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NOBLE NEWS & VIEWS



TECHNOLOGY

Choctaw-Noble Project Explores Safety, Practicality of Drones in Rural Communities



by James Grimsley, Choctaw Nation of Oklahoma senior technology consultant



Dillon Payne, Noble Research Institute ag technology application coordinator | dbpayne@noble.org

In May 2018, the United States Department of Transportation Secretary Elaine L. Chao announced 10 Unmanned Aircraft Systems (UAS) Integration Pilot Program (IPP) sites representing a mix of states, counties, cities and tribes. The purpose of the program is to accelerate safe UAS (i.e., drone) integration into the national airspace system by:

- Identifying ways to balance local and national interests related to drone integration.
- Improving communications with local, state and tribal jurisdictions.
- Addressing security and privacy risks.
- Accelerating the approval of operations that currently require special authorizations.

The Choctaw Nation of Oklahoma was one of the 10 IPP sites selected as well as the only tribal government lead participant. The Choctaw Nation entered into a key strategic partnership with the Noble Research Institute.

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The Choctaw Nation program focuses on typical rural and agricultural community applications of drone technology, including addressing both safety and public stakeholder concerns.

Additionally, the unique partnership with Noble is facilitating analyses of the practical applications of drone technology in agriculture, including viability for various applications and assessing potential return on investment (ROI) for a typical agricultural producer.

The Noble Research Institute is excited about the partnership with the Choctaw Nation and the potential of drone technology for rural communities and for agricultural producers.

DRONES IN AGRICULTURE: ARE THEY PRACTICAL?

There is a modern adage about technology called Amara's Law that states, "[w]e tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run." This adage succinctly describes — in a way — the emergence of small drones. Drones have emerged on the public stage within the last decade with a mixture of enthusiasm, hype and even concern.

In 2013, the Association for Unmanned Vehicle Systems International (AUUSI) published an economic forecast that included a prediction that around 80 percent of the civil market for drones

Conference Will Communicate Initial Results

Choctaw Nation and Noble Research Institute will co-host the Emerging Aviation Technology Conference on April 18, 2019, at the Choctaw Casino and Resort in Durant, Oklahoma. The conference will focus on drones and emerging aviation technologies, including agricultural applications and early results from the Choctaw Nation's unmanned aircraft systems integrated pilot program project.

Learn more at choaa.com

would be for agricultural purposes, approximately 10 times the predicted market size for public safety applications. You can see the full report at www.auvsi.org/our-impact/economic-report.

This forecast heightened interest in the agriculture industry and spawned early investments and startups each seeking to "cash in" on the agricultural market for drone technology. Unfortunately, many of these initial endeavors lacked insight into the practical economics of agricultural production and lacked involvement of subject matter experts from the agricultural community.

The Noble Research Institute, with its rich history of agricultural demonstrations and research, takes great pride in capitalizing on opportunities to further such a potentially powerful piece of technology for the agricultural industry.

This strategic partnership will allow Noble the opportunity to use the practical knowledge that producers provide to help steer the policies that regulate UAS in the agriculture space.

POTENTIAL BENEFITS

The Noble Research Institute is predicting two types of benefits for drone technology within an agricultural production environment:

1. Improvements in efficiencies (yields, profits, etc.).
2. Improvements in safety within the agricultural environment.



A common saying about drone technology is that it can help address the 4 Ds: tasks that are dull, dirty, dangerous and difficult. Agriculture is among the 10 most dangerous occupations in the country, according to the Bureau of Labor Statistics. The Choctaw Nation's UAS program began with the idea that agricultural worker safety could be improved by using drones to accomplish specific tasks.

REMOTELY REBAITING FERAL HOG TRAPS

An early demonstration involved using drones to remotely rebait traps for feral hogs (in this case the feral hog trap used was the Boarbuster™). In August 2018, a drone (developed and flown by Oklahoma State University) remotely delivered 10 pounds of ordinary dried corn to a feral hog trap several thousand feet away from the drone operator. The mission was successfully repeated several times with an accurate delivery in the trap each time.

The feral hog trap rebait mission was selected not necessarily to demonstrate a value for ROI, but rather to demonstrate a potential class of applications that could possibly reduce exposure to workplace hazards. In this example, the use of a drone would reduce the need for a worker to travel to perform a relatively routine and simple (but dull, dirty

A common saying about drone technology is that it can help address the 4 Ds: tasks that are dull, dirty, dangerous and difficult.

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and dangerous) task.

A large number of accidents within an agricultural producer's environment occur as a result of travel within remote agricultural properties. If the amount of travel and movement can be minimized, then it may reduce the likelihood of injuries to farm workers.

Of course, this is based on the assumption that drones can be safely integrated into the airspace and that safety issues related to drones can be effectively managed. The Noble Research Institute is addressing some of these safety issues as part of the program, and we are encouraged and optimistic about the early results.

DRONES COULD COUNT COWS

The Noble Research Institute is also encouraged by the potential applications of drone technology in agriculture that were mostly ignored when the initial drone industry forecasts emerged.

Although the overwhelming majority of early drone companies focused on crop applications, we are recognizing significant benefits for herd management. These applications range from using artificial intelligence and computer vision to accurately count and inventory herd animals to using a variety of sensors to help locate lost members of a herd quickly and efficiently. 🐮



PECANS

How to Identify and Control Pecan Nut Casebearer

by Charlie Graham, Ph.D., senior pecan specialist | cjgraham@noble.org



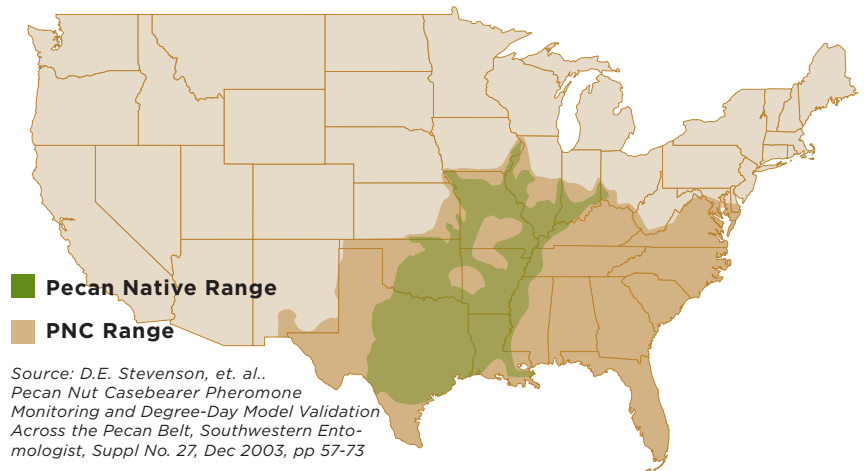
There are more than 200 insects that feed on the roots, wood, foliage and nuts of a pecan tree. Of these insects, 17 are nut feeders, with one of the most important nut-infesting insect pests being the pecan nut casebearer (*Acrobasis nuxvorella* Neunzig).

WHERE ARE CASEBEARERS FOUND?

The pecan nut casebearer (PNC) has a wide geographical range, extending from Florida to southeastern New Mexico, and north to southern Illinois. This covers most of the pecan producing regions in the U.S., excluding Arizona, California and parts of New Mexico.

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Native geographic distribution of pecans and the pecan nut casebearer.



WHAT THE PECAN NUT CASEBEARER LOOKS LIKE



Figure 1. Silk and black frass (excrement) are visible outside infested nuts.

LARVAE

Newly hatched larvae are white with a brown head. They have three pairs of legs located just behind the yellowish brown head. The tiny larva feeds for a day or two on a secondary bud at the base of a compound leaf before it enters the pecan nut. Larvae generally tunnel in at the base of the nutlet and feed for about four to five weeks, depending on the temperature. Silk and black excrement are often visible outside of the infested nuts (Figure 1). As the larvae mature, they become olive to jade green in color and are about a half inch in length. Full grown larvae enter the pupal stage inside the nut with the mature moth emerging nine to 14 days later.



Figure 2. PNC egg on the stigma of a pecan nutlet. Credit: Bill Ree, Texas A&M Agrilife Extension.

EGGS

Moths are active at night when seeking a mate. Each female lays 50 to 150 eggs during her five- to eight-day lifespan. The eggs are flat, very small and white when newly laid but are large enough to be seen with the unaided eye (Figure 2). They develop red dots/lines after two or three days (appearing pinkish in color) and turn entirely red before hatching.

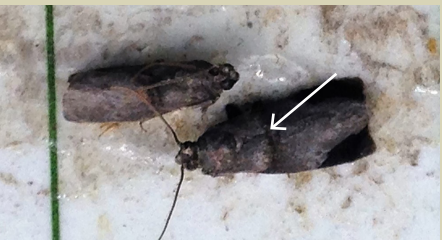


Figure 3. Arrows pointing to the ridge of scales on the forewing of a male pecan nut casebearer moth.

ADULT MOTHS

Adult PNC moths are generally about 0.3 to 0.4 inches long and range in color from a brownish gray to a grayish black. PNC moths have a unique raised ridge of dark scales extending across the middle of each front wing. When the wings are folded back, this ridge looks like a dark line running across the width of the insect just behind the head (see arrows in Figure. 3).

HOW DO YOU CONTROL CASEBEARERS?

Casebearer larvae tunnel into nutlets shortly after pollination, often destroying all nutlets in a cluster. The most reliable method of control is a properly timed insecticide application to the tree to kill the recently hatched juveniles before they can enter the young nutlets. However, treatment is a judgement call based on moth catch, egg scouting and pecan crop load. So part of this equation depends on properly identifying the adult male moths captured in orchard traps.

WHEN DO CASEBEARERS CAUSE THE MOST DESTRUCTION?

First-generation larvae are usually considered to cause the most economic loss. This early in the season, a single larvae can destroy an entire nut cluster due to the small nutlet size. Later generations will typically only have to feed on a single nut to complete development. For this reason, control is directed primarily at the spring generation.

WHEN SHOULD I SPRAY FOR CASEBEARERS?

There is a fairly small window of opportunity for insecticide applications to control newly hatched casebearer larvae. Once the larvae has bored into the nutlet, they are protected from insecticide treatments. As mentioned earlier, the necessity of control measures is determined on the severity of the infestation and the size of the nut crop. The alternate bearing cycle of pecan trees often has an impact on your management decisions. In the "on" years, when the crop load is heavy, many growers will opt not to treat and allow PNC to naturally thin excessive nuts from the tree. However, in the "off" years, when the crop load is light or if the infestation levels are severe, treatment will be necessary to maintain a commercial crop load on the trees.

Story continues on next page

WHERE TO FIND PNC TRAPS AND PHEROMONES

ALPHA SCENTS

1089 Willamette Falls Drive,
West Linn, OR 97068
Phone: 503-342-8611 or 971-998-8248
Fax: 314-271-7297
www.alphascents.com

GEMPLER'S

P.O. Box 44993
Madison, WI 53744-4993
Order by Phone: 1-800-382-8473

GREAT LAKES IPM INC.

10220 Church Road
Vestaburg, MI 48891-9746
Phone: 989-268-5693 or 989-268-5911
Toll Free: 1-800-235-0285
Fax: 989-268-5693
Email: glimp@nethawk.com
www.greatlakesipm.com

ISCA TECHNOLOGIES / MORITOR TECHNOLOGIES

P.O. Box 5266
Riverside, CA 92517
Phone: 951-686-5008
Fax: 815-346-1722
Email: info@iscatech.com
www.iscatech.com

OLIVER PECAN CO. INC.

1402 W. Wallace, San Saba, TX 76877
Phone: 1-800-657-9291
Email: soliver@centex.net

PAPE'S PECAN HOUSE

P.O. Box 1281
101 S. Hwy 123 Bypass
Seguin, TX 78155
Phone: 830-379-7442

SOUTHERN NUT 'N TREE EQUIPMENT INC AND PPI

324 SH 16 South
Goldthwaite, TX 76844
Phone: 1-800-527-1825
Fax: 325-938-5490
Email: sales@pecans.com
www.sntequipment.com

TRECE

(for bulk orders only)
P.O. Box 129
Adair, OK 74330
Phone: 918-785-3061
Order Center: 866-785-1313
Fax: 918-785-3063
Email: custserv@trece.com
www.trece.com



HOW DO I KNOW HOW BAD AN INFESTATION I HAVE?

Determination of the infestation severity is based on egg counts on nut clusters. To pinpoint when you should be scouting for egg lay, many growers rely on monitoring PNC pheromone traps (Figure 4).

WHAT IS A PHEROMONE TRAP?

The pheromone trap uses a lure containing PNC female pheromone that attracts males looking to find a mating partner. You will need to monitor the traps often — at least three times per week — and record the first capture of male PNC moths. The optimum time to apply an insecticide to control PNC larvae is about 14 days following the first capture. However, this is also the time that misidentification can have the greatest impact on your spray program.

WHAT IMPOSTERS SHOULD I WATCH FOR?

A common imposter moth that can be caught in the pheromone trap before PNC flight is the pecan bud moth. It is slightly larger than the PNC moth and lacks the raised wing scales on the forewings. Its numbers increase in the orchard earlier than PNC, but it does not feed on the young pecan nutlets. Misidentifying moths in the trap can result in wasted hours scouting for PNC eggs when there aren't any in the orchard yet. Some managers will actually spray 14 days after first moth capture without scouting for eggs. If this is the case, then the insecticide will be applied before any PNC are in the orchard. This is not a recommended protocol.

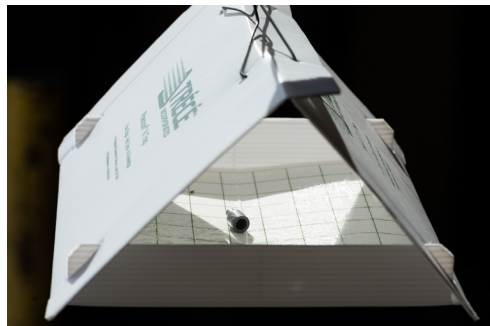


Figure 4. Pecan nut casebearer pheromone trap with lure attached.

WHEN SHOULD I START SCOUTING FOR EGGS?

Research suggests that trap catches cannot be used to predict the threat of casebearer larvae damage or the need to apply an insecticide. Instead, you should begin scouting for eggs on the nutlets approximately seven to 10 days after the first PNC moth is captured in the pheromone trap. Nut entry will occur 14 to 20 days after the first capture.

WHAT AM I LOOKING FOR WHEN I SCOUT FOR EGGS?

When scouting for egg lay, remember that most casebearer eggs are found on the stigma (distal tip of nutlet) or hidden just under the sepals of the nutlet. Many find that a good hand magnifying lens makes the job easier to find the eggs and also determine what developmental stage they are at (white, pink, red, or hatched). Ideally, insecticide applications should be made when the majority of the eggs are pink in color. A simple rule of thumb to determine if an insecticide should be used is to treat when 5 to 10

percent or more of the nut clusters sampled are infested during the “on” years. During the “off” year (light crop), reduce the threshold to only 3 to 5 percent infestation. Usually, one insecticide application is needed to control the first generation of pecan nut casebearer. However, if infestations are extremely heavy or emergence of adults is prolonged, a second application may be necessary.

HOW MANY TRAPS SHOULD I SET, AND WHERE?

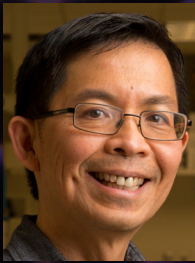
Three to five traps are usually adequate for orchards smaller than 50 acres. Larger orchards will utilize more than five traps to provide adequate coverage. You may want to use additional traps if your orchard has considerable changes in topography, such as a river bottom site transitioning to an upland site. Traps are usually attached to a nut-bearing limb at an easily accessible height to allow easy monitoring. While it is true that traps placed higher in the canopy will capture more moths, you must remember that you are monitoring moth activity, not the actual number of moths captured.

WHAT ELSE SHOULD I KNOW WHEN SPRAYING FOR PECAN NUT CASEBEARER?

Before purchasing and applying any insecticide, always read the label to determine if the product is labeled for use on the target plant or site. Many insecticides are labeled for controlling pecan nut casebearer on pecans. Base your insecticide choice on applicator safety, grazing restrictions if livestock are present, and potential impact of the insecticide on beneficial insects and other pests. Thorough spray coverage, accurate timing to treat hatching larvae, using recommended insecticide rates and proper sprayer calibration are critical for achieving good control of the pecan nut casebearer. 🐛


 PEACANS

Scientists Explore Ways to Encourage Root Formation in Pecans, Legumes



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The Noble Research Institute Plant Cell Biology Laboratory conducts basic research on plants. We ask why and how plants do what they do. Research efforts are directed toward understanding how the plant root system grows and survives under conditions of low water and nutrient levels and a range of other stresses that could lower crop yields.

Recently, we embarked on a new project that seeks ways to improve root production in pecan stem cuttings. This project was initiated because we discovered a set of small synthetic chemicals that triggered extensive formation of roots in stems of *Arabidopsis thaliana*, a model plant related to the mustard family (Figure 1).

Most plant aficionados are familiar with roots that form on the stems and even on the leaves. Roots that form

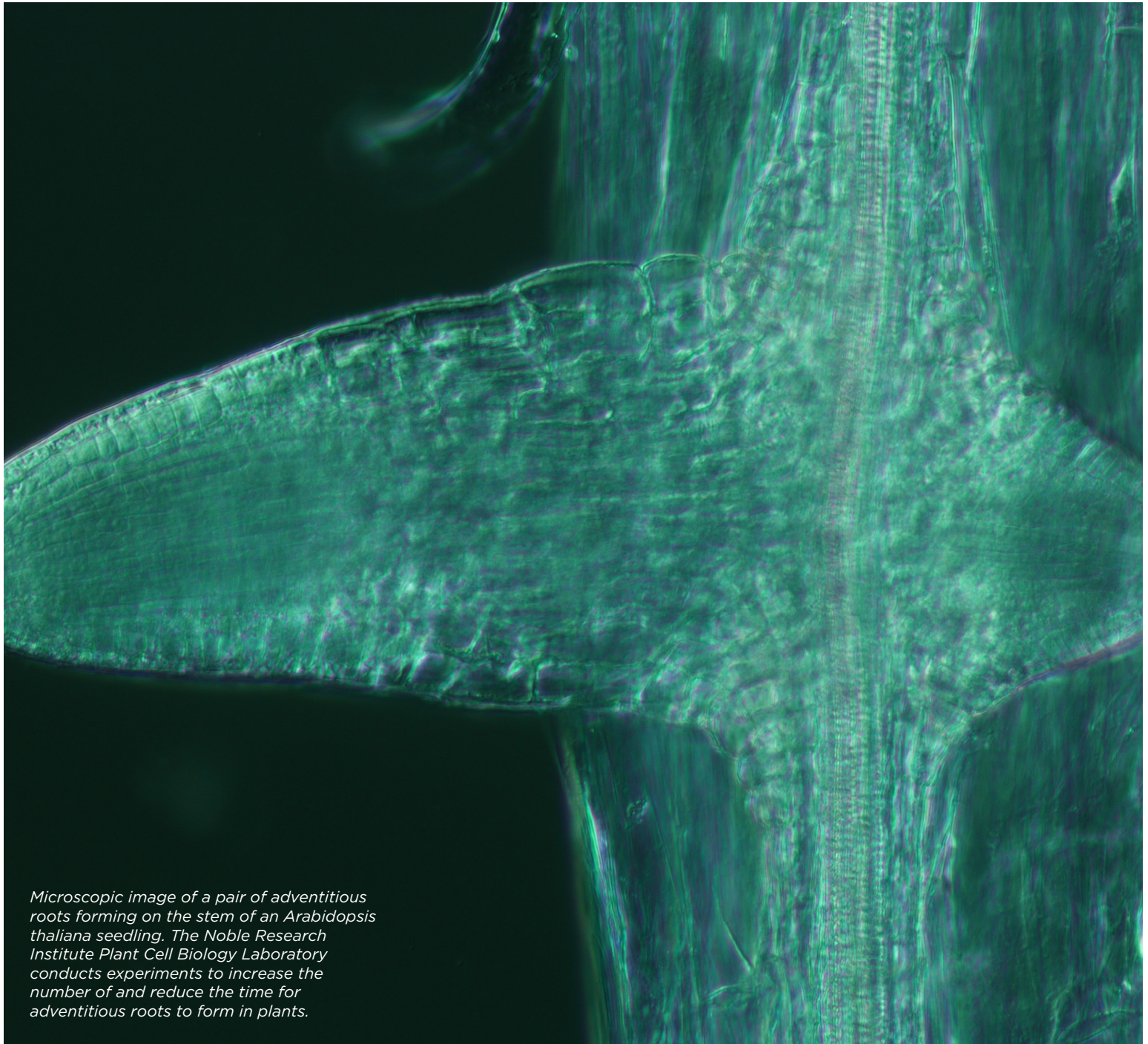
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↑
Above:
Microscopic
image of a thin
section of an
adventitious
root.

Below: An
adventitious
root forming in
a mature pecan
stem cutting.

←



Microscopic image of a pair of adventitious roots forming on the stem of an Arabidopsis thaliana seedling. The Noble Research Institute Plant Cell Biology Laboratory conducts experiments to increase the number of and reduce the time for adventitious roots to form in plants.

from any part of a mature plant other than the root itself are called “adventitious roots,” which is the basics for propagating a range of horticultural plant species. This ensures that the resulting plants remain genetically identical to the parent plant.

The ability of plants to form adventitious roots is under the tight control of many factors including:

- Humidity
- Age of the plant stem used for propagation
- Soil water content
- Plant species

With regard to the latter, some plant species are more difficult to root than others. What ties these adventitious root-inducing

conditions together is the participation of a plant hormone called auxin.

Auxins are commonly used in agriculture. For example, they are used as herbicides, the most common of which is 2,4-D. Some auxins like indole butyric acid (IBA) are also the major active ingredients in commercially available root-inducing products.

For auxin and auxin-like chemicals to trigger adventitious root formation in plants, cells within the plant have a way to sense the presence of auxin and to transport it to other cells. The sensing and transport of auxin is regulated by the plant’s genetics but can also be modified by externally applied chemicals.

Armed with this knowledge, we are conducting experiments with small chemicals

that can improve how auxins are absorbed by plant cells and those that help auxins move to the cells in which they are most effective. Some of the chemicals that are being currently tested have auxin-like activity themselves.

Together, with Charles Rohla, Ph.D., pecan and specialty agricultural systems manager, and Charlie Graham, Ph.D., senior pecan specialist, we are asking if any of these adventitious root-inducing chemicals can be part of a strategy for delivering genetically identical elite pecan cultivars and rootstocks to growers.

Recently, we initiated collaborative work with Noble’s legume breeding group, led by Suresh Bhamidimarri, Ph.D., to test the effectiveness of these small chemicals on rooting of perennial legume stem cuttings. 🐾



LIVESTOCK

Mineral Supplementation: The Benefits You May Not See



by Caitlin Hebbert,
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It's no secret that good nutritional management is one of the most vital contributions to a profitable herd.

Within the realm of cattle nutrition, protein and energy tend to receive the most hype due to their direct relationships to growth performance and overall body condition. This hype is rightfully placed since the first step to a good nutrition program is to identify and meet protein and energy requirements. The second step involves the lesser-discussed dark horse of the ruminant nutrition world: minerals.

Much of the discussion surrounding minerals is vague, and information is more often accepted by producers than is understood since the world of minerals is complicated and tedious to navigate. As a result, I often find myself on the receiving end of this conversation: "Mineral is so expensive and consumption seems to be hit-or-miss. What will happen if I stop feeding mineral?"

Mineral consumption does indeed vary — from animal to animal as well as from one month to the next. This is often reflective of changing mineral content in forage, fortified winter supplements and the

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MINERAL BENEFITS

The benefits you reap when offering mineral include:

- Greater utilization of forage and feed.
- Higher quality colostrum.
- More optimal reproductive performance.
- Fewer incidences of illness.

production phase of cattle (growing, lactating, gestating, etc.). These fluctuations should not deter you from making mineral an option to your cattle year-round, as other sources of mineral for grazing cattle are neither constant nor consistent.

It is also important to note that the mineral deficiencies of cattle on an otherwise-well-managed nutrition program are often relatively minor. This may be referred to as a subclinical deficiency, a deficiency that presents itself in obscure ways.

Subclinical symptoms, while not always initially obvious, usually become apparent after they've already impacted your bottom line. Most of these subclinical deficiencies make you scratch your head and think "Hmmm, something is a little off," but rarely would you make the connection between a change in or a lack of mineral with the discrepancies you are observing. That is, unless you were aware of those connections existing.

Below are a few such connections that I've observed anecdotally, encountered in conversations with producers and verified in research.

"MY CONCEPTION RATES ARE A LITTLE LOW THIS YEAR."

Most cow herds in the Southern Great Plains are currently in the midst of calving and are rapidly approaching breeding season. The mineral requirements (and nutritional requirements in general) of cows are at their peak when lactation is also at its peak, 30 to 60 days postpartum. It is critical at this time to make sure your cows are in optimal body condition and that they have all the tools on the cellular level to conceive early in the breeding season.

Some of these tools are minerals that are highly active in various reproductive processes. Selenium, zinc and manganese in particular have been found to have direct effects on reproduction in cattle, significantly affecting processes such as ovarian function, steroidal synthesis, and even testicular development and function in bulls.

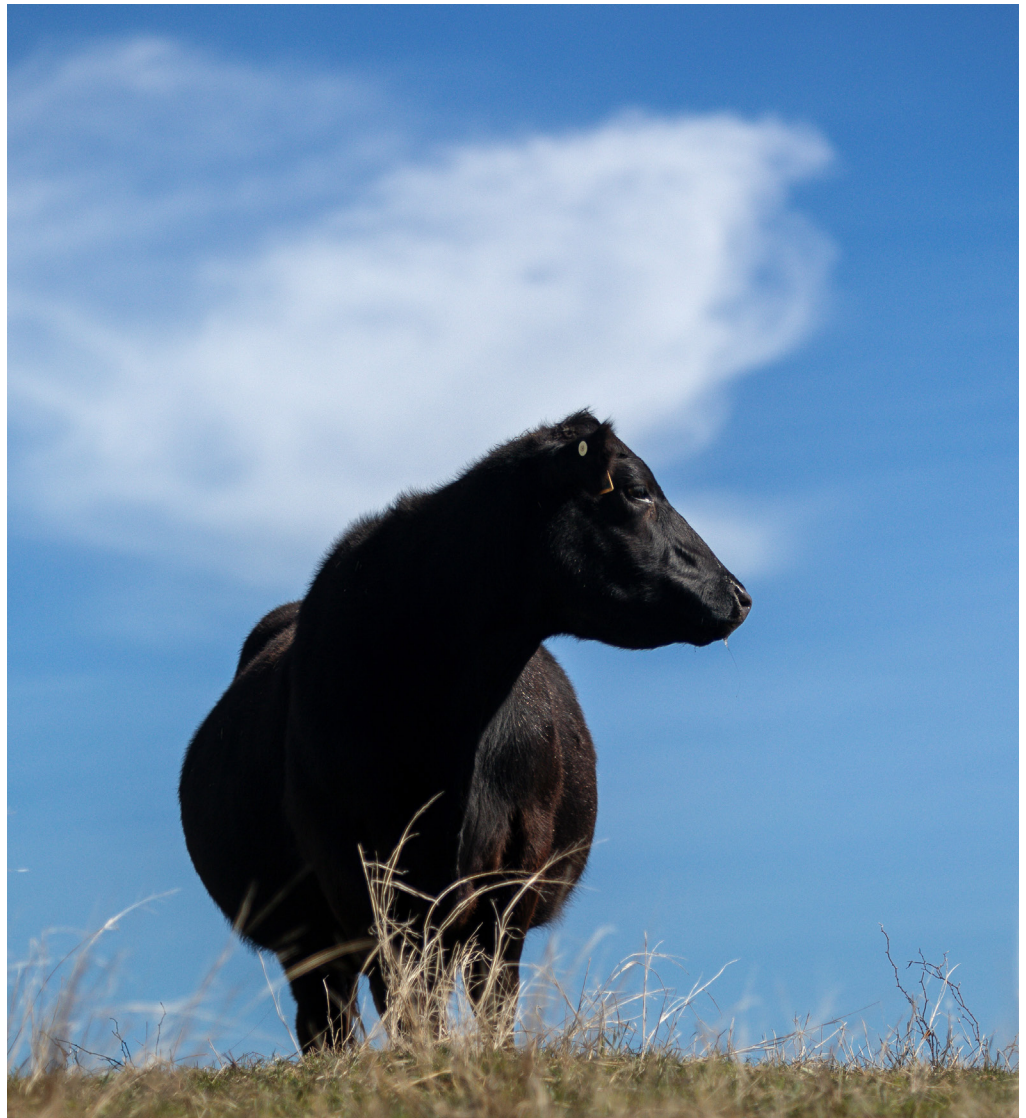
It is not uncommon for an extreme mineral deficiency to result in an open cow (as in she doesn't get bred or, just as likely, she suffers early embryonic loss following conception). However, a subclinical deficiency may yield a bred heifer or cow — but one that conceived during second or third service rather than conceiving upon first AI service or exposure to bull. This could lower pregnancy rates in a short breeding season or extend your calving season.

It is well-documented that cows and heifers that conceive early in the breeding season sustain a longer, more productive herd life. Doing what you can to ensure early conception can help boost your long-term profitability.

"I SEEM TO BE TREATING MORE CALVES POST-WEANING THAN USUAL."

Many minerals have dramatic implications in the immune system and its function. Lack of optimal mineral management at the cow-calf level is speculated to be correlated to sickness later on in life — such as incidence of respiratory illness at the feedlot.

When calves are retained at the ranch and preconditioned, the consequences or benefits



of nutrition earlier in their life often come to light. Adequate mineral nutrition may be just as important as, and may enhance, the viability of a vaccination program.

This is not to say that minerals are the magic bullet to end all morbidity problems, but they are an important part of the equation along with genetics, vaccination and overall management.

"MY CATTLE AREN'T KEEPING OR GAINING CONDITION AS WELL AS THEY HAVE IN THE PAST."

Many metabolic processes in the body are regulated or activated by minerals, including processes vital to sustain physiological systems through periods of high growth.

For example, digestibility can be driven or impeded by availability of minerals. Digestibility in ruminants is largely impacted by the state of the microbial population in the rumen, making microbes the driving force behind utilization of nutrients. Rumen microbes require a specific environment and substrates in order to thrive and survive, and the availability of certain minerals (depending on the microbe) are part of this specificity.

While you should not expect the presence or absence of a mineral supplement to behave

like an ionophore or a growth implant in terms of feed efficiency or pounds of gain, a mineral supplement is a key player in the digestibility and absorption of all nutrients and their subsequent utilization in the body. While any major nutrient deficiency will likely be visibly apparent by way of body condition or average daily gain (or lack thereof), a subclinical deficiency may cost you a pound per week, which really adds up come sale time.

Most mineral supplements are formulated to be consumed at a rate of 2 to 4 ounces per head per day. If your supplement targets 4 ounces, and a cow is "off" supplement about one-third of the year (due to her needs being met through other sources), then she's consuming about 60 pounds of mineral per year. At an estimated \$35 for a 50-pound bag of loose mineral, meeting her mineral needs costs you \$42 per head per year.

Plus \$42 is less expensive than having to replace a cow that fell out of your target calving season. It's also less expensive than the ¼ pound you may sacrifice in calves every day and the cost of just one treatment for respiratory illness.

Though not always immediately evident, being intentional and consistent about keeping mineral in front of your cattle will benefit both your herd and your bottom line in the long run. 🐮

PASTURE

Should You Fertilize Native Grass Pastures and Hayfields?

by Eddie Funderburg, Ed.D., senior soils and crops consultant | efunderburg@noble.org



We get quite a few questions each year on the feasibility and profitability of fertilizing native grass. Long-held wisdom states that it is not profitable to fertilize native grass. With that in mind, I conducted a research trial in 2008-09 to study the issue.

THE TEST

The test was conducted at two locations with native grass: one in Carter County, Oklahoma, and one in Pottawatomie County, Oklahoma. Both sites had low phosphorus levels according to the soil tests, which is very

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Effect of fertilizer rate on yield and profitability ranking of native grass at two Oklahoma locations (two-year average 2008-09).

Treatment (N-P-K)	Location		Profitability Ranking
	Pottawatomie Co., Oklahoma	Carter Co., Oklahoma	
	Yield (pounds of dry matter forage per acre)*		1= most profitable 5 = least profitable
0-0-0	2,536 D	1,504 B	1 A
50-0-0	3,674 C	2,213 B	3 A
50-50-0	4,648 AB	3,720 A	4 A
100-0-0	4,014 BC	2,161 B	5 B
100-50-0	5,212 A	4,024 A	2 A

*Yields followed by the same letter are not statistically different at the 5 percent level of probability.

common in native grass fields in the Southern Great Plains.

Five fertilizer treatments (shown in the table) with varying rates of nitrogen and phosphorus were applied in the spring of each year of the two-year study and replicated three times at each location. The plots were not fertilized in the third year of the study but were harvested to determine if there was a carryover effect from fertilization. An economic analysis was conducted to determine the economic viability of the treatments.

RESULTS

Native grass responded very well to fertilizer, especially phosphorus. In addition, plots fertilized with phosphorus produced significantly more forage than unfertilized plots or plots only fertilized with nitrogen one year after fertilization ceased. The carryover effect lasted only one year in this study.

There was no difference in profitability between the fertilization treatments except for the treatment fertilized with 100 pounds of nitrogen per acre and no phosphorus. This treatment was significantly less profitable than the others.

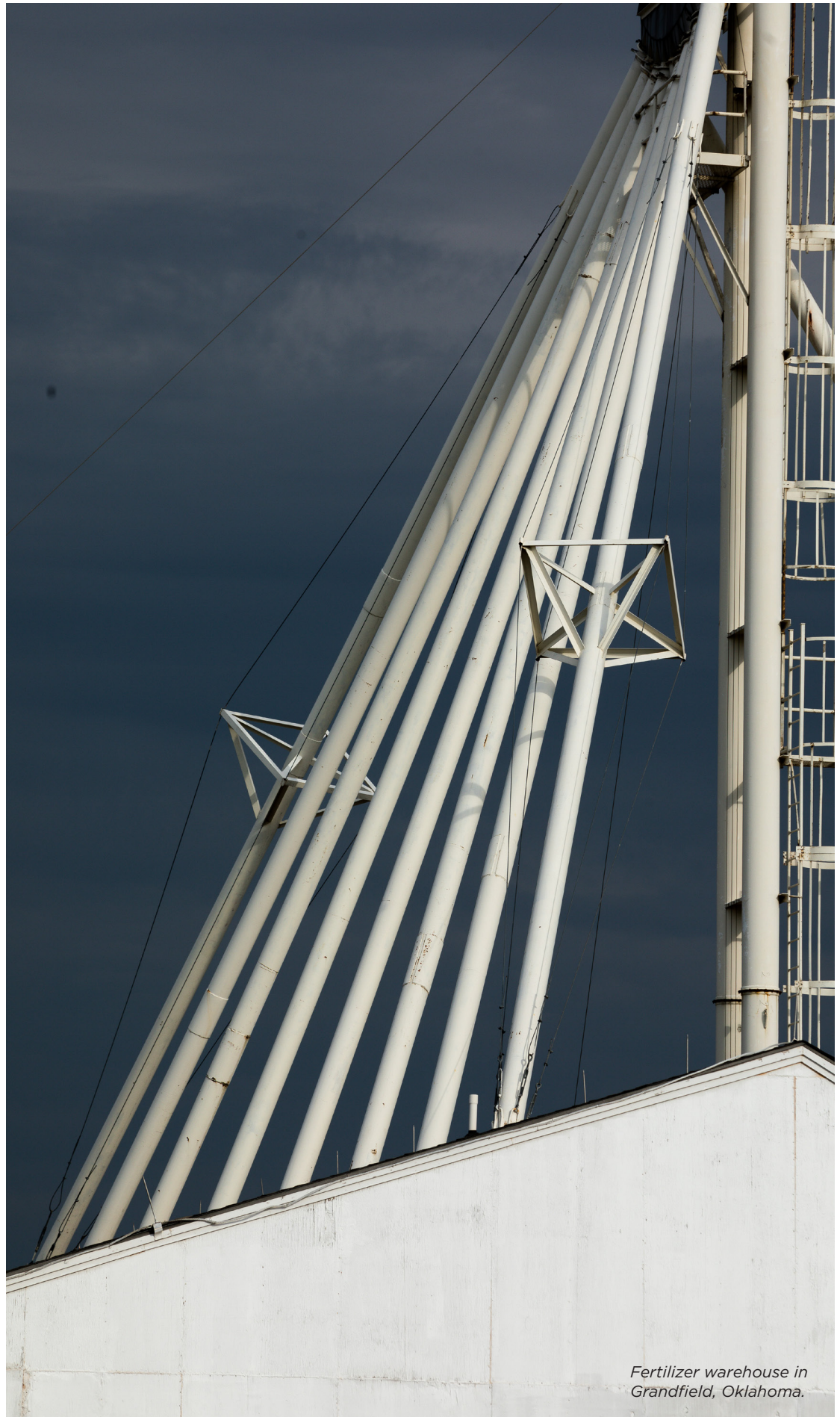
For more information on this study, a fact sheet from the Noble Research Institute can be found at www.noble.org/globalassets/docs/ag/pubs/soils/nf-so-12-02.pdf

Since there is economic risk in applying fertilizer, we generally do not recommend applying fertilizer unless there is a significant advantage to doing so. Therefore, the general recommendation of not fertilizing native grass is correct in most instances.

This will vary depending upon fertilizer and cattle prices. At least two findings can be gleaned from this study:

1. If there is sufficient land area available to run the number of cattle desired, do not fertilize native grass. Economic analysis showed that not fertilizing native grass was as profitable as applying fertilizer, according to soil test results.

2. If a rancher needs to increase carrying capacity and does not have introduced species such as bermudagrass available to fertilize, an application of 50 pounds of nitrogen per acre, plus the amount of phosphorus and/or potassium recommended from soil test results, can significantly increase the carrying capacity of the land for a growing season if sufficient rainfall occurs to allow the grass to fully utilize the fertilizer (assuming that a desired native grass community is present). Proper grazing management must be incorporated into this plan to ensure that overgrazing does not occur. 🐮



Fertilizer warehouse in Grandfield, Oklahoma.



PASTURE

What Is High Stock Density Grazing?

by Hugh Aljoe, director of producer relations and pasture and range consultant | hdaljoe@noble.org



In the January 2016 *News and Views*, there is an article titled "Potential Mob Graziers Should Consider Precautions." The focus is on ultra-high stock density (UHSD) grazing, which is the management tool

of using grazing livestock in much higher than normal concentrations to achieve landscape-focused objectives with the long-term goal of enhancing soils, forages

ROTATIONAL VS. HIGH STOCK

Often producers have called this rotational grazing and that is where HSD grazing begins. The difference is the terminology. HSD grazing has a different connotation than rotational grazing:

Rotational grazing is the process of moving livestock through pastures to graze the forage.

High stock density grazing is the intentional application of grazing livestock in higher than normal concentrations to achieve landscape-focused objectives.

and livestock production. It is usually expressed in pounds of live-weight per acre at a given moment in time. Depending on the environment and forages, ultra-high stock densities are usually in excess of 100,000 pounds of animal live-weight per acre with some producers exceeding 1 million pounds per acre; thus requiring multiple moves to fresh pasture daily.

High stock density (HSD) grazing is very similar and is inclusive of UHSD grazing by definition. However, HSD grazing doesn't have to be applied at the extremely high intensities often considered to be "mob" grazing whereby multiple moves per day are required.

High stock density grazing begins when cattle are combined into a single herd and moved through multiple pastures within a management area whereby

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pastures are grazed and rested (allowed to recover) in a managed approach.

HSD has intentional impacts on the soils, forages and ultimately livestock production. It implies there is active management occurring with the grazing livestock.

ROTATIONAL GRAZING

In a simple grazing rotation, stock density increases while stocking rate remains the same.

If you have 500 acres and 50 cows, the stocking rate is 50 cows, or one cow per 10 acres. Stocking rate is usually expressed in terms of total number of mature head, or head per acre (or acres per head). If the 500-acre property is divided into 10 pastures of equal size (50 acres each) the stock density of cattle in each pasture is one cow per one acre (or 1,200 pounds per acre, assuming average cow weight is 1,200 pounds). The stocking rate remains 50 cows per 500 acres.

If the property was managed such that each of the 50-acre pastures were subdivided into 10-acre paddocks for grazing, stock density in each paddock would be five cows per acre (50 cows divided by 10-acre paddock), or 6,000 pounds per acre (1,200 pounds per cow multiplied by five cows).

As one can imagine, the grazing duration for the cow herd becomes shorter as the pasture or paddock size becomes smaller. Cattle have to be moved (rotated) to a fresh paddock more often, depending on the amount of grazing forage that is available and the amount of forage residual desired to remain after the grazing event.

This is where the concept of planned, managed grazing and the purpose of HSD grazing applies.

WHY USE HIGH STOCK DENSITY GRAZING?

The purpose of HSD grazing is multifaceted. With HSD, a producer can intentionally:

Manage the grazing intensity — which can be from light defoliation to severe, depending on the desired objective — of a paddock or pasture.

Decrease diet selectivity by forcing the consumption of plants that are less palatable or less preferred.

Influence more uniform grazing utilization of pastures by strategic fencing, forcing utilization of areas that are avoided or grazed disproportionate to production.

At higher stock densities, trample structural components to provide additional organic material to the soil surface or to disturb exposed soil surfaces, stimulating new plant recruitment and production, or vice versa.

Most of the HSD grazing applications are deployed to enhance soil health and improve pasture condition. When applied during the course of many years in a well-planned and managed approach, total forage production can be enhanced. This subsequently increases the carrying capacity of the property and, potentially, the stocking rate.

IS THERE AN OPTIMUM STOCK DENSITY?

No, stock density is dependent on the objective to be achieved, the situation and resources.

Much is learned by trial and error. Variables such as season of application, management issue being addressed, long-term objective,



HSD GRAZING GUIDELINES

General guidelines as to the expected observed results of the properly managed application of HSD grazing at increasing stock densities as it relates to the variables of selective grazing, grazing distribution and animal impact.

Pounds live-weight of cattle per acre	Selective Grazing	Grazing Distribution	Animal Impact
<10,000	Selective	Some improvement	Very little
10,000-50,000	Less selective	Improvement	Little
50,000-100,000	Somewhat selective	Much improved	Some
100,000-250,000	Non-selective	Uniform	Observable
250,000-500,000	Very non-selective	Very uniform	Easily achieved
>500,000	Very non-selective	Very uniform	Definitively achieved

type of soils and forages, terrain, herd size and weight, etc., also impact the application of stock density. The most effective application is where one uses a temporary electric fence intentionally constructed as required to address each unique situation and achieve the desired outcomes.

The higher the stock density, the more flexible the producer must be with his or her management and usually the gentler the cattle need to be.

CONSIDER RECOVERY PERIOD

A key aspect that can be easily overlooked is the optimal recovery period following HSD grazing. If the herd impact on a site is intentionally aggressive (as in it creates lots of disturbance), the recovery period may need to be the remaining growing season or longer.

If the paddocks are lightly grazed or “top grazed” in rapid succession during a rapid growth phase, recovery will occur quickly.

Recovery is dependent on the severity of disturbance and the intensity of grazing. The greater the degree of impact, the longer the recovery period required.

GUIDELINES FOR WHAT TO EXPECT

High stock density grazing is more than rotational grazing. It is grazing with intention and purpose. It is the intentional application of grazing livestock in higher than normal concentrations to achieve landscape-focused objectives.

The greater the stock density, the greater the impact upon a resource. If done well, it can be very positive. If done poorly, it can be very damaging.

Before increasing stock density above what is achieved from implementing a well-managed grazing program, ask yourself what you wish to achieve. Then, determine through trial what stock densities is best for your intended objective. With experience, the tool of stock density becomes much easier to apply. 🐮



SPECIALTY AG

Using a Chicken Moat to Grow Fruit, Vegetables and Raise Poultry



by Will Chaney, pecan and specialty agriculture systems senior research associate | jwchaney@noble.org

Interest in protected agriculture has increased over the last several years at the Noble Research Institute. Many producers want information about new systems that can increase profitability and decrease inputs. Protected agriculture offers distinct advantages through climate and pest control, irrigation, etc. One form of protected agriculture is a chicken moat.

WHAT IS A CHICKEN MOAT?

A chicken moat is an enclosure built around an area generally used for some form of fruit and vegetable production. The main purpose is to provide a barrier between your agriculture crops and predators, including insects, rabbits and deer. The crop production area sits in the center with the chicken production area surrounding the crop production area.

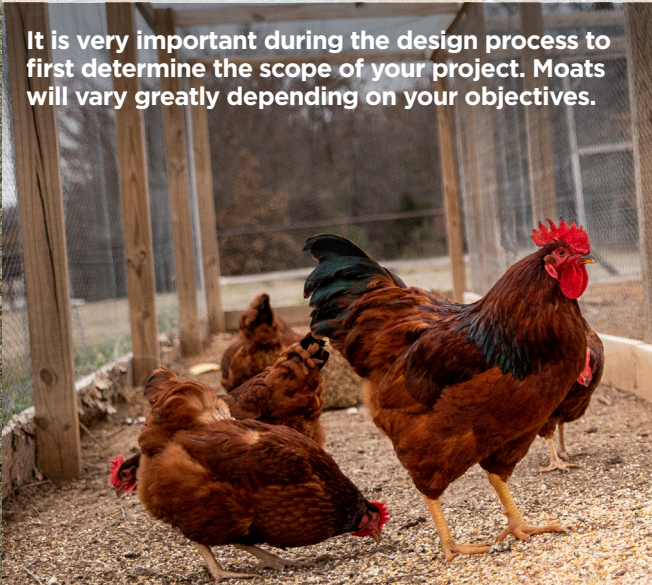
For those interested in raising chickens along with fruits and vegetables, this can be a great way to incorporate the two systems into one. We currently have a demonstration chicken moat in our protected agriculture area at the Noble Learning Center.

THE MAIN PURPOSE OF A CHICKEN MOAT IS TO PROVIDE A BARRIER BETWEEN YOUR AGRICULTURE CROPS AND PREDATORS.

Story continues on next page

THINGS TO CONSIDER WHEN BUILDING A CHICKEN MOAT

It is very important during the design process to first determine the scope of your project. Moats will vary greatly depending on your objectives.



SITE SELECTION

ONE

Site selection of the moat is critical because you need an area that is suitable for crop production and moat construction. Chicken moats can be built at any scale. I have seen moats built around a small garden in the backyard as well as a structure that covered about 1 acre built around a fruit orchard and garden.



STRUCTURES AND ENTRANCES

TWO

For the chicken structure, you will have the hutch (or house) and a run. If you have another structure nearby, you could store your feed and supplies in that building. You could also store these items in your chicken structure. You will also need to determine where you would like entry points for your structure. You will need an equipment entry point for the garden and a point of entry for chicken care. In our demonstration moat, we put our access door for the garden at the opposite end from our chicken house entry. We made our doors wide enough that the outer wall door could swing one way and the inner wall door could swing the other direction. This opens up the garden to the outside while simultaneously closing the run. This allows access with a tiller or small garden tractor. We built taller runs (head high) to allow us easier mobility if we need to access the run and to also make the structure deer-proof. On a smaller chicken moat, the runs might only come to your knee.

COVERINGS

THREE

One word of caution: be conscious of structures you build on the inside of the production area. We built a vertical herb garden from an old pallet at one end of our garden. Once our plants were mature enough, we opened the inner gate to allow the chickens into the garden area, which allowed the chickens more access for insect patrol and scratching to help with weed control. What we didn't realize was that we had built an escape ladder since there was no cover over the garden area. So, be aware of what you build to support plants and its proximity to the top of the structure. You can also cover the top of the garden area with a shade cloth. Our moat is covered with chicken wire to protect the chickens from predators such as hawks. You could also train or encourage vined plants to grow up the side and over the top of the structure. The fruits of those vines grow off the ground, which protects them from soil pathogens and pests, preventing potential diseases. Leaves and fruit overhead can also provide shade to the chickens.

DEFENSE AGAINST PREDATORS

FOUR

Our original design did not include anything beyond the outer fence of the run. However, we experienced a coyote problem when one dug under the fence. To correct this flaw in our design, we cut welded wire mesh panels in half and laid them on the ground, which provided about a 2-foot-wide barrier that we staked down and covered with gravel. This now provides some defense against animals that had tried to dig under the fence. This may not be a necessary piece of the design depending on your location.

KNOW YOUR OBJECTIVES

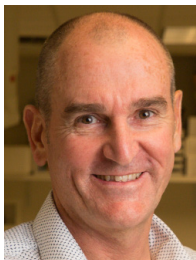
Chicken moats can be an excellent natural protective barrier against pests. There are many options and designs available to work within your operation. The materials and designs are limitless. Keeping a good focus on the objectives of your operation while aligning your pest management options will allow you to construct the best moat to fit your needs. 🐔



RESEARCH

How You May Need Less Fertilizer in the Future

by Wolf Scheible, Ph.D., professor | wrscheible@noble.org
 Michael Udvardi, Ph.D., chief scientific officer | mudvardi@noble.org



Most Oklahoma soils are limited in major plant nutrients like nitrogen (N) and phosphorus (P). Therefore, many farmers rely on synthetic fertilizers for crop and

forage production. Generally speaking, fertilizer is one of the biggest items, other than land, in an annual budget for many farmers and ranchers.

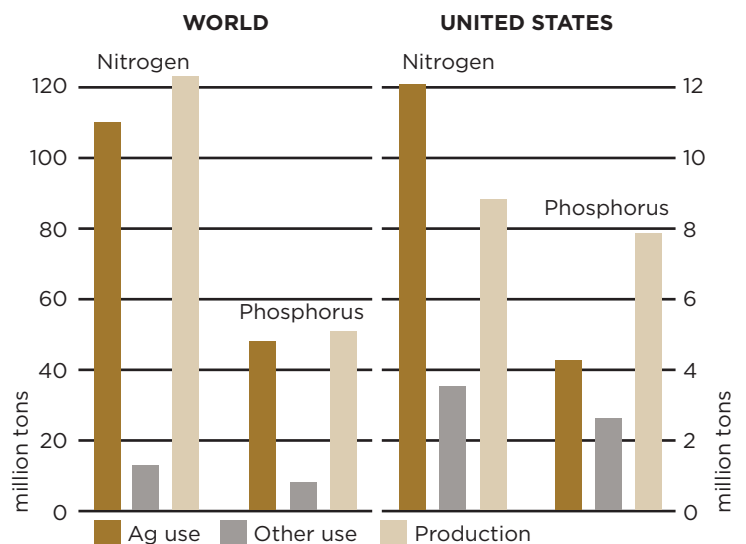
FERTILIZER IS NECESSARY BUT COSTLY

The use of fertilizer chemicals is indispensable in a world with a continuously growing human population, but it comes at a monetary and environmental price.

Only about one-third of the applied N and P fertilizers can be found in crops at harvest. The other two-thirds become unavailable to plants through processes in the soil or are lost to the environment through runoff, leaching, eluviation or erosion. This causes problems such as pollution of drinking water, eutrophication and tipping of freshwater and marine ecosystems, toxic algal blooms, and fish kills. For example, there are 6,000 to 7,000 square miles of dead zone in the coastal

Story continues on next page

USE OF NITROGEN AND PHOSPHORUS FOR U.S. AND WORLD
 Figure 1. Data from the Food and Agriculture Organization (FAO) of the United Nations show that 110 million tons of N and another 51 million tons of P chemicals were used in agriculture worldwide during 2016. See full report at www.fao.org/faostat/en/#data.



waters of the Gulf of Mexico at the mouth of the Mississippi River (learn more at <https://serc.carleton.edu/microbelife/topics/deadzone/index.html>). In the United States alone, health and environmental damages of man-made N pollution are estimated to be over \$200 billion a year.

PHOSPHORUS RESERVES ARE LIMITED

Production of N fertilizers is theoretically almost unlimited, as 78 percent of the atmosphere is nitrogen gas that can be chemically or biologically converted to ammonia. However, the future availability of rock phosphates for production of P fertilizers is a potential threat for food security. This is even more so for countries that rely on rock phosphate imports.

It has been estimated that, at the current and projected future use, the known high-quality rock phosphate deposits (found mainly in Northern Africa or China) will only last for several more generations. Each ton of P that reaches and is diluted in the oceans is ultimately lost to mankind, as it takes millions of years for new, minable P deposits to form. In the light of such situations, fertilizer savings and higher fertilizer efficiency are needed especially in agriculture, where more than 90 percent of the produced N and P chemicals are used (Figure 1).

HOW SCIENCE IS WORKING TO HELP YOU REDUCE FERTILIZER NEEDS

Scientific research and better management practices are our best bets to deliver much needed solutions to these issues. Plant scientists at the Noble Research Institute pursue different approaches in this regard, including:

- The study and application of specific plant-associated microbes (bacteria and fungi) for better soil nutrient absorption and nitrogen fixation.
- The transfer of biological nitrogen fixation to crop species that are usually not capable to perform this process ("synthetic N fixation").
- The study of naturally existing genetic variation in major crop and forage species to identify lines with higher nutrient efficiency.
- The study and use of specific genes to improve plant nutrient acquisition from the soil.

Through these efforts, farmers and ranchers will someday be able to use plants with improved nutrient efficiency due to selection, plants with inherent mechanisms that allow them to perform nitrogen fixation, and/or plants that work in association with soil microbes to enhance nutrient absorption and provide nitrogen fixation.

Integrated with improved management practices that enhance soil health and ecosystem function, successes from this work will ultimately reduce farmer and rancher reliance on synthetic fertilizers and mitigate the negative effects of fertilizers on the environment. This would benefit both producers and consumers in the United States and beyond. 🐄

\$200

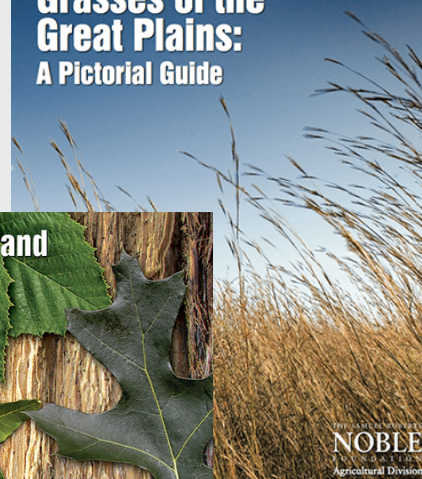
BILLION PER YEAR

Estimated health and environmental damage from man-made N pollution in the United States.

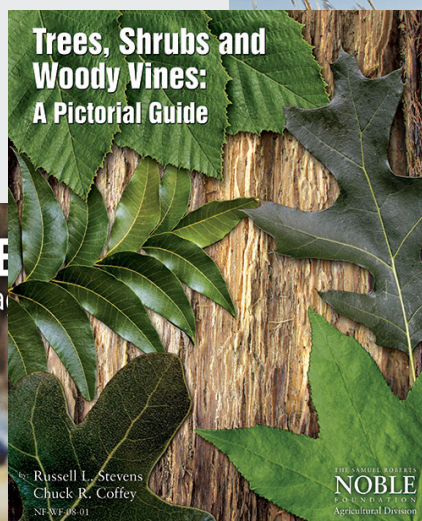
MORE NEWS AND BOOKS ONLINE

Keep up with the latest news and information from Noble Research Institute consultants and researchers at www.noble.org

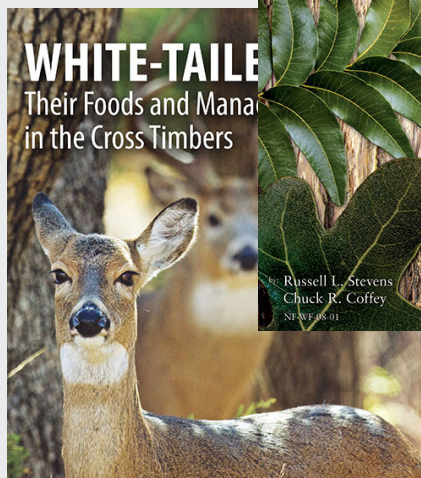
Grasses of the Great Plains: A Pictorial Guide



Trees, Shrubs and Woody Vines: A Pictorial Guide



WHITE-TAILED Their Foods and Manages in the Cross Timbers



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MAY 14 Managing for a Healthy Herd

1-5 p.m.
Noble Research Institute
Kruise Auditorium Entry 5;
No Registration Fee

Calf health is paramount to your ranch's profitability and reputation. Nutrition of the cow and calf will have a direct impact on the subsequent health of the calf on your ranch and in the feedlot. Join us to learn the finer points of herd health management.

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UPCOMING EVENTS

For more information or to register, visit www.noble.org/events or call 580-223-5810. Preregistration is requested. For other agricultural questions, please call our Ag Helpline at 580-224-6500.



APRIL | 4

Demonstrating Pecan Orchard Floor Management

Traditionally, pecan growers have used a grass drive row and an herbicide-treated band in the tree row for weed control (weed-free strip). However, orchard floor vegetative ground cover can be managed by mechanical, biological, cultural and chemical methods.

9 a.m.-4 p.m.
Kruise Auditorium, Entry 5
Registration fee: \$25, includes lunch



APRIL | 16

Managing Vegetable Crops

6:30-8:30 p.m.
Kruise Auditorium, Entry 5
No Registration Fee



APRIL | 18

Controlling Pests in Pecan Orchards

9 a.m.-noon
Kruise Auditorium, Entry 5
No Registration Fee



MAY | 7

Introduction to Integrity Beef

4-7:30 p.m.
Pavilion
No Registration Fee



MAY | 9

Irrigating and Fertilizing Specialty Crops

6:30-8:30 p.m.
Kruise Auditorium, Entry 5
No Registration Fee