AN ABSTRACT OF THE THESIS OF

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Soils of 49 agricultural and 2 "native condition" sites in the Lower Umatilla Basin, Oregon were sampled for nitrate-nitrogen, ammonium-nitrogen, chloride, and pH beginning in Fall of 1992. Several sites were sampled in Spring and Fall 1993 in order to indicate movement or loss of residual soil nitrogen over time. This study was prompted by current concern over contamination of public drinking water supplies by nitrate and the designation of over 550 square miles of this region as a Ground Water Management Area.

This study sought to identify links between agricultural management practices-primarily irrigation, fertilization, and crop rotation systems, and deep soil nitrate levels. Soil profiles were divided into 3 "management zones:" 0-3', 3-6', and beyond 6' in depth. These depths represent average rooting depths for the major agricultural crops of the study area. In general, the effective rooting depth of most area-crops does not extend beyond 6', therefore, it was determined that residual soil-nitrate found at this depth or beyond may be a potential source of ground water contamination if not managed correctly.

Results of the study indicate that proper management of irrigation, fertilization, and cropping rotation can significantly reduce the potential for contaminating ground water. Deep soil nitrate levels under most agricultural fields were consistent with the concept that some loss of nitrate below the root zone is inevitable, however, this condition can be minimized through intensive crop management.

This study concludes that responsible management of agriculture can minimize impacts on ground water, while providing quality food and fiber products to an ever-growing population. In addition, more research is needed in the area of crop physiology and response to intensively managed systems. Such research may provide insight into more efficient methods of crop production and environmental protection.

Deep Soil Nitrogen Survey, Lower Umatilla Basin, Oregon

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Zachary Augustus del Nero

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I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

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Zachary Augustus del Nero, Author

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INTRODUCTION

Nitrate levels exceeding the US Environmental Protection Agency's standard of 10 ppm, have been found in public groundwater supplies in the Lower Umatilla Basin of northeastern Oregon. This area includes some of the highest producing irrigated agricultural operations in the Pacific Northwest, as well as a wide diversity in plants, fish, and wildlife. Past management practices by area agriculture, industry, and urban developments have resulted in contamination of groundwater by chemical residues, nitrates among them.

Drainage basins, draws, and low areas may become pools or sinks for the highly soluble nitrate ion as it is carried along by excess soil moisture. The coarse-textured soils of this region characteristically are well to excessively drained, increasing the hazard of nitrate leaching losses with excess moisture.

Point source pollution may occur as a result of effluent disposal from food-processing plants, particularly those which process potatoes. Nitrate in the effluent is easily mobile as it is carried along with the waste water. Non-point sources may include: confined animal feed lots, dairies, swine farms, poultry farms, irrigated and non-irrigated crop production, and residential/urban wastes. Some consider many of these as possible point sources as well; the definition is not as important as the concept.

More than 144,000 hectares of this region, reaching into Umatilla and Morrow counties, have been designated as a Groundwater Management Area under the regulatory authority of the Oregon Department of Environmental Quality (ODEQ). The Lower Umatilla Basin Groundwater Management Area (LUBGWMA) was defined, and the Lower Umatilla Basin Groundwater Management Committee (LUBGWMC), comprised of area residents, agricultural producers and processors, and federal and state agency officials, was appointed. The LUBGWMC is charged with developing a comprehensive Groundwater Management Plan for the study area, in order to best provide for all interests.

This study was developed to provide data that might be utilized in development of the LUBGWMC Plan. It should provide information about current levels of nitrate-nitrogen (NO3-N) at depth under irrigated agricultural fields, under a variety of management systems. In order to study the effects of different farm management systems on nitrate leaching into ground water, soil analysis must be extended from the root zone to deeper soil layers (Maidl et al,1991). Soil samples were taken to depths of up to 14' using a truck-mounted Giddings soil probe, though some shallow areas could not be probed beyond 24". Sampling sites were scattered across the LUBGWMA, giving an "area-wide" view from the survey. It was hoped that this survey could identify certain practices, such as crop rotation, which could be linked to decreased amounts of nitrate below the effective rooting zone for crops.

This study was conducted over two years between June 1992 and July 1994. Samplings of 47 different fields, including two "native-condition" sites, were collected from September to December 1992. Nine sites were sampled again in the Spring of 1993. Ten sites were sampled in the Fall of 1993.

Agricultural producers are sometimes reluctant to divulge their management plans. Concern over increased governmental regulation has generated even more reluctance, so participants in this survey were guaranteed anonymity. The numbers and data generated by this survey would be available to the public; however, the individual site locations and operator identities would be confidential. Even with this assurance, many were still reluctant to, or were unable to volunteer much information on fertilizer and irrigation rates.

LITERATURE REVIEW

Nitrates in Ground Water

Health Concerns

Nitrate (NO3-N) has been identified as a potential health hazard when present in ground water at concentrations above the US Environmental Protection Agency's standard of 10 ppm in drinking water. Contamination of ground water by nitrate and other agrichemicals is of concern in many areas of the United States (CAST,1992; Doerge et al.,1991). The importance of ground water in the USA is illustrated by the fact that ground water is the source of drinking water for about half the population and about 85% of the rural population (CAST,1985).

When ingested, nitrate is reduced to nitrite (NO2-) in the oral cavity of the stomach and absorbed from the gastro-intestinal tract into the blood (Shuval&Gruner,1972). The resultant condition, known as metheglobinemia or "blue baby syndrome," is an impairment of the blood's ability to carry oxygen. Nitrite in the bloodstream becomes involved in the oxidation of hemoglobin to methemoglobin. Nitrite firmly bonds the ferric iron, thus inhibiting transport of oxygen in the blood (Jaffe,1981).

In terms of risk to public health, infant humans have been identified as the most susceptible to problems associated with nitrate contamination. This is illustrated by the common name "blue baby syndrome." Infants younger than 3 months are highly susceptible to gastric bacterial nitrate reduction because they have very little gastric acid production and low activity of the enzyme that reduces methemoglobin back to hemoglobin (Super et al,1981;Duijvenbooden and Matthijsen,1987; Follett&Walker,1989).

Fine (1982) suggested an association between nitrate intake and gastric cancer, based on the correlation of stomach cancer mortality rates against previously published data on daily nitrate intake in various countries. Experimental evidence does not show nitrate and nitrite, in and of themselves, to be carcinogenic. Nitrite can give rise to the formation of N-nitroso compounds by reaction with "nitrosatable compounds", including secondary and tertiary amines and amides, N-substituted ureas, guanadines, and urethanes. It is presently impossible to make a scientifically reliable estimate of the risk of human cancer posed by exposure to nitrate in drinking water and the possible formation of N-nitroso compounds (Follett&Walker,1989).

Ruminant animals are also sensitive to nitrate toxicity. Growth, lactation, and reproduction rates may be reduced significantly under high nitrate conditions (Wright&Davidson,1964). Follett and Walker (1989) report that nitrate toxicity is primarily a problem with ruminants in which bacterial reduction of nitrate to nitrite occurs in the rumen during the first stage of digestion and the nitrite is absorbed through the oral and gastro-intestinal tract into the blood. However, the formation rate of methehemoglobin varies considerably among species.

Current Conditions

The incidence of ground water contamination in Oregon has steadily increased as the Oregon Department of Environmental Quality (ODEQ) has improved its methods of detecting contaminated sites and has increased efforts to locate contamination (ODEQ,1992). Unacceptably high levels of nitrate contamination (Pettit,1990) in ground water (up to 76 mg/L) have led to approximately 1,440 square kilometers (550 square miles) in the Lower Umatilla basin, in Morrow and Umatilla Counties, to be designated as a Ground Water Management Area (IRZ,1993).

Some 150 wells in the Lower Umatilla Basin were tested for contaminants (including nitrates) by the Oregon Department of Environmental Quality (ODEQ). As of July, 1991, 26 of those wells were found to be in excess of the US EPA standard of 10 ppm nitrate, some reading as high as 100-200 ppm. In 1992, the ODEQ began a synoptic sampling of several hundred area wells to determine the extent of the contamination.

The precise sources of nitrate have not been identified; however, wells with the highest nitrate levels are often located in close approximation to food processing plants (primarily potato processors) and confined animal feedlots (ODEQ,1994). Potential sources of ground water contamination in the LUB area include but are not limited to: leaky canals and other water conveyances, ground water recharge projects, household septic systems, municipal sewage disposal, confined animal feedlots, agricultural operations, industrial processors, the US Army Umatilla Ordinance Depot, the U.S. Navy Bombing Range, and the Portland General Electric (PGE) coal fire plant generator (Fitch&Camacho,1992). IRZ Consulting (1993) reported that the irregular distribution of nitrate levels is consistent with point source loading. Keeney (1989) concluded that the literature leaves no doubt that in farmed areas, agricultural activities comprise the bulk of the non-point sources of nitrate.

The ODEQ identified the Lower Umatilla Basin as a Ground Water Management Area under legislative authority. The Oregon legislature adopted the Ground Water Protection Act in 1989 (Oregon House Bill 3515, sections 17 through 66). This act seeks to prevent contamination of Oregon's ground water resource while striving to conserve and restore this resource and maintain high ground water quality for present and future generations (ODEQ,1991). Under this plan, an advisory board (Ground Water Management Committee) of area producers, residents, and governmental agency representatives was established to develop a plan to mitigate the contamination problem.

Nitrogen in the Soil

Nearly 80% of the earth's atmosphere is nitrogen; however, soil nitrogen levels in the LUB area, as in many areas of the world, are insufficient to support crop production. The following sections will discuss various parts of the nitrogen cycle; focusing on pathways for input and loss of soil nitrogen from an agricultural field.

Nitrogen Input Pathways

Basically, there are six sources of soil nitrogen: (1) organic matter decomposition, (2) animal wastes, (3) nitrogen fixation, (4) agricultural fertilizers, (5) effluents and urban wastes, and (6) geologic sources. Fitch and Camacho (1992) identified several specific sources of nitrate in ground water in the LUB area.

When crop residues and other organic material is left in the field to decay, soil microbes drive the nitrification process. In this process, microorganisms utilize soil carbon and nitrogen and immobilize the nitrogen in their bodies. As the C:N ratio changes and the microorganisms die, their bodies release plant-available forms of nitrogen, thus mineralizing the nitrogen. Rates of mineralization vary from climate to climate and arid areas (like the LUB area) exhibit reduced levels- excepting irrigated fields which receive large amounts of plant residue (Brady,1990).

Animal manures are often concentrated in large commercial poultry, dairy, pork, and beef operations. Under these conditions, manures are difficult to handle and are often disposed of rather that recycled, by application to croplands at rates far in excess of fertilizer N needs (Keeney,1989). Manures may also collect in lagoons, draws, and natural depressions in the topography. These concentrations may represent a significant threat to maintaining ground water quality (Saint et al,1991). In pasture, animal wastes are deposited in concentrated patches, leading to inefficiency of waste N-use and potential for N-losses leading to ground water contamination by nitrate (Keeney,1989).

Nitrogen fixation occurs through biological and atmospheric means. Several species of nitrifying bacteria (perhaps most notably, *Rhizobium* spp.) are able to form a symbiotic relationship with leguminous plants. Under adequate conditions, with adequate inoculation of host-plant roots, the bacteria are able to fix large amounts of nitrogen to the soil. Table 1 identifies several leguminous crops and amounts of nitrogen fixed annually (Tisdale&Nelson,1975). Atmospheric fixation occurs and nitrogen is added to the soil through precipitation or lightning sources. While contributing a significant portion to the soil of the globe, N-fixation is not as significant as agricultural fertilizer application in the LUB.

Table 1. Nitrogen Fixation by Crops

CROP	#/A/Yr N-Fixed	CROP	#/A/Yr N-Fixed
Alfalfa	194	Soybeans	100
Peas	72	Beans	40

The use of fertilizers in agriculture is generally assumed to be a major source of nitrate pollution (Addiscott et al,1991). Water and nitrogen requirements for a number of agricultural crops in the LUB area are presented in Tables 7-8 on p 22. In the LUB area, most nitrogen is applied under center-pivot irrigation systems in several forms including ammonium nitrate, ureas, and other compounds. Fertilizer is typically applied preplant, at planting, supplementary through the season, or any combination of the three. Table 2 lists several modern agricultural fertilizer sources of nitrogen and their average nitrogen content (Brady,1990;Tisdale&Nelson,1975).

Table 2. Percent Nitrogen of Fertilizers

FERTILIZER	% N	FERTILIZER	% N
Anhydrous ammonia	82.2	Ammonium sulfate	20.5
Ammonium nitrate	32.5	Sodium nitrate	16.0
Urea	46.0	Dairy manure	7.0

Many of the LUB area crops, particularly the shallow-rooted species, are difficult to manage for fertilizer and water on the coarse textured soils of this region. Potatoes are a particular challenge, as they are intolerant of long periods of moisture stress. Potatoes receive nitrogen fertilizer and water far in excess of many other crops. Their roots intercept only a portion of the volume of the root zone, and nitrate leached below about 15 to 20 cm is not recovered by the potato crop (Keeney,1989). Potatoes may leave a significant amount of nitrogen in the soil profile following harvest (Connell&Binning,1991).

Effluents and waste from industrial processors and residential septic systems have been identified as possible sources of nitrate contamination of ground water. Wells with the highest nitrate levels are often located in close approximation to food-processing plants (primarily potato processors) in the LUB area (ODEQ,1994).

Effluent water may be disposed of by pumping it out onto crop fields through irrigation systems. Nitrogen fertilizer rates often exceed crop N-requirements (Pumphrey et al,1991). Significant pollution could result from septic tanks in developed urban areas as well.

Geologic sources of nitrate have been identified as significant sources of ground water contamination in several areas. These sources stem from geologic deposits made during geomorphic activity. Development of arid range lands into irrigated cropland carries the risk of leaching nitrate from sizable natural deposits and into ground water. However, there has been no documentation of significant "natural" geologic sources of nitrate in the LUB area. Results of soils sampling in several undisturbed locations (Appendix E, pp 95-96) supports this idea.

Nitrogen Loss Pathways

There is general agreement, that of all nutrient amendments made to soils, N fertilizer application has had by far the most important effects in terms of increasing crop production (Mengell,1987). Nitrogen may be lost from the soil profile in many ways. The most significant pathways for nitrogen losses from soils of the LUB area are: plant uptake, volatilization, denitrification, and leaching.

Most higher plants take up nitrogen from the soil as nitrate or ammonium. Typically, crops have higher nitrogen requirements early in the season (as in potato) for foliage production. Nitrogen is an essential element of amino acids, proteins, chlorophyll, and other "building blocks" of plant physiology (Brady,1990). Table 3 on p 12 lists several crops and corresponding annual nitrogen budgets, as reported by

Pumphrey et al (1991). It is evident by these "budgets," that crops in the LUB area remove as little as 50% of the available soil nitrogen. This may leave a significant amount of nitrogen in the soil profile, which is susceptible to loss by other means.

Volatilization is upward loss of ammonia-nitrogen (NH_3) to the atmosphere. After exposure to hydroxyl ions, ammonium compounds may convert to ammonia and volatilize. Improper placement of fertilizer on the soils may lead to high volatilization losses. In one study, 25-47% of the applied nitrogen was lost when urea was surface applied and not incorporated (Schaff&Alley,1988).

Denitrification is the upward loss of elemental nitrogen (N_2). This is a natural byproduct of bacterial action in anaerobic conditions. There is little evidence that significant denitrification occurs in most vadose zones or in aquifers because these zones are normally low in organic C and denitrifying organisms (Keeney,1989).

Leaching of nitrate is the most significant nitrogen loss pathway in relation to ground water quality in the LUB area. Nitrate is readily soluble and moves easily with excess irrigation and/or precipitation. Vogue et al (1990) warned of the "very high movement potential " of soils like those of the LUB area, and their susceptibility to leaching.

In the LUB area, application of excess water is most likely to occur when (1) irrigating pre- and post-planting, (2) irrigating when the crop is maturing, (3) in periods of cool, damp weather during the growing season, (4) not moving wheel roll lines often enough, and (5) using water as a means to control wind erosion (Pumphrey et al,1991). Also, excess water may occasionally be applied to leach excess salts from the profile and avoid increasing the soil salinity.

Since irrigation is capital- and energy-intensive, irrigated crops are usually high value and often receive high rates of fertilizer (Keeney,1989). The motivation for increasing nitrogen fertilizer applications is self-protection: farmers find it profitable to reduce the probability that they might be "caught short" (Babcock,1992). One study reported that up to 50% of applied nitrogen fertilizer can infiltrate to ground water under excessive irrigation (Exner&Spalding,1979).

Rainfall patterns are cited as key factors in determining nitrogen leaching rates. Heavy rains during cold periods of late fall, winter, and early spring coincide with high soil residual nitrate levels and low crop nitrogen uptake to result in a substantial increase in nitrate leaching (Schepers,1988;Hergert,1986). This is particularly important to the LUB area, where approximately 70% of the annual precipitation occurs during the cooler months (Table 5, p 18).

Nitrogen Management

Ground water contamination must be minimized to ensure a viable resource base and quality of life. The development of "Best Management Practices" (BMPs) are especially useful as guidelines for producers. The primary BMP's for minimizing nitrate leaching, cited throughout the literature, are proper irrigation management and metering of fertilizer throughout the season (IRZ,1993). Several other components of crop system management, such as crop rotation, can have an impact on leaching of nitrate. The guiding principle in controlling nitrate leaching losses is to minimize the amounts of nitrate present in the soil during periods when leaching is likely to occur (Keeney&Follett,1991).

Hergert (1986) reported that nitrate losses can be reduced by matching fertilizer rates to crop requirements and that the highest rates of nitrate leaching occurred during the winter and spring. Greater efficiency in nitrogen management may be achieved by supplemental fertilization during the growing season, thereby avoiding the practice of applying excessive amounts pre-plant or at planting. Rauschkolb et al (1984) suggested that maximum efficiency of nitrogen application could be achieved by periodically adding small amounts of N (usually less than 25 kg/ha).

Nitrogen "budgeting" is possible by adding up all potential sources of nitrate and deducting them from the total fertilizer recommendation. Pumphrey et al (1992) outlined the average annual nitrogen budget of intensively managed areas in the Hermiston-Boardman area, as illustrated in Table 3. Practices evaluated include N credit from soil and irrigation water, realistic yield goal selection, and irrigation scheduling according to crop water use (Ferguson et al,1991). The evidence indicates that many other features of contemporary farming practices have contributed to the problem and that limiting fertilizer use is an over-simplistic solution to the problem (Addiscott et al,1991).

Table 3. Average Annual Nitrogen Budgets

Per Acre	Alfalfa	Field Corn	Pasture	Potatoes	Watermelon	Winter Wheat
Yield	6.5 tons	185 bu	3 tons	480 cwt	16 tons	123 bu
N Removed	320 #/A	130 #/A	160 #/A	205 #/A	-	130 #/A
N in Residue	40 #/A	60 #/A	30 #/A	90 #/A	-	60 #/A
Total N Required	360 #/A	190 #/A	190 #/A	295 #/A	-	190 #/A
N Applied	25 #/A	280 #/A	110 #/A	350 #/A	140 #/A	195 #/A
N from Soil	300 #/A	60 #/A	40 #/A	80 #/A	80 #/A	75 #/A
Total N Available	325 #/A	340 #/A	150 #/A	430 #/A	220 #/A	270 #/A

Soil testing and plant analysis are useful in developing nitrogen management for each field and crop, for the entire season. Measurement of soil nitrate is routinely used to predict optimum N fertilizer application (Keeney&Nelson,1982). Soil sampling for nitrate should include each foot of rooting depth in the soil profile. Incremental sampling can more accurately assess availability and distribution of nitrogen in the soil. On deep soils, sampling to depths of six feet may be required to determine residual nitrogen levels (USDA SCS,1990).

Rauschkolb et al (1984) reported that it is nearly impossible to avoid loss of nitrogen below the root zone in sandy soils under furrow and flood irrigation. Improved control and efficiency with center-pivot and other irrigation systems can minimize nitrogen losses, however; a "zero loss" concept is largely unrealistic. One drawback to managing irrigation so closely that no excess is applied is the inevitable buildup of salts in the rooting zone. This process is relatively slow in the LUB area, as irrigation sources are usually of high quality, but, it is inevitable. Periodic flushing of salts from the root zone is required to maintain soil conditions favorable to crop plants. Flushing should be well timed so that minimal amounts of nitrogen are left in the soil profile (IRZ,1993).

Cropping system management is also a useful tool for managing soil nitrogen. Integration of deeper rooting crops may improve utilization of residual soil nitrate which is beyond the reach of such shallow-rooted crops as potato. Cereals and corn have high nitrogen requirements and effectively utilize residual nitrogen (USDA SCS,1990). There is some concern that deep rooting crops may actually contribute to the deep soil nitrate pool. Petersen & Powers (1991) reported that some deep rooted crops in rotation have proven effective in removing deep soil nitrogen; however, they may add considerable nitrate to the soil as their roots decompose.

Effects of winter cover cropping on nitrate leaching levels were investigated by Martinez and Guiraud (1990) in a lysimeter study. They concluded that a winter cover crop can substantially lessen nitrate leaching; in this study, nitrate leaching was reduced by up to 67%. Cover crops may serve other purposes as well; a quality crop may generate economic returns, improve soil structure and fertility, and reduce erosion.

The Lower Umatilla Basin Technical Advisory Committee (LUBTAC,1992) published the following list of recommendations for reducing nitrate contamination of drinking water supplies: (1) soil testing , (2) deep soil sampling, (3) nitrogen budgeting, (4) crop rotation with deep-rooted crops, (5) careful management of fertilization and irrigation for crop needs, and (6) use of soil stabilizing cover crops to avoid movement and concentration of nitrogen via wind/water erosion. These recommendations are in accordance with current knowledge on the subject of minimizing nitrate movement to ground water.

LOWER UMATILLA BASIN STUDY AREA

Geology/Soils

This study was conducted in the Lower Umatilla Basin of Northeastern Oregon, in the Hermiston-Boardman area. The combination of geological, topographic, climatic, and technological factors have resulted in high levels of agricultural production in the LUB over the past few decades.

The entire study area is underlain by deep formations of Columbia River basalt from the Miocene epoch. These flows cover about 100,000 square miles of Oregon, Washington, and Idaho to depths sometimes exceeding 4,000 feet (Fenneman, 1931). The maximum thickness of the basalt in the study area is known to exceed 2,500 feet. Individual flows range from 10 to 100 feet thick, with very little weathered material between them. This would indicate that the flows were exposed only briefly before being buried by subsequent flows (Hogenson,1956).

The study area is drained by two major river systems: the Columbia and the Umatilla. Several minor streams, such as Butter Creek, also contribute to the system. The soils of the study area formed in alluvial deposits which rest on the underlying basalt. Soil depths range from 1 meter or less at Boardman to 60 meters or more at Echo. Glaciofluvial deposits were made by area streams and the Umatilla and the Columbia rivers. The great Missoula floods of the Pleistocene Epoch carried Lacustrine silts and sands to the area. As time passed, the sands were re-worked by winds which carried the lighter silts to the east.

The USDA Soil Conservation Service (USDA SCS) has identified over 100 different soil types within the study area, 20 of which are included among the study sites (USDA SCS,1988). Table 4 lists these 20 soils by: SCS number, SCS name, effective rooting depth in inches (ERD), drainage capability class (DC) (p =poor, w =well, e =excessive), available water holding capacity in inches (AWHC), capability class when irrigated (CCI), and origin of materials. Note that all but one of the soils is well-drained; and the one exception (119A) occurs only in an enclosed drainage basin of one study field. Capability class refers to the potential productivity of a soil for agricultural production. Class I soils are prime agricultural soils with no limitations, followed by Classes II-VIII. Potential productivity decreases as the capability number increases. For example, Class VIII soils exhibit the most severe limitations for crop production. The capability subclasses indicate that the most common limitation (besides aridity) is erosion (USDA SCS,1988). The subclass "e" indicates an erosion hazard, the "w" indicates that water at or near the soil surface interferes with plant growth, and the "s" indicates shallow, stony, or droughty soil conditions (USDA SCS,1988). Low natural fertility in these soils has required the addition of fertilizers for agricultural production.

The predominant sandy texture of these soils presents many problems for the containment of leachable pollutants. Nitrogen, in the nitrate form, is water-soluble and moves freely through the soil profile with excess water. The low fertility of these soils has, traditionally, been compensated for with nitrogen fertilizers, sometimes far in excess of crop requirements. However, crop fertilizers are not the only source of excess nitrogen. Historically, confined dairy, beef, pork and turkey operations, and vegetable processing plants have produced high levels of nitrogen in manures and effluent. Though many of these sources are now gone, their legacy may remain as residues in the lower soil profiles and ground water.

Table 4. Soils of the Study Sites

SCS #	SCS Name	ERD	DC	AWHC	CCI	Parent Material
1B	Adkins fine sandy loam	60"+	well	8-11"	IIe	eolian sand
3A	Adkins fine sandy loam	40-60"	well	8-10"	IIw	eolian sand
8B	Athena silt loam	60"+	well	11-13"	IIe	loess
14B	Burbank loamy fine sand	60"+	excessive	1.5-3.5"	IVe	alluvium/ eolian sand
20B	Hezel loamy fine sand	40-60"	excessive	4.5-9"	IVe	alluvium
26B	Koehler loamy fine sand	20-40"	excessive	2-4"	IVe	mixed sand
40C	Kahler silt loam	60"+	well	8-14"	IIIe	loess/ colluvium
41B	Quinton loamy fine sand	20-40"	excessive	2-4"	IVe	mixed sand
42A	Kimberly fine sandy loam	60"+	well	6-9"	IIe	mixed alluvium
72A	Powder silt loam	60"+	well	10-14"	I	silty alluvium
74B	Quincy fine sand	60"+	excessive	2.5-5"	IVe	eolian sand
75B	Quincy loamy fine sand	60"+	excessive	3-6"	IVe	eolian sand
75E	Quincy loamy fine sand	60"+	excessive	3-6"	IVe	eolian sand
76B	Quincy loamy fine sand	60"+	excessive	2.5-5"	IVs	alluvium/ sand
76C	Winchester sand	60"+	excessive	2.5-3.5"	IVs	mixed sand
77C	Quincy loamy fine sand	60"+	excessive	3-6"	IVe	eolian sand
80B	Ritzville silt loam	60"+	well	11-14"	IIe	loess
87B	Sagehill fine sandy loam	60"+	well	10.5-12"	IIe	sand/ lacustrine sediments
95B	Taunton fine sandy loam	20-40"	well	2.5-6	IVe	sand/ alluvium
119A	Wanser loamy fine sand	6-60"	poor	3-6"	IVw	mixed sand

Climate

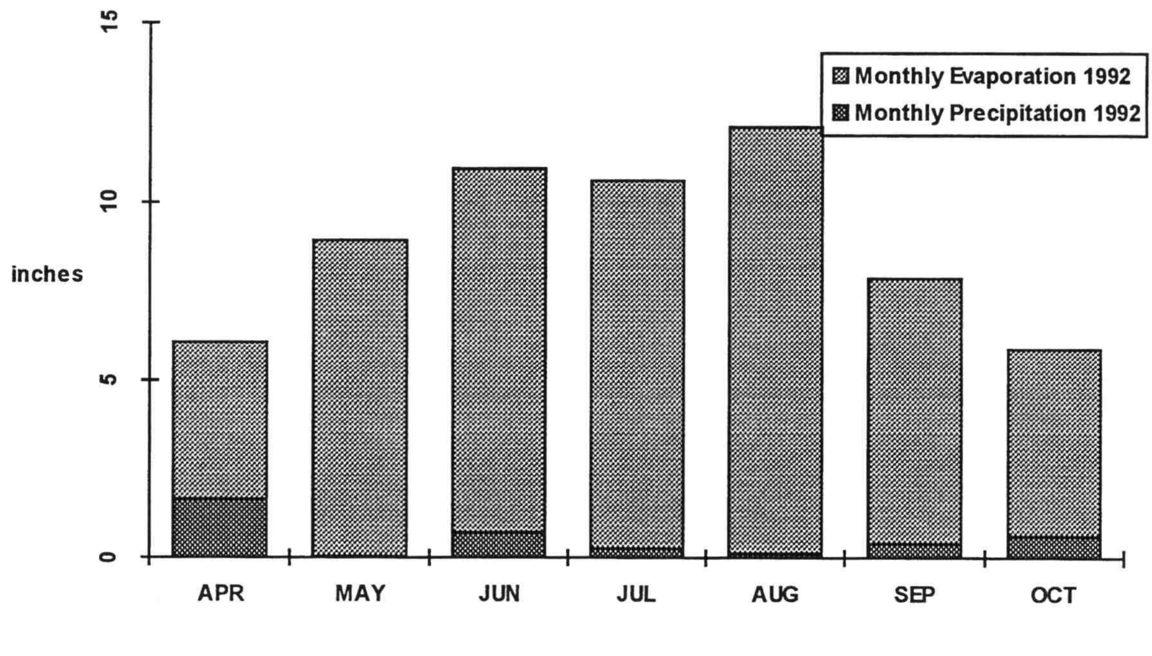
The arid climate of the study area has necessitated utilization of ground and surface water supplies to meet the demands of agricultural, industrial, and urban development. Annual precipitation averages only 10 inches, with over 70% falling in winter (Table 5). The average relative humidity at Hermiston is 55% at mid-afternoon, daily temperature averages range from 10-20 degrees F in winter, to 70 degrees F in summer. The record low of -31 degrees F (January 1957) and the record high of 113 degrees F (August, 1961) both occurred at Hermiston, centrally located in the study area. Table 5 has more detailed monthly figures for temperature, precipitation, and evaporation (Taylor,1994).

Table 5 Temperature, Precipitation, and Evaporation

Hermiston, Oregon Mean Maximum Temperature (F)												
YEAR	J	F	M	A	M	J	J	A	S	O	N	D
1992				68.6	80	88.1	87.7	90.2	76.7	67.7	49.6	40.9
1993	31.7	39.2	51.5	64.9	79.3	78.9	81.2	85.8	81.8	69.6	47.5	42.4
Hermiston, Oregon Mean Minimum Temperature (F)												
YEAR	J	F	M	A	M	J	J	A	S	O	N	D
1992				43.9	48.1	58	59.5	59.3	48.8	40.5	36	26.4
1993	16.3	22.6	32.9	41.2	51.3	54	56.9	55.6	47.4	40.2	22.7	31.4
Hermiston, Oregon Total Precipitation (inches)												
YEAR	J	F	M	A	M	J	J	A	S	O	N	D
1992				1.66	0.03	0.71	0.27	0.13	0.39	0.61	1.19	1.31
1993	1.88	1.61	1.32	0.98	0.83	1.06	.34	0.63	0.02	0.32	0.09	0.8
Pendleton, Oregon Total Evaporation (inches)												
YEAR	J	F	M	A	M	J	J	A	S	O	N	D
1992			2.9	4.4	8.9	10.2	10.3	11.9	7.5	5.3		
1992				4.1	7.4	8.4	10.5	10.2	7.8	3.7		

Figure 1 illustrates the extreme difference between precipitation and potential evaporation during the 1992 growing season, April through October. Yearly evaporation totals were 5-6 times greater than precipitation during the course of this study, 1992 and 1993. For example, in 1993, 9.88" of total precipitation was measured at Hermiston. During the same period, 52.1" of evaporation losses were recorded at Pendleton, approximately 40 miles to the east. These conditions combine with the low water holding capacity of the sandy soils to necessitate frequent irrigation for the production of valuable agricultural products. Frequent irrigation may increase the probability of impacting groundwater with excess water.

Figure 1 Monthly Evaporation and Precipitation for LUB Area



Agricultural Production

Euro-American immigrants first began arriving in the Lower Umatilla Basin in the early 1800's. Agricultural development was limited primarily by the low natural fertility of the soil and access to water for irrigation. A general synopsis of historical agricultural land use in this area is outlined in Table 6 (Fitch&Camacho,1992). Livestock grazed heavily on the native grasses and forbs, impacting them heavily. Native and non-native weed species began to flourish, resulting in the relatively poor condition of most range in the area.

Table 6 Historical Agricultural Land Use

TIME PERIOD	MAJOR LAND USE	JUSTIFICATION
	Livestock/Cash Crops	
1900-1925	Dairy and Fruit	Dairy industry strong
1925-1975	Livestock	Turkey, dairy, and hog industries strong
1975-present	Diversified agriculture	Cash crop industry strong
	Irrigated Agriculture	
1900-1950	Traditional irrigation	Flood/furrow
1950-1965	Traditional irrigation	Handline/wheeline
1965-1985	Advanced irrigation method	Center pivot
1985-present	Irrigation scheduling	Center pivot/spray scheduling
	Food-Processing Industry	
1975-present	Commercial/Industrial operation	Potato/vegetable processing

Irrigated agriculture using flood/furrow methods was first developed along creeks and flat areas with access to water. These methods required fields to be graded and leveled as necessary. Several of the sites used in this study are located in areas which have been in production for over 100 years. For example, site U18A (Appendix E, p 78) has been in production since 1865.

Between 1950-1970, the arrival of inexpensive electricity from hydroelectric projects on the Columbia River allowed increased irrigation development, bringing more acreage into production. In the 1970's, center pivot irrigation was developed in the Sand Hills region of Nebraska. The advent of this technology in the Lower Umatilla Basin marked the beginning of an agricultural boom. The uneven terrain of the range and surrounding hills became accessible for irrigation and cropping. Crops such as potatoes, small grains, corn, and alfalfa are now grown on over 160,000 irrigated acres (USDA SCS,1988). During this time, nitrogen fertilizers were also readily available and relatively inexpensive. The combination of cheap fertilizer, plentiful water, and coarse soils resulted in a potentially hazardous ground water situation.

The warm growing season of the study area is excellent for a variety of crops. The sites used are representative of the various area crops and cropping systems. The only major exception to this would be dryland production of grains such as wheat. However, those fields receive very little moisture each year and , consequently, do not appear to pose a significant threat for leaching nitrates to groundwater. Crops which are included in this survey are listed in Table 7, along with annual nitrogen fertilizer requirements for each crop (OSUES). Table 8 indicates water requirements for a few of the major crops of the study area (Pumphrey et al,1991).

Table 7. Major Crops/Nitrogen Requirements (pounds/acre/year)

Wheat	150-250	Canola	150-250	Beans	70-90	Peppermint	240
Barley	60-100	Field Corn	250-300	Onion	280	Asparagus	280
Grass	0-225	Sweet Corn	200-300	Potato	240-340		
Alfalfa	0-15	Peas	15-20	Watermelon	90-120		

Table 8. Major Crops/Water Requirements (inches/year)

Alfalfa	24-44	Potato	22-42
Field Corn	20-36	Watermelon	8-20
Pasture	20-30	Winter Wheat	18-30

Crop rotation is used to achieve a number of management goals. Soil structure and fertility may be enhanced, economic gains may be increased, or diseases may be controlled through crop rotation. Within the study area, four "classes" of cropping rotation have been identified. These classes are defined and discussed in detail in the methods and results discussion sections of this text. In general, they represent three types of crop rotation: deep rooted crops, shallow rooted crops, or a mix of the two in rotation.

Deep rooted crops may be defined as those with an effective rooting depth of 3' or more. Examples include wheat and alfalfa. Shallow rooted crops rarely root below 2-3' in the soil. Examples of shallow rooted crops are onion and potato. Shallow rooted crops pose a comparatively greater threat to ground water, as they are unable to take up nitrogen below 2-3'. In addition, these crops tend to have high nitrogen and water requirements, increasing the hazard of nitrate losses below the rooting zone. By adding deep rooting crops to such a rotation, it is hoped that nitrogen fertilizers in the 3-7' depth range may be utilized and prevented from moving down to ground water. Among the study sites, this "mixed" rotation is the most common cropping system type.

Crop production costs are currently soaring. Prices for fertilizer, fuel, labor, equipment, electricity, and other needs continually rise. The economics of costs and returns requires producers to trim costs wherever possible. Efficiency in fertilizer and irrigation budgets helps to reduce costs, however, farmers cannot risk damage to the crop by cutting rates "to the bone." Particularly with potatoes and other vegetable crops, crop quality and uniformity of quality are more important than yield in terms of marketability of the crop and income received. As a result, it is common practice to exceed crop requirements for water and nutrients as "insurance" against in-field soil variations and other unforeseen problems. A well-fertilized and watered crop is more vigorous and may be better able to withstand problems of weather, pests, disease, and competition with weeds.

Historically, confined feed-lot production of livestock was a leading agricultural industry in this region. Turkeys, beef, pork, and dairy operations were quite common until market prices dropped below production costs. Several beef feed-lots and at least one dairy are still in operation in the study area. One area feed-lot carries approximately 25,000 head of cattle. Another operation was designed for 32,000 animals. Records show that, with an average of 25,000 head, that operation produced over 7,000 pounds of nitrogen daily (Pumphrey et al,1991).

The development of food-processing plants diversified the agricultural economy even more. Potato processing has had a particularly strong impact. Potatoes are processed for freezing, french fries, potato chips, fresh-pack (direct to market), and a variety of other products. In 1991 alone, one plant generated about 640 million gallons of waste water. The waste water is spread over cropland, sometimes at rates far in excess of crop uptake ability. For example, between 1988-1990, one processor's permit allowed the application of waste water to land at a rate of 1,500 #/A/year of TKN (Total Kjeldahl Nitrogen), with a crop that could remove 400 #/A/year (Pumphrey et al,1991). This particular practice could result in up to 900 #/A/year of excess nitrogen in the soil profile.

The potential for pollution of ground water supplies from any of the aforementioned agricultural activities is of concern to area residents and managers. Perhaps none is more dramatic than that of the food-processing plants and feed-lots. However, they are few in number. In contrast, there are hundreds of thousands of acres of irrigated agricultural fields which may pose an even greater threat as "non-point" pollution sources.

METHODS

Site Selection

The Lower Umatilla Basin Deep-Soil Nitrate Survey was made possible through the cooperation of over 50 producers and agency representatives from the study area. In order to achieve the goals of this survey project, it was necessary to develop a standardized system for data collection and analysis. This system involved five distinct components: (1) site determination, (2) soil sample extraction, (3) soil analysis, (4) data analysis, and (5) reporting results.

Site determination was developed on a volunteer basis. Luther Fitch, Umatilla County Extension Agent at the Oregon State University Hermiston Agricultural Research and Extension Center (OSUHAREC), was instrumental in this portion of the survey. Area producers were sent a letter describing the goals and significance of the survey project, outlining the procedures involved, and inviting their participation. Approximately 50 positive responses were received. Respondents were contacted again and visitations were scheduled.

Interviews with each individual producer permitted the collection of background information for each site. Due to the sensitive nature of the information requested, each producer was assured that, while the numerical data from this survey were for public use, the individual locations and names of producers for each site would be held confidential. For the purposes of the survey, records on the past 5-10 years of cropping rotation and fertilization, and any unique management history for the site were requested. Information on cropping rotation was generally easily collected.

It was very difficult to persuade anyone to divulge exact amounts of nitrogen-fertilizer applied each year, as most individuals reported using "recommended amounts." Therefore, the data tables and discussion report annual nitrogen fertilizer applications for each individual crop based on Oregon State University Extension Service recommendations.

Soil Sampling

Once the background information for each individual site was collected, an optimum sampling time could be determined, as it was desirable to do so only when there were no crops in the field. Locations of irrigation and power lines were noted, as well as any other potential hazards, such as natural gas lines, so that they could be avoided during sampling. Flags were placed in the field to mark sampling sites.

Two soil cores were extracted from each site, approximately 25' apart, for a composite sample. Quality analysis for variability in the field was conducted in the fall of 1993. The results of that analysis indicated that this method was appropriate for the goals of this survey, and are outlined in Appendix C, p 50.

Soil core sampling began in late summer of 1992. Samplings for the Fall of 1992 occured between September and December. For the Spring of 1993, sites were sampled during March. The final samplings for the Fall of 1993 took place during September. Sites were scheduled for sampling according to their availability. A Giddings truck-mounted soil probe was used for extracting the soil samples.

Upon reaching the site, crop residues were cleared away from the surface, and the soil probe was positioned. The hydraulic press system and coarse soils made sampling relatively simple, and many of the cores were extracted by a single person.

However, assistance provided by Luther Fitch and Jeff McMorran (OSU PhD candidate) enabled me to complete the survey in a timely and efficient manner. Soil cores were taken as deeply as possible, ranging from as little as 2' to as much as 16'.

The USDA Soil Conservation Service recommends that soil sampling for nitrogen should include each foot in the soil profile, as incremental sampling more accurately assesses the availability and distribution of nitrogen in the soil (USDA SCS,1990). Once extracted, the soil cores were divided into 1' increments, down to the 6' level. Beyond 6', the cores were divided into 2' increments (6-8', 8-10', etc). Samples below 6' were grouped into 2' increments due to the difficulty of accurate measurement at those depths. Some soils were compacted, at various depths. The 2' sections provide an adequate indication of deep-soil nitrate levels. Each level, or increment, was deposited into a clean bucket, then stirred. After the first soil core was complete, the truck was moved approximately 25' forward, then another core was extracted. The second soil core was divided, then mixed into the bucket with the corresponding increment of depth. From each bucket, a final mixed sample was removed and placed in a soil sample bag (approved by the OSU Soils Testing Laboratory) for later analysis.

Laboratory Analysis

The third step in this system involved laboratory analysis of the samples. Soil samples were oven-dried at 40 to 60 degrees Celsius for 24 hours or more in order to remove any moisture and to effectively halt any denitrification. Once dried, the samples were passed through a standard number 10 sieve (2mm).

pH, nitrate-nitrogen, ammonium-nitrogen, and chloride content were measured for each sample in the Fall 1992 survey. Soil pH was determined using a standard glass pH electrode. Nitrate-nitrogen (NO3-N) and ammonium-nitrogen (NH4-N) levels were determined using Orion electrodes. Sub-samples were analyzed for chloride (Cl-) by the OSU Soil Testing Laboratory. Electrodes were tested for accuracy and consistency prior to analysis of samples. Electrode results were compared with results from the OSU Soil Testing Laboratory and with results from steam distillation analysis. Other soil analysis, performed between November, 1992 and January, 1993, resulted in an R-squared value of 0.54 for the ammonium electrode, and 0.96 for the nitrate electrode. Though the ammonium electrode does not appear to be as accurate as the nitrate electrode, results were considered adequate for the purposes of this survey.

Laboratory preparation and analysis were kept relatively quick and easy by the use of standardized procedures. Once sieved, 20 gram samples were prepared for nitrate analysis, and 10 gram samples for ammonium analysis. Twenty ml of distilled water was added to each nitrate sample. The sample vials were shaken for 15 minutes, and contents were allowed to settle for 15 minutes. Each sample was tested for pH using the pH electrode. Next, 8 ml of each sample was decanted into a clean vial for nitrate analysis- and 4 ml into another vial for chloride analysis. Chloride analyses were done for the Fall 1992 survey only.

For the nitrate samples, 8 ml of ionic strength adjuster (ISA) extraction buffer was added to each vial. This (NH4)2SO4 solution, consisting of 4 ml of ISA per 100 ml of buffer, saturated the solution with cations so that the electrode was not affected by variations in cation concentration. A stirring magnet was placed in each sample vial and vials were placed on the stirring plate for electrode anlaysis. Each sample was then tested for NO3-N using the Orion electrode, results were recorded, and samples were discarded.

For the ammonium samples, 20 ml of 0.2M KCl extract solution was added to each 10 g soil sample vial. This mixture was shaken for 15 minutes then allowed to settle for another 15 minutes. The material in solution was decanted into a new vial and covered. Each sample received a small measure of magnesium oxide (MgO) and a stirring magnet. The MgO raised the pH to the point where ammonium-nitrogen (NH4) volatilized to ammonia-nitrogen (NH3) and could be measured through the hydrophobic membrane of the electrode. The internal electrode operates at a pH of 4. Inside the electrode, the ammonia reconverts to ammonium and changes the pH. The electrode reads this change in pH, which is directly proportional to the amount of NH4-N in the sample. In order to achieve the best results, the electrode was left in the solution for approximately one minute. After results were recorded, the samples were discarded.

Data Analysis

All numerical data were transfered to a computer spreadsheet format for conversions and further analysis. The Quattro-Pro spreadsheet program was utilized initially. Data for soil pH, nitrate-nitrogen, and ammonium-nitrogen were inputted to the spreadsheet along with other important data such as site identification, soil type, sampling date, cropping rotation, irrigation type, and any additional unique site information. As time progressed, it became easier to use the Microsoft Excel (version 4.0) spreadsheet program to generate graphs and analyze the data, therefore, all data were transferred to that program for analysis.

Nitrate- and ammonium-nitrogen concentrations were reported in parts per million (ppm) from the electrode analysis. Numbers were then converted to pounds per acre (#/A) because fertilizer applications and other related processes are presented in this format in the United States. Parts per million can be converted to pounds per acre per foot of soil by multiplying by a factor of four. For example, a measure of 2.5 ppm NO3 would convert to 10 #/A. This simple conversion does not allow for some minor fluctuations in soil bulk densities, etc.; however, the relative accuracy of these conversions was deemed adequate for the purposes of this survey.

In order to compare sites, a system for identifying general cropping practices and distribution of nitrate in the profile had to be developed. Table 9 (p 31) shows the key used for "de-coding" information in the data tables. For Profile Distribution Type, the A, B, or C represents the soil profile zone where the highest concentration of nitrate was found. Combinations of letters indicate multiple zones of concentration. For example, an AC classification indicates that the 0-3' and 6'+ zones were highest in nitrate. The numbers 1,2, or 3 indicate whether any significant movement of nitrate was discovered during the survey. A value of 10 pounds per acre per foot was used as a "significant" amount. Whether this "movement" could be due to leaching loss, plant uptake, or denitrification could not be determined without further study. A "2" indicates that no significant movement or loss was observed. A "3" is used when the site was sampled only once, not allowing for comparison of multiple sampling results. The Cropping Rotation Type classifications are largely self-explanatory.

Soil analysis results were reported to the individual producers using a standardized form for each reporting season (Appendix E, pp 55-105). Each producer received a copy of the results for Fall, 1992. A summary of all results will be sent in the summer of 1994. Results were presented for nitrate-nitrogen, ammonium-nitrogen, nitrate + ammonium-nitrogen, chloride (Fall 1992 only), and pH. Each measurement was given for each depth increment. In addition, results were averaged for three "management depths" (0-3', 3-6', and beyond 6' depth) in the soil profile.

Table 9 Key for Profile Distribution and Cropping Rotation Types

Zone of Highest N-concentration	
A	0-3'
B	4-6'
C	7'+
1	Significant Movement
2	Insignificant Movement
3	No basis for opinion

Cropping Rotation Type	
S	Shallow rooted (0-3')
D	Deep rooted (3'+)
M	Mixed (shallow and deep)
N	Native site
1	High N-reqt (200#/A +)
2	Moderate N-reqt (100-200 #/A)
3	Low N-reqt (0-100 #/A)
4	Mixed N-reqts.

These three figures are useful in this survey because each reflects the potential impacts of rooting depth on deep-soil nitrate. The 0-3' depth represents shallow-rooted row crops, such as potato. The 3-6' range covers deeper-rooting crops, such as wheat and corn. Though some crops do root below 6' (for example, alfalfa roots were found as deep as 14'), it is generally accepted that once nitrate has reached this depth in the soil profile, it is largely unavailable to crops and may reach the groundwater.

In addition to receiving their individual results, each participating producer also received a sheet of averages for comparison. The results for all of the individual sites were listed on this sheet along with tabulated averages by depth (both individual increments and "management depths") and indicators of the area "highs" and "lows." As noted earlier, individual producer names and locations were withheld; however, the results of the analysis will be released for the area-wide survey comparison.

RESULTS/DISCUSSION

The results of this survey help to identify possible connections between cropping practices and deep-soil residual nitrogen. By following the standardized methods for sampling and analysis, as described in the methods section, the various cropping systems could be compared to one another. By identifying links between profile distribution type and cropping system type, conclusions may be drawn as to which crop management systems hold the most promise for minimizing losses to ground water. A full listing of all sites and analytical results in tabular form is presented in Appendix A, pp 45-48.

In the following text, results of the NO_3-N versus Cl- analysis will be reviewed. Next, site-variability test results will be presented, followed by site analysis results. Detailed descriptions of the profile distribution types and cropping rotation types are presented in Table 9, p 31, in the methods section. Each site is identified by its code number, followed by the profile distribution type and cropping rotation type. For example, **U07A A3/M4** identifies site U07A as a profile type A3 and cropping type M4. Individual analysis sheets are presented in Appendix E, pp 55-105, in numerical order.

In terms of establishing goals for field results, "best" will be defined as that situation having the least potential hazard for leaching of nitrates to ground water. A profile distribution of A2 or A3 would be indicative of "best" management. The highest concentrations of nitrate are found in the upper 3' of soil, presumably within reach of the following crop, and are not found to be moving. A profile distribution type C1 would be the least desirable condition, as the nitrates would be most heavily concentrated below 6' and descending.

Nitrate vs. Chloride

This survey sought to identify linkages between soil NO_3-N and Cl-. Since both are highly soluble anions, it is expected that they should behave similarly under field conditions. Cl- analyses were performed in the Fall 1992 survey. These results were compared with nitrate values for the same year. Appendix D, pp 51-54 shows the results of this comparison for 5 sites.

Observational analysis of the ratios and profile distributions show no consistent overall pattern for nitrate to chloride ratio. Agricultural fields do show elevated levels of both ions, as expected, apparently because of fertilizer application. These results are expected, as area farmers use a somewhat "individualistic" fertilizer strategy. Some growers use potassium-chloride while others use potassium-sulfate, as a matter of personal preference (Fitch,1994). Perhaps, with more detailed information about individual field fertilization histories (N and Cl-), a relationship would be more apparent.

Site Variability

Only two soil cores were taken at each sampling site, raising the question of whether results were representative of the entire field. At two sampling sites, M09B and U18A, two additional samples were taken for comparison to the original. These samples were taken at least 300' apart. The results show little deviation from the mean values for nitrate and ammonium from sample to sample, and are presented in Appendix C, p 50. The ammonium samples showed slightly more variability; however, since nitrate values are the focus of this survey, site variability results were acceptable.

Site Analysis Results

Sites M29A (ABC2/N) and M29B (ABC2/N) serve as "baselines" for the rest of the study area (see pp 95-6). These two sites are located on National Wildlife Refuges and serve as "native" soil condition sites. Both are characterized by an ABC2 profile distribution, indicating that nitrate values are relatively uniform throughout the profile. There is further evidence to show no significant movement of the nitrate following the above-average precipitation during the winter of 1992-1993. Nitrate concentrations do not exceed 10 #/A in each foot of the profile in the native sites, in comparison to agricultural production areas which usually contained higher amounts.

U01A A2/M4 p 55

This site showed some minor movement of nitrates down into the profile over the winter of 1992-3. It appears that the mixed crop rotation and associated practices are helping to minimize losses. Leaching hazard not expected.

U01B ABC3/M4 p 56

The nitrate loading at this site is nearly uniform through the profile, in relatively high amounts. The profile contains approximately 450 pounds of nitrate, 200 of which occurs below 6'. Leaching hazard present.

U01C AB3/M4 p 57

Nitrates in this profile are relatively low for production areas. The mixed rotation appears to be working well in this system. Leaching hazard not expected.

M02A ABC3/D3 p 58

Nitrate loads at this site are close to native conditions, indicating that management is working well. It should be noted that this is a low-level production field, and this field does not ordinarily receive fertilizer in addition to grazing animals' manure. Leaching hazard not expected.

M02B A3/D3 p 59

Nitrate loads here are within native conditions as well, reflecting the low-input management of the operator (same as M02A). Leaching hazard not expected.

U04A A3/none p 60

This site is unique in that it is an open area that was in confined animal feed-lot 10 or more years ago. "Native" values for nitrate occur, indicating that little or none of the residual nitrogen from the feed-lot is still in the upper profile (could only probe to 5'). Leaching hazard not expected.

U04B AB3/S1 p 61

This site sits adjacent to U04A, however, this parcel was utilized for potato production in 1992. Significant losses of nitrate occurred under this management plan, with over 400 pounds as residual after harvest; 200 of which are already below 3' deep. This represents a significant hazard if the deeper nitrate is not utilized or if it is pushed farther down with precipitation and/or irrigation. Leaching hazard present.

M05A ABC2/M4 p 62

This site shows uniform distribution through the profile, with a low overall nitrate load. The mixed cropping appears to be successful, along with other management techniques, in controlling losses. Leaching hazard not expected.

M05B A3/M4 p 63

Again, the heaviest nitrate loads are near the surface, and may be available to succeeding crops. This sample was taken following two years of corn and one of potato- all high-nitrogen crops. The low residual levels indicate excellent nitrate management. Leaching hazard not expected.

M05C A3/M4 p 64

This sample only reached to 4' deep, so it is not known what deep-soil conditions are. However, if this site is characteristic of the other two sites on M05, then it should not have significant losses to the deep soil. Leaching hazard not expected.

U06A A3/M4 p 65

This site shows very low nitrate levels. Leaching hazard not expected.

U06B A3/M4 p 66

This site shows very low nitrate levels. Leaching hazard not expected.

U07A A3/M4 p 67

This site has very low/native nitrate levels. The sampling followed 5 years of deep-rooted crops. Leaching hazard not expected.

U07B A3/M4 p 68

Moderate nitrate levels occur at this site, however, sampling only penetrated to 6' in Fall 1992, and only 3' in Spring 1993; results are inconclusive.

U07C BC2/M4 p 69

This site is a good example of a "tight" system. Crop rotation and management working well in controlling nitrate losses. Leaching hazard not expected.

M09B AB2/M4 p 70

Two years of alfalfa followed a season of potato, preceded by two more years of alfalfa at this site. This rotation seems to be working well, as residual nitrate levels are very low. Leaching hazard not expected.

M09C AB3/M4 p 73

This site has a very diverse cropping rotation, combined with intense management to result in very low nitrate levels at this site. Leaching hazard not expected.

U10A A3/M4 p 74

Sampling penetrated to only 5' at this site, therefore, results are inconclusive.

U10B A3/M4 p 75

Sampling penetrated to only 5' at this site, therefore, results are inconclusive.

U14A AB3/D3 p 76

Sampling penetrated to only 5' at this site, therefore, results are inconclusive.

M15A A3/D3 p 77

Sampling penetrated to only 5' at this site, therefore, results are inconclusive.

U18A A1/M4 p 78

This field showed some significant movement of nitrates following the winter of 1992. Nitrate levels are still relatively low, however, the movement of nitrates into the lower profile poses a potential threat to ground water. Leaching hazard present.

U18B B2/M4 p 81

This field has been under a center-pivot for only two years, and nitrate levels are still low. However, there has been some movement to below 3'. Leaching hazard not expected.

U18C A3/D3 p 82

This area has been in dryland pasture for several years and will be put into irrigated production in 1994. Nitrate levels are like those of the native sites. Leaching hazard not expected.

U19A ABC1/S2 p 83

Initially, this site showed very low nitrate levels. With some fluctuations over the next two samplings, nitrates did remain moderate. Leaching hazard not expected.

U20A A2/D3 p 84

This field has been in continuous alfalfa production for several years. Low nitrate values are concentrated at the surface, with very low values with depth. Leaching hazard not expected.

U20B A3/D3 p 85

This field has been in continuous alfalfa production for several years. Low nitrate values are concentrated at the surface, with very low values at depth. Leaching hazard not expected.

M22A AB3/M4 p 86

The mixed crop rotation and efficient management appear to be working at this site. Nitrate values are comparable to native values. Leaching hazard not expected.

M22C A3/M4 p 87

Sampling only penetrated to 3', results are inconclusive.

M23A AB3/D3 p 88

This pasture is managed at very low input levels, combined with yearly grass pasture to result in native values for nitrate. Leaching hazard not expected.

U24A A3/M4 p 89

Sampling penetrated to just 4', results are inconclusive.

U25A B1/M4 p 90

Sampling revealed a bulge of residual nitrate in the mid-depths of this site. There was significant accumulation of nitrate in the Spring 1993 sampling, as well. There is a potential hazard of losses at this site, as nitrate levels are elevated, even at 10'. Leaching hazard present.

U25B ABC3/M4 p 91

Nitrate levels are very low at this site, all the way down to 14'. This site serves as a good example of a "tight" system, with "native" nitrate levels at depth. Leaching hazard not expected.

M26A BC3/D4 p 92

This site has very low nitrate levels, evidence of excellent management. Leaching hazard not expected.

U28A B3/M4 p 93

Potential for deep-soil losses exists at this site, due to evidence of nitrate-loading in the 4-6' range. Leaching hazard present.

U28B BC3/M4 p 94

"Native" nitrate values occurred at this site, with alfalfa and other deep-rooted crops in rotation. Results indicate that cropping system is working to keep nitrate levels low. Leaching hazard not expected.

U31A B1/S1 p 97

The spring 1993 sampling indicates over 400 pounds of nitrate below 6', as well as significant movement in later samplings. Extreme leaching hazard present.

U31B B1/M4 p 98

Nitrate levels did change at this site in the spring 1993 sampling, indicating movement in the profile. This presents a potential hazard for leaching. Leaching hazard present.

U31C A3/M4 p 99

At this site, there was a substantial amount (150#/A) of residual nitrate in the top 3', following a season of potato. With proper management, this may be utilized and prevented from reaching ground water. Leaching hazard not expected.

U31D A3/M4 p 100

Nitrate levels were relatively low at this site, even though it had just come out of potato. This indicates good management. Leaching hazard not expected.

U32A A3/M4 p 101

Sampling was only able to penetrate to 4', results are inconclusive.

U32B A3/M4 p 102

Sampling was only able to penetrate to 4', results are inconclusive.

U32C A3/M4 p 103

Sampling was only able to penetrate to 2', results are inconclusive.

M33B ABC3/M4 p 104

This site exhibits the characteristics of excellent management. Nitrate values are at "native" levels throughout the profile. Leaching hazard not expected.

M33C A3/M4 p 105

Sampling was only able to penetrate to 4', results are inconclusive.

CONCLUSIONS

It is evident that the use of deep-rooted and "low-input" crops in rotation with "high-intensity" crops such as potato can be effective in reducing nitrate losses. In general, those sites which showed the lowest losses in nitrates were those which received mixed rotations and intensive management.

The presence of leaching hazards in sites exposed to mixed cropping rotation indicates that some other factor may be affecting residual nitrate levels below the root zone. This could be a result of excessive irrigation and/or fertilization rates, or inefficient timing of those applications. Further research is needed to determine the exact causes of these variations.

In general, the results coincided with expectations for this area. Deep soil nitrate levels under most agricultural fields were consistent with the concept that some loss of nitrate below the root zone is inevitable. However, the data also show that, with proper management of irrigation, fertilization, and other cropping practices, overall losses to ground water are probably not as significant as many point source contamination sites.

Field research, literature references, and common sense indicate that utilizing Best Management Practices in agricultural production may be the least expensive method for minimizing nitrate contamination of ground water, and for ensuring a lasting water source for the welfare of the local population.

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Appendices

SITE CODE	LAB ID #	PROFILE DISTRIB TYPE	CROP ROTAT TYPE	DEPTH feet	FALL 1992 pH	NO3-N ppm	NO3-N # / Acre	NH4-N ppm	NH4-N # / Acre	Cl- ppm	SPRING 1993 NO3-N ppm	NO3-N # / Acre	NH4-N ppm	NH4-N # / Acre	FALL 1993 NO3-N ppm	NO3-N # / Acre	NH4-N ppm	NH4-N # / Acre
U01A	A1	A2	M4	0-1	6.1	7.6	30	5.4	22	26	1.5	6	2.4	10				
	A2			1-2	8.2	6.5	26	2.6	10	13	1.9	8	2.2	9				
	A3			2-3	8.5	12.4	50	2.2	9	12	9.8	39	2	8				
	A4			3-4	8.7	4.6	18	1.4	6	8.5	10.4	42	1.7	7				
	A5			4-5	8.6	6.6	26	1.4	6	21	9.1	36	1.2	5				
	A6			5-6	8.5	8.7	35	1.5	6		5.6	22	1.1	4				
	A7			6-8	8.6	7.2	58	3.1	25	95	6.9	55	0.9	7				
	A8			8-10	8.8	6.9	55	0.8	6		6.6	53	0.8	6				
	A9			10-12	9.1	6.3	50	0.8	5	59	6.6	53	0.7	6				
U01B	A10	ABC3	M4	0-1	8.4	20.2	81	7.5	30									
	A11			1-2	7.6	6.5	26	3.4	14	24								
	A12			2-3	8	5.4	22	1.6	6	9								
	A13			3-4	8.2	8.5	34	1.4	6	12								
	A14			4-5	8.7	10	40	1.2	5	14								
	A15			5-6	8.6	11	44	1	4	47								
	A16			6-8	8.6	9.4	75	1.4	11									
	A17			8-10	8.9	16.3	130	0.8	6	45								
U01C	A18	AB3	M4	0-1	7.8	6.5	26	1.2	5	40								
	A19			1-2	8.4	5.1	20	1.1	4	25								
	A20			2-3	8.5	8.1	32	1.1	4	48								
	A21			3-4	8.4	6	24	1.3	5	28								
	A22			4-5	8.5	5	20	1	4	25								
	A23			5-6	8.6	4.7	19	0.9	4	24								
	A24			6-8	8.9	6.5	26	0.7	3	49								
M02A	B1	ABC3	D3	0-1	8.5	1	4	11	44	6.8								
	B2			1-2	8.8	1.2	5	1.9	8	2.4								
	B3			2-3	9	1.1	4	1	4	2.9								
	B4			3-4	9	1.2	5	0.7	3	2.3								
	B5			4-5	9	1.1	4	0.7	3	2.3								
	B6			5-6	8.9	1.2	5	0.9	4	3.1								
	B7			6-8	9	1.3	10	1.2	10	1.7								
	B8			8-10	8.6	1.5	12	1.6	13	4.9								
M02B	B9	A3	D3	0-1	7.8	1.3	5	4.2	17									
	B10			1-2	8.4	3.9	16	2.1	8									
	B11			2-3	8.8	3.9	16	1.6	6									
	B12			3-4	8.8	1	4	1.2	5									
	B13			4-5	8.5	1.2	5	2	8									
	B14			5-6	8	1.1	4	1.1	4									
	B15			6-8	8.4	1.3	10	1	8									
	B16			8-10	9	1.5	12	0.9	7	7.8								
U04A	C1	A3		0-1	6.9	8.7	35	1.7	7	31								
	C2			1-2	7.4	1.7	7	1.4	6	15								
	C3			2-3	7.5	2	8	0.9	4	7.4								
	C4			3-4	8.4	1	4	0.7	3	3.3								
	C5			4-5	8.6	1.5	6	0.8	2	5.3								
U04B	C6	AB3	S1	0-1	7.4	15.8	63	5.1	20	15								
	C7			1-2	7.4	18.2	73	2.4	10	37								
	C8			2-3	7.5	22.3	89	3.3	13	24								
	C9			3-4	8.7	22.2	89	2.2	9	17								
	C10			4-5	9.2	31.2	125	1	4	18								
M05A	D1	ABC2	M4	0-1	5.7	3.2	13	3.8	15	9.8	2.6	10	11	44	1.6	6	1	4
	D2			1-2	6.5	3.6	14	2	8	21	0	0	1.1	4	1.7	7	0.4	2
	D3			2-3	8.2	1.6	6	1.2	5	2.9	0	0	0.6	2	1.1	4	0.3	1
	D4			3-4	8.7	1.8	7	0.9	4		0.4	2	2	8	1.3	5	0.2	1
	D5			4-5	8.4	1.7	7	1.2	5	3.7	0	0	1.4	6	1.3	5	0.2	1
	D6			5-6	8.7	1.3	5	0.8	3	2.3	0	0	2.5	10	1.4	6	0.1	0
	D7			6-8	8.5	3.1	25	0.8	6	11	0	0	1.4	11	1.3	10	0.2	2
	D7A			8-10							0	0	2.3	18	1.4	11	0.2	2
M05B	D8	A3	M4	0-1	6.9	18	72	3.5	14	14								
	D9			1-2	7.9	23	92	1.5	6	7.4								
	D10			2-3	8.3	12	48	1.7	7	14								
	D11			3-4	8.5	5.1	20	1.1	4	9.7								
	D12			4-5	8.6	2.7	11	1	4	5.8								
M05C	D13	A3	M4	0-1	8.1	7.6	30	0.9	4	9.3								
	D14			1-2	8.3	6.3	25	2.1	8	11								
	D15			2-3	8.3	7	28	2.2	9	18								
	D16			3-4	8.5	8.2	33	1.6	6	10								
U06A	E1	A3	M4	0-1	7.4	2.3	9	2	8	2.7								
	E2			1-2	7.4	1.4	6	1.7	7	4.5								
	E3			2-3	7.6	1.5	6	1.8	7	71								
	E4			3-4	7.9	1.3	5	2.3	9	30								
	E5			4-5	8.2	1.2	5	2	8	11								
	E6			5-6	8.5	1.6	6	1.3	5	12								
U06B	E7	A3	M4	0-1	5.5	1.4	6	5	20	12	7.6	30	14	56				
	E8			1-2	7.6	8.4	34	3.9	16	25	3.2	13	2.5	10				
	E9			2-3	8.2	7.6	30	2.6	10	51	4.2	17	1.9	8				
	E10			3-4	8.4	4.1	16	1.8	7	20	5.3	21	2.4	10				
	E11			4-5	8.4	3.5	14	1.5	6	11	1.7	7	1.3	5				
	E12			5-6	8.8	2.6	10	1.1	4	5.5	1.1	4	1.7	7				
	E13			6-8	8.7	1	8	0.9	7	2.8	0.6	5	1.2	10				
	E14			8-10	8.5	1.5	12	1.4	11	6.2								
U07A	F1	A3	M4	0-1	8.2	5.5	22	5.4	22	46								
	F2			1-2	8.7	1.4	6	2.3	9	11								
	F3			2-3	8.6	1.2	5	1.6	6	19								
	F4			3-4	8.9	1.4	6	1.6	6	19								
	F5			4-5	8.9	1.6	6	1.5	6	31								
U07B	F6	A3	M4	0-1	7.2	16	64	2.3	9	8.8	9.9	40	9.9	40				
	F7			1-2	7.8	4	16	1.8	7	2	4.5	18	4.5	18				
	F8			2-3	8.3	3.8	15	1.4	6	2.5	11	44	11	44				
	F9			3-4	8.5	5.7	23	1.4	6	6.7								
	F10			4-5	9.4	4.5	18	1.9	8	8.8								
	F11			5-6	10	4	16	1.4	6	17								

SITE CODE	LAB ID #	PROFILE DISTRIB TYPE	CROP ROTAT TYPE	DEPTH feet	FALL 1982						SPRING 1983				FALL 1983			
					pH	NO3-N		NH4-N		Cl-	NO3-N		NH4-N		NO3-N		NH4-N	
						ppm	#/Acre	ppm	#/Acre	ppm	ppm	#/Acre	ppm	#/Acre	ppm	#/Acre	ppm	#/Acre
U07C	F12	BC2	M4	0-1	7.6	1.4	6	4.1	16	19					1.9	8	1	4
	F13			1-2	7.6	1.3	5	2.2	9	11					1.1	4	0.5	2
	F14			2-3	7.9	1.1	4	1.5	6	3.4					1.4	6	0.5	2
	F15			3-4	8.4	1.1	4	1.5	6	4.7					1.6	6	0.5	2
	F16			4-5	8.5	1	4	1.1	4	4.8					1	4	1.7	7
	F17			5-6	8.5	4	16	0.9	4	9.7					1	4	0.1	0
	F18			6-8	9.3	2.8	22	0.8	6	6.8					1.3	10	0.2	2
	F19			8-10	9.3	3.4	28	0.7	6	6.7					2.4	19	0.1	1
	F19A			10-12											5.8	46	0.1	1
M09B	G1	AB2	M4	0-1	7.7	4.2	17	2.9	12	11					2	8	1.8	7
	G2			1-2	8.2	3.6	14	1.3	5	9.6					1.4	6	0.7	3
	G3			2-3	8.2	2.3	9	1	4	12					1.9	8	1	4
	G4			3-4	8.2	4	16	1.1	4						2.7	11	0.9	4
	G5			4-5	8.8	2.4	10	0.8	3						2	8	0.2	1
	G6			5-6	8.9	1.7	7	0.9	4						2.8	11	1.1	4
	G7			6-8	9	1.8	14	0.8	6						1.6	13	1.4	11
M09BA	G7A	AB3	M4	0-1											2.4	10	1.6	6
	G7B			1-2											1.7	7	0.5	2
	G7C			2-3											1.4	6	0.5	2
	G7D			3-4											1.1	4	0.1	0
	G7E			4-5											2	8	0.1	0
	G7F			5-6											2	8	0.2	1
	G7G			6-8											1.4	12	0.1	0
M09BB	G7H	AB3	M4	0-1											1.9	8	4.7	19
	G7J			1-2											1	4	0.4	2
	G7K			2-3											1	4	0.4	2
	G7L			3-4											1.5	6	0.3	1
	G7M			4-5											1.5	6	0.4	2
	G7N			5-6											0.7	3	0.5	2
	G7P			6-8											0.4	3	0.2	2
M09C	G8	AB3	M4	0-1	8.3	2.3	9	2.1	8	4.9								
	G9			1-2	8.5	1.7	7	1.2	5	9.3								
	G10			2-3	8.1	1.3	5	1	4	37								
	G11			3-4	8.2	1.2	5	0.8	3	18								
	G12			4-5	8.7	1.2	5	0.7	3	11								
	G13			5-6	8.7	2.3	9	1.1	4	6.4								
U10A	H1	A3	M4	0-1	6.5	12	48	2.8	11	19								
	H2			1-2	6.9	7.7	31	1.5	6	22								
	H3			2-3	7.1	4	16	1.2	5	9.2								
	H4			3-4	8	5.3	21	1.2	5	11								
	H5			4-5	8.3	7.6	30	1.7	7	12								
U10B	H6	A3	M4	0-1	5.8	8	32	1.9	8	4.6								
	H7			1-2	7.6	5.4	22	1.3	5	1.7								
	H8			2-3	8.1	9.5	38	1.3	5	2.7								
	H9			3-4	8.2	11	44	1.2	5	9.8								
	H10			4-5	8.2	8.4	34	1.9	8	12								
U14A	J1	AB3	D3	0-1	6.1	1	4	4.1	16	8.9								
	J2			1-2	6.4	0.8	3	11	44	11								
	J3			2-3	6.5	1	4	2.7	11	6.6								
	J4			3-4	8.1	2.8	11	8	32	4.4								
	J5			4-5	8.3	1.4	6	7.1	28	3.7								
M15A	K1	A3	D3	0-1	8.1	24	96	3.1	12	11								
	K2			1-2	8.6	7.2	29	1.6	6	9.8								
	K3			2-3	8	4.1	16	0.7	3	8.2								
	K4			3-4	8.1	1.9	8	0.7	3	5.6								
	K5			4-5	8.3	2	8	1.9	8	12								
U18A	L1	A1	M4	0-1	8.3	13.5	54	9.8	39	44	12	48	3.1	12	28.9	116	13.4	54
	L2			1-2	8.7	8.8	35	3.4	14	20	4.1	16	1.8	7	7.4	30	1.3	5
	L3			2-3	8.8	6.1	24	1.8	7	39	2.4	10	0.8	3	3.6	14	0.7	3
	L4			3-4	8.8	2.5	10	1.1	4	30	2	8	1	4	2.7	11	1.1	4
	L5			4-5	8.7	0.9	4	1.4	6	14	7.7	31	1.1	4	3.7	15	0.4	2
	L6			5-6	9	1	4	1	4	7.9	9.2	37	1	4	6.1	24	0.5	2
	L7			6-8	8.9	1	8	0.7	6	13	5	40	0.9	7	4.6	37	0.1	1
	L8			8-10	8.7	0.9	7	0.6	5	6.3	3.2	26	0.9	7	3.1	25	0	0
	L8A			10-12							0.7	6	0.6	5	2.2	18	0	0
	L8B			12-14							0.6	5	0.8	6	1.9	15	0.1	1
U18AA	L1A	A3	M4	0-1											27.5	110	42.5	170
	L2A			1-2											7.5	30	8.5	34
	L3A			2-3											2	8	3.3	13
	L4A			3-4											2.8	11	3.8	15
	L5A			4-5											4.3	17	5.3	21
	L6A			5-6											6.6	26	7.3	29
	L7A			6-8											3.8	30	4.8	38
	L8A			8-10											3.8	30	4.3	34
	L9A			10-12											2.3	18	2.3	18
	L10A			12-14											1.3	10	1.6	1
U18AB	L1B	A3	M4	0-1											25.8	103	39.8	159
	L2B			1-2											8.5	34	8.6	34
	L3B			2-3											1.8	7	3.3	13
	L4B			3-4											3.3	13	4.3	17
	L5B			4-5											3.5	14	5.3	21
	L6B			5-6											7	28	7.3	29
	L7B			6-8											3.8	15	4.3	17
	L8B			8-10											3	24	3.5	24
	L9B			10-12											3.5	24	4.5	24
	L10B			12-14											0.8	6	1.5	24
U18B	L9	B2	M4	0-1	7.8	1.3	5	4.2	17	5.2					35	140	1.3	5
	L10			1-2	8.5	0.8	3	1.8	7	6					9.9	40	0.3	1
	L11			2-3	8.8	1	4	2.1	8	3.8					12.8	51	0.5	2
	L12			3-4	8.5	4	16	1.4	6	3.1					13.2	53	0.3	1
	L13			4-5	8.6	7.5	30	1	4	4.7					8	32	0.3	1
	L14			5-6	9	4.3	17	0.8	3	53								
U18C	L15	A3	D3	0-1	8.2	4.4	18	1.5	6	4.3								
	L16			1-2	8.3	1.2	5	1	4	2.4								
	L17			2-3	8.1	1.3	5	0.9	4	2.3								
	L18			3-4	8.3	0.9	4	0.9	4	2.9								
	L19			4-5	8.2	1.2	5	0.9	4	6.7								
	L20			5-6	9	0.8	3	1	4	11								
	L21			6-8	9.5	0.9	8	0.8	6	9.1								
	L22			8-10	9.9	0.9	8	0.9	8	4.1								

SITE CODE	LAB ID #	PROFILE DISTRIB TYPE	CROP ROTAT TYPE	DEPTH feet	FALL 1992 pH	FALL 1992 NO3-N ppm	FALL 1992 NO3-N #/Acre	FALL 1992 NH4-N ppm	FALL 1992 NH4-N #/Acre	FALL 1992 Cl- ppm	SPRING 1993 NO3-N ppm	SPRING 1993 NO3-N #/Acre	SPRING 1993 NH4-N ppm	SPRING 1993 NH4-N #/Acre	FALL 1993 NO3-N ppm	FALL 1993 NO3-N #/Acre	FALL 1993 NH4-N ppm	FALL 1993 NH4-N #/Acre
U19A	M1	ABC1	S2	0-1	7.2	0.9	4	1.3	5	12					7.4	30	1.8	7
	M2			1-2	7.5	0.9	4	1	4	16					4.9	20	0.5	2
	M3			2-3	7.5	0.7	3	0.9	4	8					5.7	23	0.6	2
	M4			3-4	7.6	0.7	3	0.8	3	5.6					2.8	11	0.4	2
	M5			4-5	6.9	1.4	6	0.9	4	8.8					1.3	5	0.2	1
	M6			5-6	7	3	12	0.8	3	8.3					2.2	9	0.2	2
	M7			6-8	7.4	4.8	38	1	8	11					2.8	22	0.2	2
	M8			8-10	8.2	2.5	20	0.7	7	8.2					3.8	30	0.2	2
	M8A			10-12											7.6	60	0.1	1
U20A	N1	A2	D3	0-1	7.9	12.8	51	4.4	18		16	64	2.3	9				
	N2			1-2	8.5	3.8	15	1.5	6		3.2	13	2	8				
	N3			2-3	8.9	2.6	10	1	4	8.9	1.3	5	1.9	8				
	N4			3-4	9.4	1.8	7	0.8	3	20	0.6	2	1.8	7				
	N5			4-5	9.5	1.9	8	1.6	6	6.2	3.1	12	2	8				
	N6			5-6	9.2	3.8	15	1.2	5	14	0.8	3	1.8	7				
	N7			6-8	9.1	2.4	20	1.1	8	6.8	3.6	28	1.4	6				
	N8			8-10	9.3	1	8	0.8	6	6.6	2.3	18	1.3	5				
	N9			10-12	8.8	1.1	8	1.2	10	7.5								
	N10			12-14	8.7	1.7	14	1.2	10	5.2								
U20B	N11	A3	D3	0-1	8.2	7.4	30	2.1	8	11								
	N12			1-2	7.9	3.2	13	1.9	8	4.7								
	N13			2-3	8.4	1.4	6	1.5	6	5.2								
	N14			3-4	8.4	1	4	1.8	7	3.4								
	N15			4-5	8.2	1.1	4	1.5	6	4.8								
	N16			5-6	7.9	0.8	3	1	4	5.5								
	N17			6-8	7.9	1	8	1	8	3.6								
M22A	P1	AB3	M4	0-1	6.2	1	4	3	12	4.5								
	P2			1-2	7.2	0.8	3	2	8	2.5								
	P3			2-3	8.1	1.1	4	2	8	7.4								
	P4			3-4	8.4	1.9	8	1.4	6	9								
	P5			4-5	9.3	0.8	3	1	4	9.4								
	P6			5-6	9	2.3	9	0.7	3	6.6								
M22C	P7	A3	M4	0-1	7.4	1.5	6	2.5	10	21								
	P8			1-2	7.6	1.6	6	1.1	4	53								
	P9			2-3	7.9	2.9	12	0.8	3	81								
M23A	Q1	AB3	D3	0-1	8.1	1.5	6	11	44	21								
	Q2			1-2	8.2	1	4	3.5	14	14								
	Q3			2-3	8.3	0.6	2	2.3	9	12								
	Q4			3-4	8.3	0.6	2	1.3	5	6.6								
	Q5			4-5	8.3	0.5	2	3.2	13	9.2								
	Q6			5-6	8.4	1	4	2.2	9	6.4								
U24A	R1	A3	M4	0-1	6.3	5.9	24	2.5	10	11								
	R2			1-2	6.4	1	4	1.1	4	5.1								
	R3			2-3	6.7	0.8	3	0.8	3	7.5								
	R4			3-4	7.2	0.9	4	0.8	3	5.2								
U25A	T1	B1	M4	0-1	7.3	4.5	18	2.2	9	46	14	56	3.4	14				
	T2			1-2	8	1.6	6	1.1	4	15	4.5	18	1.6	6				
	T3			2-3	8	8.2	33	1.4	6	20	2.5	10	1.4	6				
	T4			3-4	8.1	11.9	48	1.2	5	38	3.4	14	1.3	5				
	T5			4-5	8.5	13.2	53	0.8	3	43	25	100	1.2	5				
	T6			5-6	9.2	11.7	47	0.6	2	22	24	96	0.9	4				
	T7			6-8	9.5	8.9	72	0.6	4	16	9.7	78	0.7	3				
	T8			8-10	9.4	6.3	50	1	8	35	6	48	0.7	3				
	T8A			10-12							2.4	20	0.9	4				
	T8B			12-14							1.1	8	0.7	3				
U25B	T9	ABC3	M4	0-1	8.1	1.9	8	2.1	8	37								
	T10			1-2	8.2	0.9	4	1.4	6	7.8								
	T11			2-3	8.2	2.1	8	1.3	5	16								
	T12			3-4	8.3	3	12	0.9	4	36								
	T13			4-5	8.4	1.9	8	1.3	5	18								
	T14			5-6	8.8	1.8	7	0.9	4	26								
	T15			6-8	9.9	1.1	8	0.9	8	9.4								
	T16			8-10	9.8	2.3	18	0.7	6	5.9								
	T17			10-12	9	1.9	16	0.6	4	45								
	T18			12-14	8.6	3.3	26	0.5	4									
M26A	U1	BC3	D4	0-1	8.6	0.7	3	8.1	32	21								
	U2			1-2	9	0.6	2	2	8	12								
	U3			2-3	9.3	0.6	2	1.3	5	9								
	U4			3-4	9.5	0.6	2	0.8	3	7.4								
	U5			4-5	9.8	0.5	2	0.7	3	7.6								
	U6			5-6	9.4	0.6	2	0.6	2	8.6								
	U7			6-8	9.3	0.6	4	1.1	8	7.5								
U28A	V1	B3	M4	0-1	7.2	2.1	8	2.8	11	8.7								
	V2			1-2	7.6	3.8	15	1.9	8	6.9								
	V3			2-3	8.1	7.8	31	1.5	6	9								
	V4			3-4	8	6.7	27	1	4	8.1								
	V5			4-5	8.3	7.3	29	1.4	6	8.8								
	V6			5-6	8.4	5.6	22	1	4	6.9								
	V7			6-8	8.5	6	48	0.8	6	4.8								
U28B	V8	BC3	M4	0-1	6.1	1.3	5	1.7	7	8.6								
	V9			1-2	7.2	0.7	3	1	4	4.3								
	V10			2-3	8.3	0.9	4	1.5	6	4.8								
	V11			3-4	8.3	0.8	3	1.2	5	4								
	V12			4-5	8.4	0.7	3	1	4	3.1								
	V13			5-6	8.6	0.5	2	0.8	3	2.6								
	V14			6-8	8.1	0.5	4	1	8	4.5								
M29A	W1	ABC2	N	0-1	7.7	0.8	3	2.2	9	2.8					1	4	0.4	2
	W2			1-2	8.1	0.8	2	1.7	7	1.7					0.7	3	0.3	1
	W3			2-3	8.5	0.7	3	1.2	5	1.7					0.7	3	0.1	0
	W4			3-4	8.5	0.5	2	1	4	2					0.8	3	0.2	1
	W5			4-5	8.7	0.4	2	0.9	4	2.2					0.9	4	0.2	1
	W6			5-6	9	0.3	1	0.8	3	3.9					0.9	4	0.3	1
	W7			6-8	9.1	0.5	4	0.7	6	5.7								

SITE CODE	LAB ID #	PROFILE DISTRIB TYPE	CROP ROTAT TYPE	DEPTH *feet*	FALL 1992						SPRING 1993				FALL 1993			
					pH	N03-N		NH4-N		Cl-	N03-N		NH4-N		N03-N		NH4-N	
						ppm	*# / Acre*	*ppm*	*# / Acre*	*ppm*	*ppm*	*# / Acre*	*ppm*	*# / Acre*	*ppm*	*# / Acre*	*ppm*	*# / Acre*
M29B	W8	ABC2	N	0-1	8.4	0.6	2	1	4	1.9					1.4	6	0.6	2
	W9			1-2	8.2	0.6	2	0.7	3	2.1					1.2	5	0.4	2
	W10			2-3	8.4	0.5	2	0.5	2	1.9					1.7	7	0.6	2
	W11			3-4	8.6	0.8	3	1	4	1.9					1.5	6	0.4	2
	W12			4-5	8.7	0.6	2	0.8	3	1.9					0.9	4	0.3	1
	W13			5-6	9	0.4	2	0.6	2	2					1	4	0.2	1
U31A	X1	B1	S1	0-1	6.6	1	4	1.1	4	8.2	6.8	27	5.4	22				
	X2			1-2	7.9	1.2	5	1.1	4	3.6	0.2	1	1	4				
	X3			2-3	8.4	7.9	32	1.4	6	10	0.2	1	1.4	6				
	X4			3-4	8.4	11.9	48	0.9	4	11	22	88	1.5	6				
	X5			4-5	8.5	6.9	28	0.8	3	4.3	28	112	1	4				
	X6			5-6	8.4	7.6	30	0.7	3	3.2	28	112	1.1	4				
	X7			6-8	8.3	9	72	1.1	8	9.6	49	392	1.4	12				
U31B	X8	B1	M4	0-1	5.7	11.1	44	2.6	10	48	20	80	0.7	3				
	X9			1-2	6.5	1.7	7	1.4	6	4.3	1.8	7	1.3	5				
	X10			2-3	6.9	1.3	5	1	4	2.7	0	0	1.7	7				
	X11			3-4	7.4	5.7	23	0.8	3	9.2	0	0	2.1	8				
	X12			4-5	7.6	12	48	0.9	4	16	0	0	2.4	10				
	X13			5-6	8.3	8.5	34	0.7	3	6.9	6.5	26	5.9	24				
	X14			6-8	8.3	5.3	42	0.8	6	4.5	13	104	1	8				
U31C	X15	A3	M4	0-1	6.1	23	92	5.8	23									
	X16			1-2	7.1	9.9	40	1.7	7	20								
	X17			2-3	8.2	4	16	1.5	6	16								
	X18			3-4	8.3	2.3	9	1.3	5	13								
	X19			4-5	8.5	2.9	12	1	4	10								
	X20			5-6	8.9	1.7	7	1	4	4.7								
U31D	X21	A3	M4	0-1	5.5	10.8	43	2.3	9	8								
	X22			1-2	6.5	2.5	10	1.3	5	5.1								
	X23			2-3	7	1.5	6	1.1	4	5.2								
	X24			3-4	8.3	1.9	8	0.9	4	6.4								
	X25			4-5	8.6	1.8	7	1	4	3.8								
	X26			5-6	8.7	2.9	12	1	4	4								
	X27			6-8	5.9	4.6	36	0.8	6	5.9								
U32A	Y1	A3	M4	0-1	6.1	5.9	24	1.4	6	30								
	Y2			1-2	6.4	4.7	19	1.5	6	15								
	Y3			2-3	6.4	4	16	1.7	7	15								
	Y4			3-4	6.4	3.7	15	1.5	6	15								
U32B	Y5	A3	M4	0-1	6	4.7	19	1.6	6	6.4								
	Y6			1-2	6.7	7.1	28	1.3	5	4.5								
	Y7			2-3	6.9	5.9	24	1.1	4	3.9								
	Y8			3-4	6.8	5.5	22	1.2	5	4								
U32C	Y9	A3	M4	0-1	6.1	6.3	25	1.9	8	19								
	Y10			1-2	6.8	0.7	3	0.9	4	3								
M33B	Z1	ABC3	M4	0-1	6.2	2.7	11	1	4	7								
	Z2			1-2	6.8	0.6	2	0.8	3	2.8								
	Z3			2-3	7.1	1	4	1.3	5	4.9								
	Z4			3-4	8.1	0.6	2	0.8	3	1.4								
	Z5			4-5	9.2	0.8	3	0.7	3	3.1								
	Z6			5-6	8.7	1	4	0.6	2	8.8								
	Z7			6-8	8.9	1.3	10	0.6	4	8.3								
	Z8			8-10	8.7	2.1	16	0.7	6	8.7								
M33C	Z9	A3	M4	0-1	7.8	14.8	59	1.2	5	90								
	Z10			1-2	7.9	6.7	27	0.8	3	48								
	Z11			2-3	8	3.3	13	0.7	3	16								
	Z12			3-4	8.4	1.4	6	0.6	2									

SITE CODE	DEPTH ZONE *(feet)*	FALL 1992 NO3-N *(#/A)*
AVG	***0-3'***	***58***
	3-6'	***39***
	6'+	***38***
	SUM	***116***
U01A	0-3'	106
	3-6'	79
	6'+	164
	SUM	349
U01B	0-3'	129
	3-6'	118
	6'+	203
	SUM	450
U01C	0-3'	78
	3-6'	63
	6'+	52
	SUM	193
M02A	0-3'	13
	3-6'	14
	6'+	22
	SUM	49
M02B	0-3'	37
	3-6'	13
	6'+	22
	SUM	72
U04A	0-3'	50
	3-6'	10
	6'+	
	SUM	60
U04B	0-3'	225
	3-6'	214
	6'+	
	SUM	439
M05A	0-3'	33
	3-6'	19
	6'+	24
	SUM	76
M05B	0-3'	212
	3-6'	31
	6'+	
	SUM	243
M05C	0-3'	83
	3-6'	33
	6'+	
	SUM	116
U06A	0-3'	21
	3-6'	16
	6'+	
	SUM	37
U06B	0-3'	70
	3-6'	40
	6'+	20
	SUM	130
U07A	0-3'	33
	3-6'	12
	6'+	
	SUM	45
U07B	0-3'	95
	3-6'	57
	6'+	
	SUM	152
U07C	0-3'	15
	3-6'	24
	6'+	50
	SUM	89
M09B	0-3'	40
	3-6'	33
	6'+	14
	SUM	87
M09C	0-3'	21
	3-6'	19
	6'+	
	SUM	40

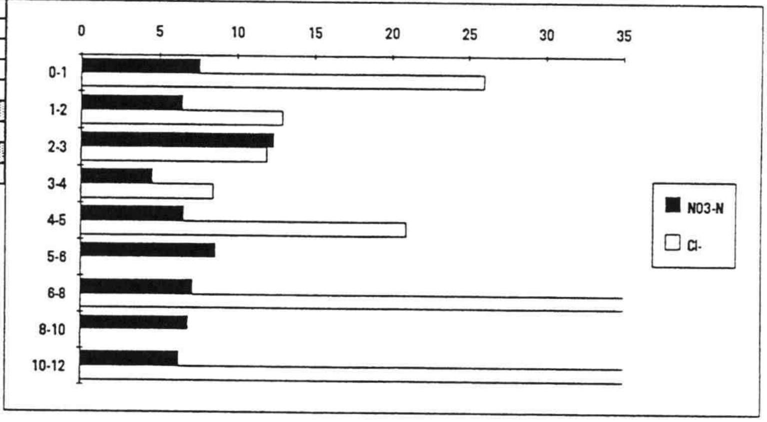
SITE CODE	DEPTH ZONE *(feet)*	FALL 1992 NO3-N *(#/A)*
AVG	***0-3'***	***58***
	3-6'	***39***
	6'+	***38***
	SUM	***116***
U10A	0-3'	95
	3-6'	51
	6'+	
	SUM	146
U10B	0-3'	92
	3-6'	78
	6'+	
	SUM	170
U14A	0-3'	11
	3-6'	17
	6'+	
	SUM	28
M15A	0-3'	141
	3-6'	16
	6'+	
	SUM	157
U18A	0-3'	113
	3-6'	18
	6'+	16
	SUM	147
U18B	0-3'	12
	3-6'	63
	6'+	
	SUM	75
U18C	0-3'	28
	3-6'	12
	6'+	16
	SUM	56
U19A	0-3'	11
	3-6'	21
	6'+	58
	SUM	90
U20A	0-3'	76
	3-6'	30
	6'+	50
	SUM	156
U20B	0-3'	49
	3-6'	11
	6'+	8
	SUM	68
M22A	0-3'	11
	3-6'	20
	6'+	
	SUM	31
M22C	0-3'	24
	3-6'	
	6'+	
	SUM	24
M23A	0-3'	12
	3-6'	8
	6'+	
	SUM	20
U24A	0-3'	31
	3-6'	4
	6'+	
	SUM	35
U25A	0-3'	57
	3-6'	148
	6'+	122
	SUM	327
U25B	0-3'	20
	3-6'	27
	6'+	42
	SUM	89
M26A	0-3'	7
	3-6'	6
	6'+	4
	SUM	17

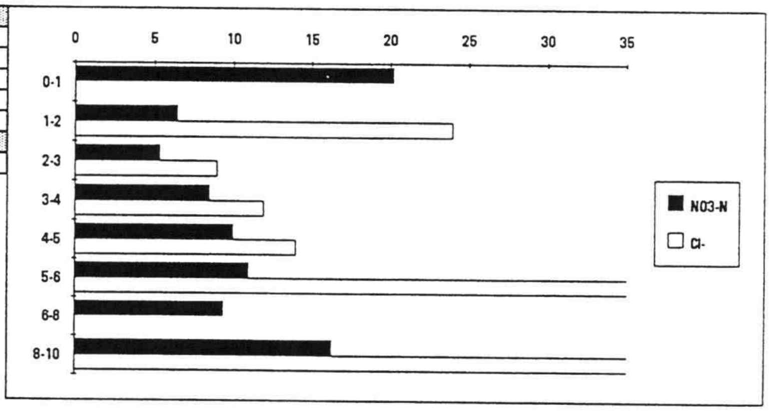
SITE CODE	DEPTH ZONE *(feet)*	FALL 1992 NO3-N *(#/A)*
AVG	***0-3'***	***58***
	3-6'	***39***
	6'+	***19***
	SUM	***116***
U28A	0-3'	54
	3-6'	78
	6'+	
	SUM	132
U28B	0-3'	12
	3-6'	8
	6'+	4
	SUM	24
M29A	0-3'	8
	3-6'	5
	6'+	4
	SUM	17
M29B	0-3'	6
	3-6'	7
	6'+	
	SUM	13
U31A	0-3'	41
	3-6'	116
	6'+	72
	SUM	229
U31B	0-3'	56
	3-6'	105
	6'+	42
	SUM	203
U31C	0-3'	148
	3-6'	28
	6'+	
	SUM	176
U31D	0-3'	59
	3-6'	27
	6'+	36
	SUM	122
U32A	0-3'	59
	3-6'	15
	6'+	
	SUM	74
U32B	0-3'	71
	3-6'	22
	6'+	
	SUM	93
U32C	0-3'	28
	3-6'	
	6'+	
	SUM	28
M33B	0-3'	17
	3-6'	9
	6'+	26
	SUM	52
M33C	0-3'	99
	3-6'	6
	6'+	
	SUM	105

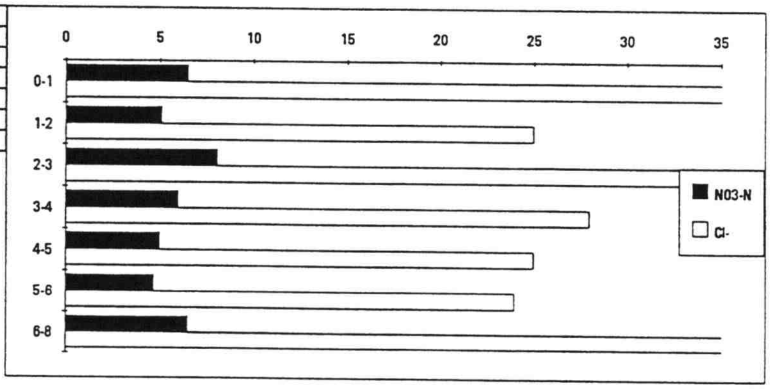
SITE CODE	LAB ID #	PROFILE DISTRIB TYPE	CROP ROTAT TYPE	DEPTH *feet*	FALL 1993				N03-N	*(#/A)*	NH4-N	*(#/A)*
					N03-N		NH4-N		MEAN	OBSERV - MEAN	MEAN	OBSERV - MEAN
					ppm	*# / Acre*	*ppm*	*# / Acre*				
M09B	G1	AB2	M4	0-1	2	8	1.8	7	8	0	11	-4
	G2			1-2	1.4	6	0.7	3	5	0	2	1
	G3			2-3	1.9	8	1	4	6	2	3	1
	G4			3-4	2.7	11	0.9	4	7	4	2	2
	G5			4-5	2	8	0.2	1	7	1	1	0
	G6			5-6	2.8	11	1.1	4	7	4	2	2
	G7			6-8	1.6	12	1.4	12	9	3	5	7
M09BA	G7A	AB3	M4	0-1	2.4	10	1.6	6	8	2	11	-5
	G7B			1-2	1.7	7	0.5	2	5	2	2	0
	G7C			2-3	1.4	6	0.5	2	6	0	3	-1
	G7D			3-4	1.1	4	0.1	0	7	-3	2	-2
	G7E			4-5	2	8	0.1	0	7	1	1	-1
	G7F			5-6	2	8	0.2	1	7	1	2	-1
	G7G			6-8	1.4	12	0.1	1	5	7	2	-1
M09BB	G7H	AB3	M4	0-1	1.9	8	4.7	19	8	0	11	8
	G7J			1-2	1	4	0.4	2	5	-1	2	0
	G7K			2-3	1	4	0.4	2	6	-2	3	-1
	G7L			3-4	1.5	6	0.3	1	7	-1	2	-1
	G7M			4-5	1.5	6	0.4	2	7	-1	1	1
	G7N			5-6	0.7	3	0.5	2	7	-4	2	0
	G7P			6-8	0.4	4	0.2	2	5	-1	2	0
U18A	L1	A1	M4	0-1	28.9	116	13.4	54	110	6	128	-12
	L2			1-2	7.4	30	1.3	5	31	-2	24	5
	L3			2-3	3.6	14	0.7	3	10	5	10	5
	L4			3-4	2.7	11	1.1	4	12	-1	12	-1
	L5			4-5	3.7	15	0.4	2	15	0	15	0
	L6			5-6	6.1	24	0.5	2	26	-2	20	4
	L7			6-8	4.6	36	0.1	0	32	4	24	12
	L8			8-10	3.1	24	0	0	26	-2	21	3
	L8A			10-12	2.2	18	0	0	21	-3	18	0
	L8B			12-14	1.9	16	0.1	1	11	5	8	8
U18AA	L1A	A3	M4	0-1	27.5	110	42.5	170	110	0	128	-18
	L2A			1-2	7.5	30	8.5	34	31	-1	24	6
	L3A			2-3	2	8	3.3	13	10	-2	10	-2
	L4A			3-4	2.8	11	3.8	15	12	-1	12	-1
	L5A			4-5	4.3	17	5.3	21	15	2	15	2
	L6A			5-6	6.5	26	7.3	29	26	0	20	6
	L7A			6-8	3.8	30	4.8	38	16	14	12	18
	L8A			8-10	3.8	30	4.3	34	13	17	10	20
	L9A			10-12	2.3	18	2.3	18	11	7	9	9
	L10A			12-14	1.3	10	3	12	5	5	4	6
U18AB	L1B	A3	M4	0-1	25.8	103	39.8	159	110	-7	128	-25
	L2B			1-2	8.5	34	8.5	34	31	3	24	10
	L3B			2-3	1.8	7	3.3	13	10	-3	10	-3
	L4B			3-4	3.3	13	4.3	17	12	1	12	1
	L5B			4-5	3.5	14	5.3	21	15	-1	15	-1
	L6B			5-6	7	28	7.3	29	26	2	20	8
	L7B			6-8	3.8	30	4.3	34	16	14	12	18
	L8B			8-10	6	24	7	28	13	11	10	14
	L9B			10-12	7	28	9	36	11	17	9	19
	L10B			12-14	0.8	6	3	12	5	1	4	2

SITE CODE	LAB ID #	DEPTH *feet*	FALL 1992 NO3-N *ppm*	FALL 1992 Cl- *ppm*	RATIO NO3-N/Cl-
U01A	A1	0-1	7.6	26	0.29
	A2	1-2	6.5	13	0.50
	A3	2-3	12.4	12	1.03
	A4	3-4	4.6	8.5	0.54
	A5	4-5	6.6	21	0.31
	A6	5-6	8.7		
	A7	6-8	7.2	95	0.08
	A8	8-10	6.9		
	A9	10-12	6.3	59	0.11
U01B	A10	0-1	20.2		
	A11	1-2	6.5	24	0.27
	A12	2-3	5.4	9	0.60
	A13	3-4	8.5	12	0.71
	A14	4-5	10	14	0.71
	A15	5-6	11	47	0.23
	A16	6-8	9.4		
	A17	8-10	16.3	45	0.36
U01C	A18	0-1	6.5	40	0.16
	A19	1-2	5.1	25	0.20
	A20	2-3	8.1	48	0.17
	A21	3-4	6	28	0.21
	A22	4-5	5	25	0.20
	A23	5-6	4.7	24	0.20
	A24	6-8	6.5	49	0.13

Depth (feet) versus Parts per million (ppm)

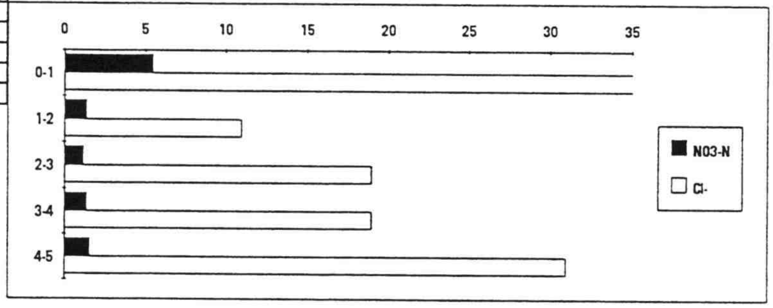


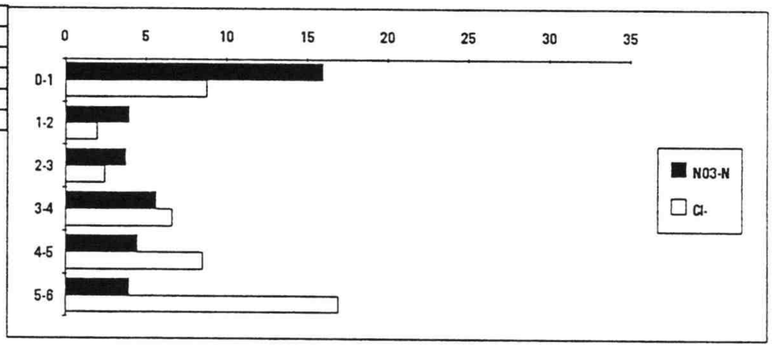


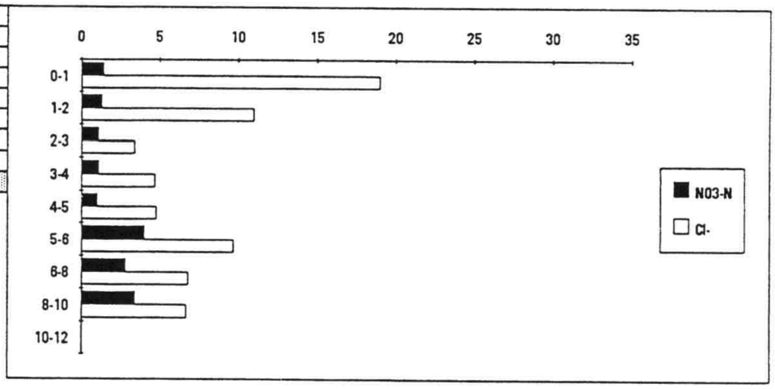


SITE CODE	LAB ID #	DEPTH *feet*	FALL 1992 NO3-N *ppm*	FALL 1992 Cl- *ppm*	RATIO NO3-N/Cl-
U07A	F1	0-1	5.5	46	0.12
	F2	1-2	1.4	11	0.13
	F3	2-3	1.2	19	0.06
	F4	3-4	1.4	19	0.07
	F5	4-5	1.6	31	0.05
U07B	F6	0-1	16	8.8	1.82
	F7	1-2	4	2	2.00
	F8	2-3	3.8	2.5	1.52
	F9	3-4	5.7	6.7	0.85
	F10	4-5	4.5	8.6	0.52
	F11	5-6	4	17	0.24
U07C	F12	0-1	1.4	19	0.07
	F13	1-2	1.3	11	0.12
	F14	2-3	1.1	3.4	0.32
	F15	3-4	1.1	4.7	0.23
	F16	4-5	1	4.8	0.21
	F17	5-6	4	9.7	0.41
	F18	6-8	2.8	6.8	0.41
	F19	8-10	3.4	6.7	0.51
	F19A	10-12			

Depth (feet) versus Parts per million (ppm)

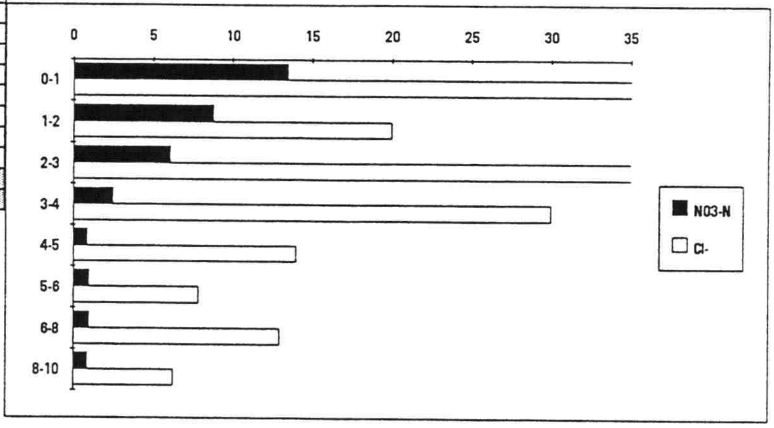


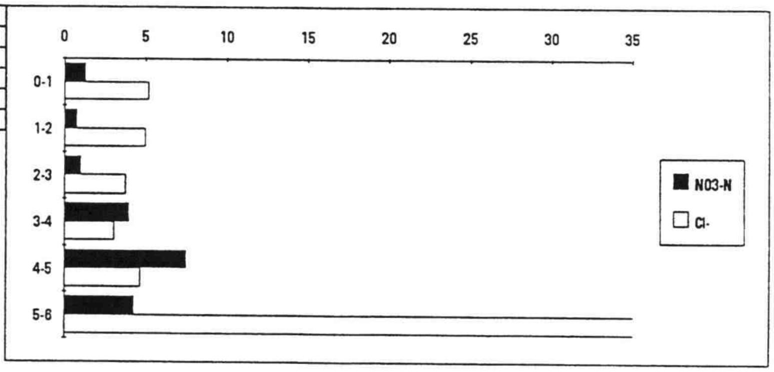


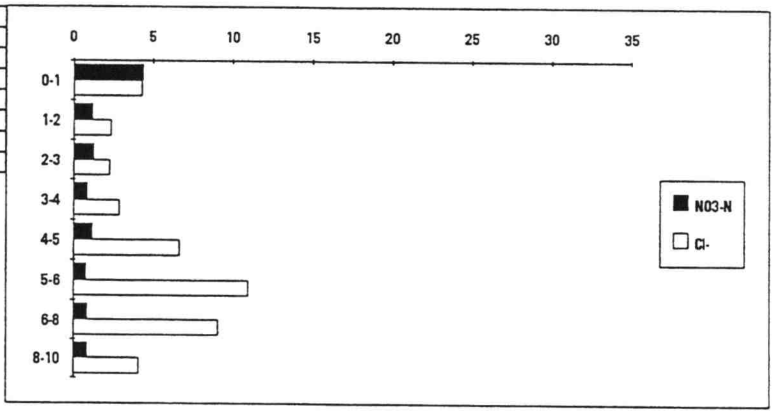


SITE CODE	LAB ID #	DEPTH *feet*	FALL 1992 NO3-N *ppm*	Cl- *ppm*	RATIO NO3-N/Cl-
U18A	L1	0-1	13.5	44	0.31
	L2	1-2	8.8	20	0.44
	L3	2-3	6.1	39	0.16
	L4	3-4	2.5	30	0.08
	L5	4-5	0.9	14	0.06
	L6	5-6	1	7.9	0.13
	L7	6-8	1	13	0.08
	L8	8-10	0.9	6.3	0.14
	L8A	10-12			
	L8B	12-14			
U18B	L9	0-1	1.3	5.2	0.25
	L10	1-2	0.8	5	0.16
	L11	2-3	1	3.8	0.26
	L12	3-4	4	3.1	1.29
	L13	4-5	7.5	4.7	1.60
	L14	5-6	4.3	53	0.08
U18C	L15	0-1	4.4	4.3	1.02
	L16	1-2	1.2	2.4	0.50
	L17	2-3	1.3	2.3	0.57
	L18	3-4	0.9	2.9	0.31
	L19	4-5	1.2	6.7	0.18
	L20	5-6	0.8	11	0.07
	L21	6-8	0.9	9.1	0.10
	L22	8-10	0.9	4.1	0.22

Depth (feet) versus Parts per million (ppm)

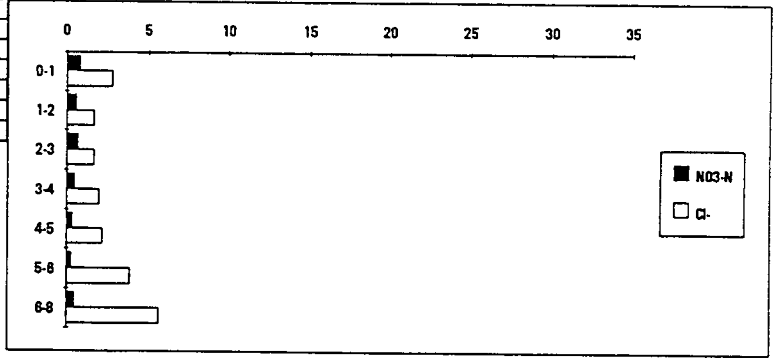


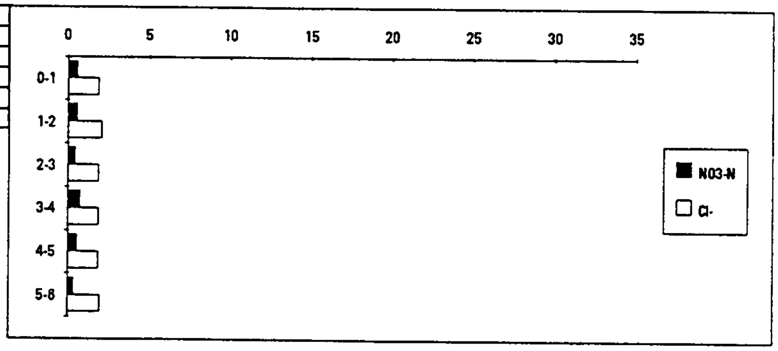




SITE CODE	LAB ID #	DEPTH feet	FALL 1992 NO3-N ppm	FALL 1992 Cl- ppm	RATIO NO3-N/Cl-
M29A	W1	0-1	0.8	2.8	0.29
	W2	1-2	0.6	1.7	0.35
	W3	2-3	0.7	1.7	0.41
	W4	3-4	0.5	2	0.25
	W5	4-5	0.4	2.2	0.18
	W6	5-6	0.3	3.9	0.08
	W7	6-8	0.5	5.7	0.09
M29B	W8	0-1	0.6	1.9	0.32
	W9	1-2	0.6	2.1	0.29
	W10	2-3	0.5	1.9	0.26
	W11	3-4	0.8	1.9	0.42
	W12	4-5	0.6	1.9	0.32
	W13	5-6	0.4	2	0.20

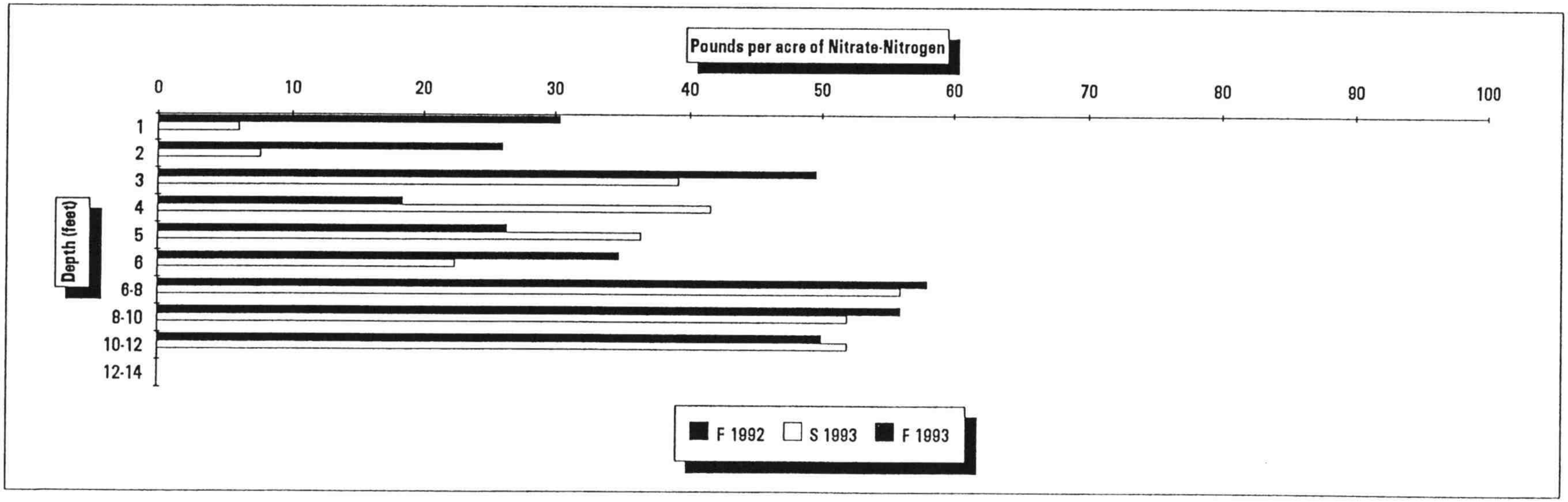
Depth (feet) versus Parts per million (ppm)





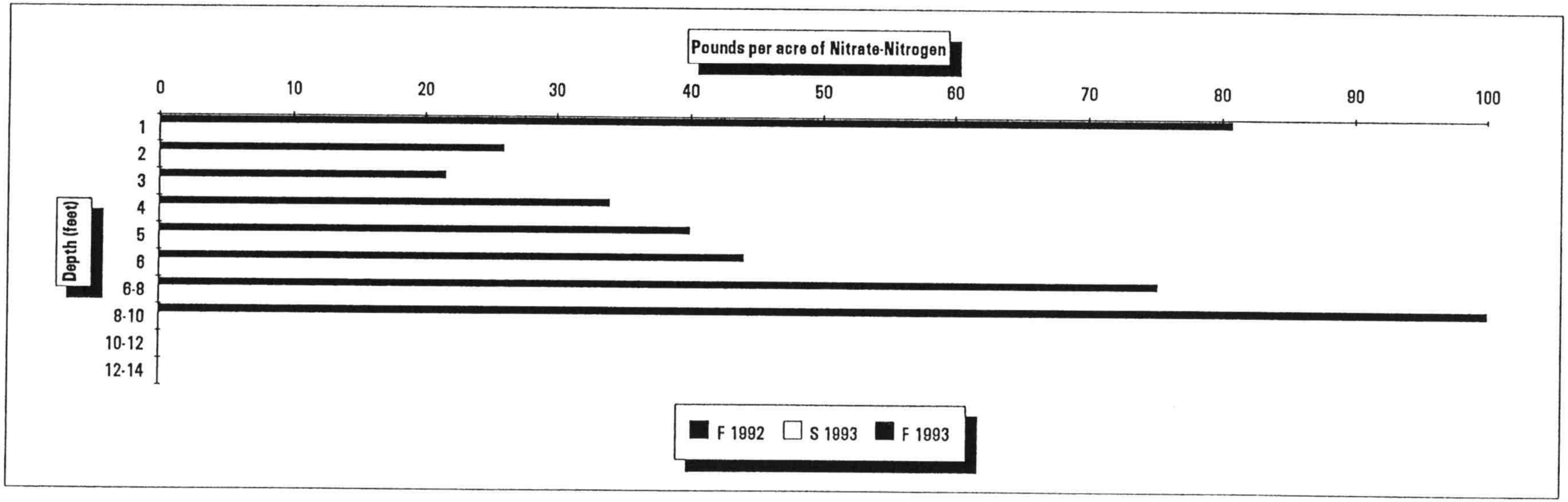
SITE CODE IDENTIFICATION:	U01A
FARM IDENTIFICATION:	6
IRRIGATION TYPE:	CP
SCS SOIL CLASSIFICATION:	88B
PROFILE DISTRIBUTION TYPE:	**A2**
CROPPING ROTATION:	**M4**
1993	
1992	WHEAT
1991	PEAS
1990	POTATO
1989	WHEAT
1988	
1987	
1986	
UNIQUE SITE INFORMATION:	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	*Change*	F 1993	*Change*	F 1992	S 1993	*Change*	F 1993	*Change*
1	30	6	-24			52	16	-36		
2	26	8	-18			36	16	-20		
3	50	39	-10			58	47	-11		
4	18	42	23			24	48	24		
5	26	36	10			32	41	9		
6	35	22	-12			41	27	-14		
6-8	58	56	-2			82	62	-20		
8-10	56	52	-4			62	60	-2		
10-12	50	52	2			56	58	2		
12-14										
SUM	*350*	*313*	*-36*			*444*	*376*	*-68*		
0-3	106	53	-53			147	79	-68		
4-6	80	100	21			97	116	20		
6+	164	160	-4			200	180	-20		
SUM	*350*	*313*	*-36*			*444*	*376*	*-68*		



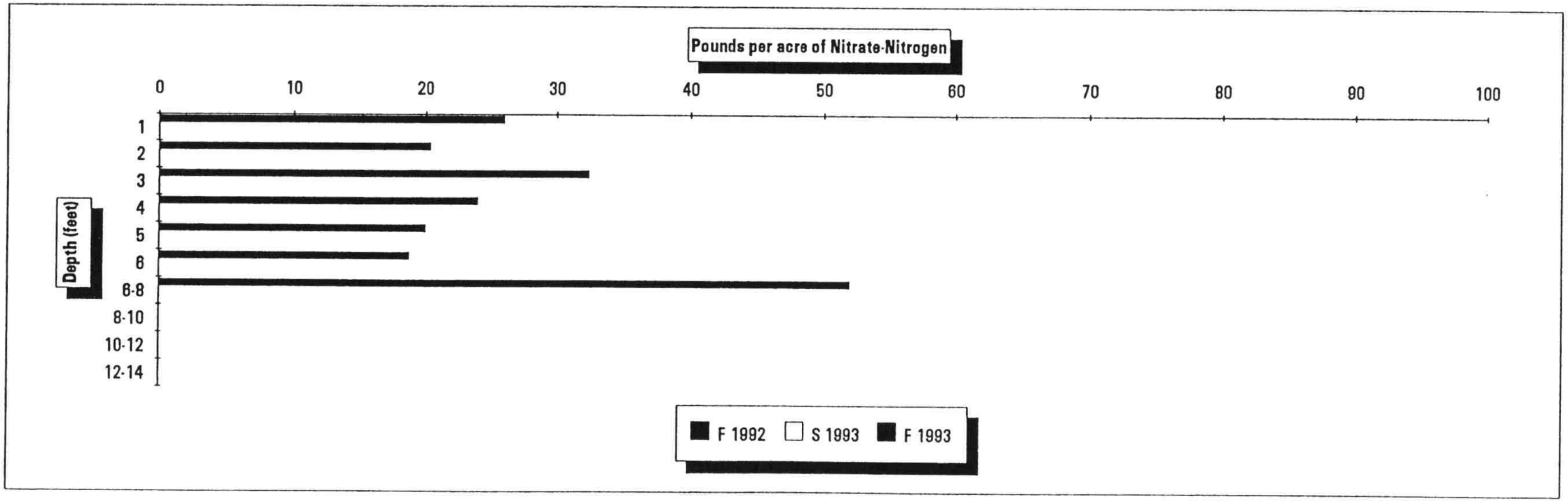
SITE CODE IDENTIFICATION:	U01B
FARM IDENTIFICATION:	9
IRRIGATION TYPE:	CP
SCS SOIL CLASSIFICATION:	88B
PROFILE DISTRIBUTION TYPE:	ABC3
CROPPING ROTATION:	M4
1993	
1992	PEAS
1991	WHEAT
1990	POTATO
1989	WHEAT
1988	
1987	
1986	
UNIQUE SITE INFORMATION:	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
1	81					111				
2	26					40				
3	22					28				
4	34					40				
5	40					45				
6	44					48				
6-8	75					81				
8-10	130					134				
10-12										
12-14										
SUM	*452*					*525*				
0-3	128					178				
4-6	118					132				
6+	206					214				
SUM	*452*					*525*				



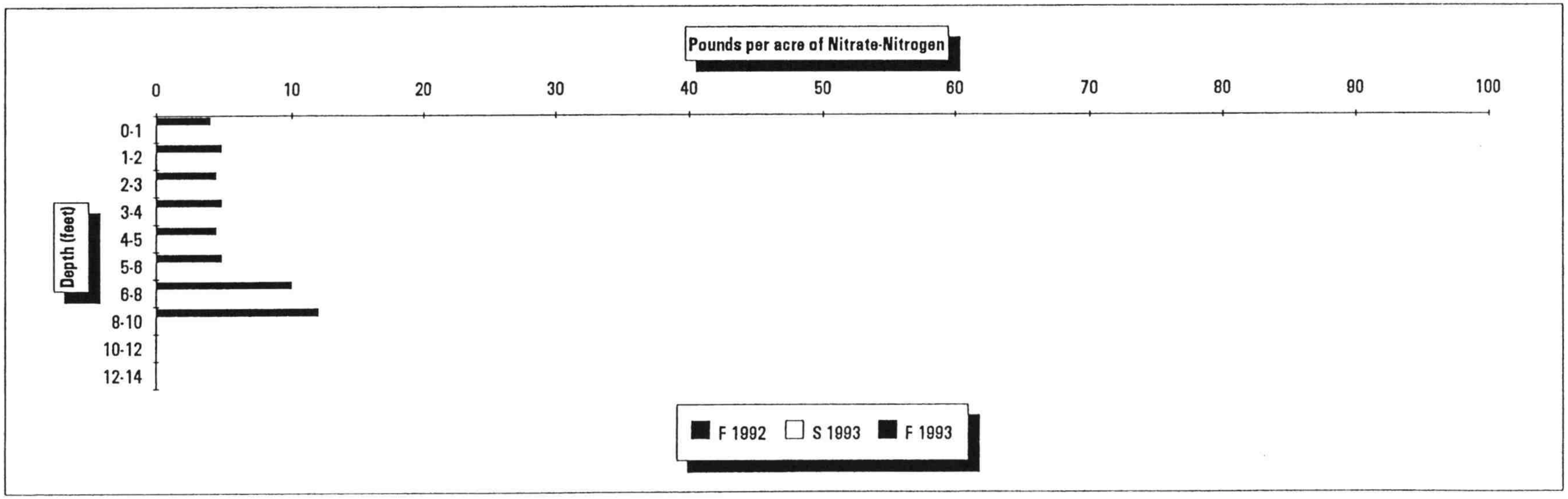
SITE CODE IDENTIFICATION:	U01C
FARM IDENTIFICATION:	17
IRRIGATION TYPE:	CP
SCS SOIL CLASSIFICATION:	88B
PROFILE DISTRIBUTION TYPE:	AB3
CROPPING ROTATION:	M4
1993	
1992	WHEAT
1991	POTATO
1990	FALLOW
1989	WHEAT
1988	
1987	
1986	
UNIQUE SITE INFORMATION:	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
1	26					31				
2	20					25				
3	32					37				
4	24					29				
5	20					24				
6	19					22				
6-8	52					55				
8-10										
10-12										
12-14										
SUM	*194*					*223*				
0-3	78					92				
4-6	63					76				
6+	52					55				
SUM	*194*					*223*				



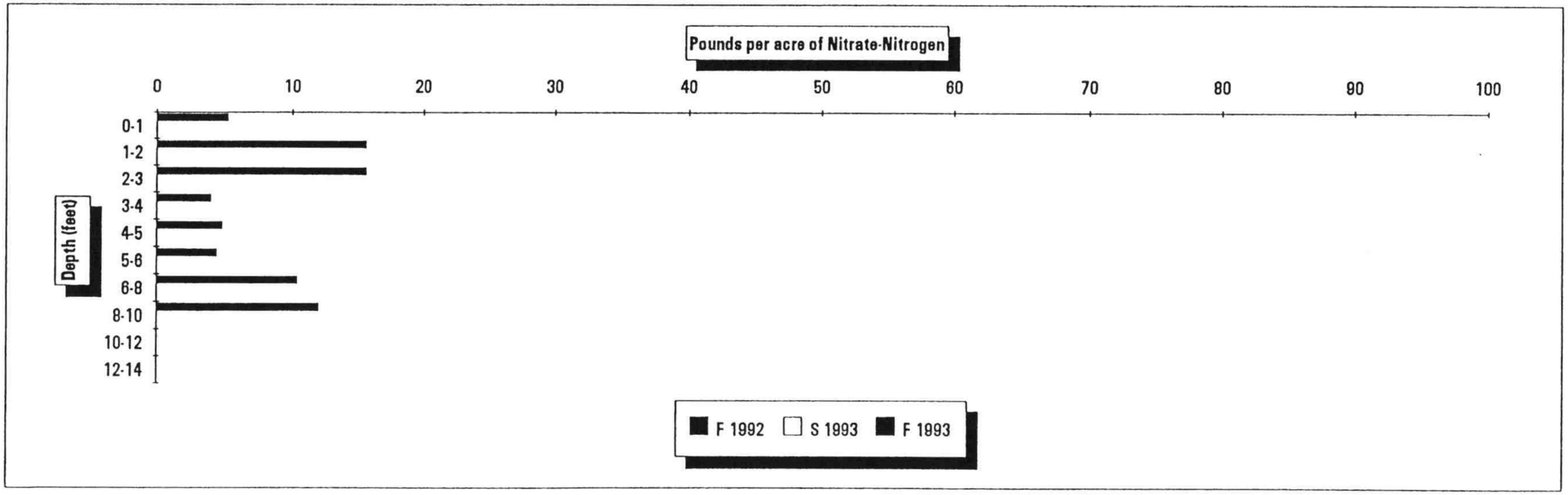
SITE CODE IDENTIFICATION:	M02A
FARM IDENTIFICATION:	PASTURE 1
IRRIGATION TYPE:	
SCS SOIL CLASSIFICATION:	20B
PROFILE DISTRIBUTION TYPE:	ABC3
CROPPING ROTATION TYPE:	D3
1993	PASTURE
1992	PASTURE
1991	PASTURE
1990	PASTURE
1989	PASTURE
1988	PASTURE
1987	PASTURE
1986	PASTURE
UNIQUE SITE INFORMATION:	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
0-1	4					48				
1-2	5					12				
2-3	4					8				
3-4	5					8				
4-5	4					7				
5-6	5					8				
6-8	10					20				
8-10	12					24				
10-12										
12-14										
SUM	*49*					*136*				
0-3	13					69				
3-6	14					23				
6+	22					44				
SUM	*49*					*136*				



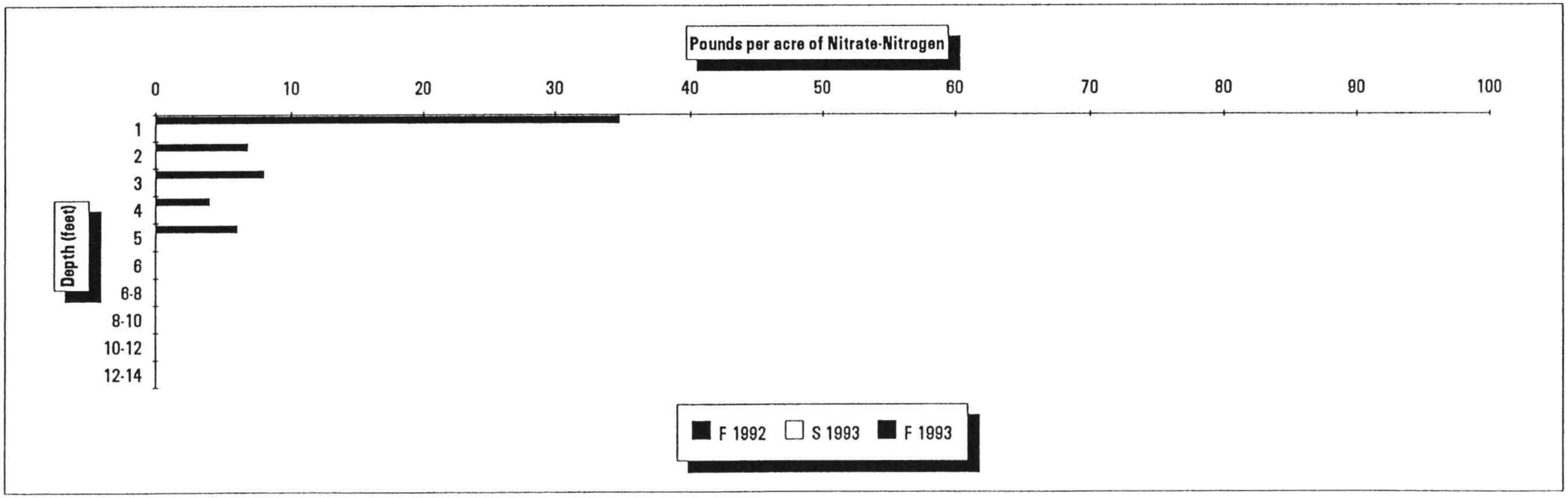
SITE CODE IDENTIFICATION:	M02B
FARM IDENTIFICATION:	PASTURE 2
IRRIGATION TYPE:	NONE
SCS SOIL CLASSIFICATION:	20B
PROFILE DISTRIBUTION TYPE:	**A3**
CROPPING ROTATION:	**D3**
1993	PASTURE
1992	PASTURE
1991	PASTURE
1990	PASTURE
1989	PASTURE
1988	PASTURE
1987	PASTURE
1986	PASTURE
UNIQUE SITE INFORMATION:	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
0-1	5					22				
1-2	16					24				
2-3	16					22				
3-4	4					8				
4-5	5					13				
5-6	4					9				
6-8	10					14				
8-10	12					16				
10-12										
12-14										
SUM	*72*					*128*				
0-3	36					68				
3-6	13					30				
6+	22					30				
SUM	*72*					*128*				

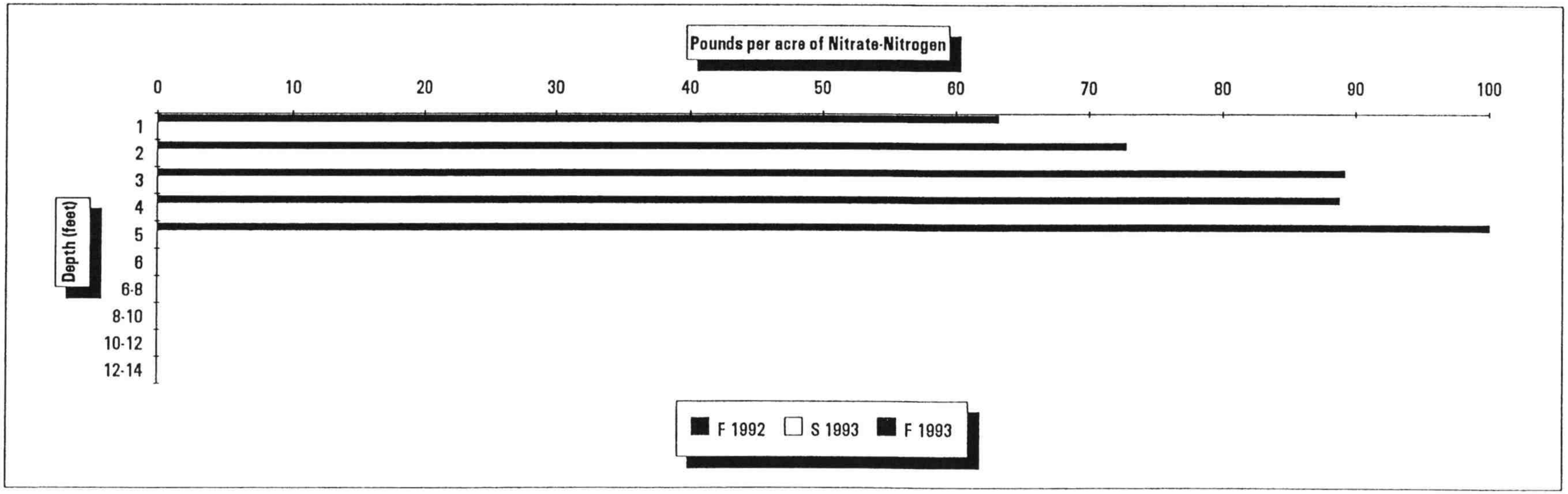


SITE CODE IDENTIFICATION:	U04A
FARM IDENTIFICATION:	OLD FEEDLOT 1
IRRIGATION TYPE:	NONE
SCS SOIL CLASSIFICATION:	1B
PROFILE DISTRIBUTION TYPE:	A3
CROPPING ROTATION:	***NONE-see below***
1993	NONE
1992	NONE
1991	NONE
1990	NONE
1989	NONE
1988	NONE
1987	NONE
1986	NONE
UNIQUE SITE INFORMATION:	
OLD EXPERIMENTAL FEEDLOT AREA, NOW USED FOR EQUIPMENT STORAGE, ETC.	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
1	35					42				
2	7					12				
3	8					12				
4	4					7				
5	6					8				
6										
6-8										
8-10										
10-12										
12-14										
SUM	*60*					*81*				
0-3	50					66				
4-6	10					15				
6+										
SUM	*60*					*81*				

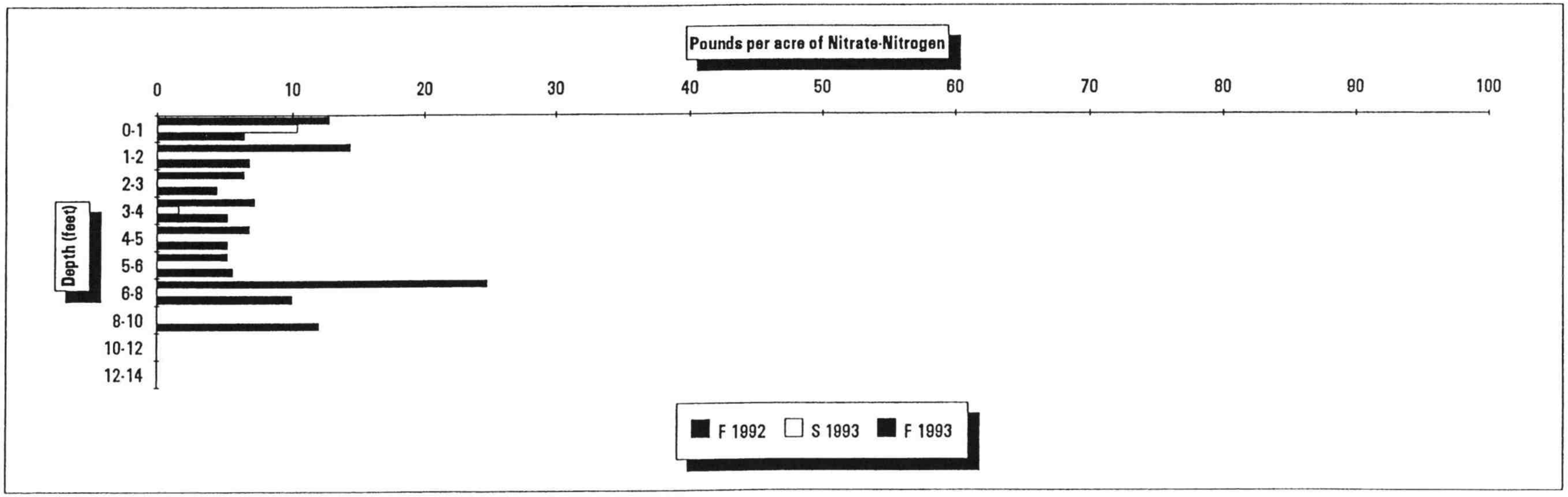


SITE CODE IDENTIFICATION:	U04B	DEPTH	NITRATE-NITROGEN					NITRATE-NITROGEN + AMMONIUM-NITROGEN				
FARM IDENTIFICATION:	OLD FEEDLOT 2	*(feet)*	*(pounds per acre)*					*(pounds per acre)*				
IRRIGATION TYPE:	HANDLINE		F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
SCS SOIL CLASSIFICATION:	1B	1	63					84				
PROFILE DISTRIBUTION TYPE:	AB3	2	73					82				
CROPPING ROTATION:	S1	3	89					102				
1993		4	89					98				
1992	POTATO	5	125					129				
1991	NONE	6										
1990	NONE	6-8										
1989	NONE	8-10										
1988	NONE	10-12										
1987	NONE	12-14										
1986	NONE	*SUM*	*439*					*495*				
UNIQUE SITE INFORMATION:		0-3	225					268				
OLD EXPERIMENTAL FEEDLOT AREA, NOW USED FOR		4-6	214					226				
EQUIPMENT STORAGE, ETC.		6+										
1992 NEMATODE TRIALS ON POTATO		*SUM*	*439*					*495*				



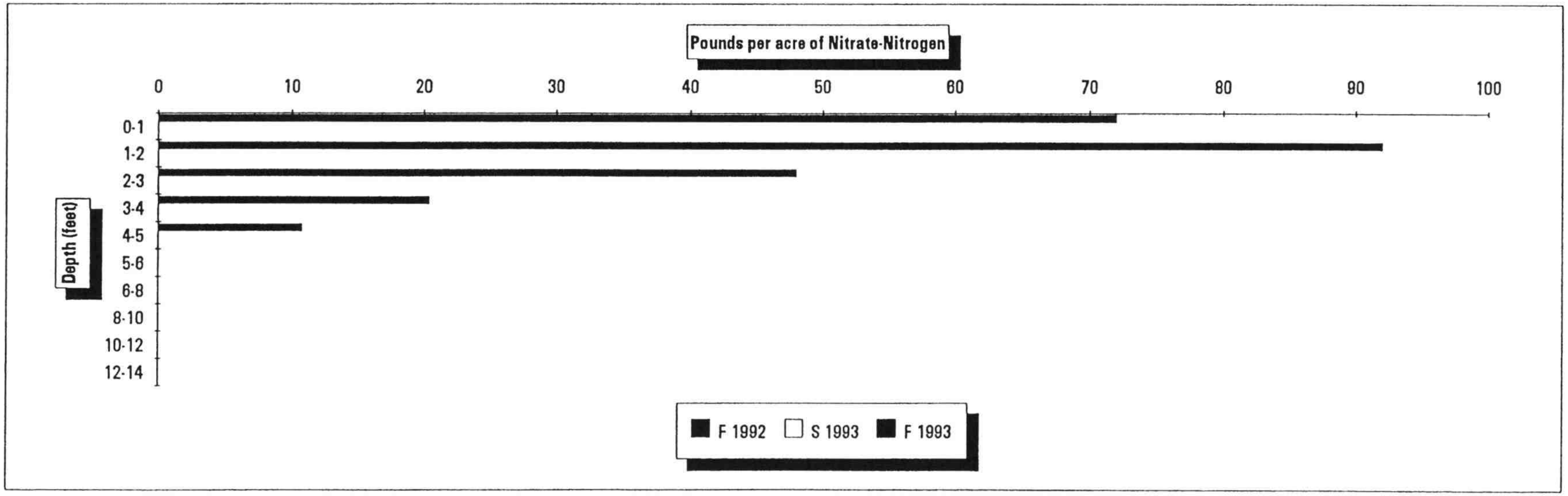
SITE CODE IDENTIFICATION:	M05A
FARM IDENTIFICATION:	301
IRRIGATION TYPE:	CP
SCS SOIL CLASSIFICATION:	40C
PROFILE DISTRIBUTION TYPE:	ABC2
CROPPING ROTATION:	M4
1993	
1992	PEAS
1991	FIELD CORN
1990	SWEET CORN
1989	WHEAT
1988	FUMIGATION
1987	WHEAT
1986	CORN
UNIQUE SITE INFORMATION:	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
0-1	13	10	-2	6	-4	28	54	26	10	-44
1-2	14	0	-14	7	7	22	4	-18	8	4
2-3	6	0	-6	4	4	11	2	-9	6	3
3-4	7	2	-6	5	4	11	10	-1	6	-4
4-5	7	0	-7	5	5	12	6	-6	6	0
5-6	5	0	-5	6	6	8	10	2	6	-4
6-8	25	0	-25	10	10	28	12	-16	11	-1
8-10		0		12	6		18		13	-5
10-12										
12-14										
SUM	*78*	*12*	*-66*	*56*	*44*	*120*	*116*	*-22*	*66*	*-50*
0-3	34	10	-23	18	7	62	61	0	24	-37
3-6	19	2	-18	16	14	31	25	-6	18	-7
6+	25	0	-25	22	22	28	30	-16	24	-6
SUM	*78*	*12*	*-66*	*56*	*44*	*120*	*116*	*-22*	*66*	*-50*



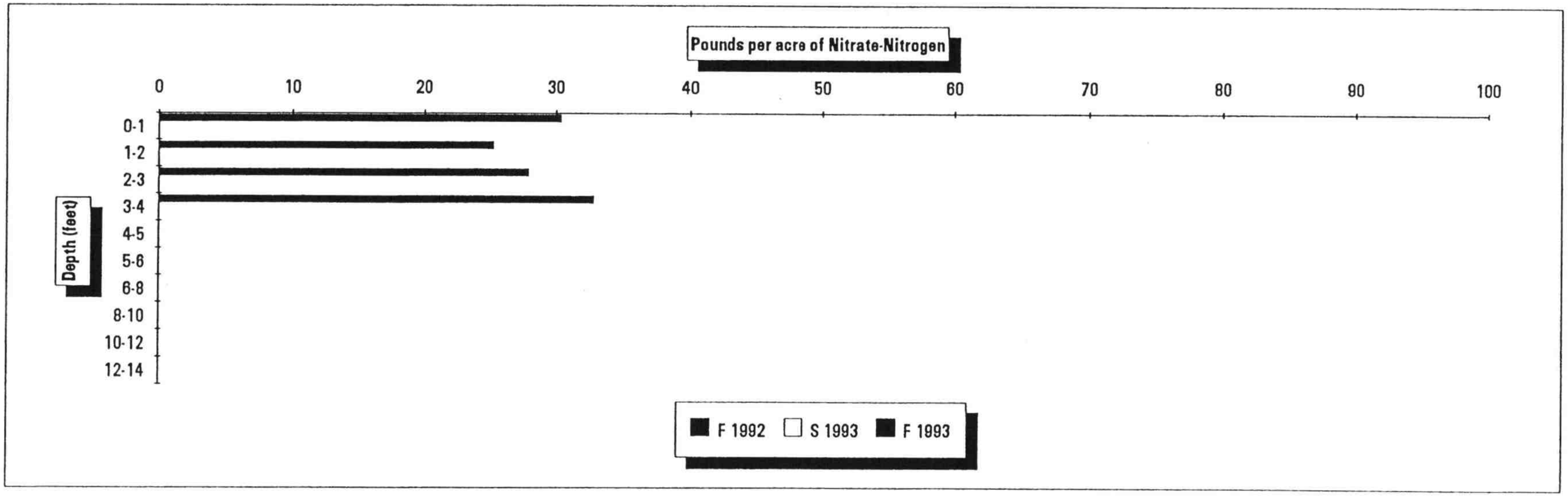
SITE CODE IDENTIFICATION:	M05B
FARM IDENTIFICATION:	306
IRRIGATION TYPE:	CP
SCS SOIL CLASSIFICATION:	40C
PROFILE DISTRIBUTION TYPE:	**A3**
CROPPING ROTATION:	**M4**
1993	
1992	FIELD CORN
1991	SWEET CORN
1990	POTATO
1989	FIELD CORN
1988	WHEAT
1987	FUMIGATION
1986	WHEAT
UNIQUE SITE INFORMATION:	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
0-1	72					86				
1-2	92					98				
2-3	48					55				
3-4	20					25				
4-5	11					15				
5-6										
6-8										
8-10										
10-12										
12-14										
SUM	*243*					*278*				
0-3	212					239				
3-6	31					40				
6+										
SUM	*243*					*278*				



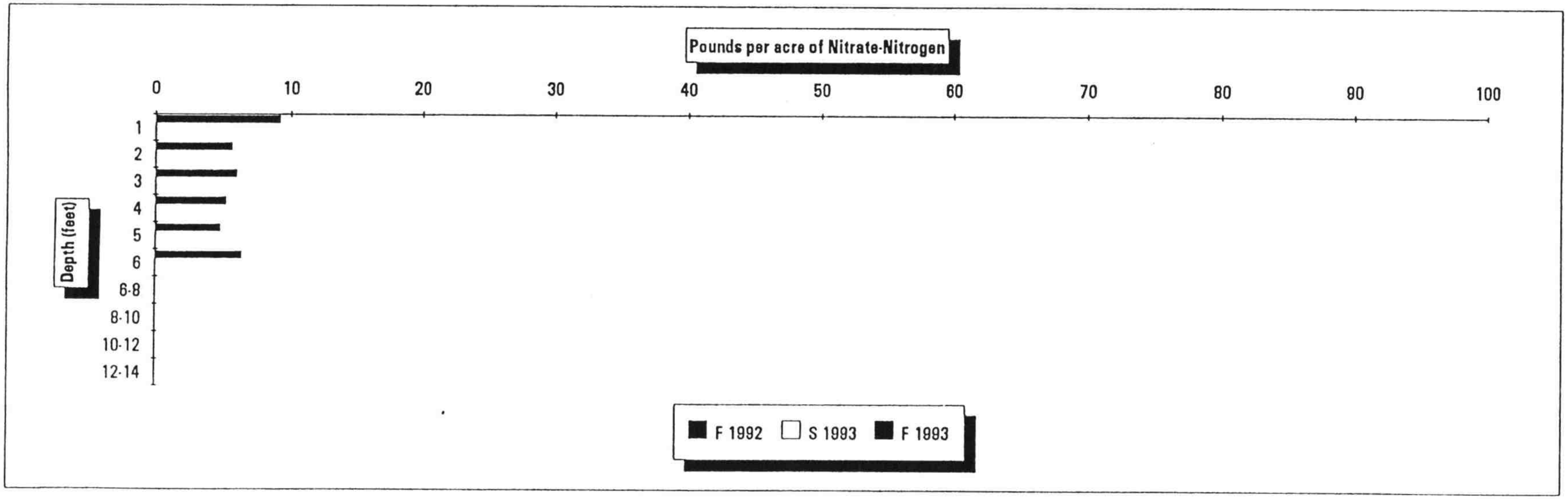
SITE CODE IDENTIFICATION:	M05C
FARM IDENTIFICATION:	315
IRRIGATION TYPE:	CP
SCS SOIL CLASSIFICATION:	40C
PROFILE DISTRIBUTION TYPE:	A3
CROPPING ROTATION:	M4
1993	
1992	ONION
1991	SWEET CORN
1990	WHEAT
1989	POTATO
1988	WHEAT
1987	CORN
1986	WHEAT
UNIQUE SITE INFORMATION:	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
0-1	30					34				
1-2	25					34				
2-3	28					37				
3-4	33					39				
4-5										
5-6										
6-8										
8-10										
10-12										
12-14										
SUM	*116*					*144*				
0-3	84					104				
3-6	33					39				
6+										
SUM	*116*					*144*				

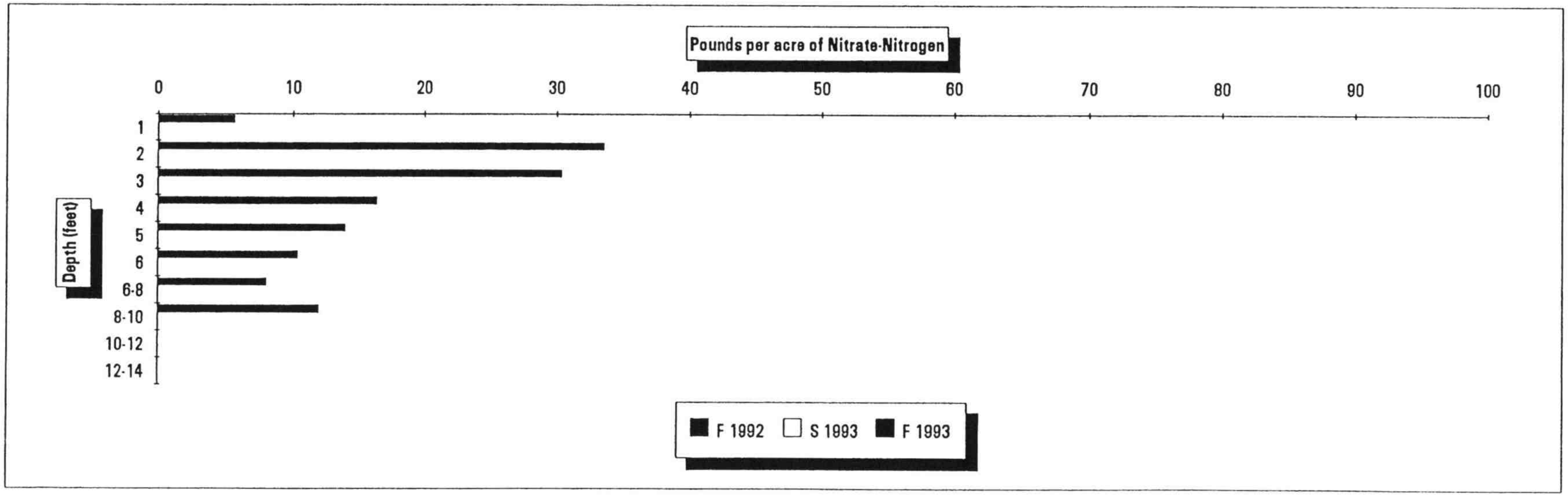


SITE CODE IDENTIFICATION:	U06A
FARM IDENTIFICATION:	OFF FEEDVILLE
IRRIGATION TYPE:	WHEELINE
SCS SOIL CLASSIFICATION:	3A
PROFILE DISTRIBUTION TYPE:	A3
CROPPING ROTATION:	M4
1993	
1992	WHEAT
1991	
1990	
1989	
1988	
1987	
1986	
UNIQUE SITE INFORMATION:	
NO FIELD RECORDS RECEIVED FROM PRODUCER	

DEPTH (feet)	NITRATE-NITROGEN (pounds per acre)					NITRATE-NITROGEN + AMMONIUM-NITROGEN (pounds per acre)				
	F 1992	S 1993	*Change*	F 1993	*Change*	F 1992	S 1993	*Change*	F 1993	*Change*
1	9					17				
2	6					12				
3	6					13				
4	5					14				
5	5					13				
6	6					12				
6-8										
8-10										
10-12										
12-14										
SUM	*37*					*82*				
0-3	21					43				
4-6	16					39				
6+										
SUM	*37*					*82*				

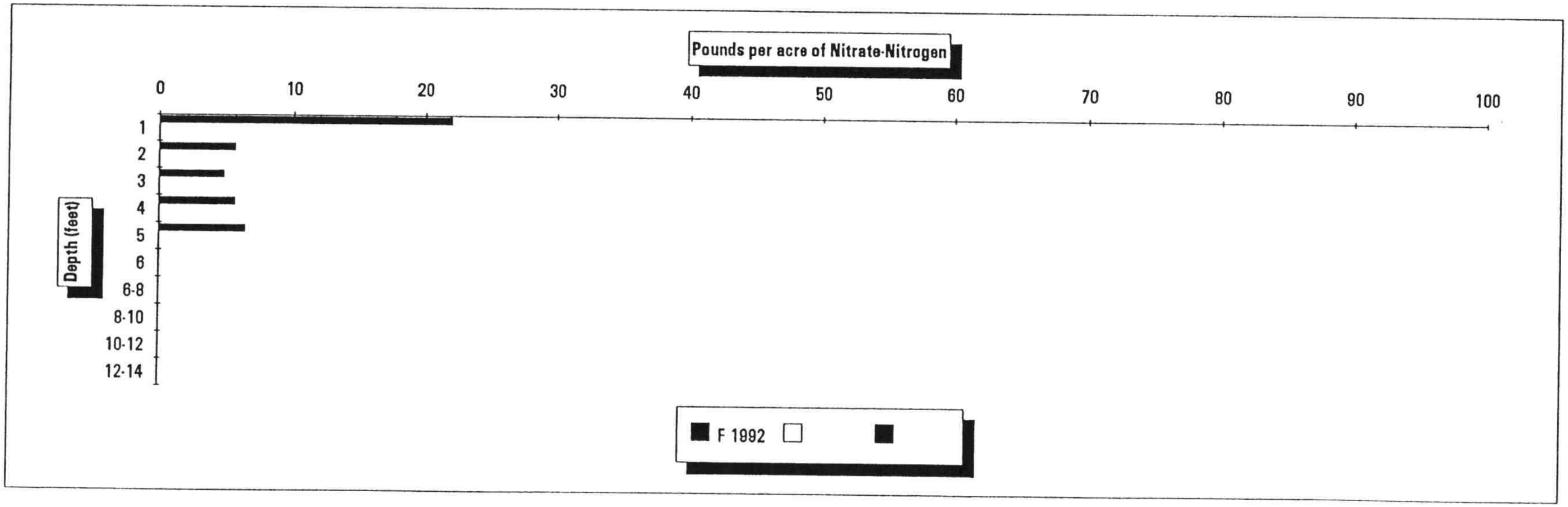


SITE CODE IDENTIFICATION:	U06B	DEPTH (feet)	NITRATE-NITROGEN (pounds per acre)					NITRATE-NITROGEN + AMMONIUM-NITROGEN (pounds per acre)				
FARM IDENTIFICATION:	HOUSE											
IRRIGATION TYPE:	WHEELINE		F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
SCS SOIL CLASSIFICATION:	42A	1	6					26				
PROFILE DISTRIBUTION TYPE:	**A3**	2	34					49				
CROPPING ROTATION:	**M4**	3	30					41				
1993		4	16					24				
1992	WHEAT	5	14					20				
1991		6	10					15				
1990		6-8	8					12				
1989		8-10	12					18				
1988		10-12										
1987		12-14										
1986		*SUM*	*130*					*203*				
UNIQUE SITE INFORMATION:		0-3	70					116				
NO FIELD RECORDS RECEIVED FROM PRODUCER		4-6	41					58				
		6+	20					29				
		SUM	*130*					*203*				



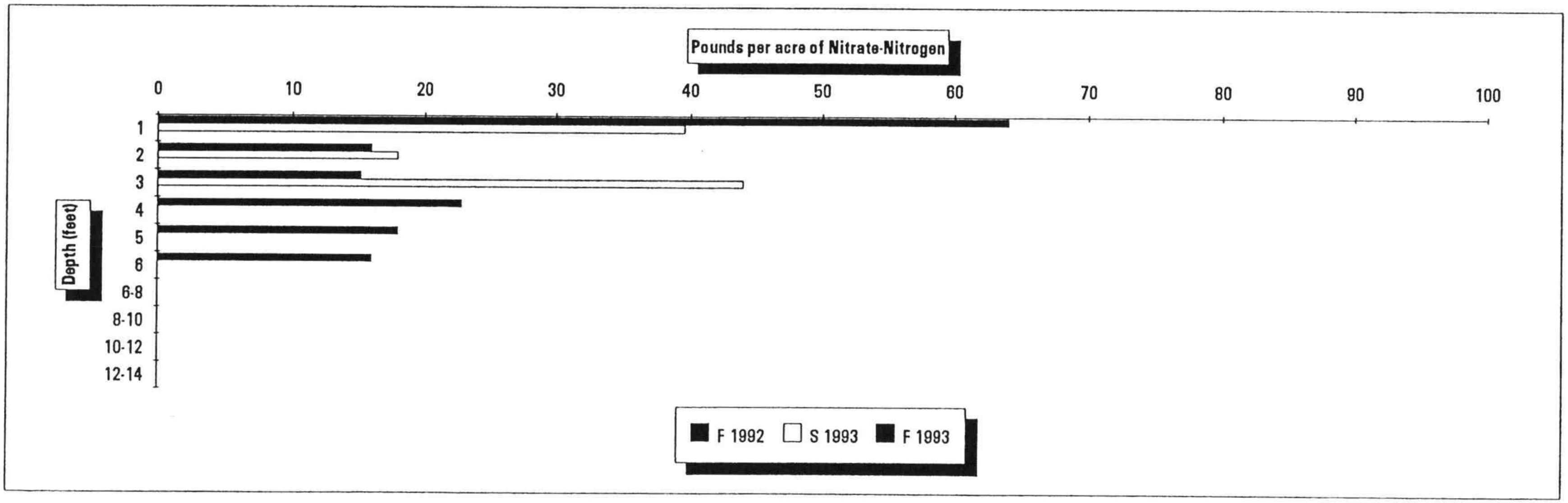
SITE CODE IDENTIFICATION:	U07A
FARM IDENTIFICATION:	26
IRRIGATION TYPE:	CP
SCS SOIL CLASSIFICATION:	95B
PROFILE DISTRIBUTION TYPE:	A3
CROPPING ROTATION:	M4
1993	
1992	WHEAT
1991	ALFALFA
1990	ALFALFA
1989	ALFALFA
1988	WHEAT
1987	POTATO
1986	BARLEY
UNIQUE SITE INFORMATION:	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992					F 1992	S 1993	***Change***	F 1993	***Change***
1	22					44				
2	6					15				
3	5					11				
4	6					12				
5	6					12				
6										
6-8										
8-10										
10-12										
12-14										
SUM	*44*					*94*				
0-3	32					70				
4-6	12					24				
6+										
SUM	*44*					*94*				



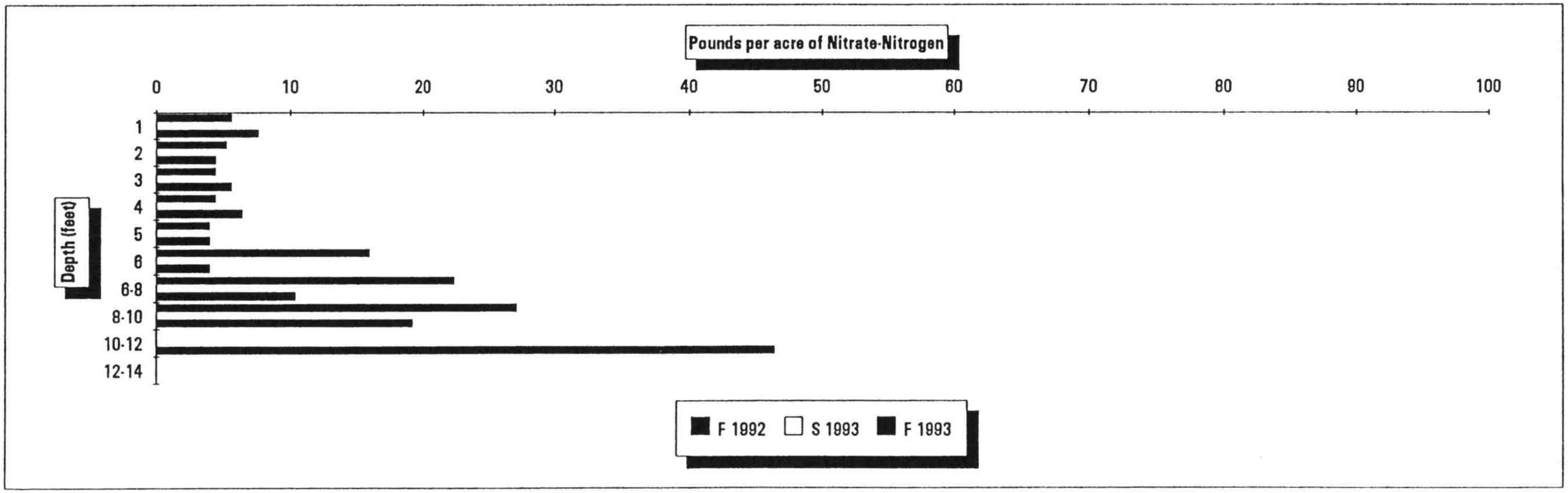
SITE CODE IDENTIFICATION:	U07B
FARM IDENTIFICATION:	E-24
IRRIGATION TYPE:	CP
SCS SOIL CLASSIFICATION:	75B
PROFILE DISTRIBUTION TYPE:	**A3**
CROPPING ROTATION:	**M4**
1993	
1992	BARLEY
1991	WHEAT
1990	PEAS
1989	WHEAT
1988	POTATO
1987	
1986	
UNIQUE SITE INFORMATION:	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
1	64	40	-24			73	79	6		
2	16	18	2			23	36	13		
3	15	44	29			21	88	67		
4	23					28				
5	18					26				
6	16					22				
6-8										
8-10										
10-12										
12-14										
SUM	*152*	*102*	*6*			*193*	*203*	*86*		
0-3	95	102	6			117	203	86		
4-6	57					76				
6+										
SUM	*152*	*102*	*6*			*193*	*203*	*86*		



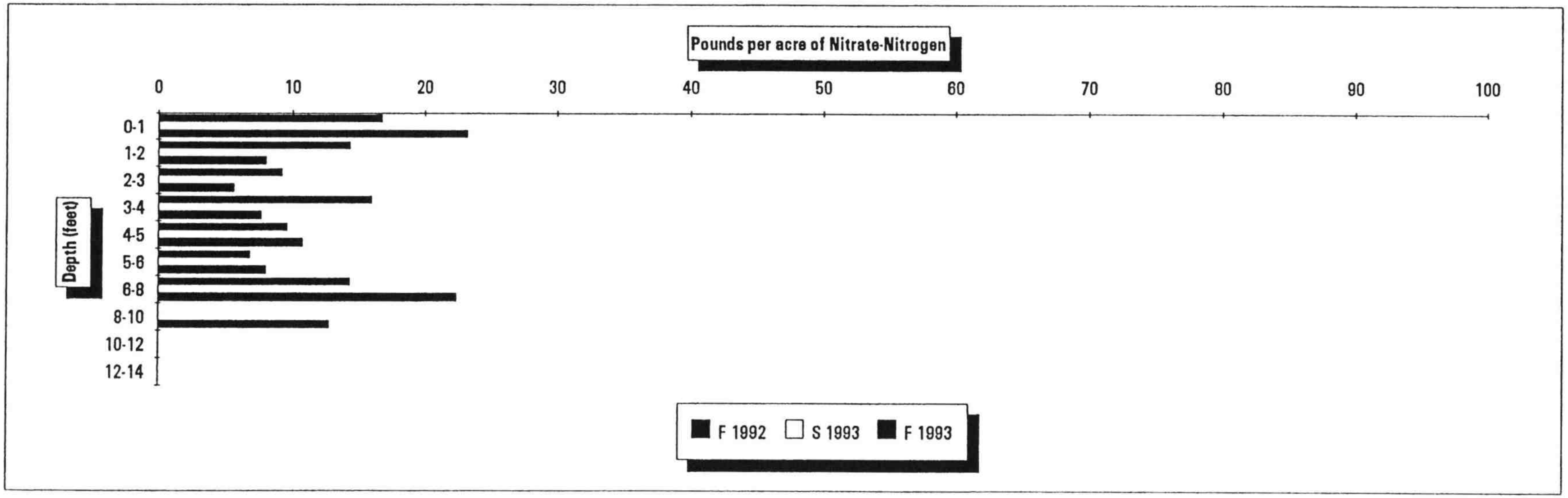
SITE CODE IDENTIFICATION:	U07C
FARM IDENTIFICATION:	E-13
IRRIGATION TYPE:	CP
SCS SOIL CLASSIFICATION:	75B
PROFILE DISTRIBUTION TYPE:	BC2
CROPPING ROTATION:	M4
1993	
1992	GRASS
1991	GRASS
1990	PEAS
1989	WHEAT
1988	FALLOW
1987	WHEAT
1986	POTATO
UNIQUE SITE INFORMATION:	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
1	6			8	2	22			12	-10
2	5			4	-1	14			6	-8
3	4			6	1	10			8	-3
4	4			6	2	10			8	-2
5	4			4	0	8			11	2
6	16			4	-12	20			4	-15
6-8	22			10	-12	26			11	-14
8-10	27			19	-8	30			20	-10
10-12				46					47	
12-14										
SUM	*89*			*108*	*19*	*140*			*127*	*-14*
0-3	15			18	2	46			26	-21
4-6	24			14	-10	38			24	-15
6+	50			76	26	56			78	22
SUM	*89*			*108*	*19*	*140*			*127*	*-14*

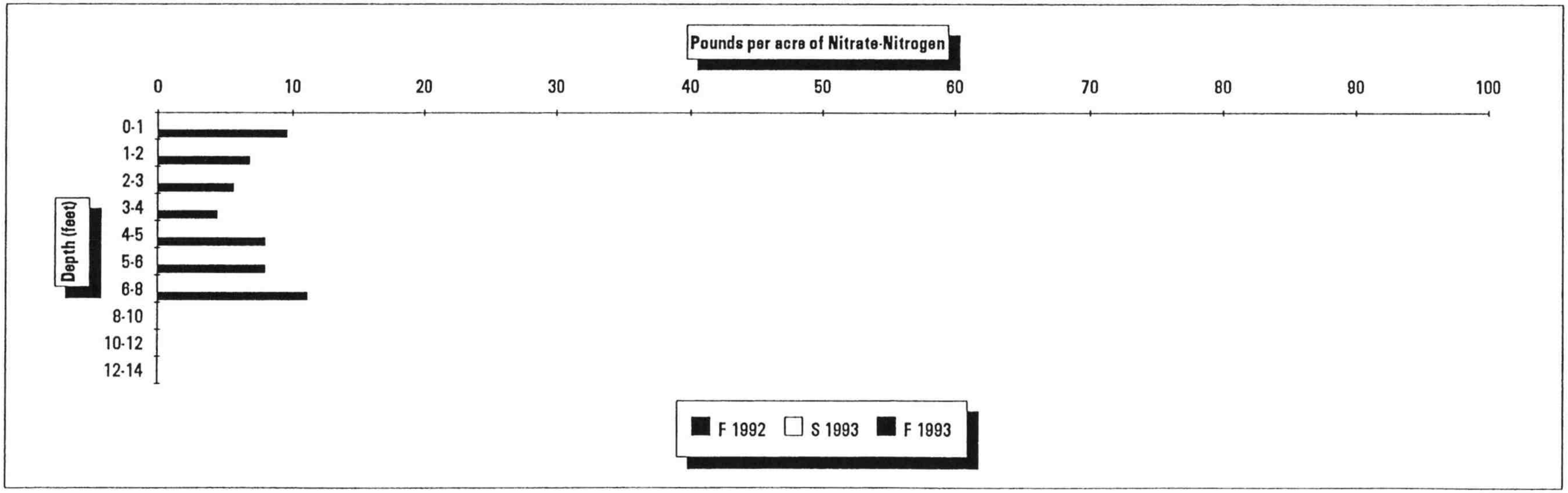


SITE CODE IDENTIFICATION:	M09B
FARM IDENTIFICATION:	C-49
IRRIGATION TYPE:	CP
SCS SOIL CLASSIFICATION:	40C
PROFILE DISTRIBUTION TYPE:	**AB2**
CROPPING ROTATION:	**M4**
1993	
1992	ALFALFA
1991	ALFALFA
1990	POTATO
1989	ALFALFA
1988	ALFALFA
1987	
1986	
UNIQUE SITE INFORMATION:	

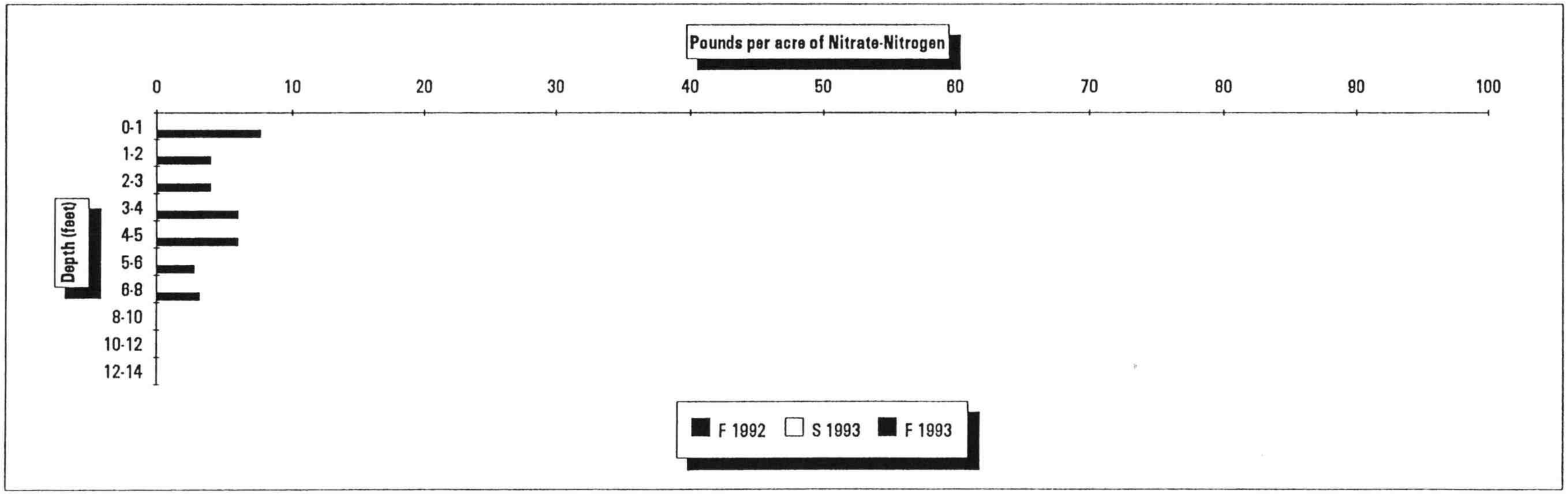
DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
0-1	17			23	6	28			24	-5
1-2	14			8	-6	20			15	-4
2-3	9			6	-4	13			8	-5
3-4	16			8	-8	20			12	-9
4-5	10			11	1	13			14	2
5-6	7			8	1	10			9	-2
6-8	14			22	8	26			35	10
8-10				13					45	
10-12										
12-14										
SUM	*87*			*98*	*11*	*130*			*162*	*32*
0-3	40			37	-4	61			47	-14
3-6	32			26	-6	44			35	-9
6+	14			35	21	26			80	54
SUM	*87*			*98*	*11*	*130*			*162*	*32*



		DEPTH (feet)	NITRATE-NITROGEN (pounds per acre)					NITRATE-NITROGEN + AMMONIUM-NITROGEN (pounds per acre)				
SITE CODE IDENTIFICATION:	M09BA											
FARM IDENTIFICATION:	C-49											
IRRIGATION TYPE:	CP		F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
SCS SOIL CLASSIFICATION:	40C	0-1				10					16	
PROFILE DISTRIBUTION TYPE:	AB3	1-2				7					9	
CROPPING ROTATION:	M4	2-3				6					8	
1993		3-4				4					5	
1992	ALFALFA	4-5				8					8	
1991	ALFALFA	5-6				8					9	
1990	POTATO	6-8				11					12	
1989	ALFALFA	8-10										
1988	ALFALFA	10-12										
1987		12-14										
1986		*SUM*				*54*					*66*	
UNIQUE SITE INFORMATION:		0-3				22					32	
FIELD VARIABILITY SITE		3-6				20					22	
		6+				11					12	
		SUM				*54*					*66*	

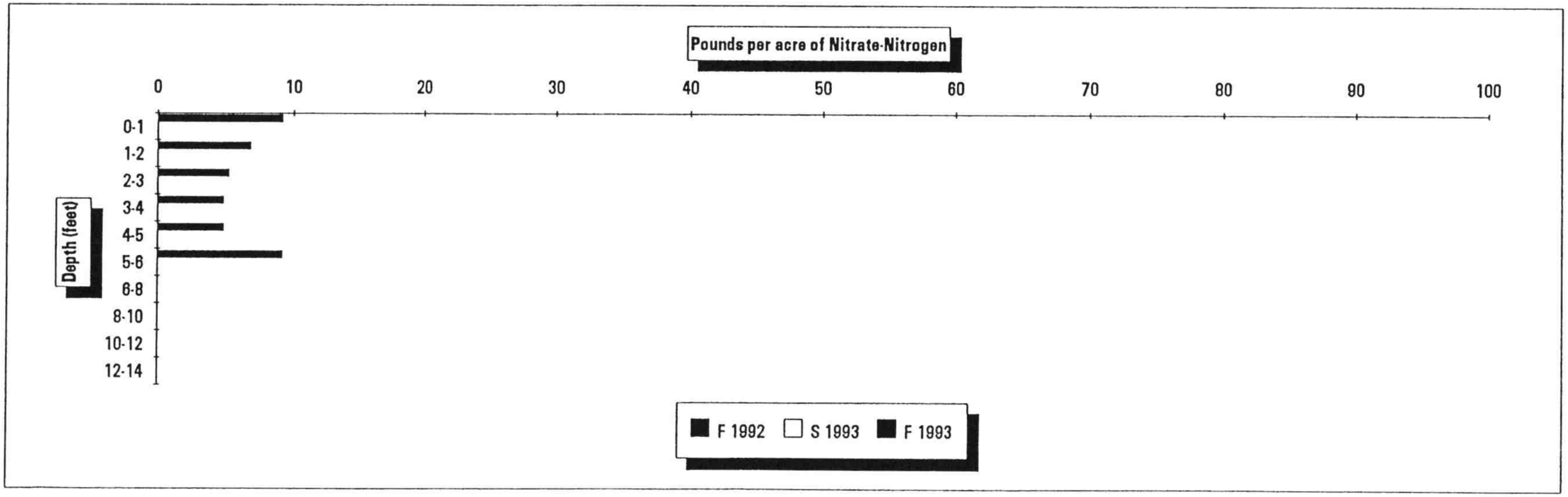


		DEPTH (feet)	NITRATE-NITROGEN (pounds per acre) F 1992	S 1993	Change	F 1993	Change	NITRATE-NITROGEN + AMMONIUM-NITROGEN (pounds per acre) F 1992	S 1993	Change	F 1993	Change
SITE CODE IDENTIFICATION:	M09BB											
FARM IDENTIFICATION:	C-49											
IRRIGATION TYPE:	CP											
SCS SOIL CLASSIFICATION:	40C	0-1				8					26	
PROFILE DISTRIBUTION TYPE:	AB3	1-2				4					6	
CROPPING ROTATION:	M4	2-3				4					6	
1993		3-4				6					7	
1992	ALFALFA	4-5				6					8	
1991	ALFALFA	5-6				3					5	
1990	POTATO	6-8				3					4	
1989	ALFALFA	8-10										
1988	ALFALFA	10-12										
1987		12-14										
1986		*SUM*				*34*					*61*	
UNIQUE SITE INFORMATION:		0-3				16					38	
FIELD VARIABILITY SITE		3-6				15					20	
		6+				3					4	
		SUM				*34*					*61*	

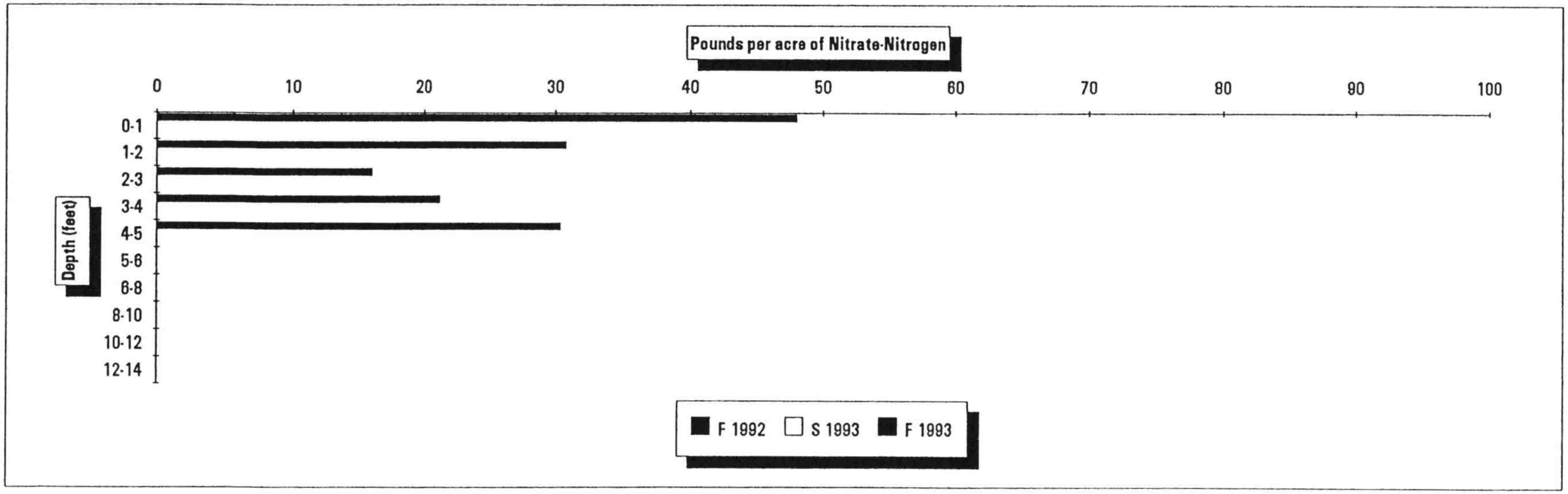


SITE CODE IDENTIFICATION:	M09C	
FARM IDENTIFICATION:	C5	
IRRIGATION TYPE:	CP	
SCS SOIL CLASSIFICATION:	40C	
PROFILE DISTRIBUTION TYPE:	**AB3**	
CROPPING ROTATION:	**M4**	
1993		
1992	ALFALFA	
1991	LIMA BEAN	
1990	PEAS/LIMA BEAN	/SUDANGRASS
1989	WHEAT	
1988	WHEAT	
1987	ALFALFA	
1986		
UNIQUE SITE INFORMATION:		

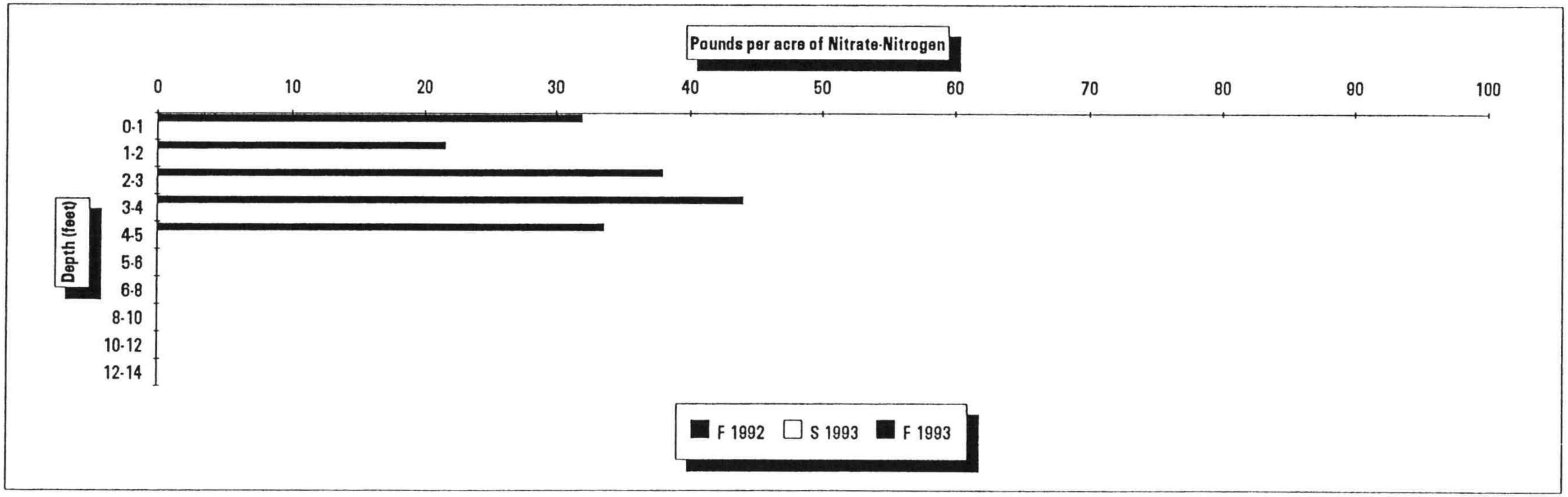
DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
0-1	9					18				
1-2	7					12				
2-3	5					9				
3-4	5					8				
4-5	5					8				
5-6	9					14				
6-8										
8-10										
10-12										
12-14										
SUM	*40*					*68*				
0-3	21					38				
3-6	19					29				
6+										
SUM	*40*					*68*				



SITE CODE IDENTIFICATION:	U10A	DEPTH (*feet*)	NITRATE-NITROGEN (*pounds per acre*)					NITRATE-NITROGEN + AMMONIUM-NITROGEN (*pounds per acre*)				
FARM IDENTIFICATION:	9											
IRRIGATION TYPE:	CP		F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
SCS SOIL CLASSIFICATION:	75E	0-1	48					59				
PROFILE DISTRIBUTION TYPE:	A3	1-2	31					37				
CROPPING ROTATION:	M4	2-3	16					21				
1993		3-4	21					26				
1992	CORN	4-5	30					37				
1991	CORN	5-6										
1990	POTATO	6-8										
1989	CORN	8-10										
1988	CORN	10-12										
1987		12-14										
1986		*SUM*	*146*					*180*				
UNIQUE SITE INFORMATION:		0-3	95					117				
		3-6	52					63				
		6+										
		SUM	*146*					*180*				

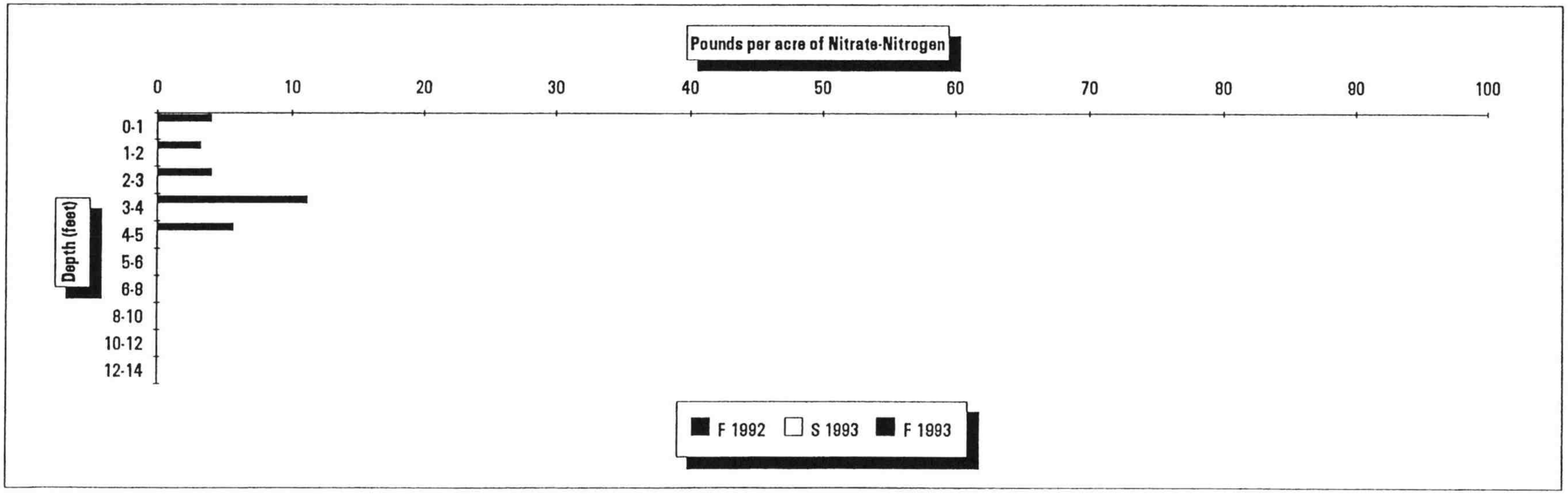


		DEPTH (feet)	NITRATE-NITROGEN (pounds per acre)					NITRATE-NITROGEN + AMMONIUM-NITROGEN (pounds per acre)				
			F 1992	S 1993	*Change*	F 1993	*Change*	F 1992	S 1993	*Change*	F 1993	*Change*
SITE CODE IDENTIFICATION:	U10B											
FARM IDENTIFICATION:	H10											
IRRIGATION TYPE:	CP											
SCS SOIL CLASSIFICATION:	75E	0-1	32					40				
PROFILE DISTRIBUTION TYPE:	A3	1-2	22					27				
CROPPING ROTATION:	M4	2-3	38					43				
1993		3-4	44					49				
1992	CORN	4-5	34					41				
1991	CORN	5-6										
1990	POTATO	6-8										
1989	CORN	8-10										
1988	CORN	10-12										
1987		12-14										
1986		*SUM*	*169*					*200*				
UNIQUE SITE INFORMATION:		0-3	92					110				
		3-6	78					90				
		6+										
		SUM	*169*					*200*				

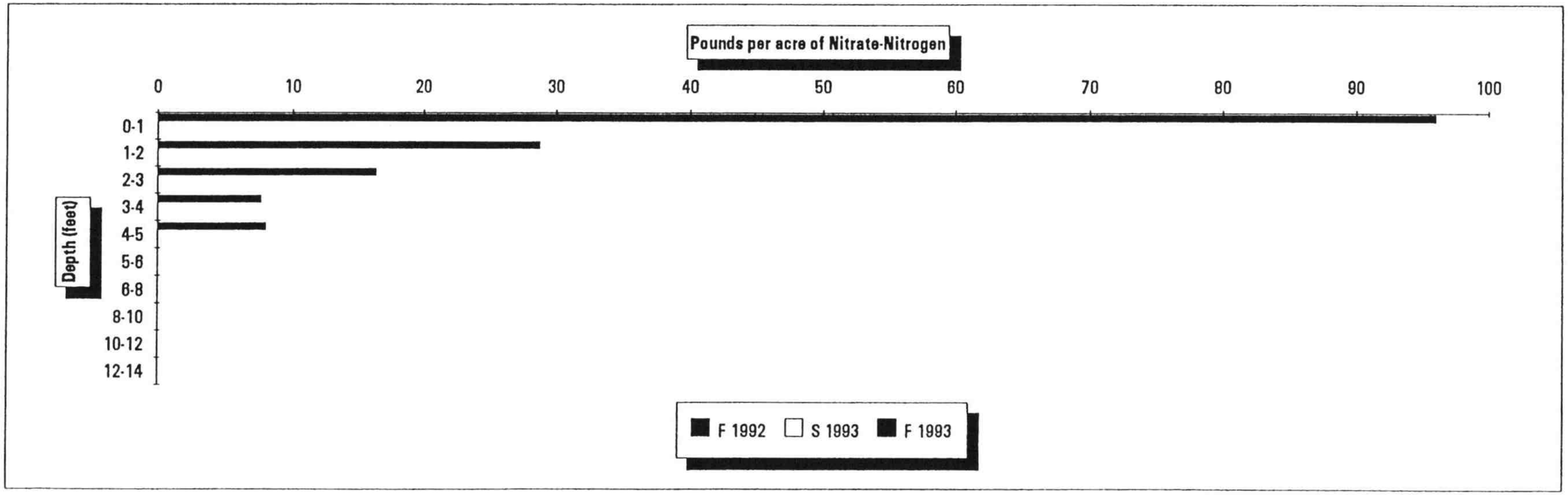


SITE CODE IDENTIFICATION:	U14A
FARM IDENTIFICATION:	PASTURE 1
IRRIGATION TYPE:	HANDLINE
SCS SOIL CLASSIFICATION:	42A
PROFILE DISTRIBUTION TYPE:	AB3
CROPPING ROTATION:	D3
1993	PASTURE
1992	PASTURE
1991	PASTURE
1990	PASTURE
1989	PASTURE
1988	PASTURE
1987	PASTURE
1986	PASTURE
UNIQUE SITE INFORMATION:	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
0-1	4					20				
1-2	3					47				
2-3	4					15				
3-4	11					43				
4-5	6					34				
5-6										
6-8										
8-10										
10-12										
12-14										
SUM	*28*					*160*				
0-3	11					82				
3-6	17					77				
6+										
SUM	*28*					*160*				

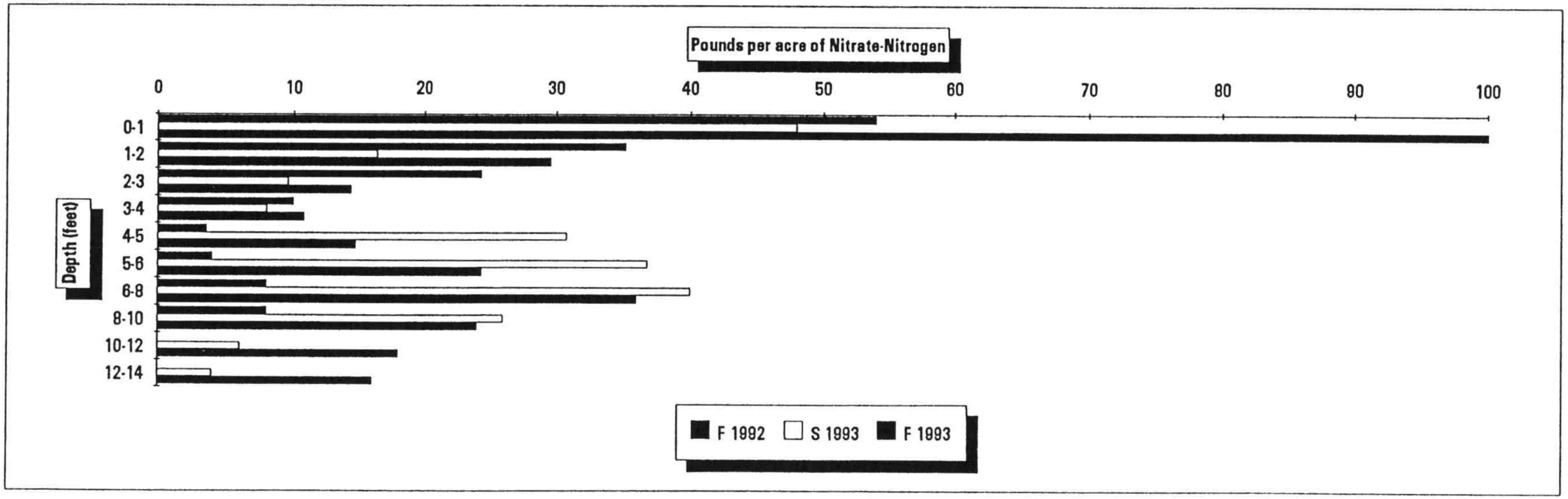


		DEPTH (feet)	NITRATE-NITROGEN (pounds per acre) F 1992	S 1993	Change	F 1993	Change	NITRATE-NITROGEN + AMMONIUM-NITROGEN (pounds per acre) F 1992	S 1993	Change	F 1993	Change
SITE CODE IDENTIFICATION:	M15A											
FARM IDENTIFICATION:	PASTURE											
IRRIGATION TYPE:	WHEELINE											
SCS SOIL CLASSIFICATION:	26B/41B	0-1	96					108				
PROFILE DISTRIBUTION TYPE:	A3	1-2	29					35				
CROPPING ROTATION:	D3	2-3	16					19				
1993	PASTURE	3-4	8					10				
1992	PASTURE	4-5	8					16				
1991	PASTURE	5-6										
1990	PASTURE	6-8										
1989	PASTURE	8-10										
1988	PASTURE	10-12										
1987	PASTURE	12-14										
1986	PASTURE	*SUM*	*157*					*189*				
UNIQUE SITE INFORMATION:		0-3	141					163				
15 YEARS PASTURE		3-6	16					26				
PAST DAIRYLAND		6+										
WATER TABLE AT 3'		*SUM*	*157*					*189*				



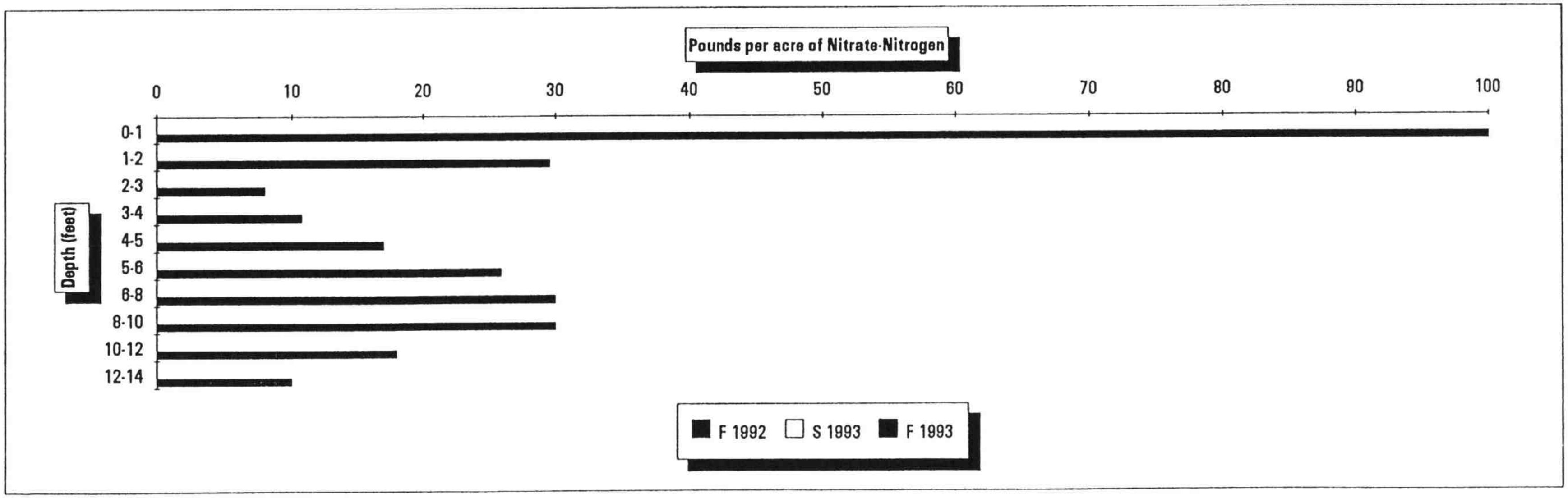
SITE CODE IDENTIFICATION:	U18A
FARM IDENTIFICATION:	WINDMILL
IRRIGATION TYPE:	CP
SCS SOIL CLASSIFICATION:	42A
PROFILE DISTRIBUTION TYPE:	A1
CROPPING ROTATION:	M4
1993	WINTER WHEAT
1992	WINTER CANOLA
1991	WINTER WHEAT
1990	POPCORN
1989	
1988	
1987	
1986	
UNIQUE SITE INFORMATION:	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	*Change*	F 1993	*Change*	F 1992	S 1993	*Change*	F 1993	*Change*
0-1	54	48	-6	116	68	93	60	-33	169	109
1-2	35	16	-19	30	13	49	24	-25	35	11
2-3	24	10	-15	14	5	32	13	-19	17	4
3-4	10	8	-2	11	3	14	12	-2	15	3
4-5	4	31	27	15	-16	9	35	26	16	-19
5-6	4	37	33	24	-12	8	41	33	26	-14
6-8	8	40	32	36	-4	14	48	34	38	-10
8-10	8	26	18	24	-2	12	32	20	24	-8
10-12		6		18	12		10		18	8
12-14		4		16	12		12		16	4
SUM	*147*	*226*	*68*	*304*	*78*	*231*	*287*	*34*	*375*	*88*
0-3	114	74	-40	160	86	174	97	-77	221	124
3-6	18	76	58	50	-26	32	88	56	58	-30
6+	16	76	50	94	18	26	102	54	96	-6
SUM	*147*	*226*	*68*	*304*	*78*	*231*	*287*	*34*	*375*	*88*



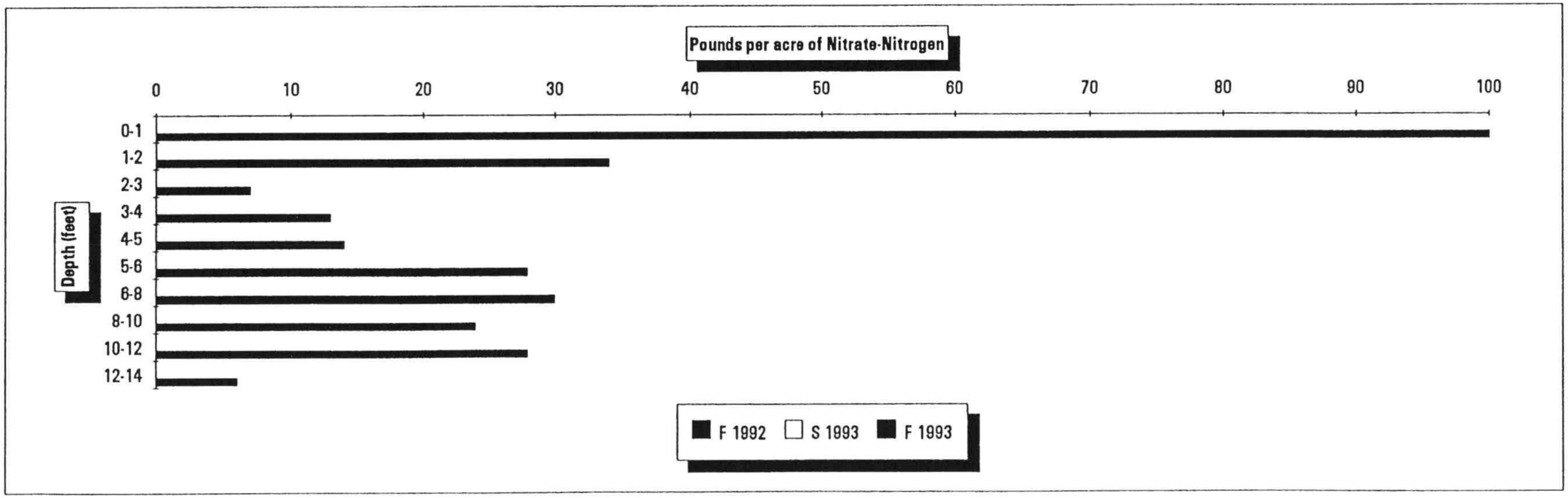
SITE CODE IDENTIFICATION:	U18AA
FARM IDENTIFICATION:	WINDMILL
IRRIGATION TYPE:	CP
SCS SOIL CLASSIFICATION:	42A
PROFILE DISTRIBUTION TYPE:	A3
CROPPING ROTATION:	M4
1993	WINTER WHEAT
1992	WINTER CANOLA
1991	WINTER WHEAT
1990	POPCORN
1989	
1988	
1987	
1986	
UNIQUE SITE INFORMATION:	
FIELD VARIABILITY SITE	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
0-1				110					170	
1-2				30					34	
2-3				8					13	
3-4				11					15	
4-5				17					21	
5-6				26					29	
6-8				30					38	
8-10				30					34	
10-12				18					18	
12-14				10					12	
SUM				*289*					*384*	
0-3				148					217	
3-6				54					65	
6+				88					102	
SUM				*289*					*384*	



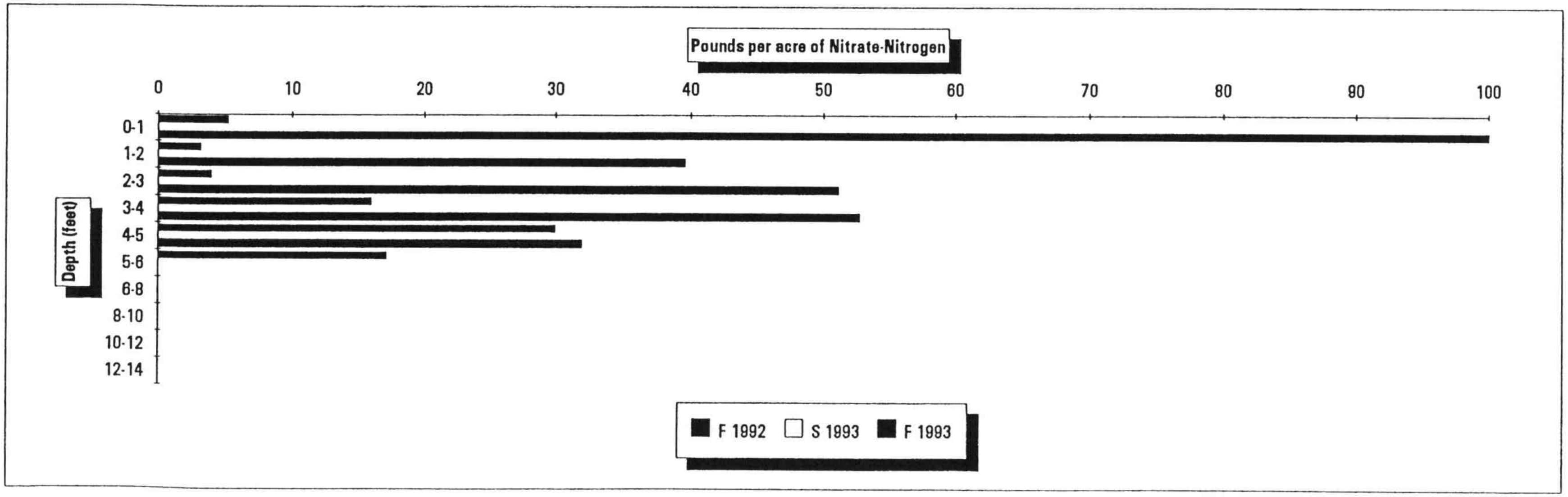
SITE CODE IDENTIFICATION:	U18AB
FARM IDENTIFICATION:	WINDMILL
IRRIGATION TYPE:	CP
SCS SOIL CLASSIFICATION:	42A
PROFILE DISTRIBUTION TYPE:	A3
CROPPING ROTATION:	M4
1993	WINTER WHEAT
1992	WINTER CANOLA
1991	WINTER WHEAT
1990	POPCORN
1989	
1988	
1987	
1986	
UNIQUE SITE INFORMATION:	
FIELD VARIABILITY SITE	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)* F 1992	S 1993	***Change***	F 1993	***Change***	NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)* F 1992	S 1993	***Change***	F 1993	***Change***
0-1				103					159	
1-2				34					34	
2-3				7					13	
3-4				13					17	
4-5				14					21	
5-6				28					29	
6-8				30					34	
8-10				24					28	
10-12				28					36	
12-14				6					12	
SUM				*287*					*383*	
0-3				144					206	
3-6				55					67	
6+				88					110	
SUM				*287*					*383*	



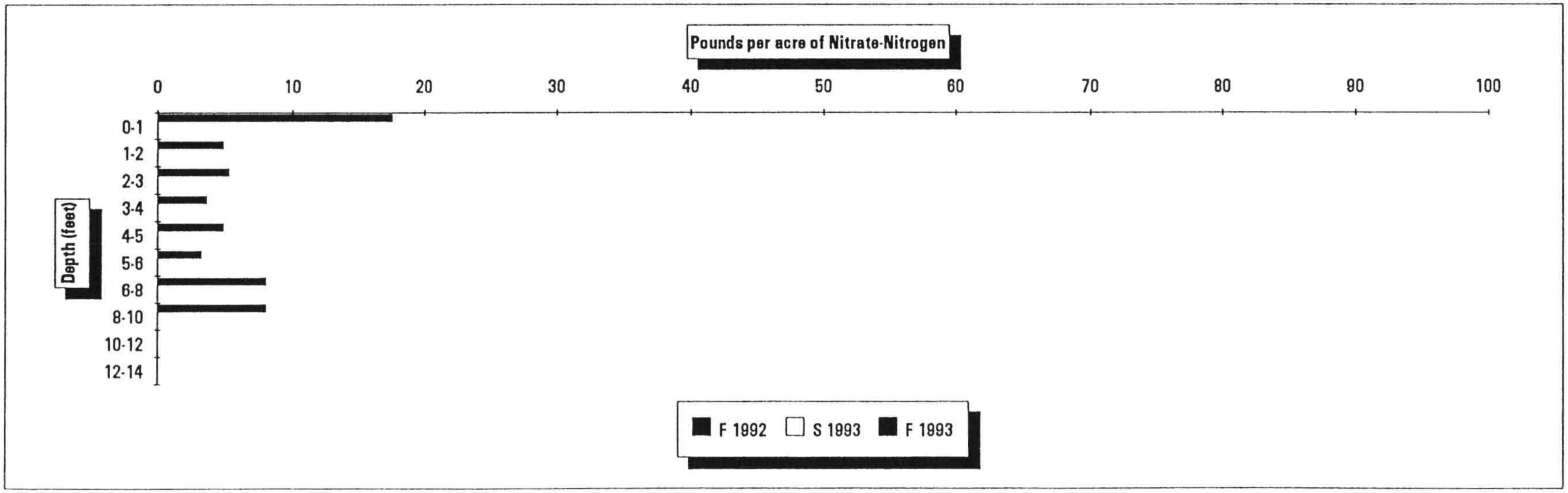
SITE CODE IDENTIFICATION:	U18B
FARM IDENTIFICATION:	N-5
IRRIGATION TYPE:	CP
SCS SOIL CLASSIFICATION:	77C
PROFILE DISTRIBUTION TYPE:	B2
CROPPING ROTATION:	M4
1993	
1992	WINTER WHEAT/ SUDANGRASS
1991	POTATO
1990	*UNBROKEN*
1989	*UNBROKEN*
1988	*UNBROKEN*
1987	*UNBROKEN*
1986	*UNBROKEN*
UNIQUE SITE INFORMATION:	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	*Change*	F 1993	*Change*	F 1992	S 1993	*Change*	F 1993	*Change*
0-1	5			140	135	22			145	123
1-2	3			40	36	10			41	30
2-3	4			51	47	12			53	41
3-4	16			53	37	22			54	32
4-5	30			32	2	34			33	-1
5-6	17					20				
6-8										
8-10										
10-12										
12-14										
SUM	*76*			*316*	*240*	*121*			*326*	*206*
0-3	12			231	218	45			239	194
3-6	63			85	22	76			87	11
6+										
SUM	*76*			*316*	*240*	*121*			*326*	*206*



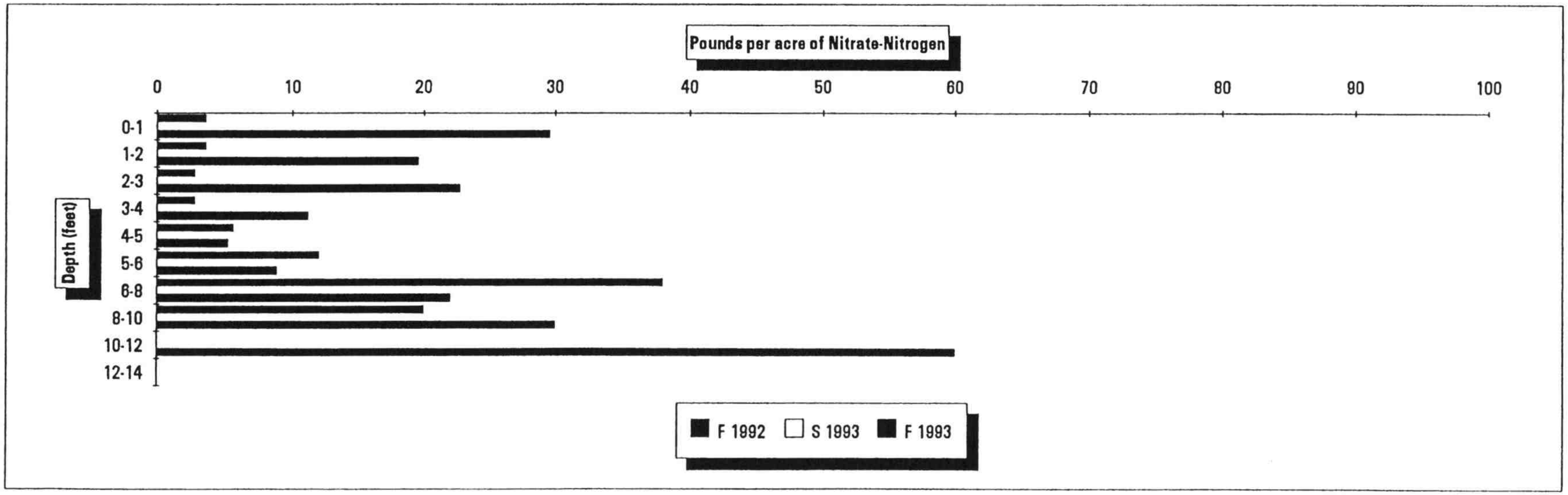
SITE CODE IDENTIFICATION:	U18C
FARM IDENTIFICATION:	N-6
IRRIGATION TYPE:	NONE
SCS SOIL CLASSIFICATION:	A3
PROFILE DISTRIBUTION TYPE:	D3
CROPPING ROTATION:	
1993	
1992	PASTURE
1991	PASTURE
1990	PASTURE
1989	PASTURE
1988	PASTURE
1987	PASTURE
1986	PASTURE
UNIQUE SITE INFORMATION:	
FUTURE CENTER PIVOT SITE	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
0-1	18					24				
1-2	5					9				
2-3	5					9				
3-4	4					7				
4-5	5					8				
5-6	3					7				
6-8	8					14				
8-10	8					14				
10-12										
12-14										
SUM	*55*					*92*				
0-3	28					41				
3-6	12					23				
6+	16					28				
SUM	*55*					*92*				



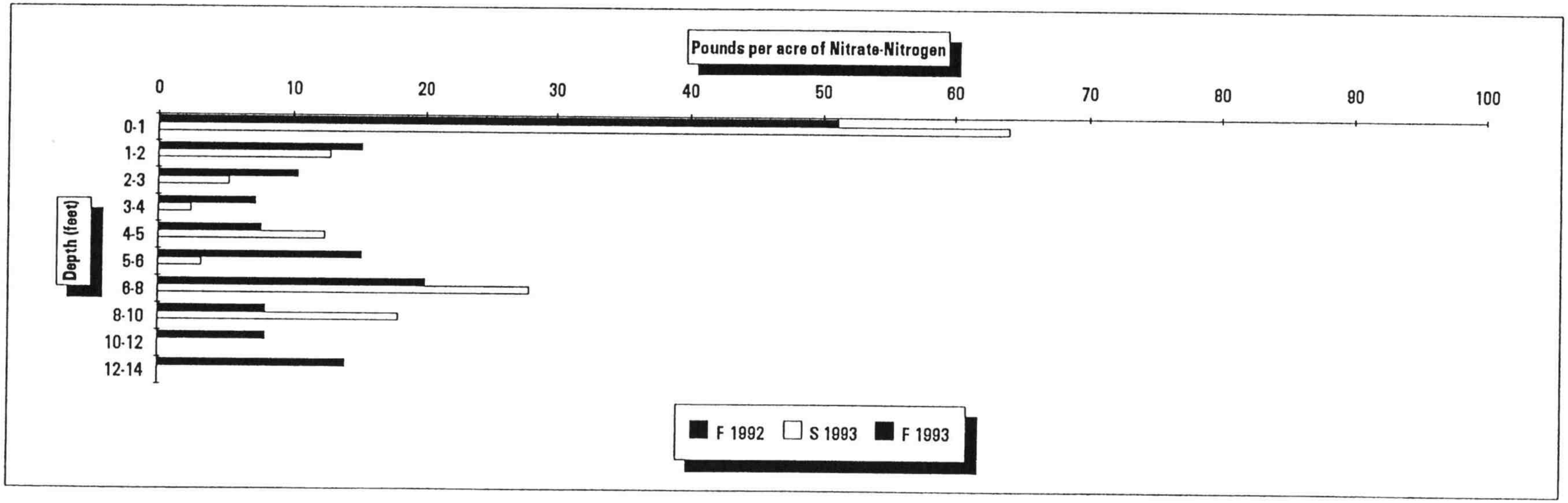
SITE CODE IDENTIFICATION:	U19A	
FARM IDENTIFICATION:	OFF SILAGE PIT	
IRRIGATION TYPE:	CP	
SCS SOIL CLASSIFICATION:	74B	
PROFILE DISTRIBUTION TYPE:	ABC2	
CROPPING ROTATION:	S2	
1993		
1992	CORN	
1991	CORN	
1990	CORN	
1989	CORN	
1988	CORN	
1987		
1986		
UNIQUE SITE INFORMATION:		

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	*Change*	F 1993	*Change*	F 1992	S 1993	*Change*	F 1993	*Change*
0-1	4			30	26	9			37	28
1-2	4			20	16	8			22	14
2-3	3			23	20	6			25	19
3-4	3			11	8	6			13	7
4-5	6			5	0	9			6	-3
5-6	12			9	-3	15			10	-6
6-8	38			22	-16	42			23	-19
8-10	20			30	10	23			31	8
10-12				60					60	
12-14										
SUM	*88*			*209*	*121*	*118*			*226*	*108*
0-3	10			72	62	23			84	61
3-6	20			25	5	30			28	-2
6+	58			112	54	65			114	49
SUM	*88*			*209*	*121*	*118*			*226*	*108*



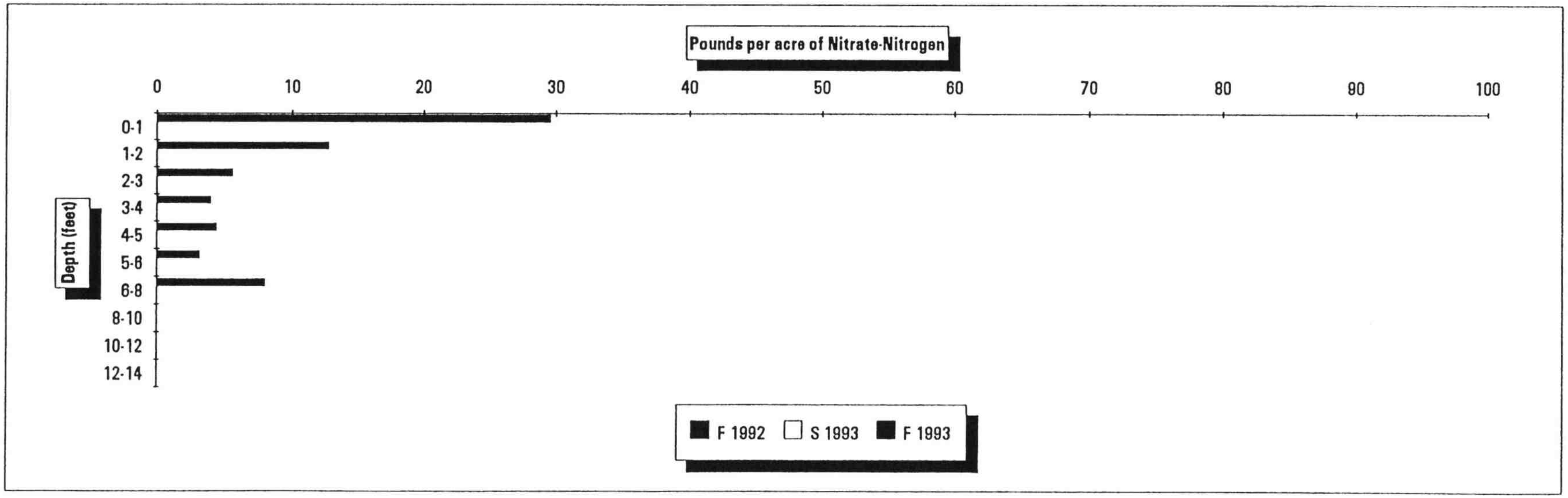
SITE CODE IDENTIFICATION:	U20A
FARM IDENTIFICATION:	NEAREST SHOP
IRRIGATION TYPE:	WHEELINE
SCS SOIL CLASSIFICATION:	72A
PROFILE DISTRIBUTION TYPE:	A2
CROPPING ROTATION:	D3
1993	ALFALFA
1992	ALFALFA
1991	ALFALFA
1990	ALFALFA
1989	ALFALFA
1988	ALFALFA
1987	ALFALFA
1986	ALFALFA
UNIQUE SITE INFORMATION:	
ROOTS AT 13.5'	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	*Change*	F 1993	*Change*	F 1992	S 1993	*Change*	F 1993	*Change*
0-1	51	64	13			69	73	4		
1-2	15	13	-2			21	21	0		
2-3	10	5	-5			14	13	-2		
3-4	7	2	-5			10	10	-1		
4-5	8	12	5			14	20	6		
5-6	15	3	-12			20	10	-10		
6-8	20	28	8			28	40	12		
8-10	8	18	10			14	28	14		
10-12	8					18				
12-14	14					24				
SUM	*157*	*146*	*11*			*233*	*215*	*24*		
0-3	77	82	5			104	107	2		
3-6	30	18	-12			44	40	-4		
6+	50	46	18			84	68	26		
SUM	*157*	*146*	*11*			*233*	*215*	*24*		



SITE CODE IDENTIFICATION:	U20B
FARM IDENTIFICATION:	ACROSS CANAL
IRRIGATION TYPE:	FLOOD
SCS SOIL CLASSIFICATION:	72A
PROFILE DISTRIBUTION TYPE:	A3
CROPPING ROTATION:	D3
1993	ALFALFA
1992	ALFALFA
1991	ALFALFA
1990	ALFALFA
1989	ALFALFA
1988	ALFALFA
1987	ALFALFA
1986	ALFALFA
UNIQUE SITE INFORMATION:	

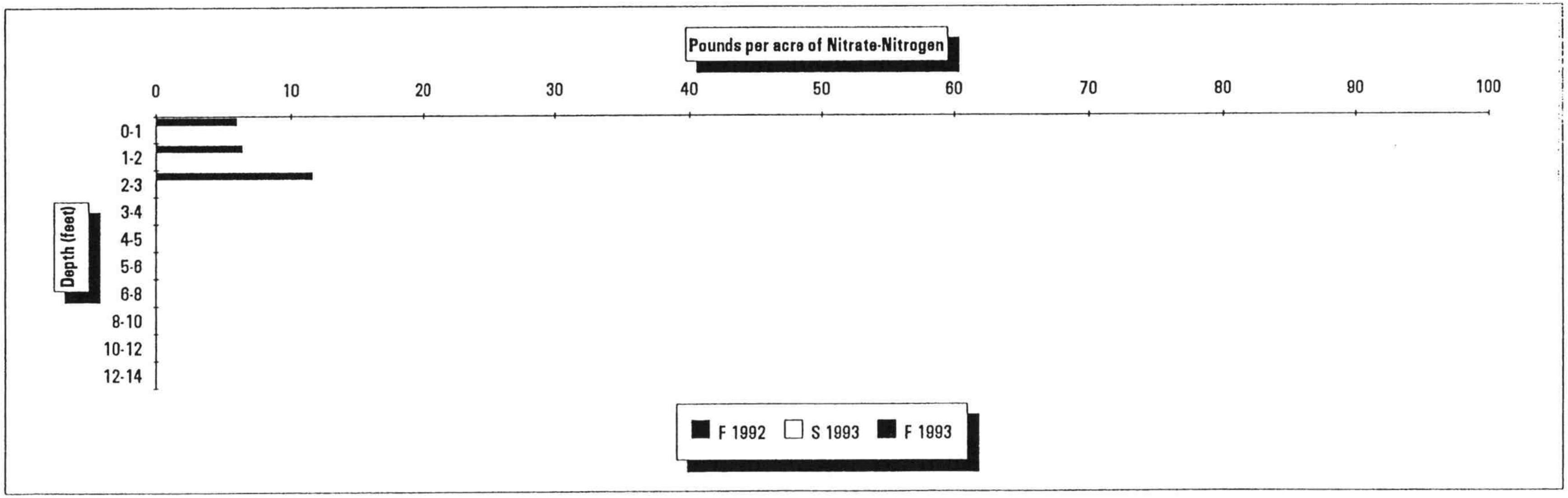
DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
0-1	30					38				
1-2	13					20				
2-3	6					12				
3-4	4					11				
4-5	4					10				
5-6	3					7				
6-8	8					16				
8-10										
10-12										
12-14										
SUM	*68*					*115*				
0-3	48					70				
3-6	12					29				
6+	8					16				
SUM	*68*					*115*				



		DEPTH (feet)	NITRATE-NITROGEN (pounds per acre)					NITRATE-NITROGEN + AMMONIUM-NITROGEN (pounds per acre)				
			F 1992	S 1993	*Change*	F 1993	*Change*	F 1992	S 1993	*Change*	F 1993	*Change*
SITE CODE IDENTIFICATION:	M22A											
FARM IDENTIFICATION:	104											
IRRIGATION TYPE:	CP											
SCS SOIL CLASSIFICATION:	40C	0-1	4					16				
PROFILE DISTRIBUTION TYPE:	AB3	1-2	3					11				
CROPPING ROTATION:	M4	2-3	4					12				
1993		3-4	8					13				
1992	ALFALFA	4-5	3					7				
1991	POTATO	5-6	9					12				
1990	SWEET CORN/ SUDANGRASS	6-8										
1989	WINTER WHEAT	8-10										
1988	POTATO	10-12										
1987		12-14										
1986		*SUM*	*32*					*72*				
UNIQUE SITE INFORMATION:		0-3	12					40				
		3-6	20					32				
		6+										
		SUM	*32*					*72*				

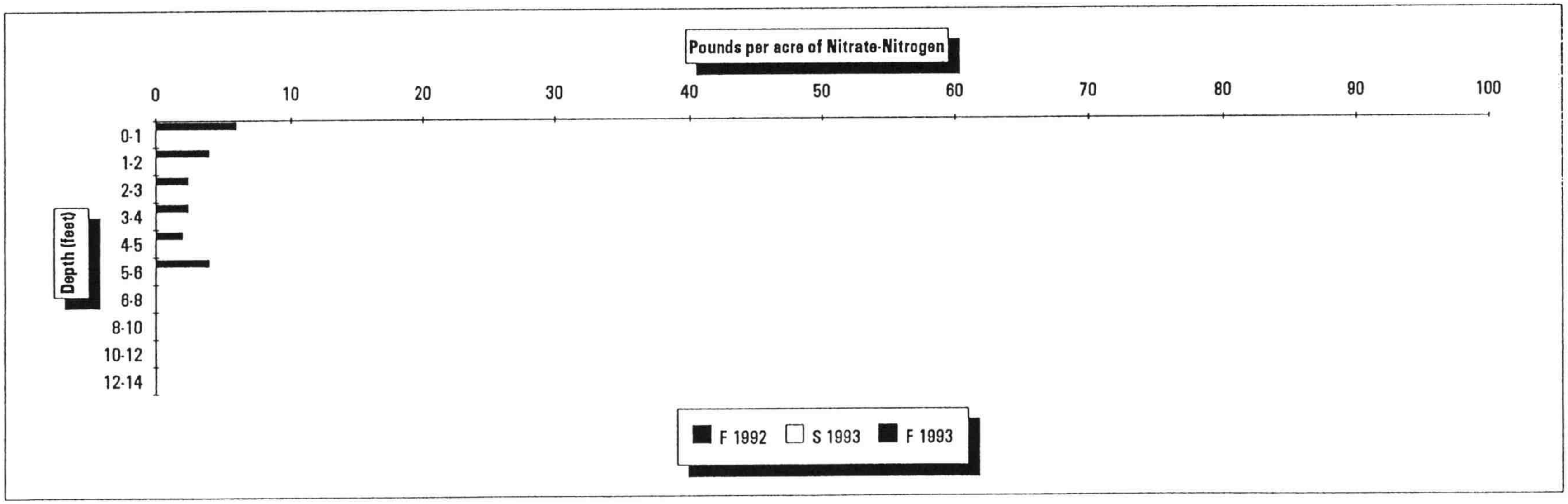
SITE CODE IDENTIFICATION:	M22C
FARM IDENTIFICATION:	917
IRRIGATION TYPE:	40C
SCS SOIL CLASSIFICATION:	CP
PROFILE DISTRIBUTION TYPE:	A3
CROPPING ROTATION:	M4
1993	
1992	ALFALFA
1991	ALFALFA
1990	ALFALFA
1989	DRY BEAN
1988	WINTER WHEAT
1987	DRY BEAN
1986	FIELD CORN
UNIQUE SITE INFORMATION:	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
0-1	6					10				
1-2	6					4				
2-3	12					3				
3-4										
4-5										
5-6										
6-8										
8-10										
10-12										
12-14										
SUM	*24*					*17*				
0-3	24					17				
3-6										
6+										
SUM	*24*					*17*				

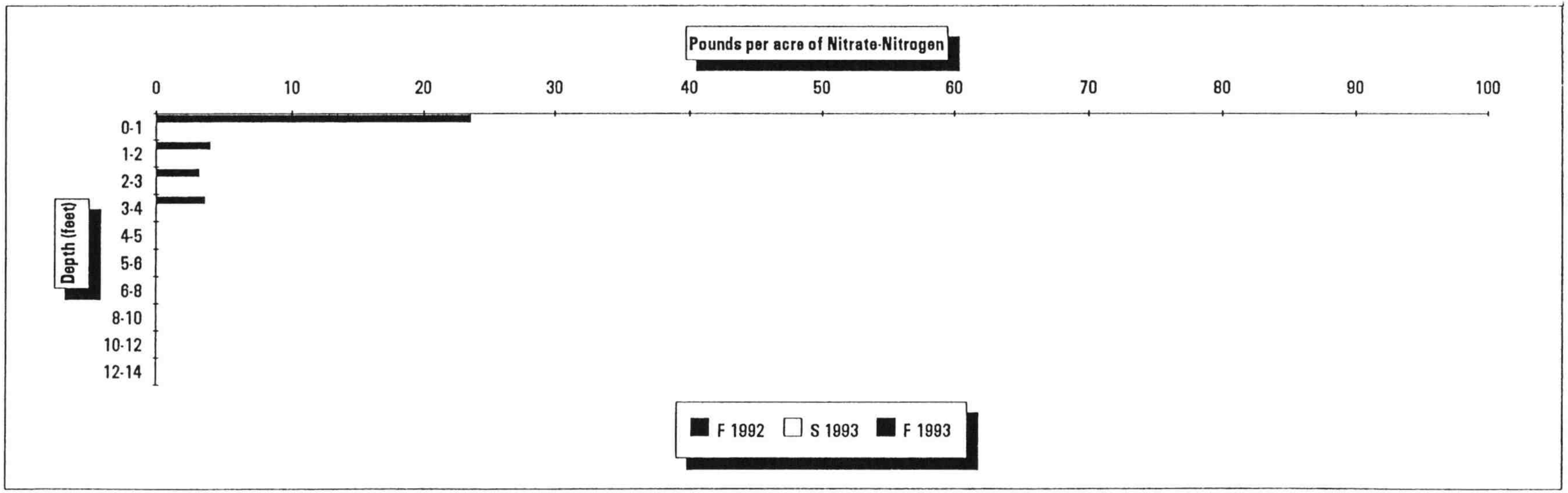


SITE CODE IDENTIFICATION:	M23A
FARM IDENTIFICATION:	PASTURE
IRRIGATION TYPE:	HANDLINE/ WHEELINE
SCS SOIL CLASSIFICATION:	8B/40C
PROFILE DISTRIBUTION TYPE:	**AB3**
CROPPING ROTATION:	**D3**
1993	GRASS
1992	GRASS
1991	GRASS
1990	GRASS
1989	GRASS
1988	GRASS
1987	GRASS
1986	GRASS
UNIQUE SITE INFORMATION:	
CANAL RUNS ABOVE PASTURE, SEEPAGE TO PASTURE	
SATURATED SOIL AT 3'	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
0-1	6					50				
1-2	4					18				
2-3	2					12				
3-4	2					8				
4-5	2					15				
5-6	4					13				
6-8										
8-10										
10-12										
12-14										
SUM	*21*					*115*				
0-3	12					80				
3-6	8					35				
6+										
SUM	*21*					*115*				

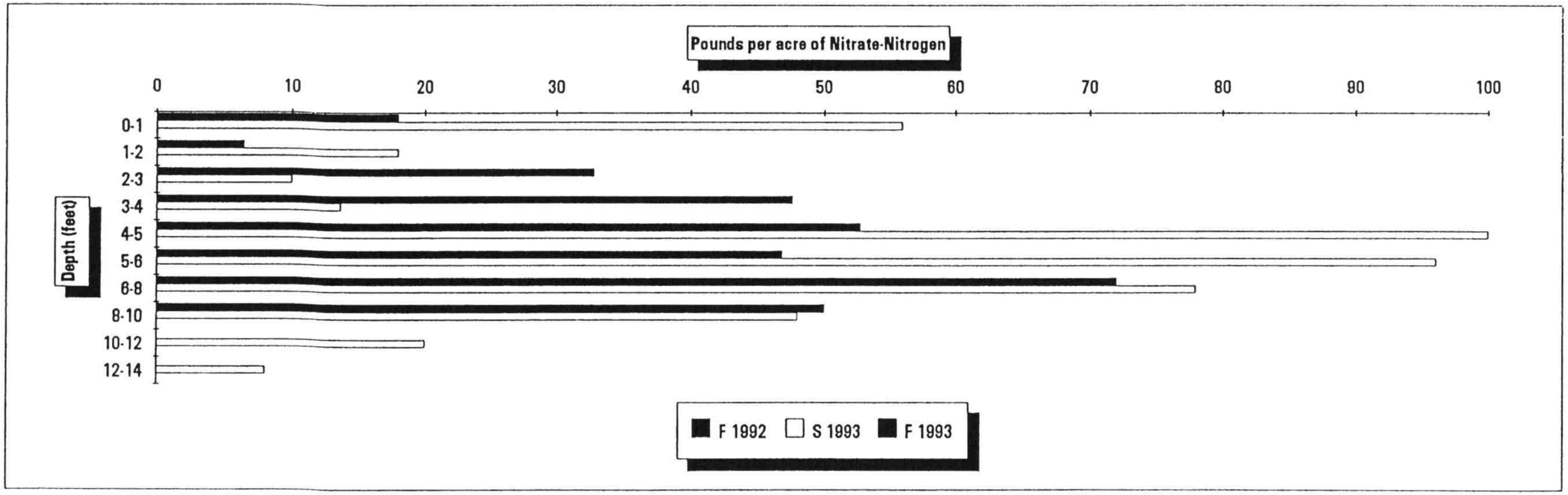


SITE CODE IDENTIFICATION:	U24A	DEPTH	NITRATE-NITROGEN					NITRATE-NITROGEN + AMMONIUM-NITROGEN				
FARM IDENTIFICATION:	REAR FIELD	*(feet)*	*(pounds per acre)*					*(pounds per acre)*				
IRRIGATION TYPE:	DRIP		F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
SCS SOIL CLASSIFICATION:	76B	0-1	24					34				
PROFILE DISTRIBUTION TYPE:	A3	1-2	4					8				
CROPPING ROTATION:	M4	2-3	3					6				
1993		3-4	4					7				
1992	WATERMELON	4-5										
1991	GRASS	5-6										
1990	GRASS	6-8										
1989	GRASS	8-10										
1988	GRASS	10-12										
1987	GRASS	12-14										
1986	GRASS	*SUM*	*34*					*55*				
UNIQUE SITE INFORMATION:		0-3	31					48				
OLD FLOOD/WHEELINE/HANDLINE		3-6	4					7				
DAIRY PASTURE		6+										
		SUM	*34*					*55*				



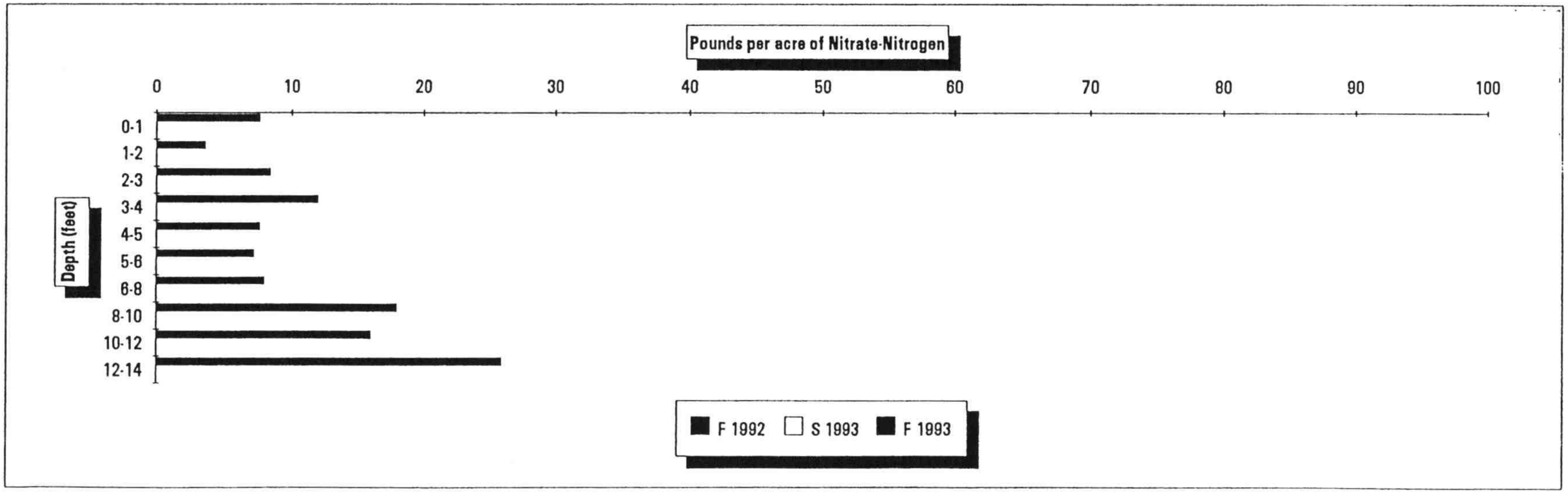
SITE CODE IDENTIFICATION:	U25A	
FARM IDENTIFICATION:	2	
IRRIGATION TYPE:	CP	
SCS SOIL CLASSIFICATION:	80B	
PROFILE DISTRIBUTION TYPE:	B1	
CROPPING ROTATION:	M4	
1993		
1992	BARLEY	
1991	WHEAT	
1990	ONION	
1989	PEAS	
1988	ONION	
1987		
1986		
UNIQUE SITE INFORMATION:		

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
0-1	18	56	38			27	70	43		
1-2	6	18	12			11	24	14		
2-3	33	10	-23			38	16	-23		
3-4	48	14	-34			52	19	-34		
4-5	53	100	47			56	105	49		
5-6	47	96	49			49	100	50		
6-8	72	78	6			76	84	8		
8-10	50	48	-2			58	54	-4		
10-12		20					26			
12-14		8					14			
SUM	*326*	*448*	*93*			*368*	*511*	*103*		
0-3	57	84	27			76	110	34		
3-6	147	210	62			158	223	66		
6+	122	154	4			134	178	4		
SUM	*326*	*448*	*93*			*368*	*511*	*103*		



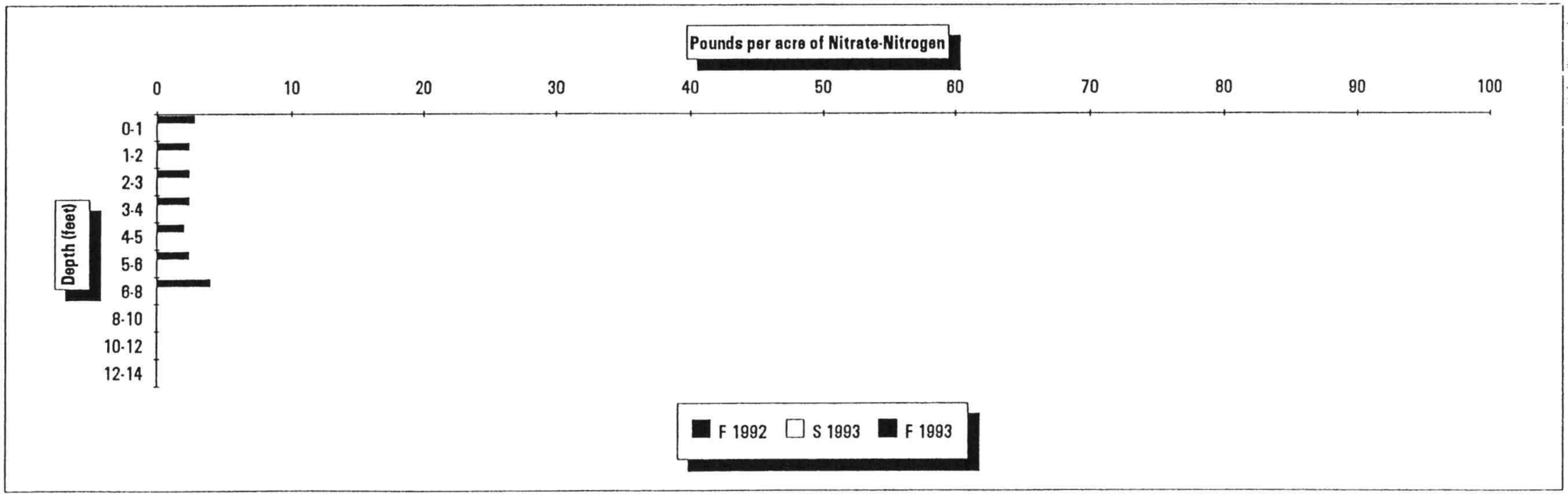
SITE CODE IDENTIFICATION:	U25B
FARM IDENTIFICATION:	5
IRRIGATION TYPE:	CP
SCS SOIL CLASSIFICATION:	80B
PROFILE DISTRIBUTION TYPE:	ABC3
CROPPING ROTATION:	M4
1993	
1992	BARLEY
1991	ONION
1990	BARLEY
1989	WHEAT
1988	WHEAT
1987	
1986	
UNIQUE SITE INFORMATION:	
PAST MINT	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
0-1	8					16				
1-2	4					9				
2-3	8					14				
3-4	12					16				
4-5	8					13				
5-6	7					11				
6-8	8					16				
8-10	18					24				
10-12	16					20				
12-14	26					30				
SUM	*114*					*168*				
0-3	20					39				
3-6	27					39				
6+	68					90				
SUM	*114*					*168*				



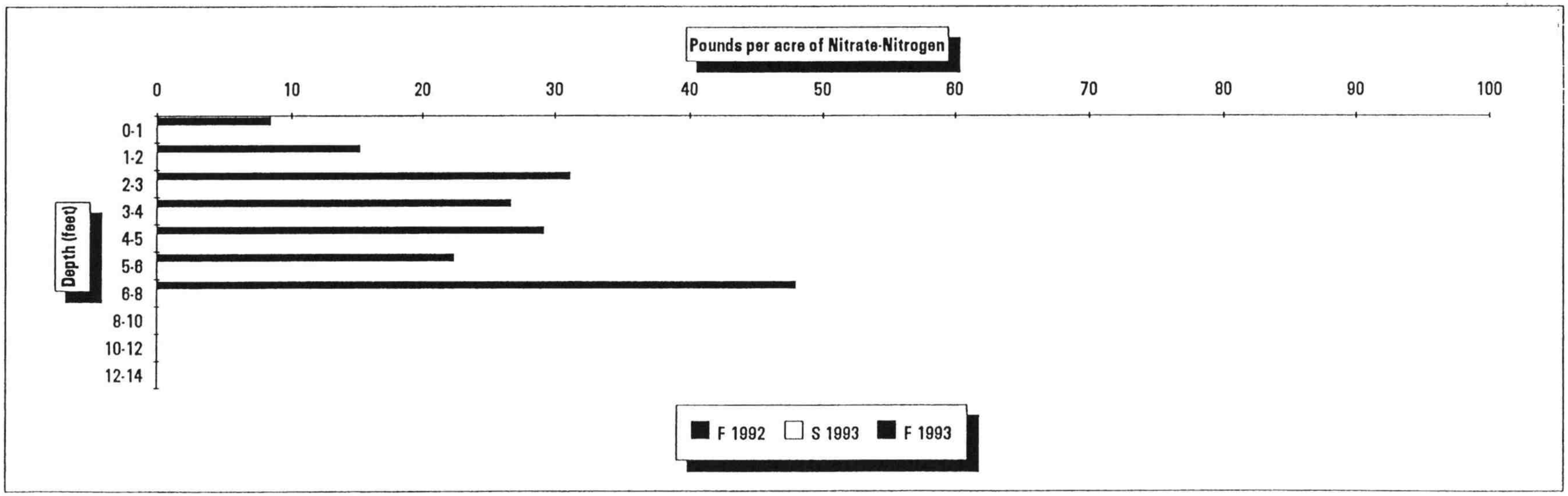
SITE CODE IDENTIFICATION:	M26A
FARM IDENTIFICATION:	TOP FIELD
IRRIGATION TYPE:	HANDLINE
SCS SOIL CLASSIFICATION:	40C
PROFILE DISTRIBUTION TYPE:	BC3
CROPPING ROTATION:	D4
1993	
1992	GRASS
1991	ALFALFA
1990	
1989	
1988	
1987	
1986	
UNIQUE SITE INFORMATION:	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)* F 1992	S 1993	*Change*	F 1993	*Change*	NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)* F 1992	S 1993	*Change*	F 1993	*Change*
0-1	3					35				
1-2	2					10				
2-3	2					8				
3-4	2					6				
4-5	2					5				
5-6	2					5				
6-8	4					14				
8-10										
10-12										
12-14										
SUM	*18*					*82*				
0-3	8					53				
3-6	7					15				
6+	4					14				
SUM	*18*					*82*				



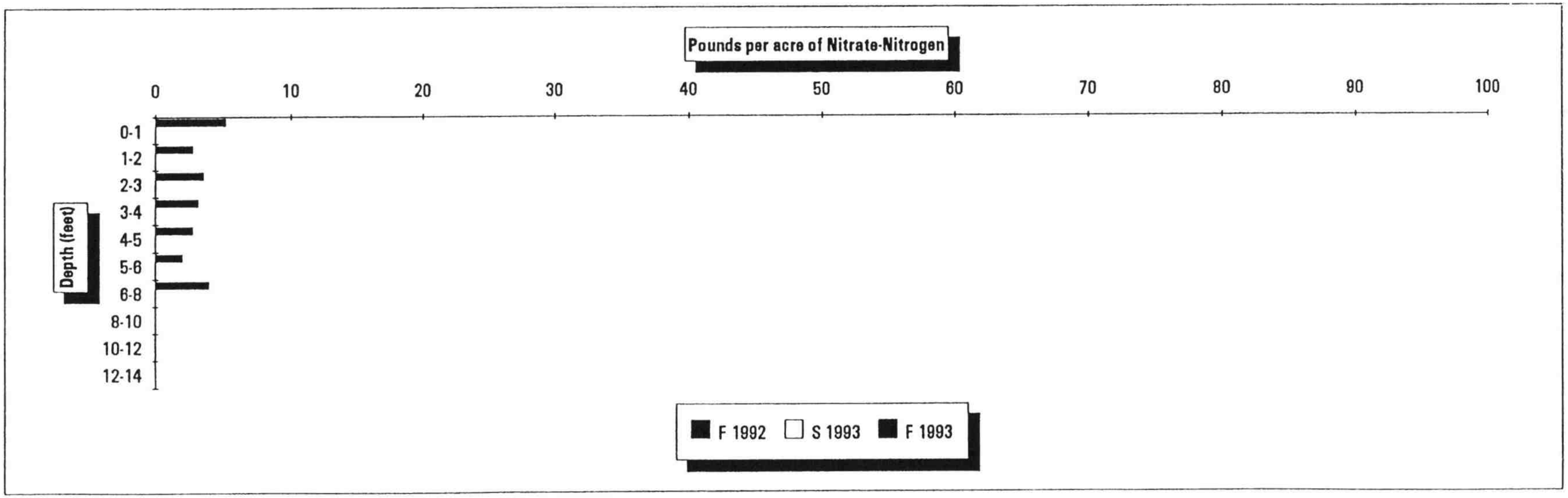
SITE CODE IDENTIFICATION:	U28A
FARM IDENTIFICATION:	PAST COOP
IRRIGATION TYPE:	FLOOD
SCS SOIL CLASSIFICATION:	42A
PROFILE DISTRIBUTION TYPE:	B3
CROPPING ROTATION:	M4
1993	
1992	WHEAT
1991	
1990	
1989	
1988	
1987	
1986	
UNIQUE SITE INFORMATION:	
PAST MINT	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
0-1	8					20				
1-2	15					23				
2-3	31					37				
3-4	27					31				
4-5	29					35				
5-6	22					26				
6-8	48					54				
8-10										
10-12										
12-14										
SUM	*181*					*226*				
0-3	55					80				
3-6	78					92				
6+	48					54				
SUM	*181*					*226*				

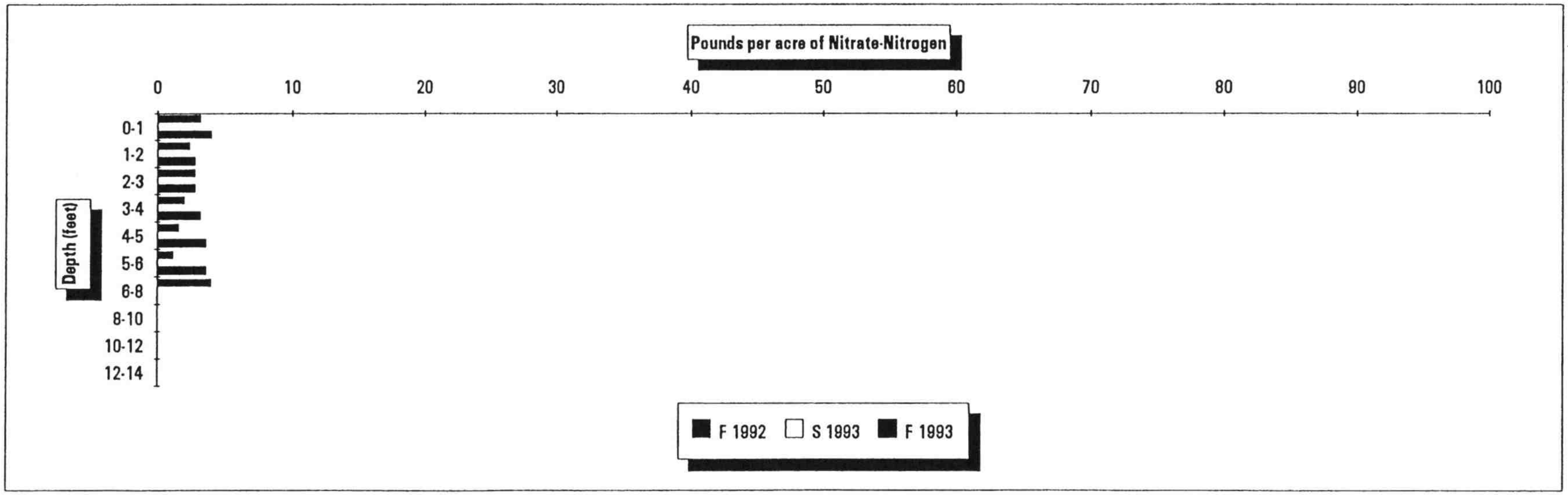


SITE CODE IDENTIFICATION:	U28B
FARM IDENTIFICATION:	SHOP
IRRIGATION TYPE:	FLOOD
SCS SOIL CLASSIFICATION:	42A
PROFILE DISTRIBUTION TYPE:	BC3
CROPPING ROTATION:	M4
1993	
1992	ALFALFA
1991	
1990	
1989	
1988	
1987	
1986	
UNIQUE SITE INFORMATION:	
PAST MINT	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
0-1	5					12				
1-2	3					7				
2-3	4					10				
3-4	3					8				
4-5	3					7				
5-6	2					5				
6-8	4					12				
8-10										
10-12										
12-14										
SUM	*24*					*60*				
0-3	12					28				
3-6	8					20				
6+	4					12				
SUM	*24*					*60*				

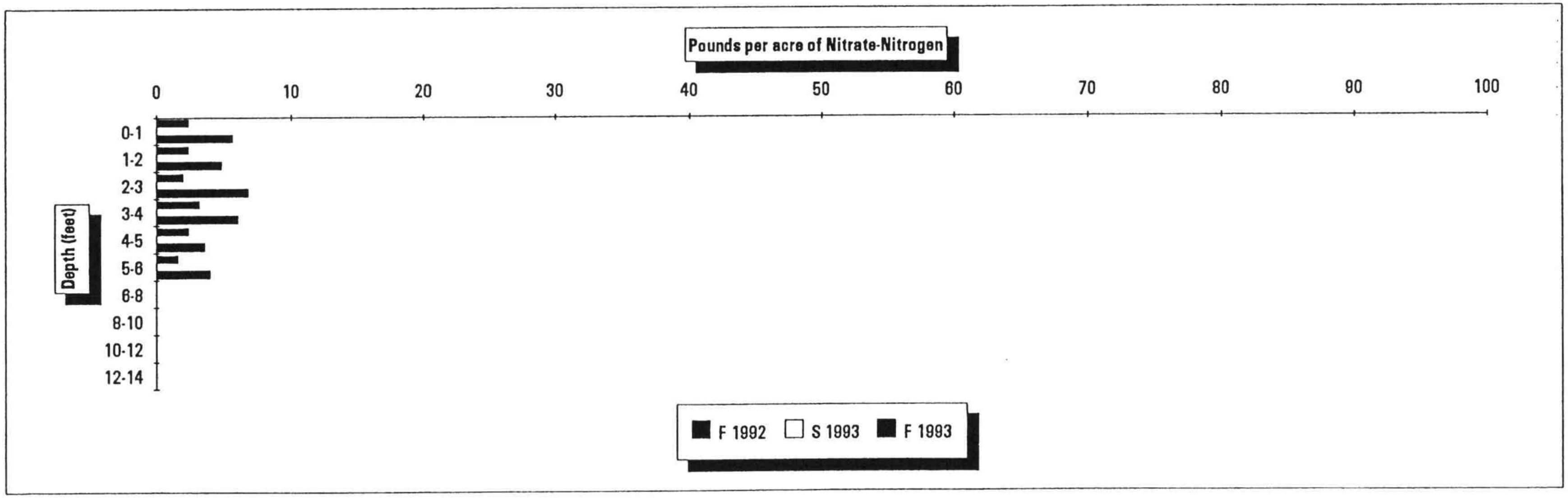


SITE CODE IDENTIFICATION:	M29A	DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
FARM IDENTIFICATION:	USFWSNWRCS											
IRRIGATION TYPE:	NONE		F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
SCS SOIL CLASSIFICATION:	87B	0-1	3			4	1	12			6	-6
PROFILE DISTRIBUTION TYPE:	ABC2	1-2	2			3	1	9			4	-5
CROPPING ROTATION:	N	2-3	3			3	0	8			3	-4
1993	NONE	3-4	2			3	1	6			4	-2
1992	NONE	4-5	2			4	2	5			4	-1
1991	NONE	5-6	1			4	3	4			5	1
1990	NONE	6-8	4					10				
1989	NONE	8-10										
1988	NONE	10-12										
1987	NONE	12-14										
1986	NONE	*SUM*	*17*			*20*	*3*	*54*			*26*	*-28*
UNIQUE SITE INFORMATION:		0-3	8			10	1	29			13	-16
LAST GRAZED IN 1981		3-6	5			10	6	16			13	-2
		6+	4					10				
		SUM	*17*			*20*	*3*	*54*			*26*	*-28*



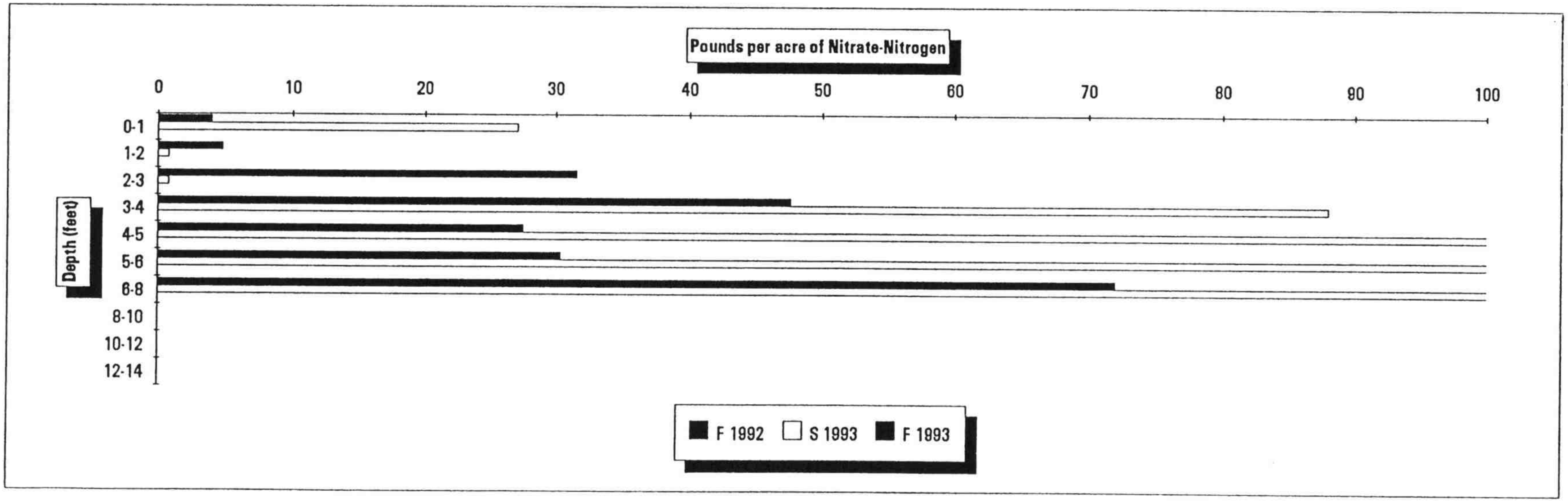
SITE CODE IDENTIFICATION:	M29B
FARM IDENTIFICATION:	USFWSNWRUM
IRRIGATION TYPE:	NONE
SCS SOIL CLASSIFICATION:	76C
PROFILE DISTRIBUTION TYPE:	**ABC2**
CROPPING ROTATION:	**N**
1993	NONE
1992	NONE
1991	NONE
1990	NONE
1989	NONE
1988	NONE
1987	NONE
1986	NONE
UNIQUE SITE INFORMATION:	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
0-1	2			6	3	6			8	2
1-2	2			5	2	5			6	1
2-3	2			7	5	4			9	5
3-4	3			6	3	7			8	0
4-5	2			4	1	6			5	-1
5-6	2			4	2	4			5	1
6-8										
8-10										
10-12										
12-14										
SUM	*14*			*31*	*17*	*32*			*41*	8
0-3	7			17	10	18			24	8
3-6	7			14	6	17			17	0
6+										
SUM	*14*			*31*	*17*	*32*			*41*	8



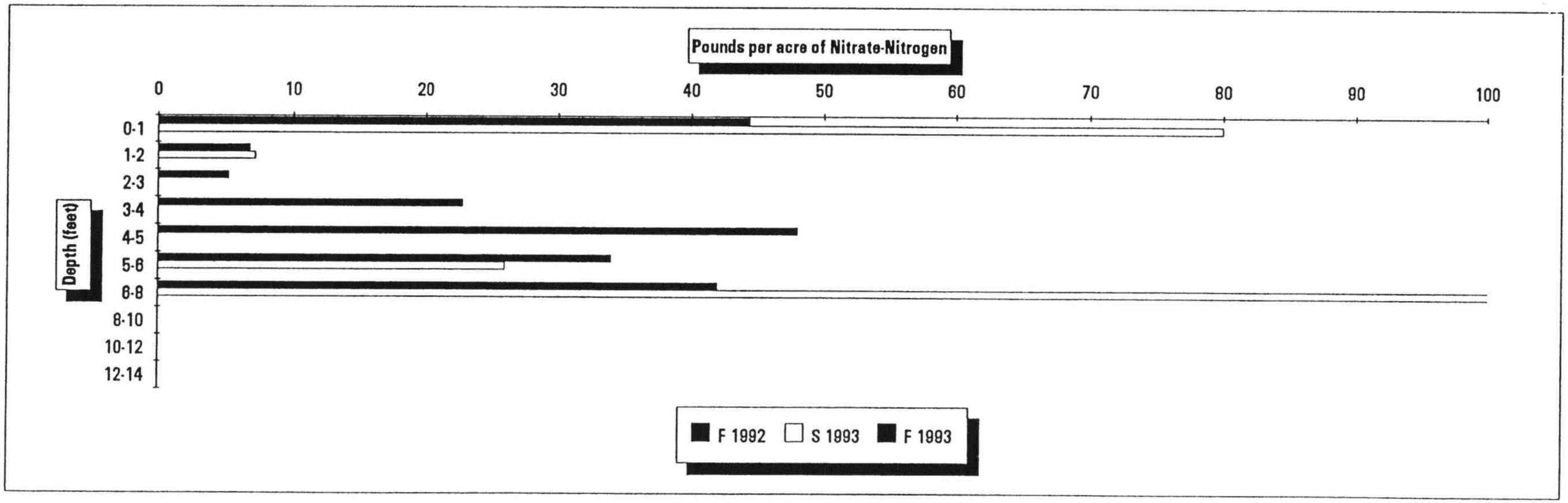
SITE CODE IDENTIFICATION:	U31A
FARM IDENTIFICATION:	ASP
IRRIGATION TYPE:	CP
SCS SOIL CLASSIFICATION:	1B
PROFILE DISTRIBUTION TYPE:	**B1**
CROPPING ROTATION:	**S1**
1993	ASPARAGUS
1992	ASPARAGUS
1991	ASPARAGUS
1990	ASPARAGUS
1989	ASPARAGUS
1988	ASPARAGUS
1987	ASPARAGUS
1986	ASPARAGUS
UNIQUE SITE INFORMATION:	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
0-1	4	27	23			8	49	40		
1-2	5	1	-4			9	5	-4		
2-3	32	1	-31			37	6	-31		
3-4	48	88	40			51	94	43		
4-5	28	112	84			31	116	85		
5-6	30	112	82			33	116	83		
6-8	72	392	320			76	398	321		
8-10										
10-12										
12-14										
SUM	*218*	*733*	*515*			*246*	*784*	*538*		
0-3	40	29	-12			55	60	5		
3-6	106	312	206			115	326	211		
6+	72	392	320			76	398	321		
SUM	*218*	*733*	*515*			*246*	*784*	*538*		



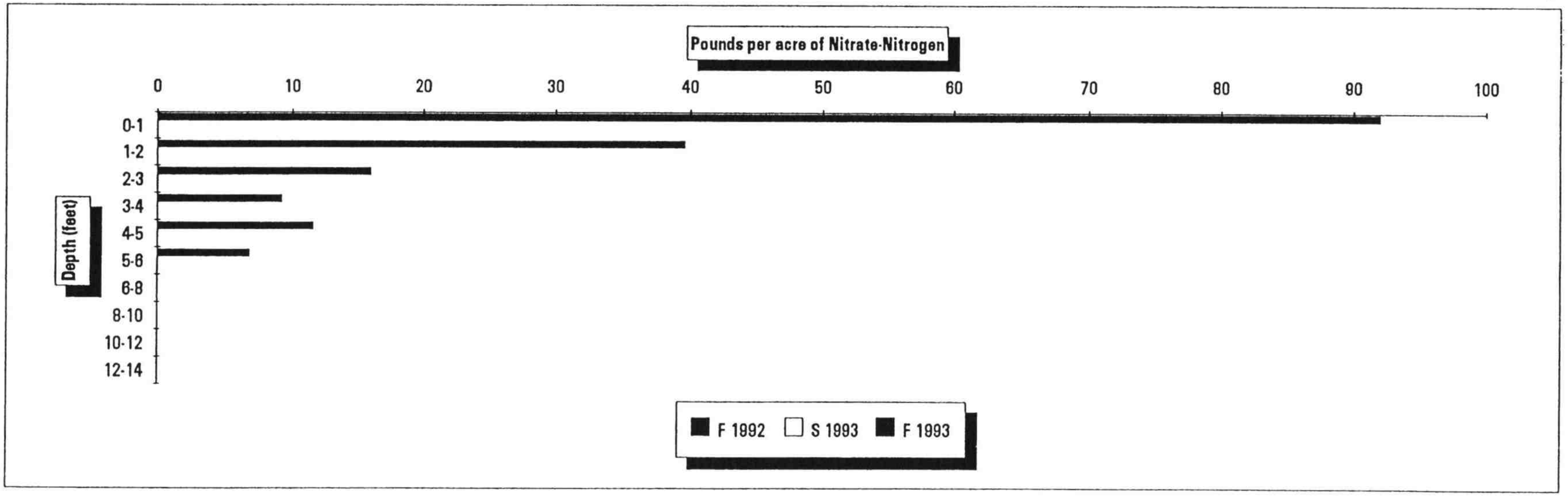
SITE CODE IDENTIFICATION:	U31B
FARM IDENTIFICATION:	M&D
IRRIGATION TYPE:	CP
SCS SOIL CLASSIFICATION:	1B
PROFILE DISTRIBUTION TYPE:	B1
CROPPING ROTATION:	M4
1993	POTATO
1992	GRASS
1991	
1990	
1989	
1988	
1987	
1986	
UNIQUE SITE INFORMATION:	
OLD STANFIELD DISTRICT	
PAST FLOOD/WHEELINE UNTIL 1985/86	
FARMED SINCE 1930'S	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
0-1	44	80	36			55	83	28		
1-2	7	7	0			12	12	0		
2-3	5	0	-5			9	7	-2		
3-4	23	0	-23			26	8	-18		
4-5	48	0	-48			52	10	-42		
5-6	34	26	-8			37	50	13		
6-8	42	104	62			45	108	63		
8-10										
10-12										
12-14										
SUM	*203*	*217*	*14*			*236*	*278*	*42*		
0-3	56	87	31			76	102	26		
3-6	105	26	-79			114	68	-47		
6+	42	104	62			45	108	63		
SUM	*203*	*217*	*14*			*236*	*278*	*42*		

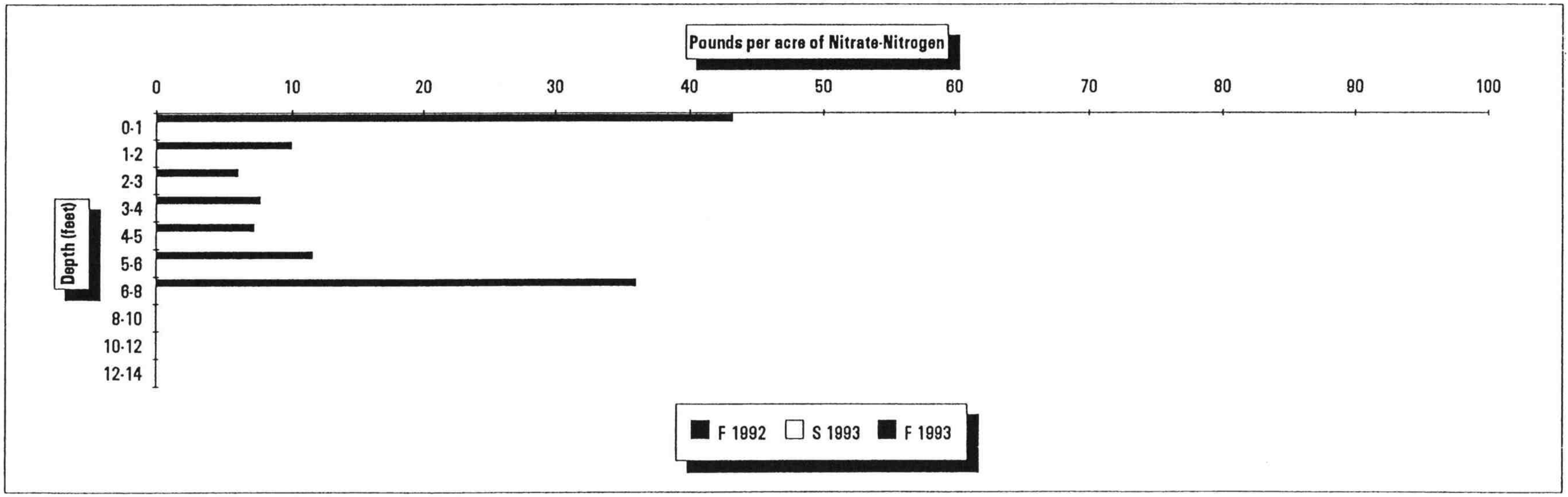


SITE CODE IDENTIFICATION:	U31C
FARM IDENTIFICATION:	POWER POLE
IRRIGATION TYPE:	CP
SCS SOIL CLASSIFICATION:	1B
PROFILE DISTRIBUTION TYPE:	A3
CROPPING ROTATION:	M4
1993	
1992	POTATO
1991	WHEAT
1990	POTATO
1989	ALFALFA
1988	ALFALFA
1987	
1986	
UNIQUE SITE INFORMATION:	
PAST WHEELINE/SOLID SET	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
0-1	92					115				
1-2	40					46				
2-3	16					22				
3-4	9					14				
4-5	12					16				
5-6	7					11				
6-8										
8-10										
10-12										
12-14										
SUM	*175*					*224*				
0-3	148					184				
3-6	28					41				
6+										
SUM	*175*					*224*				

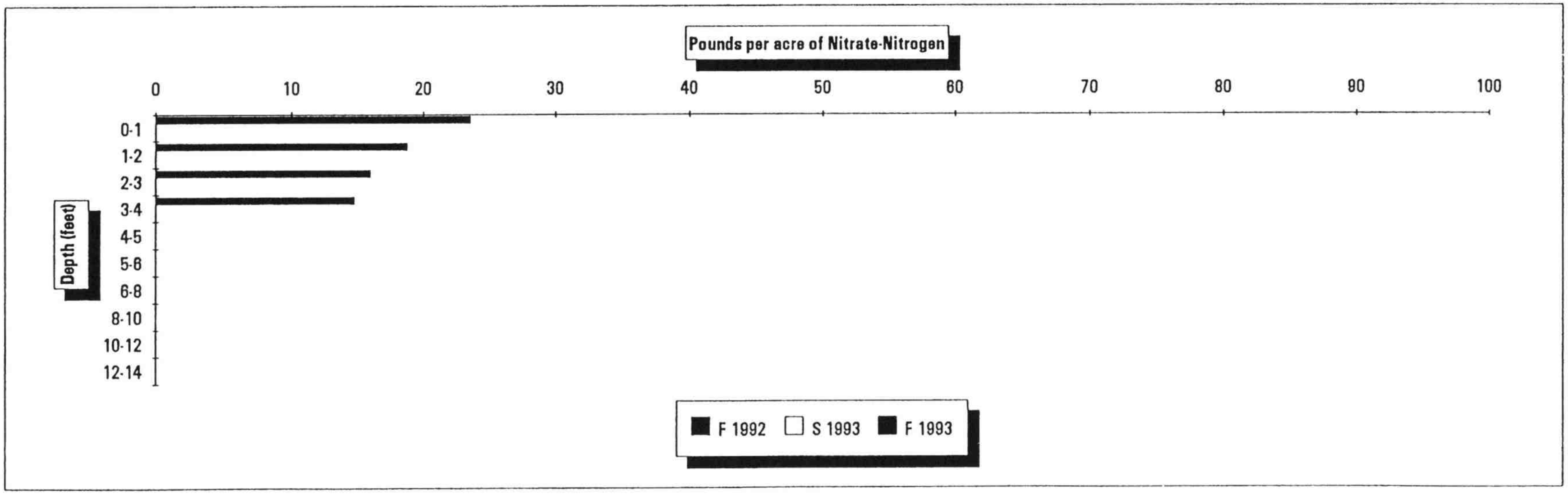


		DEPTH (feet)	NITRATE-NITROGEN (pounds per acre)					NITRATE-NITROGEN + AMMONIUM-NITROGEN (pounds per acre)				
			F 1992	S 1993	*Change*	F 1993	*Change*	F 1992	S 1993	*Change*	F 1993	*Change*
SITE CODE IDENTIFICATION:	U31D											
FARM IDENTIFICATION:	HIGHL											
IRRIGATION TYPE:	CP											
SCS SOIL CLASSIFICATION:	1B	0-1	43					52				
PROFILE DISTRIBUTION TYPE:	A3	1-2	10					15				
CROPPING ROTATION:	M4	2-3	6					10				
1993		3-4	8					11				
1992	POTATO	4-5	7					11				
1991	WHEAT	5-6	12					16				
1990	POTATO	6-8	36					39				
1989	WHEAT	8-10										
1988	POTATO	10-12										
1987		12-14										
1986		*SUM*	*122*					*155*				
UNIQUE SITE INFORMATION:		0-3	59					78				
25-60#/A OF FERTILIZER ON SURFACE FALL 1992 SAMPLING		3-6	26					38				
		6+	36					39				
		SUM	*122*					*155*				



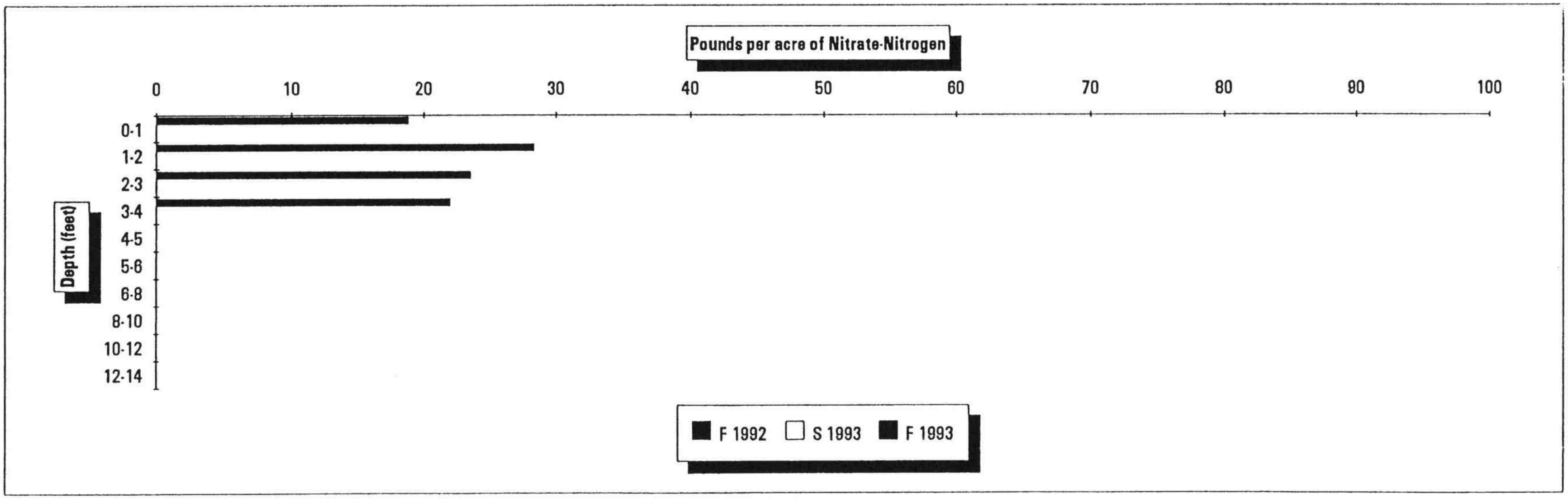
SITE CODE IDENTIFICATION:	U32A
FARM IDENTIFICATION:	TRAILER
IRRIGATION TYPE:	CP
SCS SOIL CLASSIFICATION:	14B/76B
PROFILE DISTRIBUTION TYPE:	A3
CROPPING ROTATION:	M4
1993	
1992	PASTURE
1991	
1990	
1989	
1988	
1987	
1986	
UNIQUE SITE INFORMATION:	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
0-1	24					29				
1-2	19					25				
2-3	16					23				
3-4	15					21				
4-5										
5-6										
6-8										
8-10										
10-12										
12-14										
SUM	*73*					*98*				
0-3	58					77				
3-6	15					21				
6+										
SUM	*73*					*98*				



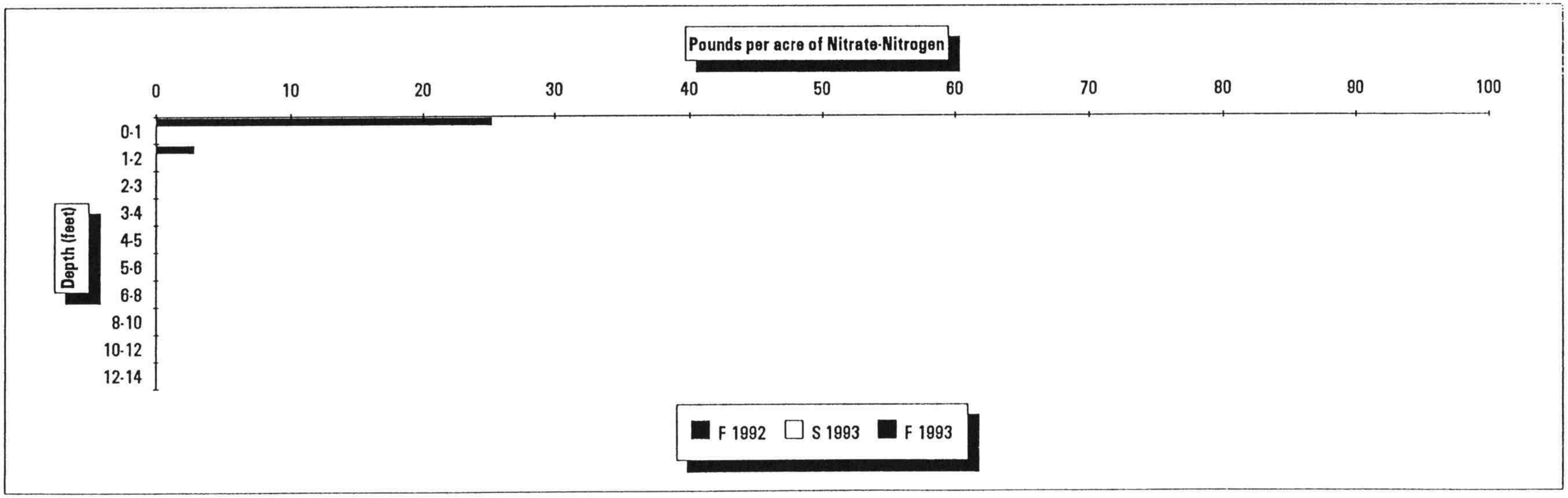
SITE CODE IDENTIFICATION:	U32B
FARM IDENTIFICATION:	SHOP
IRRIGATION TYPE:	CP
SCS SOIL CLASSIFICATION:	14B/76B
PROFILE DISTRIBUTION TYPE:	A3
CROPPING ROTATION:	M4
1993	
1992	GRASS
1991	
1990	
1989	
1988	
1987	
1986	
UNIQUE SITE INFORMATION:	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
0-1	19					25				
1-2	28					34				
2-3	24					28				
3-4	22					27				
4-5										
5-6										
6-8										
8-10										
10-12										
12-14										
SUM	*93*					*114*				
0-3	71					87				
3-6	22					27				
6+										
SUM	*93*					*114*				



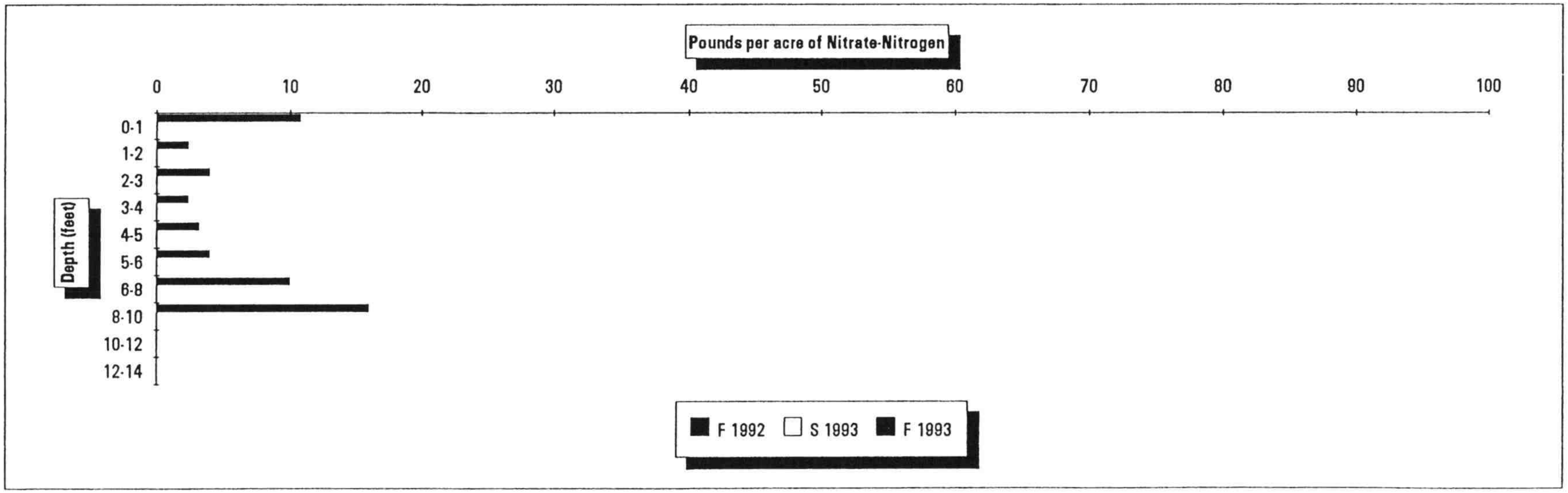
SITE CODE IDENTIFICATION:	U32C
FARM IDENTIFICATION:	PRINDLE
IRRIGATION TYPE:	CP
SCS SOIL CLASSIFICATION:	119A
PROFILE DISTRIBUTION TYPE:	A3
CROPPING ROTATION:	M4
1993	
1992	GRASS
1991	
1990	
1989	
1988	
1987	
1986	
UNIQUE SITE INFORMATION:	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
0-1	25					33				
1-2	3					6				
2-3										
3-4										
4-5										
5-6										
6-8										
8-10										
10-12										
12-14										
SUM	*28*					*39*				
0-3	28					39				
3-6										
6+										
SUM	*28*					*39*				



SITE CODE IDENTIFICATION:	M33B
FARM IDENTIFICATION:	221
IRRIGATION TYPE:	CP
SCS SOIL CLASSIFICATION:	40C
PROFILE DISTRIBUTION TYPE:	**ABC3**
CROPPING ROTATION:	**M4**
1993	
1992	WHEAT
1991	RUSSET POTATO
1990	ALFALFA
1989	ALFALFA
1988	ALFALFA
1987	
1986	
UNIQUE SITE INFORMATION:	
RIVER WATER IRRIGATION	

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
0-1	11					15				
1-2	2					6				
2-3	4					9				
3-4	2					6				
4-5	3					6				
5-6	4					6				
6-8	10					12				
8-10	16					19				
10-12										
12-14										
SUM	*53*					*79*				
0-3	17					30				
3-6	10					18				
6+	26					31				
SUM	*53*					*79*				



SITE CODE IDENTIFICATION:	M33C	
FARM IDENTIFICATION:	8	
IRRIGATION TYPE:	CP	
SCS SOIL CLASSIFICATION:	8B	
PROFILE DISTRIBUTION TYPE:	A3	
CROPPING ROTATION:	M4	
1993		
1992	SPRING WHEAT	
1991	FIELD CORN	
1990	RUSSET POTATO	
1989	ALFALFA	
1988	ALFALFA	
1987		
1986		
UNIQUE SITE INFORMATION:		
HIGH NITROGEN WELL WATER		

DEPTH *(feet)*	NITRATE-NITROGEN *(pounds per acre)*					NITRATE-NITROGEN + AMMONIUM-NITROGEN *(pounds per acre)*				
	F 1992	S 1993	***Change***	F 1993	***Change***	F 1992	S 1993	***Change***	F 1993	***Change***
0-1	59					64				
1-2	27					30				
2-3	13					16				
3-4	6					8				
4-5										
5-6										
6-8										
8-10										
10-12										
12-14										
SUM	*105*					*118*				
0-3	99					110				
3-6	6					8				
6+										
SUM	*105*					*118*