Ph.D. Proposal Outline

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1 Abstract

2 Background

2.1 What is it all about? Heterozygosity. Why it is important, worth attention?

Its effects & function;

- Yield stability & fitness, positive & negative effects (vigor & incompatibilities),
- Its role in domestication and evolution (population buffering, phenotypic plasticity. . .).

Optional: Exploitation of heterosis in commercial manner (100 years of maize hybrid breeding).

Results of some milestones in heterozygosity research (Shull, drosophila etc..) will be given (integreated or seperately).

2.2 Amaranth

Some information about amaranth;

- Taxonomy, C4, drought tolerant, using purposes, nutritional value. . .
- It harbors a big genetic diversity, which is important for population survival. . .
- Out-crossing tendency.

Its biomass - biogas potential (supported with the literature I used in my master thesis), necessity of high yielding amaranth cultivars.

So far what has been done about amaranth heterosis, what is known about hybrid amaranths (up to 88 % heterosis observed (Lehmann, 91)).

- Some literature review results about other crops; comparison of intraspesific and interspesific hybrids in terms of heterosis and stability,
- What do we know about such a comparison between intra-interspesific heterosis in amaranth (Lehmann, 91)?

Its suitability for genetic mapping (small genome size).

2.3 NGS technologies

Genetic basis of heterosis has been studied in many crops using NGS (some examples); QTL mapping?

3 Problem statement

3.1 What is the problem, bottleneck & limitations of the current status?

What are the factors influencing heterosis in amaranth (in terms of hybridization type; intraspesific vs. interspesific)? Knowledge about amaranth heterosis is very limited? & no hybrid amaranth so far is used in any research (or very limited, out of date ..etc).

Genetic basis of amaranth heterosis is not known, has not been studied.

Conditional (one step deeper); effects of genomic diversity on heterosis and yield stability; What is the relationship between biomass & stability and the different heterozygosity types possessing different levels of genetic variation?

3.2 If the above-mentioned questions be answered, what would be their contribution to the current status and academia? (relevance of the work)

Amaranth is a minor crop; contribution to agricultural productivity (potential increment in biomass yield and stability ? a new trend may start from line selection towards hybrid breeding.

Its contribution to heterosis research; amaranth is a good model crop for heterosis research, and this is the first study in amaranth focusing on the genetic basis of heterosis & stability.

4. Objectives and hypotheses

4.1 Conditional: Briefly, what has been known, one more time?

4.2 Hypotheses and objectives;

Interspesific heterosis in biomass yield and seed yield (fitness) > that of intraspesific,

Yield stability: interspesific > intrasepesific > PILs.

What will be done to test these hypothesis? (Objectives)

- Heterosis detection for biomass yield and seed yield traits in intra -interspesific F2 populations.
- Detection of GxE interactions over multi locations (and comparison between intraspesific pop. -interspesific pop.- PILs).
- Dissection of the genetic basis of heterosis and yield stability over the populations using genetic mapping approach.

5. Methods

5.1 Multi-location field trials with F2 pops. and PILs

Phenotypic data collection and analysis using mixed modelling (heterosis, GxE)

5.2 Genomic analyses

Pop. genomics analysis; genetic diversity among different populations (Intra-Inters.-F2),

QTL mapping; unraveling the genomic regions underlying heterosis and yield stability.

6. Timeline

6.1 Detailed description of work plan,

6.2 Related Giantt chart.