CropLife Media Group Webinar Q&A:
"Dealing With Drought: Securing Nitrogen With Cover Crops"

There were many great questions asked by attendees during the CropLife Media Group Webinar, **"Dealing With Drought: Securing Nitrogen With Cover Crops,"** held August 20, 2012. We have provided them here, along with answers courtesy of the Webinar speakers: Tom Kaspar (Plant Physiologist, USDA-ARS), John Meisinger (Soil Scientist, USDA-ARS), and Dave Robison (Forage & Cover Crop Agronomist, Legacy Seeds).

Q1: How to the brassicas compare to small grains in terms of nitrate recovery?
Tom Kaspar: With all cover crops the amount of nitrate taken up is dependent on how well they grow. How well cover crops grow depend on when and where they are planted and weather and soil conditions following planting. If brassicas have good growth they are excellent N scavengers. If they are planted late in the fall and don't overwinter (most species do not) then they won't take up much N compared with a cover crop like winter rye that overwinters and grows again the following spring.

John Meisinger: There have been very few direct comparisons of cereal grains vs. brassicas. One reason is their differing growth habits; brassicas need early planting and will winter kill (in normal winters), while cereal rye or wheat can be planted later and will survive the winter. So they really fit different niches in the cover crop domain – but both are very good N scavengers – so why not plant a mixture of both? The "best one" will depend on what niche you have available for cover crops and your secondary objectives after N scavenging (lower soil erosion, forages, etc.). For example, if an early planting date is available and residue cover is not a concern then the brassicas would be a good fit; if an early planting is not possible and soil erosion is important then a cereal grain would be a good fit, if fall manure will be applied and residue cover is a concern (after corn silage) then a mixture of brassica and cereal rye would be a good candidate. So which is best depends on available planting dates and the secondary goal of the producer.

Dave Robison: Brassicas (Turnips and Radishes and hybrid brassicas) are excellent scavengers of Nitrogen. For years I have seen where the forage quality on the turnips were in the 32% protein level with RVF of over 200.That is a lot of nitrogen stored in the plant! The results I got from the Ohio study showed an average of around 200#N/acre secured (following dairy manure application). I have not seen studies on the cereal grains. I know that where we had radishes or turnips with the cereal grains in our home farm test plot (following soybeans in Central Indiana) that we have better preliminary corn yields compared to straight cereal rye. (Data at found http://plantcovercrops.com/cover-crops-provide-improved-corn-yields-in-on-farm-trial.)

Q2: Do oats and radishes have better synchrony of N release with the following corn crop's N uptake than cereal rye?
TK: Because oats and radishes normally winter-kill in most of the Midwest, I would say as a general rule that would usually be the case, especially for early season N uptake by corn.

However, N dynamics related to N release and losses due to leaching, denitrification, and volatilization are extremely variable and strongly influenced by weather and soil conditions. So, in some years that general rule may not be true. For example N release may occur too early and the N is lost before the corn can use it. And as I said above you have to have good growth of the cover crop in the first place for it to even matter.

JM: I think synchrony of N release is over emphasized, because the synchrony is controlled by factors beyond the producer's control (as noted by Tom Kasper above). I think the best way to manage the "difficult to predict decomposition process" is to think of it as supplying a basal amount of N that is variable from year to year; this variable N source needs to be managed by within season monitoring (maybe the pre-sidedress nitrate test, or chlorophyll meter monitoring, or active crop sensors, etc.) and then add supplemental fertilizer N (either commercial or a traditional source or why not sidedress manure?) at a rate based on the N monitoring.

DR: From the work done on our home farm with the chlorophyll tests it appears that the Oat/Radish Mix released more N throughout the season than the plot with the cereal rye. These plots were not replicated but over 30 chlorophyll samples were taken per plot per date tested. The Oat/Radish mixture stayed above the "target" chlorophyll reading (41) three of the 6 tests while cereal rye only had readings above that level the first two weeks that the tests were taken. The Oat/Radish Mix had readings above the check all but the last reading (where it was nearly equal to the check); whereas the cereal rye was significantly below the check the last two reading dates. From this data in a very dry year I would surmise that the Oats/Radish Mixture would have better synchrony of N release with the following corn's N uptake.

Q3: What risks are there to soil moisture management with cover crops? If the spring is dry, can cover crops make the following crop's emergence worse? If the spring is wet, are there risks to getting equipment in the field to kill the cover crop?

TK: As usual, it depends. In a dry spring, cover crops do use soil water and if it stays dry that may reduce or slow emergence of the following crop. However, if rain occurs after the cover crop has been sprayed with glyphosate, then the increased surface residue can preserve soil moisture and increase emergence. I have had cereal rye cover crops out every spring in central Iowa since the early 90s and we have had one year where soybean emergence was delayed because of cover crop water use. Of course that doesn't mean that it wouldn't happen next year. As usual it would be nice if we knew what the weather was going to do, but since we don't usually recommend that if the spring is much drier than usual that the cover crop be terminated as soon as possible. In wet springs, there is a risk of not getting equipment into the fields to kill the cover crop. Wind can also be a problem for spraying. Because the cover crops do use water and the plants provide some traction and support for equipment, many times they allow spraying after a rain sooner than "bare" soil. Some farmers also use small tractors or ATV pulled sprayers to get around this problem.

JM: The above answer captures the uncertainties that a producer faces every year. All I would suggest is to watch weather conditions closely and manage accordingly, as Tom has noted above. There simply are no consistent general "rules" that can be employed, that's where management comes in.

DR: There is risk with cover crops. If the soil is dry there is likely less risk as long as the cover crop is killed in a timely fashion. If the soil is wet (like 2011 was in the eastern Corn Belt) there can be issues with killing the cover crops as early as one might wish. However, there is risk of not killing ragweed, wild mustard, winter annuals, etc…in a year like that as well. We tested our corn stand in the wet spring of 2011 comparing where we had cover crops vs. no cover crops in a no-till setting and we found equal to if not better stand where we had the cover crops. (See http://plantcovercrops.com/do-cover-crops-hinder-corn-population).

Q4: Has anyone looked at wider row (60 inch) corn with interseeding cover crops?
TK: I have not. Also, depends on how early you want to interseed.

JM: I do not know of anyone who has tried the wide-row inter-seeding, it's an interesting question.

DR: I do not know.

Q5: Do not like to use rye for a cover crop.
TK: There are advantages and disadvantages to all cover crops and some work better in some systems or locations than others.

JM: I understand that cereal rye will not fit everyone's cover crop niche, but there are other cover crop candidates that can have better management features for your situation. For example, regular winter wheat will do almost as good as rye for scavenging N (maybe 80% as good as rye, depending on factors like weather and soil properties). Wheat is also not as subject to the excessive spring growth that can be a problem with rye. Other cover crop candidates are triticale or barley. The Midwest Cover Crop website should be consulted to review other cover crop possibilities for your area.

Q6: Do the cover crop radishes release the N they take up during the following crop year? If so, how much? Your slide showed 250 pounds of N being taken up per acre into the radish - is this all released the following cropping season?
TK: I have not worked with radishes myself, but release of N from residues or organic matter is always dependent on the weather, the carbon to nitrogen ratio of the residue or organic material, soil conditions, and the following crop. So it is always variable.

JM: Yes, the radish can have a positive N supplying capacity to the next crop – assuming it is a healthy crop with good fall growth. We have tried them on our forage fields at the USDA Dairy and have seen a positive N release to the next crop. In fact, you could pick out the exact plot boundaries from the radish cover in the following grass forage. At this stage we have not quantified this N supplying component, nor compared it to other covers like some of the legumes (that are well known for N supplying capacity) or to early-terminated cereals. So it's a work in progress.

DR: Part 1– Yes. Part 2 – That is a good question that we don't know the answer to at least not with specific numbers. Part 3 – My guess is that with the brassicas that a good percentage of the N is released relatively early in the season because of when and how they decay.

Q7: Are there any "weed" plants that conserve/restore N? (i.e. lambsquarters, purslane, etc.)
TK: In general, all plants will take up some N and therefore will conserve and recycle N. Some will do a better job than others depending on how well they grow and the "normal" N concentration of their tissue. Past those considerations it is always a matter of the other advantages or disadvantages of a particular plant species.

JM: The research data we've collected comparing cereal rye and annual ryegrass to fall-winter weeds (data presented in Webinar slide #18) showed that the fall-winter weeds recovered very little (< 10%) of the N-labeled fall nitrate, while the cereal rye recovered 50-60% and annual ryegrass 40-55%. Weeds usually don't (or shouldn't) produce enough biomass to develop a strong "N sink" compared to an annual crop. If they did produce biomass comparable to our annual crops, then you would have a significant weed problem on your hands.

DR: I don't think weeds make very good cover crops.

Q8: Research claims radishes take up so much N because they cause solubilization of organic matter more than any other family.
TK: I don't know what "solubilization of organic matter" means in this context or whether radishes utilize a different mechanism for uptake of N than other plant species.

JM: I agree that the term "solubilization of organic matter" is vague and needs better definition. My thoughts are that radish is a good N scavenger because it has an aggressive deep root system; there are rooting depth research data to support this view. But I do not know of any documentation on "solubilization of organic matter".

Q9: Is there a downside to something that accelerates the burn of organic matter?
TK: If you mean is there a downside to accelerating decomposition of organic matter, I would think that usually that is not a good thing. For example, tillage usually accelerates decomposition of organic matter and in the short-term that releases more N from the soil which can increase crop growth, but in the long-term that would not be good unless you replaced that organic matter. On the other hand, if you were adding enough new organic matter that the overall rate or cycling of organic matter increased without decreasing the background soil organic matter content then that would be OK.

JM: I agree with Tom Kasper, that accelerating organic matter decomposition is generally not a good thing. This is because soil properties related to high production will most likely decline as organic matter declines. Some of the positive properties related to maintaining/building organic matter are better rainfall infiltration that lowers runoff and erosion, and provides some additional water for crops; more stable soil structure that improves infiltration; some added cation exchange capacity that is important on more highly weathered soils; and generally a higher soil N supply. An important background question beneath this question is: what level of soil organic matter do you currently have and what organic matter level would be considered adequate for your soil type and cropping systems? Some young Midwest soils contain a large amount of organic matter

that can meet crop production needs for many years, while other more weathered soils (more eroded, more intensely cropped) are vulnerable and need careful management to maintain and build organic matter.

DR: Like tillage? Yes, I believe that one reason the cover crops work so well is that they increase SOM and do not burn it off.

Q10: Are we better off to wait, or broadcast and cross our fingers?
TK: Never know for sure. It depends in part on your location, how much time is left for the cover crop to grow, soil moisture content, and the cover crop that you want to plant. There is probably no sense in overseeding/aerial seeding if it is really dry and there is no rain in sight. Drilling or planting a cover crop is almost always more reliable (on the same day) than aerial seeding. But, even with drilling the seed won't germinate if we don't get rain. Then, if it gets too late, you won't get much growth from the cover crop especially if it winter kills. For later planting dates or dry fall conditions an overwintering cover crop might be a safer bet.

DR: In a dry year I'd suggest doing a great job of having the best soil to seed contact as possible. If aerial seeding, the seed may stay viable on top of the soil for as long as 8 weeks (like it did in Central IL in 2004) if it stays very dry.

Q11: Any studies rolling vs. chemical vs. tillage? HEL
TK: There probably are, but I am not familiar with them.
JM: Yes there are studies on rolling vs. chemical killing vs. tillage. This cover crop management question should be referred to others (local Extension agents, crop consultants, etc.) because each cover crop termination method has its own advantages and disadvantages that are affected by local factors like soil properties, weather, costs, and philosophical views that affect which method should be used.

DR: I'd vote for chemical or rolling on HEL.

Q12: We have no green grass, chopped corn, clay soils...How much moisture is it going to take to germ most covers?
TK: No definitive answer, but probably about the same as a corn or soybean crop would need. Maybe 1 in if it comes slowly and temperatures are not too hot afterwards. However, if that is the only moisture in the soil and it doesn't rain after that the cover crop will not do too much.

DR: Work I did with Ed Ballard (retired U of I extension specialist) showed that if we have a ½" rain followed by another ½" rain within one week that we usually got a very good stand. The more rain you get during the first 10 days after application the better. With the exceptionally dry soils do your best to drill the cover crops in at the appropriate depth.

Q13: What will happen to N if you plant a warm season grass like sorghum-Sudan, millet etc., late summer and the grass winterkills? Will some N be held in profile still in the spring for next crop?
TK: As we discussed above it depends on how much the cover crop grows, how much N is taken up, and what the weather is like after the cover crop dies. There will be some N released from

the cover crop residue for the next crop, some that was released before the next crop, and some released after the next crop.

JM: A winter killed warm-season grass will add N to the soil N cycle, but important questions are how much N it has taken up and how much carbon does it contain. Crop residues with a lot of carbon (corn stalks, wheat straw, very mature forage grasses) provide only minimal amounts of N to the next crop because the N they contain is used by soil microbes decomposing the residues. Other crop residues with a lot of N compared to carbon (like legume covers of hairy vetch, crimson clover, etc.) can supply 60-120 lbs N per acre to the next crop. So the question of how much N a winter killed warm-season grass might supply to the next crop depends on how mature it was when it was winter killed. My experience with warm-season cover crops like sorghum-sudan is that it is a great N scavenger with a high growth rate (rapid carbon increases) that would usually fall in-between the N release of a legume and a mature cereal or mature forage grass. However, even for this in-between case, only a modest amount of N will be quickly available to the next crop, most of the N will be sequestered in slow-release organic N sources that have release rates like soil organic matter (maybe 3% per year).

DR: Warm season grasses grow more aggressively in warmer weather and I'd suppose that they would have greater uptake of N when they are growing more aggressively. There are a number of dairy farms in the Midwest using these grasses after wheat is harvested and manure is applied. After taking one or two harvests they leave the residue to grow until it dies (often times applying more manure while the crop is still growing). Like any other cover crop that dies over the winter there will probably be some N loss over the winter – but significantly less than where there is no cover crop. We need to remember that some of the N will be used to build SOM too. The higher the SOM to begin with the more likely more N will be available in the spring.

Q14: How dry was that season in Maryland?
JM: Evaluating just "how dry" the 1988 drought was in Maryland will require weekly rainfall data, because data summed over a year, or a month, usually misrepresents the critical corn pollination season where yields are most vulnerable to water stress. The precipitation data needed to answer this question is "on order" from the research site, I will update this answer after the data arrives.

Q15: Are farmers in Indiana planting cereal rye or ARG this fall given the drought? Or are folks too concerned about lack of soil moisture and creating even drier soils for next season?
DR: Thankfully most of Indiana has had some rain over the past two weeks. Where there is now "good moisture" farmers are planting almost everything in the "cover crop toolbox" (after wheat). If we continue to get rain then ARG will be the choice. If it stays dry (like in SW Indiana) guys will probably wait for rain and plant cereal rye.

Q16: If overseeding is not possible, are annual cereal grasses a practical cover crop option to use?
TK: Winter cereal grains that overwinter like winter rye, winter wheat, and winter triticale are a practical cover crop option in corn-soybean systems.

DR: Absolutely! Winter (Cereal) Rye, Fall Triticale, Winter Wheat (before soybeans) all work very well over-seeded or drilled. Oats are also a good option if they are planted at least 6 weeks before a killing freeze (22-24 degrees F).

Q17: Will you take yield data on the cover crop at the family farm in IN?
DR: Yes, hand yield data. I have the estimated yield on-line at http://plantcovercrops.com/cover-crops-provide-improved-corn-yields-in-on-farm-trial. The data looks very positive for using cover crops as each entry out yielded the no cover crop check.

Q18: Will one of the speakers please address the cost of cover crop establishment, and then address what the benefits are …..in simple terms of N recovery and nitrate loss prevention?
TK: I am not the best person to answer this question, but I will address parts of it in a general sense. First, costs of cover crop establishment and termination are going to vary from year-to-year and place-to-place and seed costs are often the biggest expense. On a short-term basis N recovery by the following crop is rather modest and it is difficult to predict how much next year's N fertilizer rate can be reduced. On a long-term basis N and other nutrients are going to be recycled to the soil at some later date, the soil is better protected from erosion, soil organic matter is going to increase slowly over time, and soil organisms that contribute to soil health and functioning are going to increase. Eventually depending on what the soil was like to begin with this should result in better crop yields or stability. So, in my opinion cover crops are a long-term investment.

JM: Tom Kasper's points above are right on. The slide that covers the percent recoveries of various cover crops is #18, which shows that 50-60% of the label N was recovered by the cereal rye and annual ryegrass, indicating that they are both very good N scavengers. However, the crimson clover, hairy vetch, and weeds are poor scavengers because they recovered less than 10% of the fall labeled N. When these same covers are compared on the basis of supplying N to the next crop the situation reverses with both grasses providing only minor amounts of N to corn, while the legumes supply 60-120 lbs N per acre (depending on weather, etc.) to a following corn crop. The evaluation of N supplying capacity to the next year corn has been studied for many years and in many regions of the US, these studies clearly show that legumes are the best covers to supply N to the next crop. The fact that different covers have their own advantages and disadvantages gives producers options for targeting their cover crops to specific purposes. The Midwest Cover Crop Counsel's website has a cover crop selection tool that provides very good information about which covers should be considered for the producer's main goal. The use of cover crop mixtures (like rye and hairy vetch, or wheat and crimson clover, etc) can provide benefits of scavenging N and supplying N, but the mixtures usually end up being somewhat of an average of each benefit when compared to pure stands. In the end, the producer will have to set the goal/goals of the cover crop and choose which species can best meet these goal/goals.

DR: I figure that aerial application is the least expensive if you count all costs (labor, repairs, depreciation, etc…) for drilling. However, drilling almost always gives a better stand. The faster a plant gets established the better it does at taking up N (all things being equal)…in other words…a Radish that was drilled and gets up in 6 days will more quickly start taking up N than a Radish aerially applied that may take 10-15 days to emerge and root).

Q19: Is the rye after both crops or just one or the other?
TK: If this is referring to the Ames, IA experiments, then yes winter rye cover crops were planted every year after both corn and soybean.

Q20: On the 53% reduction of nitrates for the corn/sb and corn/sb/rye slide at beginning of Tom's presentation.
TK: If this is referring to the previous question, then yes we planted cereal rye every year after both corn and soybean.

Q21: Is there a source for winter hardy annual rye grass varieties that would be suitable for north central Illinois?
JM: Refer to the Midwest Cover Crop Counsels web site given in one of Tom Kasper's slides, or the Purdue Cover Crop bulletin.

DR: Yes. Contact me at dave@plantcovercrops.com for a list of vendors that would have winter hardy varieties. Regardless of what variety you choose get data sheets from the seed supplier that has good winterhardiness data from the Midwest.

Q22: Who spoke last about "doing it right" please
JM: I believe I used that phrase, to indicate that the 65% reduction in shallow ground-water nitrate N over 10 years was an upper limit of what could be expected from the field-scale use of cereal rye to improve water quality. The "general rule of thumb" I usually use is a 50% reduction. The difference between the 65% and the 50% reduction is that the 65% reduction was achieved on a single small (about 30 acres) field on a University Research Farm that had the luxury of being able to accomplish field work every year (even when only small planting windows were available), use no-till grain drills to get excellent stands, do early planting of the cover right after corn harvest, etc. When Research Farm practices are transferred to larger acreages optimization is often lowered because there will be some acres that can't be planted on time or may have to be planted using alternate seeding practices that are less reliable than drilling. Thus, a somewhat lower performance level is normal as practices are transferred from research studies to the large-scale real world.

Q23: Why did the chlorophyll readings fall below the check plot for the rye and the mix of oats, rye and turnips late in the season?
JM: We should not be too quick to judge a cover crop practice by the chlorophyll meter readings. The chlorophyll meter simply measures the "greenness" of the plant at various points in time over the growing season. They are like snap-shots in time. These readings can be affected by recent drought, recent rains that produce short-term rapid growth, etc. To me the more important piece of data will be the final yield as compared to the other cover crop treatments, and the final economic evaluation of the yield results that include the costs of cover crop establishment. After these yield and economic data are collected we will have a much better idea of the usefulness of the chlorophyll meter data and what the "bottom line" is for the various cover cropping practices.

DR: I'm not sure. All plots had the same 175 Units of N applied in April (100#) and May (75# sidedressed). The Oats/Rye/Turnip Mixture was above the check all but the last test. You can see how the yields from each cover crop plot corresponded to the chlorophyll readings at http://plantcovercrops.com/cover-crops-provide-improved-corn-yields-in-on-farm-trial. The plots that had the "best" chlorophyll readings throughout the season also had the higher yield in this drought year. Will it be the same every year? I have no idea.

Q24: How do we handle the alleopathy effect of rye with corn?
TK: Other scientists would disagree, but I am not sure that the reduced stands and slow growth of corn after a cereal rye cover crop in some years and fields are caused primarily by allelopathy. That could be a topic for a pretty long discussion. Regardless, there are several ways to manage cereal rye before corn that greatly reduce the risk of problems. First, spray the cereal rye cover with glyphosate 14 days before corn planting. Second, regardless of projected planting date don't allow the cereal rye cover crop to get taller than 8 in, if possible. Other practices that seem to help are strip tillage, starter fertilizer, and good corn seed treatments, but the first two are the most important.

JM: I agree with Tom's suggestions. Although if you are in the southern part of the Corn Belt or have more mild winters than the central Corn Belt (like we do in the mid-Atlantic States), you can let the rye grow around 12-24 inches before killing it. Like Iowa, Maryland also recommends killing cereal rye at least 2 weeks before planting. If we have a very mild winter (like the past 2011-2012) the rye growth over the winter may be greater than normal, and it may have to be killed earlier that 2 weeks before corn planting in order to avoid excessive rye growth.

DR: I believe it is more of a C:N ratio effect as much as anything. I agree with Tom about killing early if possible. However, from personal experience two years in a row with planting corn into nearly waist high rye…we've had an excellent stand and improved yield over where we had no cover crop. I believe it is imperative that you put at least 50 units of N on as a starter or pop-up fertilizer. This seems to overcome any C:N ratios that are out of balance.

Q25: Jack - You mentioned lack of heat units in order to gainfully take up nitrogen in the fall and ultimately early spring. Approximately how many heat units would be considered minimum to achieve good N uptake with cereal rye or winter wheat?
JM: Ken Staver at the Univ. of Maryland has evaluated the Oct 1, Oct. 15, and Oct. 30 cereal rye planting date study (data shown in slide #7) in terms of the N uptake of each date as related to cumulative heat units (using the usual 40 degree F base temperature for winter cereals). His analysis showed that about 400 heat units are needed in the fall to take up about 25 lbs N per acre on sites with average residual N, and about 50 lbs N per acre if the soil has high residual N. It would be an interesting exercise to combine this value of 400 heat units with average daily temperature data at various locations in the Midwest (especially across some north-south transects) to see what average planting dates would provide 400 heat units and how these dates would change across the region. I realize that there has been some discussion on the validity of using the heat unit concept for a winter cereal, but I think this is a useful first-draft approach, especially since most of the residual N scavenging occurs during the fall and early-winter.

Q26: Are there studies on the N recycling/fixing abilities of "weed" plants that can also be forage for humans, such as lambsquarters, purslane, etc.? I operate a small organic vegetable CSA project.

TK: See answers to question 8 above. There are a number of studies with cover crops where the control treatment had weed plants in them and these were also measured for N uptake. Additionally, some scientists have suggested using winter annual weeds as cover crops, but I am not aware of any good studies on that. From my own experience I have seen fields with shepherd's purse, field pennycress, and dandelion that almost looked like someone had planted them as a cover crop, but I am pretty sure that was not the intent. In any case, that is an interesting idea, but I don't know if it has been investigated or not.