Developing rapid generation technology involving wild lentil crosses in order to produce Aphanomyces-resistant lentil varieties – proof of concept

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SPG Contributions	Project Status	Duration/Timeline of Project (Year to Year)	Total Project Cost
$259,289.00	Completed	May 2015 – April 2017	$259,289.00

Project Description

To develop a modified rapid generation technique for wild and interspecific lentil germplasm that will enable the rapid development of adapted lentil germplasm with new traits such as aphanomyces root rot resistance.

Aphanomyces root rot (ARR) is a lentil disease that has appeared in recent years in Saskatchewan fields under wet conditions. Since cultivated lentil has little tolerance to this disease, crosses were made between var. Eston and a wild relative (L. ervoides L01-827A). The F2 population (LR 59) developed from this cross was then screened for root rot tolerance.

Outcome

The parents scored on average 3.94 from a scale of 0 (no disease symptoms) to 6 (dead) indicating a moderate level of resistance in both species. Some LR-59 lines scored lower than both parents with the lowest score of 2.38 recorded in LR-59-129.

A generation cycle is defined as the length of time from seed to seed. For lentil, this is about 100 days in the field. Rapid generation technique (RGT) shortens this cycle by speeding up the time to germination, emergence, and flowering as well as by using immature seeds for the next generation. Using a single seed descent method, the F2 population from LR-59 was carried forward until the 6th generation to fix desired traits and eliminate deleterious recessive alleles. The specific objective of this project was to demonstrate that partially resistant lines could be rescued and that six generations of the ARR screened LR-59 population could then be produced in one year, double the number of generations normally achieved in a breeding program.

A combination of optimum growing conditions for lentil, long day length (20h), harvesting immature seeds at the physiological maturity stage (e.g. 24 days for L. culinaris var. Eston), and germinating the immature seeds in a gibberellin solution (100 µM) for 24h resulted in a generation length of 60 days on average per cycle compared to 100 days under field or greenhouse conditions. The wild parent L01-827A had the shortest generation cycle length of 51 days, and the cultivated species var. Eston required 62 days. The life cycle for the LR-59 population varied from 57 – 63 days. Therefore, six generations of lentil can be produced in one year. The developed RGT method is simple, non-sterile, cost-effective, and can be applied to cultivated and wild lentil as well as segregating populations.

Research Objective

OBJECTIVE 1

To develop a modified rapid generation technique for wild and interspecific lentil germplasm that will enable the rapid development of adapted lentil germplasm with new traits such as aphanomyces root rot resistance.