Management of snap bean pests by integrating seed dressing, foliar sprays and intercropping with maize

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Abstract
Insect pests remain a major constraint in the production of snap beans and farmers mainly rely on chemical pesticides to manage the insect pests and diseases. However, the introduction of maximum residue levels (MRLs) for export vegetables by European markets pose a challenge to the use of pesticides. This study was carried out to develop sustainable options of managing snap bean pests and reducing chemical residues on snap bean produce. Field experiments were carried out in farmers' fields in Mwea and Embu from July 2013 to January 2014 for two planting cycles under irrigation. The integrated pest management strategies evaluated included: i) seed dressing only, ii) seed dressing followed by three neem sprays, iii) seed dressing followed by two pyrethrid sprays and one neem spray, iv) seed dressing followed by three pyrethrid sprays and intercropping snap bean with maize, v) seed dressing followed by two pyrethrid sprays plus one spray with a biological product, vi) seed dressing followed by two neem sprays plus one spray with a biological product, and vii) two pyrethrid sprays and one neem spray only. The data collected included: emergence, plant stand, nodulation, thrips population, bean stem maggot population, whitefly population, bean yield and pest damage. The combination of seed dressing, two pyrethrid sprays and neem applied at the vegetative stage, early flowering and early podding reduced white fly and thrips population by up to 54% and 60% respectively. Similar results were also observed on plots where seeds dressing was done before planting combined with intercropping with maize plus three pyrethrid sprays at the vegetative stage, early flowering and early podding. Seed dressing had a direct effect on the bean stem maggots that attack the seedling at a very young stage. Spraying with pyrethrin sprays had a quick knockdown effect on the population of whitefly and thrips while the maize intercrop also reduced the pest population. These options also reduced pod damage due to thrips by up to 75 and 93% and increased yield of extra-fine by up to 157 and 162% and fine pods by up to 148 and 135%. The results showed that seed dressing followed by two pyrethrin sprays at the vegetative stage and early flowering stage plus a single spray with Nimbicidine at early podding, sprays and intercropping with maize were effective in managing snap bean pests. This demonstrates that integrated pest management options would be viable alternatives to chemical pesticides thereby enabling farmers meet the strict maximum chemical residue level requirements set by European consumers.

Key words: Phaseolus vulgaris L, seed dressing, bio-pesticides, intercropping, integrated pest management

Introduction
Snap bean (Phaseolus vulgaris L.) is grown specifically for the immature green pods primarily for export market to European Union and elite local urban markets (Infonet-Biovision, 2014). The production of snap bean, one of Kenya's most important export vegetable crops, is steadily rising (HCDA, 2013). Snap beans from Kenya are exported to United Kingdom, France, Holland, Germany, United Arab Emirates and South Africa (HCDA, 2013). Local consumption of snap beans has also increased over the last few years, providing a domestic market (HCDA, 2013). Snap bean production