PERFORMANCE AND STABILITY OF MUTATION DERIVED LINES OF COMMON BEANS (*Phaseolus vulgaris L.*)

By

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A dissertation submitted to the University of Zambia, in partial fulfillment of the requirements for the degree of Master of Science in Agronomy

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DECLARATION

I, **MUYOBO SHIMABALE**, declare that this thesis represents my own work and that it has not previously been submitted for a degree at this or any other University.

Signature……Date…….

APPROVAL

This dissertation of Muyobo Shimabale is approved as a partial fulfillment of the requirements for the award of the degree of Master of Science in Agronomy (Crop Science) by the University of Zambia.

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ABSTRACT

Common beans (Phaseolus vulgaris L.) is one of the most important legume crops in Zambia as a source of protein and income for most resource poor people in both rural and urban set-ups. It contains a higher percentage of protein as compared to maize, rice and cassava. However, common beans is characterized by low yields and performs inconsistently and unpredictably when grown in an array of environments. Low levels of production have been attributed to the use of local cultivars, low soil fertility and susceptibility to pests and diseases. Local cultivars have low yields of between 0.3 to 0.5 tonnes per hectare and have small seed size and an unattractive seed coat colour. To address this, the University of Zambia developed 22 improved beans lines through induced mutation with gamma radiation. Induced mutation creates genetic variation affecting a wide range of plant characters and can also improve a single or few qualitative traits within the shortest possible time. The 3 parent lines from which the 22 lines were derived were Solwezi Rose, Lyambai and Carioca. The mutant lines were LY2-7-B, LY2-8-B, LY4-4-B, LY1-2-B, LY2-3-B, LY2-6-B,LY1-7-B, SZ3-1-B-B, SZ9-7-B-B, SZ3-2-B-B1, SZ9-B-B-B1, SZ7-4-B-B, SZ9-B-B-B2, SZ3, CA3, CA9, CA24, SZ3-3-B-B2, LY2-2-B, CA15,CA18 and CA38. An experiment was conducted to evaluate the performance in different environments of Zambia of these mutation derived lines as well as to assess their yield stability when grown across an array of environments. The mutant lines which were in their M7 generation and their respective parents were planted in the 2008/2009 season across three environments; these being Golden Valley Agricultural Research Trust (GART) in Chisamba, Chafukuma Farmer Training Institute in Solwezi as well as Misamfu Research Station in Kasama. A 5x5 balanced lattice design was used with 6 replications. The parameters under study were days to 50% flowering, days to physiological maturity, hundred seed weight, pod length and yield per hectare. The analysis of variance showed that there were significant differences for treatment mean yields among varieties and among locations ($p \leq 0.01$). The site x line interaction was also significant ($p \leq 0.01$). It revealed the existence of GxE interaction. Pair wise comparison using least significant difference showed that none of the mutant lines had higher yields than their respective parents. However, the Francis and Kannenberg genotype grouping technique revealed that these lines were nevertheless high yielding. All the Carioca mutants matured earlier than their parent by 6 days ($P \leq 0.05$). CA 38 and CA9 flowered earlier than their parent by 3 days ($p \leq 0.05$). SZ3-3-B-B2 had a longer pod length than its parent of 126mm ($p \leq 0.05$). Using the stability analysis of Francis and Kannenberg, 16 mutation derived lines were found to be stable and high yielding while 6 mutant lines plus the three parent lines were unstable and with large variation. The stable mutants (high yielding and small variation) were CA15, CA18, CA24, CA3, CA9, LY1-2-B, LY2-3-B, LY2-7-B, LY2-8-B, SZ3-1-B-B, SZ9-7-B-B, SZ3-2-B-B1, SZ9-B-B-B1, SZ7-4-B-B, SZ3, SZ3-3-B-B2. The unstable lines (low yielding and large variation) were: SZ-PARENT, CA- PARENT, LY-PARENT, CA38,

LY1-7-B, LY2-2-B, LY2-6-B, LY4-4-B AND SZ9-B-B-B2. The stable lines were high yielding in all the environments. It is recommended that these can be released as varieties which can perform consistently high in agro-ecological regions II and III of Zambia. The lines that were low yielding and with large variation can be recommended for the specific sites at which they yielded highly. They can also be crossed so as to come up with varieties with desirable traits.

DEDICATION

To my beautiful and loving wife Molly and my wonderful children Muyobo Jr., Mabenga, and baby Zoe. You guys are a blessing.

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To God be the Glory.

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ABBREVIATIONS

ANOVA	Analysis of variance
BCMV	Bean common mosaic virus
CA	Carioca
CV	Co-efficient of variation
DT50%F	Days to 50% flowering
DTM	Days to maturity
GART	Golden Valley Agricultural Research Trust
HSW	Hundred seed weight
LSD	Least significant difference
LY	Lyambai
MAFF	Ministry of Agriculture Food and Fisheries
Plgth	Pod length
SZ	Solwezi
UNZA	University of Zambia
y/ha	Yield per hectare

LIST OF APPENDICES