Monsanto and BASF Yield-and-Stress Collaboration Update

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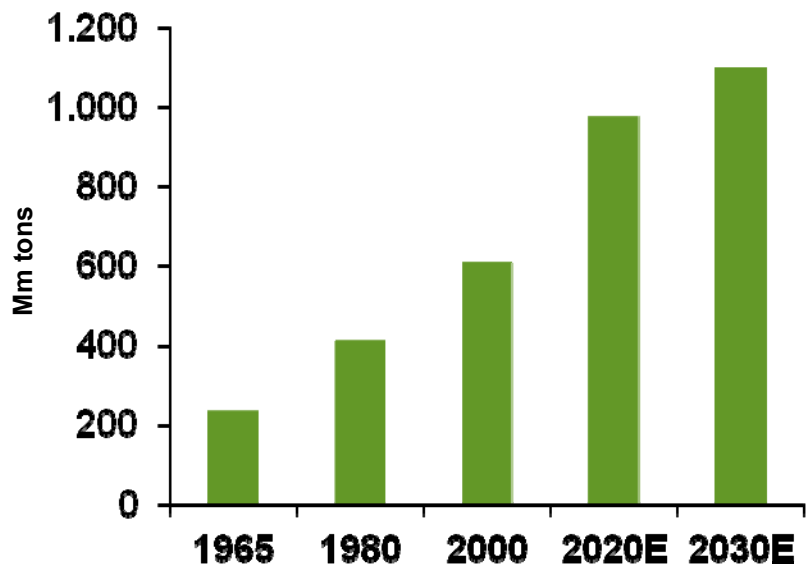
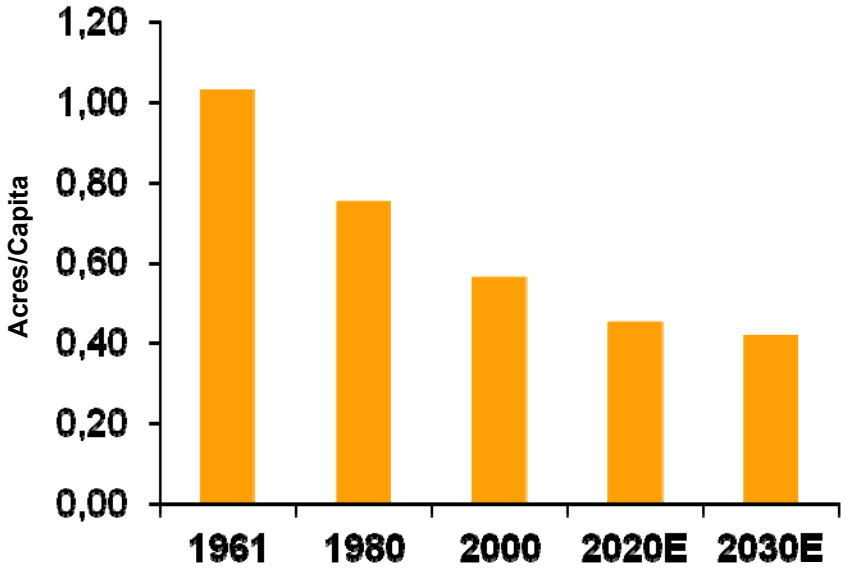
Global Demand Pull on Grain Becoming Even More Pronounced; Sustainably Increasing Productivity Per Acre Vitally Important

Stretching supply
Global corn demand[1]



Global corn consumption in MM tons

Arable land per capita
Worldwide[1]



Arable land in acres/capita

1. USDA PSD view database query for global corn and long-term estimates based on Global Insights projections

Opportunity for Agriculture Focused On Delivering More Yield With Less Inputs

A simple philosophy on opportunity:

More demand requires more	**Yield**
More yield requires more	**Innovation**
More innovation delivers more	**Growth**

Strategy: Collaboration Focused on Yield and Stress

Focus
- Joint Technology and Commercialization Collaboration
- R&D pipeline for yield-and-stress tolerance traits
- Crops: corn, soybeans, cotton, canola and wheat

Discovery
- Independent discovery programs at each company
- Lead genes go into joint development pipeline

Development
- Projects are jointly funded (50-50 cost sharing)
- Potential overall R&D budget of $2.5 billion

Commercialization
- Emerging products are commercialized by Monsanto
- Broad-licensing approach across Monsanto's commercial channels
- Value sharing: 60% for Monsanto, 40% for BASF

Monsanto's Collaboration with BASF Partners the Best Discovery and Research Platforms in Biotech Industry

Yield-and-Stress Pipeline	Discovery Phase	Phase I	Phase II	Phase III	Phase IV
Drought-tolerant corn family					
▪ Drought-tolerant corn					
▪ 2nd generation drought-tolerant corn					
Nitrogen-utilization corn family					
▪ Nitrogen-utilization corn					
Broad-acre higher-yielding corn family					
▪ Higher-yielding corn					
Broad-acre higher-yielding soybean family					
▪ Higher-yielding soybeans					
▪ 2nd generation higher-yielding soybeans					
Drought-tolerant cotton family					
▪ Drought-tolerant cotton					
Broad-acre higher-yielding canola family					
▪ Higher-yielding canola					
Broad-acre higher-yielding wheat family					
▪ Yield-and-stress wheat					

The colored bar associated with each project indicates which Phase that project is in. It is not intended to represent the relative status of the project within a particular stage.

January 2011 Phase Advancement/Additions

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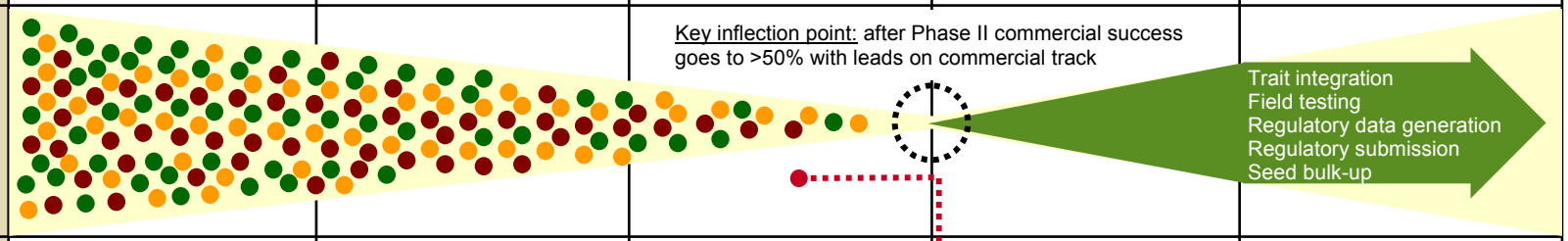
Collaboration Dedicates More Resources in Earlier Phases to Scale Up In-Crop Field Testing and Generate More Data

Biotechnology pipeline process overview

	Discovery Gene/trait identification	**Phase I** Proof of concept	**Phase II** Early development	**Phase III** Advanced development	**Phase IV** Pre-launch
Average duration[1]	24 – 48 months	12 – 24 months	12 – 24 months	12 – 24 months	12 – 36 months
Average probability of success[2]	5%	25%	50%	75%	90%
Genes in testing	Tens of thousands	Thousands	10s	<5	Pre-commercial product
Key activity	High-throughput-screening Model crop testing	Gene optimization/ crop transformation	Trait development Pre-regulatory data Large-scale transformation	Trait integration Field testing Regulatory data generation	Regulatory submission Seed bulk-up Pre-marketing



Applied lessons: pipeline process on yield-and-stress

- Increasing amount of testing done in the field versus the lab
- More resources put behind field work in early stages
- Average development cycle on the high end of duration estimates because of complexity of traits

Increased prominence of Phase II work

- Scale up in-crop, in-field testing for yield and stress in Phase II to generate more data on gene-by-germplasm interaction

1. Time estimates are based on our experience; they can overlap. Total development time for any particular product may be shorter or longer than the time estimated here.
2. This is the estimated average probability that the traits will ultimately become commercial products, based on our experience. These probabilities may change over time. Commercialization is dependent on many factors, including successful conclusion of the regulatory process.

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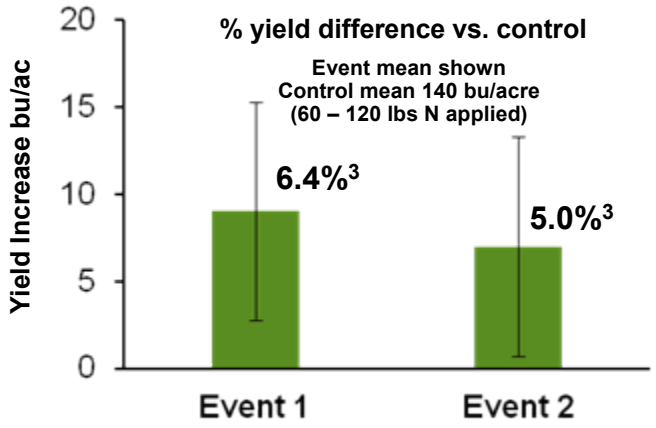
Nitrogen-Utilization Corn Advanced Into Expanded Phase II Testing; Network Established For Critical Evaluation of Leads

2010 nitrogen utilization testing: Top nitrogen lead performs across two years of testing under nitrogen limitation



Events mean demonstrate a >5% yield increase versus control

Yield efficacy demonstrated across 17 environments in two years of testing under reduced nitrogen treatment

Error bars – LSD 10

- Project advanced into expanded Phase II testing to develop several years of data showing performance of the gene across environments, and across germplasm backgrounds
- Developed a multi-location managed nitrogen testing network to enable rapid identification and development of future products

1. Acre opportunity reflects acres where technology fits at Monsanto's 2010 share in respective crops
2. 2020 value reflects gross sales opportunity of trait family in launch country in year 2020
3. significant at $p \leq 0.1$

Nitrogen-utilization corn: Lead project (Status: **Advanced Phase II**)

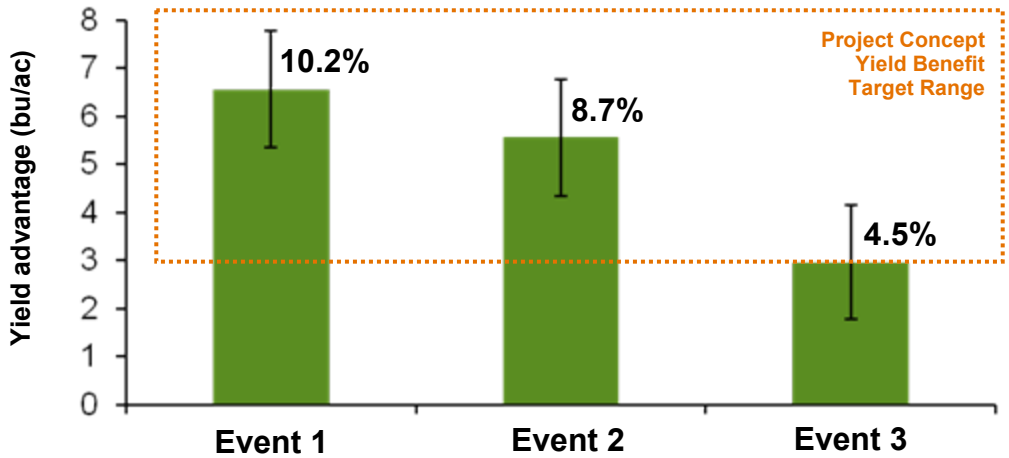
Family value considerations:

- Launch-country acres[1]: 45M – 55M
- 2020 value[2]: $250M – $500M
- Targets ways that corn plants can use nitrogen more efficiently, exploring the potential to boost yield under normal nitrogen conditions or to stabilize yield in reduced nitrogen environments

Nitrogen field testing: Jerseyville, IL- June 2010

Second-Generation Higher-Yielding Soybeans Advanced; Designed to Enhance Yield Over First-Generation Technology

Second-generation yield lead efficacy demonstrated in two consecutive years and across 14 environments in 2010 with comparator as parental line without gene



14 locations, 2 reps

- Consecutive years of consistent increased yield performance of gene across multiple environments
- Field testing data demonstrates that successive traits create an additive yield effect within project concept target
- This is a second-generation trait intended to be stacked with first-generation and designed to provide a step-change in yield potential over first-generation technology

Higher-yielding soybeans: Second-generation project

(Status: **Advanced Phase II**)

Family value considerations:

- Launch-country acres[1]: 35M – 45M
- 2020 value[2]: $250M – $500M
- This project is aimed at boosting yield potential of soybeans through insertion of genes designed to increase soybean yields

Second-generation project concept testing:

Stacks of first-generation with second-generation higher-yielding soybeans show up to 7 percent yield improvement over first-generation higher-yielding soybean trait

1. Acre opportunity reflects acres where technology fits at Monsanto's 2010 share in respective crops
2. 2020 value reflects gross sales opportunity of trait family in launch country in year 2020

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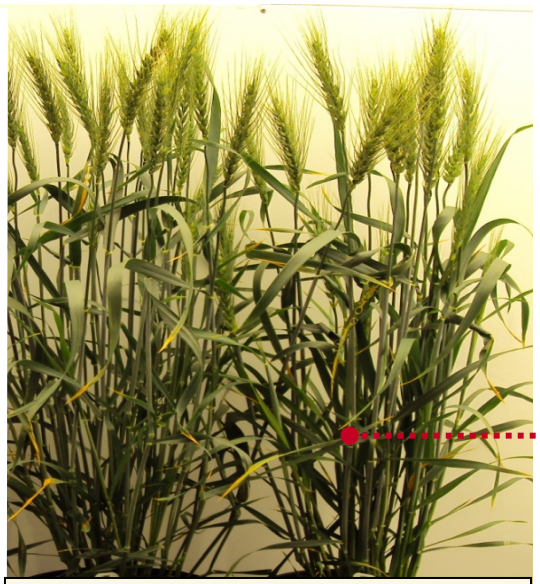
Monsanto and BASF Expanded Collaboration into Wheat; Lead Genes Advanced to Phase I

2010 St. Louis growth lab chamber: first yield-and-stress wheat transformations already complete

Trait package 1



Trait package 2

- First-generation project is intended to stack yield-and-stress traits with herbicide tolerance
- Historical lack of industry investment in wheat technology has resulted in reduced productivity compared to other major row crops

Yield-and-stress wheat:
Lead project (Status: **Advanced Phase I**)

Family value considerations:

- Launch-country acres[1]: To be determined when project enters Phase II
- 2020 value[2]: To be determined when project enters Phase II
- Applying technologies from other crops expected to deliver a step-change in wheat yield productivity

Lab work creates first wheat-trait transformations

Leveraging identified genes from other crop work in Collaboration, the first yield-and-stress transformations in wheat were made within 6 months of initiation of wheat effort

1. Acre opportunity reflects acres where technology fits at Monsanto's 2010 share in respective crops
2. 2020 value reflects gross sales opportunity of trait family in launch country in year 2020

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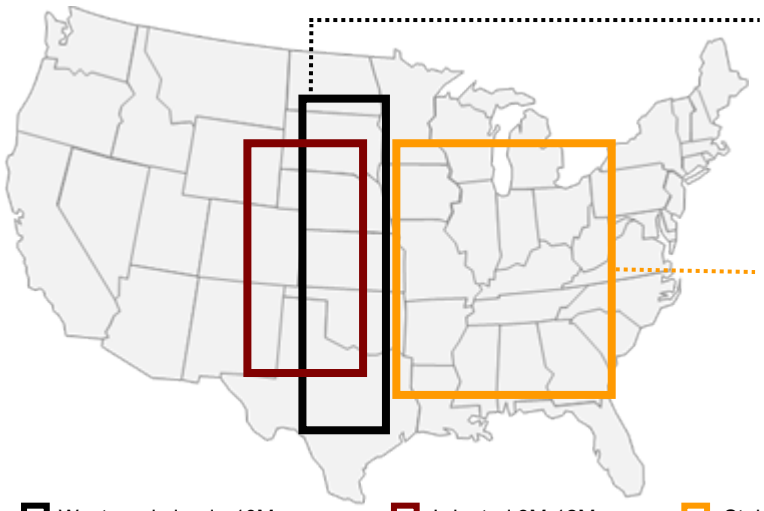
First-Generation Drought Regulatory Submissions Complete; Post-Registration On-Farm Trials Planned for 2012

Drought tolerance: Segmented value by geography



Target geography for first-generation drought-tolerant corn (Phase IV) is the ~10M acre segment of the Western Great Plains

Second-generation drought-tolerant corn (Phase II) designed to build out the family of traits and reach the insurance acres of the Central Corn Belt

Western dryland ~10M acres | Irrigated 8M-12M acres | Stability 60M-70M acres

- All regulatory submissions for planting and import have been made; on track for U.S. de-regulation on 2012 timing
- 2010 marked the third year of minimal drought conditions in the testing environment generating limited data
- Post-registration, Monsanto will apply lessons learned from previous launch experiences to build hybrid portfolio to guide commercial approach
- In 2012, expect to use on-farm plots with key growers to generate data on hybrid performance

Drought-tolerant corn: First-generation project (Status: Phase IV)

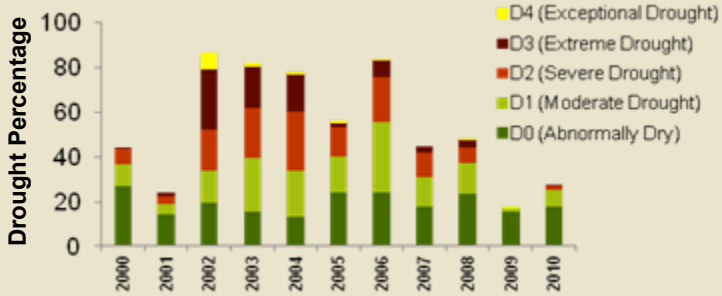
First-generation drought I:

- Launch-country acres opportunity: ~10M
- Accessible market: western dryland corn

Family value considerations:

- Launch-country acres[1]: 45M – 55M
- 2020 value[2]: $250M – $500M
- Reduces yield losses in water-stressed environments

Drought conditions: Testing season environments



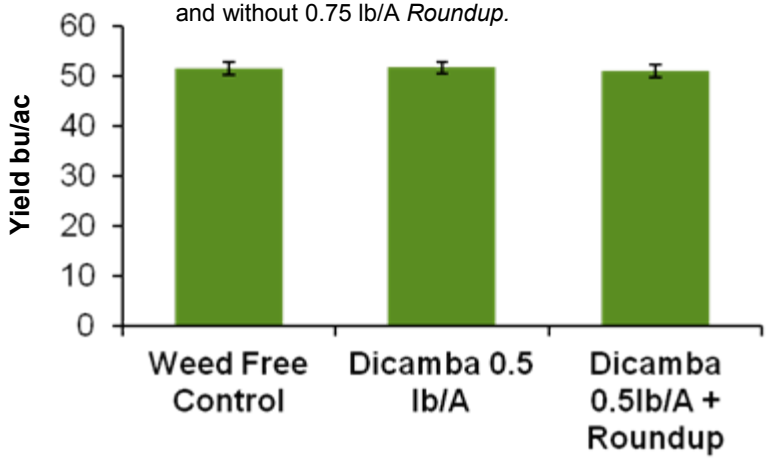
Source: USDA Drought Monitor

1. Acre opportunity reflects acres where technology fits at Monsanto's 2010 share in respective crops
2. 2020 value reflects gross sales opportunity of trait family in launch country in year 2020

Dicamba-Tolerant Soybeans Advanced to Phase IV; Significant Step Toward Providing Farmers Additional Tool for Weed Control

2010 dicamba-tolerant by *Genuity Roundup Ready 2 Yield* soybean plots show excellent tolerance to both dicamba & glyphosate applications

Test plots received two post-emergence sprays of 0.5 lb/A dicamba with and without 0.75 lb/A *Roundup.*



Error bars – LSD at 95% confidence interval

- Regulatory submissions are in progress to support product launch
- Broad germplasm testing of *Genuity Roundup Ready 2 Yield*/ dicamba soybeans stacked trait is under evaluation and will be confirmed before commercial varieties are identified
- Collaboration with BASF on advancement of dicamba tolerance cropping systems

1. Acre opportunity reflects acres where technology fits at Monsanto's 2010 share in respective crops
2. 2020 value reflects gross sales opportunity of trait family in launch country in year 2020

Dicamba-tolerant soybeans: Lead project (Status: **Advanced Phase IV**)

Family value considerations:

- Launch-country acres[1]: 35M – 45M
- 2020 value[2]: <$250M
- Additional weed management tool with an additional mode-of-action for farmers to manage tough-to-control glyphosate-resistant broadleaf weeds in burn down, pre-plant and in crop applications

Mt. Olive, North Carolina – July 2011: Addition of dicamba control system allows control of glyphosate-resistant palmer amaranth

Dicamba-Tolerant *Genuity Roundup Ready 2 Yield* Soybeans

Untreated Check	Residual + Glyphosate	Residual + Glyphosate + Dicamba

Middle photo test plot received residual + two post-emergence sprays of 1.5 lb/A glyphosate at 2-4" and at 10 days after initial POST. Right photo test plot received residual + two post-emergence sprays of 0.75 lb/A glyphosate and 0.5 lb/A dicamba

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Monsanto BASF Collaboration

Model Aimed at Value of Yield Created; Shared With Farmer

Higher-Yielding Corn 1 Example[1]

1) Incremental yield

Yield increment target	Average yield per acre	Commodity price	Potential incremental yield value
6-10%	150 bu[2]	$3/bu[3]	$27-$45/acre

2) Replacement costs

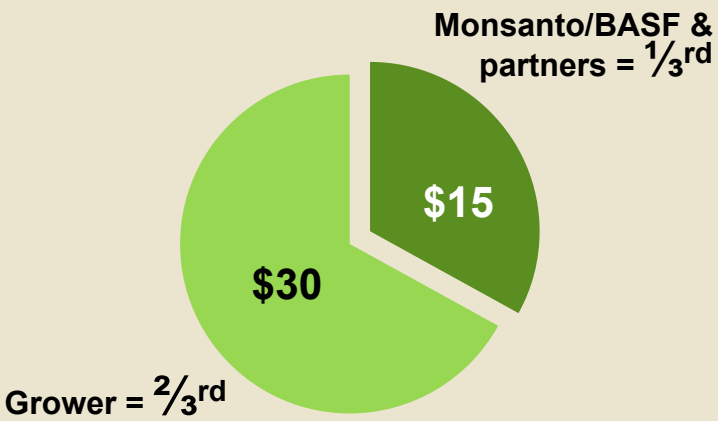
Crop input replaced	Average U.S. cost	Opportunity
N/A for this example		

3) Indirect Benefits

Peace of mind
Potential for reduced crop insurance

1. Higher-yielding corn is a phase II project. Commercialization is dependent on many factors, including successful conclusion of the regulatory process.
2. Average yield per acre for corn in the U.S. was 152.8 bushels in 2010, as per the USDA; rounded to 150 bu/acre for this example.
3. Conservative price assumption.

Total value created $27 – $45/acre, say $45 for example and assume ⅓rd - ⅔rd value sharing approach



Percentage of incremental value shared ultimately determined by market research, pricing simulations and focus groups to assess:

- Share implications
- Trait penetration effect
- Competitive reaction

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Achievements of the Monsanto BASF Collaboration

Four Years of Successful Collaboration

Collaboration pipeline progress is accelerating

Three advancements in core yield-and-stress projects in January 2011

- Nitrogen-utilization corn advanced to Phase II
- 2nd-generation higher-yielding soybeans advanced to Phase II
- Yield-and-stress wheat advanced to Phase I

Collaboration pipeline is robust with unique nominations and broad-scale testing

- >95 percent of gene nominations were unique
- Planted yield-and-stress trials from projects in early phases in more than 170 locations

BASF research platform fuels progress

Monsanto and BASF capabilities successfully interfaced

- Tens of millions metabolic data points generated
- Rice TraitMill extensively utilized in lead gene optimization

Monsanto and BASF collaboration expanded in 2010

- With the addition of yield-and-stress wheat the Collaboration expanded to five crops
- Increased potential overall R&D budget from $1.5B – $2.5B

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Collaboration in Yield-and-Stress Tolerance

Strongest Collaboration in Plant Biotechnology