Kirkhouse Trust

Prevalence and host resistance of French beans to common bean rust in Western and Central Kenya

Mr Brian Weseka Wafula

MSc in Plant Breeding and Biotechnology, University of Embu. 2023

Supervisors: *Dr Esther Arunga and Dr Felix Rotich, University of Embu.*

Mr Brian Weseka Wafula

Abstract

Rust (*Uromyces appendiculatus*) (Pers.:Pers.) Unger., is among the most destructive pathogens constraining the production of common beans (*Phaseolus vulgaris* L.) in Kenya. The study's objectives were to (i) determine the prevalence of bean rust in central and western Kenya; (ii) evaluate common bean genotypes for host resistance to rust disease under field and greenhouse conditions; (iii) characterize the Ur gene in a French bean breeding line MU#13; and (iv) identify SSR markers linked to the Ur gene in a French bean breeding line MU#13. A field survey was conducted in 150 farmers' fields in 5 counties in Kenya from September 2020 to January 2021. During the survey, germplasm and rust isolates were collected for screening in the field and under greenhouse conditions. A total of 77 common bean genotypes were subjected to natural infection under field conditions and inoculated with rust races 29-1, 29-3, 61-1, and 63-1 under greenhouse conditions at the University of Embu. The gene pool affiliation of the genotypes was determined through phaseolin protein marker analysis.

Further, F2 populations that were obtained from a cross between a French bean breeding line (MU#13) and 13 known Ur gene sources were screened using bean rust isolates to characterize the Ur gene in MU#13. Bulk segregant analysis (BSA) using 14 SSR primers and the DNA obtained from susceptible parent Amy, MU#13 (resistant parent), and the F2 plants, as well as RILs, was used in the identification of SSRs linked to the Ur gene in MU#13. The collected rust incidence and severity data were subjected to an analysis of variance using GenStat statistical software. The goodness- of-fit of hypothetical ratios in the F2 mapping populations was assessed using the Chi-square test. The findings revealed a resurgence of bean rust, with Bungoma County displaying the highest disease incidence at 71% and a severity rating of 4. On the other hand, Embu County exhibited the lowest incidence at 38% and a severity rating of 2. The common bean cultivar grown, debris management,

management of volunteer plants, use of fungicides, and crop spacing significantly ($p<0.01$) influenced bean rust incidence and severity. However, cropping system, source of seeds, and previous crop did not significantly influence rust prevalence. A significant level of variability was observed among the 77 bean genotypes in their reaction to bean rust. The genotypes KMR 11 (Angaza), Kat X56, UN6-Nakholo, UN2-Darkgreen, Enclave, Manakelly, and MU#13 were the most resistant, while Mexico 222, Widusa, Mitchelite, Amy, Samantha, Julia, GBK- 032805, and UN4-Yellow small were the most susceptible to rust. Generally, common bean genotypes of Mesoamerican origin were more resistant to rust as compared to those of Andean origin. The study further revealed a potentially new gene in MU#13. The SSR PV-ctt001, the only informative marker identified through BSA, was loosely linked to the gene, limiting its utility and therefore the need for the development of robust markers tagging the gene. This study provides baseline information for common bean rust occurrence in the two regions in Kenya and resistance sources to aid in the control of the rust disease.

Publication

Wafula, B.W., Arunga, E.E., & Rotich, F. 2023. Prevalence and Host Resistance to Common Bean Rust Disease in Western and Central Kenya. International Journal of Agronomy. Doi https://doi.org/10.1155/2023/6064130.

Rust in bean single crop (i); screening for rust resistance in the greenhouse (ii); differential reaction of MU#13 and Amy to rust (iii).