ADVANCED PLANT BREEDERS SYMPOSIUM
Successful Collaborative Variety Introduction
A Seed Production Perspective

Michael Pereira
Granum Services LLC
carpologystmike@yahoo.com
PREMINDERS

❖ Rule of thumb: First to market gets 60% if you can sustain the supply for the demand.
❖ Speed to Market works, Rush to Market does not.
❖ Advances in molecular breeding, both from an available tools and cost standpoint, has accelerated new products - and seed production challenges.
❖ There is no shortage of variety introduction challenges to be overcome across a seed company. Be proactive!
❖ It takes a cross functional team.
SEED PRODUCIBILITY DEFINED

- The degree of difficulty (or not) in producing high quality seed at large enough quantities at an economical level.
- It recognizes that quality seed in sufficient quantities comes from a baseline of healthy plants with manageable flowering, seed development and maturation characteristics and manageable seed harvesting and handling protocols for each crop.
- It is most directly related to seed yield and seed physiological quality but also can be related to genetic quality (e.g., abnormally high selfing rates) and pathological quality (e.g., high susceptibility to one or more diseases).
- When the normal process of producing seed of a crop does not result in consistent yields of high quality seed over time and locations, there is a seed producibility issue that must be solved.
THE 2 BASIC AREAS OF ATTENTION

❖ Crop Specific - Where practices/interventions can be adopted widely.
  ❖ A basic focus on general plant and seed physiological processes.
  ❖ Example - Evaluating PGR’s for converting melons to all female flowering lines.
  ❖ Example - Determining whether drip or a combination of drip and furrow irrigation is best for maximizing tomato seed yield.
  ❖ Example - Identifying the best equipment to minimize mechanical damage in beans.

❖ Variety/type/location specific - Where practices/interventions are more narrowly targeted.
  ❖ A basic focus on a particular seed producibility problem or problems for that variety or type.
  ❖ Example - Determining the dose and timing of application for PGR flower conversion in Ananas type melons.
  ❖ Example - Determining whether or not foliar boron applications can improve fruit/seed set in a tomato line exhibiting a high abortion rate.
  ❖ Example - Determining whether or not higher calcium levels can prevent fruit cracking in a problematic watermelon female line.
GENERAL APPROACHES

❖ Real Time approach
  ❖ Looking for and finding issues in-process to find solutions.
  ❖ Focused on keen observation of factors known to affect seed producibility.
    ❖ Examples - plant growth/flowering habit, fruit development, pollen shed.
  ❖ Focused on identifying the “symptoms” of a seed producibility issue.
    ❖ Examples - deformed/late flowers, fruit or seed abortion, poor pollen shed.
  ❖ Learnings are applied in the next step of the process.

❖ Dedicated Time approach
  ❖ Setting up actual stand-alone trials to find solutions.
  ❖ Primarily used for addressing crop specific issues.
  ❖ Should be set up in a statistically analyzable way.
  ❖ If this approach is necessary to solve a seed producibility issue of a new promising variety, it must be done at the earliest opportunity.
  ❖ Quick success is dependent on the quality of observations coming from the Real Time approach.
THE REAL TIME APPROACH
PRODUCTION RESEARCH IN VARIETY DEVELOPMENT

M = Marketing
S = Sales
B = Breeding
P = Production
Q = Quality
PS = Parent Seed
PR = Production Research
PD = Product Development

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Market Demand → Variety Strategy Draft → Variety Strategy

B, M, S, P, Q, PS, PR

Finished Line Development → Germplasm Evaluation and Early Line Development

B, P, Q, PR, PS

Breeder Trials → Breeder Produced Hybrid Seed → Foundation Seed → Stock Seed

B, PD → B, Q → PS, Q → P, Q

Breeder Trials → Expanded Trials

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* If needed
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PRODUCTION RESEARCH IN VARIETY DEVELOPMENT

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Market Demand → Variety Strategy Draft → Variety Strategy

- B, Q → Finished Line
- B, Q, PR, PS → Germplasm Evaluation and Early Line Development

Breeder Trials → Breeder Produced Hybrid Seed

- B, PD → Foundation Seed
- B, Q → Stock Seed
- B, Q, PR, PS → Commercial Seed

- B, Q, PR → Germplasm Evaluation and Early Line Development

Pilot Production → Foundation Seed

- B, Q → Stock Seed
- PS, Q → Commercial Seed

Expanded Trials → Foundation Seed

- B, Q, PR → Germplasm Evaluation and Early Line Development

- B, Q, PR, PS → Commercial Seed

* If needed
GERmplasm Evaluation and Early Line Development

- Refers to the initial evaluation of the germplasm to find and incorporate the desired traits plus the initial generations of selection and crossing.
- The evaluation is highly horticultural traits driven. But there should be at least a rudimentary knowledge of the general seed producibility of the germplasm base being used.
- With each selection and multiplication, there are opportunities to make observations and notes on seed producibility factors. The ones with the keenest eyes are the technicians and laborers working with the plants and doing the emasculations and pollinations.
- The goal is to have a significantly better understanding of the general seed producibility of the germplasm before entering Finished Line Development.
FINISHED LINE DEVELOPMENT

❖ Refers to the last 2-3 generations where the Breeder is deciding amongst sibling lines which one(s) to advance to make the desired hybrid.

❖ Some examples of what to look for in the male:
  ❖ Quantity and viability of pollen
  ❖ Strength and duration of flowering
  ❖ Time of flowering in relation to female (nicking)
  ❖ Susceptibility to non-resistant common diseases

❖ Some examples of what to look for in the female:
  ❖ Signs of any early pollen shed or natural abortion
  ❖ Fruit/Seed set
  ❖ Timing of flowering in relation to male (nicking)
  ❖ Germination potential
  ❖ Susceptibility to non-resistant common diseases

❖ Reverse crosses of selected lines should be considered as a common practice if issues have surfaced during Early Line Development.

❖ Key observations should be forwarded onward for use in Foundation Seed and Breeder Produced Hybrid Seed for any required further study and adaptation.
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PRODUCTION RESEARCH IN VARIETY DEVELOPMENT

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**Breeder Trials** → **B, PD** → **Breeder Produced Hybrid Seed**

**Breeder Production** → **B, PD** → **Foundation Seed**

**Expanded Trials** → **M, S, PD** → **Breeder**

**Market Demand** → **M, B** → **Variety Strategy Draft**

**Variety Strategy Draft** → **M, S, B, PD** → **Variety Strategy**

**Variety Strategy** → **B**

**Germplasm Evaluation and Early Line Development** → **B, Q, PR, PS** → **Finished Line Development**

**Finished Line Development** → **B, Q, PR, PS** → **Germplasm Evaluation and Early Line Development**

**Founding Seed** → **B, Q, PR**

**Commercial Seed**

**Stock Seed** → **P, Q**

**Expanded Trials** → **M, S, PD**

* If needed
FOUNDATION SEED

❖ Goal is to have made the best choice of finished lines for advancement balancing producibility with horticultural requirements.
❖ Develop and execute a plan for overcoming remaining challenges. This may include:
  ❖ Pruning techniques to enhance flowering
  ❖ Fertilization and irrigation to influence seed yields and quality
  ❖ Disease and pest control options where susceptibility exists
  ❖ Timing of harvest to improve germination
  ❖ Use of potentially useful plant growth hormones
❖ Caveat is that seed quantities are normally limited, which is another reason why producing a little bit extra of Foundation Seed is a good idea based on the multiplication rates of each crop.
The Foundation Seed level is a natural and critical link between the Breeder and the successful long term multiplication of the variety.

- Population size is small enough to validate genetic integrity and self multiplication with involvement of the Breeder if required.
- If a pause must be made to make “genetic repairs”, this is the least interruptive.
- The goal is to produce enough Foundation Seed for the life of a normal variety.
  - Based on a thoughtful extrapolation of the 3 year sales forecast of the variety or varieties.
  - Easier said than done.
- This is the most logical step to err on the side of more seed rather than less.
  - Excess can be used as Stock Seed.
  - Breeder can focus more on new variety development without frequent interruptions to produce more Breeder Seed.
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B, Q, PR, PS

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B, PR, PS

Pilot Production → Foundation Seed → Stock Seed → Commercial Seed

M, S, PD

* If needed
Based on learnings from breeder produced hybrid seed and Foundation Seed increases, a plan for pilot hybrid seed production is developed and executed:

- Using the most promising agronomic practices
- Using the most relevant additional inputs (e.g., hormones)
- Using the most promising plant management techniques (e.g., pruning strategies)
- Focused on at least the main targeted production area, preferably on the secondary one as well

The results in terms of cost and quality will be the basis for qualifying the true margin potential and the final go/wait/no go decision.
STOCK SEED/COMMERCIAL SEED

❖ The major seed producibility issues should be essentially solved or justified by margin and/or market penetration.
❖ These productions will be larger, so a confirmation that solutions and practices hold in large populations is the goal.
❖ The Commercial productions will be over a wider range of locations/environments, so production site specific issues can be addressed if not already addressed with pilot productions in those areas.
❖ Adjust base yields, pricing and margin accordingly.
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Breeder Trials

Breeder Produced Hybrid Seed

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M, S, PD

M, B

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THE HOME FARM
AND
SUCCESSFUL VARIETY INTRODUCTION

❖ Home Farms are typically located in an area where extended and multiple production cycles can be completed as much as possible on an extended basis. It is a rapid response site for high value productions, speed to market, parent seed and breeding support.

❖ Home Farm advantages for successful variety introduction:
  ❖ Rapid response site to solve producibility issues via stand alone trials.
  ❖ Real Time production research can be conducted in both small scale new product hybrid production and parent seed increases at the same time at the same site.
  ❖ Additionally, production personnel have early generation access to breeding material allows for a better understanding of the potential producibility issues to come.
  ❖ Breeders have access to both the parent seed and hybrid seed multiplications of their material at the same site.
  ❖ Home Farm personnel should be skilled in addressing seed producibility issues.
SEEDLESS WATERMELON EXAMPLE - Fruit splitting (Solved Real Time)
TOMATO EXAMPLE - LOW GEL VARIETIES
(Solved with Stand Alone Trials)
FINAL WORDS

❖ No seed, no sales!
❖ Super star breeders are super star collaborators.
❖ Successful variety introduction is measured by profitable staying power in the market.
❖ It takes a cross-functional team.