

The Response of Tepary Bean (*Phaseolus acutifolius*) Germplasm to Induced Mutation

by

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A dissertation submitted in fulfilment of the requirements for the degree of Master of Science in Agriculture (Plant Production) (MSc Agric)

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January 2016

Abstract

Tepary bean (*Phaseolus acutifolius*) is an important food legume cultivated in semi-arid areas in many parts of the world including the Sekhukhune region in Limpopo Province, South Africa. It is highly tolerant to drought but generally low yielding. The genetic improvement of tepary bean is limited by a narrow genetic base. However, mutation breeding, particularly chemical mutagenesis with ethyl methanesulfonate (EMS), was used successfully for inducing genetic variability in many legumes. To date, there are no reports of chemical mutagenesis in tepary bean. Therefore, this study was designed to examine the (i) seedling performance of the first generation of EMS mutagenized (M_1) genotypes under laboratory conditions and (ii) seedling and adult plant performance of the early generations (M_2 , M_3 and M_4) of tepary bean under both laboratory and field conditions. Seed of tepary bean was mutagenized with varying doses (0.0, 0.5, 1.0, 1.5 and 2.0 v/v) of EMS prior to germination in the laboratory at room temperature in plastic jars in order to raise M_1 seedlings. At the initiation of the first trifoliolate leaf, several seedling traits including percent seed germination (%G), primary root length (PRL), the root dry weight (RDW) and the shoot dry weight (SDW) were measured. There were highly significant ($P < 0.01$) differences due to dose effects among the seedlings in the majority of the attributes that were measured. The genotype x dose interaction for both the PRL and RDW was highly significant ($P < 0.01$). The mean SDW was at least 10-fold heavier than the RDW. 'Genotype 6' attained the highest (84.4%) %G at 0.5% EMS (v/v). The LD_{50} for 'Genotype 3' and 'Genotype 6' were estimated to be 3.37% and 2.26% EMS dose (v/v) respectively. EMS induced some dominant mutations that were detectable in the M_1 generation. In the second component of the study, a portion of the seed of three mutant populations was germinated in plastic jars at room temperature in the laboratory. The second portion of the seed was planted in a field experiment. In both studies, a three factorial design (genotype x generation x EMS dose) arranged in a randomized complete block replicated three times was used. Among the seedlings, the SHT in 'Genotype 6' was reduced consistently between 0.5 – 1.5% EMS v/v. Under field conditions, the mutant generation significantly ($P < 0.01$) influenced the SDW and the number of pods per plant (NPP) as well as 100-seed weight (100-SW). The mean NPP was 15.55 while the 100-SW was only 8.60 g on average. The SDW decreased markedly (by >25.0%) with the mutant generation. The results suggested that all the three factors are important in the chemical mutagenesis for generating desirable agronomic traits in tepary bean.

Key words: chemical mutagenesis, dose; early generation; mutant population.