Idaho Crops & Soils News

A newsletter for Idaho crop producers

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The goal of this monthly newsletter is to serve the best interests of Idaho crop producers. Correspondence and inquiries should be addressed to: Olga Walsh, Cropping Systems Extension Specialist, Southwest Research and Extension Center, 29603 U of I Lane, Parma, ID 83660, Phone: (208)722-6701 (ext. 218), Fax: (208)722-6708, Email: owalsh@uidaho.edu

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WHAT’S NEW?

High temperature stress in crops

The productivity of important agricultural crops is severely reduced if they experience periods of high temperatures, especially during the reproductive stages.


Although the controversial words “global warming” has been replaced by the term “climate change”, persistent high temperatures and draught are amongst the most observed extreme weather events globally.

Heat stress - a major form of abiotic stress - has an independent mode of action on the plant cells physiology and metabolism. Frequently, heat stress goes hand in hand with drought and salt stress. The following are among the most typical symptoms of heat stress:


Leaf abscission and senescence. Stay-green corn (left) has a genetically linked advantage to maintain photosynthetically active tissue even under heat and drought stress vs non stay-green corn (right). Photo credit: Mitch Tuinstra, Purdue Department of Agronomy.

Ratios of record highs to record lows for successive decades in the U.S.

A non-changing climate would have approximately equal numbers of record highs and lows, as observed in the 1950’s-1980’s. The last decade (2000’s) had twice as many record highs as it did record lows. Source: Meehl et al., 2009; figure ©UCAR, graphic by Mike Shibao.
Extreme temperatures, especially in June and July, could have had some very damaging affects on crops like barley, wheat and canola. “Idaho farmers are used to growing in dry conditions, but the added heat is just the latest complication,” Doug Finkelnburg, a University of Idaho Extension educator, said (http://www.agweb.com/article/idaho-heat-wave-could-hurt-barley-other-crops-NAA-associated-press/).

Idaho growers are also concerned about the prolonged above-normal temperatures that may have caused damage to certain crops, especially Russet Burbank potatoes and onions. The concern is that the stressed plants tend to shut down by going into survival mode instead of production mode, which ultimately reduces both yield and quality. Idaho corn and sugarbeet crops may have benefited from the heat, as these crops are much more heat tolerant. For list of heat-tolerant crops, such as peppers, okra, eggplant, and beans, please go to: http://media-cache-ec0.pinimg.com/736x/41/55/fd/4155fd5e5c88a350ab4cf3a09c08.jpg

In 2013, Washington State University researcher Kulvinder Gill has started a $16.2 million international effort to develop heat tolerant varieties of wheat. The goal is to have the first "climate resilient" wheat varieties developed and available to growers in by 2018. The team is utilizing fast-breeding which will enable the researchers to increase the heat tolerance in existing varieties.
The University of Idaho’s Jianli Chen, Wheat Breeder, Aberdeen Research and Extension Center, has been working on developing high-yielding, disease and drought tolerant wheat varieties
(http://extension.uidaho.edu/aberdeen/2013/04/aberdeen-wheat-breeding-and-genetics-program-2/)

Innovations that shaped precision agriculture revolution
This is a Part 1 (of 3) of this article that will feature several top technologies that revolutionized the way farming is done. The Part 1 will highlight Global Positioning Systems, Yield Monitors, Information Technology, and Variable-Rate Technology. In the August issue, we will focus on Automatic Steering and Planting Control, Active Crop Sensors, and Electric Conductivity.

Finally, in September issue, we will discuss Roundup Ready Crops, Weather Terminals, GIS Software, and Irrigation Control.

- Global Positioning Systems
Some of the most valuable and convenient technologies we routinely use today were initially developed by the military specialists. This includes the global positioning system (GPS). The agricultural use of GPS has began in the 1990’s, but the more widespread commercial use of GPs for agriculture occurred in 2000. Today, GPS is the foundation of precision agriculture. GPS enables the user to determine absolute or relative location of a feature on or above the earth’s surface. The position data is reported in the geo-referenced format (latitude-longitude).

- Yield Monitors
While several companies were working on developing the yield monitoring systems, the breakthrough came from Al Myers, who released the first yield monitor in 1992. Myers’s system is based on continuously measuring mass flow rate of grain in a harvester where an impact plate is disposed to be impacted by grain exiting a power driven conveyor. The force measuring apparatus generates

GPS guidance system in a tractor cab. Photo credit: http://cdn.phys.org/
an electrical signal proportional to grain impact force.

Al Myers, inventor of yield monitor. Photo credit: www.agleader.com

The yield monitors allow growers to accurately document the amount of spatial variability within fields which, in turn, shows the need to manage fields spatially.

- **Information Technology**

  Personal computers, the Internet, and computer programs designed for specific tasks on the farm replaced the slower, limiting and cumbersome pre-computer information exchange. Additionally, smart technologies incorporated into cell phones and other portable devices such as tablets, have truly revolutionized all aspects of precision farming and resulted in explosion of agricultural apps that cover everything from weather information access to fertilizer prescriptions. Novel technologies like Google Glass have enabled growers and consultants to have immediate access to many types of services from remote crop scouting and identification of potential pest/disease-related issues to data reporting and remote equipment repair and training. Brand new Google Glass-based app, Intelli SCOUT, aims to radically transform how farmers can utilize technologies to their advantage. This is achieved by enabling growers to take notes, videos, photos, dictation, local climate data, geo-tag content, share the data and even lookup crops, diseases, and insects within the expansive database.

Intelli ACOUT interface. Photo credit: www.glassalmanac.com

- **Variable-Rate Technology**

  Variable-rate technology (VRT) defines any technology that enables producers to vary the rate of product inputs. The VRT combines a variable-rate control system with the appropriate application equipment to apply inputs at a precise time and/or location. The components, such as a GPS receiver, computer, VR software, and controller are fully integrated, which allows to achieve site-specific application rates of inputs. A site-specific approach enables to address spatial variability by applying the products only where they are needed in a field. Varying the application of inputs (fertilizer, lime, seeding and pesticides and herbicides) can reduce input and labor costs, maximize productivity, and reduces the negative impact of over-application on the environmental quality.
Variable-rate seeding system adjusts flow to the hydraulic motor. The flow is proportionate to the drive speed, which determines the planting population. Photo credit: [www.pioneer.com](http://www.pioneer.com)

**Nitrogen Efficient Crops**

-with Kelli Belmont  
Research Technician, Cropping Systems Agronomy Program, University of Idaho Parma R&E Center

Nitrogen is an essential element for plant development. Comprehensive nitrogen management is important in achieving high yields crop yields. Application of commercial nitrogen fertilizers is often necessary in order to optimize yields. Plants absorb inorganic nitrogen in the forms of ammonium ($\text{NH}_4\text{-N}$) and nitrate ($\text{NO}_3\text{-N}$).

The use of legumes can also add valuable nitrogen to the soil for subsequent crops. Legumes are typically grown for their food grain seed, forage/silage, and as soil-enhancing green manures. Legume crops such as alfalfa, soybeans, beans, and clover contribute nitrogen to the soil.  


Alfalfa can add upward of 140 pounds of nitrogen per acre, whereas beans are only capable of fixing no more than 40 pounds of nitrogen per acre. The atmosphere is composed of 78 percent nitrogen in the gas form, but most plants are not able to use
atmospheric nitrogen. Legumes are able to convert atmospheric nitrogen into a usable form with the help of microorganisms (such as Rhizobia) that live in small nodules attached to the plant roots.

Both the plant and microorganism benefit from this relationship and the process is called symbiotic nitrogen fixation. The symbiotic nitrogen fixation between the microorganism and plant is a flexible relationship with many benefits. The microorganisms obtain food and energy from the root of the plant while converting atmospheric nitrogen to a form the plant can use. This fixed nitrogen is the same as found in some commercial nitrogen fertilizers.

Rhizobia are naturally present in the soil. Where the nitrogen is limiting, legume plants produce and release chemicals called flavonoids. The flavonoid release serves as a signal to the Rhizobia microorganisms that the plant is seeking bacteria for a symbiotic partnership. Once the Rhizobia are exposed to the flavonoids, they, in turn, release nodulation factor, which acts as a stimulant for rapid root hair growth. Next step is formation of “infection threads” which allows Rhizobia to enter the plant root cells via the root hairs.

Upon entering the plant root, the bacteria causes the root cells to divide more rapidly than normal, which results in formation of nodules. As the bacteria transform nitrogen from the air into ammonia, it can be used by plants as energy for growth and development. In turn, the plant provides the bacteria with nutritious sugars.

Legumes are typically able to fix between 40 and 80% of nitrogen they need for their growth and development. This means, that additional nitrogen is often not needed earlier in the season. The legume plants use the nitrogen from the soil before initiating fixation of nitrogen. Therefore, high level of nitrogen in the soil can even delay or inhibit the ability of the legume to fix nitrogen. Nitrogen supply from other sources is one of the most important factors affecting N fixation. Legumes can absorb mineralized N from manure and remove residual nitrate from the subsoil.
irrigation water, and shallow ground water, and fix less N from the air. The vast majority of fixed nitrogen is utilized by the plants and is not stored in the soil for next growing season. If the aboveground biomass of the legume is removed (e.g. for hay), the majority of the fixed nitrogen is also removed from the field.

So how do subsequent crops benefit from legumes’ ability to fix nitrogen? Legumes can be used as green manure, when the nitrogen-rich annual legume biomass, cut down in its prime at mid-bloom and incorporated into the soil. The nitrogen is added to the soil for other plants to use when the vegetation of the legume is decomposed by soil microorganisms.

Furthermore, about 15-30 percent of nitrogen is stored in the roots of legume plants. Tillage is not necessary to release legume nitrogen into the soil. Rotation with a nitrogen efficient crop such as alfalfa can enhance the nitrogen use efficiency for the following crop.

Nitrate losses due to leaching are low compare with annual crops. Although with a reduced stand of older alfalfa, nitrate losses are higher than when with a good stand. If the subsequent crop does not capture the nitrogen released from alfalfa that has the potential to leach as well. Legumes, such as alfalfa, make significant nitrogen contributions to cropping systems. With sound management, legumes reduce nitrate leaching and runoff, improves soil organic matter, and lowers commercial nitrogen fertilizer use in the following crops.

**GUEST CONTRIBUTION**

**Introduction to Quinoa**

- with Xi Liang
  Cropping Systems Specialist, Aberdeen R&E Center

The recent raise of quinoa (ke-no-ah) popularity worldwide has quadrupled prices at most retail outlets. Quinoa has been referred to as the “nutrient-rich superfood”, and it has become a hot food product, especially for high-end health food stores. Quinoa is high in iron, vitamins B and E, magnesium, phosphorus, potassium, calcium, and fiber. Not only quinoa’s protein content is much higher that other grains like rice, oats, barley, but it is one of only few plant foods considered a complete (whole) protein. This means that quinoa contains all nine essential amino acids, vital for dietary needs of humans.

Some of the proposed benefits of quinoa include: high antioxidant content, gluten-free, helps with bone, brain, colon, heart, teeth, and skin health. Some specific proposed benefits include help with lowering blood pressure, and helps to fight diabetes, may help to prevent breast cancer.
The increased consumer interest and demand for quinoa is compounded by the short supply of locally grown quinoa grain. Quinoa (Chenopodium quinoa) is a spring-seeded broadleaf cereal; it is native to the high plains of South America.

Traditionally, quinoa production has been concentrated in Peru, Ecuador, Bolivia, and Chile. The Pacific Northwest U.S. is becoming one of centers where quinoa-related research, breeding and production are booming. Quinoa is a pseudo-cereal, it can be prepared as any other grain, but technically, it is the starchy seed of an herby plant.

![Quinoa plant. University of Idaho, Aberdeen R&E Center. Photo by Olga Walsh.](image)

According to Kevin Murphy (grain breeder, Washington State University), quinoa has a great potential for high yields in many U.S. regions. His group is working on developing varieties adapted to varied climatic conditions of the U.S.A recent article by John O’Connell, Capital Press, “Quinoa gains a foothold in Eastern Idaho”, tells about growing interest of Idaho producers in alternative crops like quinoa. Several growers in Eastern Idaho are experimenting with quinoa as a rotational crop. Current anticipated cost for quinoa grain is $1 per pound, with the expected grain yield of about 2,000 pounds per acre. There are three main types of quinoa: white or ivory (the most common), red, and black.

Most common issues for quinoa growers are heat and late-season rain. Quinoa is very heat sensitive and temperatures over 95 F° can be found to kill the pollen, and prevent seed set. Persistent rains later in the growing season tend to cause extreme sprouting. Furthermore, currently, there are no herbicides labeled for quinoa, so weed control may represent a serious challenge for producers.

Research conducted in the mid-1980’s has shown that quinoa cultivars developed in Colorado for growing at elevations above 7,545 feet failed to produce at northern Idaho (elevation 2,600 feet). The evaluated quinoa varieties tested in Idaho were very indeterminate to late maturity. As a result, the plants did not produce viable seed and the crop has been damaged by fall frost. The study revealed the need for developing varieties of quinoa suitable for production in Idaho environment.

Xi Liang, Cropping Systems Specialist with the University of Idaho’s Aberdeen R&E Center, is incorporating quinoa into her cropping systems research in eastern Idaho. In spring 2015, Xi has established a rotation of four types of crops: spring wheat, sugar beet, quinoa, and cover crops (mustard and radish). The crops are evaluated in two
contrasting tillage systems - traditional and minimum tillage.

The study will help to answer some important questions in terms of disease, pest and weed management in quinoa production. Also, quinoa’s crop yield and quality will be accessed. Several physiological parameters, including root biomass and morphology, will be studied.

The expected outcomes of the project are: 1) Suggestions of weed control for quinoa; 2) Effects of pest control from cover crops; 3) Soil compaction alleviation from cover crops; and 4) Effects of tillage on crop root biomass and morphology.

Xi Liang, Cropping Systems Specialist with the University of Idaho’s Aberdeen R&E Center, demonstrated her research plots at a recent Cereal Field Day at Aberdeen, ID.

The research has encouraged a lot of questions and discussion from the field day attendees. Some of the questions were about the possibility of using quinoa as an animal feed stock crop, the methodologies for harvest and potential for evaluating products for weed control to be labeled in quinoa operations.

GET TO KNOW ID AG
Focus On Sugarbeets

Sugarbeets are one of the leading raw materials for sugar production in the United States. Beet sugar represents about 54% of the nation’s sugar production. Over 4.5 million tons of sugar are produced from beets grown on 1.4 million acres. Idaho ranks second nationally in production of sugarbeets Idaho Farm Bureau Federation; http://www.idahofb.org/index.php?action=commodities.sugarbeets).

Each year, approximately 175,000 acres of sugarbeets are planted in Idaho. Idaho growers harvest over 5.9 million tons of sugarbeets annually. The crop is processed and refined in Nampa, Paul, and Twin Falls, by the plants owned by a grower cooperative - Snake River Sugar Company.

Southern Idaho is the prime producer of sugarbeets. S. Idaho sugarbeet production has gross sales of over $140 million in 2014 (southernidaho.org; http://www.southernidaho.org/sites/southernidaho.org/files/SIEDOAgribusinessSpring%202015%20REV.pdf).

Weed control is a serious challenge in sugarbeets due to crop’s slower growing patterns. To emphasize the importance of the sugar industry for the state of Idaho: sugar industry provides 15,000 jobs, with the overall impact to the state economy is in excess of $2.
It is worth mentioning that 95% of all sugarbeets planted in the U.S. are genetically modified. Round-up ready sugarbeets (which carry a gene making them resistant to glyphosate herbicide) first became available to growers in 2005. Since then, due to continuous use of round-up chemistry to control weeds, the sugarbeet growers are facing a new serious issue – Round-up resistant weeds in their fields.

This issue has been covered in 2014 article by Sean Ellis, Capital Press: “Sugar beet growers deal with glyphosate-resistant kochia”: “Lab tests have confirmed that kochia weeds found in sugar beet fields in the Treasure Valley area of Idaho and Oregon are resistant to the weed killer Roundup.”

Healthy sugarbeet plant
Changing herbicide chemistries (using herbicides with different mode of action than glyphosate), regularly scouting fields and removing the resistant weed plants from the fields (especially prior to them setting seeds), and crop rotations are among solutions that are recommended to suppress the spread of the herbicide resistant weeds.

Common challenges in sugarbeet production include pest and disease-related issues like sugar beet cyst nematode, Aphanomyces root rot, Rhizoctonia root rot, powdery mildew, and curly top.

Sugarbeet roots affected by the cyst nematodes. The symptoms include localized stunted top growth;

Kelli Belmont, Research Technician, Cropping Systems, University of Idaho Parma R&E Center, educating sugarbeet growers on the methods to prevent and battle herbicide resistance in weeds. Amalgamated Sugar field day, July 23, 2015, Nampa, ID.

Oliver Neher, plant pathologist, Amalgamated Sugar Company LLC, Boise, ID, a sugarbeet field day organizer and presenter, has lead the discussion about sugarbeet variety testing, common diseases and current research carried out by Amalgamated Sugar in collaboration with the University of Idaho researchers.
nematodes cause serious stand and yield reductions. Affected plants have smaller storage roots severely branched with numerous fibrous roots. Caused by a parasitic roundworm, *Heterodera schachtii*.

Sugarbeets affected by the aphanomyces root rot. Caused by the soilborne oomycete *Aphanomyces cochlioides*. Symptoms include root lesions, scarring and distortion.

Leaves of sugarbeet plants affected by powdery mildew. Recurring fungal disease caused by *Erysiphe betae*. The initial symptom is wispy growth of white or gray filaments from the central point of the infected leaves have a dusty, “powdered” appearance (show up first on the older, lower leaves).

Sugarbeets affected by Rhizoctonia root rot. Caused by Rhizoctonia solani, a soilborne fungus, causes substantial sugarbeet loses. Symptoms include dark to black root tissues, cankers and cracks in roots.

Sugarbeet plants affected by curly top.

Curly top, a common virus disease transmitted by leafhoppers in a persistent manner (virus continues to exist within the insect’s body). The pathogen is confined within phloem tissues; phloem tissue necrosis, degeneration, and death of phloem cells clearly seen as dark concentric rings or streaks in cross-section of the taproot.