African Crop Science Journal, Vol. 24, No. 2, pp. 155 - 166
Printed in Uganda.
ISSN 1021-9730/2016 $4.00

DOI: http://dx.doi.org/10.4314/acsj.v24i2.4

ADAPTATION OF INTRODUCED MUNGBEAN GENOTYPES IN UGANDA

E.K. MBEYAGALA[1,2]., R. AMAYO[1,2] and J.E.P. OBUO[1,2]
[1]National Semi Arid Resources Research Institute (NaSARRI), P. O. Box Private Bag, Soroti, Uganda
[2]National Agricultural Research Organization (NARO), P. O. Box 295, Entebbe, Uganda
Corresponding author: kmbeyagala@gmail.com

(Received 2 September, 2015; accepted 4 May, 2016)

ABSTRACT

Mungbean (*Vigna radiata* (L.) Wilczek) is an important source of nutrients and income for smallholder farmers in East Africa. Mungbean production in countries like Uganda largely depends on landraces, in the absence of improved varieties. In order to enhance productivity, efforts have been underway to develop and evaluate mungbean varieties that meet farmers' needs in various parts of the country. This study was conducted at six locations in Uganda, to determine the adaptability of introduced mungbean genotypes, and identify mungbean production mega-environments in Uganda. Eleven genotypes (Filsan, Sunshine, Blackgram, Mauritius1, VC6148 (50-12), VC6173 (B-10),Yellowmungo, KPS1, VC6137(B-14),VC6372(45-60),VC6153(B-20P) and one local check were evaluated in six locations during 2013 and 2014. The locations were; National Semi Arid Resources Research Institute (NaSARRI), Abi Zonal Agricultural Research and Development Institute (AbiZARDI),Kaberamaido variety trial center, Kumi variety trial center, Nabuin Zonal Agricultural Research and Development Institute (NabuinZARDI), and Ngetta Zonal Agricultural Research and Development Institute (NgettaZARDI). G × E interactions were significant for grain yield. Through GGEBiplot analysis, three introduced genotypes (Filsan, Blackgram and Sunshine) were found to be stable and high yielding, and therefore, were recommended for release. The six test multi-locations were grouped into two candidate mega-environments for mungbean production (one comprising of AbiZARDI and Kaberamaido and the other comprising of NaSARRI, NabuinZARDI, Kumi, and NgettaZARDI). National Semi Arid Resources Research Institute (NaSARRI) was the most suitable environment in terms of both discriminative ability and representativeness and therefore can be used for selection of widely adaptable genotypes.

Key Words: Biplot, mega-environment, *Vigna radiata*

RÉSUMÉ

La fève (*Vigna radiata* (L.) Wilczek) est une importante source de nutriments et de revenu pour les paysans en Afrique de l'Est. La production de la fève dans des pays comme Ouganda dépend largement des variétés locales, à défaut des variétés améliorées. Dans le but d'accroitre la productivité, des efforts ont été fournis pour développer et évaluer les variétés de fèves pouvant satisfaire les besoins des producteurs dans différents coins du pays. La présente étude a été conduite dans six emplacements en Ouganda, en vue de déterminer l'adaptabilité de variétés introduites de fèves et identifier les zones majeures de production de fèves. Onze variétés introduites (Filsan, Sunshine, Blackgram, Mauritius1, VC6148 (50-12), VC6173 (B-10),Yellowmungo, KPS1, VC6137(B-14),VC6372(45-60),VC6153(B-20P) et une variété locale utilisée ici comme témoin, ont été évaluées dans six emplacements au cours des années 2013 et 2014. Les emplacements étaient : l'Institut Nationale de Recherche sur les Ressources Semi-Aride (NaSARRI), l'Institut Zonale de Recherche Agricole et Développement de Abi (AbiZARDI), le centre d'expérimentation des variétés de Kaberamaido, le centre d'expérimentation des variétés

de Kumi, l'Institut Zonale de Recherche Agricole et Développement de Nabuin (NabuinZARDI) et l'Institut Zonale de Recherche Agricole et Développement de Ngetta (NgettaZARDI). L'interaction génotypes et environement G × E était significatif pour le rendement en grain. Une analyse se servant de biplot, a révélé trois stables variétées introduites (Filsan, Blackgram and Sunshine), ayant des rendements élevés. Ces trois variétées sont donc recommendées pour être lancées. Les six emplacements utilizes dans cette étude peuvent être groupés en deux grandes zones proprices à la production de la fève (la première zone est constituée de AbiZARDI et Kaberamaido, tandis que la seconde est faite de NaSARRI, NabuinZARDI, Kumi et NgettaZARDI). NaSARRI s'est révélé l'emplacement le plus propice, en ce sens que cet emplacement était le plus discriminant et le plus représentatif, et de ce fait peut être utilisé pour sélectionner des variétées à large adaptation.

Mots Clés: Biplot, zones majeures, *Vigna radiata*

INTRODUCTION

Mungbean (*Vigna radiata* (L.) Wilczek), also known as greengram, is an important pulse crop not only in the Indian sub-continent where it has been cultivated for centuries, but also globally, where it serves both as a food crop and source of income (Mogotsi, 2006). The crop is rich in nutrients, especially proteins (23-25%) and micronutrients (iron and zinc), and is associated with low ant-nutritional factors such as those which cause flatulence, making it a suitable food for weaning babies (Paul *et al*., 2011; Puranik *et al*., 2011). Mungbean is considered a wonder crop due to its ability to tolerate or escape drought conditions, yet has short maturity periods and improves soil fertility through biological nitrogen fixation (Swaminathan *et al*., 2012).

In Uganda, mungbean is widely grown by smallholder farmers in the eastern and northern regions of the country (Ibedo, 2014). However, these regions are characterised by variable climatic, edaphic, biotic and land use patterns, which influence productivity of the crop (Wortmann and Eledu, 1999). Therefore, new adaptable varieties are needed to ensure profitable and sustainable production of mungbean in these areas. The new varieties must show high performance in terms of yield and other important agronomic traits. Moreover, the good performance must be reliable over a wide range of environmental conditions (Annicchiarico, 2002).

A difference in yield stability among genotypes where the performance of any one of the genotypes relative to the remaining genotypes grown in the same environment is inconsistent, is due to the wide occurrence of genotype x environment interactions (G x E). Growing awareness of the importance of G x E interactions has led crop genotypes to be assessed in multi-environment/ regional trials before variety recommendation or for the final stages of elite breeding material selection. This is because in this *era* of niche-specific variety development, G x E effects should not be ignored, rather analysed using appropriate techniques in order to explore their potential opportunities and disadvantages (Annicchiarico, 2002).

Information from multi-environment trials can help breeding programmes to understand the type and size of the G x E interactions expected in a given region, and reasons for their occurrence as well as defining a strategy to successfully cope up with the effects of interactions (Annicchiarico, 2002). Presence of G x E effects of a crossover nature results in change of variety ranking from one environment to another and this has strong implications for breeding for specification adaptation. This is important to a plant breeding programme in allocation of resources, increasing the efficiency of testing and breeding programmes, and targeting of genotypes to appropriate production areas (Yan and Tinker, 2006). Under Ugandan regulations, imported/ introduced varieties can only be recommended for release after evaluation in variety performance trials for at least two growing seasons (Seeds and Plant Act, 2006).

The objective of this study was to determine the adaptability and stability of introduced mungbean varieties in different environments of Uganda, and identify mungbean production mega environments in Uganda.

REFERENCES

Annicchiarico, P. 2002. Genotype x Environment interactions: Challenges and opportunities for plant breeding and cultivar recommendations. FAO Plant Production and Protection Paper No. 174. Food and Agriculture Organization, Rome, Italy. 115 pp.

Asfaw, A., Gurum, F., Alemayehu, F. and Rezene, Y. 2011. Analysis of multi-environment grain yield trials in mungbean *Vigna radiata* (L.) Wilczek based on GGE Biplot in Southern Ethiopia. *Journal of Agricultural Science and Technology* 14(2):389-398.

Blanche, S.B., Myers, G.O. and Kang, M.S. 2007. GGE Biplots and traditional stability measures for interpreting genotype by environment interactions. *Journal of Crop Improvement* 20(1-2):123-135. http://doi.org/10.1300/J411v20n01_07

Ceccarelli, S. 1989. Wide adaptation: How wide? *Euphytica* 40(3):197-205.

Ceccarelli, S. 1996. Adaptation to low/high input cultivation. *Euphytica* 92:203-214.

Ceccarelli, S. 2012. Plant breeding with farmers – A technical manual. ICARDA, Aleppo, Syria. pp. xi + 126.

Eisemann, R.L., Cooper, M. and Woodruff, D.R. 1990. Beyond the analytical methodology, better interpretation and exploitation of GE interaction in plant breeding. In: Kang, M.S. (Ed.), Genotype-by-environment interaction and plant breeding. Louisiana State Univ. Agric. Center, Baton Rouge, LA, USA. pp. 108-117.

Frutos, E., Galindo, M. P. and Leiva, V. 2014. An interactive biplot implementation in R for modeling genotype-by-environment interaction. *Stochastic Environmental Research and Risk Assessment* 28(7):1629-1641. http://doi.org/10.1007/s00477-013-0821-z

Giayetto, O. Cerioni, G. A. and Asnall, W.E. 1998. Effect of sowing spacing on vegetative growth, dry matter production, and peanut pod yield. *Peanut Science* 25:88-98.

Ibedo, A.S. 2014. Analysis of the greengram value chain in Uganda. MSc. Thesis. Makerere University, Kampala, Uganda. 113pp. Retrieved from http://dspace.mak.ac.ug/handle/10570/3242

Kang, M.S. 1993. Simultaneous selection for yield and stability in crop performance trials: Consequences for growers. *Agronomy Journal* 85(3):754-757. http://doi.org/10.2134/agronj1993.00021962008500030042x

Mbeyagala, K.E., Amayo, R. and Obuo, J.E.P. 2015. Selection for high yield and stability among introduced greengram genotypes in Uganda. *Journal of Agricultural Science* 7(9):154-159. http://doi.org/doi:10.5539/jas.v7n9p154

Mogotsi, K.K. 2006. *Vigna radiata* (L.) R.Wilczek. [Internet] Record from PROTA4U. Brink, M. and Belay, G. (Eds.). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands. <http://www.prota4u.org/search.asp>. Accessed 26 August 2015.

Paul, T., Rubel Mozumder, N. H. M., Sayad, M. A. and Akhtaruzzaman, M. 2011. Proximate compositions, mineral contents and determination of protease activity from green gram (*Vigna radiata* L.Wilczek). *Bangladesh Research Publications Journal* 5(3):207-2013.

Pawar, S.U., Kharwade, M.L. and Awari, H.W. 2007. Effect of plant density on vegetative growth and yield performance of different varieties of french bean under irrigated condition. *Karnataka Journal of Agricultural Sciences* 20(3):684-685.

Pratap, A., Gupta, D. S., Singh, B.B. and Kumar, S. 2013. Development of super early genotypes in greengram [*Vigna radiata* (L.) Wilczek]. *Legume Research* 36(2):105-110.

Puranik, V., Mishra, V., Singh, N. and Rai, G.K. 2011. Studies on development of protein rich germinated greengram pickle and its preservation by using class one preservatives. *American Journal of Food Technology* 6(9):742-752. http://doi.org/10.3923/ajft.2011.742.752

R Core Team. 2015. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL http://www.R-project.org

Seeds and Plant Act, 2006. Acts supplement No. 3 to The Uganda Gazette No. 32 Volume C dated 29th June, 2007. Printed by UPPC, Entebbe, Uganda.

Swaminathan, R., Singh, K. and Nepalia, V. 2012. Insect pests of greengram *Vigna radiata* (L.) Wilczek and their management. In: Aflakpui, G. (Ed.), *Agricultural Science*. pp. 252-252. InTech. Retrieved from http://www.intechopen.com/books/agricultural-science/insect-pests-of-green-gram-vigna- radiata-l-wilczek-and-their-management

Wortmann, C.S. and Eledu, C.A. 1999. Uganda's agroecological zones: A guide to planners and policy makers. Centro Internationale de Agricultural Tropical (CIAT), Kawanda, Uganda.

Yan, W. 2001. GGEbiplot-A windows application for graphical analysis of multi-environment trial data and other types of two-way data. *Agronomy Journal* 93:1111-1118.

Yan, W. 2005. Use of biplot analysis in crop breeding. In: Swanson, C.S. (Ed.), *Proceedings of the Eastern Wheat Workers and Southern Small Grain Workers Conference*. pp. 7-29, May 9-12, 2005, Bowling Green, KY. University of Kentucky, USA.

Yan, W. and Tinker, N.A. 2005. An integrated biplot analysis system for displaying, interpreting, and exploring Genotype × Environment Interaction. *Crop Science* 45(3): 1004-1016. http://doi.org/10.2135/cropsci2004.0076

Yan, W. and Tinker, N. A. 2006. Biplot analysis of multi-environment trial data: Principles and applications. *Canadian Journal of Plant Science* 86(3):623-645.

Yan,W. 2006. Biplot analysis of multi-environment trial data [slide presentation] www.ggebiplot.com/Biplot_Analysis_ of_MET_Data_IITA.pps