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**FACULTY OF AGRICULTURE AND ANIMAL SCIENCES**

**DEPARTMENT OF CROP PRODUCTION AND MANAGEMENT**

**PERFORMANCE EVALUATION OF SORGHUM (*Sorghum bicolor* (L.) Moench)  
GENOTYPES FOR GRAIN YIELD AND YIELD RELATED TRAITS**

**BY**

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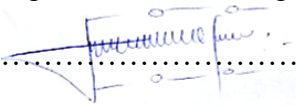
**BACHELOR OF SCIENCE IN AGRICULTURE RESEARCH PROJECT REPORT**

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## DECLARATION

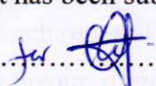
This report is my original work and has not been presented for a degree in any other university which is submitted to the department of crop production and management for the award of Bachelor Degree of science in agriculture.

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## APPROVAL

This report has been submitted with my approval as the university supervisor

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## LIST OF ABBREVIATIONS

<b>ANOVA</b>	= Analysis of Variance.
<b>CCRP</b>	= Collaborative Crops Research Project.
<b>CV</b>	= Coefficient of Variation.
<b>DAP</b>	= Days after planting.
<b>FAO</b>	= Food, Agricultural Organisation
<b>IITA</b>	= International Institute of Tropical Agriculture.
<b>Kg ha<sup>-1</sup></b>	= Kilogram per hectare.
<b>LSD</b>	= Least Significant Differences.
<b>MP</b>	=Minicore populations
<b>MUCCI</b>	=Makerere University Centre for Crop Improvement
<b>NASARRI</b>	= National Semi-Arid Resources Research institute.

## ABSTRACT

Sorghum is the third most important cereal crop after maize and rice. The area under sorghum production in Uganda is at 398,050 ha accounting for 314,553 tons total annual production. This places Uganda as the fourth leading sorghum producer in East Africa, after South Sudan, Tanzania and Ethiopia, (Andiku et al., 2021) However, low yield is one of the things which frustrates the farmer's efforts and in most cases farmers are left with no choice but to accept the loses as there has not been a permanent solution to this problem, except for farmers untested indigenous knowledge. This research study therefore, proposes to determine the performance evaluation of (*Sorghum bicolor* (L.) Moench) genotypes for grain yield and yield related traits. This experiment was carried out in Arapai campus field in alpha lattice design where 60 genotypes were randomly assigned to plots within blocks. Panicle length, panicle width, plant height, 50% days to flowering, 75% maturity, 100 seed weight, panicle weight, etc. are the parameters measured and Data collection, was done using excel and data was analyzed using GenStat 15<sup>th</sup> edition by running the analysis of variance (ANOVA) to obtain the Means, Least significant Differences (LSD), Coefficients of Variation (CV) and F-probability. The analysis of variance was highly significant for yield and harvest index ( $P < 0.001$ ), 100 seed weight, biological yield, panicle weight, panicle width, panicle length, plant height were significantly low ( $P < 0.05$ ) across the genotypes, the mean grain yield of 891.9kg/ha was recorded across the sorghum genotypes, sapkab22b\_019 having the highest grain yield of 4963kg/ha, Most of the best yielding sorghum genotypes were medium maturing and The bottom five genotypes had grain yield ranging from 526.3kg/ha to 451.4kg/ha, the lowest grain yield among the bottom five genotypes was recorded in genotype sapkab22b\_118, and sapkab22b\_095. based on season performance, the harvest index had a strong positive correlation with yield ( $r = 0.82$ ,  $p < 0.001$ ). conclusively, the sorghum genotypes showed different levels of yield indicating wide variability for sorghum yield among the selected sorghum genotypes, high yield was noticed in all the seasons but it was significantly higher in second season of 2022B than the first rainy season of 2023A. The selected high yielding sorghum genotypes could be used as breeding lines for development of cultivar with farmer preferred traits.

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## CHAPTER ONE

### INTRODUCTION

#### 1.1 Back ground

Sorghum belongs to the Poaceae family which is made up of three main species namely *S. bicolor*, *S. halepense* and *S. propinquum* (Kunth) Hitchc (Kimario, M. E., Moshi, A. P., Ndossi, H. P., Kiwango, P. A., Shirima, G. G., Kussaga, J. B., ... & Moghal, 2013) .Sorghum is one of the important grain crops in the world's semi-arid tropics, including sub-Saharan Africa, due to its adaptation to a wide range of ecological and climatic conditions ( Lamessa *et al.*, 2016). Globally, sorghum is annually produced on 41.31 million ha of land with a total production of 59.83 million tons with a mean grain yield of 1.45 tons per hectare. Sorghum is the fifth most important cereal crop in the world after rice, wheat, maize, and barley ((Semahegn *et al.*, 2020). China, India, the United States of America is the leading sorghum producers in the world while in sub-Saharan Africa (SSA), Nigeria and Sudan are the leading sorghum producers and It is the second major crop (after maize) in SSA.

In Uganda, Sorghum is the third most important cereal crop after maize and rice. The area under sorghum production in Uganda is at 398,050 ha accounting for 314,553 tons total annual production so this places Uganda as the fourth leading sorghum producer in East Africa, after South Sudan, Tanzania and Ethiopia ((Andiku *et al.*, 2021) . Sorghum is mainly produced in Uganda by smallholder farmers in the semi-arid regions of Eastern, Northern and South Western Uganda as a staple food and farmers in the country commonly use farm-saved sorghum seed as planting materials for the subsequent planting seasons and sorghum is mainly grown as pure stand, while some farmers practice intercropping with finger millets, maize, cowpeas and common beans. Sorghum grain is as nutritious as other cereal grains as it can be processed to prepare porridge and local bread among rural communities especially women and pre-school age children in Uganda ((Andiku *et al.*, 2021) .In urban areas, it may be prepared into a wide variety of other food products such as breads, lactic and alcoholic beverages and weaning meals, Sorghum has become both cash and food crop in sustaining the livelihoods of millions of people in Africa. It contains about 11% water, 340 k/cal of energy, 11.6% protein, 73% carbohydrate and 3% fat by weight ((Rakshit *et al.*, 2014) .It serves as a staple food for more than 500 million people in the semi-arid tropics of Africa and Asia. It is also used for preparing traditional beverages (Andiku *et al.*, 2021). It is a

## REFERENCES

- Akinwale, M., Gregorio, G., Nwilene, F., Akinyele, B., Ogunbayo, S., & Odiyi, A. (2011). Heritability and correlation coefficient analysis for yield and its components in rice (*Oryza sativa* L.). *African Journal of Plant Science*, 5(3), 207–212.
- Ananda, G. K. S., Myrans, H., Norton, S. L., Gleadow, R., Furtado, A., & Henry, R. J. (2020). Wild Sorghum as a Promising Resource for Crop Improvement. *Frontiers in Plant Science*, 11(July), 1–14. <https://doi.org/10.3389/fpls.2020.01108>
- 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). Genetic diversity analysis of East African sorghum (*Sorghum bicolor* [L.] Moench) germplasm collections for agronomic and nutritional quality traits. *Heliyon*, 8(6), e09690. <https://doi.org/10.1016/j.heliyon.2022.e09690>
- Are, A. K., & Reddy, S. P. (2014). *Recent advances in sorghum improvement research at ICRISAT*. *Recent Advances in Sorghum Improvement Research at ICRISAT. July 2010*.
- Aruna, C., Das, I. K., Reddy, P. S., Ghorade, R. B., Gulhane, A. R., Kalpande, V. V., Kajjidoni, S. T., Hanamaratti, N. G., Chattannavar, S. N., Mehtre, S., Gholve, V., Kamble, K. R., Deepika, C., Kannababu, N., Bahadure, D. M., Govindaraj, M., & Tonapi, V. A. (2021). Development of Sorghum Genotypes for Improved Yield and Resistance to Grain Mold Using Population Breeding Approach. *Frontiers in Plant Science*, 12(July), 1–19. <https://doi.org/10.3389/fpls.2021.687332>
- Barreto, H. J., Edmeades, G. O., Chapman, S. C., & Crossa, J. (1996). *The alpha lattice design in plant breeding and agronomy: Generation and analysis* (pp. 544–551).
- Bassuony, N. N., Zsembeli, J., Juhász, C., & Elshenawy, M. M. (2022). Estimation of genetic variability and frequency distribution in F2 generation of rice under normal and deficit water supply. *Cereal Research Communications*, 50(3), 489–500. <https://doi.org/10.1007/s42976-021-00185-7>
- Ć, D. R. L. A. (2011). *Origin , History , Morphology , Production , Improvement , and Utilization of Broomcorn [ Sorghum bicolor ( L. ) Moench ]*. June 2014. <https://doi.org/10.1007/s12231->

- FAO, WFP, & IFAD. (2019). *Food loss analysis : causes and solutions - The Republic of Uganda*.
- Faysal, A. S. M., Ali, L., Azam, M. G., Sarker, U., Ercisli, S., Golokhvast, K. S., & Marc, R. A. (2022). Genetic Variability, Character Association, and Path Coefficient Analysis in Transplant Aman Rice Genotypes. In *Plants* (Vol. 11, Issue 21). <https://doi.org/10.3390/plants11212952>
- Gaddameedi, A., Ravikiran, K. T., Mohammed, R., Phuke, R. M., Sadaiah, K., Kavi Kishor, P. B., & Ashok Kumar, A. (2018). Inheritance studies on grain iron and zinc concentration and agronomic traits in sorghum [*Sorghum bicolor* (L.) Moench]. *Journal of Cereal Science*, 83(June), 252–258. <https://doi.org/10.1016/j.jcs.2018.09.007>
- Gebregergs, G., & Mekbib, F. (2020). Estimation of genetic variability, heritability, and genetic advance in advanced lines for grain yield and yield components of sorghum [*Sorghum bicolor* (L.) Moench] at Humera, Western Tigray, Ethiopia. *Cogent Food and Agriculture*, 6(1). <https://doi.org/10.1080/23311932.2020.1764181>
- Hariprasanna, K. (2021). *Online Refresher Course on. December 2020, 0–2*. <https://doi.org/10.13140/RG.2.2.27900.97921>
- Hariprasanna, K., & Patil, J. V. (2015). Sorghum: Origin, Classification, Biology and Improvement. In *Sorghum Molecular Breeding* (pp. 3–20). [https://doi.org/10.1007/978-81-322-2422-8\\_1](https://doi.org/10.1007/978-81-322-2422-8_1)
- Inuwa, A. H., Abdulazeez, T., & Vabi, M. B. (2020). *Hakeem A . Ajeigbe , Ignatius I . Angarawai , Folorunso Akinseye ,. March 2021*.
- Kebbede, W. Y. (2020). Genetic Variability and Divergence in Sorghum: Review. *International Journal of Research Studies in Agricultural Sciences*, 6(5), 11–20. <https://doi.org/10.20431/2454-6224.0605002>
- Kimario, M. E., Moshi, A. P., Ndossi, H. P., Kiwango, P. A., Shirima, G. G., Kussaga, J. B., ... & Moghal, S. (2013). *Journal of Cereals and Oilseeds. Assessment. December*. <https://doi.org/10.5897/JCO>
- Lamessa, K., Chala, G., Tarbush, A., Gudeta, D., Haile, S., & Usmael, A. (2016). Evaluation of Sorghum ( *Sorghum bicolor* ( L ) Moench ) Varieties and Environments for Yield Performance and Stability. *Journal of Biology, Agriculture and Healthcare*, 6(21), 11–17.
- Lubadde, G., Ebiyau, J., Aru, J. C., Andiku, C., Wandulu, J. A., & Ugen, M. A. (2019). Sorghum production handbook for Uganda. pp 37. National Semi Arid Resources Research Institute of

- the National Agricultural Research Organisation (NaSARRI-NARO), Uganda. *National Semi Arid Resources Research Institute of the National Agricultural Research Organisation (NaSARRI-NARO), Uganda., August, 37.*
- Mahendrakar, M. D., Kumar, S., Singh, R. B., Rathore, A., Potupureddi, G., Kavi Kishor, P. B., Gupta, R., & Srivastava, R. K. (2019). Genetic variability, genotype × environment interaction and correlation analysis for grain iron and zinc contents in recombinant inbred line population of pearl millet [*Pennisetum glaucum* (L). R. Br.]. *Indian Journal of Genetics and Plant Breeding*, 79(3), 545–551. <https://doi.org/10.31742/IJGPB.79.3.3>
- Mashao, J., & Prinsloo, T. (1994). Sorghum production. *Sorghum Production Guide*, 1–14.
- Mohamad Wuhaib, K. (2017). Genetic Parameters for Sorghum Varieties in Different Population Densities. *International Journal of Applied Agricultural Sciences*, 3(1), 19. <https://doi.org/10.11648/j.ijaas.20170301.12>
- Mulima, E. P. (2017). *Genetic diversity of sorghum ( Sorghum bicolor L . Moench ) germplasm and hybrid potential under contrasting environments in Mozambique By A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy ( PhD ) in Plant Breedin. December, 216.*
- Muluneh, N. A., & Getachew Bekele, B. (2022). Review on Key Bottlenecks of sorghum (*Sorghum bicolor* L. Moench) production and productivity Citation: Netsanet Abera Muluneh and Bewket Getachew Bekele(2022) Review on Key Bottlenecks of sorghum (*Sorghum bicolor* L. Moench) production and productivity. *Global Journal of Agricultural Research*, 10(1), 20–30.
- Muturi W. (2013). *RESISTANCE TO THE AFRICAN AND SPOTTED STEM BORERS By. November.*
- olupot., 2011. (2020). 濟無No Title No Title No Title. *Suparyanto Dan Rosad (2015, 5(3), 248–253.*
- Ostmeyer, T. J., Bahuguna, R. N., Kirkham, M. B., Bean, S., & Jagadish, S. V. K. (2022). Enhancing Sorghum Yield Through Efficient Use of Nitrogen – Challenges and Opportunities. *Frontiers in Plant Science*, 13(February), 1–11. <https://doi.org/10.3389/fpls.2022.845443>
- Pražak, R. (2016). Prospects for sorghum cultivation in Poland. In *Acta Agrobotanica* (Vol. 69, Issue 2). <https://doi.org/10.5586/aa.1661>
- Rakshit, S., Hariprasanna, K., Gomashe, S., Ganapathy, K. N., Das, I. K., Ramana, O. V.,

- Dhandapani, A., & Patil, J. V. (2014). Changes in area, yield gains, and yield stability of sorghum in major sorghum-producing countries, 1970 to 2009. *Crop Science*, 54(4), 1571–1584. <https://doi.org/10.2135/cropsci2012.12.0697>
- Reddy, P. S., Reddy, B. V. S., Kumar, a A., Ramesh, S., Sahrawat, K. L., & Rao, P. V. (2010). Association of Grain Fe and Zn Contents with Agronomic Traits in Sorghum. *Indian Journal of Plant Genetic Resources*, 23(January), 280–284.
- Semahegn, Z., Teressa, T., Asrat, Z., Begna, T., Yali, W., & Gichele, H. (2020). Evaluation of High Land Sorghum (*Sorghum bicolor* L. Meonch) Varieties for Yield Performance. *Journal of Natural Sciences Research*, 11(23), 2018–2021. <https://doi.org/10.7176/jnsr/11-23-03>
- Senbetay, T. (2020). Genetic Variability, Heritability, Genetic Advance and Trait Associations in Selected Sorghum (*Sorghum Bicolor* L. Moench) Accessions in Ethiopia. *Journal of Biology, Agriculture and Healthcare*, 10(12), 1–8. <https://doi.org/10.7176/jbah/10-12-01>
- Sorghum bicolor*. (n.d.).
- Subhashini, S., & Selvi, B. (2019). Association and variability studies in F2 population of sorghum (*Sorghum bicolor* (L.) Moench). *Electronic Journal of Plant Breeding*, 10(2). <https://doi.org/10.5958/0975-928X.2019.00061.9>
- Tarbush, A. (2016). *Evaluation of Sorghum ( Sorghum bicolor ( L ) Moench ) Varieties and Environments for Yield Performance and Stability*. 6(21), 11–17.
- Winchell, F., Brass, M., Manzo, A., Beldados, A., Perna, V., Murphy, C., Stevens, C., & Fuller, D. Q. (2018). On the Origins and Dissemination of Domesticated Sorghum and Pearl Millet across Africa and into India: a View from the Butana Group of the Far Eastern Sahel. *African Archaeological Review*, 35(4), 483–505. <https://doi.org/10.1007/s10437-018-9314-2>