BUSITEMA UNIVERSITY
Pursuing Excellence

P.O.Box 236, Tororo
Gen:+256-454448842
Dir: +256-454448864
Mob: +256-782999874
Fax: +256-454436517
Email:ar@acadreg.busitema.ac.ug
Website:www.busitema.ac.ug

AFRICAN STEM BORER RESISTANCE IN EARLY SEGREGATING GENOTYPES OF F2 SORGHUM POPULATION IN UGANDA

BY

DRICIRU KNIGHT
REG NO. BU/UG/2018/2077

SUPERVISOR

Mr. ANDIKU CHARLES

A RESEARCH PROJECT REPORT SUBMITTED TO THE FACULTY OF AGRICULTURE AND ANIMAL SCIENCE IN PARTIA FULFILLMENT OF THE AWARD OF BACHELOR OF SCIENCE IN AGRICULTURE, BUSITEMA UNIVERSITY

MAY 2023

DECLARATION.

I Driciru Knight declare that the work presented in this research proposal is entirely my o
has been submitted to Busitema University for award of academic qualification Bach
Science in Agriculture.

Signed. DRICIRU KNIGHT Date. 10/10/2023

i

APPROVAL.

This reach proposal will be submitted for examination with my approval as the University supervisor.

Sign..... Date.....

Mr ANDIKU CHARLES

Lecturer, Department of Crop Production.

ii

DEDICATION.

I dedicate this work to all the households who participated in this research, to my family members and my supervisor. God bless you all.

ACKNOWLEDGEMENT.

Thanks to the almighty God for the good health and wisdom that guided me throughout the study. My sincere gratitude goes to my supervisor ANDIKU CHARLES for his guidance, directive and support for the development till through the work.

In special way, I would like to thank all the Lecturers of Bachelor of Science in Agriculture Busitema University, I acknowledge that I have learnt a lot from them and may God bless them all.

To all the sincere course mates special thanks and love, and I wish you all the strength in your endeavors, may people show as much care and help as you have shown me.

TABLE OF CONTENT.

Contents

LIST OF TABLE.

LIST OF ACRONYMS

SSA: Sub-Saharan Africa.

SBC: Stem borer count

NaSARRI: National Semi Arid Resources Research Institute.

UNDP: United Nations Development Program

Rep: Replicate

ABSTRACT

Sorghum is a cereal and key food staple grain to over 500 people in semi-arid tropics Africa and Asia. The grain yield in subsistence farming ranges from 0.5 t/ha to 0.8 t/ha compared to potential yield of 10 t/ha. Low yields are attributed to biotic, abiotic and social-cultural factors. Stem borers an insect pests to sorghum causes yield losses of up to 15 - 80% due to leaf damage, death heart, exit holes and tunneling damages. Multiple control measures have been employed for stem borer management but they show some limitations. Besides, host plant resistance is an economical and effective way of controlling stem borer suitable for the resource-poor farmers. Therefore, there is need to know the resistance level among the F2 population which has been developed at NaSARRI Forty eight (48) F2 population were sown in 8 x 6 alpha-lattice design of 3 replicates each in two sites – NaSARRI in Serere district and Busitema University Arapai campus in Soroti district. Data was collected on grain weight, plant height, 50% flowering leaf damage, dead heart, tunnel length, exit holes waxi blooms and leaf glossiness Genstat 18^{th} version was used for data analysis where ANOVA was performed for all the observed traits. A significant different ($p<0.05$) was detected for all the studied parameters

Some sorghum genotypes experienced low damage and registered better yields (mean 3752-3978) with genotype SILAxTanzaniaACC#42 having the highest grain yield (5720 kg/ha), followed by NAROSORG1xIS30310 (4550 kg/ha), NAROSORG1xTanzaniaACC#42 (4380) and SILAxIS12750 (3988 kg/ha). In addition, the result also revealed variation in resistance to the damage parameters across the locations and rep.

CHAPTER ONE

INTRODUCTION

1.1 Background

Sorghum (*Sorghum bicolor* L. Moench) with chromosomal number 2n=20 is a cereal grain that originally was domesticated in Africa and has since spread globally (Muturi, 2013). It is a member of grass family Poaceae, Subfamily Panicoideae, tribe Andopogoneae and subtribe Sorghinae (Breckinridge, 2022) and has five cultivated races including bicolor, guinea, kafir, caudatum & durra (Pontieri & Giudice, 2016). The crop is important staple in the diet to the poor throughout semi-arid Asian and African regions. It is the fifth important cereal grown in the world following rice, wheat, maize and barley in total area planted and productivity (Balakrishna et al., 2018). Over 90% of its production by area is in the developing countries (Deb et al., 2004). Globally sorghum is annually produced in total land area of production of 41.31 million ha and total production of 59.83 million tons was achieved and mean yield is normally 1.45 tons per ha (Andiku *et al.*, 2021). By 2020, sorghum production in the whole world was 62.0 million metric tons. By 2011, the leading producers to sorghum were Nigeria 12.6%, India and Mexico who produced 11.2% each, United states 10.0%(Tracheophytes et al., 2022) This shows a better improvement from the previous years. Nigeria and Sudan have been the leading producers of sorghum in Sub Saharan Africa (SSA) where the crop ranks the second major crop produced after maize. Uganda is the fourth leading producer of sorghum in East Africa with production of 314,553 tons from 398,050 ha of land (Andiku, Shimelis, & Laing, 2022).

Sorghum is ranked the third most vital cereal crop after maize & rice in Uganda, and it is grown for grain, forage and sugar and is a fast emerging biofuel crop in subsistence farming and it is also used for brewing purposes (Fabiana Meijon Fadul, 2019). Sorghum can grow in harsh environments where other crops for example cassava do not perform well, it can grow well without the application of any fertilizers (Nagesh Kumar et al., 2021) and it is tolerant to longer duration of water logging. High yielding sorghum cultivars having dense nutrient contents have been breed in Uganda to increase productivity level. However, some of the high yielding nutrient-dense sorghum genotypes developed in Uganda highly succumbs to insect pest attack. Among the insect pests are the stem borers *Busseola fusca* Fuller, *Chilo partellus* Swinhoe, *Chilo orichalcociliellus* Strand, *Eldana saccharina* Walker and *Sesamia calamistis* Hampson present key contribute to yield losses (Togola *et al*., 2020a). These

iii. The following quantitative sorghum characteristics can be used to indirectly select genotypes with high yields; days to 50% flowering and plant height

REFERENCES

Abbas, M., Aziz, B., Adnan, A., Safdar, M. E., Ali, M. E., Raza, A., & Hanif, A. S. (2020). Bio-fortification of calcium, zinc and iron improves yield and quality of forage sorghum (Sorghum bicolor L.). *Journal of Pure and Applied Agriculture*, *5*(3), 2617–8672. http://jpaa.aiou.edu.pk/

Abonyo, E. A. (2019). *Establishment and Efficacy of Stem Borer Biological Control Agents Released in Kenya*. *November*.

Akinwale, R. O., Odunlami, L. K., Eze, C. E., & Oladejo, A. S. (2021). Effectiveness of different alpha lattice designs in the evaluation of maize (Zea mays L.) genotypes in a rainforest agro-ecology. *Heliyon*, *7*(7), 1–11. https://doi.org/10.1016/j.heliyon.2021.e07414

Andiku, C., Shimelis, H., & Laing, M. (2022). *Assessment of sorghum production constraints and farmer preferences for sorghum variety in Uganda : implications for nutritional quality breeding*. *71*(7), 1–66.

Andiku, C., Shimelis, H., Laing, M., Shayanowako, A. I. T., Adrogu Ugen, M., Manyasa, E., & Ojiewo, C. (2021). Assessment of sorghum production constraints and farmer preferences for sorghum variety in Uganda: implications for nutritional quality breeding. *Acta Agriculturae Scandinavica Section B: Soil and Plant Science*, *71*(7), 620–632. https://doi.org/10.1080/09064710.2021.1944297

Andiku, C., Shimelis, H., Shayanowako, A. I. T., Gangashetty, P. I., & Manyasa, E. (2022). Heliyon Genetic diversity analysis of East African sorghum (Sorghum bicolor [L .] Moench) germplasm collections for agronomic and nutritional quality traits Core ideas. *Heliyon*, *8*(June), e09690. https://doi.org/10.1016/j.heliyon.2022.e09690

Aruna, C., Visarada, K. B. R. S., Venkatesh Bhat, B., & Tonapi, V. A. (2018). Breeding sorghum for diverse end uses. *Breeding Sorghum for Diverse End Uses*, 1–434.

Aswir, & Misbah, H. (2018).Title. *Photosynthetica*, *2*(1), 1–13. http://link.springer.com/10.1007/978-3-319-76887-8%0Ahttp://link.springer.com/10.1007/978-3-319-93594-2%0Ahttp://dx.doi.org/10.1016/B978-0-12-409517-5.00007-3%0Ahttp://dx.doi.org/10.1016/j.jff.2015.06.018%0Ahttp://dx.doi.org/10.1038/s41559-019-0877-3%0Aht

Balakrishna, D., Vinodh, R., Madhu, P., Avinash, S., Rajappa, P. V., & Bhat, B. V. (2018). Tissue culture and genetic transformation in sorghum bicolor. *Breeding Sorghum for Diverse End Uses*, 115–130. https://doi.org/10.1016/B978-0-08-101879-8.00007-3

Berg, J. Van Den, & Rensburg, J. B. J. Van. (2013). *Infestation and injury levels of stem borers in relation to yield potential of grain sorghum*. *1862*. https://doi.org/10.1080/02571862.1991.10634819

Bimrew Sendekie Belay. (2022). *8.5.2017*, 2003–2005.

Breckinridge, P. S. (2022). *Overview and description*. 3–8.

Calatayud, P. A., Le Ru, B. P., van den Berg, J., & Schulthess, F. (2014). Ecology of the African maize stalk borer, Busseola fusca (lepidoptera: Noctuidae) with special reference to insect-plant interactions. *Insects*, *5*(3), 539–563. https://doi.org/10.3390/insects5030539

Chandler, D., Bending, G. D., Clarkson, J. P., Davidson, G., Hall, S., Mills, P., Pink, D., Skirvin, D. J., Neve, P., & Kennedy, R. (2008). The consequences of the 'cut off'criteria for pesticides: alternative methods of cultivation. *Directorate General Internal Policies of the Union. European Parliament*, 43. http://wrap.warwick.ac.uk/id/eprint/49217

Deb, U. k., Bantilan, C., Roy, A., & Rao, P. (2004). Global sorghum production scenario. *Sorghum Genetic …*, 21–38. http://oar.icrisat.org/3041/

Fabiana Meijon Fadul. (2019). *Title No Title No Title*.

Fuller, B. F. (2022). *(https://cipotato.org /riskatlasforafrica/) 4.4.2*. *Fuller 1901*, 1–11.

Kamakshi, N., Sarma, A. S. R., & Reddy, C. V. C. M. (2021). Efficacy of Insecticides

Against Sorghum Spotted Stem Borer *Chilo partellus* (Swinhoe). *Indian Journal of Entomology*, 1–4. https://doi.org/10.55446/ije.2021.52

Kashif, M. (2011). *(PDF) Experience in Use Alpha Lattice Design in Pakistan (PDF) Experience in Use Alpha Lattice Design in Pakistan Experience in Use Alpha Lattice Design in Pakistan*. 1–9.

Kumar, R. (2022). Download Opera browser for PC. *Ravi Kumar*, 10.

Macfarlane, J. H. (1990). Damage assessment and yield losses in sorghum due to the stem borer busseola fusca (fuller) (lepidoptera: Noctuidae) in northern nigeria. *Tropical Pest Management*, *36*(2), 131–137. https://doi.org/10.1080/09670879009371456

Macfarlane, J. H. (2008). *Damage assessment and yield losses in sorghum due to the stem borer Busseola fusca (Fuller) (Lepidoptera : Noctuidae) in Northern Nigeria*. *6147*. https://doi.org/10.1080/09670879009371456

Machine, P. D. (2022). *Peanut Destoner Machine*. 1–5.

Mailafiya, D. M., Le Ru, B. P., Kairu, E. W., Dupas, S., & Calatayud, P. A. (2011). Parasitism of Lepidopterous stem borers in cultivated and natural habitats. *Journal of Insect Science*, *11*, 1–18. https://doi.org/10.1673/031.011.0115

Matama-Kauma, T., Schulthess, F., Ogwang, J. A., Mueke, J. M., & Omwega, C. O. (2007). Distribution and relative importance of lepidopteran cereal stemborers and their parasitoids in Uganda. *Phytoparasitica*, *35*(1), 27–36. https://doi.org/10.1007/BF02981059

May, A., July, J., May, A., July, J., May, A., July, J., & Green, T. (2022). *Agriculture :: Home Agriculture :: Home*. 1–10.

Muturi, W. P. (2013). *Resistance To the African and Spotted Stem Borers in Sorghum in Kenya*. *November*, 1–114.

Nagesh Kumar, M. V., Ramya, V., Govindaraj, M., Sameer Kumar, C. V., Maheshwaramma, S., Gokenpally, S., Prabhakar, M., Krishna, H., Sridhar, M., Venkata Ramana, M., Avil Kumar, K., & Jagadeeshwar, R. (2021). Harnessing Sorghum Landraces to Breed High-Yielding, Grain Mold-Tolerant Cultivars With High Protein for Drought-Prone Environments. *Frontiers in Plant Science*, *12*, 1–45. https://doi.org/10.3389/fpls.2021.659874

Okosun, O. O., Allen, K. C., Glover, J. P., & Reddy, G. V. P. (2021). *Biology , Ecology , and Management of Key Sorghum Insect Pests* . 1–63.

P.W, M. (2012). Novel source of sorghum tolerance to the African stem borer, Busseola fusca. *African Journal of Plant Science*, *6*(11), 295–302. https://doi.org/10.5897/ajps12.051

Parker, E. (2017). Points of interest. *History Today*, *67*(9), 9–10.

POMS. (2016). Plantwise Knowledge Bank Nepal. *Plantwise Online Management System*, 1–2. https://www.plantwise.org/KnowledgeBank/Clinics/%0APlantClinicsHome.aspx

Pontieri, P., & Giudice, L. Del. (2016). *Holcus*. 1–15.

Prasad, S. G., Bhagwat, V., & Kalaisekar, A. (2022). *Works Across Apps (PDF) ASSESSMENT OF RESISTANCE TO STEM BORER , CHILO ...* 1–7.

Ru, B. P. Le, & Schulthess, F. (2022). *Ecology of the African Maize Stalk Borer, Busseola fusca (Lepidoptera: Noctuidae) with Special Reference to Insect-Plant Interactions*. *5*(3), 6–11. https://doi.org/10.3390/insects5030539

Scheurer, C., & Schlegel, C. (2013). ["How can I help you?"]. *Krankenpflege. Soins Infirmiers*, *106*(11), 89. https://doi.org/10.4324/9780429446962-1

Sharma, H. C., & Ortiz, R. (2002). Host plant resistance to insects: An eco-friendly approach for pest management and environment conservation. *Journal of Environmental Biology*, *23*(2), 111–135.

Silva-aguayo, G. (2021). *Radcliffe ' s IPM World Textbook Botanical Insecticides*. 1–11.

Singh, B. U., Sharma, H. C., & Rao, K. V. (2022). *Mechanisms and genetic diversity for host plant resistance to spotted stem borer , Chilo partellus in sorghum , Sorghum bicolor*. 1–9. https://doi.org/10.1111/j.1439-0418.2011.01647.x

Subramanian, V., Hoseney, R. C., & Bramel-cox, P. (1994). Shear Thinning Properties of Sorghum and Corn starches '. *Cereal Chemistry*, *71*, 272–275.

Tende, R. M. (2007). *Screening for Development of Resistance in the African Stem Borer (Busseola fusca Fuller) and in the Spotted Stem Borer (Chilo partellus Swinhoe) to Bt-Maize 8-endotoxins*. 66.

Togola, A., Boukar, O., Tamo, M., & Chamarthi, S. (2020a). Stem Borers of Cereal Crops in

Africa and Their Management. *Pests Control and Acarology [Working Title]*, 1–30. https://doi.org/10.5772/intechopen.83719

Togola, A., Boukar, O., Tamo, M., & Chamarthi, S. (2020b). Stem Borers of Cereal Crops in Africa and Their Management. *Pests Control and Acarology [Working Title]*, 1–19. https://doi.org/10.5772/intechopen.83719

Togola, A., Boukar, O., Tamo, M., & Chamarthi, S. (2020c). Stem Borers of Cereal Crops in Africa and Their Management. *Pests Control and Acarology [Working Title]*, 1–27. https://doi.org/10.5772/intechopen.83719

Togola, A., Boukar, O., Tamo, M., & Chamarthi, S. (2020d). Stem Borers of Cereal Crops in Africa and Their Management. *Pests Control and Acarology [Working Title]*, 1–28. https://doi.org/10.5772/intechopen.83719

Tracheophytes, P., Monocots, A., Poales, C., Panicoideae, P., History, C., Culinary, U., & External, R. (2022). *Sorghum bicolor*. 1–12.

Turgut, I., Bilgili, U., Duman, A., & Acikgoz, E. (2005). Production of sweet sorghum (Sorghum bicolor L. Moench) increases with increased plant densities and nitrogen fertilizer levels. *Acta Agriculturae Scandinavica Section B: Soil and Plant Science*, *55*(3), 236–240. https://doi.org/10.1080/09064710510029051

Us, A., & Us, C. (2022). *W e l c o m e T o F l a w l e s s C o n s u l t a n t s (U) L t d*. 1–20.

Usmael, A., Terbush, A., Chala, G., & Lamessa, K. (2018). *Diagnostic Study of Planting Time on Sorghum Stalk Borer Infestation and Damage in West Hararghe , Oromia Region , Ethiopia*. *2*(4), 42–47. https://doi.org/10.11648/j.aje.20180204.12

Van Den Berg, J., Van Rensburg, G. D. J., & Van Der Westhuizen, M. C. (1997). Economic threshold levels for Chilo partellus (Lepidoptera: Pyralidae) control on resistant and susceptible sorghum plants. *Bulletin of Entomological Research*, *87*(1), 89–93. https://doi.org/10.1017/s0007485300036403

Van Den Berg, J., & Van Rensburg, J. B. J. (1991). Infestation and injury levels of stem borers in relation to yield potential of grain sorghum. *South African Journal of Plant and Soil*, *8*(3), 127–131. https://doi.org/10.1080/02571862.1991.10634819

Wambui, P. (2013). *Resistance to the African and spotted stem borers in sorghum in Kenya* . 2010–2012.