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We Maximize Nature's Potential™

Alternatives to Chemical Treatment for Organic Seed

Dale Krolikowski

Head of Business Development and Research

Germains Seed Technology, Inc

Our global challenge

Organic crop production is steadily increasing

*Since 2011 the global organic farmland area has grown by 8.4% per year, but organic food consumption is exceeding the growth of land, rising by 10.2% per year over the same period**

Finding sustainable solutions and meeting phytosanitary requirements are our biggest challenges

*Food & Beverage Media, May 2018.

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The organic farming dilemma

- Organic growers struggle with obtaining "organically grown seed"
- Organic growers lack organic fungicides, insecticides and herbicides
  - yield differences are highly contextual and *range from 5% lower organic yields (grain-fed legumes and perennials on weak-acidic to weak-alkaline soils), 13% lower yields (when best organic practices are used), to 34% lower yields (when the conventional and organic systems are most comparable)**.

With good management practices, particular crop types and growing conditions—organic systems can nearly match conventional yields

Nature* **volume 485, pages 229–232 (10 May 2012)

There are also export limitations & phytosanitary requirements (a look at Mexico)

- Seed Treatments approvals in Mexico go through AMSAC
- Organic seed treatments allowed for import
  - Hot water
  - *Trichoderma*
  - *Bacillus lydicus*
  - *Bacillus subtillis*
- All imports are done on a case by case basis: you go to this site for more information: https://sistemasssl.senasica.gob.mx/mcrfi/ConsultaCatalogos.xhtml#

There are solutions for organic growers to narrow that yield gap. These fall into these general categories

- Seed Applied Biological Products
  - Living organisms
- Natural occurring compounds
  - Do not contain *living* organisms. These may include plant extracts, fermentation products, proteins, amino acids and other substances
- Organic approved substances
  - Chemicals produced through an organically certified process
- Sanitization/ Disinfection of seed

Seed Applied Biological Products (living organisms) commercially available

Organism	Brand Names
Trichoderma harzianum	T-22™
Baciillus subtilis	Serenade®
Streptomyces	Mycostop®, Actinovate®
B. amyloliquefaciens	Double Nickel 55™
B. pumilus	Sonata®

Target pests are *Pythium, Fusarium, oomycetes, Thielaviopsis, Rhizoctonia, Botrytis, Sclerotinia, Alternaria, Xanthomonus*

How do these work & what are the downsides

Mode of action

- Protect plant roots
- Stop other species from sporulating
- Disrupt cell membranes of pathogens

Risks to performance

- Cold wet soils slow growth
- Storing treated seed in high temps & humidity
- Short shelf life
- Application methods hurt organism
- Slow growth vs. natural pathogens

Others in development with different modes of action

- Bacterial endophytes - facilitates nutrient absorption modulates plant hormone levels
- Methylotrophs – Secrete nutrients for plant growth
- Root consortia - (plethora of bacteria isolated from root colonization) that aid nutrient uptake, or affect abiotic stress control
- Tens of thousands being isolated from soil and plant roots are being characterized (genetically mapped) and tested
- Fermentation challenges exist to produce on large scale

Natural occurring compounds

The oils

- Neem
- Canola
- Spearmint
- Eucalyptus
- Rosemary
- Niaouli
- Thyme

The Fermentation Extracts

- Carbohydrates
- Proteins
- Amino Acids

These primary molecules can have biomolecular influences on seedling development

Downsides: Little commercial use, lack of efficacy, costly, however new fermentation products are always under evaluation

Organically approved chemical substances

- The USDA National Organic list of substances used for processing: e-CFR Part 205
- Organic standards are designed to allow natural substances in organic farming while prohibiting synthetic substances

§205.600 Evaluation criteria for allowed and prohibited substances, methods, and ingredients.

§205.601 Synthetic substances allowed for use in organic crop production.

§205.602 Nonsynthetic substances prohibited for use in organic crop production.

§205.605 Nonagricultural (nonorganic) substances allowed as ingredients in or on processed products labeled as “organic” or “made with organic (specified ingredients or food group(s)).”

§205.606 Nonorganically produced agricultural products allowed as ingredients in or on processed products labeled as “organic.”

Approved seed treatments can be chemically based & organically approved

Chemistry

- Copper Hydroxide

  Contact fungicide, proven foliar effectiveness, converted to a seed treatment formulation

- Spinosad

  Spinosad is an insecticide based on chemical compounds found in the bacterial species *Saccharopolyspora spinose*
  It is derived from a family of natural products **obtained by fermentation** of *S. spinosa*

Product Brands

- ProBio® SafeGuard™
- FarMore® OI100

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Good crops start with clean seed: Disinfection methods: these methods are organic

- Hot water is still the most widely used method to remove seed borne fungal and bacterial infections
  - Despite its tendency to drop seed germination
- Chlorine or Bleach (U.S. Organic allowed, not allowed by Skal)
- Heat Treatment (Dry)
  - Seen more often to reduce viroids
- Steam
  - Some companies have learned to control the process to minimize loss in germination
- Fumigants
  - Using naturally derived terpenes

Summary

- New biologicals are being identified, genetically mapped, and tested for efficacy daily
- Fermentation extracts are being characterized and plant stimulants extracted
- The plants natural defense mechanisms are being targeted
- Countries like Mexico have substances allowed for use on imported seed