SEED ENHANCEMENTS

Seed Enhancement

- Upgrading
- Mechanical refinement
- Priming
- Coatings and pellets

Incotec fluid density sorting technology
Tomato seed lots upgraded

SORTEX Z+ optical sorting

Recognition software:
- Color, reflectivity
- Features like bumps and holes
- Circularity, symmetry
- Holes
- Length, width
Chlorophyll sensing as an indicator of maturity

Seed Enhancement
- Upgrading
- Mechanical refinement
  - Debearding
  - Scarification
- Priming
- Coatings and pellets

Scarification: Well-established technology

De-linting of cotton seed: Biggest mechanical seed enhancement operation

Seed Enhancement
- Upgrading
- Mechanical refinement
- Priming
  - Brief hydration/dehydration
  - Deep priming
- Coatings and pellets

Seed priming: The two extremes
- Hydration/dehydration
  - Whole cycle lasts a day or two
  - Does not require oxygen
  - Embryo does not grow or lose desiccation tolerance
- Deep priming
  - Several days duration
  - Uses oxygen and involves growth of the embryo
  - Loss of desiccation tolerance constant danger
  - Drying conditions may be crucial
**Generalized priming strategy**

Hydrate seeds and begin germinative processes

Intermediate state (Phase II)

Germination and growth

Restricted
- Time
- Temperature
- Water potential
- Low oxygen

Enhanced seed product

Added value
- Dormancy breaking
- Stress tolerance
- PGRs

**Muskmelon priming at different water potentials and oxygen levels**

*Germination speed of dried seed*

Young Rog Yeoung, 1994 Dissertation

**Seed Priming**

![Graph showing seed priming and growth comparison](image)

From Harris Moran website

**Seed Enhancement**

- Upgrading
- Mechanical refinement
- Priming
- Coatings and pellets
  - Pesticide treatments
  - Beneficial microorganisms
  - Pelleting for plantability
  - Film-coats for appearance and slip
  - Functional coatings
  - Plant growth regulators

**Seed treatment market**

- Estimated global seed treatment market for 2016 is $3430.3 million (from $2250 million in 2010).
- Estimated compound annual growth rate from 2011 to 2016 is 13.5%.

Source: Seed Treatment Market Trends and Global Forecast (2011-2016) - MarketsandMarkets

**How Seed Treatment are applied**

- Basis coat, Weight increase 0-2%
- Complete Film coat, Weight increase 3-20%
- Encrustation, Weight increase 1-5X
- Mini pill, Weight increase 10-25X
- Standard pill, Weight increase 15-100X
Examples of film coats and pellets

Bare lettuce seed, film coated (green), encrusted (pink) and pelleted (white).

Becker Underwood products

Seed pelleting: The original seed enhancement

Small-scale coating and pelleting machines from Seed Processing in Holland

Drying step not included

Film-coater

Pelletizer

Functional coatings

Intellicoat® Temperature Triggered Coatings

Coating is a barrier to moisture.

Coating is permeable to moisture.

- Unique polymer technology that regulates germination of seed
- Functional Coating that responds to changing soil temperature
- Protects seeds under cold environments

Seed Enhancement Coatings

Landec Seed Treatment Formulations
- Effective binder for fungicides and insecticides on seed
- Faster drydown for high throughput application
- Extremely low dust off

Plant Growth Regulators

Ongoing work at Valent BioSciences

- Induction of cold tolerance
- Delay of anthesis (via delay of germination)
- Dormancy breaking and acceleration of germination
- Alteration of plant morphology
Inbred delay product: Timing in hybrid seed production

Problem: Male and female parents may not flower simultaneously since the environment is unpredictable.

Female emergence
Male emergence
Relative maturity of female parent
Relative maturity of male parent
Emergence distribution
Male emergence distribution
Female emergence distribution

Conventional solution: Split planting of male parent produces elongated pollen shed distribution.

Anthesis delay produced by new seed treatment via delay in germination

Growth Chamber Experiment:
- Var: Granger, 7 DAP, rolled paper towel
- Temperature regime:
  - 4 °C for 4 hours
  - 12 °C for 16 hours
  - 19 °C for 4 hours
- Measured with WinRhizo Scanalyzer (10 seedlings/treatment)

Benefits beside pathogen control:
- Enhanced root diameter/root volume

Product name: Stamina F³ HL
Company: BASF
Active ingredient(s): Pyraclostrobin (Headline), triticonazole, metalaxyl
Pest(s) controlled: Diseases

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Benefits of Stamina F³ HL:
- Greater Root Diameter and Root Volume with Pyraclostrobin
Benefits besides pathogen control:
Mitigate abiotic stress risks: Sensitivity to cold temperatures

LESS % OF INJURED TISSUE from STAMINA - treated seeds under cold / light freezing conditions. FIELD STUDY – Beaver Crossing, NEBRASKA, Fall 2007

Artificial seeds

- A method for the encapsulation of somatic embryos.
- Cell culture and regeneration techniques allow the mass production of somatic embryos.
- Used to generate genetically identical seedlings of poplar, orchids and other species.

Artificial or synthetic seeds

- Somatic embryos are produced asexually from vegetative tissue (callus).
- Genetically identical seedlings (clones).
- Must be encapsulated to protect from desiccation and pathogens.
Artificial seeds - Challenges

- Non uniform embryos due to multiple stages of development.
- Easy to generate roots but not shoots.
- Some of the chemical used to induce synchronization of embryo development (ABA) can cause dehydration.