August 13, 2001 -- Vol. 16, No. 16

Field Crop Advisory Team Alert

In this issue

Special drought issue

July - August 2001 brings a drought to Michigan

In most of Michigan, crops are being stressed by extremely dry conditions with unusually high heat. Meteorologist Jeff Andresen notes that Summer 2001 is reminding many of the drought that occurred in 1988.

We can't make it rain, but we have asked our specialists at MSU to consider the effects of drought on their particular areas of expertise and offer advice for these unusual conditions. We hope that rained is headed this way, but in the meantime, we offer these articles for your consideration. Please look for updates at the CAT Alert web site at: http://www.msue.msu.edu/ipm/aboutcat.htm *– Joy N. Landis, editor*

Harvesting drought stressed corn for silage

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When to harvest for silage

Corn should be harvested for silage when the whole plant dry matter is between 30 and 35 percent. The recommended harvest moisture ranges are the same for drought stressed corn as for corn grown under ideal soil moisture conditions (see Table 1).

During drought conditions, some of the corn plants may appear quite dry because the leaves are brown and dry, but just having dry leaves is not an accurate indicator of whole plant dry matter content. The stalk, cob and grain contain the majority of the whole plant moisture. Attempting to predict when to harvest corn for silage based on just looking at parts of the plant may result in the corn being harvested at less than ideal dry matter levels. The reason whole plant dry matter at harvest is so important because the ideal dry matter for the silage fermenting bacteria and the prevention of silage juice seepage is between 30 to 35 percent.

Harvesting at dry matters lower than 30 percent (too wet) can result in an undesirable silage fermentation process that may result in unpalatable silage that can reduce cow dry matter intake. Also, corn silage harvested at wetter than 30 percent dry matter will usually result in seepage run-out from silage storages.

Harvesting at whole plant dry matter above 35 percent (too dry) can result in a poor fermentation because the material was too dry and there was not sufficient moisture for the fermenting bacteria and adequate packing. The silage may not contain sufficient acid levels and may start heating during feed-out for the silo or bunker. In addition, silage drier than 35 percent might have decreased digestibility of fiber and starch.

Whole plant dry matter should be monitored starting a few weeks before traditional corn silage harvesting dates. The dry matter content of corn plants can decrease rapidly once the plant starts to dry down. When dry matters start to approach 30 percent, monitoring every day or two of plants from different fields will help assure that no fields will be harvested outside of the desirable dry matters. Drought-stressed corn can dry down very rapidly if the plants are not actively growing, especially on days when the temperature is very hot and there are strong, dry winds.

Table 1. Recommended harvest dry matter for different types of storage structures

Storage structure	% Dry matter ranges
Bunker	30 – 35
Upright – non-sealed	32 – 40
Sealed Upright	32 - 40
Silage Bags	32 - 40

Table 2. Nitrate (NO_3) levels in drought-stressed corn plants.

Plant part	NO_3 (parts per million)
Leaves	284
Ears	75
Upper 1/3 stalk	678
Middle 1/3 stalk	3,557
Lower 1/3 stalk	24,471
Whole plant	4,333

How to determine whole plant dry matter

The only way to accurately determine when the whole corn plant is at 30 percent dry matter is to use a moisture tester. A Koster™ moisture tester or microwave oven can be used to obtain an accurate dry matter.

Hand cut 15 to 20 whole corn plants at the normal chopping height (about four to six inches) from throughout a field, but not from headrows because the plants might be drier there. Chop the entire stalks into silage particle sizes. Monitor those fields and locations every two to three days by again obtaining 15 to 20 stalks for dry matter testing. This method will track the changes in dry matter and the rate at which the plants are drying down. This will aid in predicting when to start harvesting.

Kernel milk line or kernel dry matter as a method to determine whole plant dry matter

Kernel milk line has been found to not be an accurate indicator of whole plant dry matter. Research at Michigan State University and elsewhere found the whole plant dry matter varied as much as 15 percent when kernel milk line was used to predict whole plant dry matter. Thus, kernel milk line is not an acceptable method to predict whole plant dry matter.

Kernel dry matter has also been found to not be an accurate indicator of whole plant dry matter. This is the case for drought stress and non-drought stressed corn kernels.

Thus, the only accurate and acceptable way to monitor whole plant dry matter for deciding when to harvest corn for silage is to use a Koster™ moisture tester or the microwave oven method.

Nitrate toxicity potential

High nitrate concentrations in corn plants and corn silage can potentially be toxic to cattle.

Nitrates are normally taken up by plants from the soil and utilized for the synthesis of plant protein. During drought conditions, plant growth is impaired and nitrates can accumulate in the plant (Table 2). If sufficient rainfall occurs allowing for resumption of normal plant growth (this re-growth process takes a few days to start) the accumulated nitrates will be incorporated into plant protein.

During the silage fermentation process, the fermenting bacteria utilize plant nitrates for their growth process. Therefore, nitrate concentrations of drought stressed corn plants will be lower after the plants have undergone the fermentations process. The exact reduction of nitrate concentrations cannot be predicted. If the potential of nitrate toxicity is a concern, testing for nitrate in the silage should be done after the forage material has gone through the entire fermentation process, about four weeks. Green chopping or grazing of drought-stressed corn is not recommended because of the potential for nitrate toxicity.

Ensiling of potentially high-nitrate containing forages can also result in production of various nitrogen oxide gases. These gases are highly toxic to humans and livestock. The danger of silo gas can exist from ensiling time to four weeks later. During this period, do not enter a silo without first running the blower for 15 to 30 minutes. Using a self-contained breathing apparatus is highly recom-mended. Any person exposed to silo gas should seek immediate medical attention to combat delayed poisoning symptoms.

The concentrations of nitrates in a feed ingredient and the recommended feeding rates of that ingredient are in Table 3.

Laboratory testing for nitrates

Corn plants and corn silage can be tested for nitrates by many commercial feed-testing laboratories. This testing is also available at the MSU Soil and Plant Nutrient Laboratory, A-81 Plant & Soil Sciences Building, Michigan State University, East Lansing, MI 48824-1325, (517) 355-0218. Cost is $9.00 per sample for chopped plant material or silage.

Care must be taken in sampling to ensure a representative sample. Grab samples should be taken from chopped forage from various locations in the field, which represents all levels of plant stress. Mix these samples in a

Table 3. Nitrate concentration in a feed ingredient and feeding recommendations

NO_3 ppm	Percent	NO_3-N ppm	Percent	Feeding Recommendations
< 4,400	< 0.44	< 1,000	< 0.1	Safe to feed, non-toxic level
4,400-8,800	0.44-0.88	1,000-2,000	0.1-0.2	Limit the feed to less than 50% of ration dry matter
8,800-17,600	0.88-1.76	2,000-4,000	0.2-0.4	Limit the feed to less than 25% of ration dry matter, do not feed to pregnant cattle
> 17,600	> 1.76	> 4,000	> 0.4	Do not feed

%=> ppm (multiply % by 10,000) ppm=> % (divide ppm by 10,000) bucket and place approximately one pint of material in a sealed plastic bag. Time between sampling and arrival at the laboratory must be as short as possible. Refrigeration of samples is beneficial, especially when the lag extends beyond one day. Green or wet samples allowed to stand at room temperatures or higher may lose nitrate via plant enzyme and bacterial activity.

All laboratories do not express plant nitrate concentrations in a similar manner. Table 4 contains multiplication factors to convert various nitrogen compounds to nitrate (NO_3).

Table 4. Multiplication conversion factors for various nitrogen compounds to nitrate (NO_3)

Nitrogen substance	Chemical formula	Multiplication factor
Nitrate	NO_3	1.00
Nitrite	NO_2	1.35
Nitrate-nitrogen	NO_3-N	4.43
Nitrite-nitrogen	NO_2-N	4.43
Sodium nitrate	$NaNO_3$	0.73
Potassium nitrate	KNO_3	0.61

Results of Michigan State University's testing for nitrates during the drought of 1988

During the 1988 drought, which was wide spread in Michigan, whole corn plant samples were obtained from the areas affected by the drought on various dates and were tested for nitrates at the MSU Plant Diagnostic Clinic. The results are shown in the following Table 5.

The data in Table 5 indicates the following:

1998 Drought in Michigan – The drought in 1988 started in mid-June. When the first sampling period (7/21-8/1/88) was conducted, the corn plants were already subjected to at least a month of drought conditions. The data in Table 5 represents only what occurred in 1988. This data does not indicate what the nitrate concentrations might be on a given date for other years.

Fresh corn plants – The data in Table 5, is expressed as average and ranges for the four sampling date periods. Note the wide range in nitrate concentrations for each of the sampling periods. This indicates that concentrations were very variable due to the variability of drought conditions at the field locations where the plant samples were obtained.

The data in Table 5 does indicate the nitrate concentrations in the samples obtained in 1988 from across the state decreased as growing season progressed. However, data on rainfall or growing conditions occurring during the testing period from the areas where the samples were obtained is not known. Thus, nitrate concentrations for years other than 1988 will probably be different. Testing of whole corn plants for nitrate concentrations is the only way to know the nitrate concentrations for a particular field of corn.

Corn silage - Average nitrate concentrations was 880 ppm, which is much lower than for the fresh corn plant material. It is not known if plants from the field where the "Fresh Corn Plant" samples were obtained were part of the sample tested as "Corn Silage." So, the exact percent of nitrate that was reduced by silage fermentation cannot be predicted from this data.

Corn silage - All corn silage samples in 1988 had nitrate levels within the safe guidelines (Table 3) for feeding to cattle. Hopefully, similar results as what occurred in 1988 will occur in other years. That is, high nitrate levels occurring during the mid-late growing season will be lower as harvest date approaches and also lower in the silage after fermentation has occurred. For farmers, the recommendation is to test the silage for nitrates before feeding if there is a concern.

Chopping height recommendations as related to nitrate toxicity

Some publications suggest that drought-stressed corn be chopped 12 to 16 inches above normal chopping height (four to six inches) as a method to reduce nitrate concentrations. The lower third of the stalk may contain the highest nitrates concentrations (Table 2). Although, the lower third of the stalk may contain the highest nitrate levels, the silage fermentation process

Table 5. 1988 Michigan State University's analysis of for nitrates

Material	Sample dates	Number samples	Average concentration NO_3 (ppm)	Range NO_3 (ppm)
Fresh Corn Plants	7/21/88 – 8/1/88	21	8,800	20.0 – 17,100
	8/2/88 – 8/5/88	28	6,600	400 – 16,000
	8/5/88 – 8/12/88	14	3,700	300 – 11,600
	9/1/88 – 9/28/88	40	3,500	20 – 25,000
Corn Silage		17	880	20 – 3,500
Fresh Sudan Grass		5	11,300	600 – 35,000
Sudan Grass Silage		2	3,800	1,750 - 6000

D. Roberts, Michigan State University, Plant Diagnostic Clinic, 1988 will reduce the nitrate levels. The whole plant nitrate levels are more important than just the concentration in a part of the plant. The chopping at 12 to 16 inches above normal chopping height will reduce whole field yields by about five to ten percent for normal non-drought stressed corn, this yield reduction will probably be greater for drought stressed corn. This yield reduction needs to be considered. Michigan State University does not recommend chopping corn at 12 to 16 inches above normal heights.

Use of inoculants and additives

Microbial inoculants – Chopped corn is fermented by the bacteria on the plants while the corn was growing in the field. The bacteria utilize plant sugars as a substrate for growth. Normally, corn plants have a sufficient population of silage fermenting bacteria to support a good silage fermentation process. The purpose of a microbial inoculant is to provide additional bacteria that will result in an increase the rate of fermentation and production of acids that keep the silage stable during storage.

Drought-stressed corn plants may not be well eared and have poor kernel development. Under normal growing conditions corn plant sugars are converted to starch, which is stored in the kernels. Earless or poorly-eared corn plants will have sufficient sugars to support good bacterial growth because less of the sugars will have been converted to kernel starch. High temperature and humidity that often accompany droughts in Michigan will encourage silage fermenting bacteria populations to increase in the field. Under these conditions, inoculants may not be costeffective.

However, silage fermenting bacteria populations may be lower when the humidity is low and temperatures are high, especially if there are hot dry winds. Also, bacterial populations may be low when temperatures before chopping are low, below 60°, such as in the late fall. Under, these conditions use of an inoculant specific for corn silage may be cost effective.

NPN additives – Anhydrous ammonia or urea is often added at harvest to increase the crude protein content of corn silage. Because drought-stressed corn plants may contain high concentrations of nitrates, which are an NPN source, the adding of anhydrous ammonia or urea to drought stress corn at harvest is not recommended. However, if after the silage has fermented and if the nitrate level of the silage is below 4,400 ppm, urea could be added to a ration as a degradable protein source at feeding time.

Nutrient composition of corn silage from drought stressed corn

Research at Michigan State University found that corn silage grown during the 1988 drought had increased NDF (fiber) digestibility as compared to corn silage grown during 1989 a non-drought stress, normal growing year (Table 6).

Drought-stressed corn silage with no kernels or reduced kernel content will require the feeding of more grain supplementation. Once the diets using drought stressed corn silage are adjusted for differences in corn silage NDF content, the milk production should not be reduced and could possibly increase because of the higher NDF fiber digestibility.

Nutrient composition

There are no direct laboratory analyses for NE_L. The values reported from feed analysis laboratories are calculated indirectly using equations, most often based on the ADF content of the feed. Some laboratories may use equations that include NDF, lignin, crude protein NDIN, ADIN, fat and ash to estimate NE_L. Regardless of what equation is used, all NE_L values are only estimates. The only way to accurately evaluate the energy value of a feed is to evaluate actual cow response to a diet. If dry matter intake, milk production, milk composition or body condition change when cows are switched to a new ration than the ration should be evaluated and formulation adjustments made. With drought-stressed corn silage if NE_L value used to formulate a ration is too high or low the cows will indicate this with changes in dry matter intake, milk production, milk composition or body condition. This evaluation may take a period of time and cause a degree of producer and nutritionist frustration.

Challenges that occur with drought-stressed corn

Corn silage grown under drought conditions can present challenges. Reduced

Table 6. Effect of environment on fiber component and NDF digestibility of corn forage

	1988 (drought)	1989 (normal)
Growing degree days (5/1–9/1)	2387	2072
Precipitation (inches 5/1–9/1)	8.4	16.3
Dry Matter Yield (Tons DM/Acre)	4.01 **	9.49 **
NDF (% of DM)	40.8	42.2
ADF (sequential, % of DM)	19.4	21.8
Lignin (% of DM)	2.44 **	2.96 **
Lignin (% of NDF)	6.02 **	7.01 **
NDF Digestibility (%)	50.3 **	42.0 **

** differences were significant

M.S. Allen, Department of Animal Science, Michigan State University, E. Lansing, MI tonnage per acre, which will require more acres to be chopped. Since hay yields may also be reduced, farmers may need to plan on feeding more corn silage to their cattle. This will require chopping more acres of corn than normal and probably will impact the number of acres of corn planned to be harvested for grain. Farmers will need to determine which cornfields will be harvested as grain and chopped for silage. Monitor the whole plant dry matter content so that fields will be harvested at the correct dry matter.

For updates on this information, please visit: http://www.msue.msu.edu/aoe/dairy.html **IPM**

Assessing drought stress effect on corn yield

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Effect of drought-stress on the corn plant

Inadequate moisture during any period of growth can result in reduced grain yield. Nutrient availability, uptake, and transport are impaired without sufficient water. Plants weakened by stress are also more susceptible to disease and insects. Severe moisture stress is indicated by leaf wilting that is alleviated only when the plants receive additional water.

Four consecutive days of visible wilting can reduce potential corn yield by five to ten percent during the vegetative growth stage. And, during silking and pollination, yield reduction after four consecutive days of wilting can be as much as 40 to 50 percent (see accompanying table). Moisture stress during this period can result in a lack of synchronization between pollen shed and silking at pollination, because pollen grains may not remain viable and silking may be delayed.

In order to determine harvest options for drought stressed corn, an assessment of potential grain yield should be conducted. Within one to three days after a silk is pollinated and fertilization is successful, the silk will detach from the developing kernel. Thus, you can carefully remove the husk leaves from an ear shoot, shake the cob, and estimate the degree of successful fertilization by observing how many silks shake loose from the cob.

Another method to determine whether drought-stressed corn plants have been pollinated and fertilized is to look for small white blisters on the ear seven to ten days after pollen shed. To identify the blisters, take ears from several areas in the field and break them in half. Using a knife, dig out several kernels on each ear. If you find kernels that resemble blisters on the ears, you can assume kernel fertilization occurred. If you are unsure whether fertilization has occurred, observe the kernels again in five to seven days. If the kernels were fertilized, the blisters will have rapidly increased in size. If fertilization did not occur, the kernels will not have increased in size. It is also possible to tell if fertilization has occurred by slicing the kernels longitudinally through the embryo side and looking for the young embryo. Only fertilized kernels will produce embryos. Most kernels that have been fertilized will continue to develop and mature if the plants get water.

If a plant has tasseled and shed pollen but no blisters have appeared, it will be barren. A common result of prolonged moisture stress or moderate moisture stress during late pollination is the production of ears with barren tips. This occurs because the tip kernels were not pollinated or were aborted after pollination.

Drought stress prior to tassel and silk appearance may result in small ear size. From the 10-leaf to the 12-leaf stage (V10 to V12), potential kernel row number is determined in the corn plant. From the 12-leaf to the 17-leaf stage (V12 to V17), potential kernel number per row is determined. Moisture stress during the vegetative periods may reduce both ear length and the number of potential kernels on each ear. If ear size is reduced during this period, it cannot be corrected by relieving the moisture stress later in the season.

Drought stress after pollination and fertilization will result in aborted kernels or poor kernel fill, causing low-test weight and reduced yield. It may also predispose the plants to development of stalk rots.

To calculate the estimated grain yield follow these four steps

1) **Number of ears**: Count the number of harvestable ears in 1/1000 of an acre. For 30 inch rows this equates to the number of ears in 17 ft, 5 inches of row. For 22-inch rows, count the harvestable ears in 23 ft, 9 inches of row.
2) **Number of kernel rows**: Count the number of kernel rows on a representative

Effect of drought on corn yield.

Stage of development	Percent Yield Reduction (from 4 consecutive days of visible wilting)
Early vegetative	5 - 10
Tassel emergence	10 – 25
Silk emergence, pollen shedding	40 – 50
Blister	30 – 40
Dough	20 – 30

Classen, M.M., and R.H. Shaw. 1970. Water deficit effects on corn. II. Grain components. Agron. J. 62:652

The formula to calculate the estimated yield is:

$$\frac{(\text{Ear \#}) \times (\text{\# kernel rows}) \times (\text{\# kernels per row})}{90} = \text{Estimated Yield bu/acre}$$

number of ears (count the number of kernel rows on every fifth ear in the 1/1000 acre sample area and calculate the average).

3) **Number of kernels per row**: Count the number of kernels per row (do not count kernels less than the average size) on a representative number of kernel rows and calculate the average.

If the estimated grain yield is less than the projected cost of harvesting the grain, your viable harvest options are limited to harvesting the corn for silage, green chop, or direct grazing (see information on nitrate toxicity potential for green chop and direct grazing in article titled *Harvesting drought stressed corn for silage*). In cases of extreme drought, there may be no viable harvest options, and preparing the field for a rotational crop may be the only alternative. **IPM**

Methods for determining dry matter of forages and grains

Herb Bucholtz,
Animal Science

Microwave method

Equipment needed

1. Microwave Oven with turntable
2. Microwave-Safe Plate: 7 to 9 inch diameter. Caution - Do not use paper plate, they may burn.
3. Gram Scale: Capacity of at least 500 grams, accuracy at least 1.0 gram. Gram scales can be purchased from agricultural supply companies, drug and hardware stores.
4. Cup of Water: Be sure container is microwave-safe. This will help prevent the sample from burning when the sample is nearly dry.

Procedure

1. Weigh the empty plate & record weight
2. Place about 100 grams of chopped forage or cracked/ground grain on plate
   And record plate + sample weight
3. Place in microwave for approximately four minutes. Set microwave on high setting.
4. After four minutes – record plate + sample weight
5. Place back in microwave for another two minutes
6. Again – record plate + sample weight
7. Repeat step # 5 until Plate + sample weight remains unchanged (+/– 1 gram) Sample is now completely dried.
8. Subtract the plate weight from the plate+sample weight.

Example of arithmetic calculations

1. Empty Plate weighted = 200 grams
2. Forage or grain sample + plate weighs = 300 grams
   Sample weighted 100 grams [300 grams (plate + sample) - 200 gram (empty plate)]
3. Completely dried plate + sample weighs = 250 grams
4. % Dry Matter =

[250 grams (completely dried sample) – 200 grams (empty plate)] = 50 grams

50 grams ÷ 100 grams = 0.5 X 100 = 50% Dry Matter

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Economic value of drought-stressed and immature corn silage

Gerald Schwab and J. Roy Black, Agricultural Economics

Concept

There is no one "right" economic value/ price for drought-stressed and immature corn silage. However, we can establish the **maximum price** that a dairy operation, cattle feeder, or cow-calf operator can afford to pay for immature stressed corn silage delivered to their **feed bunk** in comparison with the prices of substitute feeds that can be used to accomplish the same feeding objectives. We can also establish the price the corn grower needs to have to warrant harvesting the corn for use as silage as contrasted to grain C call that the **minimum price**. The range between the minimum and maximum price provides the **price range for negotiation** between potential users and potential sellers. Supply B demand conditions in local areas will determine whether the price is closer to the minimum or the maximum. Location for bulky commodities as corn silage is an appropriate mantra much as it is often quoted for real estate.

The purpose of this section is to develop a method for estimating: (1) the dairy farmer's maximum bid price; (a similar paper for cattle feeders is available at http://beef.ans.msu.edu/). (2) The corn grower's minimum sale price; and (3) how to get from the price of corn silage at the feed bunk to the price of the corn plant standing in the field.

Economic value at the feed bunk

One approach to economic valuation at the feed bunk is for the milk or livestock- producer

Table 1. Nutrient Characteristics Used in Budgeting

Nutrient	Drought-stressed corn silage	Normal corn silage	Soybean meal 49	Corn grain	18% CP alfalfa
Dry matter, %	32.0	32.0	90.0	85.0	88.0
Net energy for lactation (Mcal/lb DM)	0.65	.71	0.88	0.90	0.61
Crude protein (% of DM)	8.8	8.0	53.0	10.0	18.0

to ask, "If I didn't feed immature corn silage, what would it cost me using an alternative ration to get the same performance from my animals?" If immature corn silage is priced so high that it costs more to feed the animal with it than it would with the alternative ration, then corn silage is priced too high! There is no economic advantage to feed it.

If we accept the framework just described, we must start thinking about what feedstuffs immature corn silage can substitute for in the cattle's diets. A bit of reflection leads us to the conclusion that its value will be dependent upon the type of animals being fed (for example, lactating dairy cows producing 80 pounds milk a day have much different nutrient requirements than dry cows or beef cows) and the alternative feedstuffs that are available.

Let's consider economic valuation based upon a ration that **substitutes** a combination of immature or droughty corn silage (CS) and soybean meal (SBM) for corn grain (C) and alfalfa hay (A). We will calculate the pro-portion of a drought-stressed CS:SBM mixture, on a dry matter basis, that is equal in energy and crude protein to a pound of a C:A mixture.

The first step will be to calculate the respective proportions that yield equal energy and crude protein. The second step will be to work backwards and find out how much we can afford to pay for drought-stressed corn silage before the CS:SBM combination starts to cost more than the C:A combination.

The feedstuffs nutrient value and dry matter assumptions used in our case example are:

Worksheet 1 provides a method for calculating the **maximum bid price** for immature corn silage, given the information we have just presented and projected prices for corn grain, alfalfa, and soybean meal. The worksheet is most relevant for lactating dairy cows.

Let's consider an example: we'll use prices that reflect a sufficiently widespread drought for corn and soybean meal as well as alfalfa prices to be influenced. Using Table 2 as a lookup table for a combination of $2.00/bu corn, $192/ton soybean meal, and $80/ton alfalfa; the maximum bid price for drought-stressed corn silage that has 90 percent of the energy value of normal corn silage is $20.93/ton. Derivation of this value to illustrate the calculation is presented in Worksheet 1.

Economic value in the field

Let's continue with our example from Worksheet 1. We projected drought-stressed corn silage's maximum bid price to someone valuing it as a substitute for corn and alfalfa hay was $20.93/ton at the feed bunk. For purposes of discussion, let's round off to $21/ton. What is $21/ton corn silage at the feed bunk worth standing in the field?

Worksheet 2 was developed to answer that question. The costs of storage, including storage losses, must be subtracted along with the costs of harvesting, hauling, and packing.

Also, the additional nutrients that will be required since the stalk and leaves won't be plowed down must be subtracted.

Worksheet 1.

Calculation of the maximum bid price for drought-stressed corn silage: based upon substitution of corn silage and soybean meal for alfalfa and corn

Description of the shares of each feedstuff, on a dry matter basis, in the drought-stressed corn silage: soybean meal and corn: alfalfa combinations:

Corn grain: Alfalfa combination (dry matter basis):

Your farm		Example
(1)Corn grain's share, %	26.5	
(2) Alfalfa's share, %	73.5	
Total	100.0	100.0

Drought-stressed corn silage: soybean meal combination (dry matter basis):

Your farm		**Example**
(3)Soybean meal, %	16.0	
(4)Drought-stressed corn silage's share, %	84.0	
Total	100.00	100.00

Prices:

Your farm		**Example**
(5)Corn grain, $/bu	2.00	
(6)Alfalfa, $/ton	80.00	
(7)Soybean meal, $/ton	192.00	

Calculation of the maximum bid price for drought-stressed corn silage, $/ton at 32% dry matter:

Intermediate calculations:

(8) Corn: (Line 1) % DM Corn) H (Line 5) 56)
(26.5).85) H (2.00) 56) $1.1134
(9) Alfalfa: (Line 2) % DM Alfalfa) H (Line 6) 2000)
(73.5) .88) H (80.00) 2000) $3.3409
(10) Soybean meal: (Line 3) % DM SBM) H (Line 230) 2000)
(17.1) .90) H (192) 2000) $1.7067

Price of drought-stressed corn silage, $/ton:

(11) [(Line 8 + line 9 - line 10)) (Line 4) % DM Silage)] H 2000
[(1.1134 + 3.3409 - 1.7067)) (84.0) 0.32)] H 2000 $20.93

Table 2. Maximum Bid Price ($/ton) for Corn Silage at the Feed bunk

Ration 1
% Corn Grain in Ration = 26.5
% Alfalfa in Ration = 73.5
Total Ration = 100.0

Ration 2:
% Soy Meal in Ration = 16.0
% Corn Silage in Ration = 84.0
Total Ration = 100.0

Alternative Prices for Feed Stuffs:

Corn Grain ($/bu)	**Soymeal ($/T)**	**Price for Alfalfa Hay ($/Ton @ 18% Crude Protein)**						
		$ 50.00	**$ 60.00**	**$ 70.00**	**$ 80.00**	**$ 100.00**	**$ 125.00**	**$ 150.00**
		Maximum Bid Price ($/Ton Corn Silage)						
$1.50	$96.00	$ 15.77	$ 18.95	$ 22.13	$ 25.32	$ 31.68	$ 39.63	$ 47.59
$1.50	$123.00	$ 13.94	$ 17.12	$ 20.31	$ 23.49	$ 29.85	$ 37.81	$ 45.76
$1.50	$144.00	$ 12.52	$ 15.70	$ 18.88	$ 22.06	$ 28.43	$ 36.38	$ 44.34
$1.75	$112.00	$ 15.75	$ 18.93	$ 22.11	$ 25.29	$ 31.66	$ 39.61	$ 47.57
$1.75	$143.50	$ 13.61	$ 16.80	$ 19.98	$ 23.16	$ 29.52	$ 37.48	$ 45.43
$1.75	$168.00	$ 11.95	$ 15.14	$ 18.32	$ 21.50	$ 27.86	$ 35.82	$ 43.77
$2.00	$128.00	$ 15.72	$ 18.91	$ 22.09	$ 25.27	$ 31.63	$ 39.59	$ 47.54
$2.00	$164.00	$ 13.29	$ 16.47	$ 19.65	$ 22.83	$ 29.19	$ 37.15	$ 45.10
$2.00	$192.00	$ 11.39	$ 14.57	$ 17.75	$ 20.93	$ 27.30	$ 35.25	$ 43.21
$2.25	$144.00	$ 15.70	$ 18.88	$ 22.06	$ 25.25	$ 31.61	$ 39.56	$ 47.52
$2.25	$184.50	$ 12.96	$ 16.14	$ 19.32	$ 22.50	$ 28.87	$ 36.82	$ 44.78
$2.25	$216.00	$ 10.82	$ 14.01	$ 17.19	$ 20.37	$ 26.73	$ 34.69	$ 42.64
$2.50	$160.00	$ 15.68	$ 18.86	$ 22.04	$ 25.22	$ 31.59	$ 39.54	$ 47.50
$2.50	$205.00	$ 12.63	$ 15.81	$ 18.99	$ 22.18	$ 28.54	$ 36.49	$ 44.45
$2.50	$240.00	$ 10.26	$ 13.44	$ 16.62	$ 19.80	$ 26.17	$ 34.12	$ 42.08
$2.75	$176.00	$ 15.65	$ 18.84	$ 22.02	$ 25.20	$ 31.56	$ 39.52	$ 47.47
$2.75	$225.50	$ 12.30	$ 15.48	$ 18.67	$ 21.85	$ 28.21	$ 36.17	$ 44.12
$2.75	$264.00	$ 9.69	$ 12.88	$ 16.06	$ 19.24	$ 25.60	$ 33.56	$ 41.51
$3.00	$192.00	$ 15.63	$ 18.81	$ 21.99	$ 25.18	$ 31.54	$ 39.49	$ 47.45
$3.00	$246.00	$ 11.97	$ 15.16	$ 18.34	$ 21.52	$ 27.88	$ 35.84	$ 43.79
$3.00	$288.00	$ 9.13	$ 12.31	$ 15.49	$ 18.67	$ 25.04	$ 32.99	$ 40.95

Worksheet 2

Maximum bid price for corn standing in the field for use as corn silage

Item	**Example**	**Your farm**
(1) Corn silage @ feed bunk ($/ton)	$21.00[a]	
2) - Storage losses (10% to 30%) (Example @ 20%)	$4.20	
(3) - Storage cost (zero for existing storage;	0.00	
Amortized cost if new facilities added)		
(4)- Harvesting (chopping)	$1.90	
(5)- Hauling and packing (depends upon distance)	$1.50	
Added cost for fertilizer due to removal of entire corn plant		
N 4.0 lbs @ 0.20	$0.80	
P_2O_5 0.6 lbs @ 0.18	$0.11	
K_2O 12.5 lbs @ 0.13	$1.62	
(6)Total (Sum Lines 2, 3, 4, & 5)	$10.13	
(7)Maximum bid price ($/ton)		
(line 1 minus line 6)	$10.57	

[a] Adapted from Worksheet 1 (or, Table 4 or Table 5). Maximum bid price for cattle feeders for our example would be $22.00/ton.

Worksheet 3

Partial Budget for Comparing Net Returns[a] to Unallocated Costs From Corn Harvested As Grain vs. Corn Harvested As Silage

Item	Example	Your farm
Corn Grain		
Revenue:		
(1) Yield, bu/acre	50.	
(2) Price, $/bu (no. 2 corn adjusted for test weight)	2.00	
(3) Gross revenue (Line 1 H Line 2)	100.00	
Harvest cost:		
(4) Combining, $/acre	$20.00	
(5) Grain Hauling @ $0.15/bu	7.50	
(6) Drying @$0.20/bu	10.00	
(7) Total (Line 4 + Line 5 + Line 6)	$37.50	
(8) Net from harvesting corn grain as grain	$62.50	
(Line 3 - Line 7)		
Corn Silage		
(9) Yield, ton/acre	10	
(10) Price, $/ton in field		
(Value from Line 7, Worksheet 2)	10.57	
(11) Net (Line 9 H Line 10)	105.70	

[a] These are returns to all costs that have been committed up to the time of harvest.

For our example, $10.13/ton costs are projected to be incurred. That leaves $10.57/ton for corn in the field. The harvesting, hauling, etc., costs were adapted from S.B. Nott, et. al., 1995 *Crop and Livestock Budgets*, Michigan State University, Agricultural Economics Report 581; and G. Schwab and Marcelo Siles, *Custom Rates in Michigan*, Cooperative Extension Service Bulletin, E-2131, April 1994.

Should you harvest your corn as silage or as grain - assuming it is worth harvesting?

Worksheet 3 asks the question: "Will you generate more net income harvesting corn as grain?" "Or, as silage?" Your pre-harvest expenses are sunk costs C they have already been committed and are irrelevant to the decision.

Let's consider an example. Suppose a cornfield will yield 50 bu/ac if harvested for corn grain and 10 ton/acre if harvested for corn silage. For those **relative** yields, corn silage wins hands down; corn silage returns $105.70/acre above unallocated costs compared to $62.50 for corn for grain.

We can explore break-even relationships. For example, what are the corn grain and corn silage yields at which returns above unallocated costs are equivalent? Consider an example. If corn grain yields were projected at 75 bu/acre, not 50 bu/acre as in the example in Worksheet 3, then the returns per acre would be $103.75 C approximately equivalent. You can do your own sensitivity analysis by looking at alternative corn grain and silage relationships.

The **relative** prices for corn and corn silage are critical. Typically, the corn grain price will be better established; the corn silage price may offer significant opportunities, but will require more work to achieve. **IPM**

Herbicide carryover - a big issue following a drought

Karen Renner and Jim Kells,
Crop & Soil Sciences

It hasn't rained in most areas of Michigan for a long time. Some areas have experienced little or no rainfall since postemergence herbicides were applied to corn and soybeans and since dry beans were planted. This dry weather will **cause an increase in the persistence of many herbicides** and this can result in injury to rotation crops.

Why does dry weather increase the carryover of many herbicides?

The persistence of an herbicide is based on: a) the chemical properties of the herbicide, b) the soil type, and c) the environmental conditions (temperature and moisture) that occur during the growing season. We have had warm temperatures lately but little or no soil moisture.

Three things happen when drought occurs

First, the plants (both crop and weeds) are not taking up any of the herbicide into plant roots and metabolizing the herbicide. Second, the microbial populations in the soil (bacteria and fungi) decline because they need water to support their growth. Therefore, herbicides that rely on microbial degradation are not being degraded! Third, all herbicides become more strongly adsorbed to the soil particles because the water film usually around the soil particles is decreasing. So we end up with herbicides adsorbed to soil particles and not degraded by microbial populations. What about the herbicides degraded by chemical processes in the soil such as hydrolysis? These herbicides will have **less** risk of carryover than herbicides degraded in the soil exclusively by microbial populations.

There is still the opportunity for significant herbicide degradation prior to soil freeze-up this fall. Normal or above normal rainfall in the second half of August through October will increase herbicide degradation as long as soil temperatures remain warm. However, **rotation crop plans should be reevaluated due to the increased risk of herbicide carryover**. Our experience over the past 15 years is that we are at much greater risk of carryover from many herbicides when we have dry weather for the first six weeks following herbicide application.

What have we learned in the past from years such as the drought year of 1988 and from other instances of carryover in Michigan?

We have learned that **Canopy** and **Classic** did **not** carryover under drought conditions. This makes sense because the major method of breakdown in the soil for these herbicides is chemical hydrolysis (**not** microbial breakdown). However, if soil pH is high, hydrolysis will decrease, so we would expect potential carryover if these herbicides were applied to fields with areas of high pH. We have learned that **atrazine** and **metribuzin** are degraded under drought conditions by chemical hydrolysis. Again, at high pH this process is reduced and therefore instances of carryover could increase on high pH soils.

Exceed carryover in Michigan occurred on high pH soils planted to soybean the year following dry weather. So, a combination of drought and high pH caused a problem. **Northstar** carryover to sugarbeets increased if dry weather occurred for four to six weeks following the Northstar application. **Reflex/Flexstar** requires anaerobic (no oxygen, flooded) conditions to be degraded by microbes in the soil. So, we are concerned about carryover from Reflex /Flexstar this year (sugar beets, cucumbers, carrots, and alfalfa are very sensitive to Reflex /Flexstar residues; corn and wheat are somewhat less sensitive). **FirstRate**, **Authority,** and at least one of the components of **Broadstrike/Dual., Python, Hornet,** and **Accent Gold** are degraded microbially and, therefore, have an increased risk of carryover under drought conditions. **Pursuit** and **Raptor** are degraded by microbes and carryover increases in a dry year. **Treflan, Sonalan**, and **Prowl** are degraded microbially.

Degradation is more rapid under flooded anaerobic conditions. We have had years where wheat was injured from Prowl, Treflan, or Sonalan applied to soybeans or dry beans in the spring. **Command** is degraded rapidly by a chemical reaction under anaerobic conditions. Command is also degraded by microbes under aerobic conditions if soil pH is 5.9 or greater. So, drought conditions increase the risk of Command carryover. **Stinger** is more persistent under dry conditions. The crop rotation interval to soybeans or dry beans increases from 10.5 to 18 months if soil organic matter is less than two percent (a lot of our Michigan fields) **and** less than 15 inches of rain falls in the 10 months following application. Some herbicide labels extend the crop rotation interval if rainfall is limited following application or caution that rotational crop injury may occur.

Are there some herbicides that can=t carryover and injure rotation crops?

Absolutely! We think of the herbicides that have limited or no residual in the soil to stop germinating weeds. These herbicides include Select, Assure II, Fusion, Poast, 2,4-D, Buctril, Banvel, Clarity, Distinct, Basagran, Betamix, Progress, UpBeet, Harmony GT, glyphosate, and a few others. Other herbicides that are soil-applied and control germinating weeds do **not** cause problems with rotation crops. These include Dual II Magnum, Frontier, Outlook, Lasso, Eptam, and Ro-Neet.

What should a grower do if wheat is planned for a field this fall?

If wheat is the planned rotation crop, please **check herbicide labels** and Table 11 in E-434 *Weed Control Guide for Field Crops* for rotation crop information. If the rotation interval is given as 3 to 4.5 months **and** the herbicide is persistent under drought conditions there is greater risk of injury to the wheat crop. Four month rotation intervals (three month have *, 4.5 months have **) prior to wheat planting include:

Accent	Accent Gold
Boundary**	Broadstrike/Dual**
Canopy XL	Classic*
Gauntlet	Hornet
Northstar*	Pursuit
Python	Scepter
Synchrony*	Steel
atrazine (1 lb)*	Basis
Authority	Sencor**
Canopy	Reflex/Flexstar
FirstRate*	Beacon*
Matrix	Raptor*

Surpass/Topnotch/Harness/Degree

Think about tillage

Tillage will dilute herbicide residues in the soil profile. Consider tillage prior to planting wheat to dilute the herbicide in the soil profile.

Watch the weather

If Michigan fields remain dry for most of the remainder of the summer and fall we will be in a similar situation as to 1988. Growers will need to consider tillage, rotation crop plans, and crop cultivar selection to reduce the potential for carryover to crops planted in the spring of 2002. We will continue to address this topic during the fall and winter months. **IPM**

Harvest restrictions following herbicide application on corn

Jim Kells and Corey Guza, Crop & Soil Sciences

The severe drought conditions across most of Michigan are raising several questions regarding early harvest of corn for forage. One of the questions relates to harvest restrictions with herbicides. Most preemergence herbicides do not have restrictions that would restrict harvesting now (mid-August). Some exceptions are Python, Hornet, and Broadstrike/Dual, which require an interval of 85 days between application and field corn harvest. There are several postemergence herbicides, which may restrict harvest options for corn. The accompanying table lists the specific harvest restrictions stated in the labels for postemergence herbicides for corn. Refer to the herbicide label for additional details. **IPM**

Forage, feed, and grazing restrictions for postemergence corn herbicides

Product	Restrictions
Accent	Do not graze or feed forage, hay, or straw from treated areas to livestock within 30 days after application.
Accent Gold	Do not graze or feed forage, hay, or straw from treated areas to livestock within 85 days after application.
Aim	No restrictions on the label.
Atrazine	Do not graze or feed forage from treated areas for 21 days following application, or illegal residues may result.
Banvel / Clarity	Corn may be harvested or grazed for feed once the crop has reached the ensilage (milk) stage or later in maturity.
Banvel + Atrazine (Marksman)	Corn may be harvested or grazed for feed once the crop has reached the ensilage (milk) stage or later in maturity.
Basagran	Do not graze treated corn and sorghum fields for at least 12 days after the last treatment.
Basis	Do not graze or feed forage, hay, or straw from treated areas to livestock within 30 days after application.
Basis Gold	Do not graze or feed forage, grain, or stover from treated areas to livestock within 30 days after application.
Beacon	To avoid possible illegal crop residues: 1) Do not graze or feed forage from treated areas to livestock within 30 days after application. 2) Do not harvest silage within 45 days after application. 3) Do not harvest grain within 60 days after application. 4) Do not apply more than the standard use rate per acre. 5) Complete all applications before tassel emergence.
Buctril	Do not cut crop for feed , fodder or graze within 45 days of application.
Buctril + Atrazine	Do not cut crop for feed or graze within 45 days of application.
Callisto	No restrictions on the label.
Celebrity	Corn may be harvested or grazed for feed once the crop has reached the ensilage stage or later in maturity.
Celebrity Plus	Do not apply within 32 days of forage harvest. Do not apply within 72 days of corn grain and stover harvest.
Distinct	Do not apply within 32 days of forage harvest. Do not apply within 72 days of corn grain and stover harvest.
Hornet/Hornet WDG	An interval of at least 85 days is required between application and field corn harvest.
Liberty, Liberty ATZ (Liberty Link Corn)	Do not apply within 60 days of harvesting corn forage and within 70 days of harvesting corn grain and corn fodder.
Lightning (Clearfield Corn)	There should be an interval of at least 45 days between an application of Lightning and corn harvest (silage fodder or grain). Do not graze or feed treated corn forage, silage, fodder or grain for at least 45 days after application.
NorthStar	To avoid possible illegal crop residues: 1. Do not graze or feed forage corn to livestock within 30 days after application. 2. Do no harvest silage within 45 days after application. 3. Do not harvest grain within 60 days after application. 4. Do not make more than one application per season at 5 oz/A. 5. All applications to corn should be made no later than 15 days before tassel emergence.
Permit	Allow 30 days before grazing and harvest of forage or silage.
Resource	Do not graze animals on green forage or use as feed less than 28 days after application.
glyphosate (Roundup Ready Corn)	Do not harvest for forage within 50 days after application. See label for additional details.
Sencor	May be grazed or harvested for silage or grain 60 days after treatment.
Stinger	Do not allow livestock to graze treated areas or harvest treated corn silage as feed within 40 days after last treatment.
2,4-D amine/ester	Do not forage or feed corn fodder for 7 days after application.

Crop insurance adjustment procedures

Gerald Schwab and J. Roy Black, Agricultural Economics

Crop insurance is touted as one tool to assist crop producers in managing the risk of yield or income loss associated with insurable crops. Many Michigan corn grain producers are currently experiencing that loss of yield and income due to drought. Depending on the severity of the drought and associated yield loss, potential income may be higher by harvesting the cornfield as silage rather than grain. Because of the reduction in potential grain yield, you may have an insurable loss. According to the Federal Crop Insurance Act, "An insurable loss shall be incurred by a producer if the gross income of the producer (as determined by the Corporation) is less than an amount determined by the Corporation, as a result of a reduction in yield or price resulting from an insured cause." (See http://www.agriculturelaw.com/links/cropins/statute.htm)

Some suggested steps for corn grain producers who are considering harvesting some fields for corn silage are:

1. Contact your crop insurance agent ASAP.

2. File your potential claim now B don't wait!

3. Schedule a field site visit for the crop insurance adjustor to ascertain yield loss.

4. Open up the field by harvesting the end rows. This will enable the adjustor to drive into the field to measure and collect samples.

5. If the field visit for the crop insurance adjustor can not be coordinated with the timing of corn silage harvest, leave two or three adjacent rows the length of the field for yield measurement. For representative yield estimate, more than one check strip might be suggested.

6. If less than 50 percent of the corn acreage in an insurance unit will be harvested for corn silage, it may not be necessary to leave check strips.

7. If toxins are thought to be present in the cornfield, collect samples of the corn silage and submit to laboratories for analysis to provide documentation of loss.

8. Remember the need for records, records, records to document expected losses. It is the producer=s responsibility to manage these data needs to support crop insurance indemnity claims.

9. Make yourself available to facilitate the field visit of your crop insurance adjustor. Provide some lead-time for scheduling. Please recognize that others are probably as busy as you. Good communications will help us all through this difficult situation. **IPM**

Michigan hay sellers list receiving more Michigan use this year

Jerry Lindquist, Extension Director, Osceloa County

For the past four years many other states have used the Michigan Hay Sellers List to locate hay to purchase. Droughts in the eastern states and the mid-west over the past few years have drawn people to the list with Michigan's abundant supply of hay. "The Hay Seller's List has developed some national recognition," says Jerry Lindquist, Osceola County Extension Director, and administrator of the site. We have had various states and agriculture trade publications add our list address to their drought web sites. Many comment it is one of the most concise, friendliest sites to use for finding hay. Now, because of our dry mid-summer, the list may receive more use from buyers of hay in Michigan.

To list hay free of charge on the Michigan Hay Sellers List, producers may go to:
www.msue.msu.edu/hay
and follow the instructions. Those without Internet access may contact their local MSU County Extension Office. All listings will stay on the list for approximately four months.

To receive a free listing of hay for sale, go to the same Internet address as listed above and go to "entries." Those without internet access may request a copy of the listings of hay for sale from their local County MSU Extension, but they should be specific as to what type of hay they are seeking, such as alfalfa/timothy small square bales, first or second cutting, in Southern Michigan. This is because the list is too long to copy if someone just says "all types of hay."

The Hay List is also a great way to check hay prices as the "statistics" part of the website contains average asking prices for all of the various types of hay that are listed.

Hay markets are warming a little as we enter the fall season. Prices remain below normal but some hay is moving and that is saying a lot after three years of abundant hay crops in Michigan. The greatest demand is for high quality alfalfa as most of the second and third cutting yields around the State were well below normal this summer. Also, the dry weather is causing pastures to run out of forage two months early, resulting in more hay being fed on grazing dairy, livestock, and horse farms.

The Hay Sellers List is sponsored by The Michigan Hay & Grazing Council and MSU Extension with support from the Michigan Department of Agriculture and the Michigan Farm Bureau. For more information contact your local County MSU Extension Office.

Management of drought stressed alfalfa

Richard H. Leep
Crop & Soil Sciences

Drought stress symptoms

Several factors occur when alfalfa is subjected to drought like conditions, which have prevailed over many areas of Michigan this summer. The alfalfa plant responds morphologically to drought stress by decreasing stem number, stem elongation, and yield while increasing leaf: stem ratio. Forage quality is usually higher in drought stressed alfalfa. The physiological response of alfalfa to drought is characterized by the following: photosynthesis is maintained during early phase of drought but slows as the drought continues and as the stomata close. Nitrogen fixation and nodule formation is reduced but more nutrients accumulate in the roots as compared to the foliage. In new seedings, root growth is affected more than shoot growth.

Drought management

Established alfalfa stands as well as new seedings experiencing drought symptoms should be harvested only if there is enough forage to economically justify harvesting. If enough alfalfa is present to justify harvesting, the quality of harvested alfalfa should be excellent. Alfalfa should be mowed or clipped after the drought is broken to stimulate regrowth. This is particularly important if the alfalfa is blooming, or near blooming, as clipping at this growth stage will encourage new crown buds to send out new shoots for regrowth. **IPM**

Insects and drought

Christina DiFonzo,
Entomology

On the entomology front, extended periods of dry weather can be beneficial or disastrous for producers. The effect depends on the type of insect, and sometimes on the stage of the insect present during the dry period.

Below, I summarize the impact of extended dry weather on important insects currently present in the field. A negative sign (-) means that dry weather impacts the pest negatively. A plus sign (+) means that the pest population or damage is **greater** in dry weather – more pluses indicate a greater effect. A question mark means there is no clear impact of dry conditions on that pest. As a general rule of thumb, sucking pests, plus insects that feed on roots or bore into plants, have a greater impact during dry periods. *Please see chart on page 14.* **IPM**

You might have mites

Chris DiFonzo, Entomology

Reports of spider mite damage are coming in from across Michigan, but particularly the Thumb. Soybeans and dry beans are obviously at risk, but even sugar beets have mite problems this season. This is highly unusual, and of course related to the record dry conditions in the Thumb. Garden plants, flowers, and shrubs around your farmstead may also harbor heavy mite populations.

Life cycle

Spider mites overwinter as adults. In spring, they move to new plant growth and lay eggs on the undersides of leaves. Mites can be blown by wind, so initial colonization of a field will often occur in the direction of prevailing winds, or along landscape features that disrupt air flow, such as tree lines, houses, or even telephone poles. Infestations usually start on dusty edges of fields. It is thought that dust dries the leaf surface, protecting mites from disease, or perhaps the dust provides a surface for the mites to anchor webs. Under a microscope, you will see that webbing acts like a “super-highway,” with mites moving back and forth above the leaf surface.

Eggs hatch in a few days and small mites begin to feed. Immature mites resemble the adults, except that they are smaller in size. They grow by molting, and if you look closely at a mite-infested leaf, you sometimes see the shed skins of immature mites. A leaf heavily colonized by mites will have eggs, young, adults, shed skins, and webbing.

Damage

Spider mites feed on numerous crops, and under certain conditions will increase to the point where they affect yield. This is especially true under dry conditions and on sandy soil where water stress is an issue. As leaves become yellow and die from mite damage, the photosynthetic ability of the plant is reduced. Yield and quality of corn and beans are both reduced by severe mite feeding. Mites pierce individual plant cells and suck out the contents, initially causing tiny yellow spots (called stippling) on leaves. As populations increase, symptoms include yellowing of leaves, and in more severe cases browning, bronzing, or death of foliage. Ironically, one sure-fire way to get rid of soybean aphid appears to be mite infestation. Soybean leaves heavily infested with mites are too physically damaged to support soybean aphid feeding; based on recent field observations, plants with many mites have few or no aphids.

Scouting

If an infestation is identified early, spot

Insects and drought *continued*

Pest/damage	Impact of drought*	Explanation
Bean leaf beetle	??	No clear impact.
Corn rootworm damage	+ +	Heavy rootworm feeding damages roots, reducing water uptake by the plant. Dry conditions may also hamper root regrowth after larval feeding.
European chafer grubs	+	EC grubs apparently do better in drier years. Thus EC grub populations in the fall of 2001 and spring of 2002 may be greater, particularly in winter wheat.
European corn borer eggs and small larvae	-	Dry conditions desiccate egg masses and newly hatched larvae.
European corn borer adult moths	-	Female moths need water to make eggs. Under dry conditions, females may produce fewer or no egg masses.
European corn borer tunneling	+ +	Larval tunneling in the stalk disturbs water movement in the plant. Under dry conditions, the impact of stalk tunneling is greater.
grasshoppers	+	Dry conditions can increase egg laying, and enhance survival of eggs. In contrast, wetter periods, a fungus infects and kills eggs (which are laid in the soil)
Japanese beetle adult	??	No clear impact.
Japanese beetle grubs	-	JB grubs tend to be more successful in wetter, not drier, years. Thus JB grub pressure in the spring of 2002 may be less.
Plant bugs	+	Sucking pest. Damage usually greater under dry conditions.
Potato leafhopper	+ + +	Sucking pest. Under dry conditions, pathogenic fungi do not infect and kill PLHs. Also, water stress and PLH feeding have been shown to interact and produce even greater plant damage.
Soybean aphid	+ +	Sucking pest. Under dry conditions, aphid feeding adds to water loss in the plant. Also, pathogenic fungi do not infect and kill aphids in dry weather.
Spider mites	+ + +	Mites feed by inserting their mouthparts into plant cells, disrupting the leaf epidermis. Under dry conditions, water loss increases and mite damage is worse. Also, pathogenic fungi do not infect and kill mites in dry weather.
Sugar beet foliar aphids	+ +	Sucking pest. Under dry conditions, aphid feeding adds to water loss in the plant. Also, pathogenic fungi do not infect and kill aphids in dry weather.
Sugar beet root aphid	+ + +	Sucking pest. Ditto explanation for foliar aphids. Wax secreted by root aphids can also block uptake of water by roots.
Thrips	+	Thrips rasp and suck plant juices. Under dry conditions, feeding scars can lose water.

Ohio State evaluation scheme for mites in soybean

(from Hal Willson et al, OSU. Printed in 6/14/99 C.O.R.N. Newsletter)

Presence of mites	**Damage**	**Assessment**
Barely detected on undersides of leaves in dry locations or on edges of fields.	Barely detected.	1 - *Non-economic*
Easily detected on undersides of leaves in dry locations or on edges of fields. Difficult to find on leaves within the field.	Foliage green, but stippling injury detectable on undersides of leaves, although not on every plant.	2 - *Non-economic*, but keep monitoring
All plants are infested when examined closely.	All plants in field exhibit varying levels of stippling, even on healthy leaves. Some speckling and discoloration of lower leaves. Field margins and dry areas exhibit severe damage.	3 - *Rescue treatment* is warranted, especially if many immatures/ eggs are present.
All plants heavily infested when examined closely.	Discolored and wilted leaves easily found throughout the field. Severe damage evident.	4 - Effective *rescue treatment* will save field.
Extremely high numbers.	Field discolored, leaves drying down. Significant foliage and stand loss.	5 - Rescue treatment may not save field. However, new growth may resume if treated.

treatments of the affected area plus a border strip may be enough. Otherwise, if mites spread across a field, the treatment threshold for dry bean is 25 percent of the plants infested with mites, with yellowing. For soybean, estimate the percentage of leaf surface damaged by mites. Treatment thresholds (based on % yellowing) vary with plant stage: pre-bloom = 40 percent; bloom R1 to pod fill R5 = 15 percent; R5 to early maturity R7 = 25 percent; after R7 = Do Not Spray, damage at this point has little impact on yield. A handy evaluation scheme (courtesy of Ohio State) for mites in soybean is printed in table form below.

Control

A systemic product like dimethoate (1 pint/ acre) is a good choice for mite control in soybean, since full coverage is not necessary (and would be difficult with a dense canopy). Lorsban (0.5 – 1 pint/ acre) and Warrior (3.8 oz/ acre) are also options. Additionally, Dimethoate and Lorsban reduce soybean aphid levels. In other crops, dimethoate (0.5 – 1 pint/ acre) can be used in dry beans for potato leafhopper and mites, while Lorsban (1-2 pints/ acre) is registered for use in sugar beets. Mite control is difficult, and more than one application may be needed. Unfortunately, multiple applications can lead to resistance. Later in the season, spraying obviously becomes more difficult due to closing of the canopy, and less effective as plants mature (yield is no longer affected).

Biocontrol

What about natural controls? A heavy rain may reduce the population a little, but don't depend on rain alone (as if you can depend on rain at all this year!). The real key is high humidity, since the fungal pathogens that kill mites require high, sustained humidity to grow and spread through the population. A brief rain, followed by quick drying, does not provide a long enough period for diseases to spread and kill a significant portion of the mite population. However, if rains come and humidity increases, hold off on spraying for a few days to see if the mite population decreases. **IPM**

On behalf of the specialists in the field crops, dairy, and livestock teams, a hearty thank you to **Rebecca Thompson** for coordinating and editing the entire special issue on short notice. --*Chris DiFonzo*

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