What's Cropping Up?

A NEWSLETTER FOR NEW YORK FIELD CROPS & SOILS

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Cultivation Equipment Offers Wide Selection

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Many growers, in response to environmental concerns and increasing pesticide regulations, are turning to cultivation for weed control in row crops. Currently there is a wide selection of machinery available. Some equipment has been in use for decades, but recent modifications have significantly improved performance and utility.

A number of factors must be considered when choosing cultivation equipment. Will cultivation be your only form of weed control? If so, you will probably need more than one piece of equipment to adequately control weeds in and between rows at several stages of growth. Another factor is tillage. High-residue conditions require specialized equipment. Speed and other restrictions related to weed and crop stage of growth are also important considerations. Below are brief descriptions of several types of cultivation equipment with their strengths and limitations.

Rotary Hoe. This equipment controls weeds both in and between rows, but it will only remove shallow-rooted seedlings, preferably before weed emergence. The hoe should be used at high speeds (8-12 mph) and it functions well in crop residues. It is also useful for breaking crusted soil to enhance crop emergence.

Tine Weeder. This is another tool that removes weeds both in and between rows, primarily in the seedling stage. The tine weeder is more aggressive than the rotary hoe but down pressure on the tines can be differentially adjusted for in and between-row positions, allowing more flexibility in timing. Between-row tines when adjusted to maximum down pressure will remove weeds larger than seedlings. Tines over the row are set at or near minimum pressure, depending on crop emergence, and remove only seedlings. If used before crop emergence, it is almost as fast as the rotary hoe, but once the crop is up speed must be reduced. The tine weeder is simple to adjust and has a low horsepower requirement, but it doesn't work well in heavy residues.

Rolling cultivator. The rolling cultivator primarily controls weeds between the row, removing seedlings as well as much larger weeds. Originally equipped with spider gangs, disc gangs have been developed for high-residue conditions. The discs also penetrate heavy soils more readily than the spiders. Soil moves exclusively in one direction, either toward or away from the row, depending on which way the gangs are set. Accurate adjustment of gang angles is critical for directional stability and overall good performance. Ground speed can be relatively fast, even when cultivating small plants. The rolling cultivator can also be used at layby to move soil into the row, covering some weeds. With proper adjustment it will work well in bedded or ridged crops. If used in soils with many cobbles, it may jam.

Conventional cultivator. Depending on shank configuration and shovel type, this cultivator works well in a variety of soil and crop conditions. It is commonly set up in parallel gangs with a gauge wheel on each gang to maintain depth of soil penetration. S-tine rigs tend to be lighter and less expensive than other row crop cultivators, yet are durable and quite aggressive. However, clearance can be a problem in high-residue situations. C-spring shanks are similar to S-tines in terms of advantages and limitations, but are more aggressive.

Recently, spring-shank cultivators designed specifically for high-residue conditions have become available. They have fewer but heavier shanks per gang (typically three) and the shanks are larger with more vertical clearance between shanks. Gang bars are longer, providing more longitudinal clearance. These machines are heavier and sometimes more expensive than S-tine equipment.

Single sweep cultivators are used in ridge till systems. Ridging cultivators reform the ridge for next year's planting while performing a rigorous last cultivation for this year's crop. These are the heaviest of the row crop cultivators and are well-suited for high-residue conditions because the single sweeps are preceded by a large coulter which slices through residue.

SOIL MANAGEMENT

Drainage Improvement Decisions Can Influence Profits

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Too much rain, too little sun and cool temperatures reduced crop yields, delayed crop maturity and caused harvesting difficulty for many growers in New York during 1992. Especially hard hit were growers who produce crops on soils which are not well drained. Corn, alfalfa, wheat and soybeans were some of the crops most affected. Although little can be done to change the weather (which caused mildewed foliage, sprouting kernels, lack of flower set, spoiled fruits and vegetables, and untimely forage, fruit and vegetable harvesting), one may be able to improve the soil drainage. Drainage improvements can facilitate better aerated root zone conditions and the ability to traffic in wet fields which has been shown to result in higher yielding, better quality crops, and more timely planting and harvest conditions.

This article briefly summarizes results of a long term cooperative study between Cornell University and the W. H. Miner Agricultural Research Institute which was carried out at the Institute's farm located in Northern New York near Chazy. The experiment involved the production of corn and an alfalfa/birdsfoot trefoil /timothy forage mix in rotation (3 yr. corn, 4 yr. forage, 2 yr. corn) on somewhat poorly drained Swanton and Rhinebeck soils. Fifty acres were established with various drainage system improvements which allowed one to replicate and characterize the soil and crop production responses from a range of no drainage improvement to right over the tile line. The experiment was designed to maximize production which meant if drainage improvements facilitated soil drying, corn was planted earlier and harvested in a timely fashion. In other words, management decisions were made to take advantage of the improved drainage condition. Fertilizer applications were similar across all treatments based on soil tests and to obtain high yields in the best drained parts of the field. The same medium maturity corn variety was used in all treatments and other cultural aspects were similar based on Cornell recommendations. Costs of the drainage improvements, crop production input costs, planting and harvest dates, crop yields and other information on weather and soil water responses were collected. One of the objectives of the study was to determine the drain spacing which would optimize net profits to a landowner investing in drainage improvements for field crop production.

The drainage spacing which maximizes net profits was determined using an economic analysis procedure where annualized drainage installation and crop input costs were subtracted from the income generated from the crop yield. Annual drainage costs were determined using a 25-year life amortized at 10% interest for 4 inch diameter drains which cost 85 cents per foot for the pipe and installation. This cost was increased by 2% to account for drainage maintenance costs. Annual crop input costs were about $245 and $203 acre for corn and alfalfa respectively which included variable and fixed costs (less land cost). These same production costs were used for all treatments. Annual income from the crops was determined using the long term yield results valued at $2.50/bushel for dry corn grain and $76/ton for dry mixed forage. Variations due to differing fuel consumption or crop quality as a result of the drainage treatments was not considered in this analysis. The annual net profit was then calculated for the different drainage spacings by subtracting the annual drainage and production costs from the annual income. The results for the corn and alfalfa forage mix for the two soil types is shown in Figure 1.

Results indicate a drain spacing of approximately 100 ft or 33 m for the Swanton soil return the highest profits. A slightly closer spacing is needed for alfalfa as compared to corn. On a Rhinebeck soil, the drain spacing of 80 ft or 25 m gives the highest return for alfalfa. Rhinebeck is a finer textured soil than Swanton so it requires closer drain spacing to be drained effectively. Alfalfa also prefers a closer drain spacing because it's sensitive to the excess water which is more likely to occur during the fall and early spring growth periods. Although a close spacing improves the chances of getting in the field early to plant corn (allowing longer season, high yielding varieties), most corn growth occurs during the summer when excess water is generally not a problem. (Both wetter than normal and dryer than normal conditions occurred during this study also). It was further observed that a closer spacing for corn was often not necessary because there was little benefit to getting on the drier field too early if soil temperature was still not adequate for seed germination.

These results are generally transferable to other soils which have similar drainage characteristics, and to other locations which have similar climatic patterns. A comparable soil to Swanton is Munson. Soils which have similar drainage characteristics to Rhinebeck include Caneadea, Cavode, Derb, Ivory, Kanona, Kingsbury, Muskellunge, Odessa, Panton, and Remsen. One must be cautious, however, when transferring these experimental results to other soils and other regions because soils are highly variable (even within the same series) and climatic patterns have a significant effect on the soil water balance and crop growth (stress) characteristics. To insure landowner satisfaction, a conservative drainage designer would reduce these optimal drain spacings by as much as 25% to account for the inherent soil and climatic variability. This drain spacing would be reduced even further to protect sensitive, higher valued crops.

These results indicate that drainage improvement decisions must be based on a number of factors. These somewhat poorly drained soils will not return any profit without the proper drainage improvements, at least if they are managed using crop inputs similar to the well drained soils (note negative profits for nondrained situation on right hand side of figure). If too much is invested in very intensive drainage, (the profit reflected on left side of the figure), money is wasted because there is an upper limit to the crop production potential and the ability to provide effective drainage if it continues to rain day after day. A drain spacing closer than the optimum should be considered as risk insurance, a cost some are willing to bear to provide more management flexibility or to stabilize yields during wetter than normal periods. However, the near vertical slope on the left side of the curves indicates that the drainage cost is high for a nominal gain in production reliability. When crop prices are high, there is more flexibility to tolerate a non-optimal drainage design and still obtain a profit (as shown by the relatively flat curve at the optimum point). For example, corn at $2.50/bushel barely returns a profit even at the optimum drain spacing improvement. These curves shift up and down (affecting net profit) in response to different drainage costs, crop input costs, for different drainage system life, maintenance costs, interest rates, and for different prices received. The optimal spacing (a right or left shift) depends on soil types, crop sensitivity to wet conditions, and the extent of the wet conditions (climate factors). Consequently, if you are considering drainage improvements to increase your profit it is not only important to evaluate your soils, but to also determine the intended use and the effects of these other factors.

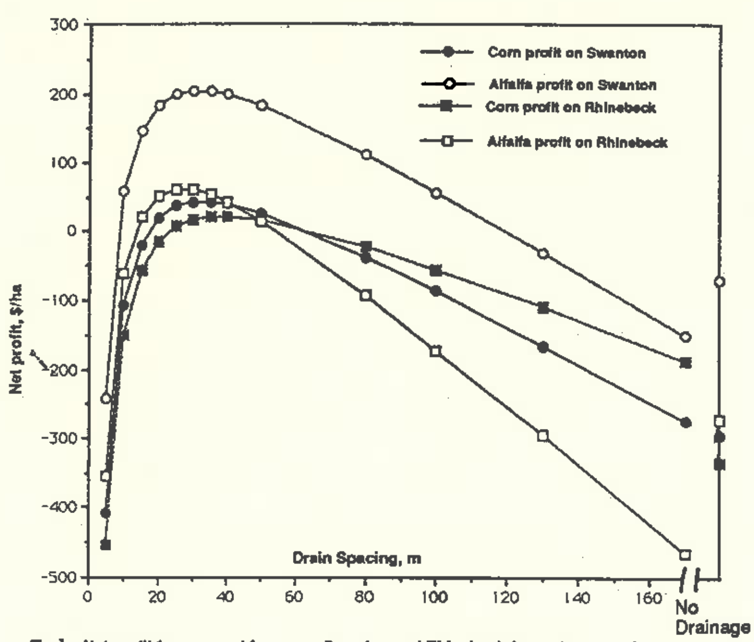

Fig. 1 Net profit for corn and forage on Swanton and Rhinebeck for various spacings.

CROP MANAGEMENT

Exotic Forages

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Spring is coming. I know this because popular Agricultural magazines are talking about new forage crops for the upcoming season that are as good or better than alfalfa. Included in the articles are usually one or more testimonials praising the newcomer. Few exotic forages, however, find a permanent niche in a given forage cropping system. The reasons why they do not are worth considering.

What are they?

I am defining exotic forages as crops that are not commonly grown in a region and are not native to that region. At one time, most of the forages that we routinely use could have been considered exotic, including alfalfa. In the past, large numbers of exotic forage crops were brought into the U.S.A. and tested extensively by USDA or university forage breeders. After testing, and also after undergoing some selection for improvement of various traits, the best of these forages were made available.

Endangered Species

Nowadays many exotic grass forages are brought into the country and made available for producers with only a testimonial or two as evidence of their potential. Why is this? It is because U.S. forage (particularly grass) breeders have been placed on the endangered species list. With the exception of alfalfa, most all other forages are not seen as economically important enough to catch the attention of companies, universities, and/or the federal government. All states are taking moderate to severe cutbacks in agricultural programs, and forage breeding programs are typically considered expendable. This leaves few scientists (and even fewer resources) left in the country to evaluate and/or modify new forage crops.

Stand Life (Persistence)

The most important thing to consider about exotic forages is whether they are annual or perennial crops. New annual forages are much easier to accept. They need only have acceptable yield and or quality traits. Perennials, on the other hand, must be able to persist wherever it is you would like to establish them. It takes many years of research and observation to conclude that a new perennial forage is sufficiently adapted to a region. Also, it is difficult to extrapolate out beyond the tested region. For example, perennial ryegrass has proven potential in southern Pennsylvania, but is generally not considered winter hardy enough to recommend for use in New York.

It is dangerous to recommend new perennials for a region without the necessary data base, but it is difficult for most researchers to justify developing such data bases. We now have a "chicken or the egg" situation for new perennial forages. We dare not recommend new perennials without supporting research data, but cannot justify obtaining such data until enough producers use the new forage and get positive results. Therefore, it will be difficult for a new perennial forage to get widespread acceptance.

Why can They do it?

Where are these exotic forages coming from? Europe, New Zealand and Australia remain committed to forages and are actively developing new forages, particularly grasses. Until nutrient management or other concerns increase the perceived importance of grasses in the U.S.A., it will be difficult to get a thorough evaluation of any new perennial grass.

The Latest in Exotics

The following are among the more promoted of new perennial forages in the U.S.A., particularly in the Northeast: 1) Prairie grass (*Bromus willdenovii*) is a perennial cool-season bromegrass (variety 'Matua') touted for its grazing potential and its ability to use nitrogen. It has been promoted as "better than alfalfa"; 2) Deborah brome (*Bromus carinatus*) is an octaploid bromegrass (variety Deborah) which claims to outyield orchardgrass; 3) Chickory (*Chichorium intybus*) is a perennial herb (varieties 'Puna' and 'Grasslands Puna') touted for its grazing potential and its high yields. It is considerably different from the common weed of the same name; 4) Perennial ryegrass (*Lolium perenne*) is touted as the best forage in the world (many varieties available). None of the above currently have conclusive evidence that they will a) persist in New York State, and b) provide better yields or quality than currently available forages.

Using the Nitrogen Soil Test

SOIL MANAGEMENT

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Background

Good nitrogen (N) management is important to optimize profit and minimize N loss. Fertilizer N should be applied at the rate required to supplement the N available from organic sources such as soil organic matter, crop residues, and manure. Our current fertilizer N recommendations are based on research estimates of N availability from these organic sources. The precision of the recommendation can be variable due to varying weather conditions which affect N availability and because many farms do not keep good records relative to soil type, manure rate, and crop rotation. The fertilizer N recommendation may be improved with a soil test to quantify N availability.

Research Conclusions

We recently calibrated the pre-sidedress nitrogen soil test (PSNT) for New York. The PSNT measures the amount of nitrate in the top 12 inches of soil when the corn is 6-12 inches tall. The amount of nitrate nitrogen found is a good indication of the amount of N that will become available during the growing season (see What's Cropping Up? 1992, Vol.2 for details). The relationship between the PSNT value and relative corn yield for 78 of our research locations is shown in the Table. A relative yield (yield obtained without fertilizer N as a percent of the maximum yield) of 95% is close to the economic optimum. Notice that the PSNT value and relative yield was lowest for continuous corn without manure and highest for corn following a sod crop and receiving manure. As the organic N input increased, the PSNT value increased because of the increase in available N, and relative yield approached the economic optimum. Sidedressed fertilizer N was not required when the PSNT value was high.

The critical level, or PSNT value where a yield increase from adding sidedressed fertilizer N is unlikely was 21 ppm. The critical level is not a hard and fast number and may normally range from 20-25 ppm. Unfortunately, the soil test is not sensitive enough to determine the rate of fertilizer N to apply when the PSNT value is 21 ppm or less. The strength of the PSNT is that it can identify fields that already have enough N with a reasonably high degree of accuracy. Therefore, the fertilizer recommendation may be improved with a combination of the PSNT to determine the need for sidedressed N, and the standard N recommendation based on N credits, to determine the rate of application.

Using the Soil Test

We are offering the soil test on a statewide basis. Because the soil test is still in the infancy stage, please use it with care on a limited number of fields and be sure to verify that the PSNT value is a reflection of the use of crop residues and manure. Let your extension specialist know how well the soil test worked.

Procedure:

1. Do not apply fertilizer N in the spring except for some in the fertilizer band at planting.

2. Take 15 to 20 representative soil cores to a depth of 12 inches when corn is 6 to 12 in. tall.

3. Sample between the corn rows to avoid the starter fertilizer band.

4. Composite the cores for each field and dry on the same day to stabilize the nitrate. Dry in an oven at about 200°F, or in a microwave. Samples can also be air dried if spread out thinly. A fan will reduce drying time. Do not put wet samples on absorbent material because it will absorb nitrate.

5. Send the sample by quickest courier to the Cornell Soil Test Laboratory, along with the information sheet. The lab will return the results *quickly* to you and your Cooperative Extension agent.

6. Call your extension specialist if you need assistance.

Soil test nitrate nitrogen (PSNT) and relative yield for several corn production systems.

System	PSNT *ppm*	Relative yield %
Continuous corn		
no manure	9	63
manure	23	92
Corn-hay rotation		
no manure	23	94
manure	32	96

CROP MANAGEMENT

Grain Corn Plant Populations

Bill Cox
Soil, Crop and Atmospheric Sciences

We have gradually revised upward recommendations for grain corn populations in Cornell Recommends. For example, in 1990, we recommended harvest populations of 20000 to 23000 plants/acre on well-drained to moderately well drained soils, which translated into a 24000 to 25000 recommended planting rate. We now recommend in the 1993 edition of Cornell Recommends harvest populations of 24000 to 26000 plants/acre, which translates into a 28000 to 29000 recommended planting rate on these same soils. We have increased recommended plant populations because modern hybrids require relatively high plant populations for maximum economic grain yields. The response of seven hybrids to nine harvest plant populations at Aurora in 1991 and 1992 underscores the importance of high populations in the management of modern hybrids (Table 1). Keep in mind that 1991 was one of the hottest and driest, and 1992 was one of the wettest and coolest growing seasons on record.

Maximum economic grain yields occurred at harvest populations of 29000 plants/acre in 1991 and 33000 plants/acre in 1992, when averaged across hybrids (Table 1). Some hybrids in 1991 produced maximum economic yields at harvest populations of 30000 plants/acre compared to less than 30000 plants/acre for other hybrids. Likewise, in 1992, some hybrids produced maximum economic yields at 36000 plants/acre compared to 30000 plants/acre for other hybrids. Apparently, hybrids respond somewhat differently to plant

Table 1. Corn grain yields of seven hybrids at nine populations at Aurora in 1991 and 1992.

Hybrid	Harvest Plant Density (plants/acre)									
	12000	15000	18000	21000	24000	27000	30000	33000	36000	Optimum*
	Bu/Acre (15.5% moisture)									
Pioneer 3733	91	106	105	105	109	118	122	112	120	~30000
	136	132	143	161	166	171	186	193	187	~33000
Pioneer 3592	93	105	102	112	115	111	118	105	113	~30000
	105	134	153	162	157	175	167	185	189	~33000
Pioneer 3527	94	125	115	106	114	114	113	124	120	~15000
	131	138	146	166	172	182	190	190	199	~36000
Pioneer 3429	87	107	110	129	125	139	142	132	134	~30000
	111	121	141	164	165	163	168	171	178	~36000
Hytest 424	101	107	120	133	134	140	140	132	139	~27000
	116	133	152	148	158	169	171	182	175	~33000
Hytest 474	96	116	114	104	122	129	132	124	131	~30000
	101	118	123	142	140	151	168	173	182	~36000
Funks 4385	99	102	107	115	123	122	130	132	130	~30000
	106	123	129	147	160	173	181	165	183	~30000
Mean	94	108	111	115	121	126	128	125	127	~29000
	115	129	141	156	160	169	176	184	185	~33000

* Optimum plant density was determined by fitting a quadratic equation to the data and assuming: grain price ($2.25), seed costs ($70/bag) and fixed costs ($240/acre).

populations, and seed companies should provide information on which hybrids perform best at higher vs. lower plant populations. Nevertheless, all hybrids in this study except one required 27000 plants/acre or more for maximum economic grain yields in both the hot and dry 1991 growing season, and the cool and wet 1992 growing season.

The data from 1991 and 1992 indicate that current plant population recommendations in Cornell Recommends remains too low for grain corn production. In 1992, we harvested the seven hybrids with a 2-row Combine in early November when grain moisture was in the 25 to 30% range and lodging was in the 0 to 5% range. In another plant population study at Aurora, we evaluated four of the same hybrids at harvest populations of 18000, 27000, and 36000 plants/acre. We could not harvest this study until mid-November when grain moisture was in the 20 to 25% range and lodging ranged from 5 to 23 to 45% for the 18,000, 27000, and 36000 harvest populations, respectively (data not shown). Needless to say, harvesting was challenging in some areas and near impossible in other areas of this study.

We will conduct our plant population study with seven hybrids for another year to gather more data to fine-tune recommendations for grain corn production. The very real potential for severe lodging even with modern hybrids, as seen in one of our plant population studies in 1992, may deter further increases in recommended plant populations for dry-shelled corn. The 2-year data set does suggest that we may further increase plant population recommendations for high-moisture grain corn.

SMALL GRAIN MANAGEMENT FIELD DAY - JUNE 3

Please plan on joining us on June 3 at the Robert B. Musgrave Research Farm for the annual Small Grain Management Field Day. Gary Bergstrom, Mark Sorrells, Bill Cox, and Bill Pardee will host this event. All individuals involved in small grain production and utilization are invited to view and discuss winter wheat and oat management research in progress.

AURORA FIELD DAY - JULY 9

Please plan on joining us on July 9 at the Robert B. Musgrave Research Farm for the annual Aurora Field Day. The Soil and Water Conservation Society Empire Chapter is holding their annual summer meeting in conjunction with the Field Day, so there will be considerable emphasis on soil and water management research. Other research stops that will be featured include timing of tillage operations, corn fertilization, field crop weed control, corn rootworm management, soybean variety selection and management, oat management, forage quality, cover crops, and much much more. Please reserve July 9 on your calendar and look for more information in the coming weeks.

NEW YORK ALLIANCE MEETING FOR CROP RESIDUE MANAGEMENT

You are invited to attend the first New York Alliance Meeting for Crop Residue Management. The purpose of the meeting is to share ideas developing crop residue management educational programs among USDA agencies, Cornell Cooperative Extension, Soil and Water Conservation Districts, farm implement and agrichemical dealers, and farmers. The tentative agenda for the June 29 meeting is:

9:00-9:20	Conservation Compliance
9:20-9:45	CTIC Perspective on Crop Residue Management Alliance
9:45-10:15	USDA Perspective on Crop Residue Management Alliance
10:15-10:45	Crop Residue Management: What's Working in New York
11:45-12:45	Lunch
12:45-1:15	Crop Residue Management Activities in New York
1:15-2:15	Small Group Discussion
2:15-2:30	Next step for New York Alliance for Crop Residue Management

Calendar of Events

June 3	Small Grain Management Field Day. Musgrave Research Farm. Aurora, NY.
June 20-23	Northeast Agronomy Meetings. Penn State Univ. University Park, PA.
June 29	New York Alliance Residue Management Workshop. Holiday Inn. Auburn, NY.
July 7	Cornell Seed Growers Field Day. Ithaca, NY.
July 9	Aurora Field Day, Musgrave Research Farm, Aurora, NY.
July 21	Empire State Soil Fertility Association Summer Meeting. Northern NY.

What's Cropping Up? is a bimonthly newsletter distributed by the Department of Soil, Crop and Atmospheric Sciences at Cornell University. The purpose of the newsletter is to provide timely information on field crop production and environmental issues as it relates to New York agriculture. Articles are regularly contributed by the following Departments at Cornell University: Soil, Crop and Atmospheric Sciences, Plant Breeding, Plant Pathology, and Entomology. **To subscribe, send a check for $8.00 along with the form at the right.**

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