What's Cropping Up?

A NEWSLETTER FOR NEW YORK FIELD CROPS & SOILS VOLUME 8, NUMBER 5, 1998

Caledonia Wheat Tops 98 Tests

Bill Pardee
Dept. of Plant Breeding

Caledonia scored a "hat trick" in 1998, topping official yield tests in New York, Michigan and Ontario, the three major white wheat producing areas of the Northeast. Caledonia has been consistent as a top yielder in Cornell trials over the past 6 years (See 3 and 6 year test results in the table below).

Caledonia is a white winter wheat from the program of Mark Sorrells, Cornell wheat breeder. Caledonia came from plants selected from within the variety Geneva.

Caledonia produces a light colored straw, which should make it popular in straw markets. It is stiff stalked, and its standability rates among the best.

Certified seed growers have planted Caledonia this fall. Ample stocks of Caledonia seed should be available for planting in 1999.

The 1998 growing season was tough for wheat growers and testers. Yields were reduced by the barley yellow dwarf virus and Septoria head blight. Harvest time rains caused wide spread preharvest sprouting. This reduced crop value and returns.

The test yields below reflect these pressures, with several high yielding varieties performing below expectations. Check 3 and 6 year averages for the best comparisons of varieties over differing years and conditions.

Tests were conducted at four sites, two in the Ithaca area, and one each in Ontario and Monroe counties in 1998. Variety performance was consistent, with Caledonia the top variety at three of the four sites.

Other varieties included Harus, Geneva and NYBatavia, all long term high performers. Marilee has an excellent 3 year record, as does Pioneer 2737W. Cayuga excels in sprouting resistance, though yields were disappointing at some sites. Cayuga's sprouting resistance held up well this season, with most reports showing few or no sprouts on Cayuga, even where other white varieties were sprouted badly.

In red wheat tests Menden (Agri Culver) and Pioneer varieties 25R57, 2510 and 2540 were top yielders, All did well in standability and test weight. The sprouting resistance of red wheats helped many growers in 1998.

Presto triticale (AgriCulver) topped all wheat varieties in yield, both white and red. Triticale is an interesting crop, looking for a market.

1998 Cornell Wheat Tests, Top Varieties

Variety	1998 Grain Yield (Bu/A)	3 year Grain Yield (Bu/Acre)	6 year Grain Yield (Bu/Acre)	Test Weight (lbs/bu)	Lodging Rating (0-9)	Sprout Score (0-9)
Caledonia	59	53	60	56	1.0	5.0
Geneva	51	51	57	57	1.3	4.0
Harus	55	53	58	57	1.7	4.2
NYBatavia	51	49	56	56	0.7	4.1
Cayuga	48	44		58	3.7	1.7
Marilee	48	53		54	0.7	4.4
2727W (Pioneer)	49	52	59	55	0.7	5.3

Water Quality

AEM Certification: Why Do We Need Another Certification Program?

Barbara Bellows, Dept. of Agriculture and Biological Engineering
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In 1996, New York State initiated the Agricultural Environmental Management (AEM) program in response to Federal clean water legislation, public concerns regarding potential and actual impacts of agriculture on environmental quality, and farmers' desires for clarity on environmental regulations and recommended practices. AEM is voluntary, incentive and educational based program that uses a multi-agency approach to assist farmers implement environmental plans on their farms. AEM has been accepted by State and Federal regulatory agencies as New York State's program to address agricultural nonpoint source pollution concerns regulated under the Coastal Zone Management Act Reauthorization Amendments. AEM tools for developing complete waste management plans will also be a vital component of the Concentrated Animal Feeding Operation (CAFO) permitting process, currently being developed through the NY State Department of Environmental Conservation.

Environmental farm plans developed through AEM need to be comprehensive and consistent to assure regulatory agencies, the general public, and farmers that this process addresses farm environmental concerns effectively and fairly. To ensure that AEM and CAFO plans meet this standard, the AEM Certification Subcommittee has recommended the formation of a training and certification process for AEM planners. Not all individuals who work on an AEM or CAFO plan will need to be certified; only the individual who "signs off" on these plans will need to be certified.

The criteria for certification are still under discussion by the agency, private sector, and farmer members of the AEM Certification Subcommittee. Elements of the certification process currently being proposed by this Subcommittee include:

- Six years of professional agricultural experience
- Professional certification such as CCA, PE, or CPESC

OR

Agency affiliation with SWCD, NRCS, or CCE with appropriate experience.

- Training in 6 modules: Water Quality, Agricultural Management, Agronomy, Agricultural Engineering, Animal Sciences, and Natural Resources
- Pass an examination covering the 6 modules
- Have three farm plans approved by a peer-review committee.

The initial training and examination for AEM planners is scheduled for the 1999 Water Quality Symposium in March. This training will focus on concepts and practices critical for the development of CAFO plans, including water quality regulations, nutrient management planning, manure management, control of silage leachate and milkhouse wastes, and erosion control.

Why another certification process?

Several CCA certified extension educators have questioned the need for an additional certification process. The AEM Certification Subcommittee views AEM certification "as building on but different from" CCA certification. An AEM planner would need to understand the science, technologies, and policies related to the environmental impacts of agricultural practices. Many of these concepts and practices are not currently addressed by CCA certification, particularly engineering principles related to barnyard management, water run-off and exclusion, and structural erosion control methods. An AEM planner also needs to have an understanding of hydrology, water quality rules and regulations, and criteria for prioritizing water quality objectives within a watershed.

Engineers or other agricultural professionals who do not have CCA certification may want to obtain AEM certification. While AEM certification will require these planners to understand nutrient management planning and calf health, they will not be required to understand all the plant production issues covered by CCA certification.

Can CCA continuing education credits be used to maintain AEM planner certification?

Maintaining AEM planner certification will require taking continuing education courses each year. Continuing education courses offered for AEM certification will probably also offer CCA continuing education credits for topics of overlapping interest, such as nutrient management planning, pesticide storage and handling practices, and soil management.

Why certified planners rather than certified plans?

The AEM Certification Committee determined that farmer confidentiality, consistency of plans, and attention to individual farm concerns could be best obtained through the use of qualified certified planners. The professional relationship established between a certified planner and a farmer can foster the development of a farm plan that addresses critical environmental concerns within the unique conditions of the farm.

The alternative, development of certified plans, would require setting criteria that may not recognize the unique environmental and management issues of each farm. Certified plans would be costly to review and require cumbersome justifications for any design or management modifications. In addition, farming practices, research-based knowledge of farm-environmental interactions, and environmental regulations are continuously changing. Consequently, farm plans will be dynamic. A plan approved this year may not be an appropriate or acceptable plan next year.

How will consistency of water quality objectives be maintained among planners?

A concern has been raised that a planner may pass the AEM certification examination but, for various reasons, not follow the recommended procedure in developing an AEM plan. To address this concern, trainings will stress that AEM certified planners should maintain a high professional standard. This standard would allow planners some flexibility in plan design to address individual farm conditions. But, the standard would obligate certified AEM planners to develop plans consistent with the principles outlined in the AEM Guide and appropriate to the specific environmental concerns of the watersheds where they are working.

Who will verify that plans developed by certified planners are being followed?

All plans for farms designated as CAFOs must be reviewed annually. Current guidelines do not provide for any agency or official to review plans as they are being implemented on farms. Complaints will initiate a review of environmental farm plans. Farmers that have an approved plan in place and can demonstrate that the plan is being followed may be protected against citizen's suits filed citing violations of the Clean Water Act.

In particular watersheds, an agency, such as the Soil and Water Conservation District, may decide to conduct an annual plan review. These reviews can help keep both CAFO and non-CAFO farm plans up to date and in compliance. Farmers, may also request a plan review on their farm.

Will certified AEM planners be protected from liability for the plans they approve?

The issue of liability protection for certified environmental farm planners is still unresolved. Liability protection will require state legislation stating that the NY Department of Agriculture and Markets can offer limits on potential liabilities.

Who can provide input into the finalization of this process?

If you have any questions about this process, please contact any of the following members of the AEM Certification Committee: Barbara Bellows (bcb5@cornell.edu), Peter Wright (pew2@cornell.edu), Lee Telega (swt2@cornell.edu), Jef Ten Eyck (jslk6250@juno.com), or Dana Chapman (NYC Watershed Agricultural Program, dchapman@cce.cornell.edu).

Soil Management

Precision Agriculture: Putting Information Systems to Work on Farms

Harold van Es and Bill Cox
Department of Soil, Crop, and Atmospheric Sciences

We read about precision agriculture, variable-rate management, yield mapping, and color-infrared imaging in the farm magazines. But we wonder whether it is another ploy to get farmers to buy expensive equipment and services, or whether it is truly a new approach to farming. In our view, it is the latter, although we still need to do a lot of work to make it work effectively for the average farmer.

What is precision agriculture? We define it as the application of computerized data acquisition / control systems and information systems to land management. In that respect, crop production follows the manufacturing industry in incorporating computer-based technology into the production process, allowing for more efficient and consistent product output. Precision agriculture is based on the premise that soil, crop, and pest-related processes are variable in space and time within fields. Information on these processes will allow for more efficient crop production and environmental protection. Precision agriculture is strongly tied to several new or improved technologies, notably Global Positioning Systems (GPS), Geographical Information Systems (GIS), fast computers, and new sensors. Precision Agriculture also builds on new statistical procedures, for example "geostatistics" which recognizes spatial patterns in fields.

Precision agriculture (PA) technology may involve many different types of equipment. Essential components are a Global Positioning System, an on-board (i.e., on the tractor or combine) computer, and a desktop computer. The GPS is a device that allows you to determine your position on the land in terms of geographical coordinates. The unit typically does that by evaluating its position relative to a constellation of satellites and a land-based beacon. The GPS units generally sold for agricultural purposes are accurate within about 3 feet. It is a very essential component of a precision agriculture system, because it is essential to know exactly where you are in a field to use the technology effectively.

The on-board computer can acquire data (e.g., from a yield monitor), or control an applicator (e.g., a fertilizer spreader). These tasks are performed while simultaneously evaluating the position of the field equipment using the Global Positioning System, i.e., the field data are *georeferenced*. The on-board unit is typically designed for just those tasks, hence the need for a desktop computer with Geographical Information System software to allow for the processing of such georeferenced field information.

Figure 1 shows a flow diagram that captures the information streams in a sophisticated precision agriculture application. In the field, information is gathered (e.g., soil samples, yield data) which are subsequently processed in the office with the specialized software (GIS and statistical packages). The field data may be combined with weather information, remotely-sensed images or other information sources. Based on this information, a prescription is developed for the application of crop inputs such as fertilizer, lime, pest control methods, organic amendments, etc. This prescription is based on a knowledge base that allows for the best management recommendation for each part of the field. The prescriptions are then entered into the on-board computer to control various types of application equipment. Precision agriculture systems may therefore include different types of applications, some of them providing *information*, while others allow for *variable rate management* (Table 1). Let's discuss them in a little more detail.

The most widely adopted information gathering tool is the *yield monitor* which provides yield data for every second (or so) of combine travel time. For most farmers, yield mapping is an entry point into precision agriculture.

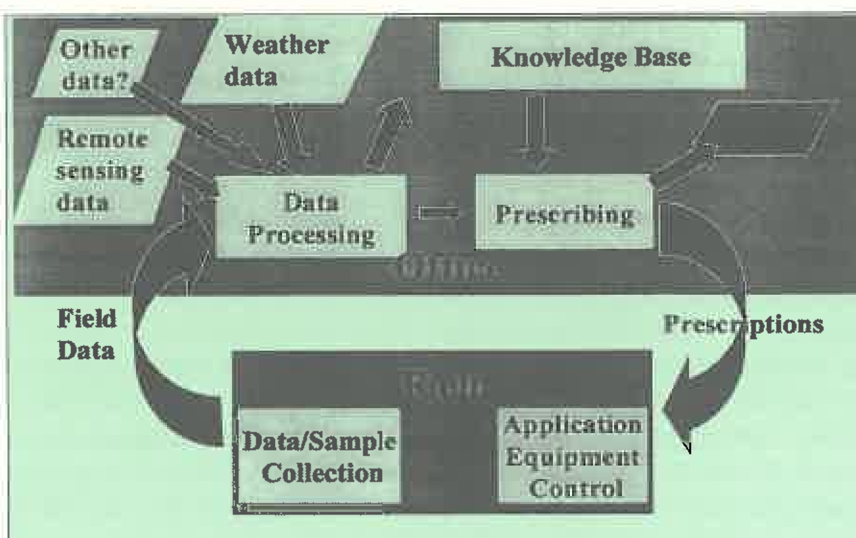

Figure 1: Precision agriculture information flow.

Precision Agriculture Components

Information	Variable Rate Management
• yield mapping	• variable fertilizer and lime rates
• mapping of "amendments"	• variable organic amendments
• intensive soil/crop sampling	• variable seeding rates
• weather data	• differential hybrids
• remote sensing	• variable pest control
– in field, on-the-go	
– air, space-based	

Table 1: Precision agriculture components.

It provides good quantitative information on yield variability that may be used to make field management decisions. In addition, it provides an effective way to keep yield records for each field.

For better fertilizer and lime application, intensive soil sampling is now being employed. This typically involves samples being taken within a field on a grid or by soil type. This information may then be used to apply these crop inputs at variable rates within a field. In most cases, the increased costs of soil sampling and analysis are offset by more efficient use of the crop inputs. For New York, this appears to be especially the case with lime application since soil pH levels often vary widely within a field.

There are several other information sources that are now being applied in precision agriculture. Notably, remote sensing has become more affordable. Services are now available to farmers that provide images from aircraft or satellite that can be used for a multitude of management decisions. Such information typically involves reflectance patterns in multiple spectral bands (including near-infrared, which is useful for assessing plant health), and is now available in digital, georeferenced format that allows for effective incorporation into a Geographical Information System. Although the knowledge base is still being developed to effectively use this information, the potential applications for more effective crop management appear very promising. It is expected that remotely-sensed information will become increasingly affordable and useful to crop management. Such images may allow for more targeted fertilizer application and pest management. For example, research is currently under way to evaluate the use of remotely-sensed images for determining N sidedress application rates. Also, they may allow a field scout to more effectively identify pest patterns in a field and recommend partial treatment of a field rather than the entire field. Remotely-sensed images of bare soil can identify areas prone to drainage or drought problems, and may be a very effective tool for evaluating hydrologically-sensitive areas in a watershed. *Weather data* can also be more effectively used in precision agriculture. After all, weather is the primary source of *temporal* variability in crop growth and we can employ weather information to better manage crops and pests.

Besides fertilizer and lime, several other crop inputs may be more efficiently managed with PA. Current or emerging technologies include variable seeding rates (e.g., higher plant densities in areas of higher yield potential), differential use of crop hybrids based on adaptability to variable field conditions, variable pest control, and variable application of soil amendments such as manure, composts and sludges. For the Northeast, the use of PA technology in manure application will be very valuable. Imagine in the near future having a record of the amount, timing, nutrient content, and location of manure being applied. This will provide important information that can assist farmers in more effectively using manure for crop production, and providing greater protection of the environment. Future manure spreaders may even be programmed to exclude applications in hydrologically-sensitive areas.

Besides the model described in Figure 1, we may see increasing use of on-the-go interpretation of field information, as shown conceptually in Figure 2. Such systems may involve sensors that are mounted on field equipment that will provide information that is immediately used to control application equipment. Currently, experiments are conducted with tractor-mounted sensors that identify weeds in a field and directly control a pesticide sprayer. In the future, we may see sensors that can estimate soil nutrient contents on-the-go and directly control a fertilizer applicator. This ultimately may be the most promising approach to precision agriculture, although we have a long way to go before this technology is operational.

In general, precision agriculture will be attractive in providing more efficient and environmentally sound ways to grow crops. In the past years, we have experienced a tremendous leap forward in the development of hardware

(See, PRECISION, page 7)

Crop Management

Row Spacing and Seeding Effects on Roundup Ready Soybeans

W.J. Cox and D.J. Otis, Dept. of Soil, Crop & Atmospheric Sciences

Roundup Ready soybeans represented about 5% of the New York soybean acreage in 1997 and about 30% of the acreage in 1998. We expect Roundup Ready soybeans to represent more than 50% of the New York acreage in 1999 and perhaps 75% of the acreage in the year 2000.

Previous research on row spacing and seeding rates with non-Roundup Ready varieties indicated that soybeans yielded best in New York when seeded in 7" row spacing at about 225,000 seeds/acre (What's Cropping Up? Vol.5 No. 6 p. 6). Non-Roundup Ready soybean varieties typically yielded 3 to 5% less in 15" and 5 to 10% less in 30" when compared with 7" row spacing. Row spacing and seeding rates may affect not only the yield potential of Roundup Ready soybeans but also weed control.

We conducted studies in 1997 and 1998 at the Aurora Research Farm to evaluate the effects of row spacing and seeding rates on yield and weed control in Roundup Ready soybeans. In both years of the study, we planted three Roundup Ready varieties (Asgrow, DeKalb, and Pioneer varieties) in row spacings of 7", 15", and 30" at seeding rates of 150,000, 200,000, and 250,000 seeds/acre. We applied 3 pints/acre of Roundup to the soybeans about 1 month after planting (~ May 20 in both years).

Results

The Aurora Research Farm received only 1.6" of precipitation in August of 1997 and again in August of 1998. The dry August conditions resulted in fairly short-statured soybeans that never completely filled in the rows in 30" spacing. Nevertheless, the Roundup application resulted in excellent weed control in both years of the study, regardless of row spacing and seeding rate. Row spacing and seeding rate thus did not affect weed control in Roundup Ready soybeans under conditions of this study, which included the use of 3 pints/acre of Roundup, dry August conditions, and moderately low weed pressure.

Row spacing and seeding rate did affect yields in both years of the study (Table 1). When averaged across varieties, Roundup Ready soybeans in 7" and 15" row spacings yielded 2 bu/acre or 5% greater compared with 30" row spacing in 1997. Soybean yields did not have variety, row spacing, or seeding rate interactions. The 5% yield advantage for Roundup Ready soybeans in 7" compared with 30" row spacing is consistent with studies on non-Roundup Ready varieties in New York. Soybeans had maximum economic yields at 200,000 seeds/acre in all three row spacings in 1997. Non-Roundup Ready soybean varieties typically had maximum economic yields at 200,000 to 250,000 seeds/acre in 7" row spacing and at 150,000 to 200,000 seeds/acre in 30" row spacing in previous studies at Aurora. The previous studies, however, mostly had somewhat wet rather than dry August conditions.

Soybeans yielded somewhat higher in 1998, but row spacings and seeding rates had similar effects as in 1997 (Table 1). When averaged across varieties, Roundup Ready soybeans yielded 3 bu/acre or 7% greater in 7" or 15" row spacings when compared with 30" row spacing. As in 1997, soybean yields did not have any variety, row spacing, or seeding rate interactions. Again, Roundup Ready soybeans had maximum economic yields at 200,000 seeds/acre in all three row spacings. We observed greater lodging of soybeans in 30" row spacing, especially at the higher seeding rates. Likewise, we observed more white mold (*Sclerotinia sclerotiorum*) early in the season in 7" row spacing at the higher

Table 1. Soybean yields, averaged across three Roundup Ready varieties, in three row spacings and at three seeding rates at the Aurora Research Farm in 1997 and 1998.

Seeding Rate	Row Spacing 7"	15"	30"	Mean
	bu/acre			
1997				
150,000	37	39	37	37
200,000	42	42	40	41
250,000	40	40	37	39
Mean	40	40	38	
LSD 0.05		2⁺		3
1998				
150,000	45	45	42	44
200,000	48	48	45	47
250,000	47	47	44	46
Mean	47	47	44	
LSD 0.05		2⁺		2

⁺LSD compares means among row spacings.

seeding rates. White mold quickly dissipated, however, in both years of the study with the onset of dry August conditions.

Conclusion

Roundup Ready soybeans averaged 6% greater yields in 7" or 15" row spacings when compared with 30" row spacing. New York soybean producers should plant soybeans in 30" rows only if they don't have access to a drill or have the potential for significant white mold disease. Roundup Ready soybeans had maximum economic yields at seeding rates of 200,000 seeds/acre, regardless of row spacing. The yield penalty, however, was greater for too low (150,000 seeds/acre) rather than too high (250,000 seeds/acre) a seeding rate so New York growers should error on the high side. Nevertheless, seeding rates in New York should not exceed 200,000 seeds/acre by much because of increased lodging potential in 30" rows and increased white mold potential in 7" rows. Roundup Ready soybeans yielded as well in 15" as in 7" row spacing so New York growers should consider planting soybeans in 15" spacing. An added benefit of planting soybeans in 15" vs. 7" row spacing is less potential for white mold disease.

(PRECISION, from page 5)

and software that allows for precision farming. However, the *knowledge base* to effectively apply precision agriculture technology is still underdeveloped. For example, if we want to use variable rate fertilizer application, we need to know how to sample the field, interpret the data and decide on how much fertilizer to put at each location. Similarly, we need to know how to effectively use a color-infrared image to make management decisions. This knowledge base is currently very inadequate, and we are therefore limited in the use of the new technologies. Clearly, this is an area that needs attention and is the focus of the Cornell Precision Agriculture Initiative.

Finally, it is imporant to point out some of the additional benefits provided by PA technology. As mentioned, it provides for detailed computerized field record keeping, which will be very attractive to most farmers. It also provides data to support field management decision. For example, yield data from poorly-drained areas in a field allow a farmer to evaluate the economic benefit of installing tile drainage. PA technology also facilitates on-farm research, with the yield monitor allowing for easy and accurate determination of the yield response of a treatment. So-called split-planter trials (two treatments are applied in each half of the planter rows) are an easy way to evaluate varieties, fertilizer rates, etc. Lastly, the extensive information that is generated by PA applications, e.g., multiple years of yield monitoring data, provides an opportunity for "data mining". By applying sophisticated statistical tools we can extract information from such extensive data sets that may allow us to more effectively manage fields in the future.

In summary, precision agriculture applies new technologies to farming. It will have dramatic impacts on crop production practices, although it will take a few years before we see the full benefits. Some services are currently provided by crop consultants, and we will see them expand over the next years. Precision agriculture provides exciting opportunities for researchers, ag businesses, and farmers. We recommend to the New York farming community to pay attention to these exciting developments.

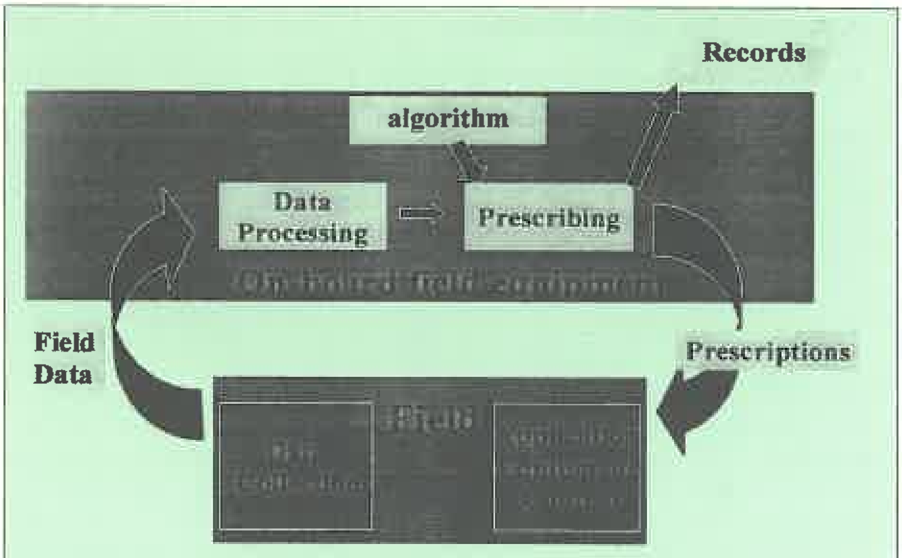

Figure 2: Information flow with on-the-go interpretation.

Calendar of Events

December 2	NE Certified Crop Advisor Training Services and Exam Preparation Course, Ithaca, NY
January 4-7	Northeastern Weed Science Society Annual Meeting, Cambridge, MA
January 5-6	New York State Agri-Business Association Annual Meeting, Waterloo, NY
January 19	Western New York Corn Congress, Holiday Inn, Batavia, NY
January 20	Finger Lakes Corn Congress, Holiday Inn, Waterloo, NY
January 21	Field Crop Congress, Ithaca area
February 7-10	Weed Science Society of America Conference, San Diego, CA
February 23	North Country Corn Congress, Miner Institute, Chazy, NY

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