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Farmers' knowledge and perception of grain legume pests and their management in the Eastern province of Kenya

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ABSTRACT

Grain legumes play an important role in community livelihood and in the national economy in Kenya. Unfortunately, in many African countries, production doesn't satisfy the demand in grains due to various constrains. Understanding farmers practices and behavior in the management of grain legume pests is a crucial step in the development of sustainable management strategies. A total of 216 farmers were surveyed in eight districts of eastern Kenya to evaluate farmers' knowledge and perceptions of grain legume pests; to examine current pest management practices, and to identify other production constraints. Grain legumes are grown by a wide age-group of farmers, with both genders equally represented. Chemical control remains the main pest management strategy, and, to ensure pesticide effectiveness, farmers also use increased application rates, chemical alternation, frequent application and mixtures of chemicals. While farmers used other control measures, they showed only limited interest in biological control. The majority of the farmers had experience in grain legume farming and were able to identify the major pests, which were the legume flower thrips *Megalurothrips sjostedti* Trybom, the cowpea aphid *Aphis craccivora* Koch and the legume pod borer *Maruca vitrata* Fabricius. Our survey revealed that education and proximity to extension services contributed significantly to farmers' knowledge of grain legume pests, suggesting the need to provide continuous training and capacity building on integrated pest management in grain legume farming. The study also suggests integration of other pest management strategies such as the use of early maturing varieties, biopesticides and biofertilizer to reduce the use of chemical for sustainable pest management.

1. Introduction

Food and nutritional security through diversification of African smallholder production systems is an important requisite for sustainable development in Africa (Heidhues et al., 2004). Grain legumes complement the nutritional value of cereals and enable the sustainable intensification of farming systems through nitrogen fixation, extending land cover, and nutrient utilization by fitting into a wide range of intercropping configurations (Bressani, 1985; Broughton et al., 2003; Tarawali et al., 1997). In Sub-Saharan African countries (SSA), grain legume cultivation directly benefits women who are usually the primary cultivators of these crops and are employed in small scale processing, preparation, and marketing of foods derived from these crops (CGIAR, 2012). Common beans *Phaseolus vulgaris* L., cowpea *Vigna unguiculata* L. and pigeonpea *Cajanus cajan* L. are the three most important food grain legumes in Kenya (Kimani et al., 1994). The production of grain legumes has potential to alleviate food and nutrition security (CGIAR, 2012). Cowpea and common beans are the most popular sources of protein for many Kenyans, particularly for poor people who often cannot afford to buy meat (USAID, 2010).

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The Eastern province of Kenya represents a key area with high potential for grain legume production (Mergeai et al., 2001; Nagarajan et al., 2007). Although Kenya has two growing seasons for grain legumes, a significant number of farmers grow them once a year because of adverse climatic conditions. More than 90% of the total national production of grain legumes, especially cowpea, and approximately 89% of the total planted area is found in the Eastern region of the country (USAID, 2010). Annual production for Kenya is estimated at 65,941 and 436,279 tonnes for cowpea and common beans, respectively (FAO, 2012). This production volume however, is insufficient to meet demand, particularly for dry grains.

Grain legume production is constrained by several factors among which arthropod pests are considered the most important and pest attack occurs during all stages of growth (Abate and Ampofo, 1996; Omongo et al., 1997; Singh and Van Emden, 1978). The diversity of legume pests dictates that a single control strategy is unlikely to produce satisfactory control in a sustainable manner. The goals and values of long-term sustainability must be reflected in combinations of practices and methods consistent with an individual farmer's resources, including technical know-how and farming practices (Ikerd, 1993). Unfortunately, smallholder farmers in developing countries are resource-constrained, and this limits their capacity to pursue the goals of sustainability.

Pest management practices in traditional legume cropping systems are mainly based on chemical sprays combined with some cultural practices such as intercropping with maize *Zea mays* L and crop rotation (Ajeigbe et al., 2010). Integrated pest management (IPM) has long been proposed as the future for sustainable crop production (Pretty and Bharucha, 2015). However, failure by farmers to correctly diagnose pest problems, knowledge of the exact chemical dosage to use, and limited access to external inputs are likely limiting factors that hinder adoption of effective IPM (Midega et al., 2012; Parsa et al., 2014). Farmers still rely on the use of chemical pesticides despite the fact that these are toxic to the environment (Khan and Damalas, 2015a; Khan et al., 2015).

The IPM concept requires new ideas through knowledge of biological interactions and information on the crop and the surrounding environment (Adati et al., 2008) as well as understanding farmers' knowledge and perceptions on the pest constraints and IPM (Nwilene et al., 2008). Therefore, documenting crop protection practices is crucial in the development of sustainable pest control strategies in grain legumes. Hence, the objectives of the study were: (i) to evaluate farmers' knowledge and perceptions of grain legume pests; (ii) to examine farmers' current pest management practices in grain legumes; and (iii) to identify other grain legume production constraints that would impact grain legume productivity in eastern Kenya and the livelihood of the small land holder farmers in Sub-Saharan African countries.

2. Methodology

2.1. Study sites

The study was conducted between April and June 2013 in the main grain legume growing areas in eight districts of the Eastern province of Kenya. These were Embu-East, Machakos, Makueni, Masinga, Mbeere-North, Mwingi, Mwingi-Central and Nzambani (Fig. 1). These sites are located in lower midland, semi-arid agroecology zones that range between 500 and 1200 m above sea level and are characterized by erratic bimodal rainfall with an average annual rainfall of 640–1000 mm (Nagarajan et al., 2007). The main cropping systems comprise cereal crops such as maize *Z. mays* L., sorghum *Sorghum bicolor* L., and pearl millet *Pennisetum glaucum* L. that are generally grown in mixed stands and intercropped with a range of legumes, including common beans *Phaseolus vulgaris* L., cowpea *Vigna unguiculata* L., and pigeonpea *Cajanus cajan* L.

2.2. Data collection

The surveys were conducted through household interviews using a semi-structured questionnaire methodology adapted from Midega et al. (2012). A total of 216 farmers were interviewed by seven teams of trained enumerators. Farmers were selected with the help of Agricultural Extension informants who were also recruited as enumerators. Each team consisted of two enumerators and one of the team members was knowledgeable of the local language and familiar with the targeted study area. The questionnaire was pretested and interviewers translated the questions into the local language, but the responses were recorded in English. Farmers' knowledge of grain legume crop pests was scored by displaying a pictorial guide showing the pest and its damage to facilitate pest recognition by the interviewed farmer.

2.3. Data analysis

For all data, descriptive statistics (means, frequencies and percentages) were calculated. To examine the socio-economic characteristics of the rural households and the differences between districts, gender, and education levels with regard to the perceptions of pests and their management practices, Chi-square tests and one-way analysis of variance (ANOVA) were conducted using JMP statistical software version 5 (SAS, 2002). Significance level was set at 0.05 and means were separated by Tukey HSD test. To evaluate the knowledge of farmers on grain legume crop pests, we considered (1) the farmers' personal characteristics (age, gender, formal education, legume growing experience, and income), (2) exposure to sources of information about pest management and method of control practiced, (3) the perceptions of pest importance for the different grain legume pests; the variable was in terms of crop attack (i.e. no damage, some damage and significant damage), (4) farmers' knowledge of legume pests; this variable was measured using a score from 0 to 3 as follows: a farmer who could not mention a legume pest by a name, description or type of damage was given a score of zero; (i.e. no knowledge = 0); a farmer who gave the name of only one pest, one feature and one type of damage caused by the pest was given a score of one; (i.e. low knowledge = 1); a farmer who was able to give the name of two pests, describe at least one feature of each pest and at least one type of damage caused by the pests was given a score of two; (i.e. medium knowledge = 2). A farmer who was able to name three or more pests, describe one or more features of each, and identify at least one type of damage caused by each pest was given a score of three (i.e. high knowledge = 3). All the categorical and ordinal parameters were compared with the reference district (i.e) Nzambani. Nzambani was selected due to its excentric location with the other growing areas and also with extension services facilities (Fig. 1).

The dependent variable knowledge level was categorical and ordinal, thus we used multivariate ordered probit regression to analyse the data. In the context of this model, the dependent variable takes j ordered categories, where $j = 0$, if the knowledge score is zero, and $j = 3$ if knowledge is high. The observed ordered responses are assumed to be linked to a latent variable z_i that is normally distributed. This link is represented in the following equation: $z_i = \chi_i\beta + \varepsilon_i$, where x_i is a $n \times k$ matrix of explanatory variables, β is a $k \times 1$ vector of unknown coefficients to be estimated, and ε_i is a normally distributed random error term.