Evaluation of pesticidal properties of *Euphorbia tirucalli* L. (Euphorbiaceae) against selected pests

Tedson Julius Mwine
Supervisor: Patrick Van Damme
Department of Plant Production, Ghent University

Public defence: 7 February 2011

This thesis is a compilation of original research papers investigating the evaluation of pesticidal properties of *Euphorbia tirucalli* L. (Euphorbiaceae) against a number of pest species. Subsistence and organic farmers in developing countries are faced with a pest and disease dilemma. They are expected not to apply synthetic pesticides and many cannot afford them. Confronted with a shortage of modern technologies like biological control techniques and refined organically acceptable alternatives, farmers have been compelled to turn to traditional means like application of plant extracts which are unfortunately often not researched upon. Indeed, some native farmers are knowledgeable about some pesticidal plants but most do not know the particular pests to use them against, the dose to apply nor how often to apply them. The implication is that even when the extracts would be effective, if they are wrongly applied, they would not perform to expected efficacy. The need of efficacy evaluation for such pesticidal plants is therefore of paramount importance.

As part of a bigger project to evaluate efficacy and utility of pesticidal plants in southern Uganda, this work was guided by the following objectives: a) develop an inventory of pesticidal plants used in southern Uganda in order to establish use and utility of *E. tirucalli* as a pesticidal plant, b) evaluate efficacy of *E. tirucalli* fresh latex on major cabbage pests in the field, c) assess *E. tirucalli* fresh latex efficacy on *Anopheles* mosquitoes in the field and d) establish nematode host status of *E. tirucalli* in order to find out if it is nematicidal or a nematode victim.

Euphorbia tirucalli the pesticidal tree.

First, we report on the utility of pesticidal plants in the Masaka district, southern Uganda, which is an important agricultural district and is slowly converting to organic farming. Because of this conversion, many farmers use synthetic pesticides less and less and are steadily turning to ecological methods like application of plant-based remedies which include E. *tirucalli*. In our study, whose main objective was to record all pesticidal plants used in southern Uganda, Masaka district, it was established that thirty-four species belonging to eighteen families are currently used in traditional plant production. Most useful species are *Azadirachta indica* and *Tagetes minuta*. Most frequently cited families are Meliaceae and Euphorbiaceae. It was noted that of the plant species recorded, some species like *Azadirachta indica*, *Melia azedarach* and *Tagetes minuta* are already scientifically established pesticidal plants whereas others like *Euphorbia tirucalli*, *Bidens pilos* and *Vernonia amygdalina* may be known for other uses but not for this purpose, hence the need for their efficacy evaluation. Some important pesticidal plants like *Euphorbia candelabrum* and *Phoenix reclinata* were reportedly becoming increasingly rare and would need conservation. The need to carry out such surveys in order to obtain inventories was observed and recording this knowledge before it disappears with the aging farmers was seen as urgent.

In another objective, an evaluation of fresh extracts from three locally available pesticidal plants in southern Uganda was carried out against two important cruciferous crop pests i.e. *Brevicoryne brassicae* and *Plutella xylostella* in order to assess their potential for use as pesticides. The research protocol followed the farmers' views that these plants could have pesticidal features as they had been observed to protect a number of leafy crops against pests. The assessment was carried out in the field using naturally infested cabbage plants (*Brassica oleracea*). Results suggest that *Euphorbia tirucalli* latex could reduce infestation of *B. brassicae* below economic threshold levels. Extracts from *Jatropha curcas* and *Phytolacca dodecandra* likewise reduced *B. brassicae* levels but could not do so to required threshold levels. The same extracts were evaluated on the diamondback moth *P. xylostella* but none was able to cause reduction of

the moth's larvae to economic threshold level. It was concluded that E. *tirucalli* latex could be used as a management measure against B. *brassicae* and a factor in integrated pest management of P. *xylostella* infestations.

In yet another study, we assessed the efficacy of E. *tirucalli* latex both as a herbal mosquito remedy and larvicide against *Anopheles fenestus* Giles and A. *gambae* Giles (which are important malaria vectors in Uganda) in a semi-natural environment. Our results indicate that E. *tirucalli* latex can bring about total mortality of *Anopheles* species larvae at the highest dilution used (1: 250) in 5 days. LT 50 and LT 90 for the same dilution were attained at 12 and 36 hours, respectively. Latex was active only for eight days which is typical for herbal biocides, whose advantage is that they do not accumulate in the environment. It is concluded that E. *tirucalli* latex has a high efficacy against *Anopheles* mosquito larvae and could eventually be considered for adoption as a plant-based mosquito larvicide, after further research.

The thesis also reports on nematicidal properties of E. *tirucalli*. We screened *Euphorbia tirucalli* roots and surrounding soil (in natural conditions) to establish its nematode host status as an indicator to its nematicidal position. A number of important phytoparasitic nematode species in East Africa and coincidentally the most abundant in our samples obtained from Uganda were ranked. Results revealed that E. *tirucalli* may either be a poor host to or even nematicidal against *Radopholus similis*, *Pratylenchus goodeyi* and *Helicotylenchus multicinctus* whereas it was shown to be parasitized by *Meloidogyne* spp. It was concluded that while E. *tirucalli* is a victim to *Meloidogyne* spp., to the first three species, it should be considered as a nematicidal plant.

In general, E. *tirucalli* extracts assessed in this work have shown remarkable performance against a number of organisms. However, a number of issues need to be pointed out in relation to the practical applicability of the extracts. We hereby point out that when applying the extracts, low doses should be adhered to in order to minimize their poisonous effects. Even when minimum doses were to be used, there could still be a problem of eco-toxicity. For example, it is known that E. *tirucalli* latex is piscicidal at low doses which points to its toxicity to even larger organisms than arthropods. Combined with a high application frequency (once or twice a week) recommended in the thesis, there is also a possibility of cumulative environmental toxicity. The extracts therefore, need to be used with caution and with as low a frequency of application as possible. However, plant extracts are generally known to get biodegraded easily since they have relatively shorter half-lives than synthetic pesticides which may point to less danger of long term eco-toxication. Although we did not observe the 'silent spring scenario' in our experiments, we presume that some other organisms (other than the target pests) could have been affected by the extracts since they were crude. There is a belief that plant-based pesticides generally have a more mild effect on non-target organisms. However, there is a need to evaluate E. *tirucalli* extracts against beneficial insects/organisms to establish whether and to what extent there is an effect and in order to avoid affecting the ecosystem. The latter problem could be overcome by extraction and purification of active ingredients from the crude extracts. The pure ingredients would then be used against targeted organisms. Further research is therefore needed in numerous application challenges like eco-toxicity, effect to non-target organisms, residual levels on produce as well as soil and water. It would also be interesting to establish the working mechanism of the latex on victim pests.