What's Cropping Up?

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Concepts for Recommending Fertilizers from Soil Tests

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We are often asked why the same sample analyzed at two different soil testing laboratories have very different fertilizer recommendations. This can be from using different soil test methods or from different concepts for making fertilizer recommendations. The concepts usually make the largest difference in the fertilizer recommendation.

Three concepts commonly used to make fertilizer recommendations from soil test are:

1. Nutrient sufficiency level
2. Nutrient buildup and maintenance
3. Cation saturation ratio

Generally, public laboratories within a geographical region usually use similar concepts modified to fit the crops, soils, and climate of the region. In humid regions where nutrients are easily leached, the nutrient sufficiency level is the most common concept, whereas in areas of little nutrient loss, the nutrient buildup concept is often used. A different concept for fertilizer recommendations can be used for each nutrient.

Nutrient Sufficiency Level

The nutrient sufficiency level concept assigns soil test nutrient ranges of low-medium-high categories that are associated with different probabilities of obtaining a plant response to the applied nutrient. When nutrients are in the low category, there is high probability fertilizing the crop with the nutrient will result in a crop response, i.e., yield increase. Whereas, when the nutrient level is in the high category, there is a small probability that a response will be obtained. Both the soil test levels and the fertilizer recommendations must be established using field calibration experiments. These experiments must be conducted for the major crops and soil within each climatic region. The nutrient sufficiency level concept provides for "fertilizing the crop" rather than the soil to produce optimum economic yield. It is the most conservative of the approaches to making recommendations because it minimizes the quantity of fertilizer added for the economic optimum yield. The sufficiency concept is usually used for mobile nutrients easily lost from the soil, such as nitrogen, even when another concept is used for phosphorus or potassium. It is also used when finances are short or there are possibilities of nutrient loss to the environment.

The nutrient sufficiency level method must be recalibrated as yields, varieties, and technology change. Under fertilization using this concept, the soil test values slowly increase from low to high levels. This method requires frequent soil sampling to determine changes in soil test values and recommendations. The time between sampling depends upon the soil test nutrient levels, the soil type, and the crop. For low soil test values, low CEC soils, or high value crops, samples should be taken yearly.

Nutrient Buildup and Maintenance

The nutrient buildup and maintenance approach is commonly known as "fertilize the soil concept." Large initial nutrients are often recommended additions to bring the soil up to high fertility levels. The buildup period as selected by the grower is commonly 1 to 5 years. The high fertility level is maintained by periodic additions of nutrients to replace crop uptake and nutrient loss. This method has the advantage of not requiring very much knowledge about soils or crop responses and does not need to be recalibrated. It permits farmers to use "extra" money from good years to build the soil and requires minimal inputs in poor years. Disadvantages include being the most expensive especially within the short run and exposing greater quantities of the nutrients to conditions favoring loss by leaching, erosion, volatilization, luxury consumption, and soil tie-up. Likewise, it does not provide for use of the nutrients released by the soil through weathering, organic matter breakdown, and other natural processes.

(See CONCEPTS, page 7)

SOIL MANAGEMENT

Optimum Spring Chisel Tillage Depth for Corn Production

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Mulch-till, a conservation tillage system that uses the chisel or disk as the primary tillage implement, is currently practiced on 23% of the corn acreage in New York. During the 1980s, the chisel replaced the moldboard plow as the primary tillage implement on many New York corn fields because of reduced soil erosion potential and lower fuel and labor (time) requirements. Use of the chisel will probably increase in New York because of the conservation compliance provision in the 1985 Food Security Act. In Otsego County, corn yields were evaluated under spring chisel depths of 5,9, and 13 inches in 1988 and 1989 on Chenango (excessively drained), Honeoye (well-drained), and Mardin (moderately well drained) soils. The objective of the study was to provide information on spring chisel depths to farmers who have adopted or will adopt the disk chisel as the primary tillage implement for corn production.

Results

Excessively hot and dry conditions characterized the 1988 growing season. Soil water measurements, which were taken throughout the growing season, indicated that corn depleted more soil water under the 9 and 13-inch chisel depths compared to the 5-inch chisel depth at the Chenango and Honeoye sites (data not shown). Soil water uptake did not differ among the three chisel depths at the Mardin site. Grain yields correlated closely with soil water uptake patterns in 1988. At the Chenango and Honeoye sites, the 5-inch chisel depth had the lowest yield (Table 1). Grain yields did not differ among chisel depths at the Mardin site in 1988.

Exceptionally wet conditions characterized May and June in 1989. The 5-inch chisel depth had higher residue cover and lower plant populations and grain yields at all sites (Table 1). Apparently, higher residue cover under the 5-inch chisel depth during the wet spring resulted in lower plant populations and grain yields. The 9 and 13-inch chisel depths had the same residue cover, plant populations, and grain yields at all sites.

Conclusion

Consistently lower corn yields under the 5-inch chisel depth across different soil types and growing seasons suggest that the 5-inch chisel depth will often result in lower yields in New York because of less soil water uptake in dry years and lower plant populations in years with wet springs. The 9 inch chisel depth which yielded the same as the 13-inch depth is the recommended spring tillage depth for corn production in New York because of its lower fuel requirement and higher residue cover compared to the 13-inch depth. When the chisel operation is performed in the spring, it is important to wait until the soil is sufficiently dry. This can be evaluated by inserting a spade to the 9-inch depth. The soil is sufficiently dry if it falls apart into 1-3" aggregates when the spade is gently turned. If the soil does not readily break up, more drying is required.

Table 1. Crop residue, plant population, and grain yield of corn under three chisel depths at three sites in 1988 and 1989.

Site	Tillage Depth	Crop Residue 1988	Crop Residue 1989	Plant Populations 1988	Plant Populations 1989	Grain Yield 1988	Grain Yield 1989
	-inch-	-----%-----		-----plants/acre-----		-----bu/acre-----	
Chenango	5	54	68	24475	24550	80	91
	9	51	39	24050	25000	86	97
	13	43	39	23625	26050	82	96
LSD 0.05		7	7	NS	1450	5	3
Honeoye	5	34	69	29650	26750	137	109
	9	30	59	29700	28450	142	114
	13	19	56	29625	28050	144	112
LSD 0.05		9	10	NS	1425	7	4
Mardin	5	43	62	23500	25500	77	82
	9	35	40	24775	27650	79	89
	13	26	39	23850	26550	79	88
LSD 0.05		8	8	950	1325	NS	3

Source: D. M. Henderson, 1990. M. S. thesis. Cornell Univ.

Interseeding Cover Crops in Corn

SOIL MANAGEMENT

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Many growers start thinking about cover crops for corn in late summer, but planning now can expand your options. Rye, a traditional cover crop, is usually seeded after silage harvest to provide cover and contribute organic matter to the soil. Rye is about the only species that will establish reliably in NY after silage harvest. Even rye frequently fails if the seeding is made after October 1. Legume species won't produce much ground cover or biomass even if they're planted by September 15.

But cover crops can be seeded earlier into standing corn. This earlier seeding not only allows corn grain producers to use cover crops, it also greatly increases the selection of species. Species seeded earlier in the growing season must be shade tolerant in order to grow under the corn canopy. Medium red clover, mammoth red clover, hairy vetch, crimson clover, alsike clover, white clover, ryegrass, fescue and rye grain have been successfully seeded in corn at cultivation time in New York. Research has also identified species that don't do well in standing corn: alfalfa, birdsfoot trefoil, oats and sorghum.

Choice of species may depend a great deal on cost (Table 1). Legumes are usually more expensive than grasses. In some cases, a legume cover crop may reduce the fertilizer N required for next year's corn crop. For example, approximately 35-50 lbs/A N may be provided by turning down a good stand of interseeded red clover. Another way to offset the cost of a legume cover is by using it as a hay crop in the succeeding year. Red clover seeded into corn at cultivation time can produce hay the following year equal to a clear-seeded stand (Table 2).

Table I. Seeding rate and approximate cost of cover crops that can be seeded into standing corn.

Cover Crop	Seed Rate lbs/A	Cost $/lb
Legumes		
Medium red clover	10-12	1.35
Mammoth red clover	10-12	.75
Crimson clover	15	1.30
Alsike clover	5-7	.75
White clover	5-7	2.70
Hairy vetch	25	1.25
Grasses		
Perennial ryegrass	18	1.14
Annual ryegrass	18	.50
Tall fescue	15-20	.80
winter rye	2 bu/A	8/bu

Table 2. Yield of red clover hay established as clear seeding or interseeding at Aurora and Mt. Pleasant*

Establishment Method	Hay yield one year after establishment: Aurora	Mt. Pleasant
	T/A	
Clear seeded	4.90	3.19
Interseeded in corn	4.23	3.38

* Research by Thomas Scott and Robert Burt, Cornell University. 1981-1983.

These early seedings should be made when the corn is at least six inches tall; seeding earlier may allow the cover crop to compete with the corn. The seeding should precede or follow a cultivation in order to provide a good seedbed and to maximize soil-seed contact. Cultivation and seeding can be accomplished in one pass by mounting a spinner/spreader on the tractor or cultivator. Success will then depend primarily on moisture. A good rain immediately after seeding usually assures a successful stand. But if there is a long period of hot, dry weather, the cover may not establish.

Interseeding in corn complicates weed control. Many of the herbicides used in corn will also control the cover crop. Band application of herbicide (10-12 inches over the corn row) at planting combined with one or two cultivations controls weeds while minimizing the effect of the herbicide on the cover crop. Another alternative is to choose a herbicide compatible with the cover crop. With this approach, broadcast application can be used, but it may be difficult to find a herbicide that controls weeds but not the cover crop. Consult your extension agent for advice and recommendations.

Summary

Several forage legumes and grasses will establish under a corn canopy and provide good cover after the corn is harvested. Seed costs for these cover crops can be quite variable. Interseeded legumes may contribute nitrogen to the succeeding corn crop, or be used as hay, offsetting the cost of establishment. Seeding can be combined with cultivation which increases the chance of a successful stand. Weed management is more difficult with interseeded cover crops, but band applied herbicide combined with cultivation has been a successful strategy.

PEST MANAGEMENT

Protecting Your Germinating Corn Stands from Seed Corn Maggot and Wireworms

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With the continuing emphasis on maximizing corn yield, the protection of germinating corn stands from seed corn maggot and wireworm losses becomes increasingly important. Current NY research by Bill Cox has shown that final plant populations at harvest should be between 26,000 and 32,000 plants per acre to maximize corn silage yields with current corn hybrids. However, these two insect pests typically reduce corn stands by 3,000-8,000 plants per acre and on occasion reduce corn stands below 15,000 plants per acre.

Seed Corn Maggot Biology

Adult seed corn maggots are medium sized flies, very similar in appearance to the common house fly. Adult flies are present throughout the growing season and locate egg laying sites by alternately flying close to the ground's surface or searching the moist soil cracks on the soil surface. The adult female flies are searching for egg laying sites close to decaying plant material or germinating seed to provide a food source for the newly hatched larvae. Adult flies lay eggs in these moist soil cracks near these potential food sources and typical looking fly larvae (maggots) hatch from the eggs within a few days. After hatching, larvae move through the soil searching for decaying plant matter or germinating seeds to feed on. Large seeded crops like corn or soybeans are very susceptible to seed corn maggot attack resulting in stand losses. Germinating corn seed are often killed or severely injured thereby reducing plant populations within an area of the field or throughout the entire field. Losses typically range from 3,000 to 8,000 plants per acre. Fields in which animal or green manure crops have been used have a greater potential for seed corn maggot attack than fields not using these manures. However, non-manured fields are also "at risk" from seed corn maggot damage.

Wireworm Biology

Wireworm larvae are long, smooth, very hard bodied, yellowish to reddish brown and commonly occur in grass sods feeding on roots of numerous grass plants. This insect becomes an economic problem when these grass sods are plowed up and planted to a large seeded crop like corn. Wireworms are the larvae of the common "click beetles" which are attracted to lights during the warm summer months. Several different species of wireworms can be economic pests with 2-7 year lifecycles (egg to adult). Wireworm populations are difficult to assess and usually occur in low to moderate levels. Stand losses from wireworm feeding typically range from 2,000 to 5,000 plants per acre.

Management of Seed Corn Maggot and Wireworms

Both of these insects are easily and inexpensively controlled with the regular use of insecticide added to the planter box as a seed treatment. **Seed corn is seldom pretreated with insecticide effective for control of these two insects.** Seed corn is treated with insecticide to protect the seed corn from insects while the corn seed is in storage. Any commercial seed treatment containing the insecticides diazinon and lindane are effective for control of these two insects. Examples of two such products are Agrox DL Plus™ and Germate Plus™. Seed treater is typically packaged in small packets which contain the correct amount of material to treat 1 bag of seed corn. For maximum effectiveness, corn seed needs to be evenly coated with the seed treatment. If a plate type or plateless planter is being used, pour 1/2 bag of seed corn into the seed hopper then sprinkle 1/2 of the seed treatment packet on the surface of the seed corn and mix thoroughly with a wood stick. Pour in the remainder of the seed corn into the hopper, sprinkle the remainder of the seed treatment on the surface of the seed and repeat mixing. In air planters, **seed corn and seed treater must be mixed in a bucket before dumping seed into the seed drum.** If seed corn and seed treater are dumped separately into the seed drum, the drum action will not adequately coat the seed with seed treater and protect the seed from seed corn maggot and wireworm injury.

Results Suggest Low Threshold for Velvetleaf in Field Corn

WEED CONTROL

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Weeds compete with crops for soil water, nutrients, sunlight, and perhaps other resources. This competition may reduce crop yields and crop quality. Weed control measures limit weed infestations so crops can be grown profitably. In other words, control measures are geared to manage weed infestations so they are not economically damaging or interfere with normal operations.

The point where the economic return from treatment of a pest population exceeds the cost of treatment is known as the economic threshold level. Integrated pest management involves monitoring fields on a regular basis for pests, including weeds, and then taking action to reduce the pest populations when they reach the threshold level. Unfortunately, economic threshold levels are not known for most weed-crop combinations.

Managing Hard-to-Control Weeds

Threshold levels for hard-to-control weeds like velvetleaf (Abutilon theophrasti Medik.) would be especially useful. Velvetleaf has become a problem on many New York farms and causes significant yield losses in row crops such as corn and soybeans. This summer annual weed has a relatively large seed that is capable of germinating over an extended period of time. As a result, velvetleaf often escapes preplant and preemergence herbicide applications. When this happens, growers must decide whether to implement additional weed control measures to control the escaped velvetleaf plants. To make an informed decision, growers need to know whether the economic return will be greater than the cost of cultivation or the cost of a postemergence herbicide application.

Research Initiated

Efforts to establish an economic threshold level for velvetleaf in field corn in New York were initiated in 1991. The experiment was conducted on a silt loam soil near East Genoa in Cayuga County. The field was plowed, disced, and cultimulched prior to planting corn 'Pioneer 3737' on 30-inch rows on May 17 at 27,700 plants/A. Dual, at the rate of 2 pt/A was applied preemergence to suppress weeds other than velvetleaf. Hand-weeding was used to establish different velvetleaf densities and to eliminate other weeds throughout the growing season.

Velvetleaf densities of 2, 4, 8, and 16 plants/square meter were established in 10 by 30 foot plots. In addition, a weed-free plot in each of the four replicates served as a control. Corn grain and stover yields were determined by hand harvesting 28 feet of the center two rows in each plot on September 27 and October 2, 1991, respectively.

Results Show Impact

Corn grain and silage yields as affected by velvetleaf density are shown in the accompanying table. Grain and silage yields from the hand-weeded controls were 161 bu/A and 21.3 T/A respectively. With only two velvetleaf plants/square meter, grain yields were reduced 25 bu/A and silage yields were reduced 3 T/A. The percent reduction at each velvetleaf density was similar for grain and silage yields with nearly a 50% reduction with 16 velvetleaf plants/square meter. Although several years data would be required to establish an economic threshold level for velvetleaf in corn, these preliminary results suggest that it might be less than two velvetleaf plants/square meter.

Effect of Velvetleaf Density on Corn Grain and Silage Yields

Velvetleaf per m²	Grain Bu/A	% of Control	Silage T/A	% of Control
0	161	--	21.3	--
2	136	85	18.2	85
4	113	70	15.0	71
8	108	67	13.9	65
16	84	52	11.3	53
LSD (0.05)	16		2.1	

DISEASE MANAGEMENT

Guidelines for Wheat Fungicide Decisions

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With wheat prices anticipated at $4 per bushel or higher in 1992, there is increased interest in the use of fungicides to control a complex of foliar diseases, namely powdery mildew, leaf spots, and leaf rust, that can seriously reduce yields in New York. While there is no foolproof formula for deciding whether it is profitable to apply fungicides, the following guidelines (summarized in Table 1), based on research results and observations in New York, should be useful when considering a spray.

1. Does the crop have a reasonable yield potential? Assess the crop in early May (stem elongation stages) for adequate stand (density of approximately 30 strong stems per foot of row for 7-inch rows on good soils) and plant vigor. If the stand is sparse or plants are not vigorous or show widespread virus symptoms, fungicide application should not be considered further.

2. Have foliar diseases been observed prior to flag (last) leaf emergence? Assess upper three leaves for disease symptoms and signs in early to mid-May, prior to flag leaf emergence. If disease (any amount) is observed on approximately 50 percent of main tillers, averaged across the field, a spray should be considered now. This threshold is exceeded in less than 50 percent of location/year situations in New York, so there is a significant risk of making an unnecessary fungicide application. The material of choice for broad-spectrum disease control at this stage is propiconazole (Tilt); tank mixes of triadimefon (Bayleton) plus mancozeb (Dithane or Manzate or Penncozeb) or benomyl (Benlate) plus mancozeb are suitable alternatives. Please note that Tilt cannot be applied legally at stages later than flag leaf emergence and that a crop (including underseeded legume) treated with Tilt cannot be grazed or used as hay, silage, or forage to be fed to livestock.

3. Have foliar diseases been observed during heading or flowering? Assess upper two leaves for foliar diseases in late May to early June; if disease (any amount) is observed on approximately 50 percent of main tillers, a spray should be considered now. A tank mix of Bayleton plus mancozeb has shown the most efficacy but Benlate plus mancozeb is a suitable alternative. Neither mixture can be applied within 26 days of harvest nor can the area be grazed within 26 days after application. Fungicide applications made after mid-June may control some diseases but are unlikely to produce significant yield benefits.

4. Are climatic predictions conducive for further disease development? Powdery mildew development is reduced dramatically once the average daily temperature rises above 70°F; this disease often disappears by June. Severe leaf spot development is favored by extended periods of wet weather; it may be insignificant if dry weather persists in May and June. Listen for regional advisories on the threat

(See GUIDELINES, page 7)

Table 1. Simplified, Scouting-based Criteria for Deciding on Foliar Fungicide Applications to Winter Wheat*

Wheat Stage	When	Scouting Observations		Decision
1. Stem elongation	early May	Adequate stand, vigorous plants	(NO)	Discontinue monitoring
			(YES)	Continue monitoring
2. Prior to flag leaf emergence	mid May	Disease on any of top three leaves of at least 50% of main tillers	(NO)	Don't spray now; Continue monitoring
			(YES)	Spray with Tilt; Continue monitoring
3. Heading to flowering	late May to early June	Disease on either of top two leaves of at least 50% of main tillers; Forecast of wet weather in next week	(NO)	Don't spray
			(YES)	Spray with Bayleton plus mancozeb

*Subjective recommendations based on maximum effficacy and economic return in research plots. Consult Cornell Recommends for Integrated Field Crop Management for information on alternative, registered fungicides.

GUIDELINES, from page 6

from leaf rust; rust inoculum often builds up in areas to the south and west of New York and is deposited here by thunderstorms in June or July. In addition to disease observations, use long-range local weather forecasts in making your spray decision.

5. Have I selected fungicides appropriate for the disease spectrum and have I read the label carefully? Be sure that the materials you spray will be effective against the range of diseases found in your field; e.g., some products effective against powdery mildew are ineffective against leaf spots or vice versa. Table 1 includes only product combinations that provide broad-spectrum disease control. Each product has special instructions and restrictions specified on the label; be sure to read and follow these instructions carefully.

6. Is the spray decision consistent with my perception of risk? A simple formula for evaluating the relative economics of a fungicide spray is: **Relative Profit = (Grain Yield Increase x Grain Price) - (Cost of Fungicide + Application Costs).** If ground spray rigs are used, the yield lost to wheel traffic should also be factored in. Each of these variables influences the relative economics of fungicide application as illustrated in Table 2. At a grain price of $4, producers will need to see approximately a 5 bu/A yield increase to break even on the added costs of fungicide application. Because disease occurrence is erratic over years and locations, fungicide application cannot be expected to result in a 5 bu or greater yield increase every year. In research conducted from 1985-91, a single fungicide spray at flag leaf emergence produced an average yield increase of 5 bu/A, but the response in individual years ranged from 0 to 10 bu/A. Spray decisions should be tied closely to disease scouting information. When considering your economic risk, also be aware that foliar fungicides will not protect potential yield components that may be diminished by scab disease (fungus that infects heads at or following flowering), viral diseases (wheat spindle streak mosaic and yellow dwarf), soilborne diseases, or several other environmental factors.

Table 2. Influence of Grain Price and Yield on the Relative Profit of a Single Foliar Fungicide Application*

Wheat Price ($/bu)	Yield Increase (bu/A) 0	5	10	15
	--Relative profit ($/A)--			
2.50	-20	-7.50	5.00	17.50
3.00	-20	-5.00	10.00	25.00
3.50	-20	-2.50	15.00	32.50
4.00	-20	0.00	20.00	40.00
4.50	-20	2.50	25.00	47.50

*Assumes additional input of $20 per acre based on $10 for fungicide and $10 for aerial application costs. Actual costs can be expected to vary.

CONCEPTS, from page 1

Cation Saturation Ratio

This concept suggests an "ideal" soil nutrient content and ratio required for maximum yield. Values commonly used are 65% Ca, 10% Mg, 5% K, and 20% H saturation of the soil cation exchange capacity. This produces a Ca:Mg ratio of 6.5:1, Ca:K ratio of 13:1, and a Mg:K ratio of 2:1. Fertilizer recommendations are made to increase or decrease the nutrients to these levels. Research has shown that plant growth is not affected by wide variations in either the percentages or nutrient ratios. Using the cation saturation method often results in very large fertilizer recommendations especially on clay and other soils with high cation exchange capacities. Recommendations may use materials not readily available in the area.

Sampling Program

Some of the best information on nutrient management is obtained from a regular soil sampling program. Soil test results examined over time, show how fast the nutrient levels are increasing or decreasing. Nutrient values may increase to very high levels if the fertilizer program is not carefully readjusted to account for increased soil test levels from fertilizer and manure inputs. Excess nutrients may reduce yields and/or be harmful to the environment. When selecting a nutrient management program, choose a quality laboratory with a fertilizer recommendation concept that fits your crops, soils, climate, and bank account.

Calendar of Events

June 3	Small Grain Management Field Day, Aurora, NY.
June 28-July 1	Northeast Agronomy Meetings, Univ. of Connecticut, Storrs, Connecticut.
July 10	Aurora Field Day, Musgrave Research Farm, Aurora, N.Y.
July 16	Empire State Soil Fertility, Association Summer Meeting
Nov. 1-6	American Society of Agronomy Meetings, Minneapolis, Minnesota.

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