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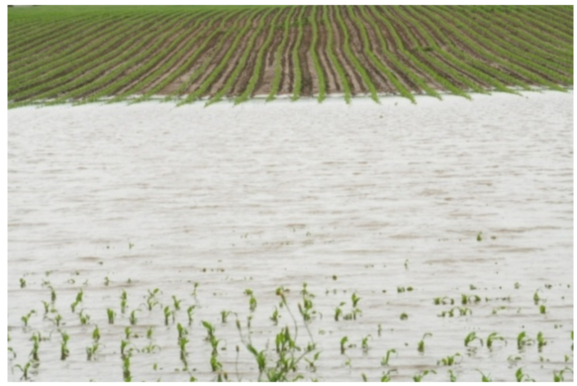
Flooding Impacts on Corn Growth and Yield

Joe Lauer, Corn Agronomist

Recent rains have caused flooding and ponding in many cornfields. Growers are concerned about corn growth and development and any yield effects that might occur from short periods of flooding. The extent to which flooding injures corn is determined by several factors including: 1) timing of flooding during the life cycle of corn, 2) frequency and duration of flooding, and 3) air-soil temperatures during flooding (Belford et al., 1985).

Respiration is the plant physiological process most sensitive to flooding. Flooding reduces the exchange of air (oxygen) between soil and atmosphere eventually leading to decreased total root volume, less transport of water and nutrients through



the roots to the shoot, and formation of sulfides and butyric acid by microorganisms that are toxic compounds to plants (Wesseling, 1974).

Soils contain pores filled with gas and/or water. The two main gases important for respiration are oxygen and carbon dioxide. The pathway for oxygen into the plant is from the atmosphere through soil pores to a thin water film surrounding plant root hairs. It is relatively easy for oxygen to diffuse into soil when pores are filled by air, but oxygen does not easily diffuse in water so the main constraint to oxygen movement is the thin water film surrounding root hairs. This boundary is magnified in flood/pond conditions. Carbon dioxide rarely accumulates to toxic levels in soil (Wesseling, 1974).

Roots are injured if the soil remains waterlogged. Continued poor aeration causes cell death and even death of roots. Measurable short term reductions for root and leaf growth rates begin immediately within 1-12 hours, but tend to recover quickly within 2-3 days (Wenkert et al., 1981). Almost immediately leaf elongation ceases and N, P, and K concentration in leaves decrease, but in roots N, P and K concentrations increase (Ashraf and Rehman, 1999). Flooding restricts root growth in the upper 18 inches of soil, but root elongation continues in deeper horizons. Soil compaction and flooding will restrict root growth more severely than either factor separately (Klepper, 1990).

All biological processes are influenced by temperature (Wesseling, 1974). Wet soils have a large heat capacity and considerable amounts of heat are required to raise their temperature. Thus, usually wet soils are cold and corn growth is slower. Drainage lowers the moisture content of the upper soil layers so air can penetrate more easily to roots, and transport carbon dioxide produced by roots, microbes and chemical reactions to the atmosphere. Lowering soil moisture content also leads to higher soil temperatures and faster growth.

Evaluating damage from flooding

The growing point of corn is metabolically active and is near or below the soil surface prior to V6 (6 visible leaf collars). Within about 48 hours the oxygen supply in a flooded soil is depleted (Purvis and Williamson, 1972; Fausey and McDonald, 1985). Without oxygen, the growing point cannot respire and critical functions are impaired. If temperatures are warm during flooding (greater than 77 degrees F) plants may not survive 24-hours. Cooler temperatures prolong survival. If flooding in corn is less than 48 hours, crop injury should be limited.

To confirm plant survival, check the color of the growing point. It should be white to cream colored, while a darkening and/or softening usually precedes plant death. Also look for new leaf growth 3 to 5 days after water drains from the field. Once the growing point is above the water level, the chances of survival improve greatly.

Things to look for later during the growing season

Even if flooding doesn't kill plants, it may have a long-term negative impact on crop performance. Excess moisture during the early vegetative stages retards root development (Wenkert et al., 1981). As a result, plants may be subject to greater injury later during a dry summer because root systems are not sufficiently developed to contact available subsoil water.
A considerable amount of oxygen is required in the soil for mineralization of nutrient elements from organic matter by microbes. Oxygen deficiencies reduce microbe activity, decreasing the rate at which ammonium and nitrate are supplied to plants resulting in nitrogen deficiency in waterlogged soils (Wesseling, 1974). Additionally, flooding can reduce the activity of mycorrhizae essential for symbiotic phosphorus uptake (Ellis, 1998). Flooding can also result in losses of nitrogen through denitrification and leaching. Where estimated nitrogen loss is significant in fields not yet tasseling and yield potential is reasonable, corn may respond to additional applied fertilizer.

Flooding causes greater crop yield losses when it occurs early in the season (Meyer et al., 1987; Kanwar et al., 1988; Mukhtar et al., 1990; Lizaso and Ritchie, 1997). When six-inch corn was flooded for 24, 48 and 72 h corn yields were reduced 18, 22, and 32% at a low N fertilizer level. At a high N level, these reductions ranged from 19 to 14% one year and <5% in another year (Ritter and Beer, 1969). When corn at a height of 30 inches was flooded for 24 and 96 h, yields were reduced 14 to 30%. With a high level of N in the soil, very little yield reduction occurred even with 96 h of flooding. When flooded near silking, no reduction in yield occurred at a high N level, but yield reductions up to 16% occurred with 96 h of flooding at the low level of N.

Mud and sediment caking leaves and stalks could damage plant tissue and allow development of fungal and bacterial diseases not typically seen. Due to early season stress the plant may be predisposed to root and stalk rots later and harvest timing of fields may need to be adjusted accordingly. A disease problem that may become greater due to flooding and cool temperatures is crazy top, a fungus that depends upon saturated soil conditions to infect corn seedlings. With warmer, wet or humid conditions Pythium can reduce stands despite fungicide seed treatments. There is limited hybrid resistance to these diseases and predicting damage is difficult until later in the growing season.

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Planting Corn in June and July! – What can you expect?

Joe Lauer- Corn Agronomist

Unprecedented rainfall continues to cause flooding and ponding leading to problems for corn establishment on 5 to 10% of planted acres in southern Wisconsin. Flooded and ponded areas have existed long enough now so that plants have been killed and areas need to be replanted. Most planted acres are still in good shape, but fertilizer and herbicide treatments need to be applied as soon as possible since the majority of the crop is at the V4-V5 stage and lay-by (V-10) will be occurring within the next two weeks. What is difficult to predict is the health of plants on the fringes of ponded areas in a field. These saturated areas have likely had N leaching and denitrification as well as impacts on plant health that will show up later in the life cycle.

For areas of fields that have been killed by flooding or ponding the following guidelines should be considered:

1. Corn can be planted for grain until June 1-5 in northern Wisconsin and until June 10 in southern Wisconsin. Risk has increased from earlier planting dates and is as great as average yield with increasing downside risk and frequent yield extremes caused by the environment.

2. After June 10, the only viable grain option is soybean until the last week of June.

3. Corn can be planted for silage uses until about June 24.

4. During the last week in June, the objective of growers needs to change from planting crops for grain and silage production to emergency dry matter production.

5. Finally, consider whether a crop should be planted at all? The best decision may be to fallow the land and control weeds.

6. Numerous emergency forages have been tested (http://www.uwex.edu/ces/forage/wfc/proceedings2003/emergencyforage.htm). These results indicate that corn can be good emergency forage when planted in June and July.

7. We conducted experiments during 2005 and 2006 to determine what could be expected by planting corn in June and July. Three corn hybrids (brown midrib, full-, and shorter-season) were planted on five different dates from April 28 to August 1 at Arlington, WI. The 2005 growing season had a killing frost on October 26, which was three weeks later than normal.

8. Seasonal dry matter production after planting during July ranged from 0.7 to 7.5 Tons DM/A while the same hybrids planted April 28 to June 1 produced 8.7 to 10.0 T DM/A (Table 1). Milk per acre is significantly lowered 92 to 17% to levels ranging from 2,300 to 24,000 lbs milk/ A for planting dates in July. Crude protein, NDF and NDFD increased with later planting dates. Although, little starch content was measured in later planting dates, overall milk per Ton tended to decrease slightly. Thus, relatively small changes in Milk per ton occurred during planting dates in July with levels ranging from 2600 to 3200 lbs milk/T, which was a 16 to 22% decrease from corn planted April 28 to June 1.

9. Full-season hybrids produced the greatest dry matter yield and Milk per acre when planted during July (Table 2). No significant interaction among corn hybrid types was measured for Milk per Ton, although brown midrib hybrids tended to produce the best quality.

10. Corn can produce significant dry matter yield when planted during July, but the amount produced depends upon when a killing frost occurs. Growers need to check on options available from their insurance companies before taking action and planting corn in late June and July for emergency forage. Herbicide labels must be adhered to before switching to other crops. A small amount of fertilizer may be justified in replanted areas. There is no guarantee that flooding and ponding will not occur again later during the growing season.

Table 1. Corn silage yield and quality response to planting date at Arlington, WI. Values are averaged across brown midrib, full- and shorter-season hybrids.

Planting date	Harvest date	Season GDUs	Forage yield	Crude protein	NDF	NDFD	Starch content	Milk (2006)	
			T/A	%	%	%	%	lbs/T	lbs/A
2005									
April 29	September 9	2369	9.5	7.4	43	60	34	3400	32500
June 1	September 21	2325	10.0	7.0	46	59	32	3300	33300
June 30	November 1	1996	7.5	7.7	51	62	20	3100	24000
July 15	November 1	1694	5.6	8.2	54	66	12	2900	16500
August 1	November 1	1304	2.8	9.6	59	73	1	2600	7300
R2			0.82	0.99	0.99	1.00	0.92	1.00	0.94
2006									
April 28	September 8	2242	9.1	7.7	45	57	33	3300	29700
June 1	October 25	2197	8.7	8.4	42	56	35	3300	28900
June 30	October 25	1723	5.9	8.9	55	63	18	3100	18500
July 14	October 25	1442	3.5	10.3	68	64	0	2800	10000
July 31	October 25	1036	0.7	12.4	68	75	0	3200	2300
R2			0.97	0.96	0.99	1.00	0.79	NS	0.99

GDUs= Growing Degree Units from planting until harvest or killing frost
Date when minimum temperature <= 28 oF: 2005= October 26; 2006= October 12

Table 2. Corn silage yield and quality response to planting date at Arlington, WI. Values are averages of 2005 and 2006.

Planting date	Forage yield	Crude protein	NDF	NDFD	Starch content	Milk (2006)	
	T/A	%	%	%	%	lb/T	lb/A
Full-season hybrid (108 d RM)							
April 29	10.0	7.4	43	56	35	3300	33300
June 1	10.3	7.3	44	55	34	3300	33800
June 30	7.5	8.0	56	60	17	3000	22600
July 15	5.3	9.4	61	63	8	2900	15300
August 1	2.1	11.1	64	72	1	2800	5600
R2	0.87	0.82	0.76	0.87	0.88	0.57	0.87
Shorter-season hybrid (94 d RM)							
April 29	9.4	7.4	42	55	37	3300	31500
June 1	9.4	7.7	41	54	39	3300	31300
June 30	7.0	8.6	50	57	23	3100	21900
July 15	4.7	9.5	60	63	8	2800	13500
August 1	1.9	11.3	63	72	1	2800	5000
R2	0.89	0.79	0.82	0.91	0.88	0.54	0.90
Brown midrib hybrid							
April 29	8.4	7.9	47	63	28	3400	28500
June 1	8.3	8.2	47	64	27	3400	28200
June 30	5.9	8.3	53	69	17	3300	19300
July 15	3.8	9.0	62	73	3	2900	10900
August 1	1.4	10.6	65	79	0	3000	3800
R2	0.89	0.78	0.79	0.89	0.89	0.47	0.88
Hybrid * Planting date interaction	**	**	**	**	**	NS	**

Bmr hybrid: 2005= 112 d RM and 2006= 102 d RM

Alfalfa Weevil Development

Bryan Jensen, IPM Program

There has not been any widespread insect problems reported lately, but there have been some isolated reports of a few different problems. Alfalfa weevil is one that should be mentioned. First crop harvest has been delayed in many areas because of rainy weather and alfalfa weevil development has been slowed because of cooler than normal weather. Although some defoliation may be apparent in first crop, the best decision of course is to cut as soon as possible. Larvae which survive and feed on second crop is more difficult to assess. The established threshold for second crop damage is to treat when 50% of the stems have feeding symptoms. However, you should take this recommendation to the next level and assess the age structure of the weevil population. Ask yourself how much damage can I prevent? Southern Wisconsin weevil degree days suggest that weevils have started to pupate. Alfalfa weevil larvae go through four instar stages, As fourth instars, weevil larvae are approximately 3/8 inch long and only require 91 degree days before pupating. At daily high and low temperatures of 75 and 60 degrees respectively, this takes approximately 5 days. So watch weevil degree day accumulations at http://www.soils.wisc.edu/wimnext/crops.html for your area and assess the age structure of your fields to see potentially how much damage you can prevent.

Image 1- Alfalfa weevil cocoon

Image 2- Fourth Instar Alfalfa Weevil

What else is going on??

Bryan Jensen, IPM Program

There have been a few reports of armyworm damage on corn planted after a small grain cover crop or in dense weed growth. This is not out of the ordinary for this time of the year. But it does make you wonder what is happening in wheat. I've noticed some lodging of wheat from recent storms. These lodged area are some of the first places I would monitor for signs of armyworm feeding. We normally thing of armyworms feeding on leaves but once the small grain has headed, armyworms can/will clip the stem off just below the head.

There have been some reports of slug feeding and a few of those reports have indicated severe injury. The cool, rainy weather we've had is very favorable to slug survival as is the presence of crop residue or weed growth. Given the value of corn it could be worth the time and effort to spot check likely areas. Although there is not a lot of threshold information available for slugs, I would suggest that you take into consideration the size of the crop and future growing conditions before treating. I would have a hard time suggesting treatment if feeding is concentrated on the lower leaves of corn that is growing rapidly. Especially if good growing conditions are predicted and there are no other reasons to think the crop is stressed. If the reverse is true I could feel more comfortable treating if weather conditions were to remain cool and cloudy. Remember that slugs are not controlled by insecticides. The use of appropriately labeled slug baits is sometimes an economical, if not temporary solution. Control may be reduced if rains breaks down the bait. and cool growing conditions (that are favorable to slug survival) persist. The best control method is warm, sunny weather that not only hastens corn growth but also increases slug mortality.

UW-Extension/Madison Plant Disease Diagnostic Clinic (PDDC) Update

Brian Hudelson, Ann Joy, Amy Gibbs, and Brooke Weber, Plant Disease Diagnostics Clinic

The PDDC receives samples of many plant samples from around the state. The following diseases/disorders have been identified at the PDDC since June 11, 2008:

PLANT	DISEASE/ DISORDER	PATHOGEN	COUNTY
FIELD CROPS			
Wheat	Kernal Abortion	None (Environmental)	Sheboygan
FRUIT CROPS			
Pear	Transplant Shock	Physiological	Outagamie
Strawberry	Angular Leaf Spot	*Xanthomonas fragariae*	Fond du Lac
VEGGIES			
Potato	Pythium Shoot Blight	*Pythium* sp.	Portage

For additional information on plant diseases and their control, visit the PDDC website at pddc.wisc.edu.

Balancing Herbicide Drift vs Spray Timing

Chris Boerboom, Extension Weed Scientist

Three recent events trigger this article. First, a call from a landowner with significant concerns after watching a herbicide application with winds alleged at 20 mph blowing towards their berry crop. Second, yesterday's wind that was gusting well over 20 mph and preventing herbicide applications at a time when we need to spray our trials just like many custom applicators and growers who need to spray corn fields. Third, a call asking about the risk of dew affecting glyphosate performance if spraying in early mornings to avoid the wind.

All together, these items highlight two of the major risks with postemergence herbicides – drift and the pressure to spray. The risk of drift is certainly real with numerous rural residential properties, vegetable, organic, or other sensitive field crops, and other sensitive sites. Last week's rains, wet fields, and winds have placed many applicators under pressure to catch up. Be careful and be smart out there. Use drift reducing technology such as drift reduction agents, spray nozzles that increase droplet size, higher spray volumes, and lower boom heights. Remember that these steps are drift reducing technologies, not prevention strategies. The best combination of technologies will not prevent drift in a high wind.

If you have a highly sensitive site (also known as a claim that would be expensive to settle), consider if you can delay the application until the wind direction shifts away from the site or delay the application until early morning or late evening when wind speeds may be lower. An application with a consistent 3-5 mph wind blowing away from a highly sensitive site is ideal as herbicides never drift upwind (studies have proven this just in case there is any doubt).

As for the question of spraying glyphosate in early morning or late evening to avoid the wind, is this a good idea with the potential of dew at these times? The clear advantage of spraying at this times of day is being able to continue spraying, hopefully when weeds are smaller and easier to control. The two concerns are if dew will affect performance and if glyphosate performance will be reduced with the early or late time of day. Based on the limited amount of research on dew's effect, I would not be overly concerned about dew unless the weeds are literally dripping wet such that spray drops cause the dew to run off the leaves. While the dew may dilute the concentration of the glyphosate, which could lessen performance, this is likely compensated for by the greater hydration of the leaf surface (i.e. slower drying and better absorption). I am more concerned about the time of day effect on glyphosate's performance. Research has shown glyphosate applications before 6 a.m. or after 7 to 8 p.m. can have reduced weed control. This effect will be seen more on broadleaf weeds, on larger weeds, and with lower glyphosate rates. While this potential exists, I would still recommend spraying at these hours to avoid wind near sensitive sites and use full glyphosate rates for the weed size being sprayed and spray while the weeds are still smaller. This should minimize the overall risk of reduced glyphosate performance.

Fortunately, the weather has been calm today and I hope everyone has a great week making effective herbicide applications without risks of drift.

Potential for Nitrogen Loss from Heavy Rainfalls

Carrie Laboski, Extension Soil Scientist

Rainfall totals over the past week (June 4 to 10) in the southern half of Wisconsin range from 3 to 12 plus inches. Many soils are saturated and some fields have had or still have standing water in all or part of the field. The million dollar question is: How much nitrogen (N) loss should I expect from denitrification or leaching and what should I do about it? I'll discuss how to evaluate the potential for N loss and corrective measures that may be taken.

Denitrification:

Denitrification is the process whereby nitrate is converted to the gases dinitrogen or nitrous oxide and subsequently released to the atmosphere. This conversion is carried out by soil bacteria. Denitrification can be a significant mechanism for N loss on medium- and fine-textured soil. It is generally not an issue on coarse-textured soils because they do not remain saturated for any length of time. There are several environmental factors that determine if denitrification occurs and to what extent.

1. *Nitrate.* Nitrate must be present for denitrification to occur. If nitrate is not present or is in low concentrations, denitrifiaction losses will be minimal.
2. *Soil water content and aeration.* Denitrification occurs in wet soils with low oxygen concentrations. Denitrification increase with the length of time the soil is saturated. Standing water may result in a greater percentage of nitrate being denitrified.
3. *Temperature.* Denitrification proceeds faster on warmer soils, particularly when soil temperature is greater than 75°F.
4. *Organic matter.* Denitrification occurs because soil bacteria are breaking down organic matter under low oxygen conditions and the bacteria use nitrate in a biochemical process. Soils with low soluble organic carbon will have less potential for denitrification than soils with high soluble organic carbon. Thus, nitrate that resides deeper in the soil profile (eg. below 12 inches) where there is less organic matter will have a greatly reduced or minimal probability of being denitrified.
5. *Soil pH.* Denitrification is negligible in soils with a pH < 5.0. Thus, pH likely doesn't limit denitrification on most of our cropland in Wisconsin.

Table 1 shows the combined effect of soil temperature and days of saturated soil on N loss. Current soil temperatures vary throughout the state but have been in the 75 to 80°F range at many locations over the past few days. Thus, there is the possibility for significant N loss if soils remain saturated for more than three days.

Table 1. Estimated N losses from denitrification as influenced by soil temperature and number of days the soil is saturated.

Soil temperature (°F)	Days saturated	N loss (% of applied)
55 to 60	5	10
	10	25
75 to 80	3	60
	5	75
	7	85
	9	95

(From Shapiro, University of Nebraska)

It is important to keep in mind that nitrate must be present for denitrification to occur. So N losses will depend on the form of N that was applied and the time between application and saturated soil conditions. Table 2 provides estimates of the time it takes for various N fertilizer materials to transform to nitrate. Conversion of ammonium based fertilizers to nitrate takes 1 to 2 weeks. Urea must first be hydrolyzed to ammonium before it is converted to nitrate. If a urease inhibitor was used with urea, then the length of time that it takes for urea to convert to ammonium may be extended 10 to 14 days depending upon the rate of inhibitor used. Injection of anhydrous ammonia increases the soil pH for several weeks, which in turn limits the amount of ammonium that is converted to nitrate. If a nitrification inhibitor was used, it will also extend the time it takes for ammonium to convert to nitrate.

Table 2. Approximate time until fertilizer N is in the nitrate form.

Fertilizer material	Approximate time until ammonium	Approximate time until nitrate
Ammonium sulfate, 10-34-0, MAP, DAP	0 weeks	1 to 2 weeks
Anhydrous ammonia		3 to 8 weeks
Urea	2 to 4 days	1.25 to 2.5 weeks
Ammonium nitrate	25% is ammonium, 0 weeks	25% in 1 to 2 weeks 25% is nitrate, 0 weeks
UAN	50% from urea in 2 to 4 days 25% is ammonium, 0 weeks	50% in 1.25 to 2.5 weeks 25% in 1 to 2 weeks 25% is nitrate, 0 weeks

Here's an example of how to estimate the amount of nitrate that might have been lost. If 120 lb N/a as UAN was applied after planting corn and four days before saturated soil conditions existed and the soil remained saturated for five days, you might expect 20-25 lb N/a to have been denitrified. 120 lb N/a x 25% = 30 lb N/a in the nitrate form, assuming minimal conversion of ammonium and urea to nitrate (Table 2). 30 lb N/a as nitrate x 75% of nitrate denitrified over 5 days = 22.5 lb N/a lost. Please note that these are estimates of N loss, and should not be considered exact.

Another method that could be used to assess the N status of your fields is to use the pre-sidedress nitrate test (PSNT). If the concentration of N in this one foot soil sample is greater than 21 ppm, then there should be adequate N for the crop. There are a couple caveats when using the PSNT in this manner. First, it will work best if N was broadcast rather than band applied. Soil samples collected from fields where N was banded, may not accurately represent the N status of the field. Second, even in medium- and fine-textured soil, nitrate may have moved into the second foot of soil. In this case, the PSNT won't measure all of the N that is in the root zone and available for the crop.

If all or most of your N for corn is coming from an organic N source (manure and/or forage legume), then the PSNT can still be used to estimate N credits that are subtracted from your selected maximum return to N (MRTN) N rate. Note: when average May-June soil temperatures are more than 1°F below the long-term average, the N credit is often underestimated. For more details on how to use the PSNT see UWEX Publication A2809 *Nutrient application guidelines for field, vegetable, and fruit crops in Wisconsin* (http://www.soils.wisc.edu/extension/).

If all of the N was applied prior to the heavy rainfall, try to determine how much N loss may have occurred using one or a combination of the methods just described. The next step is to decide whether or not you need or want to apply supplemental N fertilizer to your corn crop. When making this decision, compare the amount of N loss (in lb N/a) that you think may have occurred to MRTN rate and profitable range of N rates for your N:corn price ratio. For example let's say that corn follows soybean on a high yield potential soil and you applied 130 lb N/a preplant and now estimate that you lost 25 lb N/a. If your N:corn price ratio is 0.10, then the profitable range of N rates is 100 to 130 lb N/a. Thus, even with some N loss, you might still be within the profitable range of N rates. For more information on the MRTN, see UWEX Publication A2809 *Nutrient application guidelines for field, vegetable, and fruit crops in Wisconsin* (http://www.soils.wisc.edu/extension/).

Yield loss from under application or loss of N is real. When looking at N rate research at 35 sites across Wisconsin in 2006 and 2007, we found that using the MRTN rate for the 0.15 N:corn price ratio resulted in yield losses ranging from 6 to 11% at 20% of the sites. By comparison, 48% of the sites experienced 0 to 1% yield loss at the MRTN rate for the 0.15 N:corn price ratio. Note that these yield losses do not take into consideration the cost of N, so they should not be confused with a loss in profitability. If you are uncertain how much N may have been lost and the corn is clearly deficient in N, then application of 50 lb N/a should result in profitable yield increases.

If you are not yet comfortable using the MRTN approach to selecting N rates, remember the greatest yield increase comes from the first 50 lb N/a applied to the crop. Thus, if you estimate that 100 lb N/a or more may have been lost then apply supplemental N at a rate equal to about 50% of the amount of N lost.

Where the entire crop N requirement has not yet been applied, sidedress or other postemergence applications should contain the balance of the crop N requirement plus 25 to 50% of the fertilizer N that was already applied.

Options for applying supplemental N when it is needed include traditional sidedressing with anhydrous ammonia or N solutions. UAN solutions can also be applied as a surface band or as a broadcast spray over the growing crop. Dry N fertilizers (urea, ammonium sulfate, or ammonium nitrate) can also be broadcast applied to the crop. Leaf burning from solution or dry broadcast applications should be expected. Appling the dry materials when foliage is dry will help minimize burning. Broadcast N rates should be limited to 90 lb N/a for corn with 4 to 5 leaves and to 60 lb N/a for corn at the 8-leaf stage. Under N deficient conditions, corn will respond to supplemental N applications through the tassel stage of development if the N can be applied.

Leaching: Nitrate is the form of N that can be leached when precipitation (or irrigation) exceeds the soil's ability to hold water in the crop root zone. Leaching is a much bigger issue on sandy soils that typically hold 1 inch of water per foot of soil compared to medium- and fine-textured soils that hold 2.5 to 3 inches of water per foot of soil. Rainfall totals over the past week likely caused nitrate leaching out of the root zone for potato (18 to 24 inch root zone) and perhaps also corn (~36 inch root zone) grown on sandy soils. To determine if nitrate could leach out of the root zone, compare the rainfall totals in your area to the number of inches of water that your soil can hold in the crop root zone.

The amount of N loss from leaching is dependent not only on rainfall, but also on the amount of N in the nitrate form. Using the information in Table 2, it is possible to estimate how much nitrate may have been leached. For example, if 75 lb N/a as ammonium sulfate was applied when potatoes were planted four weeks prior to the rainfall, and 125 lb N/a as ammonium nitrate was applied three days before the rainfall, then 135 to 140 lb N/a may have leached. The 75 lb N/a as ammonium sulfate at planting would have already been converted to nitrate plus 50% of the 125 lb N/a as ammonium nitrate is in the nitrate form = 137.5 lb N/a. The potato crop will have used some of the N that was applied at planting, thus leaching losses will be less than 135 lb N/a

Urea is highly water soluble. If the leaching rainfall occurred before urea had time to hydrolyze (2 to 4 days), then urea may have leached. However, if there were more than 4 days between urea application and the leaching rainfall, then it is likely that all of the N would have converted to ammonium and remains within the root zone.

Nitrogen best management practices for corn on sandy soils is to sidedress or split apply N. If sidedress N applications have not yet occurred, then growers should proceed as planned. If split N applications have occurred, supplemental N should be applied and should equal the approximate amount of nitrate that may have leached out of the root zone. Corn grown on irrigated sandy soils are highly responsive to N fertilization. On non-irrigated sandy soils, water (usually too little) limits crop yield more than N. Under N deficient conditions, corn will respond to supplemental N applications through the tassel stage of development if the N can be applied.

Many potato fields may have already received their last application of N fertilizer and are quickly nearing the maximum rate of N uptake for the crop. Thus it is imperative to make sure that there is adequate N for the crop. Nitrogen can be applied up to 60 days after emergence; later applications may not improve yield or quality. Supplemental N application rates could be in the range of the amount of nitrate that was leached from all N applications applied after planting. Monitor the crop's N status using the petiole nitrate test to determine if later N applications may be needed. For more information on the petiole nitrate test, see UWEX Publication A2809 *Nutrient application guidelines for field, vegetable, and fruit crops in Wisconsin.*

For irrigated corn or potato fields, N solutions can be injected into the irrigation water (fertigation). Water application rates should not exceed the infiltration rate of the soil and should not exceed the soil's ability to hold the water in the root zone of the crop. Thus, if the soil profile is full of water, you may need to wait a few days before fertigating. The key is to manage the water so that the N fertilizer that is being applied is not leached.

Vegetable Crop Update - #5

Important Dates:

Haltvick Meeting, University of Minnesota-Waseca –
June 24, 2008, 12:00 – 3:00 pm

Rhinelander Ag Research Station Field Day –
July 11, 2008, 10:00 am – 1 pm

Farm Technology Days, Brown County –
July 15-17, 2008

Central Wisconsin Potato Field Day, Hancock –
July 23, 9:00 am - 12:00 pm

Langlade County Potato Field Day, Antigo –
July 24, 1:00 pm – 3:00 pm

Potato and Vegetable Crop Update

Alvin J. Bussan, UW-Madison, Department of Horticulture

Heavy rains 7 to 10 days ago have been the prominent weather event creating management and production issues in Wisconsin vegetable crops. Unfortunately severe damage has occurred to more than crops across many portions of the state with multiple roads, highways, and interstate closures as well as personal and public property damage. Our thoughts and concerns to anyone facing flood damage.

Potato Update. Growing conditions since last Friday have favored crop growth with sunny conditions and moderate temperatures. Some potatoes have closed canopy since last week depending on variety and planting dates whereas later planted or slower growing potatoes are still only 25 to 30% closed. Bannock Russet for example is still only 30% canopy closure whereas Russet Burbank is close to 90% canopy closure. Flower buds are evident with several varieties already in full bloom.

We are well into early bulking for many potato cultivars in Central Wisconsin. The tubers are about 5 to 7 days off last year's pace. The largest Russet Norkotah tubers are about 1" in diameter by 1.5" in length or 75% of the size compared to last year. Red Norland at Hancock were 1" in diameter or about half the size of tubers compared to last year. Snowden, FL1867 and FL1879 tubers were ¾ to 1" in diameter yesterday at Hancock.

Processing Crops Update. Heavy rains across the state on Thursday, June 13 or before has lead to some crusting issues in coarse and medium textured soils. At Hancock, Snap beans planted on June 12 are having a difficult time emerging through this crusted soil and germinating seeds show symptoms of being impacted by compaction. Sweet corn emergence is also slow to emerge through these soils as well. On medium textured soils, crusting is severe in some locations and is preventing emergence of snap bean and sweet corn. If irrigation is available, you may want to apply 1/4" of water to soften the ground and facilitate emergence. On heavier textured soils, rotary hoeing may be necessary to break up the crust on sweet corn. DO NOT rotary hoeing snap beans as it will break stems and cotyledons.

Fresh Market. Crusting may be a substantial issue for fresh market growers as well especially delayed or sequence plantings of small seeded vegetable crops, sweet corn, etc…. Crop emergence should occur within 5 to 7 days of planting. Investigate stands of vegetable crops planted before June 12 to determine how well crop is emergence through crusted soils. Lightly irrigate soils to soften the crusted layer to promote emergence. Rotary hoeing or working the soil lightly with tools that mimic the action will improve the establishment of crops through these soils. If you decide to till and replant areas where stands are poor pay close attention to replanting instructions for any herbicides you may have applied (see last weeks newsletter for specific replanting instructions from Jed Colquhoun).

A bigger concern may be the safety of vegetables from flooded fields. DATCP will provide information on management of flood damaged fields for next week's newsletter. Specific information regarding replanting, safety of produce from plants surviving flooding, and appropriate contacts regarding safety of produce will be available. Until that time, call the Division of Food Safety within Department of Agriculture, Trade, and Consumer Protection at 608-224-4700 for immediate questions or concerns.

Vegetable Insect Update

Russell L. Groves, Vegetable Entomologist, Applied Insect Ecologist, UW-Madison, Department of Entomology

Potatoes – Adult Colorado potato beetle (CPB) emergence and colonization in fields is drawing to a close. Although colonization in the Central Sands is lessening, adult beetles are still actively mating and continue to lay eggs. At the same time, early larval stages are becoming quite abundant resulting from the hatch of early egg masses laid 10-14 days ago. Growers and practitioners should pay close attention at this time to fields which received at-plant systemic insecticides. As noted last week, full rates of the neonicotinoids (e.g. Platinum, Belay, AdmirePro) should continue to be effective in controlling these hatching, early larvae if no product insensitivity (resistance) is established. If you notice widely distributed, in-field populations of these early larvae continuing to persist and feed in plant terminals, it is important to consider foliar applications at this time to minimize the threat of the second generation of CPB. Populations of CPB in northern Wisconsin are only beginning to become prevalent in many field locations and, like the Central Sands, have had their season extended into the late spring by the cool and wet weather.

Again in 2008, our laboratory is performing assays of adult CPB populations collected in Wisconsin to investigate the potential for increasing levels of insensitivity to the neonicotinoid class of insecticides. Similar to 2007, we are again beginning to see some selected populations of adult beetles with elevated LD_{50} values. Recall that these values are a relative measure of the ability to control a test population and very specifically determines the lethal dose of a compound (ppm) required to kill 50% of this population. Preliminary assays on selected populations of overwintered, adult CPB again document resistance ratios in the 10-fold range. It is important to note, however, that some populations can have as high as 20-fold levels of insensitivity and still be controlled with the compound in question on a field scale (e.g. > 90% control).

Cole Crops & Cabbage – In many portions of southern Wisconsin, many direct seeded cole crops are just emerging from the soil as a result of later planting dates and cool weather. Transplants are a bit farther along in some locales nearing the 9-10 leaf stage. In general, pest pressure in these crops remains quite low for the year and we have only just begun to see emerging adult cabbage white butterflies as well as some eggs. Remember, imported cabbage worm will overwinter in Wisconsin and generally becomes established first on early cole crops. Damage as a result of adult flea beetle feeding is now becoming present, but relatively low numbers of these insects have been documented so far.

Potato leafhopper – Adult potato leafhopper (PLH) have again been observed at our experimental sites at both the Arlington and Hancock, AES. Those adults captured in sweep samples from potato averaged 2-4 adults / 25 sweeps which remain below the established threshold for this pest. Remember, however, that PLH can move into Wisconsin relatively quickly and can build to significant populations over a short interval of time. Frequent scouting of susceptible crops is warranted in potato as well as recently emerged snap beans in the state, as populations can increase quickly with migratory weather events.

Has the Flooding Impacted Your Farm

Laura Paine, Grazing and Organic Agriculture Specialist, Wisconsin Department of Agriculture Trade and Consumer Protection

The heavy rains and flooding have once again hit southern Wisconsin vegetable growers. As part of the Emergency Response Team at the Department of Ag, I'm working on gathering documentation on the extent of the damage we saw on vegetable farms.

Please share damage estimates due to flooding with me on types of crops and acres affected, and dollar value losses. We would also like to know about any equipment and building damage. You can email, call, or fax your information to me. Here's my contact information: Laura Paine, laura.paine@wi.gov; 608-224-5120 (phone); 608-224-5110 (fax).

After last August's floods, we were able to document more than $3.3 million in vegetable crop losses from just 25 farms. This contributed to the documentation used to place counties under the federal disaster declaration.

There are currently seven counties under the federal disaster declaration (Vernon, Richland, Sauk, Columbia, Dodge, Milwaukee, and Racine). We expect more counties to be added as we gather information. The newly passed Farm Bill has provisions for much easier access to disaster assistance. Contact your local USDA office for information on what is or will be available.

Other sources of flood information include the following:

http://www.datcp.state.wi.us/

http://www.uwex.edu/ces/ag/issues/ExtensionResponds-Flood.html

Vegetable Disease Update

W. R. Stevenson, Department of Plant Pathology, UW-Madison

Potatoes – Late Blight Spray Threshold Alert Continues:

There are still no reports as of today of late blight anywhere in the nation. There continue to be no samples of late blight in Wisconsin and no early blight. The accumulation of late blight severity values slowed with the arrival of sunny skies and lower RH. You will note that we have surpassed the spray threshold of 18 severity values at Antigo (earliest planting), Grand Marsh and Plover. We are within one severity value of the spray threshold at Hancock. This means that growers should be treating their earliest emerging fields with a protectant fungicide. For some fields, this will be at least their second to third fungicide spray of the season. Since we have not seen the first late blight symptom yet, I'm still suggesting that the protectant fungicides be used at this time (maneb, mancozeb, chlorothalonil, metiram, fixed copper). Sprays should be applied to achieve maximum coverage of leaves and stems. New growth needs protection so shortening the spray interval may be necessary if adverse weather conditions resume. We have a long list of late blight fungicides waiting in the wings if we need them to manage a late blight situation.

Early blight is beginning to appear on the oldest most mature foliage. We'll be seeing early blight pressure heat up in the weeks ahead, particularly since we are approaching 300 P-Days when we normally focus our attention on early blight management. Once we hit the magic 300 P-Day threshold, we can begin thinking about adding a strobilurin fungicide to the mix and working a spray of Endura into the program, usually about 400 P-Days. We will say more about that in another week or so. Also for early blight management, you need to carefully consider the crop's nutritional needs and carefully read Carrie Laboski's comments in last week's newsletter on the effect of rain on N leaching. The plant susceptibility to early blight increases on N deficient plants, particularly as the plants begin to bulk, thereby making early blight more difficult to manage with fungicide sprays.

	Planted:	50% EMERGENCE	P-Days	Severity Values	Calculation Date
Antigo area	Early - May 7	June 4	98	**23**	
	Mid - May 15	June 11	37	7	
	Late – May 23	June 18	--	--	
Grand Marsh area	Early - Apr 20	May 23	181	**19**	Jun 16
	Mid - Apr 29	May 28	151	**19**	Jun 16
	Late - May 5	June 2	119	**19**	Jun 16
Hancock area	Early - Apr 16	May 10	241	17	Jun 16
	Mid - Apr 23	May 16	214	17	Jun 16
	Late - May 2	May 23	178	17	Jun 16
Plover area	Early - Apr 14	May 15	217	**22**	Jun 16
	Mid - Apr 22	May 23	175	**22**	Jun 16
	Late - May 3	June 1	123	**20**	Jun 16
Spooner	Apr 30	June 2	121	0	Jun 16

Table 1- Current P-Day (Early Blight) and Severity Value (Late Blight) Accumulations

Visit our web site at (**http://www.plantpath.wisc.edu/wivegdis/index.htm**) where you can find updated P-Day and Severity Value information throughout the growing season.

Peas: Fields should be examined for symptoms of root rot and epicotyl decay since many fields have been sitting in overly wet warm soil for extended periods. As the soils dry and plants begin to mature, they are going to be under a great deal of stress. Yields will likely take a hit as foliage begins to show the effects of below ground decay.

Snap Beans: The same situation holds true for the early planted snap beans. Cultivation can often scuff enough soil against the stem to encourage the development of adventitious roots. These roots will often keep the plant growing and help the plant produce a marketable yield, although it may be a yield below what was anticipated at planting.

It's too early to say whether white mold will be a problem this year, but for those fields not yet planted, you might consider the application of the biocontrol Contans. This biological material needs to be disked into the soil immediately after application. Once in the soil, the fungus ingredient (*Coniothyrium minitans*) attacks the white mold sclerotia and begins to weaken and rot the sclerotia. We've observed that *C. minitans* persists in Wisconsin soil up to 5 years and assists in the overall control of white mold. It's likely that fumigation will kill the biocontrol so this needs to be taken into account when considering a fumigation for control of soilborne diseases for other crops.

Other Vegetable Crops: Our soils remain wet and as we push the envelope on planting, I anticipate a banner year for Pythium and Phytophthora root rots. Growers planting into fields with a history of root rots might want to consider application of mefenoxam fungicide at planting. Check the label carefully before application to be sure this material is registered for the crop you intend to plant.