LEACHING CLASSES OF KANSAS SOILS

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D. E. KISSEL
Soil Fertility Scientist

O. W. BIDWELL
Soil Survey Research Scientist

J. F. KIENTZ
Research Associate

Applying nitrogen fertilizer at the economic optimum amount per acre (rate per acre) is essential for the farmer to attain a profitable return. Application of nitrogen at rates greater than the economic optimum may waste nitrogen, potentially pollute groundwater supplies, and be an unnecessary expense. A nitrogen rate less than the economic optimum would result in a reduced crop yield and lower economic return.

Attaining the economic optimum rate of nitrogen fertilizer is complicated by the potential for plant-available nitrogen to be lost from the soil. Losses of nitrogen cannot be predicted at the time of application since they depend in part on the unpredictable climate, particularly rainfall.

Nitrogen Loss by Leaching

Loss of available nitrogen (as nitrate) by leaching is one way in which nitrogen-fertilizer efficiency is reduced. Nitrate leaching is the downward movement of nitrate with water that drains through the soil. Loss by leaching implies that nitrate is irreversibly lost for crop uptake by moving below the deepest zone of water uptake by roots.

The amount of nitrate leached in any situation depends on soil properties, amount of water draining through the soil, and the amount of nitrate in the soil. Nitrate is the primary nitrogen compound that leaches since it is not adsorbed by soil colloids and dissolves readily in the soil water. Movement of water indicates movement of nitrate.

In general, sandy soils are much more susceptible to leaching than clayey soils because they have less capacity to hold water and are more permeable. The amount and rate of water application, either from natural rainfall or applied irrigation water, can also influence the amount of water that drains through a soil and therefore the amount of nitrate that moves with the water. Finally, if more nitrate is present in the soil, leaching loss is potentially greater.

The problem for the farmer is to maintain maximum yields of crops while minimizing nitrogen loss due to nitrate leaching. These two objectives are sometimes difficult to keep in balance. Sufficient nitrogen must be applied early in the season to get the crop off to a good start. Yet, applying the crop's total season nitrogen-fertilizer needs may not be desirable in those situations where nitrate leaching is possible.

Nitrification Affects Nitrogen Loss

Most commercial nitrogen fertilizer is applied as ammoniacal nitrogen. Ammoniacal nitrogen is not sub-

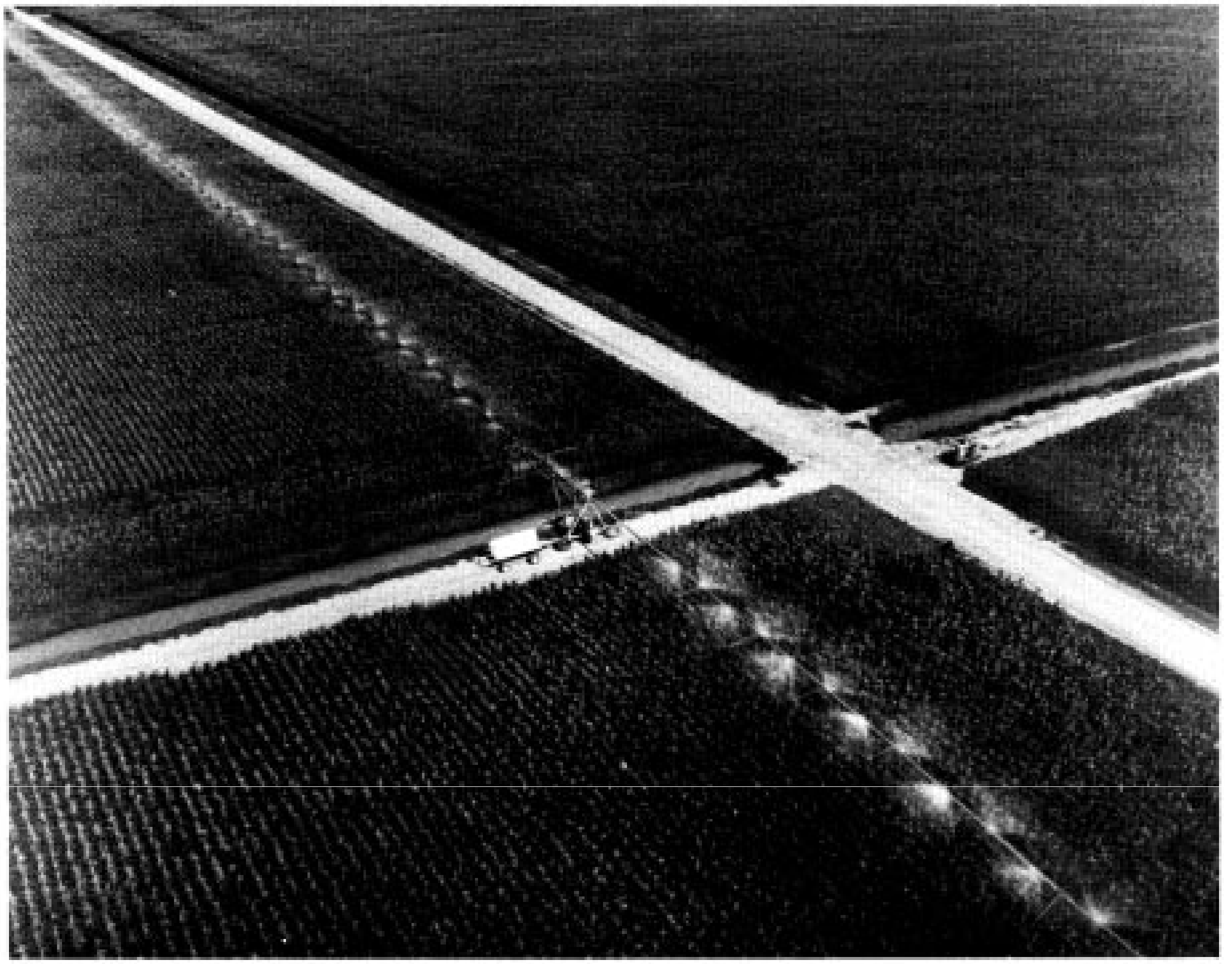

Figure 1. Consider carefully the water and nitrogen management in irrigated corn production.

ject to leaching, but does convert rapidly to nitrate by the process of nitrification under favorable conditions. Nitrification is slowed by low pH, low temperature, and dry soil conditions. In addition, some chemicals such as Nitrapyrin (sold by Dow Chemical Corp., with trade name N-SERVE) and Etradiazole (sold by Olin Corp., with trade name DWELL)* can slow nitrification and therefore potentially reduce nitrate-leaching losses since a greater proportion of the nitrogen fertilizer would remain as ammonium during the early part of the growing season.

Nitrate-leaching losses occur most readily from coarse textured soils. These losses can be reduced by applying enough nitrogen to start the crop and then applying the remainder of the nitrogen after the crop has emerged when conditions favoring leaching have passed. In the case of fall seeded small grains, nitrogen fertilizer can be "topdressed" in late winter or early spring. For spring seeded crops such as corn or sorghum, part of the nitrogen can be sidedressed, usually within 30 to 45 days after emergence. In both cases, delaying application of some of the nitrogen reduces nitrate losses during the early part of the growing season.

An alternative to delayed nitrogen applications would be to apply all nitrogen preplant but with a nitrification inhibitor that reduces the conversion of ammonium to nitrate. Such applications reduce leaching losses since ammonium does not easily leach through the soil.

In summary, nitrate leaching can be reduced by proper management of one or more of the following practices.

*Trade names are used to help identify products. No endorsement is intended.

Figure 2. Side dress application of nitrogen may improve efficiency of nitrogen use on some soils.

1. *Apply nitrogen fertilizer closer to the time actually needed by the crop.* Later application of part of the nitrogen can be accomplished by split application with "sidedressing" or "topdressing" operations, or by putting a portion of nitrogen onto the crop with irrigation water later in the growing season as needed (fertigation).
2. *Delay the nitrification of fertilizer nitrogen.* Since ammonium does not leach appreciably, slowing the conversion of ammonium to nitrate can reduce nitrogen-leaching losses. This is accomplished most often by the use of chemicals that inhibit nitrification.
3. *Carefully manage irrigation amounts and frequency* to help minimize drainage of water and nitrates below the root zone.

This publication evaluates the potential for nitrate leaching from major agricultural soils in Kansas. While we recognize that rainfall amounts decrease considerably from east to west, climatic interaction was beyond the scope of this evaluation. Also, peak rainfall occurs during the May-July period throughout Kansas. Heavy rainstorms are likely during this period even in western Kansas where total annual rainfall is considerably less than in eastern Kansas.

Influence of Soils on Leaching

Those soils most susceptible to leaching also happen to be those that are most often irrigated. Irrigation produces important leaching losses regardless of whether the soils occur in the eastern or western part of the state. Heavy rain in the May-July period is most likely to cause leaching losses on spring seeded crops since wheat will have taken up a major portion of its nitrogen by mid-May. However, heavy rains do sometimes occur at other times of the year and can have an impact on wheat production as well, particularly on coarse textured soils.

The soils listed in Table 1 are arranged into four classes of leaching potential. They are described as:

Class I. Some leaching losses of fertilizer N is likely most years. *Response to N management is likely most years.*

Class II. Some leaching losses of fertilizer N may occur in some years. *Response to N management is likely some years.*

Class III. Small leaching losses may occur occasionally. *Response to N management is unlikely most years.*

Class IV. Leaching losses are insignificant. *Response to N management is highly unlikely.*

Nitrogen management as used here means nitrogen management to reduce nitrate-leaching losses during the growing season by split applications of nitrogen fertilizer, ''fertigation" according to crop need or use of nitrification inhibitors as described.

Soils were placed into the four classes on the basis of soil texture and soil permeability to water. With regard to textural classification, classes were assigned as follows:

Textural Class I. Sands, fine sands, coarse sands, and loamy coarse sands.

Textural Class II. Loamy fine sand, coarse sandy loam, and sandy loam.

Textural Class III. Loam, very fine sandy loam, silt loam, and fine sandy loam.

Textural Class IV. Clay loam, silty clay loam, silty clay, sandy clay, and clay.

The finest textured horizon of the profile was used to determine the soil's class based on texture. For example, if a surface soil was a sandy loam, and the subsoil a loam, then the subsoil would place the series in Class III.

Class determinations based on soil texture were modified where necessary according to permeability.

The permeability of the four respective classes was as follows:

Permeability Class I.	6-20	inches per hour
Permeability Class II.	2-6	inches per hour
Permeability Class III.	0.6-2	inches per hour
Permeability Class IV.	Less than 0.6	inches per hour

The permeability of the most-limiting layer (lowest permeability) was used to determine leaching class according to permeability alone. For example, a soil whose top layer had a permeability of 10 inches per hour and

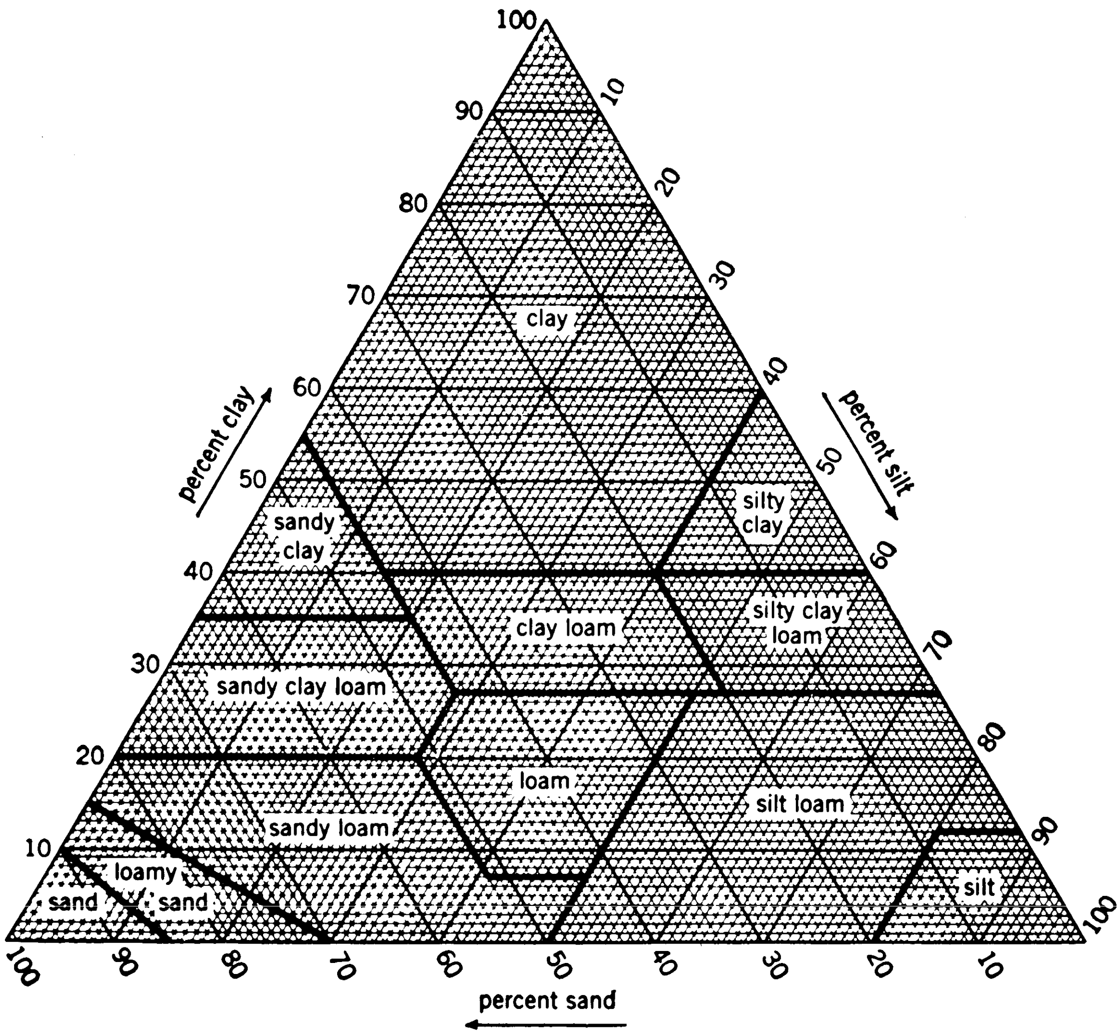

Figure 3. Chart showing the percentages of clay (below 0.002 mm), silt (0.002 to 0.05mm), and sand (0.05 to 2.0 mm) in the basic soil textural classes.

Figure 4. A Naron fine sandy loam located in Rice County: 0-14 inches fine sandy loam, 14-40 sandy clay loam, and 40-60 fine sandy loam. (Soil Conservation Service photo)

Figure 5. A Smolan silty clay loam located in Rice County: 0-13 inches silty clay loam and 13-60 inches silty clay. (Soil Conservation Service photo)

whose subsoil had a permeability of 4 inches per hour would be placed in Class II. The final class determination was then based on the factor most limiting to nitrate-leaching losses, either texture or permeability. For example, a sand (Textural Class I) with a permeability of between 2 and 6 inches per hour would be in Class II on the basis of its reduced permeability. If a soil, however, was classified as Textural Class III, yet was in Permeability Class II, it would still be classified as a Class III soil since Class III is less leachable.

The major factor for class determination then was the amount of water that would need to be displaced through the soil profile before leaching losses occurred. On the other hand, if a soil was fairly coarse textured, but contained an impermeable layer that restricted moisture movement, then the impermeable layer became the dominant influence.

An initial attempt was made to classify only those soils with more than approximately 50,000 mapped acres that were published in Soil Survey Reports through May 1981. However, some soils with less acreage were placed in the classification when they were known to have a high percentage of their acreage cultivated and, particularly, if these low-acreage soils were Class I or II soils.

Since complete soil survey reports are not available for all Kansas counties, only those counties with published soil surveys as of May 1981 (Figure 6) were included in our analysis. The counties with published soil surveys were the majority of Kansas counties, representing 34 million acres of the total of 50 million acres in Kansas.

The total acres of the four classes in Table 1 was 31 million acres, or about 91% of the 34 million acres surveyed. From these evaluations, we developed a general map showing the leaching classes of soils in Kansas according to area of the state. In general, the map indicates that the majority of Class I and II soils are located in south central and southwest Kansas. Exceptions to the location of Class I and II soils are the river valleys throughout Kansas where agriculturally important Class I and II soils are found. The acreages of the soils are relatively small but nevertheless important. Unfortunately, this detail could not be shown on the general map in Figure 7.

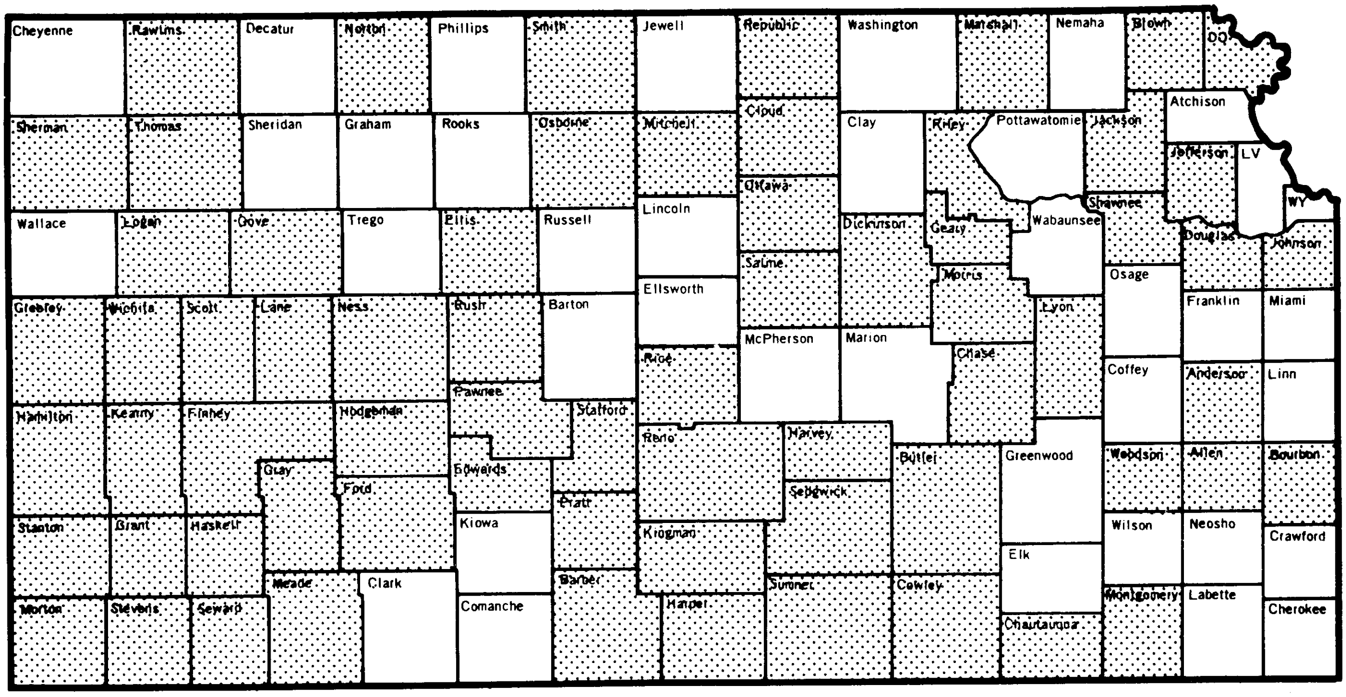

Figure 6. Shaded areas indicate Kansas counties with published soil survey reports as of May 1981 whose acreages are represented in Table 1. Copies can be obtained from your County Extension Office or the Soil Conservation Service.

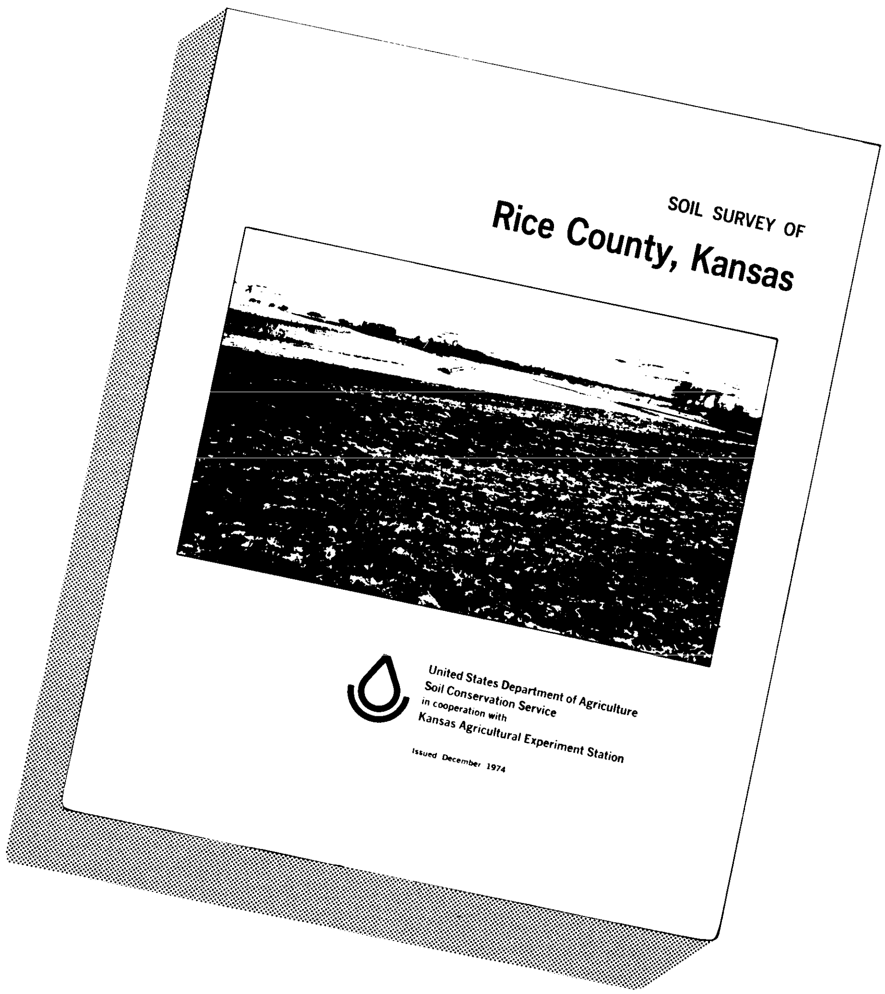

Table 1. Nitrogen-leaching susceptibilities of Kansas Soils. Class I. Some leaching losses of fertilizer N in most years. Class II. Some leaching losses of fertilizer N in some years. Class III. Light leaching losses occasionally. Class IV. Leaching losses are insignificant.

Soil Series	Major Land Resource Area 1/	Permeability (Inches/Hr)	SCS 2/ Hydrologic Group	Acres	Subgroup	Family
Class I						
Lincoln	72, 77, 78, 80	6-20	A	83,700	Typic Ustifluvents	Sandy, Mixed, Thermic
Pratt	78, 79, 80, 73, 75	6-20	A	594,900	Psammentic Haplustalfs	Sandy, Mixed, Thermic
Sarpy	74, 75, 76, 106, 107, 108, 115	6-20	A	21,000	Typic Udipsamments	Mixed, Mesic
Tivoli	72, 73, 77, 78, 79, 80	6-20	A	511,000	Typic Ustipsamments	Mixed, Thermic
			Total Acres =	1,210,600		
Class II.						
Albion	75, 78, 79, 80	2-6	B	201,300	Udic Argiustolls	Coarse-Loamy, Mixed, Thermic
Attica	78, 79, 80	2-6	B	99,100	Udic Haplustalfs	Coarse-Loamy, Mixed, Thermic
Canadian	80, 78	2-6	B	96,500	Udic Haplustolls	Coarse-Loamy, Mixed, Thermic
Carr	74, 75, 106, 107	0.6-2	B	24,000	Typic Udifluvents	Coarse-Loamy, Mixed, (Calcareous), Mesic
Dillwyn	75, 79, 80	6-20	A	51,700	Aquic Ustipsamments	Mixed, Thermic
Elsmere	64, 65, 66, 71, 72, 102b	2-6	A	25,000	Aquic Haplustolls	Sandy, Mixed, Mesic
Eudora 3/	74, 75, 76, 107, 106	0.6-2	B	32,000	Fluventic Hapludolls	Coarse-Silty, Mixed, Mesic
Haynie	107, 102	0.6-2	B	22,000	Mollic Udifluvents	Coarse-Silty, Mixed, (Calcareous), Mesic
Las Animas	69, 67, 72	0.6-2	C	40,000	Typic Fluvaquents	Coarse-Loamy, Mixed, (Calcareous), Mesic
Likes	77, 78	2-6	A	26,000	Typic Ustipsamments	Mixed, Thermic
Lincoln 3/	72, 77, 78, 80	6-20	A	21,000	Typic Ustifluvents	Sandy, Mixed, Thermic
Manter	67, 72, 49, 70	2-6	B	215,500	Aridic Argiustolls	Coarse-Loamy, Mixed, Mesic
Naron	75, 78, 79, 80	0.6-2	B	342,000	Udic Argiustolls	Fine-Loamy, Mixed, Thermic
Otero	67, 69	6-20	B	102.100	Ustic Torriorthents	Coarse-Loamy, Mixed, (Calcareous), Mesic
Platte	67, 71, 72, 73, 75	0.6-2	B-D	23,000	Mollic Fluvaquents	Sandy, Mixed, Mesic
Shellabarger 3/	74, 75, 76, 78, 79, 80	0.6-2	B	200,000	Udic Argiustolls	Fine-Loamy, Mixed, Thermic
Vona	67, 72, 60, 61	2-6	B	297,500	Ustollic Haplargids	Coarse-Loamy, Mixed, Mesic
			Total Acres =	1,766,800		
Class III.						
Armo	72, 73, 74	0.2-0.6	B	164,800	Entic Haplustolls	Fine-Loamy, Mixed, Mesic
Bates	76, 112	0.6-2	B	127,200	Typic Argiudolls	Fine-Loamy, Siliceous, Thermic
Bridgeport	72, 73, 74, 63, 66, 65	0.6-2	B	200,600	Fluventic Haplustolls	Fine-Silty, Mixed, Mesic
Campus	72, 73	0.6-2	B	77,400	Typic Calciustolls	Fine-Loamy, Mixed, Mesic
Catoosa	112, 85	0.6-2	B	156,500	Typic Argiudolls	Fine-Silty, Mixed, Thermic
Claremont	78	0.6-2	B	45,800	Typic Ustifluvents	Fine-Silty, Mixed, (Calcareous), Thermic
Clark	75, 78, 79, 80	0.6-2	B	95,900	Typic Calciustolls	Fine-Loamy, Mixed, Thermic
Colby	72, 77, 67, 64, 60, 61	0.6-2	B	779,000	Ustic Torriorthents	Fine-Silty, Mixed, (Calcareous), Mesic
Coly	71, 72, 73, 75	0.6-2	B	72,500	Typic Ustorthents	Fine-Silty, Mixed, (Calcareous), Mesic
Dale	80, 84	0.6-2	B	97,900	Pachic Haplustolls	Fine-Silty, Mixed, Thermic
Dalhart	77, 78	0.6-2	B	296,000	Aridic Haplustalfs	Fine-Loamy, Mixed, Mesic
Elandco	80, 84	0.6-2	B	41,400	Cumulic Haplustolls	Fine-Silty, Mixed, Thermic
Elkader	72	0.6-2	B	64,600	Torriorthentic Haplustolls	Fine-Silty, Carbonatic, Mesic
Eudora	106, 74, 75, 76, 107	0.6-2	B	32,000	Fluventic Hapludolls	Coarse-Silty, Mixed, Mesic
Farnum	75, 78, 79, 80	0.6-2	B	691,300	Pachic Argiustolls	Fine-Loamy, Mixed, Thermic
Geary	71, 74, 75, 76, 102, 73	0.2-0.6	B	205,200	Udic Argiustolls	Fine-Silty, Mixed, Mesic
Goshen	64, 67, 72, 73	0.6-2	B	161,900	Pachic Argiustolls	Fine-Silty, Mixed, Mesic
Grant	80	0.6-2	B	115,300	Udic Argiustolls	Fine-Silty, Mixed, Thermic
Hobbs	71, 73, 74, 75, 76, 102	0.6-2	B	170,500	Mollic Ustifluvents	Fine-Silty, Mixed, Non-Acid, Mesic
Holdrege	71, 73, 74, 75, 65	0.6-2	B	420,100	Typic Argiustolls	Fine-Silty, Mixed, Mesic
Hord	63, 65, 71, 72, 73, 75	0.6-2	B	183,600	Cumulic Haplustolls	Fine-Silty, Mixed, Mesic
Humbarger	73, 74, 75	0.6-2	B	52.100	Cumulic Haplustolls	Fine-Loamy, Mixed, Mesic
Ivan	76, 106, 112	0.6-2	B	82,400	Cumulic Hapludolls	Fine-Silty, Mixed, Mesic
Keith	60, 61, 64, 67, 72, 73	0.6-2	B	1,276,000	Aridic Argiustolls	Fine-Silty, Mixed, Mesic
Kennebec	76, 102, 103, 104. 105. 106, 107	0.6-2	B	174,700	Cumulic Hapludolls	Fine-Silty, Mixed, Mesic
Kim	67, 69, 72, 60, 61	0.2-0.6	B	48,500	Ustic Torriorthents	Fine-Loamy, Mixed, (Calcareous), Mesic
Knox	106, 107, 115	0.6-2	B	64,100	Mollic Hapludalfs	Fine-Silty, Mixed, Mesic
Kuma	67, 72	0.6-2	B	92,500	Pachic Argiustolls	Fine-Silty, Mixed, Mesic
Lancaster	74, 75	0.6-2	B	42,500	Udic Argiustolls	Fine-Loamy, Mixed, Mesic
Lula	112	0.6-2	B	60,700	Typic Argiudolls	Fine-Silty, Mixed, Thermic
Marshall	102, 106, 107, 109	0.6-2	B	57,600	Typic Hapludolls	Fine-Silty, Mixed, Mesic
Mason	112	0.2-0.6	B	61,300	Typic Argiudolls	Fine-Silty, Mixed, Thermic
McCook	67, 72, 73	0.6-2	B	55,700	Fluventic Haplustolls	Coarse-Silty, Mixed, Mesic
Milan	75, 80	0.2-0.6	B	108,900	Udic Argiustolls	Fine-Loamy, Mixed, Thermic
Monona	107	0.6-2	B	104,900	Typic Hapludolls	Fine-Silty, Mixed, Mesic
Muir	74, 75, 76, 106, 112	0.6-2	B	111,600	Cumulic Haplustolls	Fine-Silty, Mixed, Mesic
Nashville	80	0.6-2	B	57,400	Udic Haplustolls	Fine-Silty, Mixed, Thermic
Nuckolls	71, 73, 74, 75	0.6-2	B	65,300	Typic Haplustolls	Fine-Silty, Mixed, Mesic
Penden	72, 73	0.6-2	B	248,200	Typic Calciustolls	Fine-Loamy, Mixed, Mesic
Plevna	75, 78, 79, 80	2-6	D	57,400	Fluvaquentic Haplaquolls	Coarse-Loamy, Mixed, Thermic
Pond Creek	80	0.2-0.6	B	89,900	Pachic Argiustolls	Fine-Silty, Mixed, Thermic
Port	78, 79, 80	0.6-2	B	58,600	Cumulic Haplustolls	Fine-Silty, Mixed, Thermic

1/ Major Land Resource Area, Agriculture Handbook 296, Soil Conservation Service, USDA.
2/ SCS Hydrologic Groups. A through D represent soil infiltration on a bare soil after prolonged wetting. Soil A is most permeable with D being least permeable.
3/ 51% of Eudora is Class II, and 50% is in Class III. Eudora silt loams are Class III. Eudora overwash (fine sandy loam complexes are Class II.
80% of Lincoln is in Class I, and 20% is in Class II. Lincoln loamy sands and fine sandy loams are Class II. The rest are Class I.
45% of Shellabarger is Class II, and 55% is Class III. All sandy loams and loamy fine sands are Class II. Fine sandy loams are Class III.

Table 1. Continued

Soil Series	Major Land Resource Area	Permeability (Inches/Hr)	SCS Hydrologic Group	Acres	SubGroup	Family
Class III, cont'd.						
Quinlan	78, 80	0.6-2	C	77,200	Typic Ustochrepts	Loamy, Mixed, Thermic, Shallow
Roxbury	72, 73, 74, 75	0.6-2	B	400,700	Cumulic Haplustolls	Fine-Silty, Mixed, Mesic
Satanta	60, 61, 64, 67, 72, 77	0.2-0.6	B	70,900	Aridic Argiustolls	Fine-Loamy, Mixed, Mesic
Shellabarger	74, 75, 76, 78, 79, 80	0.6-2	B	250,100	Udic Argiustolls	Fine-Loamy, Mixed, Thermic
Sibleyville	106, 112	0.6-2	B	42,500	Typic Argiudolls	Fine-Loamy, Mixed, Mesic
Uly	71, 72, 73, 75, 65	0.6-2	B	499,400	Typic Haplustolls	Fine-Silty, Mixed, Mesic
Ulysses	60, 64, 67, 72, 77	0.6-2	B	2,651,000	Aridic Haplustolls	Fine-Silty, Mixed, Mesic
Vanoss	80	0.6-2	B	177,700	Udic Argiustolls	Fine-Silty, Mixed, Thermic
Verdigris	112, 76	0.6-2	B	264,900	Cumulic Hapludolls	Fine-Silty, Mixed, Thermic
Waldeck	75, 78, 79, 80	2-6	C	49,200	Fluvaquentic Haplustolls	Coarse-Loamy, Mixed, Thermic
Woodward	78, 77	0.6-2	B	48,600	Typic Ustochrepts	Coarse-Silty, Mixed, Thermic
			Total Acres =	12,473,700		
Class IV.						
Bethany	80	0.06-0.2	C	315,500	Pachic Paleustolls	Fine, Mixed, Thermic
Blanket	78, 80, 84, 85	0.2-0.6	C	156,800	Pachic Argiustolls	Fine, Mixed, Thermic
Brewer	80	0.06-0.2	C	51,800	Pachic Argiustolls	Fine, Mixed, Thermic
Carwile	78, 80	0.6-2	D	267,600	Typic Argiaquolls	Fine, Mixed, Thermic
Chase	76, 106, 112	0.06-0.2	C	53,100	Aquic Argiudolls	Fine, Montmorillonitic, Mesic
Clareson	112	0.2-2	C	104,600	Typic Argiudolls	Clayey-Skeletal, Mixed, Thermic
Clime	75, 76	0.06-0.6	C	477,000	Udic Haplustolls	Fine, Mixed, Mesic
Corinth	72, 73	0.06-0.6	C	54,100	Typic Ustochrepts	Fine, Mixed, Mesic
Crete	75, 106, 74	0.06-0.6	D	688,600	Pachic Argiustolls	Fine, Montmorillonitic, Mesic
Dennis	112	0.2-0.6	C	269,800	Aquic Paleudolls	Fine, Mixed, Thermic
Detroit	72, 73, 74, 75	0.06-0.2	C	73,000	Pachic Argiustolls	Fine, Montmorillonitic, Mesic
Dwight	75, 76, 106, 112	< 0.06	D	263,700	Typic Natrustolls	Fine, Montmorillonitic, Mesic
Edalgo	74	0.06-0.6	C	52,800	Udic Argiustolls	Fine, Mixed, Mesic
Elmont	76, 106	0.2-0.6	B	49,800	Typic Argiudolls	Fine-Silty, Mixed, Mesic
Eram	112	0.2-0.6	C	153,300	Aquic Argiudolls	Fine, Mixed, Thermic
Goessel	75	< 0.06	D	43,400	Udic Pellusterts	Fine, Montmorillonitic, Mesic
Grundy	106, 107, 108, 109, 112	0.2-0.6	C	215,200	Aquic Argiudolls	Fine, Montmorillonitic, Mesic
Harney	72, 73	0.2-0.6	C	2,704,600	Typic Argiustolls	Fine, Montmorillonitic, Mesic
Hastings	71, 73, 74, 75, 76	0.2-0.6	B	168,100	Udic Argiustolls	Fine, Montmorillonitic, Mesic
Irwin	75, 76	< 0.06	D	853,300	Pachic Argiustolls	Fine, Mixed, Mesic
Kenoma	112, 76	< 0.06	D	419,600	Vertic Argiudolls	Fine, Montmorillonitic, Thermic
Kirkland	80	< 0.06	D	96,200	Udertic Paleustolls	Fine, Mixed, Thermic
Labette	76, 112	0.06-0.2	C	396,900	Udic Argiustolls	Fine, Mixed, Mesic
Ladysmith	74, 75, 76	< 0.06	D	244,600	Pachic Argiustolls	Fine, Montmorillonitic, Mesic
Lubbock	72, 79	0.2-0.6	C	42,400	Pachic Argiustolls	Fine, Mixed, Mesic
Mansic	77. 78	0.6-2	B	221,400	Aridic Calciustolls	Fine-Loamy, Mixed, Thermic
Martin	106, 112, 76	0.06-0.2	C	490,800	Aquic Argiudolls	Fine, Montmorillonitic, Mesic
Mento	73	0.06-0.2	C	89,500	Typic Argiustolls	Fine, Montmorillonitic, Mesic
Morrill	106, 75	2-6	B	63,600	Typic Argiudolls	Fine-Loamy, Mixed, Mesic
New Cambria	73, 74	0.06-0.2	C	48,600	Cumulic Haplustolls	Fine, Montmorillonitic, Mesic
Norge	80, 84	0.2-0.6	B	76,000	Udic Paleustolls	Fine-Silty, Mixed, Thermic
Osage	112, 75	< 0.06	D	81,400	Vertic Haplaquolls	Fine, Montmorillonitic, Thermic
Oska	106, 107, 112	0.06-0.2	C	60,500	Typic Argiudolls	Fine, Montmorillonitic, Mesic
Ost	78, 79, 80	0.2-0.6	B	43,500	Typic Argiustolls	Fine-Loamy, Mixed, Thermic
Parsons	112	< 0.06	D	173,400	Mollic Albaqualfs	Fine, Mixed, Thermic
Pawnee	106	0.06-0.2	D	491,500	Aquic Argiudolls	Fine, Montmorillonitic, Mesic
Polo	107, 109, 112	0.6-2	B	60,000	Typic Argiudolls	Fine, Montmorillonitic, Mesic
Randall	77, 78	< 0.06	D	49,700	Udic Pellusterts	Fine, Montmorillonitic, Thermic
Reading	76, 106, 112	0.2-2	C	150,100	Typic Argiudolls	Fine-Silty, Mixed, Mesic
Renfro	80	0.2-0.6	D	97,100	Udertic Paleustolls	Fine, Mixed, Thermic
Richfield	72	0.2-6	C	2,743,800	Aridic Argiustolls	Fine, Montmorillonitic, Mesic
Ringo	112	< 0.06	C	42,300	Entic Hapludolls	Fine, Mixed, Thermic
Rosehill	75	< 0.06	D	99,500	Udertic Haplustolls	Fine, Montmorillonitic, Mesic
Sharpsburg	106, 107, 108, 109, 112	0.6-2	B	79,800	Typic Argiudolls	Fine, Montmorillonitic, Mesic
Shelby	106, 107, 108, 109, 115	0.2-0.6	B	154,300	Typic Argiudolls	Fine-Loamy, Mixed, Mesic
Smolan	74, 75, 76	0.06-0.2	C	109,700	Pachic Argiustolls	Fine, Montmorillonitic, Mesic
Spearville	72, 77	0.06-0.2	C	303,800	Typic Argiustolls	Fine, Montmorillonitic, Mesic
Summit	112	0.2-0.6	C	47,300	Vertic Argiudolls	Fine, Montmorillonitic, Thermic
Tabler	80	< 0.06	D	177,000	Vertic Argiustolls	Fine, Montmorillonitic, Thermic
Tully	74, 75, 76	0.06-0.2	C	197,900	Pachic Argiustolls	Fine, Mixed, Mesic
Vernon	78	< 0.06	D	117,600	Typic Ustochrepts	Fine, Mixed, Thermic
Wabash	106, 107, 108, 109, 113, 114	< 0.06	D	73,000	Vertic Haplaquolls	Fine, Montmorillonitic, Mesic
Wakeen	72, 73, 75	0.6-2	B	180,600	Entic Haplustolls	Fine, Silty, Carbonatic, Mesic
Woodson	112	< 0.06	D	274,300	Abruptic Argiaquolls	Fine, Montmorillonitic, Thermic
Wymore	75, 76, 106	0.06-0.2	D	306,300	Aquic Argiudolls	Fine, Montmorillonitic, Mesic
Zaar	112, 76	< 0.06	D	173,800	Vertic Hapludolls	Fine, Montmorillonitic, Thermic
Zenda	78, 79, 80	0.6-2	C	40,000	Fluvaquentic Haplustolls	Fine-Loamy, Mixed, Thermic
			Total Acres =	15,532,800		

Soils of Kansas

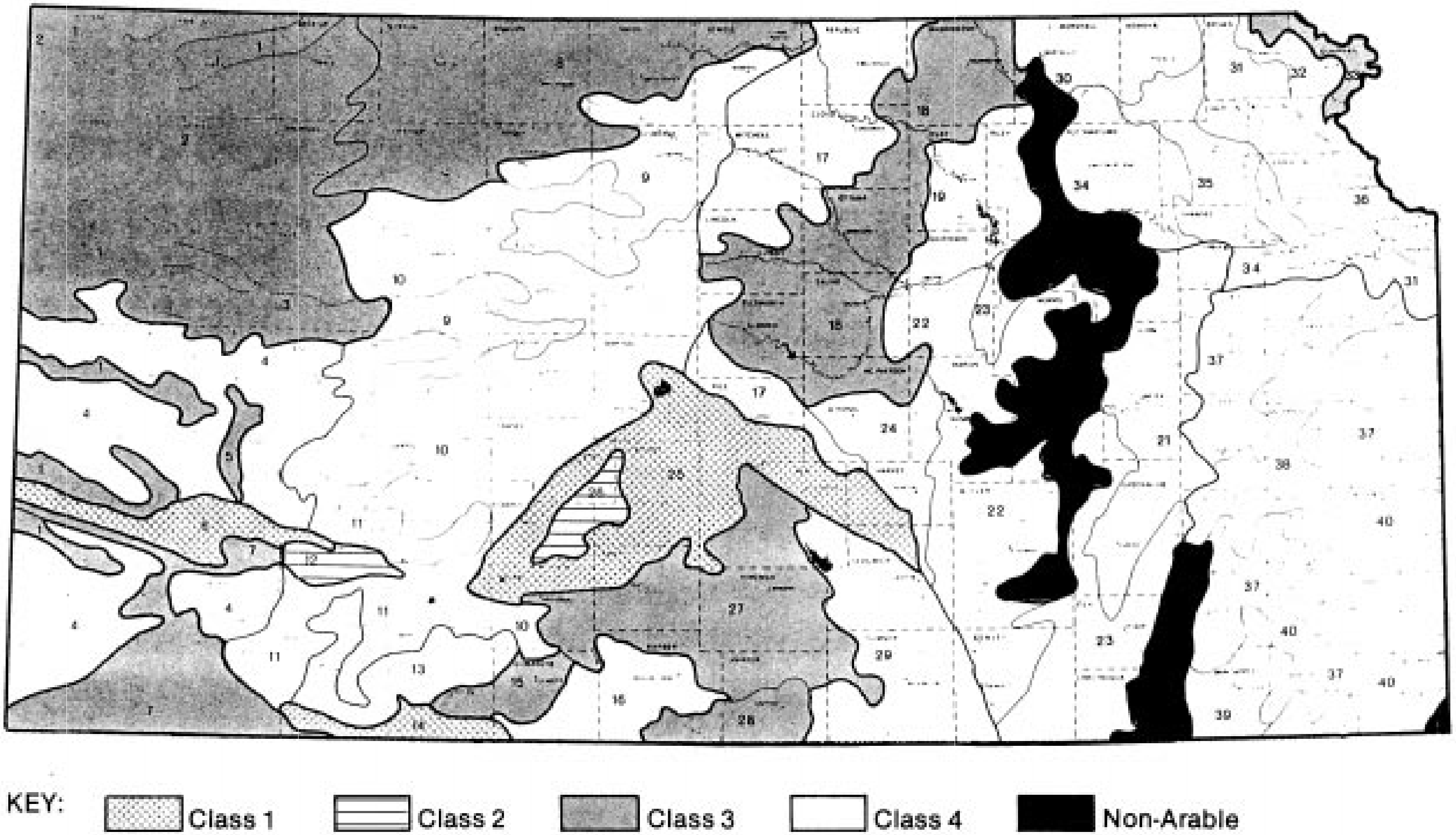

Figure 7. Distribution of the fertilizer nitrogen-leaching classes in the state.

Agricultural Experiment Station, Kansas State University, Manhattan 66506

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