

University of Minnesota Nutrient Management Podcast Episode “Alfalfa nutrient management”

June 2020

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(Music)

Paul McDivitt:

Welcome back to University of Minnesota Extension's Nutrient Management podcast. I'm your host, Paul McDivitt, communications specialist here at U of M Extension. Today on the podcast we're talking about alfalfa nutrient management. We have three members of Extension's Nutrient Management team. Can you each give us a quick introduction?

Dan Kaiser:

This is Daniel Kaiser. I'm a state nutrient management specialist. I deal with the majority of commodity crops across the state, writing nutrient management guidelines. One of these is alfalfa.

Craig Sheaffer:

Yeah. Hi, I'm Craig Sheaffer from the Department of Agronomy and Plant Genetics. And I've worked on alfalfa for 40 years and look at its management, and specifically its response to nutrients. I hope everybody's got their first cut of alfalfa off by now.

Jared Goplen:

And my name is Jared Goplen. I'm an Extension Educator in crops based out of Western Minnesota, out of the Morris Regional Extension office. And I primarily work with forage and small grain crops, but a little bit with corn and soybean as well.

Paul McDivitt:

Great. So starting off, why is managing soil inputs important for alfalfa producers?

Craig Sheaffer:

Well, I'd like to address that question. Very important because all plants have a number of essential macro- and micro-nutrients that are required for their growth. For alfalfa, we often think of potassium, phosphorus and sulfur as three big nutrients that we need. Nitrogen isn't required because plants can fix nitrogen on their own. Potassium is very important because it's a regulator or it affects biological nitrogen fixation and photosynthesis. It interacts with many enzyme systems. And sulfur is very important because it's essential for a number of the amino acids.

Craig Sheaffer:

So when we look at production of alfalfa, and alfalfa system, we take into consideration phosphorus, potassium, sulfur, sometimes there are other micronutrients, but we think of these in terms of having a productive plant growth. And the question is how much of these nutrients to apply? And the University of Minnesota over a number of years has established guidelines in order to apply these nutrients to the plants. Excessive fertilization doesn't necessarily mean you're going to get better yield or better persistence. In fact, some work we just did on potassium at a number of locations in the state, found out that with excessive fertilization, not only was it economically inefficient, but we ended up with luxury consumption. And so we had very high levels of potassium accumulated in the plants.

Dan Kaiser:

And that's one thing we see quite a bit, particularly as Craig said with potassium, is luxury uptake. It happens in many of our crops, particularly in the biomass. So if you've got a crop that is a biomass crop like alfalfa, we know that with corn in particular, if you have corn silage or you have corn green, that

there's not as much potassium in the grain aspect to it. So the plants tends to not regulate itself. So if it's there, it'll take it up. So it's one of those things that we know, if you're trying to deal with lower K, that you have to be somewhat careful, particular with high application rates. But it's interesting because I've seen situations where I think that we should be able to cap uptake on some of my plots, and it's a linear increase. So it just continues to increase with the increasing rates we apply. So that's one of the major things I think to watch out for that.

Dan Kaiser:

Sulfur has been one of the ones that, I guess, I've been interested in more recently. We've been doing a lot of work since I started back in 2008, in Minnesota, on corn. Alfalfa has been one though, it's kind of a nice crop for me in some of the areas as just a way to test, to see how the soils are for available sulfur, because it's one that's going to be a higher demand than corn. It's just not always as, when we started looking at a lot of our sites, we can't always see deficiencies in it, even though when we think we do. And I think a lot of that has to do with the fact that, if you look at where a lot of our alfalfa is grown, one of the things we've seen, particularly on some of our silt loam soils in the southeastern part of the state, is they tend to have a high mineralization potential. So those soils, I think it kind of explains some of the reason we're seeing it.

Dan Kaiser:

I know Wisconsin's been doing a lot of work, particularly Carrie Laboski over there, looking at both potassium and sulfur interactions, where they tend to see more instances of response, particularly with sulfur, will be on eroded knolls or areas of the field that are eroded where the soil doesn't have the capacity to supply sulfur. So it's one thing I think growers should watch out for, really, for that, is just watching particular areas of the field just to see. Particularly, I mean when we start looking at sulfur, we can see some of the similar soil, sandy soils, silt loam soils will be low in both K and S. So it's two things that can kind of go hand in hand on some of these locations.

Jared Goplen:

And one of the other kind of key characteristics there, you talk about luxury consumption, and there can be some animal nutrition aspects to that too, with milk fever and other things that can occur due to toxicity type issues. So it's not only an economic thing, but it also could be an animal performance issue as well.

Dan Kaiser:

Well, and we also look at it in terms of, I know Craig brought up some of the amino acid issue with when it comes to sulfur. And we do know that it's one of the things we look at routinely with many of the studies is looking at forage quality, not necessarily just tonnage, because we can see some impacts on quality of some crops at times, particularly with sulfur, just because of how sulfur interacts with nitrogen. If we talk about just crude protein or protein content of many crops, we know that nitrogen is really critical. So if we look at crops like soybean, where we're trying to promote protein, that typically nitrogen supply is going to dictate that. Sulfur can change the amino acid profile. It may not necessarily impact the overall protein content, but it can be something that, if we look at sulfur, we've seen it at times in some crops where inadequate sulfur has affected nitrogen nutrition. So we know these two can go hand in hand, so they are two things to watch.

Dan Kaiser:

And now more recently, I don't know, Craig, I mean phosphorus, we haven't really looked at phosphorus in alfalfa for, it's been quite a while. But if you look at the areas, a lot of these areas are particularly livestock producers that have manure. I've never really seen it where phosphorus has been that major of an issue. And I don't know if you have any comments on that.

Craig Sheaffer:

Yeah. I think our response to phosphorus over time, well it is a limiting nutrient if you don't have enough, has been much less than potassium. So that's why I think that, and again, if you have manure applications, usually it's not an issue.

Dan Kaiser:

And that's one of the things that we did go through with corn and beans over the last year. And I did modify the potassium guidelines. I haven't done anything right now with alfalfa. And I've been kind of looking at some of the information that we've had. The study with AFREC, particularly the K by variety study, that was one thing that, just looking at the data, not much response above about the medium class. And then there was another study that was funded, I believe by Minnesota Corn back around 2008, 2009 that Jeff Coulter was involved with, where they were looking at medium alfalfa K levels in

alfalfa stands going into ... then looking at alfalfa the last year the stand going into corn, and not seeing as much of a response with it. So that's one of the things that, looking at it, we know that potassium is important, but this has been kind of a tough one to nail down with it in terms of we know medium or less, that's an area you're going to really want to focus on fertility.

Dan Kaiser:

You get medium or higher, that's been one of that, as Craig mentioned before, that we can see some over applications occur in that where it's not economically viable.

Craig Sheaffer:

Yeah. For potassium, I used to talk about potassium being an antifreeze factor for getting alfalfa through the winter. But in that recent study that you mentioned Dan, we really didn't find that excessive levels of potassium fertilizer really prolonged our stand life or increased winter hardiness. So, I want to walk back my earlier comments about that that I've probably given, talked to farmers about for years, but there's no real benefit from that. Again, go back to your soil test guidelines or recommendations about how much potassium to apply.

Paul McDivitt:

What are some key points that growers should consider when making nutrient management decisions for alfalfa?

Dan Kaiser:

Well, I think the main thing is, as Craig just mentioned, is get a soil test. I mean, really knowing where your levels are really important, particularly for growers. Again, if you look at where a lot of our alfalfa is grown, I mean you can see a lot of it on sandier or maybe more marginal soils that have a tendency to have lower soil test values. So it's one of the things to really watch out for. We know that removal of potassium, Craig I believe two to 300 pounds, a good stands, we can remove quite a bit on a yearly basis. So that's one of the things, that it can put a lot of stress on the potassium that's in the soil. I mean, alfalfa soybean are two crops that tend to remove a lot of potassium.

Dan Kaiser:

And so, I mean just getting and knowing is really kind of I think a main thing in knowing where you're at to make sure that you're not sacrificing tonnage or quality on the particular field. Now with sulfur, there's not a lot we can do. I've been going with by organic matter level instead of going with the sulfur soil test level, because it seems like it's more related to the amount of sulfur that can be potentially mineralized throughout the growing season. So that's really what I've been stressing at growers, is if you're at about 3% organic matter in the top six inches or less, those are areas that you're really going to want to watch. With alfalfa high production systems I think I even go up to four, four and a half, somewhere in there, and just apply something maybe a little bit 10 pounds.

Dan Kaiser:

Removal of sulfur is going to be roughly between about 20 and 30 pounds based on my calculations. We recommend around 25, particularly in sandy soils, which in most cases should be enough. It's one of the things we're looking at right now. With some of our current studies, we have some rate comparisons going on, and I'm also interested in sources, because that's been a main focus of mine with our sulfur work, looking at elemental sulfur sources that tend to be slow-releasing and slow oxidizing, to make sure we're getting enough available sulfur on. So that's some of the things we're looking at right now.

Jared Goplen:

That's one too, this nutrient management side of things when it comes to alfalfa. And you look at the average alfalfa yields reported by the National Ag Statistics and other sources. And the alfalfa yields in Minnesota are a lot lower than what they should be. And oftentimes I think they get neglected. People get focused on other things and they might forget to take that soil test or make sure they have adequate fertility levels. So that's one of the issues that I see. So taking that soil test and making sure we're fertilizing those things accordingly is definitely critical for yield, but also that perennial problem of winter kill or winter injury.

Jared Goplen:

Craig alluded to excessive applications of potassium it isn't recommended to prevent winter kill or winter injury, but making sure we have enough is going to be important, because if we're short on any of

those things that will probably have some type of an effect there. So making sure we have that adequate supply is going to be important for that perennial crop to keep it in production more than just a year or two.

Craig Sheaffer:

I'd like to just reiterate our really asked Dan a question about this crop removal. I've had farmers call me and say that they've had, from their co-op, recommendations to apply potassium to the soil based on crop removal. And my response has been, "What's your soil test K level?" Particularly in these times for dairy farmers where milk prices are low, it may be a time to actually look at your soil test and draw down that level a little bit, rather than applying potassium based on crop removal. And Dan, I don't know what you think about that or how you respond, but I'd like to hear your comments.

Dan Kaiser:

Well in that study Craig, and I can't remember off the top of my head, did we see differences early on, more earlier than later in the stand with potassium applications? Was it earlier that we saw more responses as in as the stands age than we tended to see less of a response?

Craig Sheaffer:

Yes, that's right. So we actually added or uploaded more potassium into the system with time too. So there is no doubt. The most productive stands of alfalfa you will have will be those that are one year old or two years old. Now, they will drop off after that. So putting high rates of fertilizer on third-year stands is one of the factors that may not be economical.

Dan Kaiser:

Well and that's, I guess, the question. Because if you look at like a removal based strategy, I mean, based on the data I've seen, you start getting out beyond maybe two to three to four year old stands, that if you're at about a medium soil test or higher there really hasn't been that much of an advantage. I know the study that Jeff Coulter had that's, I think, one of the things that was clearly in play and where they saw a greater benefit was the corn year after the alfalfa for applying the potassium. So I think if you're looking at high production early in stands, you may want to look at your rates a little bit more. And I

think it's a big difference too, Craig, if you're buying potassium versus you have manure. If you have manure on there, obviously though you may not be managing strictly for potassium with manure, but there's probably nothing wrong with going with a more of a removal rate if you have something that you're recycling back onto your fields with the manure application to capture some of the value of that manure within the fields.

Dan Kaiser:

It is a struggle. This is a question I get a lot, just because we know that there's a lot of removal, that I know growers are kind of always interested in that just because of the amount of money they have to put towards potassium. And potassium, it's reasonable, but it's still not cheap. Particularly when you look at some of the outputs milk and some of the other things kind of going on in terms of where our commodity prices are that it isn't always economical. So that's I think one of the main concerns.

Dan Kaiser:

And if we also look at neighboring states, I know we were talking about before this podcast started some of the recommendations for Minnesota versus Wisconsin. I mean why we're different, a lot of it has to do with data right now. In terms of having, the data in terms of changing the recommendations. The majority of what we've seen has been pretty consistent if you look at how our data's shaped out versus where our recommendations are at. I'm still toying with right now is increasing our critical levels slightly, which would change things slightly going to 200 parts per million max for kind of like what we've done with corn and soybean, but we probably wouldn't change the recommended application rates. It's just hard finding consistent sites where we see responses. And that's been one of the things that I've been trying to figure out a why that is.

Dan Kaiser:

If that's something like we've been seeing with some of our other studies. Particularly we get into our silt loam soils we tend to see our soil tests and the availability of that soil test measuring being slightly lower versus what's actually there within the soil. So it's one of the things. We've got, I think, a few things we could look at. Just so with the alfalfa, we kind of struggle I know, Craig, just getting funding right now just to work on large projects with alfalfa. So that's kind of the main thing with a perennial crop is it's not a one year simple answer, it's something you've got to look at over time. So that's kind of

been one of the main things. In terms of making changes to the recommendations is to making sure that we have the data to do so at this point in time.

Paul McDivitt:

So does timing matter with alfalfa fertilizer application?

Dan Kaiser:

Well on the side with a lot of the data we have, Craig brought this up earlier. The big thing, and this came up a couple of times talking to consultants last year, is putting on a small rate, maybe 40, 50 pounds of K2O in the fall ahead of the crop to help with overwintering. And I just don't really see the benefit to that. So my recommendation to growers is, is not to not put fertilizer on your alfalfa, but it is to look at your timing as having greater flexibility, that we know we don't need to do split applications. So if you want to go on before first cut or if you'd want to put it on in the fall, I think there's opportunities to do so. So in terms of that overwintering piece, particularly for potassium, it really seems like whether it's, I don't know Craig, if you have any comments on varieties, I mean we've got such greater varietal tolerance, I think, to overwintering. And also to diseases.

Dan Kaiser:

Where in the past that may have been a bigger factor with potassium just based on some of the older varieties. So I know it's one of the things that we tested in that study, but there really weren't any differences between the varieties themselves.

Craig Sheaffer:

Yeah. So if you have a modern winter-hardy alfalfa variety, I think that applying potassium above recommended levels really isn't going to give you any benefit, because there are many other genetic factors involved in that response.

Dan Kaiser:

And I don't know, that study we had, those were mostly modern varieties, or there weren't any historical checks in that AFREC trial.

Craig Sheaffer:

No, yeah. No, and that's a good point. They were all modern varieties that were available to producers. And I might add that one of our factors that influences our recommendations about fertilizers, particularly potassium on alfalfa, is this historic data. And I actually, in writing this paper, went back and looked at that data. And indeed they had varieties with low levels of winter hardiness, and particularly low disease resistance. And potassium helped them in those cases. But now with the varieties that we have with resistance to five or six of the modern diseases, as well as tolerant to frequent cutting, we don't see differences in those entries.

Dan Kaiser:

And there's one thing too. I kind of want to go back to a point too. Before I guess I forgot to talk about too, is when you're dealing with alfalfa, I mean again Craig said P, K, sulfur, those are going to be kind of the main three we're going to be focused on. If you do have a mix, alfalfa grass, our recommendations right now are of no more than about 60 pounds of N just for the grass. One thing that you do have to be careful of, and this is something I know that does come up in manure situations, is over-application of nitrogen, either with weeds or if you have a grass mix in there kind of favoring the grass itself. So that's one of the things. We haven't looked too much at some of the grass mix stuff.

Dan Kaiser:

I would look at our current recommendations, they should be valid. We did some work on sulfur I know when Doug Holand was in Jared's position a few years back looking at sulfur. We really saw no benefit from the sulfur application. This was out around the Fergus Falls area, Morris area. And so that's one of the main thing though with nitrogen, is that just be careful with that one. If you do have an alfalfa-grass situation, there is some positives of it, but you can overdo it, particularly in just a straight alfalfa situation where you're trying to maintain legumes, because they don't necessarily do well with competition if you over-fertilize for the grass portion.

Jared Goplen:

I guess the other point too, we haven't really covered much in terms of timing. Alfalfa is a crop that's pretty sensitive to soil pH. So thinking ahead too in terms of that rotation and trying to get that lime applied ahead of time so that you can actually get that pH adjusted. I guess the other question too, and this is kind of for Dan, as in terms of timing, obviously for putting in a new stand we're going to take that soil test and get that basically apply fertilizer, get it incorporated because that's the only chance we're going to get. Have you seen anything or have any thoughts in terms of effectiveness like per pound of fertilizer top dressed versus incorporated pre-plant?

Dan Kaiser:

I haven't seen anything. In terms of, we do know that potassium does tend to have some issues, particularly if the soils get dry, we know that we need some moisture to move it to the roots. It doesn't move very far. So we've seen that in some other crops stratification does tend to be a factor to be concerned about. I haven't seen though anything in potassium in terms of that, because there's still a recommendation if you need it, it's the top dress because you can't rip it up. Certainly with lime, that's one of them, Jared. I mean, I think you're correct. It's one of the things that we want to probably look at ahead of time. And I would at least try to maybe the crop ahead of it, or maybe the one before that in the fall, if you're thinking about going to alfalfa at least get a soil test to know where you're at.

Dan Kaiser:

Lime has really been important, particularly for establishment, I mean to keep the thing going. And that's one of the things that we want to have on early enough, if at all possible. But in terms of timing of everything else, if you're dealing with a sandy soil, we know that potassium does have some mobility. So in terms of getting that down to the roots, it isn't too much of an issue. Silt loams, you'd have a little bit. As you increase clay content that mobility tends to decrease, because of how potassium is attracted to the soil cation exchange capacity.

Dan Kaiser:

So, I mean, that really is, I mean top dressing really is the only option. If I had a really low situation, you're probably going to want to frontload it a little bit, at least to get it going. Because as Craig was

saying, I mean, we're looking at production-wise. I mean, that's where we really see the more sensitivity to the crop to deficiencies. So as we age in the stand I think we have more flexibility in what needs to be done, but early on is where we really wanting to be looking at focusing some of those applications. I don't know, Craig, if that's something that you agree with or not.

Craig Sheaffer:

Oh, wholeheartedly yeah. So I was going to ask Dan about sources of sulfur for fertilizing alfalfa. What he would recommend for that?

Dan Kaiser:

So we do have some studies right now looking at that. There's two options out there. Obviously elemental sulfur, which is not plant-available. It has to be oxidized to sulfate, which is the plant-available form. The other sources would be something like gypsum, ammonium sulfate. And they're actually in the sulfate form, which are immediately available. And those are ones if you have yellowing in the field which you think is sulfur, which you could diagnose with a tissue test, I would honestly go with a sulfate form, because you should see a pretty immediate greening if you get some rain and you get that down to the roots.

Dan Kaiser:

The elementals, kind of one is the big mystery and that's one of the newer, the studies we're looking at right now. I've got a corn and an alfalfa trial. We just set out this year. The corn trial started last year, that I'm looking at longterm disease. What we've seen with some of these elemental sulfur products is some oxidation late in the growing season. So I'm kind of trying to see as over time if that will tend to build and give us benefits. We're actually looking at a product, it's potash based, it's co-granulated with elemental sulfur, which I think would have some benefits, particularly for alfalfa production, because it's got two nutrients of interest in it. The nice thing about that particular product is it's got a high K content. With some of these other products that we've been testing, the K content's been kind of low, so you're not getting as much per ton. So it takes a lot of materials.

Dan Kaiser:

So that's the main thing on the sources. If you're looking at immediately available you've got to have a sulfate source. With manure, we generally say about 65% availability, and this is coming from some numbers I got from Wisconsin. I think those numbers probably depend if it's a pit or a liquid manure versus a dry manure. I think you're going to get more readily available out of a dry, just because of somehow the changes in the anaerobic conditions can happen with sulfate, but we don't know. So if you have manure, I think you're getting some. And again, I just would recommend using about 65% availability if you've got a total S number for the first year. But if you see yellowing again, I mean look, going out and putting on, say, 50 pounds of ammonium sulfate, that can do wonders in terms of greening the crop up.

Dan Kaiser:

So something I think Craig that will have some answers to. And definitely with some of the work we're doing here in the next few years, just looking at some of the sources, because that's been a major bone of contention of mine is that growers all want to apply sulfur they call the co-op, but they don't always know exactly what source they're getting. So that's one of the questions I guess I'd always ask if I'm buying sulfur is, "What source is this." So you could scout the fields to make sure that you're not seeing any deficiencies show up, particularly early on in the growing season when there's not a lot of oxidation of the elemental sulfur or mineralization from the soil itself.

Paul McDivitt:

All right. That about does it for the podcast this week. We'd like to thank the Agricultural Fertilizer Research and Education Council, AFREC, for supporting this podcast. Thanks for listening.

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