



FO  **C**

2015

**Fertilizer Outlook &
Technology Conference**

Jami Loecker

**Agronomy Service Representative
Syngenta**



**The Integration of Fertilizer,
Crop Protection and
Seed Technology
for Better Soil Health**

The Integration of Fertilizer, Crop Protection and Seed Technology

Enhancing Soil Health Through Farm Input Solutions

syngenta

Jami Loecker,
Agronomy Service Representative
Jami.loecker@syngenta.com

Classification: Public

Today's Topics

- Why a chemical company is leading the sustainable agriculture charge
- Rescuing farmland; Fertile soil is the foundation to sustainable agriculture
 - Farmland/soil degradation
 - Best practices
 - Measurement
- Technology implementation for performance and soil stewardship
 - Hybrid and variety breeding and selection
 - Protecting and improving roots
 - Pesticides
 - Data management

Definitions of sustainability are still evolving.....



- Meeting the needs of the present without compromising the ability of future generations to meet their own needs.

[Brundtland Commission on Sustainable Development](#)

- Triple bottom line: people, planet, profit.

[SustainAbility Think Tank](#)

- Reconciling environmental, social and economic demands.

[U.N. World Summit](#)

- Meeting the needs of the present while **improving** the ability of future generations to meet their own needs.

[Field to Market: The Alliance for Sustainable Agriculture](#)

The challenge: sustainably feed a growing population



870m

people go to
bed hungry

2bn

more people
by 2050

70%

of them depend
on farming

Every day the world's population increases by 200'000

Research shows divided views

Most agree that producing more food for a growing population will be one of the next decade's most important global challenges

There is openness towards using technology but a desire to minimize use of pesticides, GM seeds and fertilizer

Few believe that farming today is performed responsibly



Many believe that productivity increases will make farming more sustainable

The dilemmas we face



Most respondents said
more arable land
is needed

What impact will this have on rainforests and national parks?



Most respondents said
more water is needed

Agriculture already uses 70% of the world's fresh water withdrawals



Most respondents said
more human labor
is needed

Urbanization is causing increasing labor scarcity

The Good Growth Plan

**More food
Less waste**



**Make crops
more efficient**

Increase average productivity of the world's major crops by 20% without using more land, water or inputs

**More biodiversity
Less degradation**



**Rescue
more
farmland**

Improve the fertility of 10 million hectares of farmland on the brink of degradation

**Help
biodiversity
flourish**

Enhance biodiversity on 5 million hectares of farmland

**More health
Less poverty**



**Empower
smallholders**

Reach 20 million smallholders and enable them to increase productivity by 50%

**Help people
stay safe**

Train 20 million farm workers on labor safety, especially in developing countries

**Look after
every worker**

Strive for fair labor conditions throughout our entire supply chain network

One planet. Six commitments.

We have created solid foundations that make our commitments credible



Endorsement through Partnerships

Independent data collection

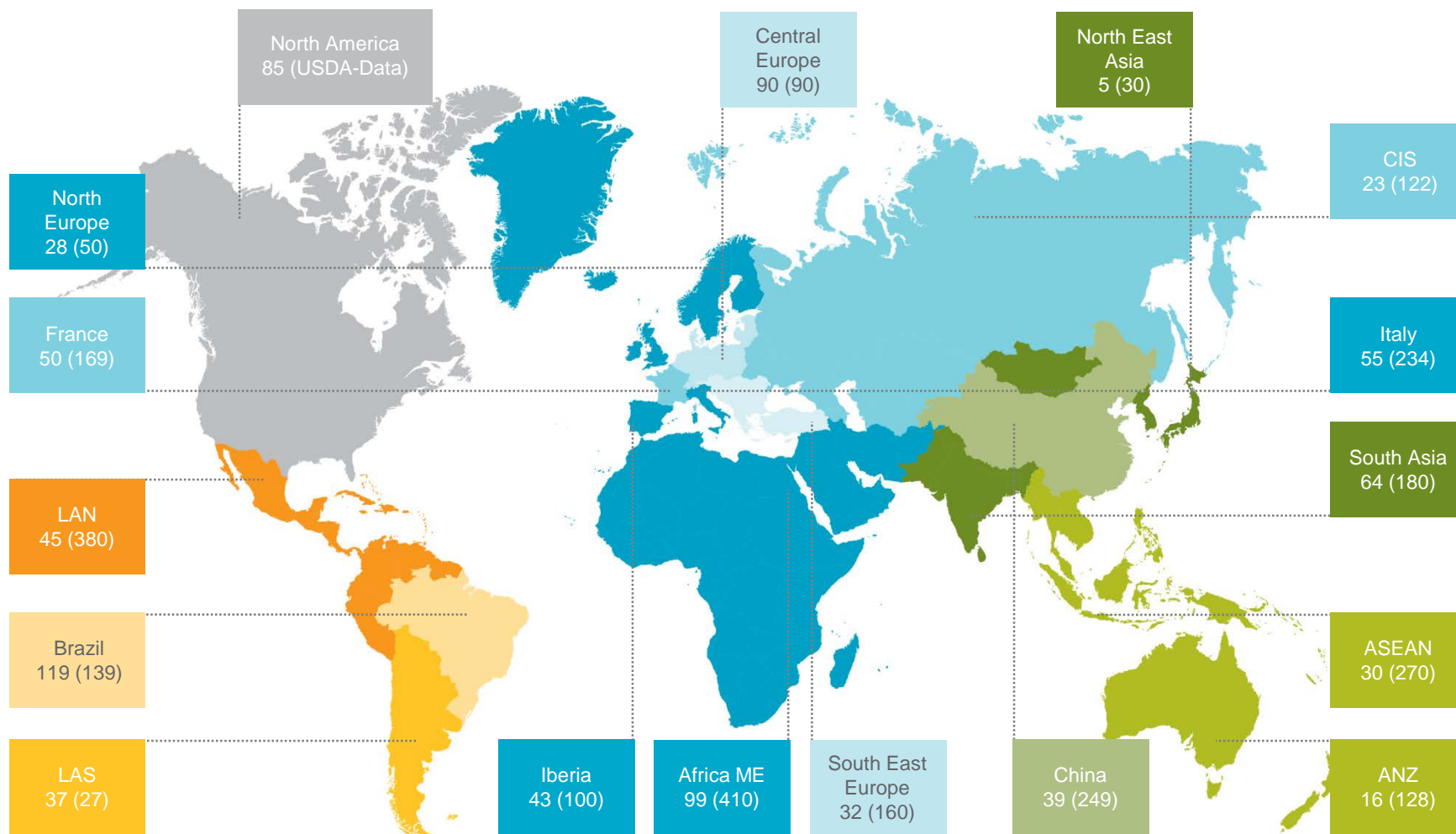


Best practices in sustainability reporting

Transparency, sharing, integration



Establishing a farm network in line with our strategic agenda



860 reference farms (2,738 benchmark farms)

Metrics

Sustainably feed a growing population

Challenge

More food,
less waste

More biodiversity,
less degradation

More health, less poverty

Commitment

Increase average productivity of the world's major crops by 20% without using more land, water or inputs

Improve the fertility of 10m hectares of farmland on the brink of degradation

Enhance biodiversity on 5m hectares of farmland

Reach 20m smallholders and enable them to increase productivity by 50%

Train 20m farm workers on labor safety, especially in developing countries

Strive for fair labor conditions throughout our entire supply chain network

Metrics

Land productivity t/ha

Nutrient efficiency t/kg N

Pesticide efficiency t/kg

Application efficiency t/# app

Water efficiency t/L

Energy efficiency t/joule

Farmland with field margins ha

Farmland with minimum tillage ha

Farmland with crop rotation ha

Farmland with sust. practice ha

Farmland with buffer strips ha

Species protection programs #

No. of smallholders reached #

Smallholder productivity increase

People trained #

Safe-use take up rate

Share of seed suppliers in fair labor programs

Share of L&G farms in fair labor programs

Monitoring on reference farms for each crop in each key commercial area compared to official benchmarks

Monitoring through on-farm surveys and census supported by third parties

Monitoring on reference farms and on-farm surveys, post-training surveys, and external audits

Make crops more efficient

Increase the average productivity of the world's major crops by 20% without using more land, water or inputs



Measurement

- Land productivity in terms of tons of production per hectare
- Nutrient efficiency through tons of production per kilogram applied
- Pesticide efficiency through tons produced per kilogram applied
- Application efficiency through tons of production per number of applications
- Water efficiency through tons of production per liter of water applied
- Energy efficiency through tons of production per joule used

Fertile Soil Is The Foundation To Sustainable Agriculture

- What if the world's soil ran out?
 - 60 years of topsoil left
 - 40% of soil used for agriculture is degraded or seriously degraded
 - Soil is being lost at 10 – 40 times the rate at which it can be replenished
- So What?
 - 30% less food over the next 20-30 years with a demand of 50% more food
 - Water management

Source: TIME Magazine

Rescue more farmland

**Improve the fertility of
10 million hectares of
farmland on the brink
of degradation**



Measurement

In order to measure our contribution to sustainable practices, we will collect data through on-farm surveys and censuses supported by third parties, and monitor the number of hectares of farmland with:

- Minimum tillage
- Crop rotation
- Sustainable soil management practices
- Buffer strips to reduce soil erosion
- Cover crops

Whole farm solutions approach

- Soil and residue management
- Biodiversity
- Plant nutrition
- Genetic selection
- Early season disease and pest management
- In season stress mitigation
- Protecting yield from late season stress and harvest losses
- Data management



Steps to start strong



Photo: Syngenta



- **Agronomics**
- **Hybrid/Variety selection**
- **High-performance seed treatment**

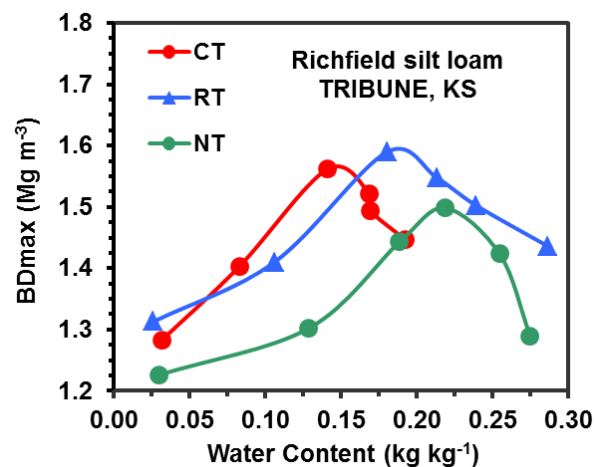
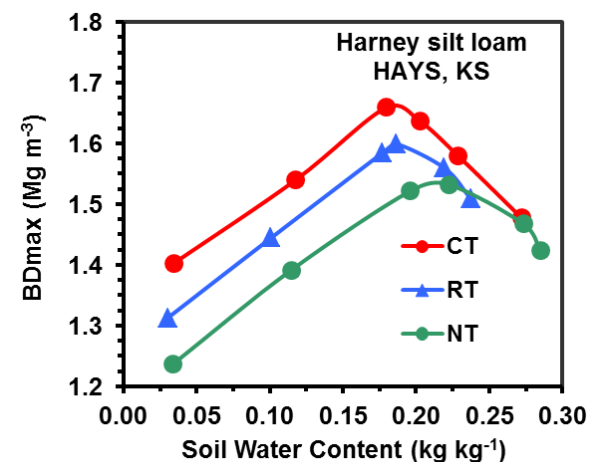
Soil stewardship

- Reducing erosion and run-off
 - Residue cover
 - Cover cropping
 - Buffer strips/multi-functional field margins
 - Wind breaks
- Tillage practices
 - No-Till
 - Conservation tillage
 - Conventional tillage
- Sustainable input applications
 - Fertility
 - Placement
 - Rate/varied rate
 - Pesticides



Soil benefits from conservation-till or no-till systems

- Reduced soil erosion
- Improves soil structure and biology
- Increases soil organic matter
- Improves water absorption
- Enhances crop growth during dry periods
- Saves energy with fewer machinery passes
- Reduces soil compaction



Blanco et al., 2009

Conventional Tillage

- Sometimes necessary
 - Weed control
 - Drainage issues



- Best Management Practices
 - Chisel plow rather than moldboard plow
 - Avoid steep slopes
 - Avoid highly erodible soil types
 - Utilize wind breaks to reduce wind erosion
 - Plant buffer strips
 - Timely tillage

Cover cropping in a conservation-tillage or no-till system

A cover crop is a plant grown to manage soil erosion, fertility, soil quality, water, weeds, pests, disease, biodiversity, and wildlife in an agricoecosystem (Le et al. 2000)

- Provide soil cover
- Prevent or reduce wind and water erosion
- May fix nitrogen
- Increase water infiltration and reduce evaporation (after termination)

Cover cropping management

- Expectations: soil improvement, nutrient management, feed
- Planting and termination plans
- Pesticide applications

Getting fertility right

Nutrient	Required to produce		Removed by grain		Harvest index %	
	<u>Corn</u>	<u>Soybeans</u>	<u>Corn</u>	<u>Soybeans</u>	<u>Corn</u>	<u>Soybeans</u>
	----- lbs/A -----		----- lbs/A -----		----- % -----	
N	256	271	148	194	58	72
P₂O₅	101	50	80	39	79	78
K₂O	180	180	59	75	32	42

- The harvest index % allows a nutrient use comparison of corn and soybeans of the net nutrients used to produce grain.
- Soybeans fix their own N but research indicates that extra N may be beneficial at yields ≥ 67 bushels per acre (bu/A).
- Soybeans are net users of K₂O compared to corn.

Harvest index % calculation: lbs/A removed by grain divided by the lbs/A needed to produce the crop.
 Source: Dr. Fred Below, University of Illinois.

Poor fertility compounds stress



Seed breeding and selection

- Ability To emerge In adverse soil conditions
 - Cool
 - Wet
 - Pathogens
- Offensive vs. Defensive hybrids and varieties
- Nutrient management through genetics
 - Nitrogen and potassium use measurements
 - Nitrogen use efficiency
- Trait selection in relation to soil environment
 - Rootworm
 - Soybean Cyst Nematode

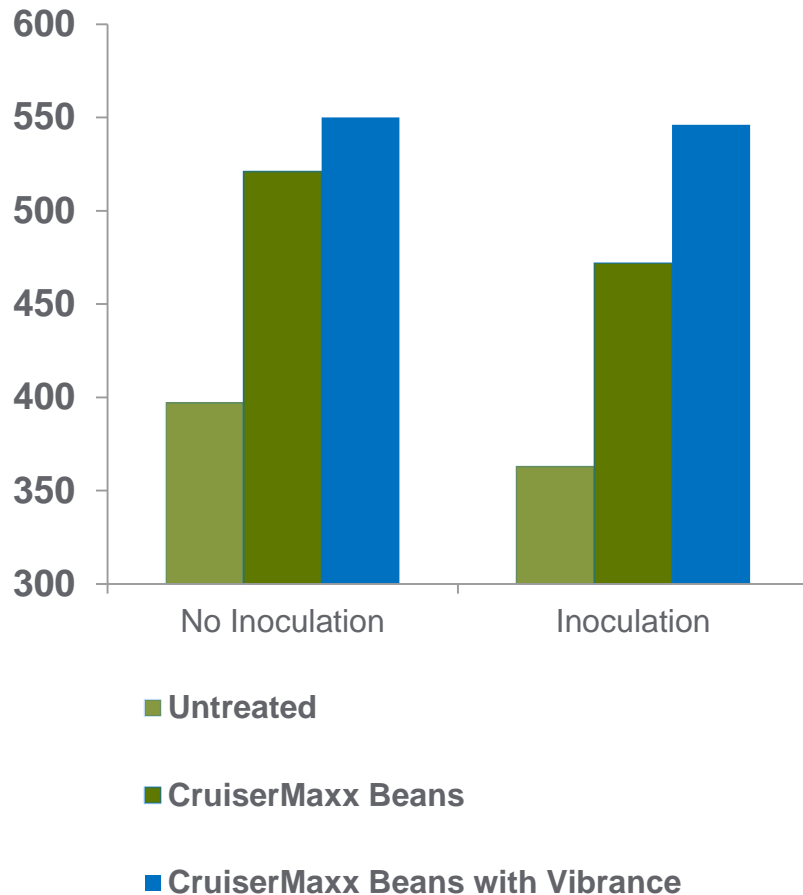
Nutrient management through genetics

- Higher yields result in greater nutrient uptake
 - In the last 50 years the N, P, and K removed through the grain in corn production has nearly doubled (Better Crops, Vol 97, 2013)
 - 100 bu corn x 1.3 lb N/bu = 130 lb N/Acre
 - 225 bu corn x 1.3 lb N/bu = 292 lb N/A
- Hybrid and variety variability for N and K uptake
- Need for more intense nutrient management for soybean production
 - Higher yields have depleted nutrients over time, leaving low levels for soybean production in the absence of additional fertilizer (Better Crops, Vol 97, 2013)

Growing and protecting a robust root system

- Seed applied fungicides
 - Early season fungal diseases
 - Pythium
 - Rhizoctonia
 - Phytophthera
 - Fusarium
- Seed applied insecticides/nematicides
 - Soil living and early season pest control
 - Corn rootworm, wireworm, seed corn maggots,
 - Corn nematodes, soybean cyst nematode
 - Bean leaf beetles, aphids, cutworms

Root forks averaged during trials



- CruiserMaxx[®] Beans seed treatment, a combination of separately registered products, increased root forks even more with added Vibrance[®] fungicide
- Performance consistent across trials with and without *Rhizoctonia* inoculation
- A healthy, robust root system will improve nutrient and water uptake

Classification: PUBLIC

Source: Syngenta Trials

Important: Always read and follow label instructions before buying or using Syngenta products.

Steps to grow strong

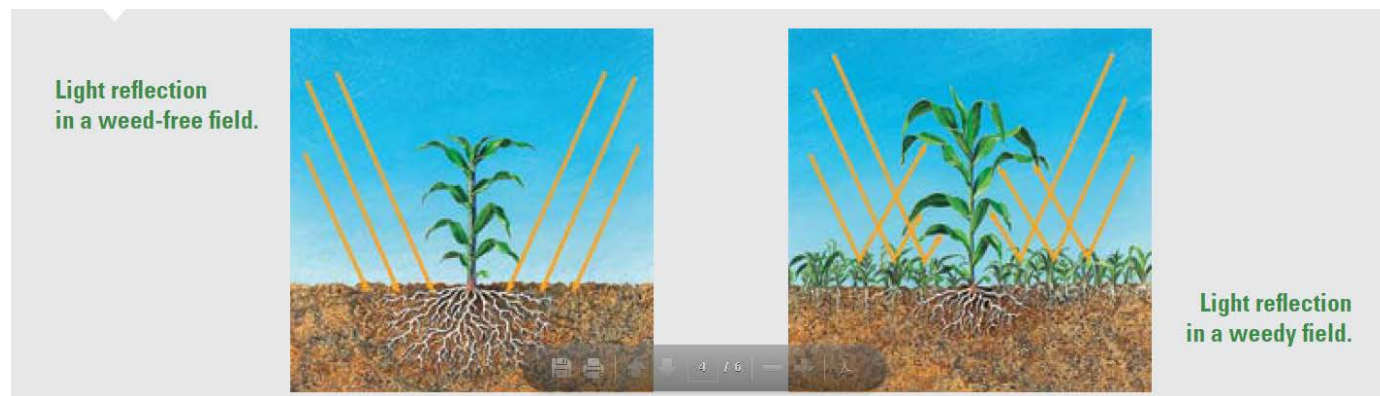
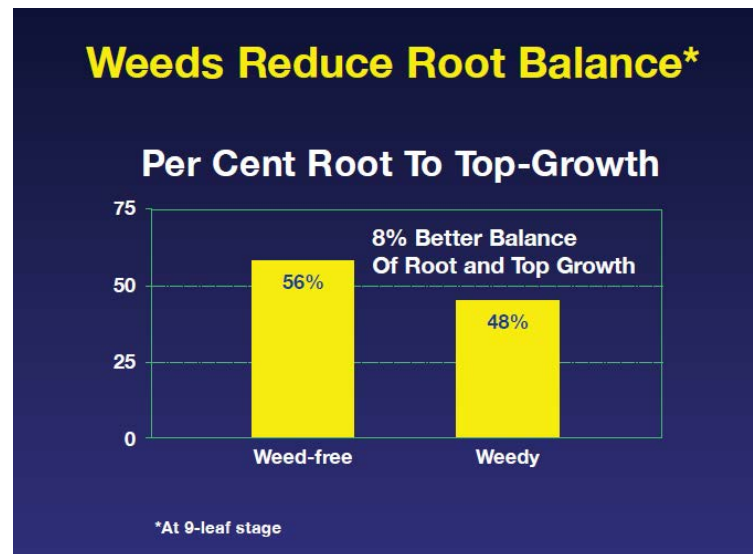


- Manage weeds throughout the season
- Control foliar insects
- Address in-season nutrient deficiencies

Weed control, protecting your investment

- Shade Avoidance Characteristics In Corn

- 17% taller
- 45% greater leaf area
- 40% greater dry leaf weight
- 12% higher top growth relative to root growth



Source: Swanton, FarmAssist Doc SCP 499-00196-A

Weed control, protecting your investment

Pounds/Acre of Nutrient Removal By Weeds

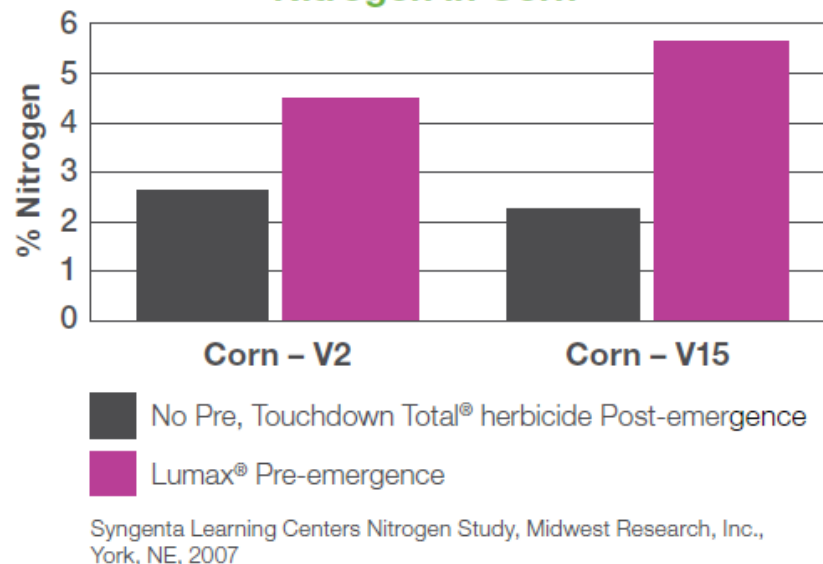
Weed Size At Termination

	2-4"	6-8"	2-4"	6-8"
N	16.27 lb	36.84 lb	3.56 lb	26.11 lb
P	1.6 lb	3.22 lb	0.31 lb	2.55 lb
K	16.16 lb	39.69 lb	4.29 lb	26.38 lb

Keystone Learning Center, 2007 Milford Learning Center, 2007

Weeds were a combination of giant foxtail, velvetleaf, waterhemp, common lambsquarter, and volunteer corn

Effect of Early Season Weeds on Nitrogen in Corn



- Early season N deficits in corn caused by weed pressure will remain season long, with the plant never recovering
- Protecting plants early ensures that they receive the most water, nutrients, fertilizer, and sunlight available
- 3 inch weeds, in 3 days, can remove 1 inch of water

Weeds are becoming harder to control



- Herbicide resistance is expanding
- Tough weed infestations in corn are up 50%*
- Farmers want better weed control**

*2013 Syngenta market research: cocklebur, kochia, marestail, morningglory, ragweed (common, giant), waterhemp (common, tall)

**2014 Syngenta market research

Weed control, best management practices for resistance management

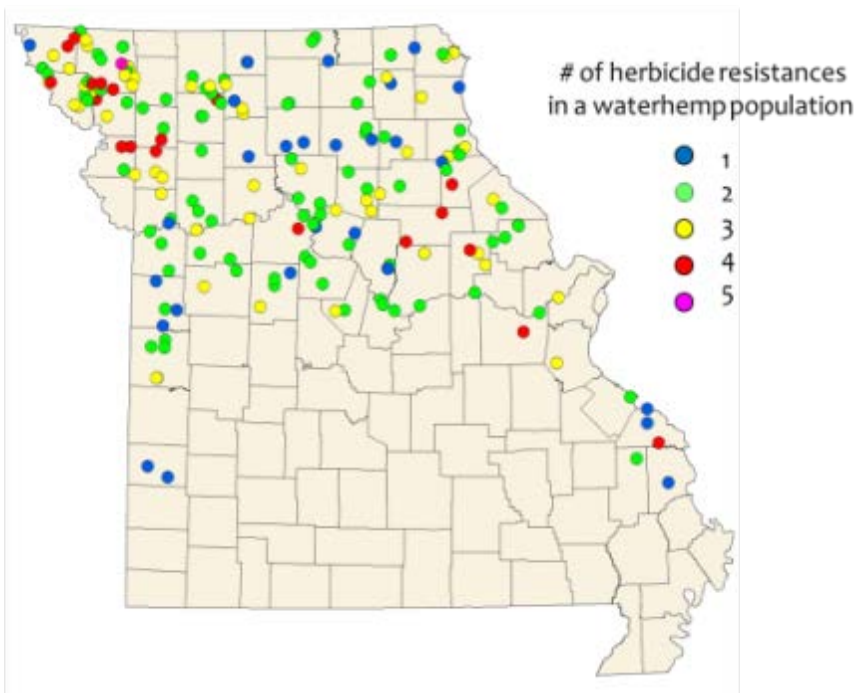
- Adopt cultural practices
- Utilize a diversified, residual herbicide program
 - Burndown
 - Pre-emergence
 - Post-emergence
- Use full, labeled herbicide rates
- Multiple, Overlapping Modes of Action



*Johnsongrass in soybean field, 2013
Photo: Syngenta*

Use overlapping residual herbicides, obtain multiple effective modes of action

Distribution of Waterhemp with Multiple Herbicide Resistances in Missouri (2013)



Source: Dr. Kevin Bradley - University of Missouri:
<http://ipm.missouri.edu/ipcm/2014/4/The-Situation-with-Herbicide-Resistance-in-Missouri-Waterhemp/>

- Populations resistant to auxins already exist in Nebraska
 - *Dicamba/2,4-D*
- Multiple mode of action resistance shows the need for increased use of:
 - Broad-spectrum, pre-emergence herbicides
 - Overlapping residual herbicide programs

Classification: Public

Important: Always read and follow label instructions before buying or using Syngenta products.

32 Trademarks are the property of a Syngenta Group Company.



Steps to yield strong



- Apply fungicides for disease control and plant stress management benefits
- Control insects
- Manage water to maximize grain fill
- Manage nutrients for maximum yield
- Harvest effectively and in a timely manner

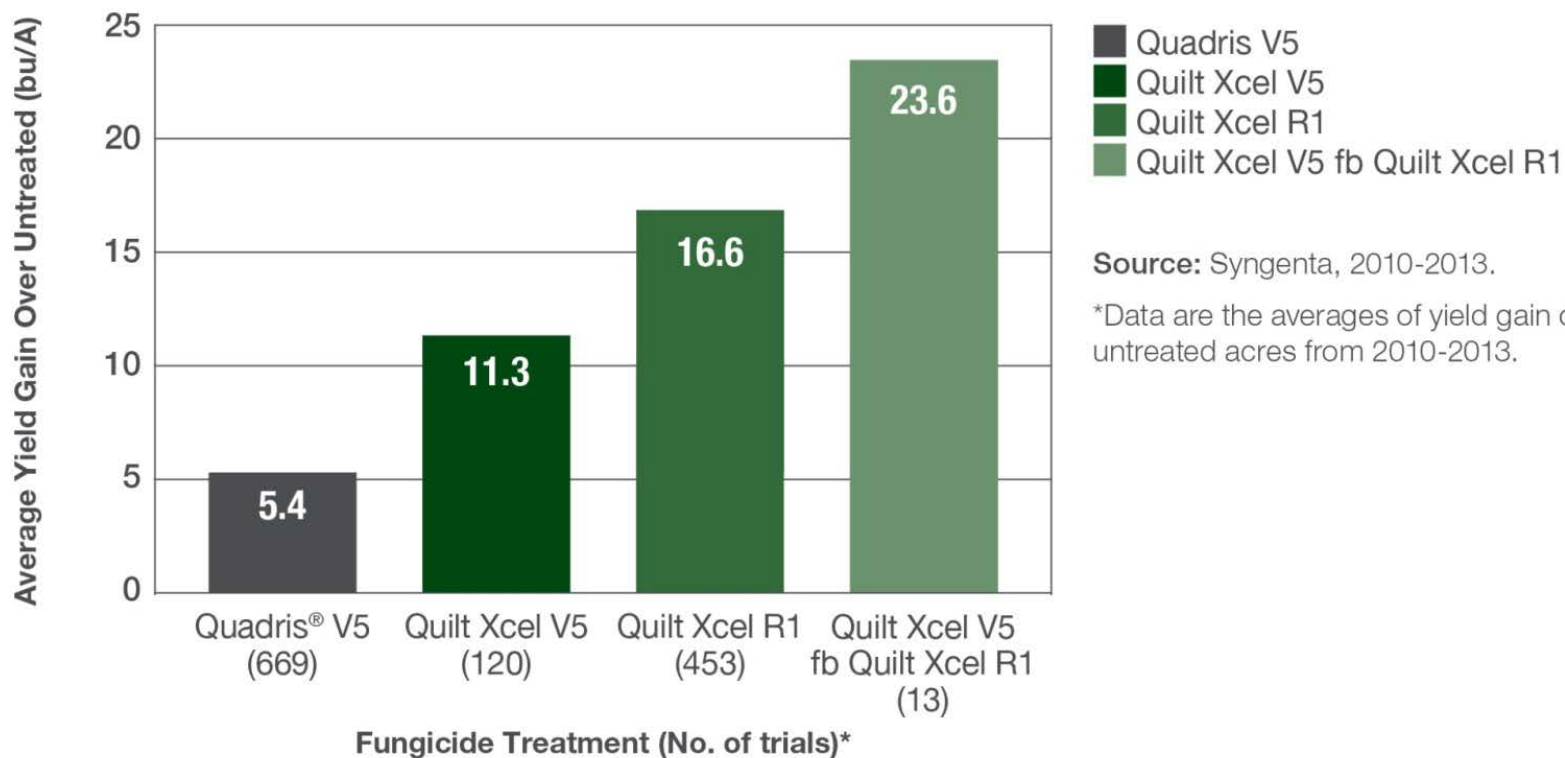
Why invest in a fungicide application?



- Fungicides control diseases and can help increase yield
- Crops can be infected with more than one disease
- Fungicides can provide plant stress management benefits

Quilt Xcel[®] fungicide helps elevate corn toward its full yield potential

Yield Benefits from Quilt Xcel[®] on Corn



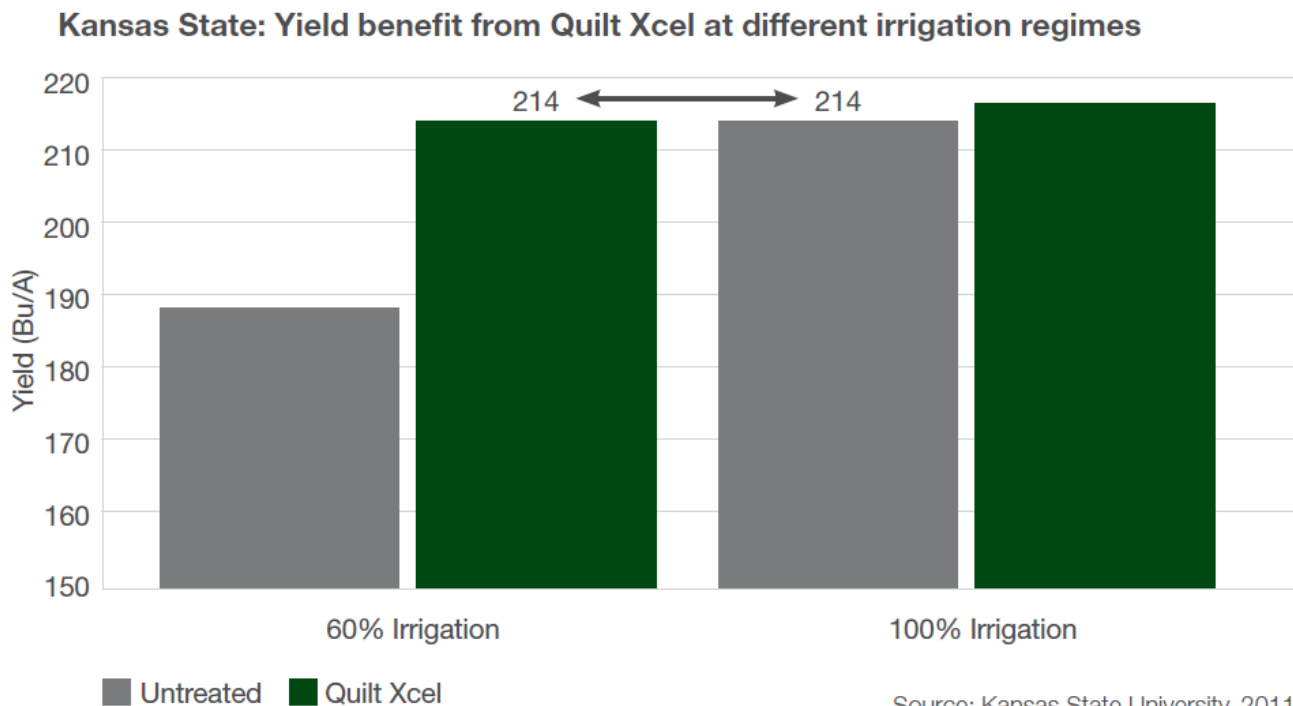
Product performance assumes disease presence.

Important: Always read and follow label instructions before buying or using Syngenta products.

35 Trademarks are the property of a Syngenta Group Company.



Fungicide, solution strategy



- Quilt Xcel enabled the corn to maximize yield potential where all factors were constant except the fungicide treatment and irrigation
 - Reduced water use
 - Equal fertilizer inputs

Product performance assumes disease presence.

Best practices for insect management

Scout



- Scout for insects and understand local economic thresholds
- Use broad-spectrum products with extended residual
- Know the beneficial insects
- Control host weeds

Product performance assumes insect presence

Manage nutrients for maximum yield



Foliar fertility



**Channel
Partners**

- High yield environments
- Scouting and Sampling
- Variable soil type fields
- Minimize trips across the field with compatible products

Omission trial data – 2012 to 2014

Dr. Fred Below, University of Illinois, Professor of Crop Sciences
(448 Syngenta-only data points across three years)

Omission trial factor	Yield increase
Fertility: At planting, banded fertilizer vs. no fertilizer	+4.6 bu/A
Variety selection: Offensive vs. defensive	<i>Data not shown due to complexities in local variety selection</i>
Row spacing: 20-inch rows vs. 30-inch rows	+2.7 bu/A
Seed treatment: Nematicide + insecticide + fungicide vs. fungicide only	+3.0 bu/A
Foliar fungicide and insecticide: Fungicide + insecticide vs. untreated	+3.6 bu/A

Avoid loss during harvest



- Monitor seed moisture levels
- Monitor plants for disease, insect damage, or other environmental stress that could affect standability
- Use proper combine settings

Syngenta Data Management



- Advanced Technology
 - An exclusive farm management software to better manage a grower's farm.
- Shared Risk Management
 - A unique, cost sharing opportunity with Syngenta to help mitigate risk in crop production.
- Outstanding Service
 - A dedicated group of AgriEdge professionals and support staff to help guide growers through the season.
- Product Portfolio
 - A comprehensive portfolio of products to address yield-limiting factors throughout the year

Sustainability and Data Management

- Since 2007, we have engaged with diverse groups working to measure agriculture sustainability

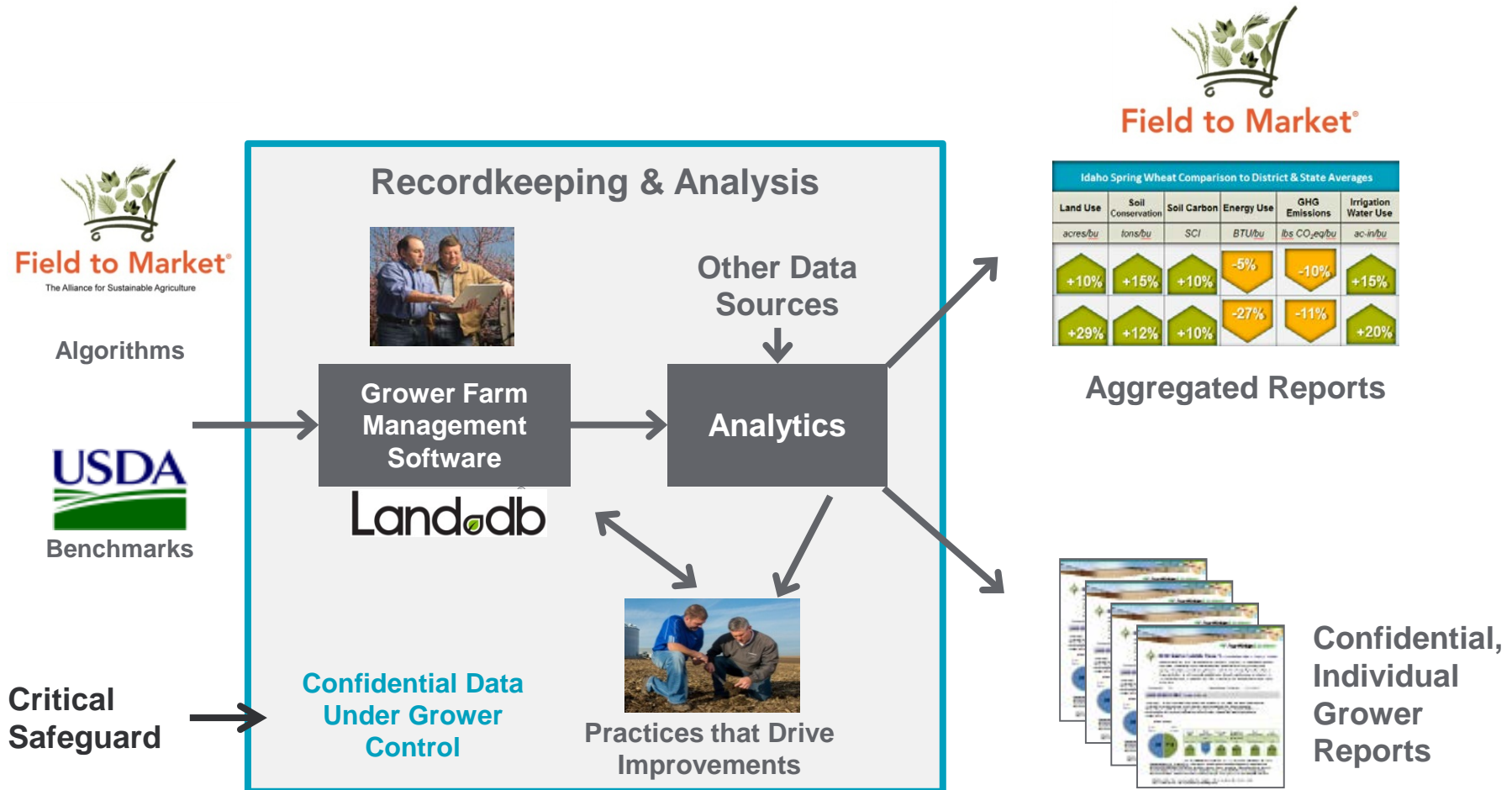


A broad stakeholder group → power of Field to Market

New members are joining on an ongoing basis



Documented performance on outcome-based sustainability metrics have value to growers and downstream companies



Land.db is a registered trademark of AgConnections, a Syngenta company

Local research and application

- Grow More Experience
- On Farm Trials
- Channel Partner Trialing
- University Trials
- Partnerships with Distributors
- 3rd Party Research
- Internal Research

SYNGENTA IS DRIVING INNOVATION

➔ 60+ innovations in current pipeline for U.S.



Local research and application

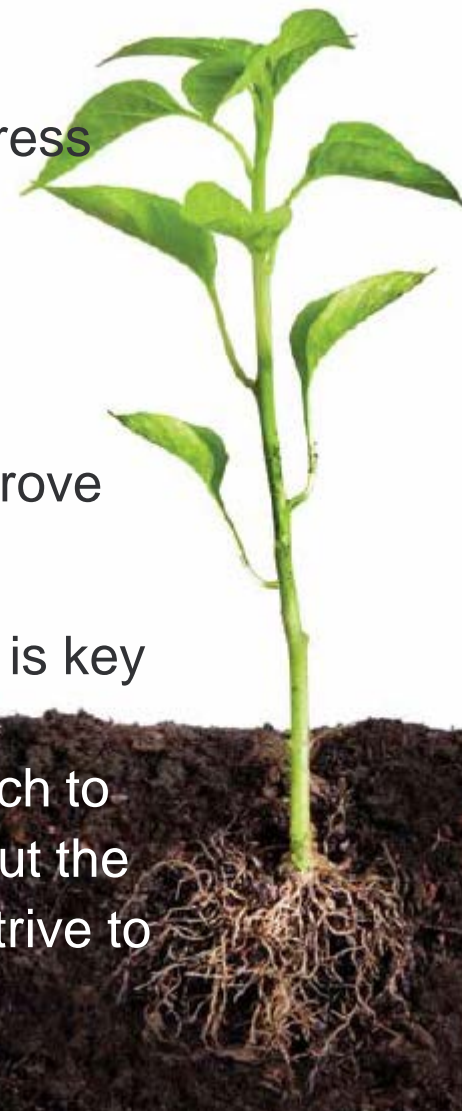
- Grow More Experience

- Designed to engage and benefit our customers and enhance their business
- Demonstrate locally relevant agronomic and leading Syngenta solutions to optimize yields
- Demonstrate Syngenta commitment to our Good Growth Plan and Sustainability
- Showcase Syngenta products and new technology portfolio



In Review

- Fertile soil is the foundation to sustainable agriculture, requiring improved soil stewardship
- Fertility is an imperative part of environmental stress mitigation
- Through proper inputs we can manage adverse growing conditions
- We must track and measure our progress to improve our sustainability
- A holistic plan with integrated cropping solutions is key
- The end user is demanding a sustainable approach to agriculture. It is our responsibility to educate about the sustainable techniques currently employed and strive to improve our practices



© 2015 Syngenta. **Important: Always read and follow label instructions. Some products may not be registered for sale or use in all states or counties. Please check with your local extension service to ensure registration status. Acuron, Besiege, Endigo ZC, Lexar, Lexar EZ, Lumax, Lumax EZ, and are Restricted Use Pesticides.** CruiserMaxx Beans with Vibrance is an on-seed application of CruiserMaxx Vibrance alone or with Apron XL. Clariva Complete Beans is an on-seed application of Clariva pn and CruiserMaxx Vibrance. Trivapro is sold as a combination of separately registered products: Trivapro A and Trivapro B fungicides. Trademarks are the property of their respective owners.

Besiege and Endigo ZC are highly toxic to bees exposed to direct treatment on blooming crops and weeds. Do not apply these products or allow them to drift onto blooming plants while bees are foraging adjacent to the treatment area.

Cautionary Statement Regarding Forward-Looking Statements

This document contains forward-looking statements, which can be identified by terminology such as 'expect', 'would', 'will', 'potential', 'plans', 'prospects', 'estimated', 'aiming', 'on track' and similar expressions. Such statements may be subject to risks and uncertainties that could cause the actual results to differ materially from these statements. We refer you to Syngenta's publicly available filings with the U.S. Securities and Exchange Commission for information about these and other risks and uncertainties including the "Risk Factors" in our Annual Report on Form 20-F. Syngenta assumes no obligation to update forward-looking statements to reflect actual results, changed assumptions or other factors. This document does not constitute, or form part of, any offer or invitation to sell or issue, or any solicitation of any offer, to purchase or subscribe for any ordinary shares in Syngenta AG, or Syngenta ADSs, nor shall it form the basis of, or be relied on in connection with, any contract thereof.