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Genetic Mapping of a Bitter Saponin Production Gene in Quinoa
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Introduction

Chenopodium quinoa (quinoa) is a high protein grain crop originating in the Andes. Quinoa’s ability to grow in drought and high salt conditions and its protein profile make it a highly sought after crop for world food security. Varieties of quinoa may be bitter or sweet, depending on whether the variety produces saponins or not. Saponins are soap-like molecules that are believed to protect the plant from birds, fungi and other micro-organisms. The anti-nutritional effects of saponins[1] on human means that they must be removed prior to human consumption. The process of desaponization is time consuming and requires specialized equipment. The goal of this project was to find a genetic marker linked to the bitter saponin production (BSP) gene to accelerate the breeding of improved sweet quinoa varieties using marker assisted selection.

Step 1: Simple Sequence Repeat Mapping
To identify these genes, we performed linkage mapping and bulk segregant analysis (BSA) using a recombinant inbred line population segregating for the presence of saponins in the seeds: Kurmi (sweet) × 0654 (bitter)[2]. Segregation ratios in this populations indicate that the presence of seed saponins is controlled by a single dominant gene.

Linkage analysis identified two microsatellite markers (KCAA009 and STAA081) that were closely linked to the BSP locus.

Conclusion

We identified two polymorphic microsatellite markers that show linkage to the bitter/sweet phenotype. We were able to use the markers to narrow down the region of the BSP gene. An annotated gene in this region is homologous to a gene in Medicago truncatula that increases saponin synthesis. The gene responsible for the sweet phenotype in quinoa is a transcription factor involved in the saponin biosynthesis pathway. When this gene is spliced abnormally, the saponin biosynthesis pathway is surpressed. The SSR marker we identified can easily be utilized in marker assisted selected programs to breed for sweet quinoa varieties[3].

References