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**RESISTANCE OF COWPEA TO SCAB DISEASE AND DIVERSITY OF
SPHACELOMA SP. OCCURRING IN UGANDA**

BY

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Reg No. 2013/HD02/1879X

**A THESIS SUBMITTED TO THE DIRECTORATE OF RESEARCH AND
GRADUATE TRAINING IN PARTIAL FULFILMENT OF THE REQUIREMENT
FOR THE AWARD OF DOCTOR OF PHILOSOPHY IN PLANT BREEDING AND
BIOTECHNOLOGY OF MAKERERE UNIVERSITY**

FEBRUARY 2017

ABSTRACT

Cowpea (*Vigna unguiculata* L. Walp) is the third most important legume food crop in Uganda with the Eastern and Northern regions accounting for most of the production in the country. However, its mean yield is less than 400 Kg/ha though the crop has a yield potential of 3,000 Kg/ha. Cowpea scab (*Sphaceloma* sp.) is a seed-borne disease and is one of the major constraints of cowpea production in the country, capable of causing yield losses of up to 100%. The disease affects all the above ground parts of the cowpea plant. There is currently a resurgence of the disease in the country leading to significant yield losses in farmers' fields, yet, only one out of the five improved cowpea cultivars recently released in the country is moderately resistant to the disease. The use of resistant cultivars in disease management is the most practical approach, easily adopted and more environmentally friendly. The objectives of this study were to: (i) determine the distribution of scab disease in different cowpea growing agro-ecological zones; (ii) identify sources of resistance and high yield potential; (iii) determine the variability of the Scab fungus (*Sphaceloma* sp) in different cowpea growing agro-ecological zones of Uganda; and (iv) determine the heritability and gene action of the genes controlling scab disease resistance. Field surveys were conducted in 17 major cowpea growing districts in Uganda across three agro-ecological zones in 2013 and 2014, and diseased plant parts were collected from farmers' fields. Amuria and Tororo were hot spots of scab disease in the country with both districts recording severity score of 4 out of a scale of 1-5 and mean disease incidence between 77-92 %. The incidence and severity of scab were significantly ($P < 0.05$) affected by altitude (> 1200 m.a.s.l), cropping systems (intercropped), previous crop grown (legume/cassava) and the cowpea cultivars grown. 100 cowpea lines including five improved cultivars were evaluated at Makerere University Agricultural Research Institute - Kabanyolo (MUARIK) and the National Semi Arid Resources Research Institute (NaSARRI), Serere, between April and July, 2014 in a 10×10 lattice design. Ten lines (SECOW3B, NE4, NE20, NE32, NE49, WC5, WC7, WC16, WC62, and WC67B) were moderately resistant to scab at both locations while one line (NE15) was resistant at both locations and high yielding suggesting that these 11 lines could serve as good parents in breeding for resistance to scab disease. Both morphological (based on colony characters on potato dextrose agar, conidia features, radial growth rate and pathogenicity) and molecular (involving inter simple sequence repeat – ISSR markers and sequencing of internal transcribed spacer – ITS region) approaches were employed to determine the variability of scab fungus occurring in Uganda. 495

pure fungal isolates of *Sphaceloma* sp. comprising 419 from infected leaves and 76 from infected pods were obtained following isolation and culture. Morphological characterization resulted in six morphological and three pathogenicity groups with most of the isolates being slow growing (> 14 days to cover 90 mm diameter petri dish). Through the pathogenicity tests, NE31 and NE70 had the widest horizontal resistance followed by ACC12.2W, Alegi, NE 15, NE 23, SECOW5T and WC 35B. Molecular characterization showed similarity coefficients ranging from 0.0248 - 0.684, suggesting a high degree of genetic variability among the isolates, with greater part of the genetic variation occurring within populations (96%; $\Phi_{PT} = 0.040$; $P < 0.001$) than among populations (4%; $\Phi_{PR} = 0.042$; $P < 0.001$). Mantel test indicated that there was no significant correlations between geographic distance and genetic distance among populations suggesting that, for the purpose of breeding for resistance to the cowpea scab fungus occurring in Uganda, there would be no need to develop different cultivars for the different regions or agro-ecological zones. 11 selected parents were crossed using a half diallel mating design and F_2 plants and the parents were evaluated at MUARIK and Serere to study the heritability and gene action controlling scab resistance. Non-additive gene effects were more important for most of the traits (Baker's ratio < 0.5) except for the number of pods per plant and seeds per pod. Alegi, NE15 and NE48 had significant negative GCA effects for scab disease severity while SECOW5T had significant positive GCA effects for high seed weight and grain yield suggesting that these parent could be selected for breeding for resistance to scab and high yield, respectively. Cross between WC35B*WC66 had high SCA effects for scab severity while six crosses had high SCA effects for high yields across the two locations suggesting that these crosses could be selected and advanced in breeding for resistance to scab and high yield, respectively.