OREGON STATE UNIVERSITY EXTENSION SERVICE

CEREAL NEWSLETTER

March 2017

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A prickly problem:

Russian thistle populations in northeastern Oregon resist glyphosate

By Chris Branam, 541-737-2940, chris.branam@oregonstate.edu; on Twitter @OregonStateExt

For years, Russian thistle has challenged weed-warring growers. OSU weed scientists have now confirmed their worst fears – some populations of Russian thistle in the northeastern part of the state have developed resistance to glyphosate, one of the most widely used herbicides in the United States and around the world.

"This is not good news for growers," said Judit Barroso, a weed scientist at OSU's Columbia Basin Agricultural Research Center (CBARC) just outside of Pendleton. "This species is a serious threat to the sustainability of the wheat-summer fallow cropping systems of the inland Pacific Northwest. It is very often the predominant broad-leaved weed in many of the fields, and growers rely extensively on glyphosate to control it."

Russian thistle, also known as a tumbleweed, causes serious crop production problems in dryland small-grain producing areas in the United States, costing growers more than $50 million annually in control measures. Growers in the arid region of northeastern Oregon rely on repeated applications of herbicides such as glyphosate to control Russian thistle.

Glyphosate is the herbicide of choice for growers in the Pacific Northwest to control Russian thistle after harvest and in summer fallow and has allowed growers to reduce their tillage passes and reduce soil erosion as a result. "As growers and crop consultants work together with OSU researchers and extension agents to find the right mix of chemical and cultural control options – everyone wants to find solutions that don't result in losses of productivity and conservation practices that we have worked hard to gain," said Mary Corp, director of CBARC.

Ten years ago, a similar plant – kochia – became resistant to glyphosate in Kansas. Glyphosate-resistant kochia populations are now found in many other states. Other examples of resistant weed problems can be found in wheat-producing regions of Australia as well.

Now, Barroso is working with growers to delay the glyphosate resistance in Oregon by rotating different herbicides and using other weed control practices. "There needs to be an immediate transition to a more diversified approach for control of this troublesome weed species," she said.

Some of the reasons for poor post-harvest glyphosate effectiveness include dust, water stress, or generally poor growing conditions during application. However, reduced control may be the result of the evolution of glyphosate resistance in the species as well, Barroso said. Glyphosate is cheaper than other herbicide options and that has encouraged its repetitive use, she said, raising the likelihood of resistance.

In the fall of 2015, growers in northeast Oregon reported difficulties in controlling Russian thistle with glyphosate. The following February, OSU researchers randomly collected 10 Russian thistle populations on fallow fields in Umatilla, Morrow and Sherman counties.

Lab testing of the samples showed that three of the collected populations in Morrow County were glyphosate-resistant. Those three populations were likely treated with glyphosate much more often than the plants that were susceptible to the herbicide, Barroso said.

Russian thistle breaks off the stem when it dies and moves with the wind. As a tumbleweed, it can spread seeds over long distances, which may allow the glyphosate resistance to spread very quickly. Each plant, growing without competition, produces more than 50,000 seeds.

Barroso conducts research at CBARC in Pendleton. The recent finding is published online in the journal Pest Management Science.

Judit Barroso, weed specialist at OSU's Columbia Basin Agricultural Research Center, removing Russian thistle from a research plot.

Screening Russian thistle populations in the CBARC greenhouse.

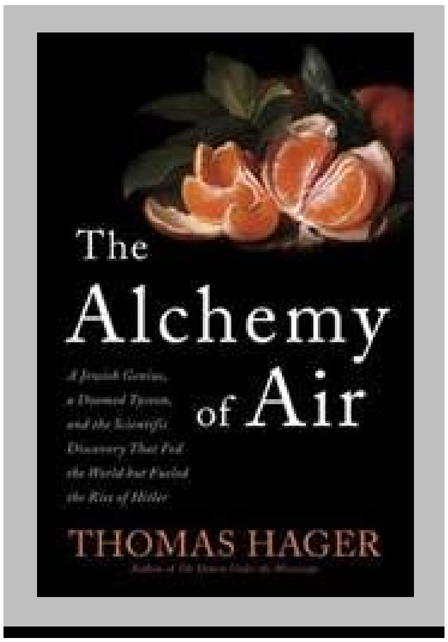
Detail of Russian thistle plants resistant to glyphosate 3 weeks after being treated with glyphosate at 4X and 8X.

Russian thistle infestation in wheat.

The Story Behind Nitrogen Fertilizer

By Don Wysocki, 541-278-5403, dwysocki@oregonstate.edu

An often asked, open-ended question is, "What would you list as the top technological developments in human history?" With some thought, each of us can come up with a strong list of candidates. What would you list? An often-overlooked technological development that has had profound impact of humans is the development of nitrogen fertilizer. Most people in agriculture know the importance of nitrogen and value what it does for crop production. In the general population, it is seldom a topic given the importance that it deserves. In my list of technological developments, it would be at the top. It is worth understanding why.



Nitrogen was discovered around 1772. The actual discoverer is not known. When nitrogen was first discovered as a gas, it was considered a "noxious, dead gas". Chemically nitrogen occurs in nature mainly as dinitrogen, N2 gas and it comprises 78% of the earth's atmosphere. Nitrogen is an inert gas, interacting with few substances at typical temperatures and pressures. Pure N2 nitrogen at room temperature only reacts with metallic lithium, with certain transition-metal complexes and with certain nitrogen-fixing bacteria often found on the root nodules of legumes like clover, peas and beans as well as other non-crop legumes.

The symbiotic nitrogen fixing bacteria rhizobia releases nitrogen in the form of NH3 as part of its metabolic process. The ammonia becomes ammonium - NH4+ when it dissolves in water. In this way, the roots of many plants can absorb it. However, from a crop production standpoint there is not enough nitrogen-fixing bacteria available to meet world needs. For more than 100 years, this deficit has been supplemented with a chemical process of fixing atmospheric nitrogen from the air, known as the Haber-Bosch (HB) process. (How many have heard this term? It is important!)

The development of Haber-Bosch is well covered in the book "The Alchemy of Air" by Thomas Hager. If you have not read this book, you should!

Briefly HB can be summarized a follows: At the end of the 19th century, Sir William Crookes, speaking to the British Association for the Advancement of Science, called on science to save Europe from impending starvation, stating that, "It is a chemist who must come to the rescue of the threatened communities." The problem was a lack of nitrogen. The two major sources of fertilizer nitrogen at the time were guano (bird droppings), which was largely depleted, and deposits of saltpeter (ammonium nitrate) in the Chilean desert.

The German chemist Fritz Haber subsequently developed an industrial process where nitrogen from the atmosphere and hydrogen under high temperature and pressure react to form ammonia.

The Haber process is carried out at temperatures of 400 to 500 ˚C at pressures of 100 to 1000 atmospheres (1 atm = 14.7 psi) 15000 psi (figure 1). In 1909, the company BASF, sent chemist Alwin Mittasch and engineer Carl Bosch to visit Haber and observe his new process. Despite some false starts, in 1912, the Haber-Bosch process became a viable way of producing ammonia-based fertilizer. For their pioneering work, Haber received the Nobel prize in chemistry in 1918 and Bosch in 1931 By about 1930 , the Haber-Bosch process was producing 43% of the world's consumption of nitrogen.

The principle feedstock for today's process is natural gas and nitrogen from the air (Figure 1). World production of ammonia by HB is slightly above 150 million tons. US production is about 35 million tons. This take place in 79 HB plants scattered around the country. Oregon has one plant located at St. Helens, producing about 100,000 tons annually

The real significance of HB comes in to focus in projecting the world population in its absence. Today the world population is near 7.4 billion. Without HB the projected world, populations would be slightly under 4 billion (J. W.; Sutton, M. A.; Galloway, J.; Klimont, Z.; Winiwarter, W. "How a Century of Ammonia Synthesis Changed the World". Natural Geosciences. 2008, 1: 636-630.). Any question on why it is on the top of my list?

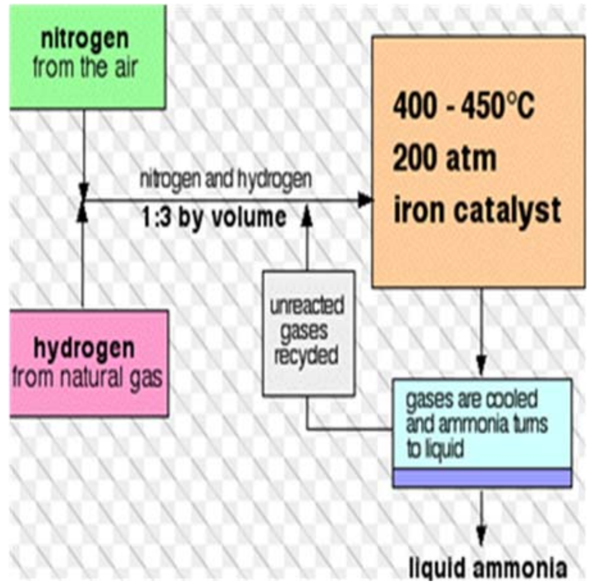


Figure 1 Schematic of Haber-Bosch.

Save the Dates June 13, 14, & 15

Pendleton and Sherman Station Field Days

In addition to the normal suite of wheat variety development and testing presentations by Bob Zemetra and the breeding team plus Mike Flowers, we will have topics that include:

- Breeding for soil borne Wheat Mosaic Virus resistance in winter wheat, When does fallow lose water to evaporation?
- A mixed cereal-oilseed crop sequences: What are the benefits from root growth, soil microbes at the root and microbial activity and nutrient cycling? What yield, water use and weeds can we expect?
- Update on wheat diseases and screening for resistance plus an activity where you can hone your skills at identifying wheat diseases.
- A presentation on stratification of soil pH and plant nutrients and how to treat for these conditions.
- Improving profitability and soil health while reducing nitrogen fertilizer use.
- Effect of biochar on soil health and wheat yield.
- Glyphosate resistance in Russian thistle and preparing a response to control resistant populations.

We plan to have pesticide and CCA credits for our Field Days. Be watching for more details in May. A field day at Hermiston Ag Research and Extension Center is also in the works for the afternoon of June 15th with a focus on irrigated wheat.

Soil-bourne Wheat Mosaic Virus Update

By Christina Hagerty, 541-278-4186, christina.hagerty@oregonstate.edu

The incidence of Soil-borne wheat mosaic virus (SBWMV) is on the rise in the Walla Walla Valley this year (14-22 in rainfall zone). Producers who have not previously had SBWMV in their fields have recently tested positive for the virus. Other producers who have previously dealt with SBWMV in patchy, localized areas are now observing symptoms in new fields, and observing widespread symptoms across entire fields.

Photo 1. Characteristic chlorotic patches in winter wheat caused by Soil-borne wheat mosaic virus.

The increased incidence of SBWMV this year could be due to early moisture in Fall 2016 (which is conducive for infection), the spread of SBWMV within the region, or perhaps a combination of these factors.

SBWMV affects fall-seeded small grains; the infection occurs in fall and first visual evidence of infection expresses in springtime. The mosaic virus is vectored by *Polymyxa graminis,* a soil-borne, fungal-like organism that moves through soil with water. In dryland conditions, patches of infected plants typically occur in low-lying wet swales that are conducive for the swimming spore stage of *P. graminis*. However, in particuiarly wet years, patches may occur anywhere in the field.

SBWMV symptoms are typically first noticed as chlorotic, yellowish patches (Photo 1). Within the chlorotic patches, plants are often stunted and display a "mosaic" pattern on leaf tissue (Photo 2).

If you suspect SBWMV, please contact me at the email listed above to help our efforts to map the SBWMV affected region. There is no cure for SBWMV, but identification of the virus is very important so that a resistant variety or blend can be planted in problematic fields the following crop year. As springtime temperatures rise, plants may recover or "grow-out" of symptoms; scouting now and collecting suspect plants for analysis before symptoms fade is important.

Photo 2. SBWMV resistant cultivar (top leaf) vs. susceptible cultivar (bottom leaf). Susceptible leaf displaying characteristic mosaic-like pattern.

With funding from the Oregon Wheat Commission, The Pendleton Cereal Pathology group is working on several objectives this season:

1. Quantify the impact of SBWMV virus on yield under dryland conditions.
2. Evaluate the efficacy of resistant and susceptible variety blends under high SBWMV disease pressure.

Please stay tuned as we work with OSU, WSU, and industry personnel to compile an extensive list of suitable SBWMV resistant varieties for the 14-22 in rainfall zone.

Director's Corner

By Mary Corp, 541-278-4415, mary.corp@oregonstate.edu

L to R: Rick Preston, Tom Sundin, David Maher, and Bob Johns play a card game of ONO-Resistant Weeds at the OSU cereal seminar in 2002.

After a wild and long winter, we are excited to be back in the fields working with growers and crop consultants across the region. Several developments around the normal culprits are occurring - strip rust, fertility, soil borne wheat mosaic virus, barley yellow dwarf virus and even some snow mold, which is rare in our region.

At last report, we were 130% of normal rainfall for the Pendleton Station, and over this weekend, as some people are thinking about spring break plans, there was no break in the rain showers that have continued. Karl Rhinhart, our CBARC farm manager, warned us 10 days ago that when spring does arrive, it is going to be a short one. So far we are still mostly waiting, so it must be getting shorter…

Spray application is an area where we have seen significant improvements in sprayer technology and equipment over the past 30 years. Drift reduction nozzle technology reduces the incidents of spray drift; reduced overlaps with computer guided steering; Weed Seeker technology allows us to just spray the weeds; chemical injections – so we mix at the nozzle what we need to spray our specific weeds - the improvements have had significant positive impacts to the economy and the environment. But we are facing serious challenges both short term, and longer term, in weed control.

Short term – we have a late wet spring where many acres need treated for weeds and volunteer wheat. As we move later into spring, broadleaf and sensitive adjacent crops like grapes and peas are emerging next to wheat and fallow fields. Care must be taken to insure that drift does not happen - even as the pressure to apply under margin weather conditions mounts. Remember the applicator, be that yourself or a hired commercial applicator, has the ultimate responsibility to make the call to "spray or not to spray." Make the right call!

Longer term - years ago, I created a card game called O-NO (very similar to UNO) to use at my extension workshop. Some of you might remember playing it. It was to teach ourselves about what class of herbicide we were using, and that multiple applications can lead to herbicide resistance. O-NO has now happened with Russian thistle resistance to glyphosate found in our region's wheat fields. Our weed scientist and extension agents are working closely with growers to find solutions – but we know that just switching to another herbicide is only a short term fix, at best. If we overuse any of our tools, be it an herbicide, a tillage implement or a match, we will find ourselves in another O-NO situation.

An integrated approach is our goal, where we understand the challenges and apply all of our best thinking to a solution that will serve us best in the long term is our goal. We will do this by working together. OSU Extension and CBARC staff welcome your calls and would like to come visit your operation in person – after the spring rush is over. Give me a call and we will schedule a visit.

Cheers, MKC

Umatilla County Extension Service
Oregon State University
2411 NW Carden Ave, Umatilla Hall
PO Box 100
Pendleton, OR 97801

UPCOMING EVENTS

MARCH

March 29
Spring Topdress Fertilizer Equipment Demo
Location: Mader-Rust Farm
Contact: Tim 541-571-4465 or Larry 541-571-4454

MAY

May 16
Wasco County Crop Hop
Location: The Dalles Auction Yard
Contact: Brian Tuck 541-296-5494

JUNE

June 13
Pendleton Experiment Station Field Day
Location: CBARC, Adams, OR
Contact: 541-278-4186

JUNE cont…

June 13
Pendleton-Ruggs Wheat Tour
Location: CBARC, Adams, OR
Contact: 541-278-4186

June 14
Sherman Experiment Station Field Day
Location: Moro, OR
Contact: 541-278-4186

June 15
Hermiston Ag Research & Extension Center Wheat Field Day
Location: HAREC, Hermiston, OR
Contact: 541-567-8321

June 22
Morrow Co. Dryland Crop Tour & Social
Location: Heppner, OR
Contact: 541-676-9642