.0	8.9
4	2	C	15	72.00	0	2	1.8	1.9	0.0	0.0	0.0	15.0	16.9
4	2	C	15	72.00	0	5	2.1	1.9	0.0	0.0	8.0	16.0	17.9
4	2	C	15	72.00	80	0	7.1	81.4	0.0	0.0	2.4	86.2	167.6
4	2	C	15	72.00	80	2	2.0	41.0	2.0	3.0	2.3	88.5	132.5
4	2	C	15	72.00	80	5	4.6	11.7	0.0	0.0	4.8	96.8	108.5
4	2	C	15	87.00	0	0	0.5	5.1	0.0	0.0	0.0	4.0	9.1
4	2	C	15	87.00	0	2	0.0	3.0	0.0	0.0	0.0	14.0	17.0
4	2	C	15	87.00	0	5	1.0	2.5	0.0	0.0	1.0	16.5	19.0
4	2	C	15	87.00	80	0	7.3	86.3	0.0	0.0	2.4	81.5	167.8
4	2	C	15	87.00	80	2	0.0	14.0	0.0	3.5	0.0	114.0	131.5
4	2	C	15	87.00	80	5	3.0	22.5	0.0	0.0	2.5	88.8	111.3
4	2	C	30	54.00	0	0	0.5	5.3	0.0	0.0	1.0	3.5	8.8
4	2	C	30	54.00	0	2	0.0	5.0	0.0	0.0	4.0	31.0	36.0
4	2	C	30	54.00	0	5	1.0	3.5	0.0	0.0	10.0	15.0	18.5
4	2	C	30	54.00	80	0	2.3	85.1	0.0	0.0	2.2	82.9	168.0
4	2	C	30	54.00	80	2	36.1	32.1	0.5	0.3	0.0	93.1	125.4
4	2	C	30	54.00	80	5	4.1	7.1	0.0	0.0	13.6	84.0	91.0
4	2	C	30	72.00	0	0	0.5	4.9	0.0	0.0	0.0	4.0	8.9
4	2	C	30	72.00	0	2	0.9	0.4	0.0	0.0	0.0	31.0	31.4
4	2	C	30	72.00	0	5	0.9	0.4	0.0	0.0	9.0	39.5	39.9
4	2	C	30	72.00	80	0	7.1	81.4	0.0	0.0	2.4	86.2	167.6
4	2	C	30	72.00	80	2	5.1	4.6	0.0	0.0	2.4	98.0	102.5
4	2	C	30	72.00	80	5	7.1	3.6	0.0	0.0	0.0	87.4	90.9
4	2	C	30	87.00	0	0	0.5	5.1	0.0	0.0	0.0	4.0	9.1
4	2	C	30	87.00	0	2	0.5	0.8	0.0	0.0	2.0	31.0	31.8
4	2	C	30	87.00	0	5	0.0	0.0	0.0	0.0	1.0	32.5	32.5
4	2	C	30	87.00	80	0	7.3	86.3	0.0	0.0	2.4	81.5	167.8
4	2	C	30	87.00	80	2	3.0	3.5	0.0	0.0	5.2	102.4	105.9
4	2	C	30	87.00	80	5	5.0	2.5	0.0	0.5	7.4	88.8	91.8

PL	DP	SOL	TMP	WC	TRT	DAY	NO3 RANGE	NO3 AVER	NO2 RANGE	NO2 AVER	NH4 RANGE	NH4 AVER	TOTALN
5	1	C	4	50.00	0	0	2.0	22.0	0.0	0.0	0.9	4.4	26.4
5	1	C	4	50.00	0	2	6.0	24.0	0.0	0.5	0.4	4.7	29.2
5	1	C	4	50.00	0	5	3.0	28.5	0.0	0.0	0.4	4.7	33.2
5	1	C	4	50.00	80	0	2.0	111.0	0.0	0.0	4.5	80.9	191.9
5	1	C	4	50.00	80	2	2.0	118.0	0.0	1.0	0.0	78.7	197.7
5	1	C	4	50.00	80	5	11.0	120.5	1.0	1.5	2.3	77.5	199.5
5	1	C	4	66.00	0	0	0.0	23.0	0.0	0.0	0.0	4.0	27.0
5	1	C	4	66.00	0	2	2.0	24.0	0.5	1.8	0.5	5.4	31.1
5	1	C	4	66.00	0	5	0.0	21.0	0.5	0.8	0.5	6.8	28.5
5	1	C	4	66.00	80	0	7.0	115.5	0.0	0.0	2.4	80.4	195.9
5	1	C	4	66.00	80	2	11.0	115.5	1.0	2.0	2.3	75.8	193.2
5	1	C	4	66.00	80	5	11.0	117.5	0.0	1.5	0.0	72.2	191.2
5	1	C	4	79.00	0	0	1.0	22.5	0.0	0.0	0.0	4.0	26.5
5	1	C	4	79.00	0	2	0.0	23.0	0.5	1.8	0.0	5.3	30.0
5	1	C	4	79.00	0	5	1.0	20.5	0.0	0.5	0.5	7.4	28.4
5	1	C	4	79.00	80	0	5.0	122.5	0.0	0.0	2.4	77.9	200.4
5	1	C	4	79.00	80	2	7.0	116.5	0.5	2.3	0.0	71.9	190.6
5	1	C	4	79.00	80	5	22.0	116.0	1.0	2.0	2.4	68.3	186.3
5	1	C	15	50.00	0	0	2.0	22.0	0.0	0.0	0.9	4.4	26.4
5	1	C	15	50.00	0	2	5.0	15.5	0.0	0.0	2.3	7.8	23.3
5	1	C	15	50.00	0	5	1.1	1.4	0.0	0.0	0.9	8.0	9.5
5	1	C	15	50.00	80	0	2.0	111.0	0.0	0.0	4.5	80.9	191.9
5	1	C	15	50.00	80	2	6.6	97.7	1.5	1.3	26.9	67.4	166.4
5	1	C	15	50.00	80	5	4.0	117.0	0.0	0.0	2.3	73.0	190.0
5	1	C	15	66.00	0	0	0.0	23.0	0.0	0.0	0.0	4.0	27.0
5	1	C	15	66.00	0	2	4.7	11.6	0.0	0.0	1.0	8.4	20.0
5	1	C	15	66.00	0	5	1.1	1.4	0.0	0.0	0.9	9.3	10.8
5	1	C	15	66.00	80	0	7.0	115.5	0.0	0.0	2.4	80.4	195.9
5	1	C	15	66.00	80	2	11.8	99.1	0.0	0.5	2.4	80.4	180.0
5	1	C	15	66.00	80	5	5.1	100.4	0.0	0.0	2.3	71.0	171.5
5	1	C	15	79.00	0	0	1.0	22.5	0.0	0.0	0.0	4.0	26.5
5	1	C	15	79.00	0	2	1.9	5.8	0.0	0.0	1.0	10.5	16.3
5	1	C	15	79.00	0	5	0.0	0.5	0.0	0.0	1.0	10.5	11.0
5	1	C	15	79.00	80	0	5.0	122.5	0.0	0.0	2.4	77.9	200.4
5	1	C	15	79.00	80	2	0.0	101.0	0.0	0.0	2.4	77.9	178.9
5	1	C	15	79.00	80	5	0.0	93.4	0.0	0.0	4.8	71.9	165.3
5	1	C	30	50.00	0	0	2.0	22.0	0.0	0.0	0.9	4.4	26.4
5	1	C	30	50.00	0	2	4.0	2.0	0.0	0.0	3.1	11.4	13.4
5	1	C	30	50.00	0	5	0.0	0.0	0.0	0.0	2.0	13.0	13.0
5	1	C	30	50.00	80	0	2.0	111.0	0.0	0.0	4.5	80.9	191.9
5	1	C	30	50.00	80	2	2.3	86.5	0.0	0.0	6.8	79.8	166.3
5	1	C	30	50.00	80	5	54.1	107.9	0.0	0.0	26.9	58.4	166.4
5	1	C	30	66.00	0	0	0.0	23.0	0.0	0.0	0.0	4.0	27.0
5	1	C	30	66.00	0	2	0.0	0.0	0.0	0.0	1.0	13.5	13.5
5	1	C	30	66.00	0	5	0.0	0.0	0.0	0.0	7.0	14.5	14.5
5	1	C	30	66.00	80	0	7.0	115.5	0.0	0.0	2.4	80.4	195.9
5	1	C	30	66.00	80	2	23.3	62.9	0.5	0.3	11.7	78.0	141.2
5	1	C	30	66.00	80	5	13.9	58.3	1.5	0.8	23.3	65.3	124.2
5	1	C	30	79.00	0	0	1.0	22.5	0.0	0.0	0.0	4.0	26.5
5	1	C	30	79.00	0	2	0.0	0.0	0.0	0.0	1.0	12.5	12.5
5	1	C	30	79.00	0	5	0.0	0.0	0.0	0.0	5.0	13.5	13.5
5	1	C	30	79.00	80	0	5.0	122.5	0.0	0.0	2.4	77.9	200.4
5	1	C	30	79.00	80	2	4.8	69.5	0.0	0.5	0.0	61.5	151.5
5	1	C	30	79.00	80	5	12.0	68.3	0.5	0.3	21.6	63.5	132.1

PL	DP	SOL	TMP	WC	TRT	DAY	NO3 RANGE	NO3 AVER	NO2 RANGE	NO2 AVER	NH4 RANGE	NH4 AVER	TOTALN
5	2	C	4	50.00	0	0	9.0	4.5	0.0	0.0	5.1	5.6	10.1
5	2	C	4	50.00	0	2	2.0	12.0	1.5	0.8	0.0	4.5	17.3
5	2	C	4	50.00	0	5	4.0	15.0	0.5	0.3	1.8	5.9	21.1
5	2	C	4	50.00	80	0	9.0	92.3	0.0	0.0	2.2	75.4	167.7
5	2	C	4	50.00	80	2	4.5	92.3	0.5	1.8	2.3	75.3	169.3
5	2	C	4	50.00	80	5	16.0	98.0	1.5	1.3	0.0	76.5	175.7
5	2	C	4	67.00	0	0	0.7	9.6	0.0	0.0	1.0	2.5	12.1
5	2	C	4	67.00	0	2	1.0	13.5	0.5	3.3	0.0	4.0	20.8
5	2	C	4	67.00	0	5	0.9	19.6	1.5	2.3	0.4	4.9	26.7
5	2	C	4	67.00	80	0	51.0	109.5	0.0	0.0	2.3	78.1	187.6
5	2	C	4	67.00	80	2	9.0	95.5	0.0	3.0	0.0	79.3	177.8
5	2	C	4	67.00	80	5	2.0	99.0	0.0	3.0	2.3	78.1	180.1
5	2	C	4	80.00	0	0	0.0	10.0	0.0	0.0	0.0	3.0	13.0
5	2	C	4	80.00	0	2	6.0	20.0	0.0	4.0	0.0	4.0	28.0
5	2	C	4	80.00	0	5	2.0	24.0	0.5	1.8	1.0	3.5	29.3
5	2	C	4	80.00	80	0	0.0	98.4	0.0	0.0	2.4	73.2	171.6
5	2	C	4	80.00	80	2	0.0	91.2	1.0	3.5	4.8	81.6	176.3
5	2	C	4	80.00	80	5	0.0	96.0	0.5	3.3	0.0	76.8	176.1
5	2	C	15	50.00	0	0	9.0	4.5	0.0	0.0	5.1	5.6	10.1
5	2	C	15	50.00	0	2	16.0	20.0	1.5	0.8	4.7	5.3	26.1
5	2	C	15	50.00	0	5	13.0	7.5	0.0	0.0	1.6	6.2	13.7
5	2	C	15	50.00	80	0	9.0	92.3	0.0	0.0	2.2	75.4	167.7
5	2	C	15	50.00	80	2	13.5	101.3	1.0	2.5	0.0	76.5	180.2
5	2	C	15	50.00	80	5	17.7	101.1	0.0	0.5	22.0	52.0	153.6
5	2	C	15	67.00	0	0	0.7	9.6	0.0	0.0	1.0	2.5	12.1
5	2	C	15	67.00	0	2	2.0	30.0	0.0	0.0	0.0	3.0	33.0
5	2	C	15	67.00	0	5	4.0	26.0	0.0	0.0	1.0	2.5	28.5
5	2	C	15	67.00	80	0	51.0	109.5	0.0	0.0	2.3	78.1	187.6
5	2	C	15	67.00	80	2	26.0	50.0	0.5	3.8	39.3	94.3	148.1
5	2	C	15	67.00	80	5	0.0	65.3	0.0	0.0	4.6	77.0	142.3
5	2	C	15	80.00	0	0	0.0	10.0	0.0	0.0	0.0	3.0	13.0
5	2	C	15	80.00	0	2	3.0	29.5	0.0	0.0	0.0	3.0	32.5
5	2	C	15	80.00	0	5	0.0	26.0	0.0	0.0	0.0	3.0	29.0
5	2	C	15	80.00	80	0	0.0	98.4	0.0	0.0	2.4	73.2	171.6
5	2	C	15	80.00	80	2	4.8	72.0	3.5	1.8	2.4	78.0	151.7
5	2	C	15	80.00	80	5	4.8	69.6	0.0	0.0	4.8	74.4	144.0
5	2	C	30	50.00	0	0	9.0	4.5	0.0	0.0	5.1	5.6	10.1
5	2	C	30	50.00	0	2	3.3	9.3	0.0	0.0	1.3	9.3	18.6
5	2	C	30	50.00	0	5	0.9	0.4	0.0	0.0	9.0	14.5	14.9
5	2	C	30	50.00	80	0	9.0	92.3	0.0	0.0	2.2	75.4	167.7
5	2	C	30	50.00	80	2	27.0	72.0	1.0	4.5	13.5	76.6	153.1
5	2	C	30	50.00	80	5	5.0	20.5	9.0	4.5	29.3	68.6	93.6
5	2	C	30	67.00	0	0	0.7	9.6	0.0	0.0	1.0	2.5	12.1
5	2	C	30	67.00	0	2	0.1	0.9	0.0	0.0	2.0	15.0	15.9
5	2	C	30	67.00	0	5	1.0	0.5	0.0	0.0	3.0	24.5	25.0
5	2	C	30	67.00	80	0	51.0	109.5	0.0	0.0	2.3	78.1	187.6
5	2	C	30	67.00	80	2	0.0	35.0	1.0	0.5	4.6	84.0	119.5
5	2	C	30	67.00	80	5	2.3	8.1	0.0	0.0	7.0	82.8	90.9
5	2	C	30	80.00	0	0	0.0	10.0	0.0	0.0	0.0	3.0	13.0
5	2	C	30	80.00	0	2	0.5	0.3	0.0	0.0	4.0	17.0	17.3
5	2	C	30	80.00	0	5	1.0	0.5	0.0	0.0	1.0	24.5	25.0
5	2	C	30	80.00	80	0	0.0	98.4	0.0	0.0	2.4	73.2	171.6
5	2	C	30	80.00	80	2	1.0	22.5	1.0	0.5	2.4	85.2	108.2
5	2	C	30	80.00	80	5	3.0	15.5	4.5	5.3	0.0	60.0	80.8

Table 11 cont.

							NO3		NO2		NH4		
PL	DP	SOL	TMP	WC	TRT	DAY	RANGE	AVER	RANGE	AVER	RANGE	AVER	TOTALN
5	1	CB	4	73.00	0	0	0.2	10.6	0.0	0.0	0.1	8.5	19.1
5	1	CB	4	73.00	0	2	1.0	14.5	0.5	0.3	0.6	10.0	24.8
5	1	CB	4	73.00	0	5	4.6	12.7	0.0	6.5	0.8	14.3	33.5
5	1	CB	4	73.00	80	0	4.0	109.0	0.0	0.0	0.3	79.4	188.4
5	1	CB	4	73.00	80	2	1.0	106.5	0.0	0.0	0.9	81.3	187.7
5	1	CB	4	73.00	80	5	2.8	98.6	4.0	5.0	1.5	83.1	186.7
5	1	CB	15	73.00	0	0	0.2	10.6	0.0	0.0	0.1	8.5	19.1
5	1	CB	15	73.00	0	2	2.4	1.9	0.0	0.0	0.4	19.1	21.0
5	1	CB	15	73.00	0	5	0.3	1.5	0.0	0.0	0.3	25.1	26.7
5	1	CB	15	73.00	80	0	4.0	109.0	0.0	0.0	0.3	79.4	188.4
5	1	CB	15	73.00	80	2	9.2	78.6	0.0	6.5	0.6	88.8	173.9
5	1	CB	15	73.00	80	5	4.3	50.0	0.0	0.0	0.0	95.5	145.5
5	1	CB	30	73.00	0	0	0.2	10.6	0.0	0.0	0.1	8.5	19.1
5	1	CB	30	73.00	0	2	0.9	2.3	0.0	0.0	0.1	32.8	35.2
5	1	CB	30	73.00	0	5	3.2	3.3	0.0	0.0	1.1	47.1	50.4
5	1	CB	30	73.00	80	0	4.0	109.0	0.0	0.0	0.3	79.4	188.4
5	1	CB	30	73.00	80	2	3.6	9.5	0.0	0.0	3.1	101.4	110.9
5	1	CB	30	73.00	80	5	5.3	7.8	0.0	0.0	2.0	105.0	112.7
5	2	CB	4	77.00	0	0	0.2	18.3	0.0	0.0	0.0	5.4	23.7
5	2	CB	4	77.00	0	2	0.7	20.8	0.0	0.0	0.1	8.3	29.1
5	2	CB	4	77.00	0	5	0.5	16.6	0.5	5.3	0.0	11.9	33.8
5	2	CB	4	77.00	80	0	1.8	99.1	0.0	0.0	2.6	81.2	180.3
5	2	CB	4	77.00	80	2	2.0	104.0	0.0	0.0	0.6	81.5	185.5
5	2	CB	4	77.00	80	5	5.0	103.5	1.0	5.5	1.6	86.1	195.1
5	2	CB	15	77.00	0	0	0.2	18.3	0.0	0.0	0.0	5.4	23.7
5	2	CB	15	77.00	0	2	0.1	3.8	0.0	0.0	0.1	16.4	20.2
5	2	CB	15	77.00	0	5	0.7	4.6	0.0	0.0	1.0	24.4	29.0
5	2	CB	15	77.00	80	0	1.8	99.1	0.0	0.0	2.6	81.2	180.3
5	2	CB	15	77.00	80	2	7.1	66.1	1.0	11.5	0.3	89.9	167.5
5	2	CB	15	77.00	80	5	3.7	39.8	0.0	0.0	0.0	95.9	135.7
5	2	CB	30	77.00	0	0	0.2	18.3	0.0	0.0	0.0	5.4	23.7
5	2	CB	30	77.00	0	2	1.4	4.2	0.0	0.0	2.8	29.3	33.5
5	2	CB	30	77.00	0	5	2.3	3.4	0.0	0.0	1.8	38.7	42.1
5	2	CB	30	77.00	80	0	1.8	99.1	0.0	0.0	2.6	81.2	180.3
5	2	CB	30	77.00	80	2	1.5	16.8	0.0	0.0	0.3	99.5	116.3
5	2	CB	30	77.00	80	5	1.6	14.3	0.0	0.0	1.6	98.3	112.6
5	3	C	4	74.00	0	0	8.9	14.2	0.0	0.0	3.0	4.3	18.4
5	3	C	4	74.00	0	2	0.6	10.4	0.0	0.0	0.6	4.4	14.8
5	3	C	4	74.00	0	5	0.7	6.3	0.5	3.8	0.1	8.0	18.1
5	3	C	4	74.00	80	0	4.0	105.0	0.0	0.0	4.7	65.3	170.2
5	3	C	4	74.00	80	2	1.8	92.0	0.0	0.0	0.9	66.3	158.2
5	3	C	4	74.00	80	5	7.4	94.2	0.5	4.8	2.6	68.3	167.2
5	3	C	15	74.00	0	0	8.9	14.2	0.0	0.0	3.0	4.3	18.4
5	3	C	15	74.00	0	2	0.1	2.9	0.0	0.0	0.1	9.3	12.2
5	3	C	15	74.00	0	5	0.7	1.1	0.0	0.0	0.5	16.3	17.4
5	3	C	15	74.00	80	0	4.0	105.0	0.0	0.0	4.7	65.3	170.2
5	3	C	15	74.00	80	2	2.5	70.1	0.0	14.5	1.5	71.6	156.2
5	3	C	15	74.00	80	5	5.5	40.3	0.5	0.3	2.7	77.1	117.6
5	3	C	30	74.00	0	0	8.9	14.2	0.0	0.0	3.0	4.3	18.4
5	3	C	30	74.00	0	2	0.8	3.5	0.0	0.0	0.7	16.5	20.0
5	3	C	30	74.00	0	5	1.3	2.8	0.0	0.0	0.1	28.1	30.9
5	3	C	30	74.00	80	0	4.0	105.0	0.0	0.0	4.7	65.3	170.2
5	3	C	30	74.00	80	2	1.2	17.9	0.0	3.0	1.2	77.6	98.5
5	3	C	30	74.00	80	5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	4	C	4	70.00	0	0	0.0	4.4	0.0	0.0	0.0	1.2	5.6
5	4	C	4	70.00	0	2	0.6	3.8	0.0	0.0	0.0	1.5	5.3
5	4	C	4	70.00	0	5	0.1	2.3	0.0	0.0	0.5	3.8	6.0
5	4	C	4	70.00	80	0	2.2	82.7	0.0	0.0	1.1	62.6	145.3
5	4	C	4	70.00	80	2	8.7	86.3	0.0	0.0	0.8	59.6	145.8
5	4	C	4	70.00	80	5	6.0	103.0	21.0	11.5	1.5	61.1	175.6
5	4	C	15	70.00	0	0	0.0	4.4	0.0	0.0	0.0	1.2	5.6
5	4	C	15	70.00	0	2	0.7	2.8	0.0	0.0	0.1	2.9	5.7
5	4	C	15	70.00	0	5	0.4	1.6	0.0	0.0	0.3	7.4	9.0
5	4	C	15	70.00	80	0	2.2	82.7	0.0	0.0	1.1	62.6	145.3
5	4	C	15	70.00	80	2	8.7	89.1	2.0	21.5	0.0	60.0	170.6
5	4	C	15	70.00	80	5	3.0	70.1	2.0	21.0	0.0	64.7	155.8
5	4	C	30	70.00	0	0	0.0	4.4	0.0	0.0	0.0	1.2	5.6
5	4	C	30	70.00	0	2	0.1	4.1	0.0	0.0	0.1	6.1	10.3
5	4	C	30	70.00	0	5	0.1	1.9	0.0	0.0	0.0	14.0	15.9
5	4	C	30	70.00	80	0	2.2	82.7	0.0	0.0	1.1	62.6	145.3
5	4	C	30	70.00	80	2	10.4	54.7	4.5	32.8	1.7	62.6	150.1
5	4	C	30	70.00	80	5	3.7	44.9	0.0	18.0	2.1	68.1	131.0
5	5	C	4	67.00	0	0	0.2	3.8	0.0	0.0	0.1	0.9	4.7
5	5	C	4	67.00	0	2	0.3	3.1	0.0	0.0	0.0	0.9	4.0
5	5	C	4	67.00	0	5	0.2	1.7	0.0	0.0	0.0	2.8	4.9
5	5	C	4	67.00	80	0	23.3	109.3	0.0	0.0	10.5	67.8	177.[illegible]
5	5	C	4	67.00	80	2	0.4	91.3	0.0	0.0	1.5	53.1	144.[illegible]
5	5	C	4	67.00	80	5	6.7	95.6	0.0	0.0	0.0	53.6	149.[illegible]
5	5	C	15	67.00	0	0	0.2	3.8	0.0	0.0	0.1	0.9	4.7
5	5	C	15	67.00	0	2	0.5	3.1	0.0	0.0	0.2	1.1	4.1
5	5	C	15	67.00	0	5	0.1	0.8	0.0	0.0	0.3	3.8	4.6
5	5	C	15	67.00	80	0	23.3	109.3	0.0	0.0	10.5	67.8	177.[illegible]
5	5	C	15	67.00	80	2	0.8	96.2	0.5	11.3	2.0	51.1	158.6
5	5	C	15	67.00	80	5	0.1	89.1	1.0	18.5	0.9	52.6	160.[illegible]
5	5	C	30	67.00	0	0	0.2	3.8	0.0	0.0	0.1	0.9	4.7
5	5	C	30	67.00	0	2	0.7	3.1	0.0	0.0	0.2	2.5	5.6
5	5	C	30	67.00	0	5	0.1	1.8	0.0	0.0	0.9	5.9	7.7
5	5	C	30	67.00	80	0	23.3	109.3	0.0	0.0	10.5	67.8	177.[illegible]
5	5	C	30	67.00	80	2	2.0	83.8	1.5	27.8	0.9	51.9	163.5
5	5	C	30	67.00	80	5	6.2	78.3	0.0	23.0	0.6	52.7	154.0
5	6	C	4	66.00	0	0	0.3	2.0	0.0	0.0	0.5	2.8	4.3
5	6	C	4	66.00	0	2	3.7	3.8	0.0	0.0	3.7	4.5	8.4
5	6	C	4	66.00	0	5	0.3	1.6	0.0	0.0	0.9	2.8	4.4
5	6	C	4	66.00	80	0	13.2	89.4	0.0	0.0	0.6	55.1	144.5
5	6	C	4	66.00	80	2	0.3	89.8	0.0	0.0	0.6	49.4	139.1
5	6	C	4	66.00	80	5	1.4	93.0	0.0	0.0	0.6	46.6	139.6
5	6	C	15	66.00	0	0	0.3	2.0	0.0	0.0	0.5	2.8	4.3
5	6	C	15	66.00	0	2	0.2	1.3	0.0	0.0	0.6	2.2	3.5
5	6	C	15	66.00	0	5	0.1	0.9	0.0	0.0	0.2	2.1	3.0
5	6	C	15	66.00	80	0	13.2	89.4	0.0	0.0	0.6	55.1	144.5
5	6	C	15	66.00	80	2	3.3	91.9	0.5	4.3	0.6	45.7	141.9
5	6	C	15	66.00	80	5	3.4	87.6	1.0	6.5	1.5	44.6	138.7
5	6	C	30	66.00	0	0	0.3	2.0	0.0	0.0	0.5	2.8	4.8
5	6	C	30	66.00	0	2	0.0	0.9	0.0	0.0	0.6	2.9	3.8
5	6	C	30	66.00	0	5	0.3	0.9	0.0	0.0	0.2	3.6	4.5
5	6	C	30	66.00	80	0	13.2	89.4	0.0	0.0	0.6	55.1	144.5
5	6	C	30	66.00	80	2	0.0	97.2	2.5	12.3	1.5	45.6	155.0

PL	DP	SOL	TMP	WC	TRT	DAY	NO3 RANGE	NO3 AVER	NO2 RANGE	NO2 AVER	NH4 RANGE	NH4 AVER	TOTALN
5	7	C	4	64.00	0	0	0.1	1.6	0.0	0.0	0.2	2.4	3.9
5	7	C	4	64.00	0	2	0.0	1.7	0.0	0.0	0.4	2.1	3.8
5	7	C	4	64.00	0	5	0.2	2.0	0.0	0.0	0.6	2.3	4.3
5	7	C	4	64.00	80	0	0.6	99.4	0.0	0.0	3.3	56.3	155.6
5	7	C	4	64.00	80	2	10.6	89.5	0.0	0.0	2.7	50.5	140.0
5	7	C	4	64.00	80	5	4.4	97.6	0.0	0.0	2.4	45.8	143.4
5	7	C	15	64.00	0	0	0.1	1.6	0.0	0.0	0.2	2.4	3.9
5	7	C	15	64.00	0	2	0.1	0.8	0.0	0.0	0.3	1.6	2.4
5	7	C	15	64.00	0	5	1.0	1.0	0.0	0.0	3.8	3.8	4.8
5	7	C	15	64.00	80	0	0.6	99.4	0.0	0.0	3.3	56.3	155.6
5	7	C	15	64.00	80	2	0.5	87.1	1.5	2.3	2.8	45.6	135.0
5	7	C	15	64.00	80	5	1.9	82.6	0.5	2.8	1.8	44.3	129.6
5	7	C	30	64.00	0	0	0.1	1.6	0.0	0.0	0.2	2.4	3.9
5	7	C	30	64.00	0	2	0.2	0.6	0.0	0.0	2.2	3.6	4.2
5	7	C	30	64.00	0	5	0.1	0.8	0.0	0.0	0.5	3.1	3.9
5	7	C	30	64.00	80	0	0.6	99.4	0.0	0.0	3.3	56.3	155.6
5	7	C	30	64.00	80	2	0.0	81.2	0.0	8.5	0.0	49.2	138.9
5	7	C	30	64.00	80	5	0.8	77.7	1.5	10.3	0.3	40.3	128.3
N5	1		4	70.00	0	0	0.3	33.1	1.0	0.5	0.0	9.1	42.7
N5	1		4	70.00	0	2	0.4	30.4	0.5	5.8	0.3	15.0	51.2
N5	1		4	70.00	0	5	4.1	18.4	2.0	24.0	0.2	21.0	63.4
N5	1		4	70.00	80	0	4.0	112.0	0.0	0.5	1.4	71.9	184.4
N5	1		4	70.00	80	2	13.0	109.5	0.0	6.5	2.3	78.3	194.3
N5	1		4	70.00	80	5	8.8	99.6	0.5	30.8	1.2	84.8	215.1
N5	1		15	70.00	0	0	0.3	33.1	1.0	0.5	0.0	9.1	42.7
N5	1		15	70.00	0	2	0.0	0.0	0.0	0.0	2.2	32.4	32.4
N5	1		15	70.00	0	5	2.8	1.4	0.0	0.0	0.5	42.8	44.1
N5	1		15	70.00	80	0	4.0	112.0	0.0	0.5	1.4	71.9	184.4
N5	1		15	70.00	80	2	0.8	15.1	0.5	2.3	0.0	94.8	112.1
N5	1		15	70.00	80	5	0.5	10.8	0.0	0.0	5.0	111.5	122.3
N5	1		30	70.00	0	0	0.3	33.1	1.0	0.5	0.0	9.1	42.7
N5	1		30	70.00	0	2	0.2	35.7	0.0	0.0	2.3	48.4	84.1
N5	1		30	70.00	0	5	0.2	2.8	0.0	0.0	1.6	68.8	71.6
N5	1		30	70.00	80	0	4.0	112.0	0.0	0.5	1.4	71.9	184.4
N5	1		30	70.00	80	2	0.2	8.4	0.0	0.0	1.0	125.5	133.9
N5	1		30	70.00	80	5	3.3	9.3	0.0	0.0	5.0	134.5	143.8
N5	2		4	63.00	0	0	0.6	28.1	0.0	0.0	0.1	5.9	34.0
N5	2		4	63.00	0	2	2.5	26.9	1.0	4.0	0.7	10.3	41.2
N5	2		4	63.00	0	5	1.6	25.6	1.0	8.0	0.4	13.3	46.9
N5	2		4	63.00	80	0	2.0	123.0	0.0	0.0	4.6	84.0	207.0
N5	2		4	63.00	80	2	3.0	120.5	0.5	3.8	0.4	86.5	210.7
N5	2		4	63.00	80	5	10.0	115.0	1.0	9.5	0.3	92.1	216.6
N5	2		15	63.00	0	0	0.6	28.1	0.0	0.0	0.1	5.9	34.0
N5	2		15	63.00	0	2	0.9	1.1	0.0	0.0	0.6	20.0	21.1
N5	2		15	63.00	0	5	0.1	1.1	0.0	0.0	3.9	24.8	25.9
N5	2		15	63.00	80	0	2.0	123.0	0.0	0.0	4.6	84.0	207.0
N5	2		15	63.00	80	2	1.0	84.3	1.0	10.0	1.0	94.2	188.5
N5	2		15	63.00	80	5	3.4	51.2	0.0	0.0	0.0	103.0	154.2
N5	2		30	63.00	0	0	0.6	28.1	0.0	0.0	0.1	5.9	34.0
N5	2		30	63.00	0	2	0.3	0.6	0.0	0.0	0.2	14.0	14.6
N5	2		30	63.00	0	5	1.1	0.6	0.0	0.0	1.2	12.4	12.9
N5	2		30	63.00	80	0	2.0	123.0	0.0	0.0	4.6	84.0	207.0
N5	2		30	63.00	80	2	1.2	11.9	0.0	0.0	6.0	107.0	113.8

PL	DP	SOL	TMP	WC	TRT	DAY	NO3 RANGE	NO3 AVER	NO2 RANGE	NO2 AVER	NH4 RANGE	NH4 AVER	TOTAL
N5	3		4	67.00	0	0	8.9	61.1	0.0	0.0	0.4	6.7	67.8
N5	3		4	67.00	0	2	1.7	62.8	0.5	3.3	0.7	11.8	77.8
N5	3		4	67.00	0	5	1.2	57.6	0.5	9.3	1.1	20.1	86.9
N5	3		4	67.00	80	0	3.0	137.5	0.0	0.0	1.0	79.1	216.6
N5	3		4	67.00	80	2	3.0	106.5	0.5	2.3	1.5	89.1	197.9
N5	3		4	67.00	80	5	1.0	124.5	2.0	10.0	3.3	97.8	232.3
N5	3		15	67.00	0	0	8.9	61.1	0.0	0.0	0.4	6.7	67.8
N5	3		15	67.00	0	2	0.1	7.1	0.0	2.5	0.5	26.3	35.8
N5	3		15	67.00	0	5	1.3	7.3	0.0	0.0	2.3	42.4	49.8
N5	3		15	67.00	80	0	3.0	137.5	0.0	0.0	1.0	79.1	216.6
N5	3		15	67.00	80	2	3.0	84.2	1.0	10.0	2.0	103.0	197.2
N5	3		15	67.00	80	5	3.1	27.6	0.0	0.0	1.0	120.5	148.1
N5	3		30	67.00	0	0	8.9	61.1	0.0	0.0	0.4	6.7	67.8
N5	3		30	67.00	0	2	0.1	8.3	0.0	0.0	1.7	48.9	57.2
N5	3		30	67.00	0	5	0.1	0.5	0.0	0.0	2.1	60.3	60.8
N5	3		30	67.00	80	0	3.0	137.5	0.0	0.0	1.0	79.1	216.6
N5	3		30	67.00	80	2	1.7	2.6	0.0	0.0	11.0	127.5	130.1
N5	3		30	67.00	80	5	2.7	5.9	0.0	0.0	11.0	133.5	139.4
N5	4		4	69.00	0	0	3.4	43.8	0.0	0.0	2.3	8.4	52.3
N5	4		4	69.00	0	2	0.8	45.1	0.0	2.5	0.3	9.8	57.3
N5	4		4	69.00	0	5	1.7	38.3	0.0	7.5	0.0	13.4	59.2
N5	4		4	69.00	80	0	5.0	138.5	0.0	0.0	0.0	84.1	222.6
N5	4		4	69.00	80	2	9.0	137.5	0.0	3.5	0.6	80.7	221.7
N5	4		4	69.00	80	5	2.0	132.0	0.0	7.0	2.5	86.3	225.2
N5	4		15	69.00	0	0	3.4	43.8	0.0	0.0	2.3	8.4	52.3
N5	4		15	69.00	0	2	0.4	6.2	0.5	0.3	0.2	17.6	24.0
N5	4		15	69.00	0	5	0.1	0.6	0.0	0.0	0.1	26.8	27.5
N5	4		15	69.00	80	0	5.0	138.5	0.0	0.0	0.0	84.1	222.6
N5	4		15	69.00	80	2	2.0	100.0	1.0	1.5	1.8	88.1	189.6
N5	4		15	69.00	80	5	0.7	55.6	0.0	0.0	5.3	100.3	156.0
N5	4		30	69.00	0	0	3.4	43.8	0.0	0.0	2.3	8.4	52.3
N5	4		30	69.00	0	2	1.1	1.8	0.0	0.0	0.6	32.2	33.9
N5	4		30	69.00	0	5	0.2	0.1	0.0	0.0	1.6	39.0	39.1
N5	4		30	69.00	80	0	5.0	138.5	0.0	0.0	0.0	84.1	222.6
N5	4		30	69.00	80	2	4.5	13.9	0.0	0.0	2.0	103.0	116.9
N5	4		30	69.00	80	5	2.8	8.4	0.0	0.0	3.0	113.5	121.9
N5	5		4	55.00	0	0	1.0	28.6	0.0	0.0	0.4	6.1	34.7
N5	5		4	55.00	0	2	1.1	29.9	0.0	0.0	0.2	6.4	36.3
N5	5		4	55.00	0	5	0.3	28.0	0.0	0.0	0.9	7.1	35.2
N5	5		4	55.00	80	0	1.0	119.5	0.0	0.0	3.0	85.6	205.1
N5	5		4	55.00	80	2	10.0	114.0	0.0	0.0	1.2	84.7	198.7
N5	5		4	55.00	80	5	0.0	107.0	0.0	0.0	1.2	84.1	191.1
N5	5		15	55.00	0	0	1.0	28.6	0.0	0.0	0.4	6.1	34.7
N5	5		15	55.00	0	2	3.0	21.8	1.0	6.5	2.4	10.3	38.6
N5	5		15	55.00	0	5	0.4	2.3	0.0	0.0	0.4	16.7	19.0
N5	5		15	55.00	80	0	1.0	119.5	0.0	0.0	3.0	85.6	205.1
N5	5		15	55.00	80	2	7.0	106.5	0.5	5.8	3.0	86.2	198.4
N5	5		15	55.00	80	5	5.4	90.8	0.0	0.0	4.5	92.1	182.9
N5	5		30	55.00	0	0	1.0	28.6	0.0	0.0	0.4	6.1	34.7
N5	5		30	55.00	0	2	1.4	3.2	0.0	0.0	0.1	20.6	23.8
N5	5		30	55.00	0	5	2.5	6.6	0.0	0.0	0.4	40.3	46.9
N5	5		30	55.00	80	0	1.0	119.5	0.0	0.0	3.0	85.6	205.1
N5	5		30	55.00	80	2	11.5	94.3	0.5	6.3	5.5	92.8	193.2
N5	[illegible]		30	55.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table 12 Denitrification rate coefficients of representative soil samples at saturated or near saturated moisture content.

PL	DP	SOL	TMP	WC	TRT	RD-2	RD-5	RD-AVE
1	1	S	4	35.00	0	-0.080	-0.058	-0.069
1	1	S	4	35.00	80	-0.008	-0.024	-0.016
1	1	S	15	35.00	0	0.044	0.029	0.036
1	1	S	15	35.00	80	0.002	0.010	0.006
1	1	S	30	35.00	0	0.915	0.401	0.658
1	1	S	30	35.00	80	0.044	0.038	0.041
1	2	S	4	36.00	0	-0.014	0.009	-0.002
1	2	S	4	36.00	80	0.084	0.028	0.056
1	2	S	15	36.00	0	0.079	0.090	0.084
1	2	S	15	36.00	80	0.073	0.046	0.060
1	2	S	30	36.00	0	0.658	0.523	0.590
1	2	S	30	36.00	80	0.150	0.074	0.112
3	1	S	4	26.00	0	-0.037	0.046	0.004
3	1	S	4	26.00	80	-0.027	-0.014	-0.020
3	1	S	4	35.00	0	0.0	0.0	0.0
3	1	S	4	35.00	80	-0.016	0.004	-0.006
3	1	S	4	42.00	0	-0.059	-0.018	-0.038
3	1	S	4	42.00	80	0.005	-0.024	-0.009
3	1	S	15	26.00	0	0.013	-0.010	0.001
3	1	S	15	26.00	80	-0.035	-0.013	-0.024
3	1	S	15	35.00	0	0.084	0.027	0.055
3	1	S	15	35.00	80	0.047	0.003	0.025
3	1	S	15	42.00	0	-0.015	-0.012	-0.014
3	1	S	15	42.00	80	0.012	-0.010	0.001
3	1	S	30	26.00	0	0.184	-0.024	0.080
3	1	S	30	26.00	80	0.019	-0.006	0.006
3	1	S	30	35.00	0	0.370	0.109	0.240
3	1	S	30	35.00	80	0.040	0.020	0.030
3	1	S	30	42.00	0	0.379	0.104	0.242
3	1	S	30	42.00	80	-0.003	-0.024	-0.013
3	2	S	4	27.00	0	-0.042	-0.031	-0.036
3	2	S	4	27.00	80	0.019	0.017	0.018
3	2	S	4	36.00	0	-0.020	-0.020	-0.020
3	2	S	4	36.00	80	0.004	0.012	0.008
3	2	S	4	43.00	0	-0.044	-0.025	-0.034
3	2	S	4	43.00	80	0.025	0.005	0.015
3	2	S	15	27.00	0	-0.083	-0.003	-0.043
3	2	S	15	27.00	80	0.001	0.009	0.005
3	2	S	15	36.00	0	0.108	0.038	0.073
3	2	S	15	36.00	80	-0.013	0.003	-0.005
3	2	S	15	43.00	0	0.114	0.044	0.079
3	2	S	15	43.00	80	0.007	0.007	0.007
3	2	S	30	27.00	0	0.325	0.047	0.186
3	2	S	30	27.00	80	0.021	-0.007	0.007
3	2	S	30	36.00	0	0.917	0.237	0.577
3	2	S	30	36.00	80	0.011	-0.018	-0.004
3	2	S	30	43.00	0	1.006	0.264	0.635
3	2	S	30	43.00	80	0.026	-0.030	-0.002
6	1	C	4	72.00	0	-0.206	-0.099	-0.153
6	1	C	4	72.00	80	-0.058	-0.016	-0.037
6	1	C	15	72.00	0	0.307	0.156	0.231
6	1	C	15	72.00	80	0.014	0.104	0.059
6	1	C	30	72.00	0	0.254	0.116	0.185
6	1	C	30	72.00	80	0.726	0.526	0.626
6	2	C	4	69.00	0	-0.040	-0.010	-0.025
6	2	C	4	69.00	80	0.0	0.000	0.000
6	2	C	15	69.00	0	0.957	0.431	0.694
6	2	C	15	69.00	80	0.020	0.146	0.083
6	2	C	30	69.00	0	0.994	0.322	0.658
6	2	C	30	69.00	80	0.718	0.479	0.598
4	1	C	4	55.00	0	-0.055	-0.044	-0.049
4	1	C	4	55.00	80	-0.035	0.007	-0.014
4	1	C	4	74.00	0	-0.013	0.079	0.033
4	1	C	4	74.00	80	0.008	0.015	0.011
4	1	C	4	88.00	0	-0.013	0.240	0.114
4	1	C	4	88.00	80	0.013	0.024	0.019
4	1	C	15	55.00	0	0.155	-0.074	0.040
4	1	C	15	55.00	80	0.066	0.044	0.055
4	1	C	15	74.00	0	0.948	0.417	0.682
4	1	C	15	74.00	80	0.230	0.162	0.196
4	1	C	15	88.00	0	1.071	0.543	0.807
4	1	C	15	88.00	80	0.218	0.122	0.170
4	1	C	30	55.00	0	0.878	0.472	0.675
4	1	C	30	55.00	80	0.695	0.215	0.455
4	1	C	30	74.00	0	*********	0.613	********
4	1	C	30	74.00	80	1.080	0.531	0.806
4	1	C	30	88.00	0	1.253	0.467	0.860
4	1	C	30	88.00	80	0.986	0.623	0.805
4	2	C	4	54.00	0	-0.174	-0.194	-0.184
4	2	C	4	54.00	80	0.035	-0.016	0.010
4	2	C	4	72.00	0	-0.101	0.151	0.025
4	2	C	4	72.00	80	-0.023	-0.004	-0.013
4	2	C	4	87.00	0	0.121	-0.033	0.044
4	2	C	4	87.00	80	-0.015	-0.001	-0.008
4	2	C	15	54.00	0	0.631	-0.163	0.234
4	2	C	15	54.00	80	0.055	-0.032	0.011
4	2	C	15	72.00	0	0.474	0.189	0.332
4	2	C	15	72.00	80	0.308	0.388	0.348
4	2	C	15	87.00	0	0.265	0.143	0.204
4	2	C	15	87.00	80	0.798	0.269	0.533
4	2	C	30	54.00	0	0.029	0.083	0.056
4	2	C	30	54.00	80	0.484	0.497	0.491
4	2	C	30	72.00	0	1.253	0.501	0.877
4	2	C	30	72.00	80	1.437	0.624	1.030
4	2	C	30	87.00	0	*********	0.624	********
4	2	C	30	87.00	80	1.603	0.672	1.137
NS	1		4	70.00	0	-0.036	-0.047	-0.041
NS	1		4	70.00	80	-0.015	-0.029	-0.022
NS	1		15	70.00	0	*********	0.636	********
NS	1		15	70.00	80	0.936	0.469	0.702
NS	1		30	70.00	0	-0.030	0.497	0.233
NS	1		30	70.00	80	1.297	0.499	0.898
NS	2		4	63.00	0	-0.047	-0.036	-0.042
NS	2		4	63.00	80	-0.005	-0.002	-0.004
NS	2		15	63.00	0	1.620	0.648	1.134
NS	2		15	63.00	80	0.133	0.175	0.154
NS	2		30	63.00	0	1.923	0.769	1.346
NS	2		30	63.00	80	1.172	0.544	0.858
NS	3		4	67.00	0	-0.039	-0.018	-0.029
NS	3		4	67.00	80	0.117	0.004	0.061
NS	3		15	67.00	0	0.925	0.425	0.675
NS	3		15	67.00	80	0.189	0.321	0.255
NS	3		30	67.00	0	0.998	0.961	0.980
NS	3		30	67.00	80	1.984	0.630	1.307
NS	4		4	69.00	0	-0.042	-0.009	-0.025
NS	4		4	69.00	80	-0.009	-0.001	-0.005
NS	4		15	69.00	0	0.962	0.858	0.910
NS	4		15	69.00	80	0.155	0.183	0.169
NS	4		30	67.00	0	1.596	1.216	1.406
NS	4		30	69.00	80	1.149	0.561	0.855
NS	5		4	55.00	0	-0.022	0.004	-0.009
NS	5		4	55.00	80	0.024	0.022	0.023
NS	5		15	55.00	0	0.005	0.504	0.255
NS	5		15	55.00	80	0.032	0.055	0.043
NS	5		30	55.00	0	1.095	0.293	0.694
NS	5		30	55.00	80	0.087	0.206	0.146

Table 13 Potential N fixation (expressed as μg ethylene produced/ g soil/day) and extractable N in representative soil profile samples.

	Day 7			Day 14		
Soil	N fixation	μgNO_3^--N/g	μgNH_4^+-N/g	N fixation	μgNO_3^--N N/g	μgNH_4^+-N/g
2-1	0.002	0.2	15.7	0.002	0.3	15.5
2-1-b	<0.002	10.1	10.3	<0.002	8.7	14.9
2-2	0.002	3.1	21.8	<0.002	1.2	26.6
2-2-b	0.002	1.3	11.0	<0.002	1.3	10.5
2-4	<0.002	0.0	6.3	<0.002	0.6	5.0
2-6	<0.002	2.3	1.2	<0.002	3.1	1.8
5-1	0.021	1.2	35.2	0.015	2.6	24.7
5-1-b	0.039	0.1	38.9	0.031	0.9	25.4
5-2	0.014	3.6	31.3	0.012	1.0	20.7
5-2-b	0.019	0.7	36.7	0.010	1.0	23.9
5-4	0.003	0.2	13.3	0.002	0.6	14.0
5-6	0.443	0.5	2.8	0.062	0.6	6.0

APPENDIX

Rates of gaseous loss, mineralization and plant uptake of nitrogen in soil systems: A Literature Review.

Rates of gaseous loss, mineralization and plant uptake of nitrogen in soil systems: A literature review. C. Grant Kowalenko, S.R.I.

The purpose of this review is to present the extent of knowledge of the rate of processes that are important in the nitrogen economy of soils, particularly under field conditions. Some mention will be given to factors effecting these rates, but most of the effort is directed toward presenting a range of the rates of these processes. It will be seen that very few reports deal directly with the measurement of rates, especially under field conditions and much of the information is derived from literature dealing with other aspects. An attempt is made to present a unified term for the rate, but this is not always possible. The term chosen was kg/ha/day.

GASEOUS LOSS OF N

Several mechanisms have been shown as being possible for the loss of N from the soil system. These include volatilization as NH_3, biological denitrification, chemical decomposition of oxidized inorganic N forms and gaseous leakage during nitrification and plant growth. Only the first two mechanisms will be considered in terms of rates of loss and the later two will be discussed briefly in terms of what is known of the mechanisms.

(1) Chemical decomposition of oxidized inorganic N forms

The term chemical decomposition of oxidized inorganic N is used to distinguish this chemical mechanism from NH_3 volatilization. There has been considerable recurring interest in possible losses of nitrogen from soils and mechanisms have been discussed (Broadbent and Clark, 1965; Reuss and Smith, 1965; Allison, 1966; Woldendorp, 1968; Chao, 1967; Bremner and Nelson, 1968; Nelson and Bremner, 1969, 1970; Nommik and Thorin, 1972; Bollag et al., 1973; Van Clumput and Baert, 1976). Most of the processes require fairly specific conditions before they proceed (eg) low pH and/or significant concentrations of NO_2. Agricultural soils are not always acidic nor have significant concentrations of nitrite been detected, however, certain agricultural practices such as band fertilization may result in lowering soil pH and formation of high nitrite concentrations in localized areas (Pang et al., 1975a,b) which could result in chemical decomposition involving nitrite. Although mechanisms and conditions of chemical decomposition of oxidized forms of inorganic nitrogen have been clearly shown, the quantitative significance of this loss mechanism has not been shown in field situations. Without quantitative measurements, rates can not be estimated.

(2) Gaseous "leakage" during nitrification and plant growth

Gaseous losses of nitrogen as nitrous oxide has been shown to occur during nitrification (Yoshida and Alexander, 1970). It can be argued that conditions required to produce significant amounts of nitrous oxide are not usually present in soils, however, localized situations such as during fertilization may encourage the process. The study referred to examined only one species of *Nitrosomonas* in culture systems, and more extensive studies of different organisms and in soil situations are needed to show the quantitative significance in soil systems.

Nitrogen gases can also be lost from plants during growth. Viets (1965) has discussed some of the possible mechanisms of loss. Recently Craswell and Martin (1975a,b) and Daigger et al. (1976) have suggested that significant losses of N due to plants does occur in cropping systems. Other workers (eg. Rumberg and Sneva, 1970) have noted losses of N during plant maturation, but attributed these losses to shedding of pollen, anthers and filaments. Further study on this area is required to quantitatively evaluate this possible N lost from field systems. From the work of Daigger et al. (1976), the period during crop maturation appears to be the critical time, possibly during extensive translocation of N compounds.

(3) Volatilization as NH_3

Several reviews (Allison, 1955, 1965; Harmsen and Kolenbrander, 1965; Woldendorp, 1968) have shown the following factors influence the volatilization of nitrogen as NH_3:

(i) pH and/or $CaCO_3$ content
- high pH encourages loss, insignificant losses below pH 6.
- formation of NH_3 results in localized pH increase.

(ii) soil texture (C.E.C.)
- sandy soils (low C.E.C.) result in higher loss.

(iii) moisture content of soil
- drying increases loss.

(iv) temperature
- increased losses with higher temperatures

(v) method of fertilizer application
- losses greater during surface application of ammonia (anhydrous) applied to dry sandy soils.

(vi) form of fertilizer or associated cation
- volatilization shown to decrease in the following order: NH_3 (liquid or anhydrous) $> (NH_4)_2SO_4 > NH_4NO_3 > NH_4$-phosphates.

This information suggests that NH_3 volatilization is significant only under particular fertilization practices such as surface application, anhydrous application to dry sandy soils or application to limed or high pH soils. It is probable that for this reason most of the recent studies of NH_3 volatilization are oriented toward surface application systems. Studies on fertilization of forests are concerned primarily with surface application (Overrein, 1968, 1969; Volk, 1970; Nommik, 1973; Mahendrappa and Ogden, 1973; Mahendrappa and Salonius, 1974) but these will not be considered further. Similarly, studies with agricultural orientation have been primarily concerned with surface applications of fertilizer materials and have been mainly done under laboratory conditions.

Before a consideration of rates of NH_3 lost from soils that can be derived from the literature, one should be careful to know how this rate was calculated. Several laboratory (Filimonova and Strel'nikova, 1974; Mills et al., 1974) and field (Makarov, 1960; McGarity and Rajaratnam,

1973) experiments serve to illustrate the point. In order to have a comparable rate term throughout the discussion, the term kg NH_3-N lost/ha/day is used. However, the interval over which this loss is measured will influence the rate expressed on a per day measurement. Suppose ammonium volatilization occurs very rapidly in the first few hours of the measurement duration of a day, then decreases to negligible amounts for the remainder of the day, the maximum instantaneous rate of loss may be very large at first and negligible later on. Calculation of the rate of loss on a per day basis over that day of measurement then, is really an average rate over that period of time that measurement is made. For this reason, the time interval of the measurement of NH_3 loss and subsequent average rate per day calculation is given.

Table 1 gives rates of NH_3 loss under a variety of conditions and rates vary from 0-10.8 kg N/ha/day. When considering a particular soil situation each of these factors must be considered in terms of their effect on the rate of NH_3 loss. Mills et al. (1974) showed similar results using NH_4Cl instead of urea and several pH ranges. Besides pH, they superimposed plant growth, which in general reduced the amount of NH_3 lost when compared to a fallow system. This is probably because the plant takes up NH_4-N, reducing the amount available for volatilization. Chao and Kroontje (1964) showed that as water evaporated from a soil in a flow through system, the rate of NH_3 loss increased. They presented the equation

$$N/t = at^b$$

where N/t = ppm NH_3 loss/hr, t = hrs & a and b = constants to show the effect of water saturated and unsaturated are flowing over a soil. The a and b constants were 48.43 and -0.6819, and 10.43 and -0.3714 for unsaturated and saturated atmospheres, respectively. They also derived linear regression equations for four soils in terms of the amounts of NH_3 lost in the form

$$Y = bX + C$$

where Y = ppm NH_3 volatilized, X = NH_3 application rate, b and C = constants. The constants were different for each soil.

The results for three Ontario soils (Table 2) show that liming these soils (initial pH were all near 5) increased NH_3 loss. The rate of loss is probably small because of the long incubation time, however, the total amount of N lost from these systems was relatively small. Despite the inadequacies of the method for measurement for rate calculations, the results do show the influence of soil type and liming rate on the rate of loss. Fenn and Kissel (1976) show a multiple regression equation containing either 3 or 4 variables for NH_3-N loss. The variables included temperature, rate of NH_4^+-N application, soil $CaCO_3$ content and time. They did note that the equations tended to overpredict N loss below 0.5% $CaCO_3$ and underpredicted it at high $CaCO_3$ amounts. They went on to discuss the limitations of applying their study to field conditions.

The cation associated with the ammonium fertilizer source has been recognized as an important factor affecting the volatilization of ammonia from soil. Urea is readily converted to NH_4^+ which in turn is readily available for volatilization. Table 3 shows several studies where the

Table 1. Rate of NH_3 loss from soils treated with urea under a variety of laboratory conditions

Treatment	Application (kg N/ha)	Days of test	Rate of NH_3 lost (kg N/ha/day)		
pH[1]: 7.5	120	10		6.0	
6.0	"	"		2.0	
5.0	"	"		1.1	
Temperature (°C)[1]:					
35	120	11		2.6	
15	"	"		1.1	
7	"	"		0.6	
Depth[1]:					
Surface	120	13		1.5	
3.8 cm	"	"		0.5	
Initial moisture (%)					
A[1] 37.5	120	14		1.7	
21	"	"		1.0	
1	"	"	fsl	0.3	sil
B[2] 30	300	10	1.4		9.8
20	"	"	8.8		10.8
10	"	"	0.6		4.4
5	"	"	0.03		0.3
Application[2]	300	28			3.4
	150	"			1.2
	50	"			0.2
	0	"			0

[1]Earnest and Massey, 1960
[2]Kresge and Satchell, 1960

Table 2. Rate of NH_3 loss from limed and unlimed Ontario soils incubated for 67 days[1]

Soil	$CaCO_3$ treatment	Rate of NH_3 loss kg N/ha/day
Vaudreuil (s)	0	0.03
	pH 7	0.25
	10%	0.18
St. Thomas (s)	0	0.03
	pH 7	0.08
	10%	0.42
Haldimand (c)	0	0.02
	pH 7	0.05
	10%	0.07

[1]Kowalenko, C.G., unpublished results

Table 3. Rate of NH_3 lost from surface application of various ammonium compounds under laboratory conditions.

Reference	Compound	Application (kg N/ha)	Duration (day)	Rate of NH_3 loss (kg N/ha/day)	
Fenn and Kissel, 1973	NH_4F	550	4	89	
	$(NH_4)_2SO_2$	"	"	72	
	$(NH_4)_2HPO_4$	"	"	67	
	NH_4NO_3	"	"	24	
	NH_4Cl	"	"	24	
	NH_4I	"	"	22	
Matocha, 1976	$(NH_2)_2CO$	600	14	22	
	$(NH_4)_2SO_4$	"	"	10	
	SCU[1]-30	"	"	4	
	SCU-20	"	"	1	
Kresge & Satchell, 1960	NH_4NO_3/urea			sl	sil
	0/100	354	11	25	26
	45/55	286	"	7	8
	70/30	241	"	4	3

[1] Sulfur coated urea

form of the fertilizer was examined in terms of loss of NH_3. In each case, this has been directed toward surface application and very high rates of loss can occur. Again, one should realize that the values are average rates over the interval of the measurements, hence the instantaneous maximum rate of NH_3 loss can be exceedingly high.

Very few reports show data for field experiments of NH_3 loss. This is probably because current field methods applied still introduce an artificial situation (eg. absorption systems require a canopy) or measurement of NH_4^+ remaining in a system may include other types of loss. Table 4 shows results of three field experiments, which shows the possible losses. The results show the importance of large instantaneous losses from particular fertilizer practices.

This review of rates of the process of NH_3 volatilization shows that most of the studies have been concerned with a particular fertilizer practice (surface application). With this practice, very large quick losses of NH_3 can occur. On the other hand, small but continuous losses may be possible, but have not been considered to any great extent. It appears safe to assume that intimately mixed NH_4^+ at moderate application rates results in small, almost insignificant, losses which may or may not be continuous (eg. Hooker et al., 1973 - Table 4; Stefanson, 1972). Another area of potentially large NH_3 losses is from manure application (see Lauer et al., 1976) but the diversity of materials and methods of application makes it difficult to relate one study to the other.

(4) Biological denitrification

A large amount of work has been done on biological denitrification but most of it has been laboratory oriented. A number of soil and environmental factors have been shown to influence the rate of the process (Table 5). The results presented have been calculated on a per day basis to allow comparison from one study to the other. An exceedingly wide range of rates of denitrification is evident and this is probably due in large measure to the experimental set up rather than differences in soils used. In most cases shown in the table, conditions were such that denitrification was promoted (eg) addition of a high energy carbon source, anaerobic atmosphere, etc. This was usually done to facilitate the measurements. Each study had specific conditions, therefore comparison from one reference to the other must take these differences into account. Values within a particular study are comparable, therefore, the table should show the effect a particular factor has on the rate of the process. It is evident from the table that two different units are used for the rate and this is due to the authors' view of the process. A good example for the two approaches for rate calculation is shown by Stanford et al. (1975b) where zero and first order reaction approaches are calculated and discussed. This study even suggests a second order reaction in certain cases. A valuable discussion on denitrification kinetics by Kohl et al. (1976) shows the limitations of good fits of data to mathematical forms. They point out that the mathematical forms may be useful for certain uses (eg) modelling activities but do not prove anything about the reaction mechanism. The report of Sandhu and Moraghan (1972) shows the effect measurement time (even very short time) has on the rate of denitrification, where the rate can vary from 0-99 μg N/g soil/day. Numerous other

Table 4. Rate of NH_3 loss from field systems

Reference	Compound	Application (kg N/ha)	Duration of measurement	Rate of NH_3 loss (kg N/ha/day)
Makarov, 1960	Urea	variable	variable short term	0-1.05
McGarity and Rajaratnam 1973	Urea	118	3 hr periods 24 hr. 14 days	7.68 (max) 2.4 (max) 0.03 (ave)
Hooker et al., 1973	Plowing of native sods	-	160 days	0.006

studies have been done on denitrification but most of these have insufficient information for rate calculation. A new laboratory approach which may have great potential in measuring denitrification rates bears consideration for the future (Bolderston et al., 1976; Yoshinari and Knowles, 1976). The technique enables measurement of N_2O as the gaseous product by blocking N_2O reduction with acetylene. Considerable examination of this technique is required before application.

A laboratory technique which extends denitrification measurements to soil-plant systems has been used to determine the effect of a number of factors on the process (Table 6). This system would not distinguish between gaseous losses from the soil and that from the plant. The previous discussion on plant N suggested that most losses occur during maturity. The 35-40 day experimental did not extend into this apparently critical stage of plant growth for N losses, therefore most of the denitrification would be a result of the soil. The experiments in the majority of cases showed that plants stimulated denitrification. This cannot be compared with a fallow vs cropped condition in the field because in the field situation the fallow would have a different moisture status than a cropped system due to transpiration. The laboratory studies reported in the table would have the moisture contents adjusted to the same percentage.

A number of workers have used another laboratory approach to simulate some field conditions by using continuous flow soil columns (Table 7). Most of these workers have applied zero or first order reaction calculations to examine the rate of the process hence the units are not uniform. McLaren (1976) suggests that microbial numbers be taken into account when calculating rate constants. The diversity of factors which may influence the rate in this experimental system is very large and this makes it difficult to relate the rate constants to field situations. Volz et al. (1974) have made an attempt to apply this approach to a particular field situation.

Very few measurements of denitrification in the field have been done because of the analytical problems associated with it. The few results available (Table 8) suggest lower rates than what might be considered from laboratory incubations (Table 1). Similar comments can be made on field measurements as on laboratory measurements (ie) the length of the measurement period can be an important factor in calculating the rate. Two possibilities exist for denitrification namely (1) short bursts of denitrification involving high rates and (2) moderate to small losses over an extended period. In both cases, measurement of the rate of the process is very difficult and no method is entirely satisfactory. It should also be noted that measurement of N_2O flux from a soil (see Table 8) only measures one of the gaseous products of the process, therefore values calculated are probably underestimated.

An alternative of measuring denitrification losses by analysing the gases evolved is through N balance methods. With the advent of isotope methods, N balances can be done with much greater accuracy than relying on non-isotope methods. A large number of ^{15}N balance studies are reported, most of which are laboratory or greenhouse studies. Table 9 displays a number of the balance studies done out in the field using ^{15}N. These results show a range of 0-1.43 kg N lost/ha/day. It must be noted that some studies eg. Shields et al. (1973)

Table 5. Laboratory incubation studies showing the effect of a variety of factors on rate of denitrification

Factor	Condition		Rate of denitrification Average	Range	Unit	Reference
Temperature (^oC)	30		149	60-257	μgN/g/day	Cooper & Smith, 1963
	25		106	86-132	"	
	20		77	60-98	"	
	35		2.98	2.17-3.79	day^{-1}	Stanford et al 1975c
	15		0.70	0.45-0.54	"	
	5		0.04	0.03-0.03	"	
Application rate (μgNO_3-N/g soil)	270		8.4	0-32.1	μgN/g/day	Wijler & Delwicke, 1954
	143		9.3	0-55.7	"	
	78		18.9	0-48.0	"	
	48		22.9	0-32.2	"	
	300		257	-	μgN/g/day	Cooper & Smith, 1963
	150		226	-	"	
	75		226	-	"	
	37.5		158	-	"	
pH	8.0		-	0-12	μgN/g/day	Focht, 1974
	6.0		-	0-6	"	
	4.35		-	0-3.5	"	
Aerobic-anaerobic cycler (total of 128 days)	Aerobic	Anaerobic				
	2	2	1.77	-	μgN/g/day	Reddy & Patrick, 1975
	4	4	1.66	-	"	
	8	8	1.56	-	"	
	16	16	1.45	-	"	
	32	32	1.31	-	"	
	64	64	1.00	-	"	
	128	-	0.50	-	"	
	-	1280	0.04	-	"	
Soil type	7 soils		-	38-91	"	Khan & Moore, 1968
	17 "		19.6	2-55	"	Burford & Bremner, 1975
	6 "		0.38	0.07-0.91	day^{-1}	Stanford et al., 1975a
	30 "		13.75	1.87-25.0	"	
	30 "		0.37	0.0264-0.9	μgN/g/day	Stanford et al., 1975b
Glucose (mgC/g soil) (15^oC)	0		0.13	0.04-0.24	day^{-1}	Stanford et al., 1975c
	0.3		0.70	0.54-0.86	"	
Cropping (15^oC)	Fallow		50	-	μgN/g/day	Bailey, 1976
	Crop		82	-	"	
Sample depth	0-25cm		0.15	0.09-0.23	"	Dubey and Fox, 1974
	25-50cm		0.01	0-0.02	"	
	50-125cm		0	0	"	
Hr. of incubation	0-4		44	30-60	"	Sandhu and Moraghan, 1972
	4-8		28	12-48	"	
	8-24		62	23-99	"	
	24-48		29	15-50	"	
	48-96		4	0-10		

Table 6. Sealed growth chamber studies of denitrification in a soil-plant (*Triticum aestivum*) system at 20C constant temperature

Factor	Condition	Rate of denitrification (kgN/ha/day)[1] Average	Range	Reference
Moisture content	8-36%	2.94	0.15-7.09	Stefanson & Greenland, 1970
	16-24%	1.69	0-6.05	
	28-36%	7.26	0-28.0	
Vegetation	Fallow	1.80	0.10-6.96	Stefanson, 1972a
	Cropped	2.11	0.15-7.15	
N source	NO_3	2.08	0.76-5.02	Stefanson, 1972b
	NH_4	0.94	0.54-3.67	
Sample	Undisturbed	0.40	0.25-1.61	Stefanson, 1972c
	Disturbed	0.60	0.47-1.97	
Soil	Pasture	1.97	0.77-4.76	Stefanson, 1973
	Cultivated	0.93	0.24-1.70	
Fertilizer depth	5 cm	1.35	0.45-2.24	Stefanson, 1976
	15 cm	1.35	0.87-2.02	
	25 cm	1.35	0.67-2.24	

[1] Experimental period between 35-40 days

Table 7. Denitrification from continuous flow soil[1] columns

Temperature (°C)	Other Conditions	Average	Range	Units	Reference
20	2 sequential runs	0.0024	0.003-0.0017	hr^{-1}	Starr et al, 1974
19.5	ambient atmosphere	0.002	-	"	
"	0.5% O_2	0.019	0.003-0.05	"	
"	5% O_2	0.001		"	Misra et al,
"	20% O_2	0.0035	0.001-0.008	"	1974a,b
34.5	0.5% O_2	0.035		"	
"	5% O_2	0.04		"	
"	20% O_2	0.045		"	
22	zero order calc.	0.056		μgN/g/hr	Doner et al, 1974
"	perfusion		$1.2\text{-}2.3 \times 10^{-5}$	ppm/hr cm^{-3}	Ardakani et al,
"	100 ppm NO_3 after				1975
	various condition-	0.2		μgN/g/hr	Doner, 1975
	ing				

[1]Soils were either Hanford sl or Columbia sil.

Table 8. Estimations of gaseous N loss from field systems

Method	Soil		Rate of denitrification (kgN/ha/day)	Reference
N_2O flux measurement	Urrbrae (fsl)		0.01-0.09	Burford & Millington, 1968
Gas measurements	Chernozem &	Day time	0.0004-0.0065	
	Podzol	Entire day	0.0004-0.0215	
	Chernozen		0.0076	Borisova et al,[1] 1972
	Podzol		0.0029	
N balance	Chernozen		0.695	
	Podzol		0.363	
N_2O flux measurement	Permanent pasture		0.010	
	Pasture cropped		0.28	Burford and Stefanson, 1973
	Cultivated cropped		0.26	
	B horizon		0.008-0.024	
NO_3 changes in ponded soil	Hanford (56) Aug	2-7	1.45	
		7-9	2.47	Volz et al, 1975a
		9-13	0.70	
		13-15	2.31	
N_2O and $^{15}N_2$ flux measurement	Yolo (1)		0-12	Rolston et al, 1976

[1]Measurements during June through August

show almost complete recovery of ^{15}N applied and in many cases it is a result of the experimental set up which may or may not relate to practical methods. In the example given, glucose was added at such a rate that N was immobilized leaving little or no NO_3 available for denitrification. This may be similar to adding N fertilizer to high straw situation which Myers and Paul (1971) did show reduced denitrification. Other cautions must be given when considering these results for denitrification. First, it has to be assumed that unrecovered N is denitrification. Other types of losses, such as volatilization, chemical decomposition may also be included which may result in overestimation of the rate of this particular process. On the other hand, ^{15}N only gives information on the labelled input (ie) loss due to the fertilizer N and will not include denitrification of unlabelled soil N. This would result in underestimation of the rate of denitrification from the soil. Isotope N balances have been done on forested situations and are not discussed here except to mention a couple of reviews (Gessel et al., 1973; Knowles, 1975).

Long term balance sheets using non-isotope methods will include both soil and fertilizer N. Allison (1955; 1965) and Kundler (1970) reviewed the literature available on N balance sheets and concluded that 5-30% (average 15%) of the nitrogen in a soil system is lost, most likely due to denitrification. Table 10 summarized the information available on rates of denitrification from Allison's review. The author of the review discussed the limitations of such an approach. Other balance sheets are probably available since this review, but considering the limitations of the method little additional information can be added. Two specific cases of rates that can be calculated from non-isotope balance sheets suggest very high rates of denitrification (eg) minimum of 3.9 and 717 kg N lost /ha/day from Wallingford et al (1974) and Avorimelech and Ravek (194) reports, respectively. These are cases where large losses of N by denitrification would be expected.

In conclusion, one can see that although considerable work has been done on denitrification and other gaseous N losses most studies have considered the process from a qualitative rather than quantitative aspect. Rates shown in the tables were largely calculated from the data provided in the report. Many other reports did not have sufficient information to make rate calculations. The comments in the text showed limitations of available data (eg) timing of measurement especially, and if this area is to be understood more fully then experiments designed with this specifically in mind must be done.

MINERALIZATION

Mineralization of soil nitrogen is the conversion of organic nitrogen to inorganic nitrogen. The first inorganic N compound formed is NH_4^+-N, but in most soils nitrification (oxidation of $NH_4^{\pm}$N to NO_3^--N) proceeds very rapidly such that NH_4^+-N does not accumulate. The result then is decrease of the organic N with a corresponding increase in NO_3^--N rather than ammonium. The term ammonification is often used as the conversion of organic N to NH_4^+-N and nitrification is used for the further oxidation of NH_4^+-N. Mineralization is used synonymous to ammonification in some of the literature but often is used as a term including ammonification and nitrification. In this discussion mineralization is used as the term for formation of inorganic N from the organic N which may or may not be further oxidized. It should also be remembered the inorganic N can be converted to organic N (immobilization concurrent to mineralization) therefore measurements of inorganic N changes are usually values for the net effect of these processes.

Similar to denitrification, mineralization is difficult to quantify, not only because changes of inorganic N are a net result of mineralization and immobilization but other gains (N fixation, precipitation, etc.) and losses (denitrification, volatilization, leaching, etc.) must also be considered. In a plant system, it is almost impossible to separate the contribution of mineralized soil N from N extracted from deep in the profile to plant N. It is for this reason that considerably more information is available from laboratory than from field studies.

Since almost all of the N in soil is organically bound and since plants are not able to absorb significant amounts, mineralization is an important process in soil-plant systems. In order to assess the adequacy of the soil to supply N to a crop, the initial level of inorganic N and the rate of mineralization have to be considered. The most difficult part of this exercise is to determine the rate of mineralization. There has been an early and continuing interest in incubation systems which give information on mineralization rates (Harmsen and van Schreven, 1955; Bremner, 1965; Keeney and Bremner, 1966, a, b 1967). There have been many variations of the incubations with some attempts to simplify the procedure by forming a chemical test (Jenkinson, 1968). A major problem associated with this procedure is relating the mineralization rate to field conditions. More recently this concept has been pursued at greater depth with modifications to take into consideration temperature (Stanford et al., 1973a, 1975), moisture content (Stanford and Epstein, 1974) and length of incubation (Stanford et al., 1974 besides soil effects (Stanford and Smith, 1972). These values have also been related to plant growth (Stanford et al., 1973b). Table 11 shows results of this type from several studies. Comparisons are difficult because of differences in incubation methods, duration of test, type of storage, etc. Use of this test has gained various responses in application to fertility assessment. In Ontario, for example, an incubation system pioneered by Eagle and Matthews (1958) was eventually abandoned because of lack of confidence. It is also difficult to relate these incubation rates to rates that occur in the field. Values obtained in this way are usually high with short term incubations in the laboratory often relating to mineralization throughout an entire growing season (Harnsen and van Schreven, 1955). Mineralization potentials give relative rather than actual N-supplying capacities of soils (Stanford, 1973).

Simplicity is an important factor in choosing a method of evaluating mineralization potentials of soils, therefore, short incubations under constant moisture content and temperature are desirable. However, comparison with field observations have suggested that field situations are much more complex. Laboratory studies have shown that environmental factors such as freezing-thawing, wetting-drying, partial sterilization, fluctuating temperatures and moisture-temperature interactions (Mack, 1963; Agarwal et al., 1971; Biederbeck and Campbell, 1973; Shields et al., 1974; Kowalenko and Cameron, 1976) and soil factors such as pH,

Table 9. Denitrification rate calculated from ^{15}N balance study under field conditions

Crop	Duration (days)	Rate of denitrification (kgN/ha/day)	Reference
Corn	730	0.07-0.16[1]	Owens, 1960
Corn	56	0.48	Firth et al., 1973
	84	0.49	
Oats	Assume 100	0.16-0.20	Zamyatina et al., 1968
"	" "	0.16-0.50	Zamyatina, 1971
"	" "	0.17	Koren'kov et al, 1975
Wheat	Assume 120	0.03-0.33	Myers & Paul, 1971
Wheat	0-28	0	
	28-70	0.16	
	70-105	0.47	
	0-105	0.22	Craswell & Martin, 1975
Fallow	0-28	0	
	28-70	0.40	
	70-105	0.21	
	0-105	0.22	
Barley	0-85	0.48	
Fallow	0-43	0.63	
	43-85	0.75	Kowalenko (unpublished
	85-159	0.09	data)
	159-316	0.15[2]	
	316-511	0.06[2]	
Sorghum	142	0.06-0.30[3]	Westerman et al, 1972
"	58	0.41	Kissel et al, 1976
	149	0.13	
Sudan grass	56	0.24-0.72	Carter et al, 1967
	70	1.10[2]	
Pasture			
- autumn fertilization	0-28	0-1.43[4]	
	0-84	0.06-0.47	Simpson, 1968
- winter fertilization	0-28	0.02-0.88	
	0-84	0.03-0.53	
Pasture			
- prairie-like soil	56	0.34	
- solodic "	301	0.002	Vallis et al, 1973
- yellow & gleyed podzolic soil	56	0.002	

[1]Rate increased with increasing level of irrigation
[2]Some evidence of leaching losses
[3]Rate increased with increasing rate of fertilization
[4]High rate of loss may include volatilization of NH_3

Table 10. Denitrification rate from long term balance sheets (Allison, 1955)

Place	Duration (yrs)	Number of treatments	N not accounted for (kgN/ha/yr) Range	Average
I Lysimeter experiments				
Ithica, NY	15	2	45-49	47
" "	8	4	4-50	24
Geneva, NY	16	2	12-52	32[1]
Windsor, Conn.	10	11	[+12][1] 8-72	24
Riverside, Calif.	15	6	1-36	24
II Field experiments				
Rothemsted, Eng.	60	4	[+2][1] 4-160	55
New Brunswick, NJ	40	10	49-87	66
Overall range			1-160	
kgN/ha/day			0.003-0.44	

[1]Net gain of N
[2]Average included net gain

Table 11. Some mineralization potentials of soils using laboratory incubation methods.

Number of soils	Duration (wks)	Temperature (°C)	Rate Range (Ave)	Reference
5	1	35	49-92(70) μgN/g/wk	Eagle & Matthews, 1958
10	1	30	16-58(32) " "	Keeney & Bremner, 1967
"	3	30	9-30 (18) " "	
53	3	25	3-37 (12) " "	Jenkinson, 1968
10	2	"	-2-64(23) " "	Lathwell et al, 1972
"	16	"	2-16 (7) " "	
39	30	35	[1]0.054-0.009 wk^{-1}	Stanford & Smith, 1972

[1]Rate constant

nitrogen and carbon fractions etc. (Haque & Walmsley, 1972; Dancer et al., 1973; Mundra et al., 1973; Cornfield, 1952; Cornforth, 1971) can influence mineralization rates. Carbon amendments will alter the balance of mineralization-immobilization (Black and Ritz, 1972; Ahmad et al., 1972, 1973), which is a very important consideration in systems cultivating straw or other organic residue into the soil. The nature of the organic material, particularly the C/N ratio is critical in the mineralization-immobilization balance. Ordinary chemical methods can only measure the net result of mineralization-immobilization processes, but tracer techniques have the advantage of distinguishing more clearly the relative importance of the two opposing transformations. A variety of laboratory studies using tracer techniques have greatly added to our understanding of these processes (Hiltbold et al., 1950; Janson, 1958; Broadbent, 1966; Moore and Russell, 1970; Wojcik-Wojtkowiak, 1972; McGill et al., 1975; Chichester et al., 1975).

Experience with field and laboratory information has resulted in the generalization that 1 to 3% of the soil N is mineralized during the growing season (Bremner, 1965a,b; Woodruff, 1949; Slater and Green, 1933; Bartholomew and Kirkham, 1960). This type of information has limited usefulness when specific cases are being considered and particularly when rate information is desired for specific reasons or parts thereof. Table 12 shows estimated average daily rates of mineralization that can be calculated from field data provided. It should be remembered the kind of problems associated with this type of calculation (ie) losses and gains make a difference as well as the season and length of time between measurements. However, the data does show a range between 0 and 3.84 kgN released/ha/day. Tracer techniques, whether using ^{15}N, Multiple labelling or radio-carbon dating, has and will add greatly to understanding the dynamics of organic matter degradation in soils (Clark and Paul, 1970; Shields and Paul, 1973).

Another approach to the consideration of N mineralization is the effect that cultivation has on organic N. In general, cultivation results in a decline of the organic nitrogen and in order for the N to be lost as NO_3, N must be mineralized. It appears that the cultivation increases net mineralization - the soil from the virgin equilibrium level until a new lower equilibrium level has been reached (Bartholomew and Kirkham, 1960; Stevenson, 1965). There has been recurring interest in this aspect in western Canada (Alberta Soil Sci. Workshop, 1976; Martel and Paul, 1974; Ferguson and Gorby, 1971; Bishop and Atkinson, 1954; Campbell et al, 1975) and few studies in eastern Canada (Ho-Yen et al., 1954).

More recently, mathematical simulation activities have had to consider this process and its rate in the soil and many approaches are possible (Morel, 1970; Dutt et al., 1972; Beek and Frissel, 1973; Hagin and Amberger, 1974; Greenwood et al., 1974; Campbell et al., 1974; Russel, 1975; Parnas, 1975; Slavnina and Pashveva, 1976). These as yet have theoretical beginning and have yet to be adequately tested particularly under field conditions.

Table 12. Average daily rate of mineralization estimated from field studies

Location	Soil	Duration of measure	Mineralization (kgN/ha/day) Average	Range	Reference
New York	-	15 yr.	0.12	0.10-0.14	Allison, 1955
"	-	16 "	0.26	0.16-0.36	
Connecticut	-	10 "	0.03	0-0.11	
"	-	10 "	0.09	0-0.21	
California	-	15 "	0.26	0.15-0.39	
England	-	59 "	0.03	0-0.08	
New Jersey	Limed	40 "	0.12	0.02-0.19	
	Unlimed	40 "	0.16	0.06-0.21	
Saskatchewan	Chern. Blk.	191 days	0.41	0.14-0.64	Shields *et al*, 1973
"	" Br.	1 yr.	0.21	-	Rennie *et al*, 1974
S. Ontario	Maple woodlot	2 yr.	1.75	3.84-0.64	Ellis, 1974
	Pasture	"	1.51	-	
	Pine plantation	"	0.43	-	
	Old-field	"	0.56	0.96-0.64	
E. Ontario	Orthic Gleysol	85 days	0.93	0.77-1.10	Kowalenko, unpublished

PLANT UPTAKE

Another very important N process in the nitrogen cycle of soil systems in plant uptake. A great deal of work has been done on this subject both from a plant physiological (Baldwin, 1975; Baldwin et al., 1972; Bassioni, 1972; Brewster and Tinker, 1972; Clarke and Barley, 1968; Hillel et al., 1975; Nielsen, 1972; Pate, 1973; Philips et al., 1976; NaNagara et al., 1976) and soil-modelling (Caassen and Barber, 1976; Greenwood et al., 1974; Seligman et al., 1975) orientation. This review is not intended to cover all aspects of nitrogen uptake rate but rather to present sufficient data to get a general picture of the situation. Emphasis is placed on field data and on selected crops (ie) corn, soybean, tobacco, wheat, rye, tomato and potato which were grown in the plots involved in this project. Several general comments can be made at the outset about a review of this type. First, few field studies have the rate of N uptake as the primary objective and the rates have been calculated from data presented. Many studies potentially have suitable data for this calculation except that one or two bits of information are not recorded (ie) precise length of time between samplings, N content of all plant parts, etc. The other prevalent feature of these reports are that most studies of plant N in the field do not include the contribution of the roots. This is probably because of the extreme difficulty of getting an accurate measure of the root mass and its N concentration. Often approximations are made of the contribution of root N to the total N of the plant (Viets, 1965; Stanford, 1973). This review then attempts to show N uptake rate using data of changes of plant N over specified time intervals. Many of the studies only include above ground plant parts and if a true rate is desired, an approximation of plant root N over that period can be added. Where possible, references on root N are suggested and possibly solution culture values may be useful.

(1) Corn

Table 13 shows representative uptake rates of N by corn and the data shows a relatively wide range of rates and that these rates can vary depending on the period of growth. The data in table 13 does not include the nitrogen in the root and if desired the root N may be estimated by considering root development patterns (Follett et al., 1974; Mengel and Barber, 1974; Warnacke and Barber, 1974) and the % N in roots at these stages. A management practice that may influence the uptake on a hectare basis would be planting density and Table 14 shows results of uptake rate based on a single plant basis. This shows the rate can vary considerably and at certain stages of growth there may be a net loss of N (this may be due to loss of pollen, etc - Viets, 1965).

Not all of the plant N is removed from the soil system upon harvest and the proportion that remains depends on the management system. For example, corn may be only grown for the grain and the stover is worked back into the soil. In that case, about 50-61% of the above ground plant N will be removed with the grain (Chaudhary et al., 1975) and the remainder becomes part of the soil system. A much greater amount of N is removed from the system if corn is used for silage.

Table 13. Average daily rate of N uptake by above ground parts of corn calculated on a per hectare basis

Time	Uptake rate-Av.(range) kgN/ha/day	Reference
1971	0.93 (0.72-1.13)	Chaudhary et al, 1975
1972	1.04 (0.90-1.16)	
June 1 - July 29	1.49 (0.37-2.29)	Hanway, 1962
July 1 - Sept 22	0.80 (0.05-1.24)	
Unspecified	3.15	Firth et al, 1973

Table 14. Rate of N uptake by corn calculated on a per plant basis

Days after seeding	Uptake rate (mgN/plant/day)	Reference
0-12	1	
12-19	6	
19-26	38	
26-33	81	
33-40	93	
40-47	96	Bar-Yosef and[1]
47-54	159	Kafkafi, 1972
54-61	-21	
61-68	-46	
68-75	11	
75-83	-7	
83-90	-18	
Av.	30	
34-49	77(52-96)	
49-76	47(12-74)	NaNagara *et al*, 1976
76-97	37(21-46)	
34-97	51(32-68)	
1970 0-14 (after silking)	31	
14-28 " "	17	Beauchamp *et al*, 1976[1]
1971 0-28 " "	26	

[1]Does not include accumulation of N in roots.

(2) Potatoes

Ezeta and McCollum (1972) provide a review table of N uptake rate by tops and tubers with a range of 1.7-4.2 kg N/ha/day. Reports by Soltanpour (1969) and Lorenz *et al*. (1974) suggest lower rates of uptake, with 0.20-1.25 kg N/ha/day calculated from their data. In each of these reports the roots were not included hence root development data and root N concentration are needed to estimate the contribution of this part to the total plant N (DeRoo and Waggoner, 1961; Ezeta and McCollum, 1972; Li and Soyre, 1975; Lesczynski and Tanner, 1976).

Unlike corn, a portion of the underground plant part (tuber) is removed entirely from the soil plant system, hence tuber N is lost from the field. Tuber N accounts for about 71% of the total N taken up (Soltanpour, 1969).

(3) Soybeans

It is difficult to know how to approach N uptake rate of soybeans since they are capable of fixing N by symbiotic process. This means that part of the N uptake may be from the air as well as from the soil, when the symbiotic process is proceeding. Table 15 presents uptake data and although nodulated and nonnodulated values are shown, it is difficult to know the exact distribution of N uptake between soil and air sources. Eck and Davis (1971), Hanway and Weber (1971a) and Mitchell and Russell (1971) may be useful references to estimate the contribution of roots to N uptake rate calculations.

Between 65-89% of the above ground plant-N is seed N at harvest (Hanway and Weber, 1971b; Ham *et al*., 1975).

(4) Tobacco

Table 16 presents data on N uptake rate of tobacco considering the entire plant. In a field system, N uptake rate is important from transplant to harvest. Planting density may be important in considering uptake on a hectare basis so uptake rate on a single plant basis is included. The results show a wide range - rates dependent on the plants and environmental/fertilizer conditions as well as stage of growth.

A majority of the above ground plant N is removed at harvest but about 25% of the plant N will remain as roots (Takahashi, 1974).

(5) Tomato

There appears to be little work on N uptake by the entire tomato plant under field conditions probably because of the convenience of leaf N analysis to determine the nutrient status and greater interest in greenhouse growth conditions. Table 17 shows data on N uptake considering only above ground parts. More information on N uptake rate by tomatoes may be gathered from greenhouse and other non-field studies with suitable precautions (Cannell *et al*., 1963; Ajayi *et al*., 1970; Shelton, 1976).

At harvest about 61% of the above ground plant N is present in the fruit (Hester, 1938).

Table 15. Rate of N uptake by above ground parts of soybean

Rate of N uptake (kgN/ha/day)		Reference
2.02		Hanway and Weber, 1971b
1.72 (4.9 max.)		Hammond *et al*, 1951
Non nod.	Nod.	
0.49-2.67	0.68-2.12	Ham *et al*, 1975

Table 16. Rate of N uptake by tobacco on hectare and single plant basis

Time (days)	Rate of uptake gN/plant/day	Reference
July 10 - July 24	0.15 (0.12-0.19)	Zartman, Phillips &
July 24 - Aug. 7	0.16 (0.05-0.12)	Atkinson, 1976
Aug. 7 - Aug. 21	-0.01 (-0.05-0.01)	
Aug. 21 - Aug. 28	0.04 and 0.11	
Aug. 21 - Sept. 6	0.10 and 0.10	
65 after transplant	0.17	Takahashi, 19
93 " "	0.22	
	kgN/ha/day	
31-45 after transplant	3.2 (2.5-4.1)	
45-59 " "	3.4 (1.1-6.4)	Zartman, Phillips &
59-73 " "	0.06 (0-0.2)	Leggett, 1976
73-83 " "	1.8 (0.9-2.3)	

Table 17. Rate of N uptake by tomato plants (above ground parts)

Time (days)	Uptake rate (gN/plant/day)	Reference
30	0.02	
60	0.12	Hester, 1938
90	0.36	
Av	0.16	

(6) Wheat

Table 18 shows the range of daily uptake rate by wheat as effected by stage of growth and environmental/fertilizer conditions. Most of the data includes above ground plant parts only, but the report of McNeal *et al*. (1966) supplemented by knowledge of root development (Troughton, 1962; Welbank *et al*., 1974) may make the results more meaningful in terms of the total N uptake.

Wheat grain may account for 72-82% of the above ground plant N at harvest.

(7) Rye

The rate of N uptake is rather difficult to assess if it is plant in the fall. This type of planting would result in a long dormant period over winter where the uptake calculation over the growing period would become meaningless. There appears to be little, if any, field oriented data where N uptake by fall rye can be calculated. This probably also reflects the relatively lower economic value of this cereal. Rumberg and Sneva (1970) have some field data of N uptake but only in the flowering stage where there was an apparent loss. Their nutrient solution culture experiment shows 0.013 and 0.004 g N uptake/plant/day for 11 and 23 successive periods.

Grain N may account for 29% of the total plant N at harvest.

Table 18. Rate of N uptake by wheat using only above ground plant parts and total plant

Time after planting	Uptake rate (kgN/ha/day)	Reference
0-20	1.49	McNeal et al, 1966[1]
20-33	3.90	
33-42	3.71	
42-54	2.92	
54-64	0.88	
64-84	0.20	
84-94	1.42	
0-94	1.86	
210	0.77	Fuehring, 1969
1956-60	1.01	Widdowson and Penny, 1972
1961-65	0.82	
1966-1970	0.78	
June 16 - July 2	1.59	Spratt, 1974
July 2 - July 15	1.90	
July 15 - July 28	1.93	
July 28 - Aug. 12	-1.18	
Aug. 12 - Aug. 28	1.04	
0-42	0.58(0.50-0.65)	Craswell and Strong, 1976
0-70	1.09(0.91-1.43)	
0-119	0.87(0.72-0.97)	

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GASEOUS LOSS OF N

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INTERNATIONAL JOINT COMMISSION
GREAT LAKES REGIONAL OFFICE
100 Ouellette Avenue
Windsor, Ontario N9A 6T3

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