# Demand-Led Plant Breeding

*Chapter 4*

***New Variety Design and Product Profiling***

*Shimelis Hussein*

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# New Variety Design and Product Profiling

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# Chapter 4 Objectives

1. To understand the **core method of product profiling** to:
   - Characterize existing varieties used by farmers; and
   - Identify future properties important to clients and other stakeholders along the value chain
2. To understand **how to create new designs and set benchmarks** to meet client needs
3. To understand how to **prioritize a range of traits** using demand-led approaches and make trade-off decisions
4. To understand how to **translate a new variety design into a practical breeding program** with clear goals and objectives

# Chapter 4 Contents

# 1. INTRODUCTION

## Opening Group Discussion

- How do you design your new varieties?
- How do you decide the performance required from your new varieties?

# 2. **NEW VARIETY DESIGN AND PRODUCT PROFILING**

# New Variety Design

- **Target clients –** Define who the new variety is targeted to serve i.e. what market segment(s)
- **Value chain needs –** Understand clients and stakeholders along the whole targeted value chain
- **Crop uses –** Define all uses of the crop as food, feed, energy, propagation seed or other purposes
- **Variety identity and descriptors –** Understand every facet of the crop plant, pre and post harvest and differences between varieties

# New Variety Design

- **Variety awareness and demand** - Regular contact with clients and stakeholders. Involve them in decision-making and testing of new designs to create “product pull” and widespread use of the variety when it is registered
- **Product profiling -** A ***“product profile”*** **is the name given to the technical specification of a new variety**. This design specification contains a detailed set of technical attributes or traits with quantitative measures
- **Trait prioritization** – Determining the relative priority of different traits in a new variety design is an important and active process in demand-led variety design

# New Variety Design and Product Profiles

**Key messages**

- Up-to-date ***qualitative and quantitative market research*** data on clients' needs are essential to make decisions.
- A key aspect in the design (often overlooked) is the cost and feasibility of ***seed multiplication***
- To understand and create an ***advocacy program*** with ***government regulators*** to adapt current registration requirements to include new, market-led design features that offer additional benefits to farmers and consumers

# Client and Market Importance

The core goal for a demand-led breeder is to create a new variety that meets a client demand by either:
- Improving design features within existing varieties, - or
- Providing new benefits that will increase new varietal adoption.

The four main inputs required for new variety design are:

- **Market research**
- **Variety performance**
- **Traits required**
- **Trait prioritization**

# Client and Market Importance

A primary consideration in demand-led variety design is how to define the inherent and relative value of each trait within the product profile, by considering:

- **Technical and scientific feasibility** - Trait combinations may be difficult or impossible to achieve due to fundamental physiological or genetic reasons
- **Legal considerations and freedom to operate -** Access to germplasm and native traits that have intellectual property rights and are owned by others requires careful consideration
- **Skills and resources** - Delivery requires the appropriate personnel, skills and resources to be available.
- **Cost** - The variety design must be affordable.

# Individual Exercise

- List five traits that you are breeding for and who is benefiting.
- Place the traits against the primary beneficiaries.

# 3. **CREATING A PRODUCT PROFILE**

# What is a Product Profile?

- The name given to the full range of **technical attributes** of a new variety with quantitative measures
- Also called "***ideotype***" or "***product specification***"
- The best product profiles always set a **target benchmark for the required performance of each trait;** by comparisons vs. the performance of existing varieties and/or expressed on a numeric or photographic scale
- Trait descriptors/dictionaries are compiled and published by the CGIAR International Research Centers and national research intuitions

# Product Profile and New Variety Design

- A product profile is required for each prospective new variety that can be communicated to other breeders, scientists, managers and non-scientific stakeholders
- International crop descriptors are a prerequisite to proceed
- Each product characteristic required must be quantified and measurable vs. a target benchmark
- The product profile needs to be tested with customers before major investments in a new breeding program

# Creating a Product Profile

| Trait category | No | Trait | Trait description | Variety benchmark | Performance required (=, >, >=, >>) |
|---|---|---|---|---|---|
| Crop yield | 1 | | | | |
| | 2 | | | | |
| Plant architecture<br>Seed production | 1 | | | | |
| | 2 | | | | |
| Biotic stress | 1 | | | | |
| | 2 | | | | |
| Abiotic stress | 1 | | | | |
| | 2 | | | | |
| Crop handling, harvest, storage, transport | 1 | | | | |
| | 2 | | | | |
| Value chain clients, consumers, processors | 1 | | | | |
| | 2 | | | | |

# Example of Variety Profiling (Zucchini)

# Product Profile Design

| Trait type | Trait description | Quantification | Benchmark Variety | Performance required |
|---|---|---|---|---|
| Harvest & storage | Blossom End Scar Size | Small | Otto | = |
| | Colour | Light green | Carisma | = |
| | Fruit Size (in cm) | 16-18 | Otto | > = |
| | Fruit Shape | Cylindrical | Queen | = |
| | Fruit uniformity uniformity | High | Queen | = |
| | Early marketable yield | Good | Otto | > = |
| | Marketable Yield (tons/1000 $m^2$) | Low waste | Otto | = |
| | Easiness to pick (peduncle over 4 cm) | High | Carisma | = |
| | Handling (skin) tolerance | Good | Otto | > = |
| | Consistency and post-harvest life | Good | Queen | = |

# Farmers' preferences


Trait performance benchmark

Easiness to pick

Peduncle over 4cm

# Retailers' preferences


Trait performance benchmark

Peduncle shelf-life

# Consumers' preferences


Trait performance benchmark

Fruit size
16-18 cm
Glossiness vs. Otto

# 4. Trait Prioritization

# Priority of Traits

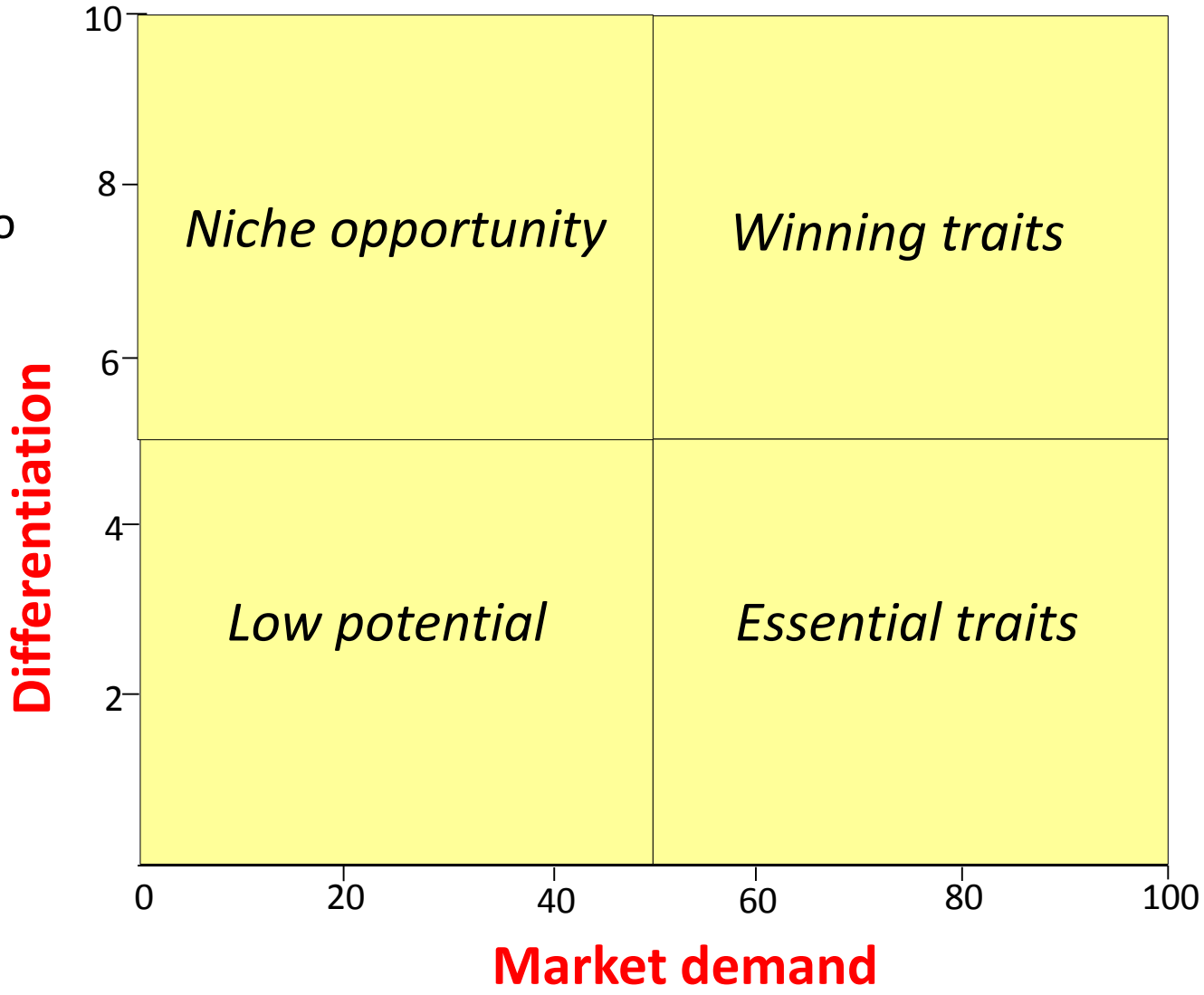
- Important and challenging decision for every breeder
- Market evaluation for each trait has two dimensions

1. **Differentiation**
   - Willingness to pay price premium
   - Opportunity to grow market share
2. **Market demand**
   - % growers/area that need this trait

# Trait Prioritization

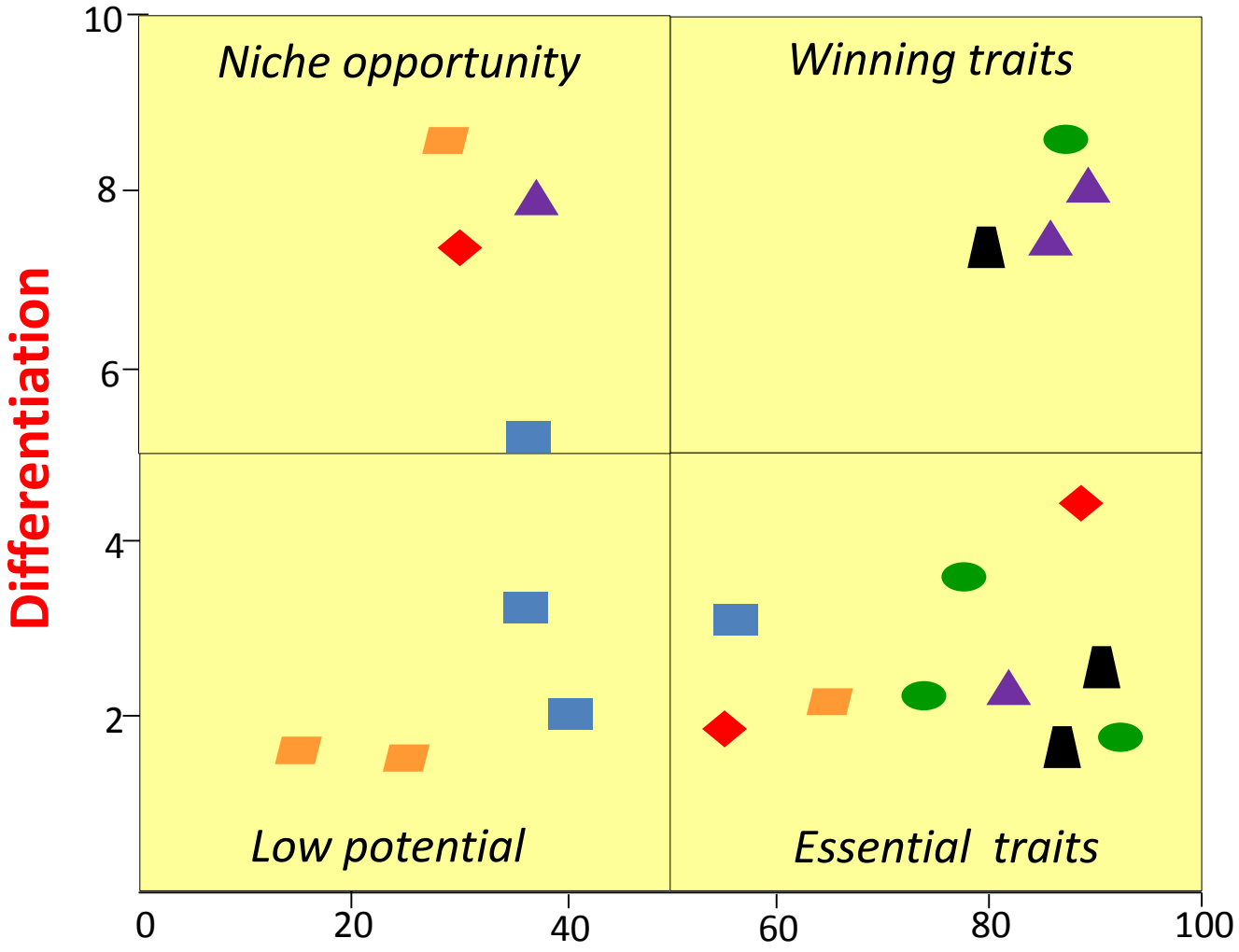
Willingness to pay price premium

Opportunity to grow market share




% growers/area that need this trait

# Trait Prioritization




Yield
Plant architecture
Biotic stress
Abiotic stress
Crop handling
Consumer preference

**Differentiation**

Willingness to pay price premium

Opportunity to grow market share

# 5. Setting External (Non-Market) Performance Standards for a New Variety

What are the non-market standards that you have to meet in order to get a new variety released and grown?

# Setting Non-Market Standards

- **Variety registration requirements**: Dialogue with key officials re registration processes and time frame; markers for varietal identification, adoption, monitoring, performance assessment; requirements for new consumer-based traits e.g. nutritional quality;
- **Advocacy**: Create an advocacy program for changes in registration to assess requirements for market-led traits
- **Seed production and scaling**: Scaling up seed multiplication and what are the associated costs? Seed production costs decide commercial viability.

# Considerations on External Standards of a New Variety

- Traits known and part of the official crop descriptors or creating a new variety with a very different phenotype
- Minimum requirements set by the national testing agency or national variety releasing committee
- Traits adhere to farmers or market or industry preferred requirements

# Considerations on External Standards of a New Variety

- The need for historic performance data (genotype x environment, stability analysis)
- Field and laboratory evaluation protocols to make comparisons
- Government interest and urgency for the new variety
- Relative performance of a new variety vs the national list of recommended varieties

# Variety registration, breeders' rights and control

- Variety registration requirements, breeders' rights and the way cultivars are commercialized differ across countries
- Within a country the requirements may differ for different crops
- A new variety has to be registered and should appear on the recommended list of cultivars
- The new cultivar has to be an improvement over the benchmark using a set of variety descriptions.

# Variety registration, breeders' rights and control

- Several countries (>73) are member of the International Union for the Protection of New Varieties of Plants (UPOV)
- UPOV member agreed to acknowledge breeders' rights over a variety
- UPOV stimulates breeders' rights at an international level
- UPOV has issued a set of basic rules for the development of breeders' rights in the countries of its membership

- A new cultivar, in order to obtain breeders' rights, must be:
  **D** Distinguishable, from all other registered cultivars
  **U** Uniform
  **S** Stable, not changing during maintenance and multiplication.
  **N** Novel, innovative and should not be commercialized already

- The DUSN criteria are established through the results of DUSN trials

# 6. Validating New Variety Designs

# Validating New Variety Designs

- Ensure all new variety designs reflect conclusions from market research
- Validate any revisions to the ideal design that may alter future demand with farmers and other value chain clients before investment in the breeding program
- Identify factors that affect farmer variety preference and adoption and devise a strategy to manage and mitigate the risk factors limiting adoption

# Validating New Variety Designs

- Communication of the product profiles and best ways to display and win support for new variety design
- Visioning of potential landscape changes is essential
- Clarify with clients that new design still responds to market demand, after trade-off decisions made on ideal profile vs. feasibility of breeding the new variety
- Engage with key stakeholders in the value chain during the whole timeline of variety development

# 7. Translating Product Profiles into Breeding Objectives

# Translating Product Profiles into Breeding Objectives

- Product profile aligns with a set of measurable breeding goals and objectives
- Successful demand-led variety design and development creates new varieties that are fit-for-purpose, high quality, and feasible
- The breeding science and its technical and practical feasibilities depend on defined goals and objectives

# Translating Product Profiles into Breeding Objectives

- New varieties are highly innovative and require new combinations of traits
- The new varieties are: Distinguishable (D), Uniform (U), Stable (S) and Novel (N) - meeting the DUSN trial requirements
- Product profiles may require some revisions to increase the probability of delivery
- Innovation and ease of delivery can be inversely correlated; Paradigm shifts may require supporting investigative science programs and pre-breeding activities

# Challenges in Demand-led Breeding

- Inadequately defined product profile
- Poorly defined breeding goals, not supported by specific, measurable objectives
- Performance standards either not set or not met

# 8. Conclusion

How does demand led design differ from current practice?

What are the implications for the role of the plant breeder ?

# How is Demand-led Variety Design Different from Current Practice?

1. **Competitor product profiling** - Analysis of characteristics of existing varieties and landraces and their differentiating characteristics at each stage in the value chain
2. **New variety design** – A product profile is created that contains many traits and characteristics (typically > 40) with performance benchmarks to create breeding objectives
3. **Quantitative benchmarks** – A target quantitative benchmark for each trait for line progression to variety release.
4. **Trade-off decisions on traits** – A decision process to determine final variety design that takes account of client needs, technical feasibility and fiscal considerations.

# How is Demand-led Variety Design Different from Current Practice?

- ***Demand-led approaches*** combine consumption and consumer based traits with farmer requirements to drive adoption of new varieties. Current practices typically focus on a smaller number of farmer requirements only.
- Active and inclusive decision-making with value chain actors is core to demand-led breeding.
- A prioritized list of traits for the proposed variety design is discussed and agreed with clients and stakeholders before breeding goals set and breeding commences.
- Variety design includes bioassays/markers to monitor progress towards set benchmarks for demand-led traits.

# Implications for Role of the Breeder

- **Variety identity** – In depth understanding about the full range of characteristics that comprise each variety and landrace used by clients
- **Registration officials** – Early dialogue with registration officials to develop a detailed understanding about the variety registration processes and requirements.
- **Co-ordination and consultation** – Greater consultation and co-ordination time and liaison skills are needed to understand the needs of clients all along the value chain.
- **Communication skills** - Demand-led breeders need to present new variety designs to a range of clients, non-technical professionals, government officials and investors

# Challenges

- In the large private sector seed industry,
  - Demand-driven product design successfully introduced into productive plant breeding programs
  - Combined with excellent science and technology, development rigor and appropriate awareness campaigns with farmers and customers,
  - Leads to significant gains in adoption rates and market share of new varieties.

# Challenges

- The challenge is finding cost-effective ways to tailor demand-led approaches to new variety design, product profiling and success criteria into public sector and small seed company breeding programs in developing countries
- Need to harness skills and cooperation of the private sector; and better understand tropical crop value chains and market trends
- Opportunities for new public and private sector partnerships to solve problems together

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