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Application of molecular marker assisted selection in developing common bean varieties with improved multiple resistances to the major diseases in Uganda.

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Abstract

Pods of a plant of the BC4F5 generation derived from intercrosses of NABE 12C and the disease resistant varieties G2333 (ANT resistant), RWR 719 (Pythium resistant), and Mex 54 (resistant to ALS), 2017.

The bean root rot disease mainly Pythium spp. is a major problem affecting bean production especially in the major bean producing areas of the Great lakes region including southwestern Uganda, Rwanda, western Kenya, northern and the southern highlands of Tanzania. The problem of Pythium bean root rot appears to be made worse by declining soil fertility, resulting from intensive land cultivation by the small holder farmers. Probably for a more sustainable farming system, breeding of common bean genotypes tolerant to both the bean root rot disease and low soil fertility problem would be a welcome improvement. This requires information on the suitable resistant or tolerant germplasm and their nature of inheritance of the resistance genes, which is currently not understood. This research was therefore undertaken in order to: (a) investigate the inheritance of resistance to bean root rot disease caused by Pythium spp. in two common bean genotypes RWR 1946 and RWR 2075, and (b) identify the allelic relationship of the resistance genes in these genotypes and RWR 719 (a previously characterized Pythium root rot resistance source). In addition, these studies also aimed at: (c) identifying genotypes tolerant to both Pythium root rot disease and low soil fertility (low P and Al toxicity), and (d) determining early

generation inheritance of selected low phosphorus tolerance related traits in common bean genotypes RWR 1946 and RWR 2075. Inheritance of resistance to Pythium root rot investigated in the F1, F2 and backcross populations revealed a single dominant gene that could fully express in several backgrounds and was present at the same locus in the genotypes RWR 1946, RWR 2075 and RWR 719. On the other hand, phenotypic evaluation of the selected known low soil fertility tolerant or susceptible genotypes to identify new sources of Pythium root rot resistance revealed that the BILFA nursery is a potential source of Pythium root rot resistance. Assessment of the leaf area, shoot and root dry weights, total root length, lateral and basal roots production, shoot P concentration and P uptake under varying phosphorus availability was performed on 13 common bean genotypes. Results confirmed that genotypes RWR 1946 and RWR 2075 were tolerant to low soil phosphorus availability and responsive to added phosphorus. Unfortunately, when the same genotypes were evaluated under high aluminum saturation of up to 55.2%, they were sensitive to aluminium toxicity. Parental genotypes RWR 1946, RWR 2075, K 132 and their F1s crosses were evaluated under low and high phosphorus availability to determine early generation inheritance of low phosphorus tolerance related traits. Results revealed that increased lateral and basal root production, total root length and higher shoot growth as traits for low phosphorus tolerance were heritable and were to a great extent likely be due to additive genes. The findings of this study are important because genotypes with tolerance to both Pythium root rot disease and low soil phosphorus constraints have been verified. Tolerance or resistance to such two important stresses makes them very good breeding materials since the problem of declining soil fertility is on the increase in the Great lakes region and consequently with likely outbreaks of the bean root rot disease.

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Seeds of NABE 12C (i), NABE 14 and of plants selected with markers associated with ANT resistance in the breeding programme (iii); Bean breeding populations in the greenhouse (iv).