

**INTEGRATING HOST RESISTANCE WITH TOLERANCE IN MULTIPLE
CROPPING SYSTEMS FOR MANAGEMENT OF PLANT PARASITIC NEMATODES
IN SUGARCANE**

CHIRCHIR ALEXANDER KIPKORIR

**A THESIS SUBMITTED IN FULFILMENT OF THE REQUIREMENTS FOR THE
AWARD OF DOCTOR OF PHILOSOPHY IN CROP PROTECTION**

DEPARTMENT OF PLANT SCIENCES AND CROP PROTECTION

FACULTY OF AGRICULTURE

UNIVERSITY OF NAIROBI

-2015-

DECLARATION BY THE CANDIDATE

This thesis, "Integrating Host Resistance with Tolerance in Multiple Cropping Systems for Management of Plant Parasitic Nematodes in Sugarcane" is my original work and has not been presented for a degree in any other University.

Signature..........Date.....30/10/2015

ALEXANDER K. CHIRCHIR (A80/82981/2012)

DECLARATION BY THE SUPERVISORS

This thesis has been submitted with our approval as university supervisors.



PROF. JOHN W. KIMENJU
University of Nairobi

6/11/2015

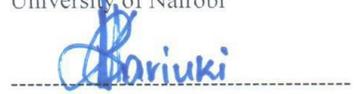
DATE



PROF. EMMANUEL S. ARIGA
University of Nairobi

12/10/2015

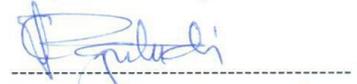
DATE



DR. GEORGE M. KARIUKI
Kenyatta University

6/11/2015

DATE



DR. CHRISPINE O. OMONDI
Kenya Agricultural and Livestock Research
Organization - Coffee Research Institute

30/10/2015

DATE

ABSTRACT

Sugarcane productivity in Kenya has been on the decline over the past decade due to various factors including pests and diseases. Plant parasitic nematodes (PPNs) are known to infest sugarcane fields due to poor agronomic practices that include use of traditional varieties, continuous monoculture and inadequate fertilizer use. A study consisting of glasshouse and field experiments was conducted to assess the potential of integrating host resistance, intercropping and fertilization into nematode management packages to enhance sugarcane productivity and improve food security and income generation for small-scale sugarcane farmers. Fourteen (14) sugarcane cultivars were randomly selected and screened in the glasshouse to determine their resistance status to root-knot (*Meloidogyne* spp.) and lesion (*Pratylenchus* spp.) nematodes, and compared to N14 as the standard. Ten (10) food crops commonly grown in the sugarcane zones were screened in the glasshouse to select those that suppress the lesion and/or root-knot nematodes. Four sugarcane cultivars namely KEN83-737, KEN82-216, Co945 and Co617 showed resistance against *Meloidogyne* spp. Moderate resistance was observed on varieties N14, EAK70-97, KEN98-530, CB38-22, KEN00-13, KEN82-121, KEN82-472, KEN82-493 and KEN82-62. Varieties Co421 and D8484 were susceptible. When exposed to *Pratylenchus* spp., cultivar KEN83-737 showed resistance, CB38-22, KEN82-216, KEN00-13, KEN82-121, Co617, Co945 and N14 were moderately resistant, KEN82-493, KEN98-530, KEN82-62, D8484 and EAK70-97 were moderately susceptible while KEN82-472 was classified as susceptible and Co421 highly susceptible. The intercrops amaranthus (*Amaranthus blitum*) and spiderplant (*Cleome gynandra*) were found to be suppressive to both nematode species while African

nightshade (*Solanum nigrum*) and Jute mallow (*Corchorus olitorius*) were susceptible. Whereas slender leaf (*Crotalaria brevidens*) was suppressive to lesion it was susceptible to root-knot xiv nematodes. Intercropping of sugarcane with an appropriate food crop suppressed nematode populations and produced consistently higher sugarcane equivalent yields (SEY) than sugarcane pure stand. Intercropping KEN83-737 × spiderplant produced the highest SEY of 3.03 followed by Co421 × spiderplant at 2.81. The least SEY was that of N14 × African nightshade at 2.26. Fertilizer application enhanced tolerance of the susceptible cultivar Co421 to nematode inoculation, but this property was not demonstrated for the resistant cultivar KEN83-737. Integration of host resistance with intercropping and fertilizer application influenced nematode populations, sugarcane yields, food production and revenue generation. The lowest SEY was obtained in pure stand sugarcane plots with neither intercrop nor fertilizer. Intercropping sugarcane with spiderplant without applying fertilizer improved SEY by 1.32 times. Applying fertilizer to sugarcane pure stand improved SEY by 1.54 times. However, the highest improvement of SEY occurred when sugarcane was intercropped with spiderplant and fertilizer applied, which increased SEY by 3.22 times. The intercrop of KEN83-737 × spiderplant when fertilized with diammonium phosphate was demonstrated to be the most suitable combination for suppression of plant parasitic nematodes, higher sugarcane yields and better food production and revenue generation. This combination is recommended as it will contribute to the improvement of food security and nutrition. Further, this will contribute to better incomes at the household level, thus has the potential of contributing to the improvement of the livelihoods of the small-scale sugarcane farmers.