What's Cropping Up?

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SUPPLEMENTAL MANURE SPREADING GUIDELINES TO REDUCE WATER CONTAMINATION RISK DURING ADVERSE WEATHER CONDITIONS

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Executive Summary

■ Depending on conditions in the field, manure spreading can cause water quality problems and has resulted in DEC action and a fine to one New York Concentrated Animal Feeding Operation (CAFO) in 2004.

DEC may take action if staff observe "gross water quality violations" caused by farm practices that can be traced to the source, *even if the practice was in compliance with the Comprehensive Nutrient Management Plan (CNMP) of the farm.*

While following a CNMP *will not* prevent manure runoff in all possible circumstances, careful management should reduce risk.

Producers and planners are encouraged to consider the following to reduce risk of major runoff leading to a water quality violation:

Identify lowest risk fields for spreading as a last resort (e.g. in cases where storage is full, etc.).

• Before spreading, especially during wet or snowy periods, evaluate runoff potential along with other management needs: soil wetness, weather forecast for rainfall or snowmelt, presence of diversion or field ditches and drainage tile, rate per acre and total amount of manure to be applied.

• When conditions for runoff are high, consider delaying the application, reducing rate/acre, reducing the total amount applied, and/or applying smaller amounts of manure over a period of days rather than hours.

Why Supplemental Guidelines?

Manure is routinely applied to agricultural fields. Land application of manure is the most cost-effective and generally accepted method for handling and removing manure from animal housing facilities. Without storage facilities, manure may need to be land applied at times when there is higher risk for runoff and nutrient losses and little crop uptake of the nutrients. However, even with storage, manure may need to be applied under adverse conditions in order to manage the storage facility within acceptable levels.

In order to reduce the risk of manure nutrients being transported to surface or groundwater, nutrient management planning tools have been developed. For example, the New York Phosphorus Index (NY PI) was designed to reduce soil P accumulation near transport sensitive areas, and to estimate relative runoff risk of dissolved and particulate phosphorus from manure or fertilizer spreading activities. This assessment is based on various field attributes and the likelihood of runoff occurring during a certain time of year. The NY PI evaluates spreading suitability in any given season or month based on historical averages (location risk), but it does not consider the actual conditions on the ground for any given day (present conditions risk). The New York Nitrate Leaching Index (NY NLI) was similarly developed to evaluate the nitrate leaching risk based on long term precipitation averages and general soil drainage characterization (expressed as hydrologic group). **These planning tools are risk *indicators*, and were not developed to *quantify* actual manure or nutrient movement (e.g, wash off) during runoff events, or losses of pathogens, etc.**

Though rarely enforced in agriculture, under New York State law a surface water quality violation occurs when human activities cause "substantial visible contrast with natural conditions" (ECL 17-0501). In the winter of 2003-04, DEC took enforcement action on a farm where it was determined that a "gross" water quality violation resulted from manure spreading, even though no fish were killed, *and even though the spreading plan met NRCS 590 standards and allowed for manure to be applied on that field, at that rate, during that time period.* The violation stemmed from application of the total annual field allowance on a moderately sloped field, nearby to a stream, during the winter, when heavy rains were predicted. This citation was a clear sign to all producers and planners that following a CAFO plan does not prevent an enforcement action when actual water quality violations occur.

The water quality violation enforcement mentioned above indicates that planners and producers could use additional guidelines to evaluate existing field conditions and to improve manure spreading decisions. Significant rainfall or snowmelt events contribute a substantial portion of the nutrient and sediment load to water bodies and where these conditions can be anticipated, producers should strive to not apply the manure or to reduce runoff risk through careful management. The supplemental guidelines were developed to describe conditions that reduce allowable manure application and to introduce the concept of CNMPs identifying fields that are safer for manure application or stockpiling when conditions are less favorable.

There are many situations where some discoloration of nearby surface water is unavoidable, especially when rainfall closely follows manure spreading or tillage practices. The guidelines below are provided to help evaluate high risk manure spreading conditions where extra care is required. These guidelines are suggested to address DEC concerns and to help producers better address the present conditions and answer the following basic question: ***"Given the current soil and ground conditions and the weather forecast, should manure be applied to all or part of this field today?"***

Supplemental Spreading Guidelines

There are ten factors to evaluate before spreading at any point in time that can be divided into three groups: (1) weather conditions; (2) field conditions; and (3) manure application management. Each will be addressed below.

Weather Conditions:

1. *Forecast shows probability of precipitation? When? How much?*
Weather forecasts for 24 to 48 hours out are quite accurate with respect to the probability of precipitation. If the probability is 30 to 50% or more, it is quite likely some precipitation will occur. This is particularly true when the precipitation is expected to occur from a wide-area low front type storm, compared to 'isolated' thundershowers. Unfortunately, forecasting how much rain will fall is more difficult and predictions tend to be less accurate, although significant improvements have been made in recent years. If the expected precipitation amount is 0.25 inches or less, there is usually little risk of runoff, even from wet and frozen soils. Precipitation amounts of 0.25 to 0.5 inches will produce some runoff from wet soils, but not much from soils that have high infiltration capacities providing they aren't already in a saturated or frozen condition. It is difficult to simplify the runoff risk for different soil and site conditions when precipitation exceeds 0.5 inches, but it would be a good idea to try to avoid manure applications when amounts are expected to exceed 1 inch.

2. *Warm front expected to generate significant snowmelt?*
Warm fronts can occur at anytime throughout the winter and the likelihood of generating runoff from snowmelt increases quickly when the temperature approaches about 40°F for 6 hours or more. An older snowpack will require a high(er) temperature or longer duration to produce runoff. If nighttime temperatures also remain above freezing, the runoff risk is higher. It's a good idea to evaluate fields for manure spreading when snowmelt occurs. The most risky runoff locations within a field are soon exposed because the snow cover tends to disappear more quickly where the runoff is occurring.

Field Conditions:

3. *Soil moisture/saturation, % of field capacity, frozen or not:*
The soil drainage classification is probably the best general soil index to evaluate soil moisture status during the winter months. The poorly drained soils will be the wettest throughout the soil profile. These soils are somewhat slower to freeze and tend to generate the first runoff. Larger 4-wheel drive equipment and drainage improvements may make these soils accessible for spreading manure, but the runoff risk will be greater.

4. *Ground cover (vegetation, residue cover, and roughness):*
A good ground cover intercepts rainfall and reduces the tendency for runoff water to move quickly across the surface. Ground cover and vegetated buffers help to trap and filter suspended manure particles and soil.

5. *Slope and slope length:*
The risk for runoff is not necessarily greater for steeper slopes because it is more dependent on the soils infiltration rate. Runoff risk on sloping soil will be greatest, however, for soils with a low infiltration rate or when soils are frozen. Slope length is usually not a good indicator of runoff risk but manure applications made at the top of a long slope should be less risky than those made at the top of a short slope, especially when good ground cover is present. The risky locations to apply manure on sloping soils are usually at the base of concave slopes where water often emerges.

6. Drain tile, surface inlets, ditches, etc.:
By their very nature these are hydrologically active areas and the NRCS nutrient management standard calls for setbacks to be put in place around surface inlets, ditches, etc., when there is a direct surface connection. These setbacks are especially important when spreading under wet conditions. Spreading manure near and upslope of surface ditches that go across the slopes (i.e., those which intercept water) will be more risky than where ditches tend to run parallel with the major slope. Spreading manure on fields that have tile drainage, especially those which are installed in soils that exhibit preferential flow (tending to have more clay), and when the tiles are flowing and discharge directly to a watercourse, is risky.

7. Nearby surface water:
Higher risks are experienced where surface runoff from a field is expected to flow directly to a stream or waterbody. This is most likely to occur in fields that are both close to surface water and where the field surface is oriented toward the waterbody.

Manure Application Management:

8. Manure consistency:
Liquid manure is more likely to move across the surface as runoff or through soil to tile lines, depending on conditions. Semi-solid or bedded pack manure is somewhat less risky in many conditions.

9. Method of application:
Manure that is surface applied presents a higher risk because the material is less able to mix and react with soil. An enriched layer of manure on the soil surface increases runoff risk. Where acceptable from a soil erosion control and groundwater protection standpoint, manure may be injected or incorporated to reduce runoff risk.

10. Application rate and total spreading volume:
An operation spreading 3 or 4 tons of manure each day over time does not present the same level of risk as one that may spread many days worth of manure in one or two days. High rates of liquid manure applied over many acres at the same time can be very risky in some conditions.

Watch Out and be Prepared for These

High risk spreading conditions are more likely when one or more of the following conditions exist:
1. Significant rainfall or snowmelt is predicted within 24-48 hours.
2. Soil is frozen, snow covered or saturated [Comment; deep (>8 in.) snow cover may not be all that risky because snow captures the material in the pack, and melts off the bottom].
3. Tile drains are flowing at least moderately from field drainage (as opposed to ground water interception).

Under the conditions above, extra precautions must be taken on fields, or parts of fields, with the following characteristics:
1. Significant surface runoff or subsurface flow can reach a stream or ditch.
2. Orientation toward a stream or watercourse and slope is greater than 3-5%.
3. There is little or no ground cover from crop residue, sod or cover crop.

Take Home Message

In high risk conditions, producers should work with the CAFO planner to adjust the manure spreading date, rate and method to account for the increased risk, even if the P index evaluation allows spreading during that part of the year. Spreading in these conditions should occur on lower risk fields or parts of fields. In situations where this is not possible, precautions include: reducing application rates, introducing or increasing setback distance, and/or applying manure over a period of several days as opposed to all in one day. As conditions of risk increase, application rates need to be reduced further and other safety measures need to be applied in proportion to the increased risk. Planners should strive to identify lower risk fields for high risk spreading conditions and producers need to work closely with planners to develop a sound spreading plan in these conditions.

CNMP's should include the identification of a field or two where, under extreme conditions such as full storage, manure can be temporarily stored or over-applied. Wherever possible, these fields should be less than 5% slopes and as far as practical from any stream or ditch, preferably at least 500 feet.

Predicting weather is tricky business, and these guidelines will not prevent runoff. Increasing awareness of the conditions that contribute to runoff and shifting plans accordingly should reduce the possibility of causing a water quality violation. Producers and planners should carefully evaluate existing storage capacity to determine if manure management options can be improved during periods of significant rainfall or snowmelt.

Crop Management

Soybean Seeding Rates Revisited

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The price of soybean seed has increased significantly in recent years and seed costs now approximate $40/acre. Coupled with the current low price for soybeans ($5.00 - $5.50/bu range), soybean growers are wondering whether they can reduce soybean seeding rates to save on input costs. Based on research from 1996 to 1998 on Roundup Ready varieties, Cornell recommends seeding rates of 200,000 seeds/acre for drilled (7 inch) soybeans. Research at the Aurora Research Farm in 2003 and 2004 for soybeans under conventional tillage (moldboard plowed and cultimulched once), however, has not supported this recommendation.

We planted Pioneer 92B38 on 20 May 2003 and 92B38 and NKS19V2 on 20 May 2004 in 7 inch row spacing under conventional tillage at five seeding rates (150,000–320,000 range depending upon the growing season). Each seeding rate was replicated five times. We used a John Deere 450 drill in 2003 and a John Deere 1590 No-Till Drill in 2004. Plots measured 100 feet long and 10 feet wide, and we harvested the middle four feet of each plot in late October of 2003 and early October of 2004.

When averaged across the two growing seasons, 92B38 yielded the same at all five seeding rates (Table 1). Soybeans suffered from stress in 2003 because of a dry August (1.65 inches of precipitation) and significant aphid feeding. We thought that stress may have limited the response of soybeans to increased seeding rates in 2003. In 2004, a stress-free season, 92B38 did not respond to higher seeding rates, despite average yields of 60 bu/acre. Likewise, S19V2 did not respond to higher seeding rates (Table 2). Significant lodging did not occur in either growing season so lodging did not influence the response of either soybean variety to increased seeding rates.

We will continue this study for another year at the Aurora Research Farm. We will also evaluate the response of soybeans to seeding rates under zone tillage. In the meantime, we urge soybean growers to run test strips on their own farms to see if they can reduce seeding rates below 200,000 seeds/acre without incurring a yield penalty.

Table 1. Seeding rate, final stand, and yield of 92B38 at 7" row spacing under conventional tillage in 2003 and 2004 at the Aurora Research Farm.

SEEDING RATE		FINAL STAND		YIELD		
2003	2004	2003	2004	2004	2004	Avg.
-------seeds/acre-------		-------plants/acre--------		------------------bu/acre------------------		
~160,000	~150,000	108,900	146,110	37	61	49
~200,000	~175,000	138,450	174,265	39	61	50
~240,000	~200,000	178,140	199,330	39	60	50
~280,000	~225,000	219,675	208,220	38	61	50
~320,000	~250,000	248,200	239,053	38	61	50
LSD 0.05		11,196	9,654	2	NS	NS

Table 2. Seeding rate, final stand, and yield of S19V2 at 7" row spacing under conventional tillage in 2004 at the Aurora Research Farm.

SEEDING RATE	FINAL STAND	YIELD
---------seeds/acre---------	---------plants/acre---------	------------bu/acre------------
~150,000	142,000	52
~175,000	175,600	52
~200,000	197,500	53
~225,000	214,475	51
~250,000	225,650	52
LSD 0.05	9362	NS

Plant Populations for Corn - Grain

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Crop Management

Plant breeders have added new traits to corn hybrids so seed costs have increased. Consequently, planting corn at the correct rate to obtain the optimum plant population has increased in importance. Planting at too high a rate without a yield benefit reduces profit because of increased seed costs. Planting at too low a rate while incurring a yield loss reduces profit because the lost revenue offsets the reduced input costs. We initiated a planting rate study on corn for grain in 2003 to evaluate the response of 21st century hybrids to planting rates.

We planted Pioneer 38A24 and DKC53-34(RR/YGCB) on 7 May 2003 and Pioneer 37F16 and DKC53-34(RR/YGCB) on 6 May 2004 at four seeding rates (~25,000, 30,000, 35,000, and 40,000 plants/acre) with a White Air Seeder. Plots measured 100 feet by 10 feet and each seeding rate was replicated four times. We harvested the center two rows of each plot with an Almaco Plot Combine when grain moistures averaged about 25%. On the day of harvest, we counted the number of lodged plants below the ear in each plot.

Because of the wet spring conditions in both years, the study was planted on Friday evenings/nights after a long day of planting other experiments. We did not change planter plates or adjust air pressure for the two different hybrids in either year because we had never experienced many differences among hybrids in planting rates in the 10 years of experiments with the planter. Unfortunately, the White Air Seeder did not plant the two hybrids at the same rate in either year of the study presumably because of differences in seed size. Nevertheless, we can still gather useful information from the study.

Harvest populations of DKC53-34(RR/YGCB) ranged from about 25,000 to 37,000 plants/acre in 2003 and from about 20,000 to 30,000 plants/acre in 2004 (Table 1). Despite high yields in both years of the study, DKC53-34(RR/YGCB) yielded best at harvest populations of about 25,000 plants/acre (Table 1). In 2003, significant lodging probably limited the response of DKC53-34(RR/YGCB) to higher planting rates (Table 1). In 2004, however, lodging was not a factor and DKC53-34(RR/YGCB) still yielded best at a harvest population of about 25,000 plants/acre. Apparently, DKC53-34(RR/YGCB) has an optimum harvest population of about 25,000 plants/acre so grain corn growers should plant this hybrid at about 28,000 kernels/acre when expecting 90% emergence rate (after May 10 – May 15).

Harvest populations of Pioneer 3824 ranged from about 18,400 to about 27,400 plants/acre in 2003 (Table 1). 38A24 did not show much lodging at these relatively low harvest populations so yields showed a linear response to plant populations (Table 1). Harvest populations of 37F16 ranged from about 27,700 to 39,000 plants/acre so some significant lodging occurred at harvest populations of about 35,000 plants/acre or greater (Table 1). 37F16 did not respond to planting rates in 2004 because the low harvest population was 27,700, the recommended populations, and because of increased lodging at the higher planting rates.

Conclusion

We will continue this study for two more years and hopefully obtain more consistent harvest populations between the hybrids. In the meantime, growers should run strip trials on their own farm, especially on new hybrids that are planted on significant acreage, to determine optimum harvest populations on their farm. We recommend harvest populations of about 26,000 to 28,000 plants/acre for most soils in New York and the results from these studies indicate that this recommendation appears accurate for 21st century hybrids.

Table 1. Harvest populations, percent lodging, and grain yield of DKC53-34(RR/YGCB) in 2003 and 2004 and 38A24 in 2003 and 37F16 in 2004 at four planting rates at the Aurora Research Farm.

PLANTING DATE	HARVEST POPULATION		LODGING		GRAIN YIELD	
	2003	2004	2003	2004	2003	2004
	plants/acre		%		bu/acre	
			DKC53-34			
~25,000	24,700	20,310	2.5	1.2	187	178
~30,000	28,600	25,125	10.7	1.5	188	197
~35,000	33,160	28,000	16.9	3.3	187	189
~40,000	37,020	30,440	29.0	2.9	175	188
LSD 0.05			5.7	NS	NS	15
	38A24	37F16	3824	37F16	3824	37F16
~25,000	18,420	27,700	1.6	4.5	165	186
~30,000	21,580	33,125	4.7	5.7	171	189
~35,000	25,090	34,875	6.1	9.5	180	180
~40,000	27,370	39,000	8.8	14.6	186	180
LSD 0.05			4.3	5.8	15	NS

Weed Management

Hedge Bindweed Control Boosts Corn Yields

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Like all weeds, vine weeds compete with crops to reduce yield and quality. In addition, vine weeds often interfere with harvest operations. Hedge bindweed and field bindweed are among the vine weeds found in NY corn fields. Both are perennial members of the morningglory family and reproduce by seed and fleshy creeping rhizomes (underground stems). Although hedge bindweed rhizomes can be extensive, they are rather shallow compared with those of field bindweed. As a result, hedge bindweed is generally considered easier to control than field bindweed.

Research was initiated at the Musgrave Research Farm near Aurora to evaluate several postemergence herbicides and herbicide combinations for short-term (seasonal) hedge bindweed control. A field that was heavily infested with hedge bindweed was fall plowed and prepared for planting in 2003. A spring application of 22 oz/A of Roundup WeatherMax was applied for burndown purposes. Corn, DeKalb hybrid DKC42-95RR was zone-till planted May 30, 2004 and a blanket application of 1.3 pt/A of Dual II Magnum was applied June 2 for annual grass control and yellow nutsedge suppression. Mid-postemergence (MPO) bindweed treatments were applied June 24 when corn was in the V3 stage (~7 inches tall) and bindweed had vines up to 24 inches long. MPO applications were made in 20 gallons per acre of water and included 0.25% (v/v) of nonionic surfactant and 2.5% (v/v) of 28% urea ammonium nitrate.

Short-term Control

Plots were evaluated 4 weeks after treatment (WAT) for short-term bindweed control. Control ranged from 28% with 3 oz/A of Callisto up to 99% with 16 oz/A of Clarity, the rate labeled for use up to 8-inch corn (Table 1). Clarity at 8 oz/A, the maximum labeled rate after corn is 8 inches tall, performed almost as well (93%). Although 22 oz/A of Roundup WeatherMax, 0.76 oz/A of Beacon, or 1 oz/A of Permit provided only 63, 38, and 63% bindweed control respectively, there was a significant increase in control when 4 oz/A of Clarity was tank-mixed with these products. The addition of Clarity increased the average control of these treatments from 55 to 86%. There was no increase in bindweed control when 4 oz/A of Clarity was tank-mixed with 1 oz/A of Exceed or with 0.75 oz/A of Steadfast. When applied alone, Exceed and

Table 1. Hedge bindweed control 4 weeks after treatment with mid-postemergence herbicide applications at Aurora, NY in 2004.

Herbicide(s)*	Rate Amt/A	Control (%) Alone	+ 4 oz/A Clarity
Clarity	8 oz	93	-
Clarity	16 oz	99	-
RU WeatherMax	22 oz	63	81
Callisto	3 oz	28	-
Beacon	0.76 oz	38	90
NorthStar	5 oz	86	-
Exceed	1 oz	80	85
Permit	1 oz	63	88
Yukon	8 oz	93	-
Steadfast	0.75 oz	86	89
Untreated	-	0	-
LSD (0.05)		8	8

*Applied with 0.25% (v/v) NIS and 2.5% (v/v) 28% UAN.

Steadfast controlled 80 and 86% of the bindweed respectively. Finally, 5 oz/A of NorthStar, a pre-mix of Beacon and the sodium salt of dicamba (the active ingredient in Clarity and Banvel) and 8 oz/A of Yukon, a pre-mix of Permit and the sodium salt of dicamba provided 86 and 93% bindweed control respectively. All treatments will be evaluated again next growing season for long-term (residual) control of this perennial broadleaf weed.

Grain Corn Yields

The heavy bindweed infestation reduced grain corn yields to 23 Bu/A when no MPO application was made for bindweed (Table 2). MPO applications of 8 and 16 oz/A of Clarity produced yields of 137 and 144 Bu/A respectively. When Roundup WeatherMax was applied alone, the yield was 129 Bu/A, but tank mixing 4 oz/A of Clarity with the Roundup increased yield to 154 Bu/A. Tank mixing 4 oz/A of Clarity with Beacon or Permit boosted average yield for these treatments from 87 to 143 Bu/A an increase of 56 Bu/A. Since tank-mixing 4 oz/A of Clarity with Exceed or Steadfast did not improve bindweed control, there was no increase in yields with these tank mixes. When applied alone or with 4 oz/A of Clarity, Exceed and Steadfast treatments yielded an average of 151 Bu/A. The premixes, NorthStar and Yukon produced an average yield of 130 Bu/A.

Summary

Although grain corn yields were somewhat variable (a 28 Bu/A difference was needed to show differences between treatments), improved short-term bindweed control resulted in significant yield increases during the season of treatment. The plot area will be planted to corn in 2005 to determine the effect these treatments will have on residual or long-term bindweed control and grain corn yields the year following treatment.

Table 2. Grain corn yields following mid-postemergence herbicide applications for hedge bindweed control at Aurora, NY in 2004.

Herbicide(s)*	Rate Amt/A	Yield (Bu/A) Alone	+ 4 oz/A Clarity
Clarity	8 oz	137	-
Clarity	16 oz	144	-
RU WeatherMax	22 oz	129	154
Callisto	3 oz	112	-
Beacon	0.76 oz	76	130
NorthStar	5 oz	131	-
Exceed	1 oz	146	150
Permit	1 oz	99	156
Yukon	8 oz	128	-
Steadfast	0.75 oz	156	153
Untreated	-	23	-
LSD (0.05)		28	28

*Applied with 0.25% (v/v) NIS and 2.5% (v/v) 28% UAN.

Calendar of Events

Mar. 8, 2005	Field Crop Industry Day, Holiday Inn, Waterloo, NY
Mar. 15, 2005	Southern Tier Field Crop Workshop, Holiday Inn, Horseheads
Mar. 16, 2005	Madison County Crop Congress, Empire Tractor, Cazenovia
Jun. 2, 2005	Small Grains Management Field Day, Musgrave Farm, Aurora, NY
Jul. 6, 2005	Weed Science Field Day, Valatie, NY
Jul. 13, 2005	Weed Science Field Day, Aurora, NY
Jul. 14, 2005	Weed Science Field Day, Freeville, NY
Jul. 30-Aug. 3, 2005	American Phytopathological Society Annual Meeting, Austin, TX
Oct. 5-7, 2005	Northeastern Division of American Phytopathological Society, Geneva, NY

What's Cropping Up? is a bimonthly newsletter distributed by the Crop and Soil Sciences Department 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: Crop and Soil Sciences, Plant Breeding, Plant Pathology, and Entomology. **To get on the mailing list, send your name and address to Pam Kline, 234 Emerson Hall, Cornell University, Ithaca, NY 14853.**

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