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GOLDEN OPPORTUNITIES

Volume 5 Annual 2021

Dedicated to Innovation

Superior sunflower hybrid portfolio performance across markets, new commercial canola hybrids and new Nuseed Omega-3 Canola varieties give growers new golden opportunities.

+ PLUS

- Big Data
- Pollinator Habitats
- Drying and Storage
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THE GOLDEN ERA OF AGRICULTURE

Plants have the potential to solve tough problems.

Agriculture has experienced several key inflection points in its history. Mechanization in the 50s and the 'Green Revolution' of fertility and crop protection chemistry in the 70s and 80s resulted in increases in harvested crop volume. Key advancements in hybrid genetics in the 80s and early 2000s, followed by the biotech 'input' era that started around 2000, led to a dramatic upsurge in the ability of agriculture to feed the growing world population.

We are now at a point in history when breeding advances, technology and a tremendous amount of hard-won knowledge are enabling us to move beyond incremental improvements in crops as commodities.

Nuseed's R&D and commercial teams are working globally to unlock the potential and deliver plant-based solutions for both our farm customers and end-use customers. We've focused on crops that grow in both hemispheres – canola, carinata, sorghum, and sunflowers and it's already paying off.

"WE ARE NOW AT A POINT IN HISTORY WHEN BREEDING ADVANCES, TECHNOLOGY AND A TREMENDOUS AMOUNT OF HARD-WON KNOWLEDGE ARE ENABLING US TO MOVE BEYOND INCREMENTAL IMPROVEMENTS IN CROPS AS COMMODITIES."

- BRENT ZACHARIAS, NUSEED GLOBAL GROUP EXECUTIVE

In 2019-2020 alone, Nuseed commercialized two proprietary crops for very specific and value-added end-use markets. Nuseed Carinata is now commercially grown in Argentina for renewable fuel and Nuseed Omega-3 Canola is grown in Montana and North Dakota as a sustainable land based source of the essential omega-3 nutrient for aquafeed (Aquaterra) and human nutrition (Nutriterra). In addition to two new Nuseed Omega-3 Canola varieties, we also introduced our first commercial canola hybrids in Canada and the U.S. Along with our sunflower portfolio, offering hybrids right for every field and every market, we are working hard to provide our North American farm customers with golden opportunities.

Through the combination of successful local seeds businesses, global reach, world-class R&D, and the Nuseed Value Chains connecting growers, industry, and end-use customers, Nuseed is already delivering VALUE BEYOND YIELD® in the current Golden Era of Agriculture.

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PUBLISHER
Nuseed Americas

EDITOR
Dee Dee Rezac
deedee.rezac@nuseed.com

EDITORIAL
Garrett Driver
Erin Gerdes
Jim Gerdes
Justin Ingalls
Mark Jackson
Daris Kampfe
Jeremy Klumper
Clint Munro
Trygg Olson
Alison Pokrzywinski
Roger Rotariu
Jed Wall
Brent Zacharias

CONTRIBUTORS
Julie Pomehichuk, Issues Ink
Marc Zienkiewicz, Issues Ink
Laura Handke, Issues Ink
Lindsay Hoffman, Issues Ink
Treena Hein, Issues Ink

DESIGN
Kyle Drawatony, Issues Ink

Return undeliverable addresses to:

Issues Ink

1395-A S.Columbia Road, P.O. Box 360, Grand Forks, ND, USA, 58201

FOR IN-SEASON SUNFLOWER, CANOLA AND NUSEED OMEGA-3 CANOLA INFORMATION FOLLOW NUSEED US AND CANADA ON AND

NAVIGATING THE DIGITAL FRONTIER

Data. Automation. Hardware and software. Growers have more technology than ever at their disposal, but how to make sense of it all? Growers are figuring that out.

Raven Dot has the ability to pair with a wide range of implements which are critical to agricultural production and will offer a variety of labor-saving solutions to farmers and agri-retailers alike. Photo courtesy of Raven Autonomy.

A suite of new technologies has come available to help tackle the age-old problem of labor shortages and other issues growers have been dealing with for decades — centuries even.

All of them have one thing in common — digitization.

But what is digitization and how do growers wrap their heads around it?

"In the early days, no one really knew what 'digital' meant — but we all thought it was a cool word. Digital platforms mean so many different things to so many different people," says Roger Rotariu, North American Marketing Lead for Nuseed.

"In a lot of ways, for me, it's just a new way of doing things, a new way of capturing information. You can do with it what you want to — keep it simple or get really deep into it, if that's your thing. It's a tool like any other, really."

Rotariu's been in the seed business long enough to remember when things moved slower than they do today.

"As recently as five years ago, in order to launch a new seed variety or hybrid, you'd have to go out there and compare 40 acres of this against 40 acres of that. You'd have to be there right when the farmer took his combine out because you can't hold them up. They've got, you know, 5,000 other acres to combine in a short window," he recalls.

"Now, we have tools that really shave a lot of that time off. Things really have changed. It's a totally new world in terms of how easy it is to start proof testing new products and sunflower and canola growers are benefiting in all kinds of ways."

More Autonomy

Imagine spending more time out of the cab, knowing that tasks are still being accomplished with absolute precision.

Imagine not needing anyone to drive that tractor, and not having to worry about having enough people on hand to do the work.

Skilled farm labor is becoming harder to find every year, the capital cost of new equipment is extremely high, and used equipment depreciates quickly.

Standardized autonomous power units are the ideal solution, according to Wade Robey, Executive Director for Raven Autonomy. They reduce labor costs and are less costly to operate providing improved efficiency, he says.

Equipment design is simplified, and a wide range of implements will be available allowing for multiple operations across the growing season without the limitation of skilled labor. This combined with the ability to use a single power platform that links with multiple implements provides significant capital cost advantages per acre while lowering depreciation expense.

Early in 2020, Raven acquired DOT Technology Corp., the developer of the Dot Autonomous Power Unit (APU). Raven Dot has the ability to pair with a wide range of implements which are critical to agricultural production and will offer a variety of labor-saving solutions to farmers and agri-retailers alike, according to Robey.

Fusing Raven's current precision ag technology portfolio with Dot, and the recently acquired Smart Ag now provides Raven with core technology platforms in communication and logistics, guidance and steering, path planning, perception and obstacle avoidance and machine and application control. It is this combination of technologies that enables Raven to deliver autonomous solutions to the market today.

The key in the future will be to develop a wide range of the most critical farm implements that will connect into the Raven Dot and allow growers to automate their operations like they have never been able to before, Robey says.

"We currently offer an autonomous seeder that's built by SeedMaster and a sprayer that is built by Pattison Liquid Systems, both Canadian ag equipment manufacturers. We also offer a spreader that was built by Iowa-based New Leader. Raven's vision is to build the APU, and then partner with equipment providers to bring implements to Dot that are compatible with the platform and can perform the most critical operations on farm," Robey says.

Dot is powered by a 173 HP Cummins diesel engine, which drives four hydrostatic pumps (one for each wheel) and an auxiliary pump for implement operation. The power from each hydrostatic pump is transferred to its designated wheel via hydraulic hose. Each wheel has a hydraulic motor running a planetary gear box that can power the unit smoothly at any speed, from creeping to 12 MPH.

In fields, Dot operates within prescribed, farmer-approved routes that are generated through the simple creation of highly accurate boundaries. Positional information from an RTK GPS receiver mounted on Dot ensures it is always operating within the approved area. If Dot drifts from its path, it will halt movement and send a message to the operator.

"We are looking at how this technology can benefit farmers who plant small grains, including canola, and we see significant potential for labor savings and improved efficiency in their operations. Canola is one of Canada's biggest crops, and the potential for value creation is tremendous. Raven Dot is a technology that is readily adaptable to high value crops like canola and we will see rapid adoption of autonomy in the Canadian market in the coming years," Robey says.

Right now, Dot is being run and validated in the field by Raven's team of engineers and support staff. As Raven re-introduces Dot for commercial sale in the market next year, it will include a full suite of perception, obstacle detection and avoidance technologies.

"I BELIEVE THAT THE NEXT REVOLUTION IN AGRICULTURE IS GOING TO COME ON THE DIGITAL SIDE. GROWERS HAVE ACCESS TO THE BEST GENETICS. HOW CAN THEY USE DIGITAL TECHNOLOGY TO REALIZE THE FULL POTENTIAL OF THOSE GENETICS?"

- DARRYL MATTHEWS

Dot will be able to run autonomous missions in the field, Robey adds.

"There will definitely be labor savings associated when you remove the operator from the cab. Dot will also allow farmers to run longer hours and even have 24-hour operations using these technologies. Additionally, because you can lay out a route plan and you can optimize it, there will be an opportunity to do those seeding, spraying and spreading operations more efficiently and more safely, because you're removing humans from the machine."

The farmer will continue to play the pivotal role and he sees Dot and the company's other autonomous offerings working in the field alongside manned vehicles that are coordinated and connected to share the workload for many years to come.

The farm of the future? With precision ag technology, this is what farming looks like today: Trimble Agriculture's family of Android displays helps farmers complete field applications quickly and efficiently while also mapping and monitoring field information in real time.

"This combination will allow farmers to optimize their activities and perform farm operations within shorter time windows, with improved agronomic results and with better bottom-line economic outcomes."

Data, Data, Data

The future of farming will be driven not just by machines like Dot, but by better understanding how to combine digital hardware and software in smarter and ever more efficient ways. This is where digital farming and technology like Bayer's Climate FieldView platform comes into play.

Developed and delivered by The Climate Corporation, a subsidiary of Bayer, FieldView helps farmers gain a deeper understanding of their fields year-round with tools that allow them to easily collect and store data, optimize management decisions quickly and efficiently, and help reach their yield potential while minimizing application of crop inputs.

Many growers in Nuseed's Omega-3 canola program use the platform, which makes field data management easy. Growers can gather, store and see field data in real time in one simple-to-use digital platform that a grower can take advantage of from the field, office, or anywhere else.

"For us, this platform is about giving growers the opportunity to collect what we call machine-generated data. They gather data from seeding to spraying through to harvest to ultimately be able to compile it and use it

Pat Comte is Canadian Vice President of IN10T, a U.S.-based digital ag company. He says one of the biggest pain points farmers have is trying to capture all the digital data that's available.

to perform analysis on the back end in terms of looking at variety performance, or the performance of certain seed treatments, and many other things," says Kerran Clements, Regional Manager for The Climate Corporation based in Edmonton, Alta.

Bayer is regularly adding new data layers to feed its global R&D engine and enables the development of new features for farmers through the FieldView platform. With fertility prescriptions in FieldView, canola farmers and their agronomic partners can work together to sustainably optimize productivity through improved timing and rates of nutrient inputs.

Such software platforms add a whole new dimension to how growers are able to go about the business of farming. Technologies like those provided by Hummingbird allow growers access to data they've never been able to make use of before.

Hummingbird is an artificial intelligence business that provides advanced crop analytics to its customers by using proprietary machine learning algorithms applied to remote sensing captured imagery. Through its web and mobile platform, the company makes crop-specific analyses and application maps available to customers within 24 hours.

"Instead of having multiple agronomists running around expending resources such as farmers' time, we can use technology such as what Hummingbird provides that uses GPS coordinates — every three to five days the satellite goes over a field and you get an image of the progression of a crop," Rotariu says.

Improved Decision Making

According to Darryl Matthews, Senior Vice President Natural Resources for Trimble and a former member of the Nufarm family, digital technologies like the ones provided by the precision agriculture company allow growers to essentially have a full-time "agronomist" on hand 24/7 to help them in their seed purchasing decisions.

"Aligning the variety with the average environmental conditions for where a particular field is located is another major challenge the grower faces. After that, there's aligning the best variety for conditions that a field won't particularly see in a given year. If you align those very close, that's where you can see significant benefits," he says.

"That can be attained through looking at the variety and the type of growing conditions it performs the best in. You then take your typical average heat units, or accumulated heat units, and growing conditions and moisture that a particular field receives in an annual year on average, and then aligning those two to ensure that you pick the best variety for that field. That's where you can get the ultimate performance."

Trimble Agriculture's family of Android displays helps farmers complete field applications quickly and efficiently while also mapping and monitoring field information in real time.

"Digital agriculture is now taking all of those attributes that affect the field — the weather, the variety, the nutrition, and the crop protection solutions the grower chooses — and tying that all together into one. I believe that the next revolution in agriculture is going to come on the digital side. Growers have access to the best genetics. How can they use digital technology to realize the full potential of those genetics?" Matthews adds.

What to do with the Data?

Platforms like FieldView, Hummingbird and Trimble use data to provide valuable information to the farmer. What makes platforms like these so handy is they allow growers to harness the power of data, which is something that can often be difficult to do.

That's where a company like IN10T (pronounced "intent") comes in.

A U.S.-based digital ag company, IN10T helps accelerate adoption of new technology, says the company's Canadian Vice-President Patrick Comte.

"One of the biggest pain points that our clients will have is trying to capture all the digital data that's available. There are so many different platforms and different pieces of new technology that are available, but actually capturing that data and making sense of it and doing the analytics is always the tough part," Comte says.

Through the IN10T FarmerTrials network, clients can tap into a network of over 1,500 farmers who desire to test and learn about cutting-edge technologies and solutions. This valuable network accelerates the product development process by getting it in the hands of their target customers in real-world scenarios earlier in the product lifecycle.

"We just recently expanded into Canada, and as we establish that market and pick up new clients, a lot of that work will be focused on crops like canola and sunflower, to name just two. And one of the biggest challenges that clients have is knowing what to do with all the data they have access to. We capture it, contextualize it, and provide the desired analytics," Comte says.

"Although harnessing digital data is extremely important when developing new innovations, it's still important to capture the grower experience as they are trialing new technology. We match digital data with grower perceptions and real-life experience in field scale trials to help tell the story."

It's almost overwhelming for people to try to make sense of so much information, says Nuseed's Rotariu. Every client is different, and the data they need is different, and it really depends on the product they are using.

What are they trying to accomplish? What is the end result they're looking for? And how do they know what data is going to be used to help get them to that point?

That's the game changer, says Rotariu — the ability to narrow things down for the grower.

"All this data we now have can be pretty overwhelming at first. That's where you really find success — figuring out what to do with it all. The good news is, growers are able to do that more and more each day."

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UNHERALDED OPPORTUNITIES

Increasing demand for healthy oils and food products, combined with more snacking at home and bird feeding during the pandemic, sets up 2021 to be the best year ever to grow sunflowers.

The U.S. and Canadian market outlook for sunflowers has never been brighter for both oil and confection in history, according to John Sandbakken, Executive Director of the National Sunflower Association.

"It's a very good time to get into sunflowers if you have never grown the crop, and an excellent time to expand acreage in 2021," Sandbakken says. "The profit potential has never been higher, and the market opportunities have never been stronger. The industries in Canada and the U.S. have worked together and farmers are being offered great prices right now to keep the momentum going."

The overall production ratio for oil versus confection has stayed stable over the last few years and Sandbakken doesn't expect this to change much in the short-term. "It's about 80% for oil, 20% for confection and I think this will stay about the same for the next year," he says. "Confection may gain a bit after that, it's hard to say, but we definitely expect acreage to grow for both markets."

Oil Demand

The long-term increased demand from consumers for ever-healthier products is a major driver behind the growing market for sunflower oil. In May 2020, results were released of a new global survey called 'FATitudes,' commissioned by Cargill, finding that a strong majority – almost 70% – of consumers worldwide are closely monitoring the type and amounts of fat/oil in the packaged foods they choose to buy – and healthier oils are winning the day.

On the frontline of sunflower production across the U.S. — this means, in the short-term — the current demand for oil from both NuSun® mid-oleic hybrids and high oleic hybrids is strong, and Sandbakken expects

John Sandbakken, Executive Director of the National Sunflower Association.

that the shifting towards more high oleic hybrid acreage will continue. "There's still good demand for NuSun mid-oleic oil but long-term, it will decline," he explains. "High oleic oils are the future and are already becoming a staple in the food industry, displacing more soybean oil in food products every year. High oleic oils slow down the oxidation process, extending food product shelf life, and they also deliver the great taste that's always been a characteristic of sunflower oil. And since the U.S. Food and Drug Administration (FDA) ruling two years ago, the 'healthy halo' of high oleic sunflower oil has become all the brighter."

In November 2018, high oleic oils received an FDA 'Qualified Health Claim,' in which the agency stated that "supportive but not conclusive scientific evidence suggests that daily consumption of about 1.5 tablespoons (20 g) of oils containing high levels of oleic acid may reduce the risk of coronary heart disease." Cargill offers food makers high oleic sunflower oil (conventional and organic) that falls under this qualified health claim. Similarly, ADM offers high oleic sunflower oil in normal, dewaxed, expeller-pressed and dewaxed expeller-pressed formats.

"It's resulted in a huge boost in demand for high oleic sunflower oil in the food industry, because products that contain it are able to be promoted as heart-healthy," says Sandbakken. "The FDA claim continues to help us gain market share from soybean oil, as consumers reach for new alternative and healthy products in the baked goods, snacks and spreads categories, to name a few. High oleic sunflower oil is also being used in many of the new plant-based food products."

"Part of that is the functionality it provides, but another part is the heart health claim. High oleic sunflower oil is also very low in saturated fat, and these days, no food companies want to use oils that have higher levels of that type of fat. I think that while there are certainly export opportunities for high oleic sunflower oil, domestic market demand is getting stronger every month."

Confection Sunflowers

The confection sunflower market is also hitting a high note right now, due to several distinct factors.

Increased Demand for Bird Food Driving Sunflower Demand

While COVID-19 has had a negative effect on many things, bird food demand is not one of them. "Over the past few years, the bird food market has been steadily declining," says Alison Pokrzywinski, a Technical Agronomist and Nuseed Sunflower Product Manager, North America. "Some of the reasons for this have included an aging population, mild winters in the Northeast and other interests taking over people's time in an age of technology."

Sandbakken echoes the sentiment, noting that in 2019, the sunflower market for bird seed was probably lower than it had been for years, following a long-term decline. However, the pandemic changed everything. Since families across the globe have found themselves spending a huge amount of time at home since March 2020, a new interest was sparked (or has been re-ignited) across all generations in families to attract birds to backyards and porches.

Pokrzywinski notes that in some years as bird food supply starts to dwindle before sunflower harvest starts, bird food prices can spike for short amounts of time, but 2020 was different. "This summer there were sustained price spikes as bird food sales increased," she says. "While the typical pricing of summer 2020 would have been around $18-$19/cwt, some bird food buyers were offering growers as high as $35/cwt to meet consumer demand."

Sandbakken agrees that due to the pandemic, demand has been incredibly strong from March onward. "It's like the glory days," he says. "It's been phenomenal to see the demand this year."

Looking ahead, Pokrzywinski thinks growers should realize the opportunities in 2021 as new crop bird food contracts are there for the taking. "The demand does not appear to be dwindling, as many more lockdowns across the U.S. occurred throughout the holiday season," she notes. "Bird food processors are looking for acres to contract to help them take ownership in a fight for 2021 sunflower acres."

Louise Carduner, Originator for Sunflower and Bird Food Division of Scoular Canada (a grain and oilseed company based in Manitoba, Canada), notes that she and her colleagues are actively encouraging growers to plant black oil sunflowers for birdseed in 2021. The company buys both confection and black oil sunflower seed from Manitoba growers, who produce the vast majority of sunflowers in Canada. In June, Scoular relocated its Winnipeg bird food operations to its bird food manufacturing facility in Winkler, Man., an expansion that created six additional jobs.

Looking forward, Pokrzywinski hopes that after life returns to normal, or into a new normal at least, "the popularity of feeding the backyard birds will continue among the young and old."

One is the fact that the crop production in 2020 has gone extremely well across the U.S. Both the quantity and quality are excellent, Sandbakken explains, and this will expand export opportunities in Europe. Spain is the top confection market globally, where sunflower seeds are a traditional snack going back centuries when sunflowers from the 'New World' were brought to Spain by returning explorers. Sandbakken predicts that exports for this market over the next few months could easily increase 25 to 45% over years past.

Longer seed length is in demand in Spain and other European countries for snacking. Nuseed released two new confection hybrids in 2019 with seeds that can reach 0.98 to 1.18 inches (25 mm to 30 mm) in length.

In addition, the Euro has gained against the dollar, making U.S. imports to the European Union more competitive. Sandbakken notes that currency exchange rates are one of several factors that affect export demand every year. Another is competition from other countries.

Thirdly, demand for confections is especially strong right now due to the pandemic. People have to spend more time at home and are therefore eating more meals and snacks in the home rather than in restaurants and other shared spaces.

"With confection production, farmers have to do a little more management of insect pressure and so on, but there is a premium," Sandbakken explains. "First-time sunflower growers will usually produce for what's broadly called the oil market, that includes crushing, kernel processing and birdseed. They first learn how to grow the crop before deciding whether to grow for the confection market."

"THE FDA CLAIM CONTINUES TO HELP US GAIN MARKET SHARE FROM SOYBEAN OIL, AS CONSUMERS REACH FOR NEW ALTERNATIVE AND HEALTHY PRODUCTS IN THE BAKED GOODS, SNACKS AND SPREADS CATEGORIES, TO NAME A FEW."

- JOHN SANDBAKKEN

Confection producers have always been offered contracts with an 'Act of God' clause, where growers are contracted for a given yield and if yield falls below that, the shortfall is forgiven. Some oil market contracts also started containing this clause starting about 10 years ago, says Sandbakken, making the cultivation of sunflowers more attractive than ever.

2021 and Beyond

With the weakened U.S. dollar and other factors, the confection seed and sunflower oil export markets will be strong in the near-term. Domestic demand for oil has never been stronger, and demand for high oleic oil will continue to grow.

"Globally," adds Sandbakken, "sunflower production was much lower in 2020 than in years before, so that will also help domestic demand in that we won't be importing much oil. I believe the U.S. is in the driver's seat for gaining more global market share for all sunflower products and this progress will continue."

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Adam Anderson
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605-295-2745

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605-354-1809

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701-640-4568

Dave Olson
Bloomfield, NE
605-660-5558

Gary Pastian
De Smet, SD
605-203-0750

Grant Norder
West Fargo, ND
402-768-1663

Jed Wall
Wahpeton, ND
701-640-1653

Kyle Mueller
Faulkton, SD
605-824-4796

Maria Harvey
Bismarck, ND
701-640-8445

Nick Frobuccino
Elbow Lake, MN
218-770-3126

Todd Lauseng
Watertown, SD
605-880-8608

Zach Leier
Bismarck, ND
701-220-6568

NOTHING BUT OPPORTUNITY

Sunflowers aren't just another pretty face.

With five market classes, growers have many marketing options for this bright crop. While they are generalized into two larger categories – oilseed and non-oilseed – their end uses are far more varied. Let's break them down.

Oil

Approximately 75% of sunflowers grown in the U.S. are utilized for the oil that can be extracted from the seeds. Sunflower oil is naturally made up of a combination of mono-unsaturated, polyunsaturated, and low levels of saturated fat. Oil sunflowers are generally classified based on their oleic (monounsaturated fat) content.

Primary categories of commercially available hybrid seeds:

- NuSun®: Oleic levels of 55-75%
- High-oleic: Oleic levels greater than 85% (common minimum crush requirement)

Confection

With a thicker hull than oilseed sunflowers, confection sunflower seed is typically larger, longer and lighter in test weight. They are planted at a lower population in the field to grow longer more plump seeds. The largest of the seeds get sold to the in-shell market, like what you eat at baseball games, while the smaller seeds are utilized in the dehull market.

Conoil

A cross between oilseed and confection varieties, conoils have excellent market versatility being used primarily for dehull but also for oil, confection, or bird food, depending on processor requirements. This seed type is generally higher in oil content than confection seeds and realizes greater yields.

Dehull

Generally medium sized seeds, the dehull market requires processors to mechanically remove the hull and separate the kernel. The separated kernels are consumed as a snack or food ingredient with some product also going to the bird food market. While varieties are bred specifically for the dehull market, other classes can also be used for the dehull market.

Bird Food

Each year several hundred thousand acres of sunflowers are grown specifically for birdseed. In the U.S., the birdseed business is a multi-billion dollar industry. Oil type sunflower seeds, not crushed for oil, are often sold into high quality bird food markets but confection, dehull and conoil also supply this class. Bird food market varieties are often the smallest seeds.

NUSEED SUNFLOWER HYBRIDS PROVEN FOR EVERY FIELD AND EVERY MARKET

HYBRIDS	OIL	CONFECTION	CONOIL	DEHULL	BIRD FOOD
Cobalt II	X				X
Daytona	X				X
Hornet	X				X
N4H302 E	X				X
N4H422 CL	X				X
N4H470 CLP	X				X
N4H521 CL	X				X
Camaro II	X				X
Falcon	X				X
N4HM354	X				X
Talon	X			X	X
4334		X			
LD5009		X			
N6L691 CL		X			
Panther DMR		X			
Badger DMR			X	X	
N5LM307			X	X	X

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THE TOP FIVE

A close look at the top threats to yield in 2021 and how to mitigate each one.

In the 2021 season, 2,000 pounds per acre should be an absolute minimum expectation for sunflower growers in most of the main sunflower-growing regions of the U.S. and Canada. In order to make sure your season goes as well as possible, we've gathered the latest updates and best advice from leading experts on the most serious threats.

Insect Threats

On the insect front, there are numerous insect pests in the sunflower growing regions of U.S. and Canada. For early season and late season pests, two of the major ones are cutworms and red sunflower seed weevils. Let's review best practices for these insect pests, with Dr. Adam Varenhorst, Field Crop Entomology Extension Specialist at South Dakota State University.

For early season insect pests, there are several species of cutworms found in the main U.S. sunflower growing region, with dingy cutworms often being the most common in South Dakota. However, there are additional species that can be found in sunflower fields. All the cutworm species have the potential to cause early-season defoliation and also stand reduction through stem cutting. Conditions that can increase populations in the field include wet soil, excess debris to hide under and the presence of weeds at or before planting.

Growers typically plant treated seed at planting to manage **cutworms**, which can help reduce cutworm feeding. However, when large populations are present foliar insecticides may be necessary to prevent consid-

erable stand losses. Because cutworms are nocturnal feeders, foliar insecticide applications should occur in the late afternoon or early evening.

In terms of rescue treatments after planting, Varenhorst says there are several different active ingredients to choose from that are effective. "If signs of defoliation and cut stems are observed during scouting," he says, "dig into the debris and soil. The economic threshold for rescue spraying is 1 cutworm/ ft^2 or 25-30% of the plants in a field with stem cuts."

Red sunflower seed weevil is another sunflower pest issue that is capable of causing considerable yield loss if left unmanaged, Varenhorst explains. In South Dakota, populations of red sunflower seed weevils have been observed that are 10-100 times over the oilseed sunflower action threshold of an average of 4-6 red sunflower seed weevils per head. Red sunflower seed weevils will arrive in fields prior to flowering and the adults will be present on the head at flowering onset (R5.0). Scouting should begin then, says Varenhorst, and continue to the R5.7 growth stage. "To scout for red sunflower seed weevils, walk into each field at least 75 feet and then begin scouting. It's important to not scout the edges of a field because red sunflower seed weevil populations are much greater in these areas. Once in the field, count the number of red sunflower seed weevils per head on three plants from four random locations within the field. he says. "For confection sunflowers the action threshold is an average of 1 adult per head. Because spraying must occur during flowering, the recommendation is to spray when bees are less active in the field."

It is also important for growers to note that since 2017, Varenhorst and his colleagues have been conducting research in North and South Dakota into the reduced susceptibility of pyrethroid insecticides such as lambda-cyhalothrin, and have found evidence that there are populations within South Dakota that exhibit reduced susceptibility to lambda-cyhalothrin, esfenvalerate and zeta-cypermethrin active ingredients.

Phomopsis Stem Canker

Phomopsis stem canker is another serious threat to your harvest in 2021. It has been a yield-limiting disease in sunflower since the epidemic in 2010 in the main U.S. sunflower-producing region, explains Dr. Febina Mathew, a Plant Pathologist at South Dakota State University.

The disease was first identified in the early 1980s in the U.S. but wasn't a major concern. It was also believed for many years that a single fungal pathogen was involved. However, after the epidemic and analyzing samples from the disease surveys conducted by the National Sunflower Association, Mathew and her colleagues have determined there are multiple fungi species involved.

"We are researching how the species might interact and cause disease, but we need more understanding of each species' biology," she says. "There has been a lot of attention paid to the disease since the epidemic in 2010, and we know that while weather played a role that year, that outbreak was also due to a new fungus that had entered the U.S., one that was involved in an epidemic of Phomopsis stem canker in Australia in 2009 and in Argentina in 2015."

As with any similar fungal disease, Mathew's research has focused on four areas: developing diagnostic assays to determine pathogen species present, testing fungicide chemistries for effectiveness, screening sunflower hybrids for resistance and studying the importance of 'endophytic' fungus (those that live within a plant for at least part of their life cycle without causing apparent disease) in disease development. "We are currently researching the effectiveness of fungicides and found that use of QoI fungicides (FRAC 11) can provide a 5.6% increase in yield, but weather conditions (e.g. rainfall) and disease

Trygg Olson is a Field Sales Leader for Nuseed Americas.

Alison Pokrzywinski is a Technical Agronomist and Sunflower Product Manager, North America, for Nuseed.

Dr. Adam Varenhorst is a Field Crop Entomology Extension Specialist at South Dakota State University, where he oversees research related to the management of insects in South Dakota's major agricultural crops.

Dr. Febina Mathew is a Plant Pathologist at South Dakota State University. She conducts research in pathogen detection and diversity, emerging diseases, host-pathogen interactions, and development of disease management strategies.

pressure at the time of fungicide application obviously matter," she says. "These fungicides should be applied at R1 growth stage of sunflower, when the miniature floral head is formed on the plant." The fungicides trials were conducted by Mathew in collaboration with Dr. Sam Markell and Dr. Bob Harveson from North Dakota State University and University of Nebraska Panhandle Research and Extension Center, respectively.

On the sunflower genetics front, Mathew and her students at SDSU are working with a group at University of British Columbia to identify candidate disease resistance genes that seed companies can eventually use in their breeding programs. "With the recent availability of the sunflower genome and genomic tools, we are hoping to identify the possible candidate genes involved in resistance to Phomopsis stem canker as well as their function," Mathew explains. "We anticipate identification of genes by the end of 2021."

She notes that while fungicides are not a magic bullet, they offer some protection until disease-resistant hybrids are available for farmers. "Other ways to manage Phomopsis stem canker would be tillage and crop rotation," says Mathew. "Also, management of weeds is very important, because weeds could also be a host for these pathogens."

Plant Spacing and Equipment Troubleshooting

Every year, plant spacing in sunflowers remains one of the two top yield-limiting factors, and is therefore an issue that growers need to take very seriously.

"Depending on the year, plant spacing is either the number one or two issue based

on the USA Sunflower Survey," notes Trygg Olson, Field Sales Leader at Nuseed Americas. "The survey is conducted in seven states across the country including North Dakota, South Dakota, Minnesota, Kansas, Nebraska, Colorado and Texas. Looking at the survey in 2013, 209 fields were surveyed and plant spacing was the number one issue causing yield loss with over 25% of the fields. This was followed by disease and drought. In 2015, plant spacing came in at number two with 13% of the 201 fields surveyed, while disease was the most limiting. Jumping ahead to 2019, which was an extremely wet year throughout the northern growing region of N.D., S.D. and Minn., disease was the number one factor limiting yield followed closely by plant spacing at nearly 20% of all fields surveyed. We always hear about blackbirds destroying crops and killing yield, but from 2013 to 2019, out of 715 fields surveyed, in only 4 to 8% of these fields' yield loss was due to blackbirds while 16 to over 25% were caused by plant spacing."

While disease, drought and blackbirds are something growers have little control over, if any, plant spacing is a factor that growers have complete control over.

And, as Olson explains, there are many tools available to use to help set up producers' planters. Some of these include operator's manuals, National Sunflower Association (NSA) resources, equipment dealers and seed suppliers. "These are all great sources of information available to find the right plates and settings to get started," says Olson. "Secondly, we need to look at the equipment itself."

Over time, planter plates will wear, causing the orifice to get too large to pick up a seed or causing it to pick up multiples, resulting in skips and or doubles. Alison Pokrzywinski, a Technical Agronomist and Nuseed Sunflower Product Manager, North America, notes that research on the yield and quality losses associated with skips or doubles in sunflowers is being investigated at the U.S. Department of Agriculture Sunflower Genetics Lab, led by Dr. Brent Hulke in Fargo, N.D.

"His preliminary research is showing that sunflowers are very good at still maintaining yield in the presence of variable stands, but the lack of uniformity does affect the quality of the stand," says Pokrzywinski. "A lack of uniformity brings about issues of increased disease (Phomopsis for example) where there are multiple plants fighting for the same space. The micro-environment with increased plants creates a more disease-friendly environment and the smaller stalks makes it more likely to lodge." Dectes stem borer are also more likely to do devasting damage to those plants that have smaller stalks by completely lodging over in the fall.

"HAVING AN EVEN PLANT STAND IS THE BEST RECIPE FOR SUCCESS WHEN IT COMES TO MAKING SIZING GRADES."

- ALISON POKRZYWINSKI

Coming back to planter plates, Olson says, "We also need to keep in mind the brushes can also become worn and will not perform as intended. While we look at the planting equipment, we will need to look at the whole planter. One needs to make sure that the machine is operating in a smooth fashion. Look at bearings to make sure they are in good shape, and drive chain and sprockets to make sure there are no frozen links and there is smooth rotation while turning. If the rotation is tough or jerks while rotating the drive tire, it will be an indicator of where an issue may be – a place to start looking." He adds that a little time checking things over and prepping machines properly will put everyone a step closer to achieving high quality and profitability.

Uniform plant stands also promote the best results for insecticide spraying during bloom and carries through to harvest to provide even drydown for desiccation timing or harvesting (if you didn't desiccate). "Having an even plant stand is the best recipe for success when it comes to making sizing grades," Pokrzywinski adds. "Seed size is incredibly important for conoil and confections where the seeds need to fit over a certain size screen."

She adds that sunflowers will typically flex their head size based on the space allowed. "The more space they are given, the larger the heads," she explains, "and the closer the plants, the smaller the heads size. It's often a balancing act in sunflowers, aiming to find the perfect population that will bring forth yield, excellent standability and meeting the processor requirements for your end market. For confection sunflowers this typically means a lower population with larger heads, aiming for large seeds that will be sold for the in-shell market." Growers for the bird food market need to meet a minimum 28 pound test weight requirement and sometimes too low of a population can bring that test weight down too far.

"Setting planting populations aside, no matter what market the sunflowers are being sold into, establishing a good plant stand with very few doubles or skips is the ultimate goal and key to starting off a successful growing season," says Pokrzywinski. "Everyone always talks about yield and quality loss as it pertains to confection sunflowers, but in oilseeds, whether for crush or bird food, yield and quality also matter and plant spacing is key."

DEDICATED TO INNOVATION

From opening doors for market access to making sunflowers more pest resilient, Nuseed's R&D team is delivering more options for growers.

Jim Gerdes, Nuseed R&D Lead for Sunflower, pollinating at the Nuseed sunflower nursery.

"NO ONE ELSE IS EVEN ENTERING INTO TRIALS WITH THE TYPES OF GENETIC OFFERINGS WE ARE BRINGING TO MARKET. WE ARE THE ONLY COMPANY BRINGING THESE PRODUCTS TO ALL SECTORS OF THE MARKETPLACE — IT'S FUN FOR US TO BE WORKING AT THE GROUND LEVEL IN BUILDING NEW MARKET SEGMENTS."

- GARRETT DRIVER

When Nuseed developed the Innovation Center in West Sacramento, Calif., the goal was to bring as many aspects of the seed industry together in one place as possible. Research and development, seed production, supply chain components — all of the integral pieces of moving from ideation to a seed that would be sold, along with location strategy, was factored into the decision.

"There was a lot of discussion around where to place the Innovation Center in North America," says Garrett Driver, North America Supply Chain Manager. "The team decided on West Sacramento because of its strategic location to other seed companies in the industry and the research leg of UC Davis — a great research institution in the biotech industry. We needed to be positioned to get out and work within the industry and with growers."

Another goal of the Innovation Center was to bring the Nuseed team together in one location to improve communication and collaboration. The West Sacramento facility brought together supply chain, customer service, sales, human resources, finance, and research and development, under one roof, to make decisions about pipeline and bringing new innovation to market.

"Prior to the Innovation Center, we had several offices that Nuseed had rented," Driver says. "We were just very fragmented in terms of how each leg of our company operated. Don't get me wrong, we were still connected and got together for meetings, but we were missing that day-to-day collaboration that is now common for us."

Putting Innovation to Work

Today, a major component of the breeding work Nuseed is doing focuses on sunflowers. Sunflowers are a non-GMO crop because herbicide tolerance has been established through years of selective breeding. Nuseed has introgressed the Clearfield®, Clearfield® Plus and ExpressSun® herbicide traits and downy mildew resistant traits into a number of hybrids to help growers manage weeds.

Although Clearfield technology was initially adopted and sought out by growers, in the past five years, ExpressSun has gained popularity. The main drivers of this shift in demand are price and differing residuals.

"ExpressSun doesn't have the same residuals that Clearfield has, and it is a cheaper solution," says Jeremy Klumper, a Nuseed Sunflower Breeder who heads up the oilseed sector for the company. "The downside to an ExpressSun system is that it doesn't control certain weeds and grasses, but farmers can and do add a grass herbicide and the cost is still less than the other options.

"ExpressSun does not cover cocklebur, but Clearfield doesn't cover Russian thistle; there is considerable overlap in the products, and different management opportunities exist within each," he says.

Options are the number one reason Nuseed continues to work with all three: Clearfield, Clearfield Plus and ExpressSun. The company realizes that every farm has different weed control needs and Nuseed is committed to being able to provide solutions to the growing challenges their customers face.

"A lot of the work that our lab has been doing is focused on the trait purity side of germplasm. In addition to working on herbicide traits, we are also working on oleic levels, disease resistance and other traits that we plan to integrate, or already have integrated, into our lines," says Driver. "Having a lab onsite helps with turnaround time and allows us to have results and make decisions faster than some of our competitors."

Those technologies and other trait integrations are helping Nuseed to excel in both the oilseed and confection sunflower markets.

Strides Toward New Markets

Although consumer demand has weakened — as snacking preferences have changed in the past decade — Nuseed continues to deliver a robust research and development program while seeking out both new ideas and markets within its confection sunflower portfolio.

"Nuseed has more invested in our confection sunflower breeding program than anyone else in the U.S.," Nuseed Confection Sunflower Breeder, Erin Gerdes says, "Nuseed is excelling in molecular lab work because of the Innovation Center and has the ability to do a lot of marker assisted selection. We have invested more in this technology than others in the space, and I believe that is showing in our market position."

Gerdes says the technology allows for a faster incorporation of disease resistance and helps to identify parentage lines faster; it allows the research and development and breeding team to take the best and develop new lines with those same traits. In short, it speeds up the process.

With breeding nurseries in Rothsay, Minn. and Sacramento, Calif., Nuseed is able to learn which lines will withstand harsh environments and accelerate seed increases in a more forgiving climate.

"We do most of our research and early generation sunflower breeding on 55 acres in Rothsay. Those acres are divided between confection and oilseed," Gerdes says, "We also have breeding services in Sacramento; California's growing environment is much nicer (than that of Rothsay). The reason that we do a lot of early germination work in

Nuseed sunflower nursery near Rothsay, Minn.

Rothsay is because it's a harsh environment, and it helps us select early for plants that are disease resistant and can withstand harsh growing conditions. If we did all of the work in California, we would have varieties that wouldn't thrive in the Midwest."

In the confection sunflower seed market, seed quality and appearance are king because that is the portion of the plant that will be consumed. With that quality and appearance also comes size; bigger seeds and bigger plants, which also lead to bigger standability and in-field damage issues. "As the seed gets bigger, the plants get bigger, and the hard part, on our end, is finding the right parent lines to bring in," says Gerdes. "A lot of what we do is developing parent lines for seed and standability. Bigger heads also means more susceptibility to the head breaking off and head diseases."

Unlike the confection sunflower market, the oilseed market in North America was stable to slightly increased in 2020, with most of the growth in the sector fueled by birdseed. "There are a couple of things that play into the oilseed market stability right now," says Klumper. "With COVID-19, people are staying home right now, and they are feeding birds. It's cheap entertainment. The other thing: when economies are good, people have more disposable income for things like birdseed."

The improved demand has also helped to strengthen acres after a five year decline. "Sunflower oil acres dropped to a new low in 2019, and then we saw a significant jump in 2020 to bring acres back up to where we were in 2015," Klumper says. "I think a lot of that was due to other commodity prices being low. Sunflower always pencils out well if you are willing to accept the challenges and risk of growing it."

An important area of development for Nuseed is in the XXL market with the introduction of seeds that are more than one inch long. Driver says this endeavor is a test of the market and the industry's ability to reestablish a place on the grocery store shelf with consumers.

Providing Genetic Solutions

Gerdes notes that the agronomics aren't as good in confection sunflowers, namely due to the fact that sunflowers are native to the Midwest and the plant has had thousands of years of disease resistance developing beside it.

"Developing and using markers helps a lot," she says. "You can't always see disease resistance with the naked eye but you can see that resistance using genetic markers. One disease that Nuseed is seeing success in combating is Orobanche. Orobanche is a parasitic weed that has become a major problem in Europe, and while it has yet to enter the U.S., the Nuseed team is confident that they will have genetics in place when it does. The team is also working on fungal diseases like advanced downy mildew, which continues to be a problem for U.S. farmers, and sclerotina and Phomopsis, two fungal diseases that show up later in the growing season when it is more difficult to treat.

"We do a lot of tissue sampling and seed sampling to identify that certain genetic packages are homozygous for the gene of interest," Klumper says.

Klumper also notes that the use of marker assisted identification is no longer revolutionary to the seed industry. However, what sets Nuseed apart is the company's dedicated lab space and speed in which Nuseed can identify a trait and move it through the pipeline to market.

"The genetic technology accelerates the process so we don't have to wait for an active infection or even lab screenings to see if we have resistance to a certain disease. We can take a leaf tissue punch and get all of the information we need from our West Sacramento lab in a couple of weeks. Our dedicated lab devotes the largest portion of its attention to canola and sunflowers, we aren't waiting in line for lab space, and that is unique in the industry," he says.

That dedication, the devotion of a breeding program that focuses solely on sunflowers as a primary business driver, is very unique and what truly sets Nuseed and its team apart from the industry.

"No one else is even entering into trials with the types of genetic offerings we are bringing to market," Driver says. "We are the only company bringing these products to all sectors of the marketplace — it's fun for us to be working at the ground level in building new market segments.

With larger companies, you get into the habit of producing large scale year-over-year, but in those situations, you are maintaining market presence, not building new ones, like we are," he says.

HAPPY HONEY BEES

Canola and sunflowers provide bees an ideal habitat and efficient means of feeding. Certain farming practices are conducive to the survival of pollinators which benefits both growers and beekeepers.

Honey bee and wild pollinator health numbers are declining due in part to lack of suitable habitat to provide forage and nutrition. The loss of habitat is due to declining wild spaces and increased agricultural activities. According to the U.S. Canola Association (USCA), increasing the acreage of cropland planted annually to canola or sunflowers would have an immediate positive impact on honey bee and wild pollinator health.

Canola provides ideal habitat and food source for honey bees and other pollinators. Canola flowers produce abundant nectar, which has a good sugar profile for honey production. Canola pollen offers pollinators a good nutritional balance of amino acids and protein, plus a plentiful source. Canola allows pollinators to feed efficiently without covering large distances. Canola fields also bloom for relatively long periods, so some fields can provide bees and pollinators with a good source of nectar for up to a month.

Sunflowers can also provide late-season supplemental habitat and food source for pollinators. Sunflowers bloom in late summer, providing habitat and forage at a time when fewer plants are blossoming.

Canola is typically self-pollinating, meaning that bees are not required for the plant to set seed. However, the presence of bees can, under some circumstances, prove beneficial. According to the Canola Council of Canada, studies have indicated that bee pollination:

- Encourages higher canola yields with better ripening
- Results in more uniform flowering and earlier pod-setting
- Increases the number of pods per plant, seeds per pod and seed weight
- Reduces the amount of time canola blooms by 17%
- Increases seed weight per plant from 13% to nearly 50%

In addition, bees may help control canola diseases. Researchers are exploring the potential for honey bees to spread beneficial fungi for controlling insects like lygus bugs.

Bees Love Canola, Canola Loves Bees

According to the USCA, canola farmers and beekeepers have a vested interest in cooperating and protecting bees as much as possible. A lot of work has been done in recent years to improve honey bee and pollinator habitat on U.S. farms.

Just this past October, the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) released a revised Conservation Stewardship Program titled "Diversify crop rotation with canola or sunflower to provide benefits to pollinators" that provides incentives to producers to include canola or sunflowers in crop rotations. The revised program includes key input from the USCA, National Sunflower Association (NSA) and other stakeholders.

In addition, the USCA, in partnership with the Honey Bee Health Coalition, recently issued "Best Management Practices for Pollinator Health in Canola Fields" with related materials for growers and beekeepers.

"Canola flowers produce high amounts of nectar and pollen, offering a good sugar profile for honey production and a nutritional balance of proteins and fats," notes USCA President Rob Rynning. "Canola flowers also allow bees to feed efficiently within reasonable distances for up to a month."

Conservation Stewardship Program

The U.S. Canola Association, along with the National Sunflower Association, American Honey Producers Association and American Beekeeping Federation, has been working together with the U.S. Department of Agriculture's Natural Resources Conservation Service to improve conservation practices that would ultimately lead to improved honey bee and pollinator habitat on U.S. farms.

In October of 2020, the NRCS released a revised Conservation Stewardship Program titled "Diversify crop rotation with canola or sunflower to provide benefits to pollinators" that provides incentives to producers to include canola or sunflowers in crop rotations. The revised program includes key input from the USCA, NSA and other stakeholders.

Title: Diversify crop rotation with canola or sunflower to provide benefits to pollinators
Conservation Practice 328: Conservation Cropping System
Applicable Land Use: Crop (Annual and Mixed)
Resource Concern: Animals
Enhancement Life Span: 1 year

Enhancement Description:
Diversify existing crop rotation by adding pollinator friendly canola or sunflower crops into the rotation. The crop rotation shall include a minimum of three different crops. Each year, the pollinator friendly crop will be planted on a minimum of 5% of cropland acres contained within the agricultural operation. Use of insecticides compliant with grower industry best management practice is allowed only during pre-bloom and bloom of canola or sunflower.

Criteria:

- Crops will be grown in a planned sequence and shall include a minimum of three different crops. The crop rotation must include at least one year of canola or sunflower. Other pollinator friendly crops may be included. For these criteria, a pollinator friendly cover crop is considered a different crop. A pollinator friendly crop is defined as a crop, planted for harvest or as a cover crop, which provides nectar for pollinators and other beneficial insects. Examples of pollinator friendly crops are canola, sunflowers, clovers, and borage. To meet the purpose and definition of a pollinator friendly crop, these "flowering" crops must be allowed to bloom prior to harvest or termination.
- Each year the enhancement is planned, the pollinator friendly crop will be planted on a minimum of 5% of cropland acres contained within the agricultural operation. Plan/contract the actual acres planted to the pollinator friendly crop.
- Where applicable, plan suitable crop substitutions when the planned crop cannot be planted due to weather, soil conditions, or other local situations.
- Foliar systemic insecticides may not be applied to the pollinator friendly crop.
- Insecticides and fungicides applied during crop pre-bloom and bloom period of the canola or sunflower crop must be mitigated through integrated pest management and must follow industry best management practices.
- Apply pesticides only when economic thresholds are met.
- Apply pesticides at night or within two hours of sunset as this is when bees are least active.
- Follow best practices for minimizing drift:
  - Use a low-drift nozzle, calibrate spray equipment, and use medium to-coarse droplet size if possible.
  - Install cones or shrouds on field sprayers to reduce off-field movement.
  - When spraying fields, consider spot spraying or only applying pesticides to infested areas.
- Select crop pest products with a residual activity of less than 8 hours.
- Improve foraging areas for bees and other pollinators. Where possible, include flowering plants in non-crop areas. Avoid pesticide drift onto non-crop areas that include floral resources. Leave areas that include these resources intact whenever possible.

To protect these beneficial insects, canola farmers are advised in the BMPs to:

- **Communicate and coordinate with beekeepers.** Before planting, growers should find out if hives will be placed in or near their fields. If so, they are advised to create an agreement with beekeepers to guide interactions throughout the growing season based on what, where and when they apply insecticides.

- **Reduce exposure to pesticides**. Growers should only use insecticides when necessary as part of an integrated pest management program and choose products with low toxicity to bees and short residual toxicity time. It is important to follow label instructions, use technologies and techniques to minimize drift, not mix insecticides with other pesticides, and avoid generating dust with treated seeds. If possible, farmers should avoid spraying when bees are present, during bloom, on other flowering plants or when weather could increase risk of exposure. They should also practice good clean-up and disposal of treated seeds, insecticides and their containers.

- **Provide safe forage**. Growing no-till canola is an ideal habitat and food source for bees. If planting cover crops, farmers are advised to add flowering plants into the mix. In non-crop areas, growing flowers, trees and shrubs is also good for bees. Farmers should control flowering weeds prior to planting, avoid mechanical tillage where possible, and not spray non-crop areas with insecticides.

"Bees are essential for hybrid canola seed production," adds Pat Murphy, USCA 1st Vice President. "They increase seed germination, reduce green seed counts and raise oil content. Bee pollination also encourages higher canola yields with better ripening. That's due to more uniform flowering, earlier pod-setting, reducing bloom time, and increasing seed weight plus the number of pods per plant and seeds per pod."

Other best practices in the document include referring to your state-specific Managed Pollinator Protection Plan and scouting fields to determine whether a pesticide application is needed.

Training Honey Bees with Sunflower's Scent

There have also been several studies and research programs looking at honey bees and their link to crop production.

In a recent study published in the journal *Current Biology*, researchers were successful in training honey bees to pick up on the scent of sunflower to seek them out for pollination. The experts report that honey bees prompted with odors similar to sunflowers supported a significant increase in sunflower crop production.

"We show that it's possible to condition honey bees to a rewarded odor inside the colony, and this experience modifies the bees' odor-guided behaviors later," said study co-author Walter Farina of the Universidad de Buenos Aires. "The most surprising and relevant result is that the foraging preferences for the target crop are so prolonged and intensive that it promoted significant increases in the crop yields."

The team had previously demonstrated that honey bees could develop long-term memories related to food scents inside the nest. They also found that these memories could influence which plants the bees pollinated.

To train bees to forage on sunflowers, the researchers developed a simple synthetic combination of odors that the bees would associate with the natural floral scent of sunflowers. Next, they supplied the hives with food that contained their new formula.

The investigation confirmed that early experiences with the scent of sunflowers established memories that later influenced the bees' foraging preferences – which the experts derived by decoding their waggle dances.

The scent training led the bees to visit sunflowers more often. Furthermore, hives that had trained bees also brought more sunflower pollen back to the hive. Ultimately, sunflower seed production was boosted by 29 to 57%.

"Through this procedure, it is possible to bias honey bee foraging activity and increase yields significantly," said Farina. "In other words, pollination services might be improved in pollinator-dependent crops by using simple mimic odors as part of a precision pollination strategy."

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NEW SEED COATING **BOLSTERS GROWER EXPERIENCE**

In 2020, sunflower growers noticed a change in the color of their Nuseed sunflower seed. Here's why the new coating provides improvements for the customer.

In 2019, sunflower growers who used Nuseed hybrids noticed something different: a new green polymer seed coating.

It was the beginning of a transition of seed technology advancement for its entire sunflower seed portfolio, which growers saw in 2020.

Why the change? Nuseed wants to ensure that it offers its customers the best in available seed technology, including the polymer it uses. It expects this new seed coating to provide growers with improved flowability, decreased bridging and increased singularity at planting.

"All three of those factors help the sunflower kernel go through the planter," says Garrett Driver, Nuseed Supply Chain Manager.

"This came from feedback from growers and customers, people who are out in the fields using our seed in real-world conditions. They wanted no bridging, better singulation, and better flowability through their equipment. And so, about four years ago, we started our trials to address those concerns."

Need for Change

Sunflower seeds, of course, are unique in their size and shape which makes them more of a challenge to work with. While Nuseed's previous seed coating did the job for many years, as both seeds and seeding equipment have evolved, it was an opportunity to improve coatings.

Flowability and bridging was a top priority. Bridging occurs when the seed stops flowing and forms a dam or clog inside the machine.

"It eventually shakes loose, and the seeds fall through, but what sometimes happened is you would cover, say, 600 acres in a field, but you'd get gaps where no seed got planted because the clog hadn't dislodged itself at that point," Driver says.

"There were also some grower issues that were identified in terms of just overall stand establishment in some of their sunflower fields as well, which can result from singulation problems."

Singulation refers to the measurement of the planter dropping one seed at a time into the seed tube. Singulation differs from seed spacing in that even if singulation is perfect, spacing is affected by what happens subsequent to the seed being dropped into the tube. Spacing can be affected by everything from mechanical issues to the speed the seeder is being pulled at.

"Our sales team got out there with the growers during planting, to see exactly what was occurring."

It's that direct feedback and insight from growers that ultimately allowed Nuseed to develop a solution.

Evolving Seed, Evolving Technology

Seed is increasingly used as part of the delivery mechanism for active ingredients that help protect young plants from seed and soil-borne disease, insect and fungal pressures. As more inputs are added to the seed, an inert seed coating or polymer outer shell is used to help these seed enhancements stay on the seed.

Sunflower seed is evolving. As new varieties are bred, the physical seed changes, meaning

seed coating technologies must change right along with them.

Genetics have a lot to do with the overall kind of planting experience a grower gets with the seed, Driver says. In the sunflower world there are two distinct types of sunflower — one is the oilseed variety, which generally are smaller seeds, and confection sunflowers, which are larger.

"Oilseed sunflowers are usually smooth and smaller, and typically will flow and plant better compared to the confection variety. The other bigger challenge of sunflower seed in general is the density of the seed which is much lighter compared to, say, soybean or corn," Driver explains.

JEFF OBERHOLTZER, A SUNFLOWER GROWER IN MOHALL, S.D., SAID HE HAS EXPERIENCED 99% SINGULATION WITH THE NEW COATING.

"Being lighter, but still having a fairly large surface area, it can be a little more challenging to plant sunflower in tougher environmental conditions. A lot of wind — even high humidity or rain — does increase the humidity in the air which can change how well the seeds flow through their equipment. That's where it's pretty critical to have the right products on the seed and ultimately provide the best value to the customer."

That's done through seed treatments that are held onto the seed by a polymer. A polymer is a binding component that basically acts as a thin coating on the seed, notes William Olson, North American Sales Manager for Incotec, which supplied the new polymer to Nuseed.

This applied technology helps protect the seed treatment investment while also enabling increased flowability and plantability of the seed to achieve consistent seed drop (singulation).

"Sunflower is different than all the rest of the crops. It's a large seed, and in the case of confection sunflower features a rough surface. You have to make sure you get a good coating on the outside because we want to have good flowability through the planter. That's where the polymer comes in and makes all the difference in the world," Olson says.

"At the grower level, planting equipment has changed and is getting larger, and so the issue of proper seed placement is huge."

The new coating design involved invaluable input from growers and seed suppliers, including Jed Wall, Sunflower Business Development Lead for Legend Seeds in Wahpeton, ND.

"We started off with a whole gamut of different treatment and polymer options and worked through them to determine what had the best singulation and the least amount of doubles and skips. And then we took it to the field via some of the newer machines, just to see how it flowed through different tubing and the like," Wall says.

"We saw a drastic improvement with Nuseed's new polymer. The flowability was just wonderful and it really is top-notch in the industry right now."

Jeff Oberholtzer, a sunflower grower in Mohall, SD, said he has experienced 99% singulation with the new coating.

"It was the easiest planting experience I've ever had. We weren't getting any doubles, no skips," he says. A double occurs when two seeds are dropped at once, and a skip occurs when no seed is dropped at all, he adds. "The seeds are all the same size and they just fit right into the meter dish," Oberholtzer says.

The Meaning of Green

As part of the change, growers also noticed Nuseed sunflower seed change color, from blue to green. Why the change?

"Most seed coatings are blue. We wanted to differentiate ourselves. The change of

colorant from blue to green is to help identify the uniqueness of our seed and our brand," Driver says. "Growers recognize the green Nuseed logo, so we thought it would be appropriate to make our seed colorant green. We thought it was a nice touch."

It's important to note that neither colorants nor polymers contain any active ingredients, and germination is not impacted by the change in either polymer or colorant. A change in polymer or seed colorant does not require any change in handling or agronomic practices for the grower. Nuseed recommends safe seed handling and the proper setting of planting equipment. These recommendations do not change, Driver adds.

As with all sunflower planting, proper planter settings and testing are paramount. Visit nuseed.com for resource information regarding planter settings, seeding rates and best practices. Refer to your planter manufacturer guide for specific information on your equipment settings.

Nor does the new polymer affect what active ingredients are used on the seed. Nuseed sunflowers continue to be available with leading sunflower seed treatment products to protect against seed and soil-borne diseases, fungus and insects, Driver says.

COVERING UP

Looking at the benefits and best practices of using sunflower in a cover crop mixture and growing a mixture of cover crops into sunflower.

Agronomists and producers are becoming increasingly aware of the importance of protecting soil from wind and water erosion. Cover crops have become more important in farming systems and can boost soil fertility and reduce soil erosion.

Emily Paul, Sales and Product Development Director at Pulse USA, has a broad background in the agriculture industry including agronomy sales, crop consulting, production contracting and seed sales. She says planting a cover crop revolves around several factors and goals, and when it comes to using sunflowers in a cover crop mixture those reasons for incorporation are as unique as the next cover crop seed. However, the main benefit of using sunflower in cover crop mixes involves its roots. The deep root of sunflower is beneficial to sequester residual nitrogen.

"Sunflowers in cover crop mixtures are primarily used for soil health benefits such as cycling and scavenging nutrients, reducing soil erosion and alleviating soil compaction," explains Paul. "Their deep tap root pulls nutrients and water up from soil layers that most other cover crop species cannot reach adding diversity and synergy to a mixture."

Paul, who grew up on a family farm near Rugby, N.D., and dedicates her time to the pulse and cover crop industry, says sunflower as a cover crop benefits livestock and wildlife as well.

"Sunflowers are great to incorporate into mixes for livestock and wildlife benefiting both the land, the environment and the animal," she says. "The height of sunflowers is attractive for food plot mixes to provide more shelter to deer, upland and other game birds. Their flowers are especially attractive for promoting sustainability in our ecosystem for bees, pollinators and other beneficial insects."

Saving the Soil

"Sunflowers are a great crop for soil conservation and much of that success can be accredited to their root structure and deep tap root," says Paul. "Their root structure holds soil together, alleviates soil compaction and biologically breaks through soil layers reducing the need for conventional tillage practices."

According to Paul, the sunflower tap root resembles an elevator bringing nutrients, microbes and water from deeper soil layers closer to the soil surface for subsequent crops to have better access to. "Sunflowers improve overall field conditions and farmers notice how well they can remedy their soils by softening and breaking the ground up for improved planting conditions," says Paul.

Wait, there's more. Sunflowers also have good salt tolerance. "Fields with salinity issues that hinder crop production can be remedied through the use of sunflowers allowing farmers to conserve the land they have to grow on," Paul explains.

Sunflowers are a warm season broadleaf, so Paul says it is best to use them in mixes planted once soil temperatures have reached 55-60°F.

Cover Crops Into Sunflower

To embrace sustainable farming practices and build soil health, farmers are now working on fitting cover crops into every phase of their rotation to achieve multiple goals. One practice that is currently gaining interest in the U.S. is seeding cover crops into sunflower.

In this case, various mixes of cover crops could provide the following benefits:

- Flowering throughout the growing season to attract beneficial insects and possibly reduce insecticide applications.

- Competition with weeds in a crop where herbicide options are limited.
- Diverse root structures to build soil health properties.

The benefit to soil health and soil conservation is especially appealing.

"Top soil preservation and the maintenance or building of organic content in the soil are important management strategies to increase soil health," wrote Hans Kandel, Extension Agronomist Broadleaf Crops at North Dakota State University, in a Crop and Pest Report last June that looked at the benefit of seeding a cover crop into sunflower.

"Some potential benefits of interseeding a cover crop mixture, including a legume, in sunflower, are nitrogen fixation, soil erosion control, improved snow trapping, improvement of the soil structure and organic matter content, and fodder or green manure production the year after the legume establishment," wrote Kandel.

Timing is critical when it comes to interseeding a cover crop to ensure the sunflower crop still yields near its potential. According to Kandel, it is important to give the sunflower (the primary crop) a head start and plant the cover crop from the V4 to V8 growth stages.

Planting too late in the season, from V8 to bloom, will not provide enough light for the cover crop establishment.

Cover Crop Experts

Keith Berns and his brother Brian co-own Green Cover Seed and Providence Farms in Bladen, Nebraska, where their family has been farming for more than 100 years. They farm corn, soybeans, rye, triticale, peas, buckwheat, and sunflowers using continuous no-till and a variety of cover crop strategies to maximize the health of their soil. In 2007, the Berns brothers founded Green Cover Seed to fill the demand they saw for cover crop and forage seed mixes. Since then, their business has grown exponentially, becoming one of the major cover crop seed providers and educators in the United States.

"Our goal when we farm is we never want to see the soil unless we go looking for it," says Berns in a video on the Green Cover Seed website. In the video, Berns shows off a cash crop of sunflowers, along with a mix of cover crops which he has planted into a field with a healthy thatch of triticale straw. Since the sunflowers grow above the cover crops, he explains that he will be able to harvest those flower heads for their oil, leaving intact the cover below to protect the soil until the next round of planting. As we learned earlier, sunflowers are a great crop for soil conservation, something Berns agrees with.

"A sunflower has a massive root system," says Berns. "The roots are what's really helping build our soil, it's building soil structure, it's giving an environment for all of the soil microorganisms to live. Earthworms love sunflower roots."

The brothers have tried hundreds of crop cover mixes and from that knowledge they developed an online tool to help farmers decide which blend of cover crop seeds is best suited for their purposes. Called the SmartMix Calculator, this online decision-making tool uses geographic and climatic data combined with user-provided planting dates and goals.

To view informational videos and blog posts on using sunflower in cover crop mixtures and to access the SmartMix Calculator, visit greencoverseed.com.

NDSU: Experimenting with Cover Crops into Sunflower

Hans Kandel, Extension Agronomist Broadleaf Crops at North Dakota State University, performed a study evaluating the benefit of intercropping a cover crop into sunflower.

"In my experiment, the legumes hairy vetch with a seeding rate of 28.8 lb/a, sweetclover (9.5 lb), alfalfa (16 lb), black lentil (22.3 lb) and snail medic (22.3 lb) were interseeded into sunflower on the day of sunflower planting, at the V4, and V10 growth stages of sunflower. The sunflower yield was reduced when legumes were interseeded at the same time as sunflower planting, except with black lentil (which produced 1237 lb of legume biomass). The sunflower yield, head diameter, achenes per head, and 100- kernel weight were not significantly lower when legumes were interseeded at the V4 or V10 growth stages. The amount of legume biomass produced is indicated in Figure 1. Legume biomass was lower when the legume was interseeded at the later (V10) growth stage."

According to Kandel, the lessons learned were:

- Black lentil can be seeded at the same time as sunflower or slightly later. Other legumes needed to be seeded after the V4 of sunflower in order not to negatively influence the sunflower yield.
- Delaying planting of the cover crop beyond the V4 will reduce the amount of cover crop biomass produced.
- Use hairy vetch only if you have a plan to control the crop so it will not become a weed.
- Although only five cover crops were used in the trial, it is anticipated that various cover crops and cover crop mixtures may work in interseeding into sunflower.

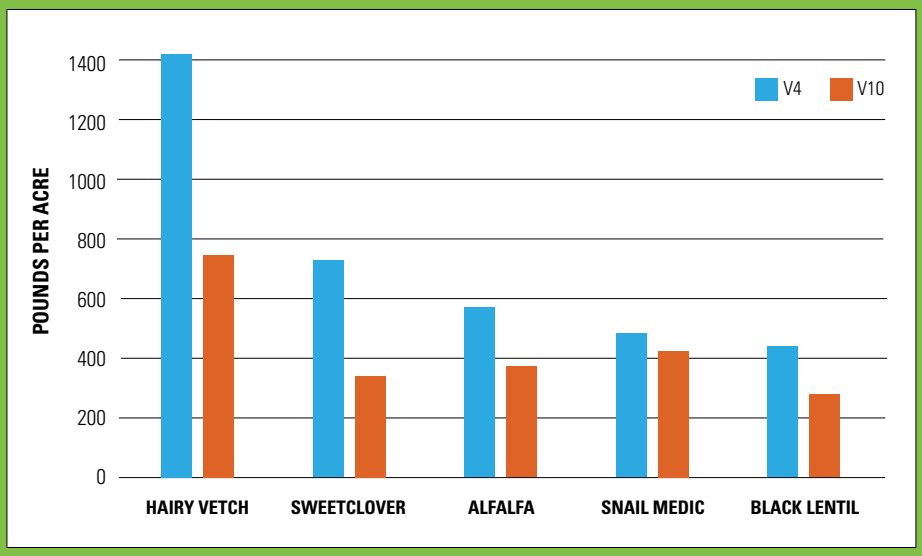

Figure 1. Legume biomass (dry matter) produced when interseeded into sunflower at the V4 or V10 growth stages averaged across four replications, two hybrids, two seasons, and a total of five environments. Credit: Hans Kandel, NDSU


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SMOOTH PLANTING – AND HARVEST

A review of how best to adjust, inspect and otherwise check on your planter and combine to maximize yield and harvested seeds.

In order to grow the best crop of any kind, farmers are well aware their machinery must be working properly, and that settings and speeds must be correct. Here are some general and sunflower-specific reminders to consider during your annual planter inspection, as well as some thoughts on optimizing harvesting equipment as another growing season begins.

In sunflowers and other large seed crops, planter mechanical issues can lead to unacceptable ranges in head size, kernel size and kernel quality. Poor planting can also result in lodging and make harvesting difficult. The first thing to check on a planter is proper inflation and tire size. If these are not in line with the manufacturer's recommendations, population variation can result.

Next, the closing wheel alignment should be checked, as well as the wear on disk openers. Make sure all drives (chains, bearings and shafts) are working well and check to see all chains and sprockets are properly aligned. Also check all seed tubes and sensors to make sure they are clean and functional. Row cleaners should float freely with maintained pivot point and bearings. Remember that residue left in-furrow can change soil temperature and cause delayed emergence.

With air seeders, check opener disks for wear and if they are 17" or less, install new ones. Examine firming and closing wheel arms, check bushings, and check the condition of the air delivery system, making sure the air system fan is operating at proper speed. Also go over all hoses and distributors for wear, air leakage, cracks or blockages.

Assure seed boots are within spec, and if more than ½" is burned off the bottom of the boot, replace it. You can also check this by using a tape measure or ruler to make sure the boot is 11.3" or longer. Then, calibrate downforce to ensure the boot is running properly. Remember that too much downforce will cause the boot to run deeper in the trench, and therefore it won't run parallel to the ground.

Make sure all bearings are in good condition and check that you have the proper metering roll for the application. Also check the metering roll for wear and debris. Along the way, give everything a good lubrication before you enter the field. Also consider filling your planter hoppers only half full to reduce the potential for bridging.

At Planting

After planting a few acres, be sure to check your calibrations and seed usage. For each seed lot, test your meter on a plant meter stand to determine the best speed, air or vacuum pressure, plate size, finger type and which eliminator setting should be used. This will take a bit of time, but it's an important way to make sure you achieve proper plant population and spacing.

COMBINE ADJUSTMENT INDICATORS	
PROBLEM	**POSSIBLE CAUSE**
Excessive tailings	Air flow too low, overthreshing at cylinder/rotor, or chaffer openings too narrow
Trash in hopper bin	Overthreshing, cylinder/rotor speed too high, concave too tight, fan too low, or sieve too wide
Broken or crushed heads	High cylinder/rotor speeds or narrow concave spacing
Crushed seed with hull intact	Concave spacing too tight
Dehulled or broken seeds	High cylinder/rotor speeds or excessive returns
Unthreshed heads on the ground	Poor gathering at the header
Seed is being thrown out the back	Speed/air flow; slow down the machine and air flow rate

Source: Randy Taylor, Kansas State University Extension Ag Engineer

When planting, check seed placement by doing some digging. You may need to switch plates, and/or change baffle settings, singulator or double eliminator settings, and vacuum or air pressure for desired singulation.

You'll know your vacuum is set properly if your skips and multiples are close to equal; if you have more multiples, lower your vacuum, and if more skips, increase your vacuum. Revisit these settings between seed lots and for each lot, make sure the speed of the meter is adjusted to what's best.

Harvest

After you've taken care of your crop all season it's important to prepare for a successful harvest. Experts say that out of all the steps in sunflower production, harvesting gets the least attention. Minor adjustments to combines can make a big difference, and here are some things to consider to make sure seed harvested is maximized.

After giving the combine a checkover and lubrication, make sure the fan is set at the right speed. Sunflower seeds are lighter than other grains, and adequate air flow keeps trash floating across the sieve. However, if fan speed is too high, you'll be blowing too much seed out the back. Your target for seeds thrown behind the combine should be less than 10 seeds/ft^2, which is 100 pounds per acre of actual yield. However, in the discharge area, note that 40 seeds/ft^2 represents a loss of 100 pounds per acre. Some growers use a piece of plastic to block off the back 12" of the cleaning screens to keep more seed in the combine. In addition, to reduce seed loss at harvest, make sure your harvesting equipment is running as close to, if not the same as, the feederhouse on the combine.

At the other end, if fan speed is too low, you're going to have empties, which will affect the test weight. Industry experts encourage sunflower growers to check desired test weight during the harvest to make sure you are on track. Some blanks will always occur, but the more there are, the lower the test weight.

Regarding the rotor of the combine, if it's spinning too fast, or if the concaves are set too tight or too loose, you'll start grinding the seed up and shelling seeds out. Concave settings should be open (cylinder-to-concave spacing of 1" at the front of cylinder and ¾" at the rear).

Ground speed is also important during harvest. You want to keep the combine full so that it will do a good job of threshing and this will likely be somewhere between 3 and 5 mph (4.8 to 8 km/h). However, today's large combines often need to travel more than 5 mph to keep full.

Cylinder speeds can range from 300 to 500 revolutions per minute, but keep in mind that using the slowest cylinder speed with the largest concave opening results in reduced seed damage.

Remember to mitigate risk of fire. The most important way to do this is to keep the combine clean. Growers should blow the combine down at least twice per day and have at least two fire extinguishers on hand. Some growers also use a snorkel extension for the air intake to decrease fire risk.

Although sunflower headers generally require little upkeep, check them twice during the harvest season. At the beginning and end of the year, lubricate them well and check that chains are tight.

Type of Head

Many sunflower growers adapt combines they use for small grains to harvest this crop. Platform and corn headers require some changes, including the addition of catch pans, a deflector bar and a small reel, but a rotating drum can be used to replace the deflector bar and reel. Row-crop headers don't require any modifications to harvest sunflowers.

However, it can pay to invest in a sunflower-designed head, as it generally does a better job of harvesting. While the return on investment of purchasing such headers has been debated in the sunflower circle for years, many believe that because they reduce harvest loss – resulting in 300 to 600 more lbs of seed per acre in the combine – they pay for themselves quickly.

There is another advantage to these headers as well, which comes into play when harvesting conditions aren't optimal. Sunflower-specific headers can make the harvest of downed sunflower crops considerably easier instead of a huge headache because the snouts are designed to get underneath the sunflowers to stand them back up for harvesting.

Planter and Harvest Equipment Tips for Canola

There are several planter equipment options that growers have in 2021 for canola. Seeding of this crop these days can be conducted with drills, airseeders or row unit planters. Whichever type of planting equipment is chosen however, care must be taken because of canola's small seed size and low seeding rate.

While row unit planters can have canola plates added, research and grower experience has shown that that the sensors in these systems don't do a great job at detecting seed in the tubes. Meghan Moran, Field Crop Canola Specialist at the Ontario Ministry of Agriculture and Food, also states that the use of drills tends to result in lower rates of canola emergence, so growers must keep that in mind for their targeted plant population.

Various canola research trials from 2020 show that using precision planters can tighten up row spacing and ensure highly consistent seed depth, boosting yield significantly compared to conventional air drills.

Staff at Oklahoma State University Department of Plant and Soil Sciences recommend that canola planting equipment does not cause deep furrows. Overall, seedbed conditions are more critical for canola establishment than for small seeded grains such as wheat. Ensure your planting equipment is seeding to a depth of 1" at most, as seeding any deeper may result in variable or slow emergence. Some recommend a seeding depth of ½" or even ¼". Seed should be covered but not compacted into the seed wall.

For harvesting canola, the Canola Council of Canada (CCC) explains that because the characteristics of a standing crop can be distinctly different from that of a windrowed crop, combine settings may be quite different in each situation. The cleaning system may be the limiting factor in maximizing oilseed harvest for a dry, swathed crop for example, but the rotor is more likely to be the limiting factor in a straight cut crop.

In general, for straight cut, ensure your reel height is not set too low or substantial loss will result. CCC advises starting with the same settings you use for swathed canola and then fine-tune from there. Also remember that green canola straw can use up combine power and overload the shoe if over-threshed.
In a lodged field, travel perpendicular to the crop lean to facilitate better pickup in both travel directions. Lastly, always use a loss pan in combining canola to accurately determine losses.

WHERE ON THE WEB: For a Combine Seed Loss Guide and troubleshooting tips visit: https://www.canolacouncil.org/download/130/agronomy-guides/2556/ccc_pami_combine_seed_loss_guide_2017-2.pdf

STORAGE and DRYING

Best practices and advances in grain monitoring technology.

The ability to store harvested canola and sunflower without any quality deterioration is critical to farmers' operations.

If you looked up grain storage expert in the dictionary you would most certainly find a photo of Dr. Kenneth Hellevang, NDSU Extension Engineer and Professor. He has provided information on storing sunflowers in previous editions and he says the mechanics with canola storage are similar to sunflower.

Hellevang stresses that what's important to remember is all grain drying fundamentals apply, no matter what method is being used to dry the grain. These fundamentals can be found in the NDSU Extension Service Publications written by Hellevang.

There are several important differences between drying sunflowers and other grains growers should understand, he says. The biggest being the grain's weight. "Sunflowers weigh less per bushel, so if you're accustomed to drying a heavier crop like corn or wheat, you'll find sunflowers dry quicker because there are less pounds of water that need to be removed."

In addition, canola and sunflower can be more volatile in storage than other grains grown due to the high oil content in the seeds. As a result, extra care must be taken to properly condition it in order to maintain quality.

Recommended Moisture Content

Oilseeds must be stored at 8% moisture or lower, says Hellevang. "The 8% is associated with a 40% oil content of the seed. Now, we're seeing oil contents closer to 45%, which is good from a marketing and oil production standpoint, but it also means the storage moisture content needs to be lower – somewhere between 7 and 8%," he explains.

Centaur sensors bring wireless monitoring of grain conditions so growers can protect their crops in the bin.

Growers could also focus on managing stored grain temperatures by cooling grain in the fall and winter. In northern regions, Hellevang says to bring grain temperatures down to just below freezing, roughly 30°F (-1°C). In southern climates, a realistic goal is 40°F (4.4°C) or cooler. For storing grain through warmer temperatures, such as the following summer, the target is to keep the grain as cool as possible, says Hellevang.

The stored grain temperature increases in the spring not only due to an increase in outdoor temperatures but also due to solar heat gain on the bin. Solar energy produces more than twice as much heat gain on the south wall of a bin in early spring as it does

Grain Storage and Drying Best Management Practices

Dr. Kenneth Hellevang, North Dakota State University

- ☐ Monitor
  - a. Temperature
  - b. Moisture
  - c. Insects
  - d. Mold
  - e. Carbon dioxide

- ☐ Check grain frequently to detect any storage problems early
  - a. Every two weeks until cooled
  - b. Every two to three weeks during winter
  - c. Every two weeks during spring and summer

- ☐ Manage: aerate and dry
  - a. Temperature
  - b. Moisture
  - c. Use sensors and fan controllers but remember that technology does not replace management
  - d. Maintain recommended long-term storage moisture content

	Moisture
Canola	8.0%
Sunflower (oil)	7-8.0%

  - e. Remember to verify that the moisture content measured by the meter has been adjusted for grain temperature. In addition, remember that moisture measurements of grain at temperatures below about 40°F may not be accurate. Verify the accuracy of the measurement by warming the grain sample to room temperature in a sealed plastic bag before measuring the moisture content.

- ☐ Cover the fan when it is not operating to prevent warm air from blowing into the bin and heating the stored grain and also keeps snow and pests out.

- ☐ Check vents – ventilate the top of the bin to remove the solar heat gain that warms the grain. Provide air inlets near the eaves and exhausts near the peak or use a roof exhaust fan. Bin vents can become blocked with frost and ice when the fan is operated at temperatures near or below freezing, which may lead to damage to the roof. Leave the fill and access door open as a pressure relief valve when operating the fan at temperatures near or below freezing.

- ☐ Turn fans off during snow/rain/fog

- ☐ Watch for mold

- ☐ Be aware of safety hazards associated with handling grain and apply recommended safety practices

during the summer. Hellevang recommends periodically running aeration fans to keep the grain temperature near or below 30°F until the grain is dried if it exceeds recommended storage moisture contents, and below 40°F as long as possible during spring and early summer if it is dry.

Recommended Airflow Rates

Sunflowers – natural air-drying for oil sunflowers requires an airflow rate of 0.75 cfm/bu for up to 15% moisture. The drying should start when outdoor temperatures average about 40°F, says Hellevang.

Canola – farmers need to limit the temperatures as the moisture content increases. Natural air-drying works well if you are doing it in September or October, but as we get late fall, early winter, the moisture holding capacity of the air is going to be gone, says Hellevang.

Monitoring With the Use of Technology

With today's technological advancements, monitoring the temperature and moisture contents of your grain is easier than ever.

Grain monitoring systems can help growers stay on top of moisture management, storage temperatures, grain conditioning, and more. Here's a quick look at some of the leading grain storage monitoring technology in the marketplace today.

TSGC, Inc.'s GrainTrac technology allows farmers remote bin monitoring and fan control. Readings are taken four times per day and farmers can receive real-time data and alerts via text or email.

OPI grain monitoring systems (OPI Blue and Integris Pro) allow you to monitor your grain temperature and moisture continuously. Farmers receive temperature rise alerts or rate of change alarms, which can indicate hotspot development and mold growth.

GrainTrac's technology allows farmers remote bin monitoring and fan control.

"FARMERS NEED TO MAKE SURE THEY'RE APPLYING THE FUNDAMENTALS TO WHATEVER CLIMATE THEY'RE WORKING IN,"

- DR. KENNETH HELLEVANG

GrainViz grain imaging technology, recently acquired by AGCO, gives growers and commercial operators advanced insight into the moisture content and conditions of the grain in their steel storage bins in order to proactively manage the quality and quantity of their stored grain. GrainViz will be sold by GSI and is expected to be introduced in 2021.

Centaur is a technology-based company that has developed several platforms using patented Internet of Things solutions. The company has a wireless solution for farmers and elevators that delivers real-time quality monitoring, spoilage alerts, aeration management and more. Centaur sensors bring wireless monitoring of grain conditions and real-time quantity. Data is available on the cloud in real time. Temperature, moisture, and CO2 concentration is reported, along with spoilage and quality analytics.

Balancing Act

While Hellevang agrees sensors can be useful, he also maintains that technology does not replace management. In general, Hellevang recommends growers conduct a thorough evaluation of stored grain conditions every couple of weeks when outside temperatures are warm. In the winter months, stored grain should be checked every two to four weeks, he says.

Techniques for achieving successful drying and storage in one region may not work in others, notes Hellevang. "The weather changes, and what we can do in Iowa is different from what we can do in North Dakota or Kansas. Farmers need to make sure they're applying the fundamentals to whatever climate they're working in," he says.

Ultimately, drying and storing sunflowers and canola is a balancing act. "We get paid on how many pounds we deliver, whether it's oil or sunflower seeds. The goal is to have it dry enough to store, but not too dry so that we start losing value in what we're delivering to market," says Hellevang.

THINK TANK

Our Nuseed team offers their insights into the challenges and future opportunities for the sunflower and canola sectors.

What are the key topics/issues that sunflower and canola growers are facing right now?

Garrett Driver: In most recent times it is in field pests. This last season saw a huge increase in flea beetle activity in canola. Sunflowers likely see most of their pests later in the season being downy mildew or sunflower head moth or seed weevil, all of which require chemistry to help manage.

Erin Gerdes: As the only commercial field crop native to North America, sunflowers have been fighting (the disease/pest) battle in the U.S. for much longer than other major crops. The advantage of this is a unique wellspring of available genetic disease resistance from domesticated sunflower's wild cousins. However, the disadvantage is that diseases and pests have also had much more time to adapt to these resistances, making genetic resistance to certain diseases nearly impossible to find and/or harness. We will continuously be seeking a balance between genetic and chemical disease management.

Jim Gerdes: There is always pressure from competing crops and commodity pricing. Major crops such as corn and soybean have huge investments in R&D that have resulted in these crops being more and more competitive in traditional sunflower growing environments. Being native to North America, a number of diseases, weeds, and insects have co-evolved with sunflower. In addition, the non-GMO status of sunflowers limits some of the tools available to breeders. This makes sunflower production more challenging than many crops.

Justin Ingalls: The oilseed market has been relatively stable and a bright spot allowing growers to earn a return on their investment while maintaining a balance to their cropping rotations, and utilization of their equipment and grain handling facilities. The market value and contract consistency sunflower and canola crops bring to growers' farming operations will be a topic of continued discussion as we ride the commodity pricing roller-coaster with other cropping options.

Daris Kampfe: Obviously, you have to maintain somewhat of a rotation from year to year. I feel this is going to be the case for a while. For instance, there are some growers that planted a few acres of sunflowers in 2020, who don't typically grow them, just because of the greater profit potential over their other main stay crops.

Jeremy Klumper: Sunflower acres grew in 2020 partly because sunflower contracts were good, and the other crops were poor. Now that corn and beans are on the rise, growers could back off sunflower acres. Fortunately, the industry had a positive year all-around, providing good momentum for 2021.

Clint Munro: Growers have to manage their business while dealing with a number of issues that are out of their control. This includes trade disputes which can impact demand, as well as the price relationship between each product. Another example is the access to technology, which can be delayed or prevented due to varying regulatory rules and approval procedures between countries. This can be relating to new technology such

as genetic plant breeding, or the potential ban of existing products such as certain pesticides.

Trygg Olson: With pricing of the big three seeing record highs in the late 2000s, it was easy to plant these crops. Since that time, we have seen the pricing of these crop prices decrease to extremely low levels, making it hard for producers to make a profit or at least break even. Sunflowers with multiple market opportunities, along with good stable contract pricing, allows growers the opportunity for a great return on investment. Sunflowers also help the soil by utilizing nutrients and moisture that have migrated down the soil profile.

Alison Pokryzwinski: Each of these crops has a different set of key topics and challenges. Research funding can sometimes be limited when the acres just aren't there. For example, there are countless university and public breeding programs for other crops such as corn and wheat, but only one public sunflower breeding program for sunflowers, which is the USDA-ARS based out of Fargo, N.D. Luckily, there are some great associations out there to help keep research going for these niche crops such as the National Canola Research Program (NCRP) and the National Sunflower Association (NSA). Having access to the public work that the USDA-ARS in Fargo does helps to complement our U.S.-based sunflower breeding program.

Roger Rotariu: Specific to these crops, most producers focus on the short-term production challenges.

Sunflower
Weed Control: As a non-GMO crop, getting good, cost-effective weed control is a challenge especially when faced with increasing herbicide resistance issues.

Disease control: Diseases like Phomopsis and sclerotinia continue to drastically impact yield.

Markets: Investment in producer services and market opportunities are limited. Growers need more opportunities and support to ensure the benefits of sunflower oil/meal/food are enjoyed by a broader audience.

Canola
Disease Control: Clubroot and new strains of blackleg are affecting yields in many areas of the prairies. Growers are looking for breeding companies to come with new strains of resistance.

Harvest Management: Growers are now understanding the many benefits of harvesting canola in one pass. As this trend continues, the onus is on breeding companies to develop new lines that are capable of maintaining pod integrity through combining.

Insect Management: With the risk of loss of different classifications of insecticides, such as neonicotinoids, risk of crop damage to insects such as flea beetles and cutworms are more pronounced.

Jed Wall: One of the key topics that growers are facing right now is what to plant in 2021. We had one of the best sunflower crops ever in 2020, so growers are excited to put them into their crop plan for 2021. One of their biggest decisions will be selecting a hybrid to match with their acres and how they will be marketing their crop this year. Right now, there are a lot of great contracts out, giving growers attractive options to choose from. At Legend Seeds, we are dedicated to helping growers with this choice by providing them with the right hybrids that will help them increase profitability.

What are the biggest challenges and how can they be overcome?

GD: From a production standpoint, I think it is pest management, which is the biggest

BIOS


Garrett Driver

GARRETT DRIVER

Garrett Driver was born and raised on a family farm in Northern California where his family still grows rice, wheat, safflower, milo, corn, sunflowers, melons and walnuts. He currently works at Nuseed Americas as the North America Supply Chain Manager where he oversees and manages the seed production process for sunflowers and canola from R&D through commercial sales.


Erin Gerdes

ERIN GERDES

Erin Gerdes is the Confectionary Sunflower Breeder and Manager of Breeding Nurseries based in Breckenridge, MN. She has been working in the sunflower industry in various capacities for more than 20 years and holds a master's degree from Bowling Green State University in Ohio.


Jim Gerdes

JIM GERDES

Jim Gerdes has a MS in Agriculture/Plant Breeding from South Dakota State University and a PhD in Plant Breeding and Plant Genetics from the University of Wisconsin-Madison. He has been with Nuseed for nearly seven years as the R&D Lead for Sunflower. Jim has nearly 30 years of experience in sunflower breeding, working with both oilseed and confectionary types.

challenge. Most integrated pest management programs require a multi-prong approach. It is best to look at chemistry and cultural practices that can be used to help overcome the threats and vulnerability for the specific insects or disease that need to be overcome.

EG: One of the biggest challenges facing the sunflower business is producibility of hybrid planting seed. Sunflowers, and especially confectionary sunflowers, have historically been notoriously difficult to produce. To combat this, Nuseed has implemented a comprehensive production research program designed to gather detailed information on hybrid parent producibility across a wide geographical range. The information gathered will allow us to determine the key traits involved in successful hybrid seed production, select optimal environments for production of specific material, and develop a performance baseline for future sunflower hybrid parent development.

Another challenge for growers and seed producers alike is disease. Nuseed has worked quickly to build a remarkably efficient and effective sunflower trait integration program focused on bringing advanced genetic resistance to major sunflower diseases from around the world to our hybrid portfolio, all with the use of traditional breeding methods.

JG: Insects, diseases, and weeds continue to pose challenges for sunflower growers. Several other key issues include bird predation and stand establishment. Nuseed has aggressively worked with disease resistance germplasm sources and herbicide resistance released by the USDA-ARS Sunflower Research Unit in Fargo to incorporate genes into our programs. There is a wealth of native traits available in wild relatives of sunflower, as well as other traits developed through non-GMO technologies that are allowing us to address many of these challenges.

JI: One of the biggest challenges we have is meeting the demand of sunflower oil consumers. Healthy, tasty components and stable structure of the edible sunflower oil continues to drive demand. Part of the solution is our Nuseed breeding program focused on additional high oleic sunflower hybrids coupled with herbicide tolerance.

DK: Growers are struggling right now to find "in crop" herbicide options. With other crops you have multiple herbicide options—not only in the same crop—but also in the same bag or variety in some cases. In sunflowers and canola your options are more limited. For sunflowers, we push the PRE's early season or maybe a fall application in some instances. This spring in some areas we had very limited rainfall 30 days after the PRE's were applied and they simply didn't work like expected.

JK: Sunflower — like other crops — need to have proper plant spacing. The National Sunflower Association does a survey every other year, and the number one issue on production fields is plant population — too low or too high. Making sure that planting equipment is properly set up for the seed size you have can make a significant difference to the final stand and yields.

CM: Weatherproofing the crop is also an ongoing challenge. Although crop genetics and management practices have significantly increased yield potential, being able to capture good yields when the season presents less than ideal conditions such as delayed planting or low rainfall will be achieved by continued collaboration between growers and businesses developing new technology.

TO: There are challenges for all crops that are produced today. As we look into sunflower, some of the biggest challenges facing producers early on is cutworms. Cutworms

Justin Ingalls

JUSTIN INGALLS

Justin Ingalls is the Commercial Sales Lead for Nuseed, based in Sioux Falls, S.D. He is responsible for all aspects of commercial sales efforts for Nuseed sunflower and canola in North America and is focused on their network of distributors with the purpose of helping them help their growers. He also leads the team of field sales representatives. A farmer in his spare time, he is a lifelong advocate of production agriculture.

Daris Kampfe

DARIS KAMPFE

Daris Kampfe has been a Field Sales Leader for Nuseed since November 2019. His territory is primarily the state of South Dakota, which works out well for him, since he lives in Pierre, S.D. His passion is for production agriculture and working with producers and dealers alike to provide quality seed solutions. His 10 years prior to Nuseed was in the agriculture industry, as well with the local co-op in Pierre, which is a CHS. In that time, he experienced many different levels of the ag retail business from chemical applicator, agronomy sales rep, to agronomy sales manager.

Jeremy Klumper

JEREMY KLUMPER

Jeremy Klumper is a North Dakota native and a Nuseed Sunflower Station Leader for North America and Europe. He grew up farming with relatives, which influenced his decision to search out a career in agriculture.

can be devastating as they feed above and below ground following the row. Looking at canola, in 2020 the flea beetle was a major challenge in the canola growing regions.

AP: Sclerotinia (commonly known as white mold) is a devastating disease that plagues both of these crops. Since sclerotinia effects so many crops across numerous regions, a coalition of commodity associations were formed to help understand and combat this devastating disease. Sclerotinia resistance is a quantitative trait that involves many genes and the environment, making it very difficult to breed for in both crops. To date, there is no actual resistance of sclerotinia in either crop, but there are hybrids available with increased levels of tolerance.

In canola, fungicides are effective in helping to prevent the disease in any given growing season. The challenge is understanding what the level of infection risk is and if it warrants a fungicide application. Several factors are often considered such as: environmental conditions prior to flowering, density of the canopy, yield potential, weather forecast, genetics, and presence of the disease.

Sunflowers on the other hand are not so fortunate. Sclerotinia can affect sunflowers one of three ways: headrot, mid-stalk rot or basal rot and all three involve different genes. While many fungicides have been tested to combat sclerotinia in sunflowers, none have been shown to have high levels of activity in preventing the disease.

RR: When asked this question, most answers would fall into the simple equation: Revenue – Costs = Profit. The simple fact is that farming has become a big business and the risk reward scenario is currently highlighting the significant financial risks all farmers are facing. To add to this equation, we now have the influx of the digital farm and environmental considerations.

Revenue: Farmers continue to be faced with inconsistent access to profitable markets. International tariffs have a negative impact as well as subsidies in competing markets that drive down global pricing. At this time, the global edible oils markets are strong, leading to good profitability, but continued work is required to continue to build new markets and a level competitive field. As focus continues on "output value" described as downstream crop value as opposed to "input value" which implies to production benefits, we will see farms producing more value added products for end use consumers which, in turn, creates increased market opportunities and value.

Costs: Fertilizer, seed, chemical and capital equipment are the major variable costs, which impact operations. Each is a response to separate geographical and environmental needs from weed control to moisture to accessing staff. Farmers have access to technologies, at a cost, but do they have access to the financing to cover their regional needs and take advantage of their opportunities?

Digital Farming: Most agree that future profitability from environmental credits to local management decisions will be impacted by the digital revolution in farming.

What do you foresee for the industry in 2021 and beyond?

GD: Change, opportunity, and growth. Agriculture is one of the proven resilient industries that no matter the geography, we find a way to adapt. I think better yielding varieties, with earlier maturity are on the horizon. Modern day agriculture — through advancement in technology — is only a smartphone away from the customers. For Nuseed, it is not simply looking for increased tons of grain or crop, but ultimately increased value in the products, which are being brought to market.

Clint Munro

CLINT MUNRO

Clint Munro was raised on a grain farm in Western Australia, where he completed a Bachelor of Business (Agriculture) at Curtin University. Within industry associations, Clint has held the positions of Director of the Canadian Oilseed Processors Association and director of the Australian Oilseed Federation. At Nuseed, Clint manages the supply chain for the omega-3 canola including grower production, crushing and oil delivery to end customers.

Trygg Olson

TRYGG OLSON

Trygg has been a Field Sales Leader for Nuseed for over three years. Growing up on a farm in the Red River Valley of North Dakota, he has been around agriculture his entire life. Before coming to Nuseed, he spent 20-plus years in the agronomy business. Olson says its been great to see the change to agriculture and farming practices over the years. He looks forward to seeing the new advancements of the future. Trygg's territory covers the northern half of Minnesota, North Dakota, and the eastern half of Montana, along with the addition of our Canadian Sunflower Business. He is based in in Carrington, N.D.

Alison Pokryzwinski

ALISON POKRYZWINSKI

A part of the Nuseed Team since 2014, Alison Pokryzwinski is the North American Sunflower Product Manager and Quality Commercial Lead. She has been working with sunflowers since 2006, when she began her career working as a Sales Agronomist in North Central South Dakota. After five years of making on-farm recommendations, Alison decided to go to graduate school at NDSU in Plant Science, focusing on sunflower breeding so that she could help be a part of the future success of sunflower growers.

These will range from higher oil content, healthier oil profile and wider adaptability into commodity markets to give customers more choices on how and where to market their grain even after planting. Focusing to bring value to the end user will continue to add value to the growers providing those products to market.

EG: It's definitely an exciting time to be working with sunflowers! Although it is an established field crop, we continue to learn more about the benefits of and new uses for sunflower oil and kernel every year. This knowledge — combined with the availability of advanced genetic disease resistance and the general propensity of sunflowers to tough it out where other crops may fail — has the potential to make sunflowers an increasingly competitive crop in a grower's rotation.

JG: Sunflowers have incredible diversity for many characteristics including oil, protein, and other output traits. The increased attention on healthier oils, plant-based proteins, and non-GMO foods put sunflower in a very good position going forward.

JI: The future is bright. Investments in breeding new hybrids with herbicide tolerances for weed pressures, disease packages that evolve to combat Mother Nature and increasing high oleic oil content are all signs that point in a positive direction for sunflower growers.

JK: Shoppers are more health conscious than ever and looking for food companies to provide them quality products.

CM: The overall industry looks promising for 2021, with strong demand for agricultural products and signs of the early stages of a market that is trending higher. Beyond 2021, I expect the oilseed industry to be influenced by sustainability pressures, including decisions on renewable fuels, which could increase the consumption of vegetable oils. The growth in specialty crops with output traits will provide growers additional opportunities to partner with companies and capture greater returns on their farm.

TO: Looking ahead to 2021/22, I foresee a bright future. With the pandemic and people starting to take their health more seriously. This may open many doors to sunflowers as a heart healthy non-GMO oil along with other proteins that can be utilized in other markets including, but not limited to, feeding of livestock. With the advancements in breeding there will be new and better options available to the producer to help increase their ROI. We have all seen major advancements in technology for agriculture especially over the past 15 to 20 years. It's going to be exciting to see what happens in the next five to 10 years and beyond.

AP: Continued support of associations and initiatives such as the NSA, NCRP and NSI are important to niche crops such as canola and sunflowers. I foresee companies such as Nuseed continuing to work alongside other sunflower programs like the USDA-ARS Sunflower Unit in Fargo to bring forward the best genetics possible for our growing regions.

RR: For Nuseed this answer is "Value Beyond Yield…" There are many "golden opportunities" with sunflower and canola that can be untapped for the future. From the plant characteristics of canola that lend itself to scientific discovery to the natural healthy oil properties and to wide growing capabilities of sunflower for uses such as cover crops. These crops are well-positioned in the North American market to answer current and future needs.

JW: I think the outlook of our industry is very bright. We are just beginning to see how molecular research is helping our breeding staff — not only speed up the process of bringing new hybrids to the marketplace — but also helping them screen for advanced downy mildew resistance, oil quality and resistance to certain diseases in a much quicker timeframe. I also foresee the industry continuing to improve on seed treatments and polymers. We have seen a huge improvement in seed treatments, polymers, and seed flowability additives in the past 10 years that have helped contribute to better stands and higher yields. There are also some huge advancements that will help us control tough insects, such as wireworms, that will be released in the very near future. If you have not grown sunflowers in the past five years, it is time to give it a second look.

Roger Rotariu

ROGER ROTARIU

Roger Rotariu is the North American Marketing Lead for Nuseed. Prior to joining Nuseed, he was the North American Strategy Lead and Canadian Marketing Director for Nufarm. With 30 years of agriculture experience in strategy, marketing and sales, Roger has experienced a significant amount of change in the farming industry. With time spent as a trader with Cargill to managing a small independent seed company to working with the Bayer canola team, Roger has many stories on the evolution of agriculture. The challenge of launching a brand-new seed company in Western Canada is one that he has eagerly undertaken.

Jed Wall

JED WALL

As Sunflower Business Development Lead at Legend Seeds, Jed Wall is responsible for leading and supporting Legend Account Managers and providing sales support to their dealer network for their sunflower and canola business needs. A native of Wahpeton, N.D., he received his Associate Degree in crop production sales and service from North Dakota State College of Science. He uses his 20-plus years of sunflower experience to help growers maximize yield opportunities and is driven to assist them in finding the best outlet for their crop to help them increase profitability.

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SEASON-LONG SUNFLOWER AND CANOLA ADVICE

From planting through to storage, these tips will keep you on track to reach your yield and profit goals.

PRE-PLANTING

1. Seed Selection

- ☐ Get familiar with the different sunflower markets: oil, confection and conoil.
- ☐ Markets play a central role in a producer's hybrid choices. Producers must choose the sunflower hybrid for the market they wish to enter as well as the specific region where it will be planted.
- ☐ Your local Nuseed sales representatives are an excellent source of information and guidance: they know the hybrids they sell, the markets they can be used for and the regions they are suited for.

2. Confirm Seed Selection

- ☐ Before purchasing seed, confirm seed selection with the processor or contract.

3. Rotation

- ☐ Crop rotation plays a large role in the crop's success.
- ☐ A minimum three-year rotation is recommended to reduce disease and weed pressure.
- ☐ For best results, rotate sunflowers with corn or cereals, and rotate out of canola, rapeseed, dry edible beans and soybeans, or other crops susceptible to the same diseases as sunflowers.

4. Fertilization

- ☐ After rotation, meeting the crop's specific nutrition requirements is important.
- ☐ Fertilize for realistic targets based on geography, soil type and annual rainfall. Fertilization timing and method is based on farming practices and may vary from region to region.
- ☐ Soil analysis and a fertility management plan will identify a field's nutrient needs. In some cases, over-fertilization can do more harm than good. For example, too much nitrogen can decrease yields and cause lodging.
- ☐ Remember, fertilizer should never be placed in the seed furrow.

5. Seedbed

- ☐ Proper seedbed preparation is required prior to seeding sunflowers. Whether using conventional-till or no-till, an even seedbed promotes uniform germination and emergence, and good plant stand establishment.

☐ In no-till situations, maintain clean fields with good chemical control to get plants off to a strong start.

PLANTING

1. Planter Maintenance

☐ Replace any broken or worn out parts annually. Focus on the in-furrow opening disc and seed tube wear that affect depth control.

☐ Check to be sure the seed metering device and seed tubes are capable of planting the larger confection planting seed.

☐ Use seed flow products, such as graphite or talcum powder, to mix with seed to improve seed flow. Recommendations vary by planter type, so refer to your operator's manual for the appropriate seed flow product.

2. Seeding Rate

☐ Nuseed recommends specific seeding rates for each Nuseed product. Recommended seeding rates are based on commercial grain characteristics desired by specific end use markets.

☐ Actual seeding rates may need to be adjusted according to soil type and available moisture. For example, in geographies where available moisture is limited, the seeding rate should be reduced by as much as 20% to produce desirable commercial grain.

3. Seeding Depth

☐ Confection sunflower seed generally requires more available moisture to germinate and emerge than oilseed sunflower due to the larger, thicker shell. Nuseed recommends planting into adequate moisture. Confection sunflower should NEVER be planted deeper than 2 inches.

4. Planting Speed

☐ Slow down! The large size and light test weight make confection sunflower more challenging to plant. Slowing the planter down allows the seed metering device to work properly and more accurately. Each planter is different but a good general starting speed is 5 mph.

5. Seed Placement

☐ Singulation (having one seed per location) is very important. Having multiple seeds in a location will create competition between plants resulting in smaller commercial grain.

IN-SEASON

1. Weed Control

☐ Nuseed recommends using a labeled pre-plant incorporated herbicide for early season weed control. In reduced tillage systems use a labeled burn-down herbicide. When possible select a herbicide tolerant hybrid to provide additional weed control options.

2. Disease Control

☐ Following the recommended crop rotations will result in overall reduced disease incidence. The presence of diseases varies by geography so mandatory application of fungicides is not required. In areas where sunflower rust *(Puccinia helianthi)* can occur use an approved fungicide applied at the R5.1 stage to reduce rust levels if the upper 4 leaves have a 1% infection level or higher.

3. Insect Control

☐ Where approved for, use of a seed applied insecticide will reduce below ground insects that damage emerging seedlings. Nuseed also recommends an in-furrow insecticide applied at planting to control chewing insects that can reduce stands. In some growing regions seed boring insects can be controlled during the bloom stage with approved insecticides. Always check local regulations before applying a herbicide, fungicide or insecticide.

HARVEST & POST-HARVEST

1. Desiccants

☐ This is a common pre-harvest aid that enables an earlier confection sunflower harvest. They reduce the potential losses due to bird depredation, lodging and weather-related quality issues. Check local regulations for a list of desiccants approved for use on confection sunflower prior to application.

☐ Ensure grain moisture is 35% or less before desiccant application. Check the moisture when the back of the sunflower head is yellow and the bracts around the head are brown. It is very important the crop is physiologically mature prior to desiccant application.

2. Equipment

☐ Proper calibration of harvest equipment is necessary to reduce foreign materials in the commercial grain, removal of empty seeds and to reduce cracking of the outer shell. Open the concave of the harvester and reduce the cylinder speed to reduce damage from the harvester.

3. Grain Storage

☐ Be sure commercial grain is clean from foreign material and dry prior to placing into storage. The moisture content should be 9% or less for long-term storage.

☐ Maintain the integrity of your confection sunflower crop. Do not mix confection sunflower with other sunflower or commercial grains.

☐ Monitor the commercial grain moisture in storage to avoid molds and spoilage that can affect grain quality and the price you receive from the buyer. Have your bins probed and tested regularly.

SEASON-LONG CANOLA GUIDELINES

PRE-PLANTING

1. Seed Selection

☐ Markets play a central role in a producer's hybrid choices. Producers must choose the canola hybrid for the market they wish to enter as well as the specific region where it will be planted.

☐ Your local Nuseed sales representatives are an excellent source of information and guidance: they know the hybrids they sell, the markets they can be used for and the regions they are suited for.

2. Confirm Seed Selection

☐ Before purchasing seed, confirm seed selection with the processor or contract.

3. Rotation

☐ A three-year rotation is recommended to reduce disease and weed pressure.

☐ No single crop rotation will suit all circumstances. The choice of which crops to grow, and in what sequence, depends to a large extent on the soil and climatic conditions and management skills.

4. Fertilization

☐ Fertilize for realistic targets based on geography, soil type and annual rainfall. Fertilization timing and method is based on farming practices and may vary from region to region.

☐ Canola generally needs nitrogen, phosphorus and sulphur fertilizer each year. A small percentage of fields will also benefit from a potassium application.

5. Seedbed

☐ A good seedbed will:

- supply enough moisture for germination and seedling establishment
- provide adequate warmth and aeration
- have minimal physical resistance for the seedlings to emerge
- be relatively free of weeds and disease
- offer some resistance to erosion

PLANTING

1. Germination/Emergence

☐ Factors such as soil moisture, soil temperature, fertilizer toxicity, seeding speed, seeding depth, seed placement, seed-to-soil contact, seed vigor, seedling disease and dormancy can affect germination and emergence.

2. Planter Maintenance

☐ For drills with independently mounted opener units: check that opener tips are in good shape, packer wheels are properly inflated, depth settings are the same for each unit, all tires are properly inflated, and frame height is in line with specifications in the operator's manual.

☐ For drills with openers on a fixed frame: front-to-back and side-to-side leveling of the frame is key. Tire pressure, hydraulic cylinder seepage, inner wing down pressure, bent shanks, worn discs and inconsistencies in opener wear are also important inspection points.

3. Seeding Rate

☐ Seeding rates should be adequate to achieve 50-80 plants per square metre (approximately five to eight plants per square foot). Yield potential tends to drop off with fewer than 30-40 plants per square metre (three to four plants per square foot).

☐ Seeding rates should be adjusted based on target plant density (desired plants per square foot or per square metre) and thousand seed weight. This will ensure that target plant populations can be achieved.

4. Seeding Depth

☐ For seeding, use a tillage tool that can consistently place canola at a ½" to 1" depth, cutting through residue and placing seed into soil with proper coverage and adequate packing to ensure good seed-to-soil contact.

5. Planting Speed

☐ Each seeding tool has a different ideal speed for consistent placement. And soil type, residue cover and moisture will mean different ideal speeds from field to field and year to year. Every field could be handled differently to find a balance between placement and speed.

IN-SEASON

1. Weed Control

☐ Early weed control. A combination of pre-seed weed control and one in-crop application before the four-leaf stage of the crop is often enough. Canola that gets off to a good start with weed competition reduced early in the season rarely sees an economic benefit to a second in-crop application of herbicide.

2. Disease Control

☐ Canola health can have a huge impact on canola yield and longevity, so effective scouting strategies, proper identification and accurate assessment of diseases is crucial to successful canola crops.

☐ Canola diseases such as blackleg, clubroot, sclerotinia stem rot, alternaria, aster yellows, root rot, seedling disease complex and verticillium stripe (amongst others) should be understood in order to be properly managed for a healthy, productive canola crop.

3. Insect Control

☐ A variety of pests and insects can have a significant impact on canola production. Since this impact can vary between locations, conditions and years, effective scouting strategies at the correct time, proper damage assessments and accurate economic threshold utilization will help you manage insects throughout the growing season for a successful canola crop.

☐ Some of the main pests to scout for include flea beetles (shortly after emergence), cut worms (early growth stages) and worm species such as Bertha Armyworm and Diamondback Moth (flowering through podding). An economic threshold is the level of infestation (pest insect density) at which lost yield (ex. due to feeding/insect pest damage) exceeds the cost of the chemical and its application.

HARVEST & POST-HARVEST

1. Swathing or straight cutting?

☐ Straight cutting can offer both benefits and drawbacks, depending on each grower's operation. It can be used as a tool to manage logistics at harvest, reduce labor, time and equipment requirements, and capture more yield, while it can also slow down the harvest operation and require an additional in-crop application.

☐ If you decide to swath, for optimal canola yield and quality, time swathing to at least 60% seed color change (SCC) on the main stem of the plant.

2. Equipment

☐ Research conducted by Prairie Agricultural Machinery Institute concluded that all headers tested could be used to successfully straight cut. While there were differences in ease of operation and small differences in loss, the largest predictor of loss along the header was the degree of shatter tolerance in the variety.

☐ The characteristics of a standing crop can be distinctly different from that of a windrowed crop. As a result, combine settings may be quite different in each situation. For example, the cleaning system may be the limiting factor in a dry, swathed crop, but the rotor is more likely to be the limiting factor in a straight cut crop.

3. Grain Storage

☐ Canola seeds have high oil content, so they can be more volatile in storage than the other grains grown. As a result, extra care must be taken to properly condition it in order to maintain its quality.

☐ Condition canola to 8% moisture content and less than 60 degrees Farenheit as soon as possible after harvest, for safe long-term storage.

☐ Monitor storage facilities closely within the first six weeks after harvest when respiration can be high. Regular monitoring should occur throughout the winter.

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