NITROGEN GUIDELINES FOR FIELD CROPS IN NEW YORK

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Executive Summary

- Nitrogen (N) is an essential macronutrient, taken up by crops in large quantities. Nitrogen deficiency impacts both crop yield and quality. Excess N may lead to excessive vegetative growth, lodging, delayed maturity, increased disease susceptibility, low crop quality, and nitrate accumulation, while also contributing to acid rain, damage to the ozone layer in the stratosphere, nitrous oxide (N_2O, a potent greenhouse gas) emissions, eutrophication of surface waters, contamination of ground water, and negative impacts on fish and other aquatic species. Thus, it is important from both an economic and an environmental standpoint to manage N optimally.

- The two primary objectives of N management are: (1) to have adequate inorganic (plant available) N available during the growing season; and (2) to minimize the availability of inorganic N during the fall, winter, or early spring, when N may be transported to surface and groundwater or lost through volatilization and/or denitrification.

- This manual presents Land Grant University guidelines for N management of field crops. It replaces Ketterings et al. (2003). Crops include, among others, corn grown for grain, corn grown for silage, grass hay, mixed grass and alfalfa stands, sorghum sudangrass, forage sorghum, teff, and winter cereals grown for forage production in corn and sorghum rotations.

- All guidelines presented here should be considered foundational. Because the true optimum N rate for any field can only be confirmed at harvest, producers and planners must work with ranges to ensure adequate N is supplied to crops, while striving to avoid excess applications.

- Since 1999, farmers, including Concentrated Animal Feeding Operations (CAFOs), with at least three years of yield data have been incentivized to use the field-specific yield data for the farm.

- Since 2013, farmers can opt to follow the Adaptive Management Process (http://nmsp.cals.cornell.edu/publications/files/AdaptiveManagementGuidelines.pdf) and apply N to a selected field beyond the foundational guidelines presented in this document. However, adjustments should be made when the environmental assessment required as part of the adaptive management process shows higher N rates are not needed for yield or quality.

Acknowledgments

Agronomic nitrogen fertilizer guidelines for many field crops in New York were first developed based on decades of field research by emeriti professors D.R. Bouldin, S.D. Klausner, D.J. Lathwell, and W.S. Reid. An earlier version of this document was co-authored in 2003 by S.D. Klausner and K.J. Czymmek, then Senior Extension Associate with the PRO-DAIRY program.

Over the past 20 years, additional research has focused on including more crops, new rotations, and reviewing and updating of guidelines and book values for yield indices. The 2022 edition of the Nitrogen Fertility Guidelines for Field Crops in New York includes a new yield index database and equations for deriving guidelines for corn grown for grain and corn grown for silage reflecting a summary of 230,000 acres of corn yield data collected in the past 5-6 years, guidelines for growing winter cereals such as winter wheat, cereal rye, and triticale as double crops in corn or forage sorghum rotations, as well as guidelines for N management of teff.

We thank K.J. Czymmek with whom many of the current guidelines were co-developed. We also thank G. Albrecht, B. Jordan, R. Bush (New York State Department of Agriculture and Markets, NYSAGM), J. Hornesky and D. Gates (Natural Resources Conservation Service, NRCS), and S. Latessa (New York State Department of Environmental Conservation, NYSDEC), for reviewing this document. We are grateful to the many New York Certified Nutrient Management Planners, Certified Crop Advisors, Cornell Cooperative Extension staff, Soil and Water Conservation District staff, Natural Resources Conservation Service staff, and farmers who supplied yield data, participated in the many on-farm research trials, and gave valuable feedback as new guidance systems were being developed.

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1. Introduction

Nitrogen (N) is an essential macronutrient that is taken up by plants in large quantities. Crops take up N that is released to the soil solution through atmospheric deposition, soil organic matter mineralization, crop residue decomposition and animal manure and inorganic fertilizer addition. Furthermore, N may become available through biological fixation (Figure 1).

Only inorganic N, principally nitrate (NO_3^-) and ammonium (NH_4^+) is available for plant growth. Nitrite (NO_2^-) can be taken up but this N form is toxic to plants and generally present in trace quantities only. A deficiency in N negatively impacts yield and crop quality while excess N may lead to excessive vegetative growth, lodging, delayed maturity, increased disease susceptibility, low crop quality, and NO_3^- accumulation. Excesses may contribute, among others, to acid rain, damage to the ozone layer in the stratosphere, nitrous oxide (N_2O) emissions, eutrophication of surface waters, contamination of ground water, and negative impacts on fish and other aquatic species.

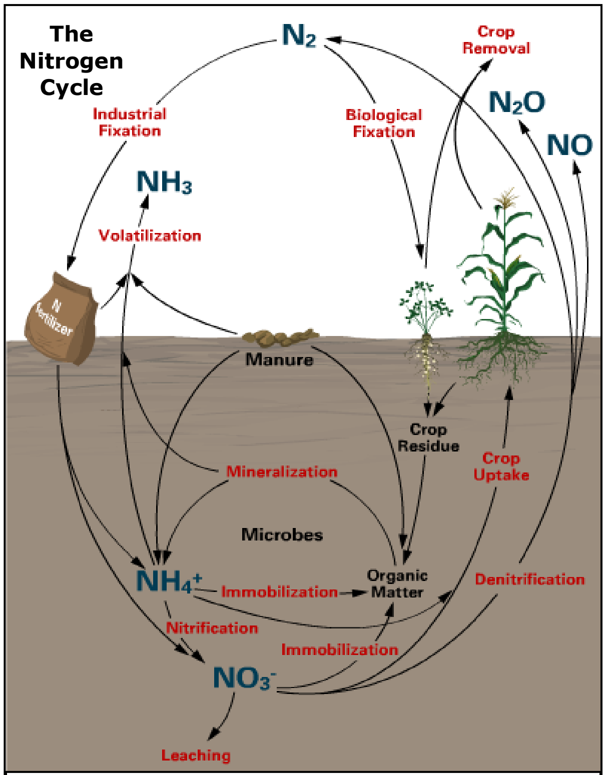

Figure 1: Nitrogen cycle.

The NO_3^- concentration in ground and surface waters is an important water quality index. The United States Environmental Protection Agency (USEPA) has set the Federal Standard for maximum permitted amount of nitrate-N in drinking water at 10 mg N per L or 43 mg NO_3^- per L.

It is important from both an economic and an environmental standpoint to manage N optimally. Thus, the two primary objectives of N management are: (1) to have adequate inorganic N available during the growing season; and (2) to minimize the availability of inorganic N during the fall, winter, or early spring, when N may be transported to surface and groundwater.

2. Nitrogen Reactions in Soil

2.1 Fixation

The atmosphere is about 78% dinitrogen gas (N_2) by volume. This gaseous N is chemically stable and unavailable to most biological organisms. However, some species of bacteria can convert N_2 to N-containing organic compounds. This process is called biological fixation. It is the primary mechanism by which atmospheric N_2 is added to the soil. Legumes such as alfalfa and clover have root nodules that contain N-fixing bacteria that convert atmospheric N_2 to protein. The legume, upon its death, will increase the amount of organic N in the soil as decomposition proceeds.

N_2	→	NH_3	→	$R\text{-}NH_2$
(nitrogen gas)		*(ammonia)*		*(organic nitrogen)*

2.2 Mineralization

Organic N exists in plants, soil organic matter, soil microorganisms, animal manure, etc. When organic N decomposes, it is converted into ammonium (NH_4^+). This process, facilitated by microorganisms, is called mineralization. Because NH_4^+ is positively charged, it is generally adsorbed by the negatively charged soil particles that dominate soils. Thus, the NH_4^+ leaching potential is minimal.

$R\text{-}NH_2$	→	NH_3	→	NH_4^+
(organic nitrogen)		*(ammonia)*		*(ammonium)*

2.3 Nitrification

Certain microorganisms in the soil convert ammonium to nitrite (NO_2^-) and then to nitrate (NO_3^-) by a process called nitrification. Nitrification occurs rapidly when soil is moist, warm, and well aerated. These conditions coordinate well with early summer when crop N needs are on the rise. Nitrification will significantly increase soil acidity (decrease pH) by producing H^+ ions. Liming may be needed to counteract the added acidity. Nitrification rate is affected by soil temperature and is virtually zero below 41°F and above 122°F. The optimum soil temperature range for nitrification is 67-86°F. Nitrifying bacteria require oxygen. Thus, soil drainage and aeration stimulate nitrification. Although NH_4^+ is not very prone to leaching, application of NH_4^+ containing fertilizer may still result in leaching losses when nitrification is rapidly occurring.

NH_4^+	→	NO_2^-	→	NO_3^-
(ammonium)		*(nitrite)*		*(nitrate)*

2.4 Denitrification

When there is a depletion of oxygen in the soil, anaerobic bacteria can convert nitrate into gaseous forms of N including nitric oxide gas (NO), nitrous oxide gas (N_2O), and N_2. This process, called denitrification, results in a loss of plant available N from the soil and its return to the atmosphere. Denitrification is accelerated in poorly aerated (<10% oxygen), and/or waterlogged soils. The optimum soil temperature for denitrification is between 77 and 95°F. Denitrification ceases to take place at soil temperatures <33°F and >122°F. Dinitrogen gas is environmentally harmless. However, NO and N_2O can contribute to the formation of nitric acid (an important component of acid rain). Both gasses also contribute to the greenhouse effect. In addition, N_2O contributes to the destruction of ozone.

NO_3^-	→	NO_2^-	→	NO	→	N_2O	→	N_2
(nitrate)		*(nitrite)*		*(nitric oxide)*		*(nitrous oxide)*		*(dinitrogen gas)*

2.5 Immobilization

Soil microbes compete with plants for available NH_4^+ and NO_3^-. Immobilization refers to the process by which inorganic N is bound in the microbial biomass, thus making it unavailable to plants until the microbes die and decompose, in which case the N re-enters the mineralization process. Immobilization and mineralization occur simultaneously in the soil. Whether the net effect is an increase or a decrease in inorganic N depends on which process dominates. A high (>25) carbon (C) to N ratio of the organic material that is being decomposed may result in a (temporary) net immobilization of N. This may be observed when large amounts of straw or sawdust bedding are included with manure applications. It may also occur when low N containing crop residue is tilled into the soil.

$$\underset{\textit{(ammonium)}}{NH_4^+} \rightarrow \underset{\textit{(organic nitrogen)}}{R\text{-}NH_2} \leftarrow \underset{\textit{(nitrate)}}{NO_3^-}$$

2.6 Ammonia volatilization

Nitrogen can be lost to the atmosphere by volatilization, a process whereby a substance is converted from a solid or liquid to a gas. Typically, N is lost by volatilization of ammonia (NH_3) when urea-containing fertilizers or manure are applied on the soil surface and not incorporated. Little or no ammonia loss occurs from surface applications of acidic fertilizers such as ammonium nitrate or ammonium sulfate unless the soil pH is very high. Ammonia volatilization increases with increasing soil pH and decreasing moisture content. High temperatures also stimulate volatilization. As much as 50% of the total amount of manure N may be lost if the manure is not incorporated after application.

$$\underset{\textit{(urea)}}{H_2N\text{-}\overset{\overset{O}{||}}{C}\text{-}NH_2} \rightarrow \underset{\textit{(ammonium)}}{NH_4^+} \rightarrow \underset{\textit{(ammonia)}}{NH_3}$$

3. Sources of Nitrogen

There are four main sources of N: (1) native soil organic matter; (2) organic amendments (animal and green manure, compost, plowed under sods); (3) biologically fixed N; and (4) inorganic fertilizer N. To calculate the inorganic N requirement for optimum economic yield, adjustments need to be made for biologically fixed N and/or N released from one or more of the organic sources. Procedures used to estimate N release from plowed under sods and from manure applications are discussed below.

3.1 Soil organic matter

Soil organic matter (OM) consists of plant and animal residues, living soil organisms, and substances synthesized by these organisms. Soil microbial breakdown of OM results in the release of many essential plant nutrients. Soils in New York can typically supply 40 to 80 lbs N/acre annually depending on soil type, OM content, and previous management. Despite its variable nature, soil OM is an important source of available N and must be accounted for when determining fertilizer guidelines. The soil's N supplying capacity (SoilN in lbs N/acre) is a function of soil type and artificial drainage class. Soil management groups are described in Appendix Table 1. Estimates of soil N supply can be found in Appendix Table 2.

3.2 Legumes, grass sods, soybeans and cover crops

Legumes can, through biological N fixation, acquire enough N to meet their needs if proper inoculation and nodulation occur. Grasses, including corn, cannot fix atmospheric N and therefore require N addition either supplied by companion legumes, animal or green manures, soil organic matter mineralization, or fertilizer application.

Sod crops that are credited for N are listed in Table 1. When the legume, grass, or legume/grass sod is killed, the organic N will become available to subsequent crop(s) through mineralization. The amount of N available from these crop residues is a function of the sod density and quality, the % legume, and time since the sod crop was terminated. If a good quality sod is 100% grass, the amount of organic N is estimated to approach 150 lbs/acre. Legumes contribute a greater amount of N because of their greater N content (Table 2).

Table 1: Cornell crop codes and descriptions of "sod" crops.

Crop Codes*	Crop Description	Crop Codes*	Crop Description
ABE & ABT	Alfalfa Trefoil Grass	CLE & CLT	Clover
AGE & AGT	Alfalfa Grass	CSE & CST	Clover Seed Production
ALE & ALT	Alfalfa	CVE & CVT	Crownvetch
BCE & BCT	Birdsfoot Trefoil Clover	GIE & GIT	Grasses Intensively Managed
BGE & BGT	Birdsfoot Trefoil Grass	GRE & GRT	Grasses
BSE & BST	Birdsfoot Trefoil Seed	PGE & PGT	Pasture with Improved Grasses
BTE & BTT	Birdsfoot Trefoil	PIT	Pasture Intensively Grazed
CGE & CGT	Clover Grass	PLE & PLT	Pasture with Legumes

* A crop with a crop code ending with an "E" is in its establishment year while a crop code ending with a "T" implies an established sod.

Table 2: Expected N credits from terminated sods.

		Available N		
Legume in sod %	Total N pool lbs N/acre	Year 1* lbs N/acre	Year 2 lbs N/acre	Year 3 lbs N/acre
0	150	83	18	8
1-25	200	110	24	10
26-50	250	138	30	13
50 or more	300	165	36	15

* First year following plow down or chemical termination.

The sod N contribution depends on the number of years since a sod crop was terminated. Of the total amount of organic N contained in the sod, 55% is expected to be available to the first crop after termination, 12% to the next crop and 5% to the third crop or year. This N contribution reduces the N needs of subsequent crops accordingly. Thus, 55% or 83 lbs N/acre of an estimated 150 lbs N/acre in a good grass sod is expected to be available to the next crop. No N credits are expected for crops planted more than three years after sod termination.

Corn that follows soybean in a rotation typically requires less N than continuous corn (Swink et al., 2007). This is often attributed to non-N rotation effects including interruption of pest cycles, improved soil physical properties, changes in mycorrhizal communities, and/or presence of growth promoting substances related to soybean. Soybean residue decomposes more rapidly than corn residue. This leads to more rapid immobilization and an earlier N release peak than would be seen for corn after corn. Actual N savings for corn after soybean can be impacted by soil type and properties (greater savings on medium textured soils with low OM than on sandy or heavy clay soils with higher OM) and tillage (higher N savings in tilled than in reduced-till systems). There is no consistent link between previous year soybean yield and the amount of N with which corn guidelines can be reduced. The optimum economic N rate for corn grown after soybeans in New York can be lowered by 20-30 lbs N/acre (SoyN credits) as compared to corn after corn (Swink et al., 2007).

Cover crops can also supply N to the crop that follows. The amount of biomass, its N content, and its C:N ratio (maturity) can greatly influence N dynamics in the soil after termination of the cover crop. The optimum economic N rate for corn grown in New York after spring termination of a fall-planted, timely seeded, overwintering cover crop, such as cereal rye, winter wheat, or triticale, can be lowered by 20-30 lbs N/acre (CCN credits) as compared to corn after corn. Cover crop credits could be higher for interseeded legumes like red clover or hairy vetch. The optimum economic N rate for corn after clover that was interseeded into a small grain can be lowered by 70-120 lbs N/acre (only for the first year of corn following clover termination). For corn after termination of a cover crop that was planted after small grain harvest in July/August of the previous season, the total N uptake may be 70-90 lbs N/acre or even higher (greater cover crop biomass production compared to late planted cover crops) which could result in cover crop credits of 40-50 lbs N/acre. All cover crop N credits apply when the C:N ratio of the cover crop biomass is less than 25, generally this is when cereal grains are at Feekes stages 9 (flag leaf) or 10 (boot stage) or less mature. The N rate for corn after a more mature biomass is terminated should not be lowered.

3.3 MANURE

There are primarily two forms of N in manure: inorganic (NH_4^+) and organic N (Figure 2). The inorganic N is initially present in urine as urea and may account for approximately 50% of the total N. Urea in manure is no different from urea in commercial fertilizer. It hydrolyzes rapidly to ammonium. In principle, inorganic N in manure is equally available for plant growth as fertilizer N. However, parts or all of it may be lost because NH_4^+ is rapidly converted to ammonia as the pH increases and the manure begins to dry. Atmospheric exposure of manure on the barn floor, in the feedlot, in storage, or after spreading increases N loss. Thus, an analysis of the manure is useful to determine how much inorganic N may be conserved before spreading. Table 3 shows the fraction of the inorganic remaining for plant use from various livestock manures given alternative application methods and timing of application.

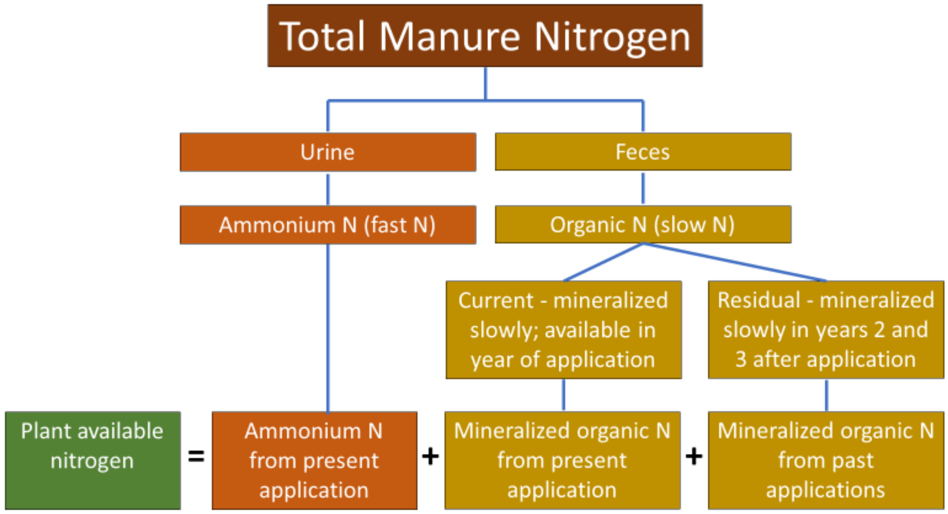

Figure 2: Manure contains ammonium and organic N (modified from Klausner, 1997).

Table 3: Estimated ammonia-N availability as affected by manure application method.

Manure application method	Ammonium N utilized by the crop (%)
Injected during growing season	100
Incorporated within 1 day	65
Incorporated within 2 days	53
Incorporated within 3 days	41
Incorporated within 4 days	29
Incorporated within 5 days	17
No conservation/Injected in fall	0

The more stable organic N is present in the feces and is only slowly released. The decomposition of stable organic N to a plant available inorganic form occurs at different rates. The less resistant organic N decomposes during the year of application, and the more resistant organic N decomposes very slowly in future years. Repeated application to the same field results in an accumulation of a slow-release manure N source.

A decay or mineralization series is commonly used to estimate the rate of N availability from stable organic N. A decay series of 35, 12, and 5% is used to estimate the rate of decomposition of organic N in liquid (<18% dry matter, DM) dairy manures in New York. This sequence of numbers means that 35% of the organic N is mineralized and potentially taken up by the growing crop during the year the manure was applied, 12% of the initial organic N application is mineralized and taken up during the second year, and 5% is mineralized and taken up in the third year. There is evidence that manure containing large amounts of bedding may mineralize at a slower rate than fresh manure. Therefore, the estimated availability of N during the year applied is reduced from 35 to 25% when the DM content of bedded manure exceeds 18% (Table 4).

Fertilizer guidelines from Cornell University are adjusted for the release of N from both the current year application (as outlined above) and previous years' applications (residual manure N credits). The following calculations are used to determine the residual manure N contribution (ResidualN_manure):

ResidualN_manure = ResidN1 + ResidN2
ResidN1 = Decay_lastyr/100 * (Organic N/100) * ManureRate_lastyr
ResidN2 = Decay_2yrs/100 * (Organic N/100) * ManureRate_2yrs [1]

Where:

ResidualN_manure is the total residual N from manure (lbs N/acre)
ResidN1 is the residual N from manure applied last year (lbs N/acre)
ResidN2 is the residual N from manure applied two years ago (lbs N/acre)
Decay_lastyr is the organic N decay last year (%, see Table 4)
Decay_2yrs is the organic N decay 2 years ago (%, see Table 4)
ManureRate_lastyr is the amount of manure applied last year (lbs/acre)
ManureRate_2yrs is the amount of manure applied 2 years ago (lbs/acre)
Organic N is the organic N content of the applied manure on an as sampled basis

Table 4: Decay series for stable organic N in manure by animal type. A "last year release rate" of 12% indicates that an estimated 12% of the organic N applied in the manure is expected to be utilized by the crop a year after application.

Source	Dry Matter Content (%)	Release rate for organic N in manure (%) Present Year "Decay_current"	Last Year "Decay_lastyr"	Two Years Ago "Decay_2yrs"
Cows	<18	35	12	5
Cows	≥18	25	12	5
Poultry	<18	55	12	5
Poultry	≥18	55	12	5
Swine	<18	35	12	5
Swine	≥18	25	12	5
Horses	<18	30	12	5
Horses	≥18	25	12	5
Sheep	<18	35	12	5
Sheep	≥18	25	12	5

4. Nitrogen Guidelines for Specific Field Crops

All guidance is designed to support the 4R concept of nutrient stewardship which promotes the right source, right rate, right time and right place for fertility amendments. Nitrogen needs will vary by crop and field and practical limits exist for the number of different manure and fertilizer application source, rate, method, and timing combinations across a farm. Therefore, it is unfeasible to plan all fields on a farm to a zero N balance relative to the guidelines in this document. To address this for farms required to meet the NRCS-NY Nutrient Management Conservation Practice Standard (CPS) 590, for all fields where manure and/or fertilizer applications are planned, it is expected that the N balance (N allocated in the CNMP *minus* N guideline for the field and crop) does not exceed 20 lbs/acre. This flexibility is available only as a planning *evaluation* tool, so that planners may compare their N recommendations relative to the N guidelines (i.e., N guidelines may not be programmed or calculated as the N guideline *plus* one to 20 additional lbs/acre). Guidelines can be met by inorganic N application or a combination of inorganic and manure application. Independent of how much of the N is satisfied with manure or other organic sources that need to be mineralized, for some crops, a minimum amount of inorganic N is recommended for optimal economic yields (Table 5).

Table 5: Recommended minimum inorganic nitrogen (N) application.

Crop		Minimum inorganic N rate (lbs/acre)
Triticale peas (TRP)		40
Grasses:	Topdressing (GRT)	50
	Topdressing intensively managed (GIT)	100
Pastures:	Native and improved grasses (PNT, PGT)	50
	Intensively managed grass (PIT)	90

4.1 Grain corn, corn silage

The N guidelines for corn silage (COS) and grain corn (COG) are similar. Guidelines depend on soil specific (see Appendix Table 1 for a brief description of soil management groups) yield index (YI), N supply by the soil, rotation credits for sod crops, soybeans, or cover crops, adjusted for the soil's specific N uptake efficiency (ability of that soil to deliver N to the crop). In 2022, a new yield index and guidelines system was developed after evaluation of >230,000 acres of corn silage and grain yield data from cash grain and dairy operations in New York.

Grain corn: NetN = (YI_corngrain*A–SoilN–SodN)/(N_eff/100)–SoyN–CCN [2]

Silage corn: NetN = (YI_cornsilage*B–SoilN–SodN)/(N_eff/100)–SoyN–CCN [3]

Where:

NetN is the total N (lbs N/acre) from any source required for optimum crop production.
YI is the soil and drainage specific yield index (Appendix Table 2)
A and B are YI multipliers (Table 6)
SoilN and SodN are N (lbs N/acre) from soil organic matter and sods (sections 3.1, 3.2)
N_eff is the soil type and drainage dependent uptake efficiency (Appendix Table 2)
SoyN and CCN are soybean and cover crop N credits in lbs N/acre (section 3.2)

For farms that have at least three years of corn yield data for a specific field, average yield for the field can be used to substitute for the YI values from Appendix Table 2. With only three years of yield data, the lowest yielding year can be dropped from the average while yield tracking continues. With four years of data, the lowest yielding year can be dropped from the average to obtain a 3-year average while tracking continues. With five years of data, up to two low yielding years can be dropped to determine the 3-year average. Once five years of data are obtained, maintain a rolling average of the most recent five years with the option to drop the two lowest yielding years from the average. Yield for grain should be entered in bu/acre at 85% DM. Yield for silage is entered in tons/acre at 35% DM.

Table 6: Corn grain and silage yield index multipliers for N guidelines for corn grain and silage.

Corn Grain Yield Index	A		Corn Silage Yield Index	B
Bushel/acre	lbs N/bu		Tons/acre	lbs N/ton
≤150	1.20		≤16.0	11.0
155	1.20		16.5	11.0
160	1.17		17.0	11.0
165	1.15		17.5	10.8
170	1.12		18.0	10.6
175	1.10		18.5	10.4
180	1.08		19.0	10.2
185	1.05		19.5	10.0
190	1.03		20.0	9.8
195	1.01		20.5	9.6
200	0.98		21.0	9.4
205	0.96		21.5	9.1
210	0.94		22.0	8.9
215	0.91		22.5	8.7
220	0.89		23.0	8.5
225	0.87		23.5	8.3
230	0.85		24.0	8.1
235	0.85		24.5	7.9
≥240	0.85		≥25.0	7.7

Research in New York has shown that first year corn following a sod for fields without a recent manure history (within past two years), or fields with rotation credits can benefit from a small starter N application of 20-30 lbs N/acre. Thus, the recommended amount of starter N (NetN) is 20-30 in lbs N/acre, which can be supplied as inorganic N or a combination of inorganic and organic N. The N guidelines can be increased by 20 lbs/acre for a no-till crop production system due to slower soil warming in the spring.

4.2 SORGHUM, SUDANGRASS, SORGHUM SUDAN HYBRID, MILLET

The N guidelines for grain sorghum (SOG), sorghum forage (SOF), sudangrass (SUD), sorghum sudan hybrid (SSH), and millet (MIL) are derived from N guidelines for corn grain:

NetN = (YI_corngrain*A – SodN – SoilN)/(N_eff/100) – SoyN – CCN
If NetN > 50 lbs N/acre, then NetN = NetN * 0.8 [4]

Where:

NetN is the total N (lbs N/acre) from any source required for optimum crop production
YI is the soil and drainage specific yield index (Appendix Table 2)
A is a YI multiplier (Table 6)
SoilN and SodN are N (lbs N/acre) from soil organic matter and sods (sections 3.1, 3.2)
N_eff is the soil type and drainage dependent uptake efficiency (Appendix Table 2)
SoyN and CCN are soybean and cover crop N credits in lbs N/acre (section 3.2)

The latter equation indicates that if the net N requirement, calculated using the corn grain yield index, is >50 lbs/acre, it is adjusted to 80% of the corn N requirement. The N guideline is increased by 20 lbs/acre for a no-till crop production system. Multiplier A can be found in Table 6. Values for SoilN, and N_eff can be found in Appendix Table 2. For SodN credits, see Table 2. SoyN and CCN are soybean and cover crop N credits in lbs N/acre (section 3.2). The minimum recommended amount of N (NetN) for each of these crops is 20-30 in lbs N/acre.

For brown midrib (BMR) varieties of forage sorghum or sorghum sudangrass harvested for silage in multi-cut systems, if no manure is applied, broadcast 110-130 lbs N/acre at planting and topdress the same amount soon after each cutting for higher yield and protein content. Use of a urease inhibitor or timing of application to allow for rain-incorporation of the urea-based N fertilizer can protect the N applied for greater uptake efficiency. When such forages follow sod termination or manure has been applied in the past year, N application rates should not exceed 35-55 lbs N/acre per cut.

4.3 Alfalfa, Alfalfa Grass, Birdsfoot Trefoil, Birdsfoot Trefoil-Clover, Clover-Grass

Generally, when a field is less than 25% legume, it should be managed as a grass (see section 4.4). Fields with 25% or more legumes should be managed with a focus on legume requirements. To establish a legume or legume-grass sod, no N is required. Thus, the N guidance for establishment of alfalfa (ALE), alfalfa grass (AGE), birdsfoot trefoil (BTE), birdsfoot trefoil-clover (BCE), and clover-grass (CGE) is 0 lbs N/acre. Nitrogen guidelines for topdressing of pure legume stands (ALT, BTT, BST, CLT, CST, and CVT) are also zero. Nitrogen guidelines for topdressing of legume stands (ALT, BTT, BST, CLT, CST, and CVT) are also zero. Nitrogen guidelines for topdressing of legume-grass stands (AGT, ABT, BCT, BGT, and CGT) depend on the percentage of legume in the sod (guidelines are not adjusted for N releases from previous sods or soil organic matter):

If the stand is 100% grass:	NetRequiredN = 75 lbs/acre	
1 to 25 % legume	NetRequiredN = 40 lbs/acre	
If the stand is more than 25% legume:	NetRequiredN = 0 lbs/acre	[5]

The deeper rooting system of established alfalfa as compared to grasses and/or corn, its relatively high P and K demands, and its ability to reduce N fixation upon availability of a readily available N form, make alfalfa a more appropriate alternative (assuming odor is controlled) for manure application than corn or grass fields for which N needs have already been met. Established stands with non-fixing alfalfa varieties or mixed alfalfa-grass stands with more than 50% grass are better alternatives for manure application than newly established monocultures of N-fixing alfalfa cultivars or fields rotating into an alfalfa seeding or more alfalfa-rich mixed stands. For established stands (topdressing), smothering and/or salt injury to the stand increases with manure application rates more than 4,000 gallon per acre per cut, especially when applications are delayed beyond 3-4 days after cutting (Ketterings et al., 2007). If manure is being applied in the last production year to address P and K levels that have been reduced over the life of the alfalfa-grass stand, it is recommended to apply the manure while the crop is still actively growing to enhance N uptake (during summer or early fall) and to kill the alfalfa-grass in the following spring (rather than the previous fall) to prevent large N fluxes prior to establishment of the following corn crop.

4.4 Establishment and topdressing of grass

To establish a grass stand (GIE and GRE), 50 lbs N/acre is recommended. For topdressing, the guidelines depend on the intensity of management of the grass. In most conditions and given adequate rainfall, supplemental N to grass stands will increase yield and protein content. In addition, the dense sod formed by grass root systems substantially limits N losses below the root zone.

For both 3-4 and 4-5 cut systems, apply 75-100 lbs of fertilizer N per acre at green-up, followed by 50-75 lbs of N/acre after first cutting, and 50 lbs N/acre after subsequent cuttings with a maximum of 275 lbs N/acre for 4-5 cut systems. For grass that is not managed intensively (1-2 cut system) this recommendation is reduced to 75 lbs N/acre per year.

Establishment of a grass sod (GIE, GRE):	NetN = 50 lbs N/acre	
Topdressing of an intensively managed grass (GIT):	NetN = 225-275 lbs N/acre	
Topdressing of grass in a 1-2 cut system (GRT):	NetN = 75 lbs N/acre	[6]

Research suggests that the N applied at green up and after first cutting has greater impact on yield and protein content than equal allocations after each cutting, so producers can choose to shift the N allocation per cutting, using 275 lbs N/acre from manure and/or fertilizer as an annual upper limit. For example, an application of 125, 100 and 50 lbs N/acre could be made at green-up, after first, and after second cutting, respectively.

At first green-up in early spring, while manure can be the N source, fields are often too wet to handle traffic from heavy manure tankers and grass may be more responsive to the readily available N in urea or urea ammonium nitrate fertilizer. When sulfur (S) is needed as well, ammonium sulfate can be considered. If manure is used after first cutting or later cuttings, the standard manure N credit charts (Section 3.3) should be employed. For manure use, there are three items of caution: (1) odors resulting from surface application of stored manure can impact neighbors and may limit application opportunities; manure injection equipment can greatly reduce odor issues without harming the stand; (2) some farmers have reported crop damage after use of high rates of manure; and (3) over time, multiple applications of manure in the same crop year will cause soil P accumulation and may eventually restrict future manure spreading because of New York Phosphorus Index guidelines (Czymmek et al., 2021).

4.5 Wheat, wheat with legume, winter barley, winter barley with legume

Application of the right amount of N to wheat (WHT), wheat seeded with legume (WHS), winter barley (BWI), and winter barley seeded with legume (BWS) is critical as both N deficiency and excess will impact yield and quality. Inadequate N can limit tillering and shoot growth. Excess N can result in lodging, which can cause yield and harvest losses. Recommended N application rates vary depending on soil type, crop rotation and/or manure application history.

For grain production 60-80 lbs N/acre is recommended but if a sod crop was grown in the rotation less than 1 year ago, this guideline is reduced to 20 lbs/acre independent of soil type. If it was two years or more ago that a sod was terminated, it is recommended to apply 50-70 lbs N/acre (Table 7). Unlike corn, the guidelines here do not consider the % legume or soil N contribution. Soil management group (SMG) is determined by clay content, rooting depth, and soil structure (Appendix Table 1). Clayey soils tend to fall in group 1, while sandy soils tend to be in group 5. Most of the silt loam soils in central New York are in group 2 while the silt loam soils of the southern tier of the state are in group 3. Soils in group 6 are muck soils.

Table 7: Nitrogen guidelines for wheat, wheat seeded with legume, winter barley, and winter barley with legume following sods.

Soil management group	Sod terminated <1 year ago	Sod terminated 1-2 year ago	Sod terminated >2 years ago
	lbs N/acre	lbs N/acre	lbs N/acre
1-4	20	50	60
5	20	60	70
6	20	70	80

These crops should receive 10-20 lbs N/acre of the recommended amount of N as a banded application at planting. The remainder should be topdressed in April when the crop is in the tillering stage prior to rapid stem elongation. Avoid applying N to wet or frozen soil as it will not be effectively utilized by the plant. If lodging is a common problem, reduce topdress N rates by 20-40 lbs N/acre; if lodging occurs only sometimes, reducing the N rate by 10-20 lbs N/acre may correct the problem without causing yield decline. Studies conducted in New York have indicated that for straw production, only 20 lbs N/acre are needed.

Growers interested in intensive management of wheat for grain production should consider a split-application of N. Apply the first application in early April to promote tillering with a second application in late April or early May, just before rapid growth to insure N availability during the period of maximum uptake. Limit the total application to no more than 10 lbs N/acre above what is listed in Table 7 to reduce the risk of lodging. The N fertilizers popularly used for winter cereals are urea and ammonium sulfate. Urease inhibitors can be used to reduce the risk of volatilization loss commonly associated with topdressing of these fertilizers.

4.6 OATS, OATS WITH LEGUME, BARLEY-SPRING, BARLEY-SPRING WITH LEGUME, RYE SEED PRODUCTION

The N guidelines for oats (OAT), oats with legume (OAS), barley-spring (BSP), barley-spring with legume (BSS) and rye seed production (RYS) depend on the number of years since sod was grown on the field and the SMG (Table 8). Unlike corn, the guidelines for these crops do not consider the percent legume or soil N contributions.

Table 8: Nitrogen guidelines for oats, oats with legume, barley-spring, barley-spring with legume and rye seed production following sods. SMG = soil management group (Appendix Table 1, 2).

Soil management group	Sod terminated <1 year ago	Sod terminated 1-2 year ago	Sod terminated >2 years ago
	lbs N/acre	lbs N/acre	lbs N/acre
1-4	20	50	60
5	20	60	70
6	20	70	80

4.7 Winter Wheat, Cereal Rye, and Triticale Grown for Forage in a Double Crop Rotation

The results of on-farm N rate trials conducted throughout New York between 2013 and 2016 showed that the optimum N rate for spring applied N (at green-up or dormancy break) for winter cereals being harvested as forage ranged from 0 to 120 lbs N/acre, averaging about 70 lbs N/acre. Soil drainage condition (adequately drained either naturally or artificially), presence or absence of recent manure applications, and planting date (before or after 1 October) were most useful for predicting if a location was N limited (Figure 3).

For sites with drainage challenges and either no recent (within the past two years) manure additions or with a recent manure addition but planted after 1 October, 60-90 lbs N/acre at spring dormancy break is recommended. Based on field research in New York, no additional N may be needed for higher yielding, better drained fields, and fields that received manure and were planted before October 1 (Figure 3). If yields are limited by factors other than N supply (e.g. soil health challenges such as compaction), addition of N will not increase yield.

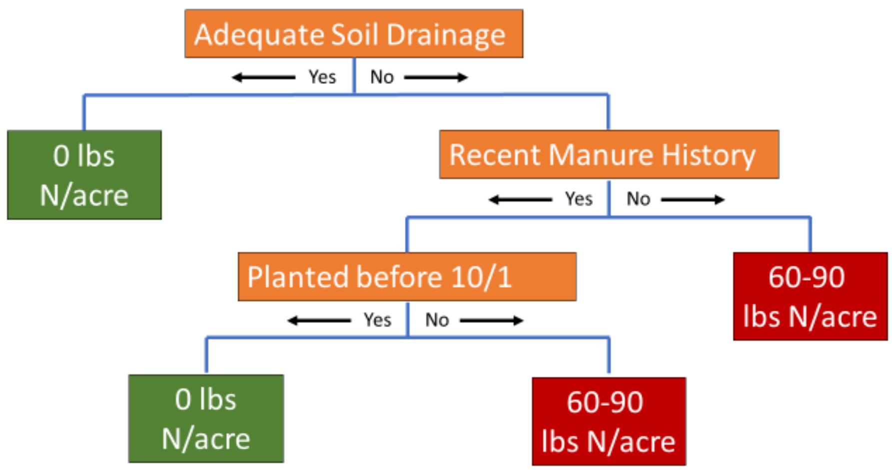

Figure 3: Decision tree analyses for predicting N needs of winter cereals at green-up derived from N rate studies conducted between 2013 and 2016 in New York.

Nitrogen management did not greatly impact forage fiber and digestibility. Crude protein (CP) may increase with N addition beyond the rate that optimizes yield. Spring-applied manure can be used to supply half of the N needed in the spring for winter cereals grown for forage (and all the P and K), but commercial N fertilizer may be preferred as weather may impact the feasibility of manure application at green-up and N release from manure in the colder months.

4.8 Sunflowers

The N need of sunflowers is estimated as 66% of the grain corn N needs for a specific soil type, drainage, and rotation. The N requirement increases by 20 lbs/acre for a no-till crop production system. The minimum amount of N recommended is 20 lbs N/acre.

$$NetN = [(YI\_corngrain*A - SoilN - SodN)/(N\_eff/100)] * 0.66 - SoyN - CCN \quad [7]$$

Where:

NetN is amount of N (lbs N/acre) from any source required for optimum crop production
YI is the soil and drainage specific yield index (Appendix Table 2)
A is a YI multiplier (Table 6)
SoilN and SodN are N (lbs N/acre) from soil organic matter and sods (sections 3.1, 3.2)
N_eff is the soil type and drainage dependent uptake efficiency (Appendix Table 2)
SoyN and CCN are soybean and cover crop N credits in lbs N/acre (section 3.2)

4.9 CHRISTMAS TREES

The N guidelines for Christmas trees (TRE and TRT) increases with each year of growth from establishment to 5-year stands (Table 8).

Table 8: Nitrogen guidelines for Christmas trees (TRE and TRT).

Crop code	Years since planting	N guideline (lbs N/acre)
TRE	Establishment year	0
TRT	1	30
TRT	2	40
TRT	3	50
TRT	4+	60

4.10 OTHER FIELD CROPS

Nitrogen guidelines for other crops not described in 4.1-4.9 are constant values (Table 9).

Table 9: Nitrogen guidelines for selected field crops.

Crop name	Crop code	N guideline (lbs N/acre)
Buckwheat	BUK	20
Idle land	IDL	0
Pasture with improved grasses, establishment phase	PGE	50
Pasture with improved grasses, established (top-dress)	PGT	75
Pasture-rotational grazing, establishment phase	PIE	50
Pasture-rotational grazing, established (top-dress)	PIT	150
Pasture with legumes, establishment phase	PLE	40
Pasture with legumes, established (top-dress)	PLT	40
Pasture with native grasses, established (top-dress)	PNT	75
Soybeans	SOY	0
Triticale/peas	TRP	80
Teff	TEF	50
Waterways, pond dikes, establishment phase	WPE	50
Waterways, pond dikes, established (top-dress)	WPT	70

Soybeans do not require supplemental N fertilizer because they can fix N through a symbiotic relationship with *Bradyrhizobium* bacteria. Thus, the N requirement of soybeans in the table above is 0 lbs N/acre. As a result, soybean fields are not the best choice for maximizing the value of manure nutrients either if there are other crops like corn or grass hay fields that can benefit from the N. However, manure addition does have benefits beyond N supply and there are legitimate reasons to apply manure to fields that will be rotated to soybeans. For example, manure supplies nutrients other than N and where low soil test levels suggest a potential response to phosphorus (P), potassium (K), sulfur (S), or micronutrients, manure is a reasonable choice to supply these nutrients. Furthermore, because harvest of soybeans will remove nutrients, manure can reduce the need for fertilizer purchases. Nitrogen fixation is reduced but not eliminated when manure is applied to legume fields. In addition, a significant portion of the N taken up by soybean plants comes from nitrate supplied by mineralization of organic N sources in the soil. As a result, not all the N applied with manure (or fertilizer) will be taken up by the plants. Research has shown that N losses from manure or fertilizer through leaching or denitrification could increase substantially if the additional N applied with fertilizer or manure exceeds 50% of the total N removed by the soybean harvest. If manure is used, it is recommended to inject or incorporate the manure shortly after application to reduce the risk of manure runoff and N volatilization. Rates should be adjusted based on the application method as described in section 3.3.

5. Nitrogen Fertilizers

Table 10 lists common fertilizers and their N, P_2O_5, K_2O, sulfur (S), calcium (Ca), and magnesium (Mg) content, salt hazard, acid-forming tendency, and additional notes.

Table 10: N, P_2O_5, K_2O, S, Ca, and Mg contents as well as the salt hazard and acid forming tendency of commonly used N containing fertilizers (adapted from Weil and Brady, 2017; Cornell Field Crops and Soils Handbook, 1987).

	N	P_2O_5	K_2O	S	Ca	Mg	Salt hazard	CCE*	Additional notes
Ammonium nitrate ($NH_4 NO_3$)	33-34	0	0	0	0	0	high	-59	Dry material. Can be left on surface or incorporated into soil. Absorbs moisture from the air. It can be blended but not with urea. High risk of fire or explosions if mixed with oxidizable forms of C (e.g., fuel oil).
Ammonium sulfate ($[NH_4]_2S0_4$)	20-21	0	0	24	0	0	high	-110	Dry material. Used for direct application and blended fertilizers. Can be left on surface or incorporated into soil. Rapidly lowers the soil pH.
Urea - ammonium nitrate (UAN)	28-32	0	0	0	0	0	medium	-52	Liquid fertilizer. About 50% is in urea N form. Once applied, UAN behaves as dry urea and NH_4NO_3. To minimize N loss, incorporate into soil. May cause leaf burn. UAN weighs 11-12 lbs per gallon.
Potassium nitrate (KNO_3)	13	0	36	0.2	0.4	0.3	very high	+26	Dry crystalline material. A specialty fertilizer used for direct application or as blended fertilizer.

* Acid forming tendency expressed as kg $CaCO_3$/100 kg of fertilizer. A positive number indicates an increase in pH upon application. A negative number implies a fertilizer induced decrease in pH.

Table 10 (continued): N, P_2O_5, K_2O, S, Ca, and Mg contents as well as the salt hazard and acid forming tendency of commonly used N containing fertilizers (adapted from Weil and Brady, 2017; Cornell Field Crops and Soils Handbook, 1987).

Anhydrous ammonia (NH3)	82	0	0	0	0	0	low	-148	A high-pressure liquid. It turns into a gas when released. The gas is toxic. Needs pressurized equipment. Must be injected 6-8 inches deep on friable, moist soil to avoid N losses. Weighs about 5 lbs per gallon. Rapidly lowers the soil pH.
Urea (NH_2-CO-NH_2)	45-46	0	0	0	0	0	medium	-84	Dry material. Should be incorporated. Urea-N rapidly hydrolyzes to NH_4^+. Use for direct application, in mixed fertilizers, and liquid N. Not recommended as starter.
Sulfur coated urea	30-40	0	0	13-16	0	0	low	-110	Dry material. Variable slow rate of release. Rapidly lowers soil pH.
Mono-ammonium phosphate (MAP) ($NH_4H_2PO_4$)	11-13	48-52	0	1-2			low	-65	Dry material. Used for direct application and in mixed fertilizers. Excellent starter fertilizer, either alone or with a small amount of potash although the N:P ratio may be too low for high P soils.
Di-ammonium phosphate (DAP) ($[NH_4]_2HP0_4$)	18-21	46-53	0	0-1			medium	-70	A dry material. Used for direct application and in blended fertilizers. Produces free ammonia and is hence not a good starter fertilizer.

* Acid forming tendency expressed as kg $CaCO_3$/100 kg of fertilizer. A positive number indicates an increase in pH upon application. A negative number implies a fertilizer induced decrease in pH.

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Appendix

APPENDIX TABLE 1: SOIL MANAGEMENT GROUPS (SMG) FOR NEW YORK

SMG	General description
1	Fine-textured soils developed from clayey lake sediments and medium- to fine-textured soils developed from lake sediments.
2	Medium- to fine-textured soils developed from calcareous glacial till and medium-textured to moderately fine-textured soils developed from slightly calcareous glacial till mixed with shale and medium-textured soils developed in recent alluvium.
3	Moderately coarse textured soil developed from glacial outwash and recent alluvium and medium-textured acid soil developed on glacial till
4	Coarse- to medium-textured soils formed from glacial till or glacial outwash
5	Coarse- to very coarse-textured soils formed from gravelly or sandy glacial outwash or glacial lake beach ridges or deltas
6	Organic or muck lands

APPENDIX TABLE 2: SOILS DATABASE

Soil management group (SMG), drainage class (D; V = very poorly drained; P = poorly drained; S = somewhat poorly drained; M = moderately drained; W = well drained), inorganic nitrogen (N) uptake efficiencies (N_eff in %), soil N supply (N_sup, in lbs N/acre) and corn yield indices for corn grain (YI_corngrain), and corn silage (YI_cornsilage) for undrained (UD) and artificially drained (DR) fields. Artificially drained refers to fields with subsurface (tile) drainage.

Name	SMG	D	N_eff		N_sup		YI_corngrain		YI_cornsilage	
			DR	UD	DR	UD	DR	UD	DR	UD
Acton	4	M	70	65	65	65	165	160	18.0	17.5
Adams	5	W	70	70	40	40	140	140	15.0	15.0
Adirondack	4	W	75	75	70	70	110	110	12.0	12.0
Adjidaumo	1	P	60	55	75	65	155	125	16.5	13.5
Adrian	6	V	65	55	120	90	165	105	18.0	11.5
Agawam	4	W	75	75	65	65	165	165	18.5	18.5
Albia	3	S	65	60	70	60	165	145	18.0	16.0
Albrights	2	M	70	70	75	75	165	155	18.0	17.0
Alden	3	V	60	50	80	65	135	110	14.5	12.0
Allagash	5	W	75	75	65	65	155	155	16.5	16.5
Allard	3	W	75	75	70	70	165	165	18.5	18.5
Allendale	3	P	60	55	70	60	150	130	16.0	14.0
Allis	3	P	65	60	75	65	150	130	16.0	14.0
Alluvial land	3	S	65	60	75	70	150	125	16.0	13.5
Almond	3	S	65	60	75	65	140	135	15.0	14.5
Alps	3	M	70	70	75	75	165	160	18.0	17.5
Altmar	5	M	70	65	60	50	165	150	18.0	16.5
Alton	5	W	75	75	65	65	165	165	18.0	18.0
Amboy	4	W	75	75	60	60	165	165	18.5	18.5
Amenia	4	M	70	70	65	65	165	160	18.5	18.0
Angola	2	S	65	60	80	70	165	150	17.5	16.0
Appleton	2	S	65	60	75	65	165	145	18.0	16.0
Arkport	4	W	75	75	50	50	165	165	18.0	18.0
Armagh	2	P	60	55	80	70	150	130	16.0	14.0
Arnot	3	W	70	70	70	70	150	140	16.0	15.0

Name	SMG	D	N_eff		N_sup		YI_corngrain		YI_cornsilage	
			DR	UD	DR	UD	DR	UD	DR	UD
Ashville	3	V	55	50	75	65	140	120	15.0	13.0
Atherton	3	P	60	55	75	55	155	140	16.5	15.0
Atkins	3	V	60	50	75	65	155	120	16.5	13.0
Atsion	5	P	65	60	70	60	140	115	15.0	12.5
Au gres	5	S	65	55	65	60	150	140	16.0	15.0
Aurelie	3	P	60	55	80	70	140	120	15.0	13.0
Aurora	2	M	70	70	70	70	165	160	18.0	17.5
Barbour	3	W	75	75	75	75	165	165	18.5	18.5
Barcelona	3	S	65	60	75	65	165	140	18.0	15.5
Barre	1	P	65	55	80	70	155	130	16.5	14.0
Bash	3	S	65	60	75	65	165	140	18.5	15.5
Basher	3	M	70	70	70	70	165	165	18.5	18.5
Bath	3	W	75	75	75	75	165	165	18.0	18.0
Becket	4	W	75	75	60	60	150	150	16.0	16.0
Becraft	3	M	70	70	75	75	175	175	20.0	20.0
Belgrade	3	M	70	70	80	80	170	165	19.0	18.5
Benson	4	E	70	70	65	65	120	120	13.0	13.0
Berkshire	5	W	75	75	65	65	165	165	18.0	18.0
Bernardston	4	W	75	75	65	65	165	165	18.5	18.5
Berrien	5	M	70	70	55	55	165	165	18.0	18.0
Berryland	5	V	60	50	75	70	135	105	14.5	11.5
Beseman	6	V	65	50	130	90	165	95	18.5	10.5
Bice	5	W	75	75	65	65	165	165	18.5	18.5
Biddeford	2	V	60	50	75	70	140	110	15.0	12.0
Birdsall	3	V	55	50	75	70	135	115	14.5	12.5
Blasdell	3	W	75	75	70	70	165	165	18.0	18.0
Bombay	4	M	70	70	65	65	165	165	18.5	18.5
Bonaparte	4	E	70	70	50	50	150	150	16.0	16.0
Bono	1	V	60	50	80	70	150	110	16.0	11.5
Boots	6	V	65	55	130	90	165	95	18.5	10.5

Name	SMG	D	N_eff		N_sup		YI_corngrain		YI_cornsilage	
			DR	UD	DR	UD	DR	UD	DR	UD
Borosaprists	6	V	65	55	140	90	175	85	20.0	9.5
Boynton	3	P	65	55	75	70	150	130	16.0	14.0
Braceville	4	M	70	70	75	75	165	160	18.0	17.5
Brayton	4	S	65	60	70	70	155	140	16.5	15.0
Bridgehampton	3	W	70	70	70	70	175	175	20.0	20.0
Bridport	2	S	65	60	75	65	165	150	18.0	16.5
Briggs	4	W	75	75	60	60	150	150	16.0	16.0
Brinkerton	2	P	65	55	80	70	150	130	16.0	14.0
Broadalbin	4	M	75	75	65	65	165	165	18.5	18.5
Brockport	1	S	65	60	80	70	165	140	18.0	15.5
Brookfield	3	W	75	75	75	75	165	165	18.5	18.5
Buckland	3	W	70	70	70	70	135	135	14.5	14.5
Bucksport	6	V	65	55	140	90	175	85	20.0	9.5
Budd	4	W	75	75	40	40	155	155	16.5	16.5
Burdett	2	S	65	60	80	70	165	145	18.0	16.0
Burnham	3	P	65	60	80	70	140	115	15.0	12.5
Busti	3	S	65	60	70	60	165	145	18.0	16.0
Buxton	2	M	70	70	70	70	165	165	18.0	18.0
Cambria	2	P	60	55	75	65	155	130	16.5	14.0
Cambridge	3	M	70	70	70	70	165	160	18.0	17.5
Camillus	3	W	70	70	75	75	165	160	18.0	17.5
Camroden	3	S	65	60	75	70	165	155	17.5	16.5
Canaan	4	E	70	70	65	65	110	110	12.0	12.0
Canaan rock outcrop	4	E	70	70	65	65	110	110	12.0	12.0
Canadice	2	P	65	55	70	60	165	135	17.5	14.5
Canandaigua	3	P	65	55	80	70	165	145	17.5	15.5
Canaseraga	3	M	70	70	80	80	165	165	18.0	18.0
Canastota	2	M	70	70	75	75	165	160	18.0	17.5
Caneadea	2	S	65	60	75	65	165	150	18.0	16.5
Canfield	3	M	70	70	75	75	165	160	18.0	17.5

Name	SMG	D	N_eff		N_sup		YI_corngrain		YI_cornsilage	
			DR	UD	DR	UD	DR	UD	DR	UD
Canton	4	W	75	75	60	60	165	165	18.5	18.5
Carbondale	6	V	65	55	130	90	165	95	18.5	10.5
Carlisle	6	V	65	55	130	90	165	95	18.5	10.5
Carrollton	3	W	75	75	75	75	155	155	16.5	16.5
Carver	5	E	70	70	40	40	110	110	12.0	12.0
Carver-Plymouth	5	E	70	70	40	40	110	110	12.0	12.0
Castile	4	W	75	75	75	75	165	165	18.5	18.5
Cathro	6	V	65	55	140	90	175	85	20.0	9.5
Cathro-Greenwood	6	V	65	55	140	90	175	85	20.0	9.5
Cattaraugus	3	W	75	75	75	75	165	165	18.0	18.0
Cavode	2	S	65	60	75	70	165	150	18.0	16.5
Cayuga	2	W	70	70	75	75	165	165	18.5	18.5
Cazenovia	2	M	75	70	75	75	165	165	18.5	18.5
Ceresco	3	M	70	70	75	75	170	170	19.0	19.0
Chadakoin	3	W	75	75	75	75	165	165	18.5	18.5
Chagrin	3	W	75	75	75	75	165	165	18.5	18.5
Champlain	5	E	70	70	50	50	110	110	12.0	12.0
Charles	3	P	60	55	80	70	135	120	14.5	13.0
Charlton	4	W	75	75	65	65	165	165	18.5	18.5
Chatfield (E)	4	E	70	70	50	50	150	150	16.0	16.0
Chatfield (WE)	4	W	70	70	65	65	150	150	16.0	16.0
Chaumont	1	S	65	55	75	65	150	130	16.0	14.0
Chautauqua	3	M	70	70	75	75	165	165	18.0	18.0
Cheektowaga	5	P	65	55	75	55	155	130	16.5	14.0
Chenango	3	W	70	70	70	70	165	165	18.5	18.5
Cheshire	4	W	75	75	75	75	165	165	18.0	18.0
Chippeny	6	V	65	55	130	90	165	95	18.5	10.5
Chippewa	3	P	65	55	75	70	150	130	16.0	14.0
Churchville	2	S	65	60	80	70	165	150	18.0	16.5
Cicero	2	S	65	60	75	70	165	150	18.0	16.5

Name	SMG	D	N_eff		N_sup		YI_corngrain		YI_cornsilage	
			DR	UD	DR	UD	DR	UD	DR	UD
Clarkson	2	M	70	70	75	75	165	160	18.5	18.0
Claverack	4	M	70	70	70	70	165	165	18.0	18.0
Clymer	4	W	75	75	70	70	165	155	18.0	17.0
Cohoctah	4	P	65	55	80	70	150	130	16.0	14.0
Collamer	3	M	70	70	75	75	165	165	18.5	18.5
Colonie	5	W	70	70	50	50	155	155	16.5	16.5
Colosse	4	E	70	70	50	50	105	105	11.0	11.0
Colrain	4	W	75	75	65	65	165	165	18.5	18.5
Colton	5	E	70	70	50	50	125	125	13.5	13.5
Colwood	3	P	65	55	80	70	165	145	17.5	15.5
Conesus	2	M	70	70	75	75	165	160	18.5	18.0
Conotton	3	W	75	75	70	70	165	165	18.0	18.0
Constable	5	W	70	70	50	50	110	110	12.0	12.0
Cook	5	V	60	50	80	70	135	115	14.5	12.5
Copake	4	W	75	75	65	65	165	165	18.5	18.5
Cornish	3	S	65	60	75	65	165	150	17.5	16.0
Cosad	4	S	70	60	70	60	165	150	18.0	16.5
Cossayuna	4	W	75	75	65	65	165	165	18.5	18.5
Covert	4	M	70	70	60	60	165	160	18.0	17.5
Coveytown	4	S	70	65	75	65	165	145	17.5	15.5
Covington	1	P	60	55	75	70	140	120	15.0	13.0
Crary	4	M	70	65	70	60	165	155	18.0	17.0
Croghan	5	M	70	70	50	50	150	150	16.0	16.0
Culvers	3	M	70	70	75	75	165	155	18.0	17.0
Dalbo	3	M	70	70	75	75	165	145	18.0	16.0
Dalton	3	S	65	60	75	70	155	145	16.5	15.5
Danley	2	M	70	70	75	75	165	160	18.0	17.5
Dannemora	4	P	65	55	75	65	135	120	14.5	13.0
Darien	2	S	65	60	75	70	165	150	18.0	16.5
Dawson	6	V	65	55	140	90	175	85	20.0	9.5

Name	SMG	D	N_eff		N_sup		YI_corngrain		YI_cornsilage	
			DR	UD	DR	UD	DR	UD	DR	UD
Deerfield	5	M	70	70	65	60	165	160	17.5	17.0
Deford	4	P	60	55	75	65	150	125	16.0	13.5
Dekalb	4	W	75	75	70	70	150	150	16.0	16.0
Depeyster	3	M	70	70	75	75	165	165	18.5	18.5
Deposit	3	M	70	70	75	75	165	160	18.5	18.0
Derb	3	S	65	60	75	70	165	145	18.0	16.0
Dixmont	5	M	70	70	65	65	165	160	18.0	17.5
Dorval	6	V	65	55	140	90	175	85	20.0	9.5
Dover	4	W	75	75	70	70	165	165	18.0	18.0
Duane	4	M	70	70	60	60	140	140	15.0	15.0
Dunkirk	3	W	75	75	75	75	165	165	18.5	18.5
Dutchess	4	W	75	75	65	65	165	165	18.5	18.5
Duxbury	4	W	75	75	65	65	140	140	15.0	15.0
Edwards	6	V	65	55	130	90	165	95	18.5	10.5
Eel	2	M	70	65	75	75	165	165	18.5	18.5
Eelweir	4	M	70	70	50	50	165	160	18.5	18.0
Elka	4	W	75	75	70	70	165	165	18.0	18.0
Ellery	3	P	65	55	75	70	150	130	16.0	14.0
Elmridge	5	M	70	70	60	60	165	165	18.5	18.5
Elmwood	4	M	70	70	60	60	165	165	18.5	18.5
Elnora	5	M	70	70	50	50	165	165	17.5	17.5
Empeyville	4	M	70	70	60	60	155	150	16.5	16.0
Enfield	3	W	75	75	75	75	175	175	20.0	20.0
Ensley	3	P	60	55	75	65	140	120	15.0	13.0
Erie	3	S	65	60	75	65	165	145	18.0	16.0
Ernest	3	W	75	75	75	75	110	110	12.0	12.0
Essex	5	W	75	75	70	70	140	140	15.0	15.0
Fahey	5	M	70	70	65	55	150	150	16.0	16.0
Farmington	3	W	75	75	65	65	135	135	14.5	14.5
Farnham	4	M	70	70	70	70	165	160	18.0	17.5

Name	SMG	D	N_eff		N_sup		YI_corngrain		YI_cornsilage	
			DR	UD	DR	UD	DR	UD	DR	UD
Fernlake	4	E	70	70	60	60	110	110	12.0	12.0
Flackville	4	M	70	70	70	70	165	165	18.0	18.0
Fonda	2	V	60	50	80	70	150	120	16.0	13.0
Franklinville	4	W	75	75	75	75	165	165	18.0	18.0
Fredon	4	S	65	55	75	70	165	140	18.0	15.5
Freetown	6	V	65	50	130	90	165	95	18.5	10.5
Fremont	2	S	65	60	75	65	165	155	17.5	16.5
Frenchtown	3	P	60	55	75	65	155	120	16.5	13.0
Frewsburg	3	S	65	60	75	65	140	125	15.0	13.5
Fryeburg	3	W	75	75	70	70	140	140	15.0	15.0
Fulton	1	P	60	55	75	65	155	125	16.5	13.5
Gage	3	P	60	55	75	65	140	135	15.0	14.5
Galen	4	M	70	70	60	60	165	165	18.5	18.5
Galestown	5	E	70	70	40	40	135	135	14.5	14.5
Galoo	4	W	70	70	50	50	110	110	12.0	12.0
Galoo rock outcrop	4	W	70	70	50	50	110	110	12.0	12.0
Galway	4	W	75	75	70	70	165	165	18.5	18.5
Genesee	2	W	75	75	80	80	180	180	20.5	20.5
Georgia	4	M	70	70	75	75	165	160	18.5	18.0
Getzville	3	P	60	55	75	65	135	120	14.5	13.0
Gilpen	3	W	75	75	75	75	165	165	18.0	18.0
Gilpin	3	W	75	75	70	70	165	165	17.5	17.5
Glebe	4	W	70	70	70	70	110	110	12.0	12.0
Glebe-Saddleback	4	W	70	70	70	70	110	110	12.0	12.0
Glendora	4	W	75	75	70	70	110	110	12.0	12.0
Glenfield	3	V	60	50	75	65	165	145	17.5	15.5
Gloucester	4	E	70	70	50	50	165	165	18.0	18.0
Glover	4	E	70	70	60	60	135	135	14.5	14.5
Gougeville	5	V	60	50	75	65	150	125	16.0	13.5
Granby	5	P	60	55	65	60	150	125	16.0	13.5

Name	SMG	D	N_eff		N_sup		YI_corngrain		YI_cornsilage	
			DR	UD	DR	UD	DR	UD	DR	UD
Grattan	5	E	70	70	50	50	155	155	16.5	16.5
Greene	3	S	65	60	75	65	165	145	17.5	15.5
Greenwood	6	V	65	50	140	90	175	85	20.0	9.5
Grenville	4	W	75	75	75	75	165	165	18.5	18.5
Gretor	3	S	65	60	75	65	135	120	14.5	13.0
Groton	4	M	70	70	70	70	165	160	17.5	17.0
Groveton	4	W	70	70	65	65	140	140	15.0	15.0
Guff	1	P	55	50	75	60	135	120	14.5	13.0
Guffin	1	P	60	50	65	60	110	95	12.0	10.5
Gulf	4	P	60	55	75	65	135	120	14.5	13.0
Hadley	3	W	75	75	70	70	165	165	18.5	18.5
Haights	3	W	70	60	60	50	150	145	16.0	15.5
Haights-Gulf	3	P	70	60	60	50	150	145	16.0	15.5
Hailesboro	3	S	65	60	75	65	165	150	18.0	16.5
Halcott	2	W	70	70	75	75	120	115	13.0	12.5
Halsey	4	V	60	50	75	70	150	140	16.0	15.0
Hamlin	2	W	75	75	80	80	180	180	20.5	20.5
Hamplain	2	W	75	75	80	80	175	175	20.0	20.0
Hannawa	4	P	60	55	70	60	150	135	16.0	14.5
Hartland	4	W	75	75	75	75	180	180	20.5	20.5
Haven	4	W	75	75	65	65	175	175	20.0	20.0
Hawksnest	3	W	70	70	75	75	120	115	13.0	12.5
Hempstead	4	W	75	75	65	65	175	175	20.0	20.0
Henrietta	6	V	65	55	130	90	175	85	20.0	9.5
Herkimer	3	M	70	70	75	75	165	165	18.5	18.5
Hermon	4	W	70	70	50	50	155	155	16.5	16.5
Hero	4	M	70	70	70	70	165	160	18.5	18.0
Heuvelton	2	M	70	70	75	75	165	145	18.5	16.5
Hilton	2	M	70	70	75	75	165	160	18.5	18.0
Hinckley	5	E	70	70	50	50	140	140	15.0	15.0

Name	SMG	D	N_eff		N_sup		YI_corngrain		YI_cornsilage	
			DR	UD	DR	UD	DR	UD	DR	UD
Hinesburg	4	W	75	75	60	60	155	155	16.5	16.5
Hogansburg	4	M	70	70	75	75	165	160	18.5	18.0
Hogback	5	M	75	75	50	50	110	110	12.0	12.0
Hogback-ricker	5	M	75	75	50	50	110	110	12.0	12.0
Holderton	3	S	65	60	75	65	165	155	18.0	17.0
Hollis	4	S	65	60	60	50	140	120	15.0	13.0
Holly	2	P	60	55	75	60	140	115	15.0	12.5
Holyoke	3	W	70	70	70	70	110	110	12.0	12.0
Holyoke rock outcrop	3	W	70	70	70	70	110	110	12.0	12.0
Homer	2	S	65	60	75	65	165	145	18.0	16.0
Honeoye	2	W	75	75	75	75	165	165	18.5	18.5
Hoosic	4	W	75	75	60	60	155	155	16.5	16.5
Hornell	2	S	70	65	75	70	155	145	16.5	15.5
Hornellsville	3	S	65	60	75	65	140	130	15.0	14.0
Houghtonville	5	W	75	75	65	65	155	155	16.5	16.5
Houghtonville-Rawson	5	W	75	75	65	65	155	155	16.5	16.5
Houseville	2	S	65	60	75	65	165	145	18.0	16.0
Howard	3	W	75	75	70	70	165	165	18.5	18.5
Hudson	2	M	70	70	80	80	165	165	18.5	18.5
Hulberton	2	S	65	60	80	70	165	145	18.0	16.0
Ilion	2	P	65	60	80	70	155	140	16.5	15.0
Insula	4	W	75	75	65	60	135	135	14.5	14.5
Ipswich	6	V	65	50	99	90	165	95	18.5	10.5
Ira	4	M	70	70	65	65	165	160	18.0	17.5
Ischua	3	M	70	70	75	75	155	150	16.5	16.0
Ivory	2	S	65	60	75	65	150	140	16.0	15.0
Jebavy	5	P	60	55	70	60	140	120	15.0	13.0
Joliet	4	P	65	55	75	65	150	110	16.0	11.5
Junius	5	P	65	55	60	50	150	130	16.0	14.0
Kalurah	4	M	70	70	75	75	165	160	18.5	18.0

Name	SMG	D	N_eff		N_sup		YI_corngrain		YI_cornsilage	
			DR	UD	DR	UD	DR	UD	DR	UD
Kanona	2	S	65	55	70	60	140	122	15.0	13.0
Kars	4	W	70	70	65	65	165	165	18.0	18.0
Kearsarge	3	E	70	70	70	70	135	135	14.5	14.5
Kendaia	2	S	65	60	75	65	165	145	18.0	16.0
Kibbie	3	S	65	60	75	65	165	150	18.0	16.5
Kingsbury	1	S	65	60	75	65	165	150	17.5	16.0
Kinzua	3	W	75	75	75	75	165	165	18.5	18.5
Knickerbocker	5	E	70	70	65	65	155	155	16.5	16.5
Lackawanna	3	W	75	75	75	75	165	165	18.0	18.0
Lagross	3	W	75	75	75	75	165	165	18.0	18.0
Lagross-Haights	3	W	75	75	75	75	165	165	18.0	18.0
Lairdsville	2	M	70	70	75	75	165	165	18.0	18.0
Lakemont	1	P	60	55	75	65	155	130	16.5	14.0
Lakewood	5	E	70	70	40	40	110	110	12.0	12.0
Lamson	4	P	65	55	75	65	165	130	17.5	14.0
Lanesboro	3	W	70	70	75	75	110	110	12.0	12.0
Langford	3	W	70	70	75	75	165	165	18.0	18.0
Lansing	2	W	75	75	75	75	165	165	18.5	18.5
Leck kill	3	W	75	75	75	75	165	165	18.0	18.0
Leicester	4	P	65	55	75	65	155	125	16.5	13.5
Leon	5	P	65	60	70	60	140	115	15.0	12.5
Lewbath	3	W	75	75	75	75	140	140	15.0	15.0
Lewbeach	3	W	75	75	75	75	165	165	18.0	18.0
Leyden	2	M	70	70	75	75	165	160	18.0	17.5
Lima	2	M	70	70	75	75	165	160	18.5	18.0
Limerick	3	P	65	55	75	70	165	130	18.0	14.0
Linden	4	W	75	75	75	75	165	165	18.5	18.5
Linlithgo	3	S	65	65	75	70	165	155	18.0	17.0
Livingston	1	V	55	50	75	65	125	105	13.5	11.5
Lobdell	3	M	70	65	75	75	165	165	18.5	18.5

Name	SMG	D	N_eff		N_sup		YI_corngrain		YI_cornsilage	
			DR	UD	DR	UD	DR	UD	DR	UD
Lockport	2	S	65	60	80	70	165	140	18.0	15.5
Lorain	1	P	60	55	70	60	150	130	16.0	14.0
Lordstown	3	W	75	75	70	70	155	155	16.5	16.5
Lovewell	2	M	70	70	75	75	165	155	18.5	17.5
Lowville	4	W	75	75	75	75	165	165	18.5	18.5
Loxley	6	V	65	50	130	90	165	95	18.5	10.5
Lucas	2	M	70	70	80	80	165	165	18.5	18.5
Ludlow	4	M	70	70	75	75	165	160	18.0	17.5
Lupton	6	V	65	55	140	90	175	85	20.0	9.5
Lyman	4	E	70	70	60	60	110	110	12.0	12.0
Lyman-Becket-Berkshire	4	E	70	70	60	60	110	110	12.0	12.0
Lyme	5	P	65	55	70	60	150	125	16.0	13.5
Lyons	2	P	60	55	75	65	155	130	16.5	14.0
Machias	4	M	70	70	70	70	165	165	18.0	18.0
Macomber	4	W	75	75	75	75	125	125	13.5	13.5
Macomber-Taconic	4	W	75	75	75	75	125	125	13.5	13.5
Madalin	1	P	60	55	75	65	155	125	16.5	13.5
Madawaska	5	M	70	70	60	60	165	165	18.0	18.0
Madrid	4	W	75	75	65	65	165	165	18.5	18.5
Malone	4	S	65	60	75	65	165	145	18.0	16.0
Manahawkin	6	V	65	55	130	90	165	95	18.5	10.5
Mandy	3	W	75	75	75	75	155	155	16.5	16.5
Manheim	2	S	65	60	75	65	165	145	18.0	16.0
Manhoning	2	S	65	60	75	65	165	140	18.0	15.5
Manlius	3	W	70	70	70	70	155	155	16.5	16.5
Mansfield	3	V	60	50	75	65	135	110	14.5	12.0
Maplecrest	2	W	75	75	75	75	165	165	18.5	18.5
Marcy	3	P	60	55	75	65	140	135	15.0	14.5
Mardin	3	M	70	70	75	75	165	160	18.0	17.5
Marilla	3	M	70	70	75	75	165	165	18.0	18.0

Name	SMG	D	N_eff		N_sup		YI_corngrain		YI_cornsilage	
			DR	UD	DR	UD	DR	UD	DR	UD
Markey	6	V	65	55	130	90	175	85	20.0	9.5
Marlow	4	W	75	75	60	60	165	165	18.0	18.0
Martisco	6	V	65	50	120	90	165	105	18.0	11.5
Massena	4	S	65	60	75	65	165	145	18.0	16.0
Matoon	1	S	60	60	75	65	165	145	18.0	16.0
Matunuck	6	V	65	50	130	90	165	95	18.5	10.5
Medihemists	6	V	65	55	130	90	175	85	20.0	9.5
Medina	3	W	75	75	75	75	165	165	18.5	18.5
Medomak	3	V	55	50	75	65	120	100	13.0	11.0
Melrose	4	W	75	75	50	50	165	165	18.0	18.0
Menlo	4	P	60	55	70	60	140	125	15.0	13.5
Mentor	4	W	75	75	60	60	165	165	18.0	18.0
Merrimac	4	W	70	70	75	75	155	155	16.5	16.5
Middlebrook	3	M	70	70	75	75	165	160	17.5	17.0
Middlebrook-Mongaup	3	M	70	70	75	75	165	160	17.5	17.0
Middlebury	3	M	70	65	75	75	165	165	18.5	18.5
Millis	4	W	75	75	60	60	165	165	18.0	18.0
Millsite	4	W	70	70	65	65	150	150	16.0	16.0
Mineola	4	M	70	70	75	75	165	160	18.5	18.0
Miner	1	P	60	55	75	65	155	125	16.5	13.5
Mino	4	S	65	60	60	50	165	140	18.0	15.5
Minoa	4	S	65	60	60	50	165	140	18.0	15.5
Mohawk	2	W	70	70	75	75	165	165	18.5	18.5
Moira	4	M	70	70	70	70	165	155	17.5	16.5
Monadnock	4	W	75	75	60	60	140	140	15.0	15.0
Monarda	4	S	65	60	70	65	165	145	18.0	16.0
Mongaup	3	W	75	75	70	70	155	155	16.5	16.5
Montauk	4	W	70	70	65	65	165	165	18.5	18.5
Mooers	5	M	70	70	60	60	150	145	16.0	15.5
Morocco	4	P	65	55	65	60	165	140	18.0	15.5

Name	SMG	D	N_eff		N_sup		YI_corngrain		YI_cornsilage	
			DR	UD	DR	UD	DR	UD	DR	UD
Morris	3	S	65	60	75	65	155	145	16.5	15.5
Mosherville	4	S	65	60	70	60	165	140	18.0	15.5
Muck	6	V	65	55	130	90	175	85	20.0	9.5
Muck-peat	6	V	65	55	130	90	175	85	20.0	9.5
Mundal	4	W	75	75	60	60	95	95	10.5	10.5
Mundalite	3	W	75	75	70	70	155	155	16.5	16.5
Mundalite-Rawsonville	3	W	75	75	70	70	155	155	16.5	16.5
Munson	2	S	65	60	75	65	165	150	18.0	16.5
Munuscong	4	P	65	55	65	60	140	105	15.0	11.5
Muskego	6	V	65	55	130	90	175	85	20.0	9.5
Muskellunge	3	S	65	60	75	65	165	140	18.0	15.5
Napoleon	6	V	65	55	130	90	175	85	20.0	9.5
Napoli	3	S	65	60	75	65	135	125	14.5	13.5
Nassau	4	E	70	70	50	50	125	125	13.5	13.5
Naumburg	5	S	65	55	65	60	150	140	16.0	15.0
Nehasne	4	W	75	75	70	70	165	165	18.5	18.5
Nellis	4	W	75	75	70	70	165	165	18.5	18.5
Neversink	4	P	60	55	70	60	135	120	14.5	13.0
Newfane	4	W	75	75	50	50	165	165	18.0	18.0
Newstead	4	S	65	55	70	60	165	145	18.0	16.0
Newton	5	V	60	50	60	50	135	125	14.5	13.5
Niagara	3	S	65	60	75	65	165	150	18.0	16.5
Nicholville	4	M	70	70	70	70	165	160	17.5	17.0
Ninigret	4	M	70	70	70	70	165	160	18.5	18.0
Norchip	3	P	60	55	80	70	120	100	13.0	11.0
Norwell	5	S	65	60	70	60	165	145	18.0	16.0
Norwich	3	V	60	55	70	60	135	115	14.5	12.5
Nunda	2	M	70	70	75	75	165	160	18.5	18.0
Oakville	5	W	70	70	50	50	150	140	16.0	15.0
Occum	4	W	75	75	75	75	165	165	18.5	18.5

Name	SMG	D	N_eff		N_sup		YI_corngrain		YI_cornsilage	
			DR	UD	DR	UD	DR	UD	DR	UD
Odessa	2	S	65	60	75	75	165	155	18.0	17.0
Ogdensburg	4	S	65	55	70	60	165	145	18.0	16.0
Olean	2	M	70	70	80	75	165	160	18.5	18.0
Ondawa	4	W	75	75	75	75	165	165	18.5	18.5
Oneida	4	S	65	60	75	65	165	145	18.0	16.0
Onoville	3	M	70	70	75	70	165	155	18.0	17.0
Ontario	2	W	75	75	75	75	165	165	18.5	18.5
Onteora	3	S	65	60	75	65	165	140	18.0	15.5
Ontusia	3	S	65	60	70	60	155	145	16.5	15.5
Oquaga	3	W	70	70	65	65	150	150	16.0	16.0
Oramel	2	S	70	70	75	75	165	165	18.5	18.5
Organic	6	V	65	50	130	90	165	95	18.5	10.5
Orpark	2	S	65	60	75	65	165	155	17.5	16.5
Orwell	2	P	60	55	75	65	150	140	16.0	15.0
Ossipee	6	V	65	55	130	90	175	85	20.0	9.5
Otego	2	M	70	70	75	70	175	165	20.0	19.0
Otisville	4	E	70	70	50	50	140	140	15.0	15.0
Ottawa	5	W	70	70	50	50	165	165	18.0	18.0
Ovid	2	S	70	65	75	70	165	145	18.0	16.0
Palatine	2	W	70	65	70	65	150	150	16.0	16.0
Palms	6	V	65	50	140	90	175	85	20.0	9.5
Palmyra	3	W	75	75	70	70	165	165	18.5	18.5
Panton	1	P	65	55	75	65	155	140	16.5	15.0
Papakating	2	P	60	55	75	60	140	115	15.0	12.5
Parishville	4	M	70	70	70	70	165	155	17.5	16.5
Parsippany	1	P	60	50	75	60	155	130	16.5	14.0
Patchin	3	P	60	55	75	65	125	105	13.5	11.5
Pawcatuck	6	V	65	50	130	90	165	95	18.5	10.5
Pawling	4	M	70	70	75	75	165	165	18.5	18.5
Paxton	4	W	75	75	65	65	165	165	18.0	18.0

Name	SMG	D	N_eff		N_sup		YI_corngrain		YI_cornsilage	
			DR	UD	DR	UD	DR	UD	DR	UD
Peacham	3	P	60	55	80	70	110	95	12.0	10.5
Peat	6	V	65	55	130	90	175	85	20.0	9.5
Peat-muck	6	V	65	55	130	90	175	85	20.0	9.5
Peru	4	M	70	70	60	60	165	160	18.0	17.5
Petoskey	4	W	75	75	50	50	165	165	18.0	18.0
Phelps	3	M	70	70	70	70	165	165	18.5	18.5
Philo	3	M	70	70	75	75	165	165	18.5	18.5
Pillsbury	4	S	65	60	75	65	150	120	16.0	13.0
Pinckney	3	M	70	70	75	75	165	160	18.0	17.5
Pipestone	5	S	65	60	65	55	150	120	16.0	13.0
Pittsfield	4	W	75	75	75	75	165	165	18.5	18.5
Pittstown	4	M	70	65	70	70	165	155	18.5	17.5
Plainbo	5	E	70	70	50	50	120	120	13.0	13.0
Plainfield	5	E	70	70	30	30	135	135	14.5	14.5
Plessis	3	S	65	60	75	65	140	125	15.0	13.5
Plymouth	4	E	70	70	50	50	110	110	12.0	12.0
Podunk	4	M	70	70	75	75	165	165	18.5	18.5
Poland	2	W	75	75	75	75	165	165	18.5	18.5
Pompton	4	M	70	70	50	50	165	165	18.0	18.0
Pootatuck	4	M	70	70	65	65	165	165	18.5	18.5
Pope	4	W	75	75	75	75	165	165	18.5	18.5
Potsdam	4	W	70	70	70	70	165	165	18.0	18.0
Poygan	1	V	60	50	70	60	135	115	14.5	12.5
Punsit	3	S	65	60	75	65	165	150	17.5	16.0
Pyrities	4	W	75	75	75	75	165	165	18.5	18.5
Quetico	4	W	70	70	50	50	95	95	10.5	10.5
Quetico-rock outcrop	4	W	70	70	50	50	95	95	10.5	10.5
Raquette	4	S	70	60	70	60	165	150	18.0	16.5
Rawsonville	5	W	75	75	50	50	110	110	12.0	12.0
Rawsonville-Beseman	5	W	75	75	50	50	110	110	12.0	12.0

Name	SMG	D	N_eff		N_sup		YI_corngrain		YI_cornsilage	
			DR	UD	DR	UD	DR	UD	DR	UD
Rayne	3	W	75	75	75	75	165	165	18.5	18.5
Raynham	3	S	65	55	75	65	165	135	18.0	14.5
Raypol	3	P	60	55	75	60	135	120	14.5	13.0
Red hook	4	S	65	60	75	65	165	145	18.0	16.0
Redwater	3	S	70	65	75	75	165	165	18.5	18.5
Remsen	2	S	65	60	75	65	165	140	18.0	15.5
Retsof	2	S	65	60	75	65	165	145	18.0	16.0
Rexford	4	S	65	50	75	65	165	145	17.5	15.5
Rhinebeck	2	S	65	60	75	65	165	150	18.0	16.5
Ricker	4	E	70	70	60	60	110	110	12.0	12.0
Ricker-Lyman	4	E	70	70	60	60	110	110	12.0	12.0
Ridgebury	4	P	65	55	70	60	165	145	17.5	15.5
Rifle	6	V	65	50	130	90	165	95	18.5	10.5
Riga	2	M	70	70	75	75	165	165	18.0	18.0
Rippowam	4	P	65	55	70	60	155	130	16.5	14.0
Riverhead	4	W	75	75	40	40	155	155	16.5	16.5
Rockaway	2	W	75	75	75	75	165	165	18.0	18.0
Romulus	2	P	60	55	75	60	150	130	16.0	14.0
Ross	2	W	75	75	75	75	180	180	20.5	20.5
Roundabout	3	S	60	60	70	60	165	150	17.5	16.0
Rumney	2	P	65	55	75	65	165	135	18.0	14.5
Runeberg	4	P	55	50	70	60	135	115	14.5	12.5
Ruse	4	P	60	55	65	55	135	120	14.5	13.0
Rushford	3	M	70	70	75	75	165	160	18.0	17.5
Saco	3	V	55	50	75	65	140	110	15.0	12.0
Salamanca	3	M	70	70	75	75	155	150	16.5	16.0
Salmon	4	W	75	75	70	70	165	165	18.0	18.0
Saprists	6	V	65	55	130	90	175	85	20.0	9.5
Saugatuck	5	S	65	60	70	60	140	115	15.0	12.5
Scantic	2	P	60	55	75	65	150	140	16.0	15.0

Name	SMG	D	N_eff		N_sup		YI_corngrain		YI_cornsilage	
			DR	UD	DR	UD	DR	UD	DR	UD
Scarboro	4	P	65	55	70	60	155	125	16.5	13.5
Schoharie	1	M	70	70	75	75	165	165	18.5	18.5
Schroon	5	M	70	70	50	50	165	165	18.5	18.5
Schuyler	3	M	70	70	75	75	165	165	18.0	18.0
Scio	3	M	70	70	75	75	165	160	18.5	18.0
Scituate	4	M	70	70	75	75	165	165	18.0	18.0
Scriba	4	S	65	60	75	65	155	144	16.5	15.5
Searsport	4	P	65	55	70	60	155	125	16.5	13.5
Shaker	2	P	65	60	75	65	165	145	18.0	16.0
Shoreham	2	V	60	50	70	70	140	110	15.0	12.0
Sisk	4	V	60	55	75	65	125	100	13.5	11.0
Skerry	5	M	65	60	75	65	150	145	16.0	15.5
Sloan	3	V	55	50	75	65	135	115	14.5	12.5
Sodus	4	W	75	75	75	75	165	165	18.0	18.0
Somerset	5	P	65	60	75	65	155	140	16.5	15.0
St johns	4	P	65	55	70	60	155	125	16.5	13.5
Staatsburg	3	W	75	75	70	70	135	135	14.5	14.5
Stafford	4	S	65	60	60	50	165	150	17.5	16.0
Steamburg	3	M	70	70	75	75	155	150	16.5	16.0
Stetson	5	W	75	75	70	70	165	165	17.5	17.5
Stissing	4	P	65	60	70	60	165	140	18.0	15.5
Stockbridge	3	W	75	75	75	75	165	165	18.5	18.5
Stockholm	5	P	60	60	70	60	150	140	16.0	15.0
Stowe	4	W	75	75	65	65	165	165	17.5	17.5
Sudbury	4	M	65	60	65	65	165	160	17.5	17.0
Suffield	2	M	70	70	80	80	165	165	18.5	18.5
Summerville	4	E	70	70	50	50	120	120	13.0	13.0
Sun	4	V	60	55	70	60	150	125	16.0	13.5
Sunapee	4	M	70	70	65	65	165	150	17.5	16.0
Suncook	5	E	70	70	40	40	135	135	14.5	14.5

Name	SMG	D	N_eff		N_sup		YI_corngrain		YI_cornsilage	
			DR	UD	DR	UD	DR	UD	DR	UD
Suny	4	P	55	50	70	60	165	125	17.5	13.5
Surplus	4	V	60	55	75	65	135	105	14.5	11.5
Surplus-Sisk	4	V	60	55	75	65	135	105	14.5	11.5
Sutton	4	M	70	70	70	70	165	165	18.5	18.5
Swanton	4	P	65	60	60	50	165	135	18.0	14.5
Swartswood	4	W	75	75	70	70	165	165	18.0	18.0
Swormville	1	S	65	60	75	65	165	140	18.0	15.5
Taconic	3	W	75	75	75	75	135	120	14.5	13.0
Taconic-Macomber	3	W	75	75	75	75	135	120	14.5	13.0
Tawas	6	V	65	50	130	90	165	95	18.5	10.5
Teel	2	M	70	65	75	75	165	165	18.5	18.5
Tioga	3	W	75	75	75	75	165	165	18.5	18.5
Toledo	2	V	60	50	80	70	150	120	16.0	13.0
Tonawanda	2	S	65	60	75	65	165	150	18.0	16.5
Tor	4	S	60	60	75	65	125	100	13.5	11.0
Torull	3	S	65	60	75	65	165	145	17.5	15.5
Towerville	3	M	70	70	75	75	165	165	18.0	18.0
Trestle	3	W	75	75	75	75	170	170	19.0	19.0
Trout river	5	E	70	70	50	50	140	140	15.0	15.0
Troy	3	M	70	70	70	70	165	160	18.0	17.5
Trumbull	1	P	60	55	75	65	155	125	16.5	13.5
Tughill	4	V	55	50	65	55	125	100	13.5	11.0
Tuller	3	S	65	60	75	65	140	125	15.0	13.5
Tunbridge	4	W	75	75	70	70	135	135	14.5	14.5
Tunbridge-Adirondack	4	W	75	75	70	70	135	135	14.5	14.5
Tunkhannock	3	W	75	75	75	75	165	165	18.0	18.0
Turin	2	S	65	60	80	70	165	145	18.0	16.0
Tuscarora	4	M	70	70	50	50	165	165	18.0	18.0
Unadilla	3	W	75	75	75	75	165	165	18.5	18.5
Valois	3	W	75	75	75	75	165	165	18.5	18.5

Name	SMG	D	N_eff		N_sup		YI_corngrain		YI_cornsilage	
			DR	UD	DR	UD	DR	UD	DR	UD
Varick	2	P	60	55	75	75	150	130	16.0	14.0
Varysburg	2	W	70	70	75	75	165	165	18.5	18.5
Venango	3	S	65	60	70	60	165	145	18.0	16.0
Vergennes	1	M	70	70	75	75	165	160	18.0	17.5
Vly	3	W	75	75	75	75	135	135	14.5	14.5
Volusia	3	S	65	60	70	60	155	145	16.5	15.5
Waddington	4	W	75	75	60	60	165	165	18.0	18.0
Wainola	5	S	65	60	70	60	165	125	18.0	13.5
Wakeland	3	S	65	60	75	75	165	140	18.0	15.5
Wakeville	3	S	65	60	75	65	165	150	17.5	16.0
Wallace	5	E	70	70	40	40	150	140	16.0	15.0
Wallington	3	S	65	60	75	65	165	155	18.0	17.0
Wallkill	3	V	60	50	80	65	165	105	18.0	11.5
Walpole	4	P	68	65	60	55	155	130	16.5	14.0
Walton	3	W	75	75	75	75	165	165	18.0	18.0
Wampsville	3	W	75	75	75	75	165	165	18.5	18.5
Wappinger	3	W	75	75	75	75	165	165	18.5	18.5
Wareham	5	P	65	60	75	65	155	140	16.5	15.0
Warners	3	V	60	50	75	70	135	120	14.5	13.0
Wassaic	4	M	70	70	65	65	165	165	18.0	18.0
Watchaug	4	M	70	70	70	70	165	165	18.0	18.0
Waumbeck	4	M	70	70	65	65	155	145	16.5	15.5
Wayland	2	P	60	55	75	60	140	115	15.0	12.5
Weaver	3	M	70	70	75	75	165	155	18.5	17.5
Wegatchie	3	P	65	55	80	70	165	145	17.5	15.5
Wellsboro	3	M	70	70	75	75	165	155	18.0	17.0
Wenonah	4	W	75	75	65	65	165	165	18.5	18.5
Westbury	4	S	65	60	70	60	150	130	16.0	14.0
Westland	2	V	55	50	75	60	165	145	17.5	15.5
Wethersfield	4	W	75	75	75	75	165	165	18.0	18.0

Name	SMG	D	N_eff		N_sup		YI_corngrain		YI_cornsilage	
			DR	UD	DR	UD	DR	UD	DR	UD
Wharton	2	M	70	70	75	75	165	165	18.0	18.0
Whately	4	V	60	50	70	60	155	110	16.5	11.5
Whippany	2	S	65	60	75	65	165	155	18.0	17.0
Whitelaw	4	W	75	75	65	65	165	165	18.5	18.5
Whitman	4	V	60	50	75	60	135	121	14.5	13.0
Wilbraham	4	S	65	60	65	60	165	150	17.5	16.0
Willdin	3	M	70	70	75	75	165	160	18.0	17.5
Willette	6	V	65	50	130	90	165	95	18.5	10.5
Williamson	4	M	70	70	70	70	165	160	18.0	17.5
Willowemoc	3	M	70	70	75	75	165	155	18.0	17.0
Wilmington	4	P	60	55	70	60	165	130	17.5	14.0
Wilpoint	1	M	70	70	80	80	165	160	17.5	17.0
Windsor	5	E	70	70	40	40	135	135	14.5	14.5
Winooski	4	M	70	70	75	75	165	165	18.5	18.5
Wolcottsburg	1	P	60	55	75	65	155	125	16.5	13.5
Wonsqueak	6	V	65	55	130	90	175	85	20.0	9.5
Woodbridge	4	M	70	70	75	75	165	160	18.0	17.5
Woodlawn	4	W	75	75	75	75	120	120	13.0	13.0
Woodstock	4	E	70	70	60	60	110	110	12.0	12.0
Woodstock-rock outcrop	4	E	70	70	60	60	110	110	12.0	12.0
Wooster	3	W	75	75	75	75	165	165	18.0	18.0
Woostern	3	W	75	75	75	75	165	165	18.5	18.5
Woostern-Bath-Valois	3	W	75	75	75	75	165	165	18.5	18.5
Worden	4	S	60	60	75	65	110	95	12.0	10.5
Worth	4	W	75	75	70	70	155	155	16.5	16.5
Wurtsboro	4	M	70	70	70	70	165	160	18.0	17.5
Wyalusing	3	P	60	55	75	65	140	120	15.0	13.0
Yalesville	4	W	75	75	60	60	155	155	16.5	16.5
Yorkshire	3	M	70	70	75	75	165	155	17.5	16.5