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IMPACT OF *Mikania micrantha* ON CROP PRODUCTION SYSTEMS IN VITI LEVU, FIJI

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ABSTRACT

A study assessing the economic impacts of Mikania micrantha Kunth. ex. H.B.K. (hereafter, mikania) was conducted using a targeted questionnaire survey in the high rainfall eastern and moderate rainfall western regions of Viti Levu. The survey questionnaire was distributed to 320 (with 59% response rate received) and 275 (with 40% response rate received) farmholders in high rainfall eastern and low rainfall western regions of Viti Levu, respectively. Outcomes of the survey revealed that respondents recognised the negative impact of mikania with a large majority (94% in root crop areas and 100% in sugarcane areas) indicating that they control the weed to prevent crop loss while (76% in root crop areas and 97% in sugarcane areas) do so to prevent the spread of mikania to other areas. A high proportion of respondents in root crop (57%) and sugarcane (66%), indicated that herbicides were the most frequently used management tool for mikania. Controlling weeds was also considered by farmholders as a costly activity, with 35% respondents in root crop areas and 29% respondents in sugarcane areas reporting that they spend AUD $31.00 and $21.00 ha^{-1} on controlling mikania infestations in root crop and sugarcane areas, respectively. Mikania is mostly controlled in production areas leaving non-production areas as reservoirs for reinfestation. Efforts may be best concentrated in managing the weed in both production and non-production areas. In addition, research using an effective biological control agent(s) for mikania in non-production areas would assist in reducing the density and area of infestation of the weed.

Key words: *Mikania micrantha*, questionnaires, crop loss, root crop, sugarcane

INTRODUCTION

Mikania micrantha Kunth. ex. H.B.K. (Asteraceae; hereafter, mikania), is native to Central and South America where the majority of

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the genus is found (Holmes, 1995; Ruas *et al*., 2000). Mikania can reproduce both by its windblown seeds and creeping stems which root at the nodes (Zhang *et al*., 2004). It was introduced into the Asia and Pacific region probably by human intervention (Waterhouse, 1994) and has become one of the major weeds of plantation crops and home food gardens (Abraham and Abraham, 2005; Macanawai *et al*., 2010). Suppression of crop growth and yield loss caused by mikania has been reported in rubber (*Hevea brasiliensis* (A. Juss.) Muell. Arg; Watson *et al*. 1964) and oil palm (*Elais guineensis* Jacq.; Caunter and Lee 1996) in Malaysia and in tea (*Camellia sinensis* (L.) Kuntze (Barbora, 2001; Singh, 2008), pineapple (*Ananas comosus* (L.) Merr. and banana (*Musa* spp.; Abraham *et al*., 2002) in India.

In Fiji, mikania was first reported in 1907 and was found infesting sugarcane fields (Knowles, 1907). Since then, mikania has become a menace to both mid and long-term crops such as sugarcane (*Saccharum officinarum* L.), taro (*Colocasia esculenta* (L.) Schott, cavendish banana *Musa* spp. (AAA group) and cassava *Manihot esculenta* (Robinson and Singh, 1973; Garnock-Jones, 1978; Macanawai *et al*., 2010). The sugarcane farming areas in Viti Levu are centered around Rakiraki, Tavua, Ba, Lautoka, Nadi and Sigatoka towns (Fig. 1). These areas are considered to be within the moderate rainfall region of Viti Levu, which receives a monthly average of 206 hours of sunshine, 21 minimum and 30 °C maximum temperature and 170 mm rainfall (Fiji Meteorological Department 2008). The wetter region of Viti Levu is located in the eastern side of the island covering Naitasiri, Tailevu, Serua, Namosi and Rewa provinces (Figure 1). This area receives a monthly average of 154 hours of sunshine, 22 minimum and 29 °C maximum temperature and 244mm rainfall (Fiji Meteorological Department, 2008).

Although, the presence of mikania is obvious in many cropping systems due to its creeping and smothering habits, its on-farm impact as perceived by farmers in the Pacific region has not been formally documented. This study is a timely investigation into farmholders' and stakeholders' views about the weed. Such information would be helpful in informing decision makers regarding the management of mikania weed should be considered before making decisions to support any project to manage the weed at local or national level. The objective of this study is to evaluate root crop and sugarcane farmers' perceptions regarding the impacts of mikania and its management on crop production systems in Viti Levu by using questionnaire survey.

MATERIALS AND METHODS

Study Areas

The four provinces surveyed in the eastern region (high rainfall areas) of Viti Levu surveyed were Naitasiri, Tailevu, Namosi and

Serua. These provinces were selected as they represent the main root crop production areas in the region. In the sugarcane farming regions (modedrate rainfall areas), the areas surveyed were parts of Ra and Ba provinces covering Rakiraki, Tavua, Ba, Lautoka and Nadi towns.

Farmholders Survey

A targeted survey was undertaken between June and July 2009 to identify and quantify the on-farm impacts of mikania to crop farmers in the eastern region of Viti Levu Fiji. The survey questionnaire used in this study adopted a structure used in assessing the economic impact of lantana (*Lantana camara* L.) in Australia (AECGroup Limited 2007). Our questionnaire in the current study consisted of several question categories including (1) farmholders profile, (2) information on land use, (3) density and extent of mikania infestation (4) control methods used and cost of controlling mikania and (5) other economic impacts of mikania. This approach is often the only cost-effective and feasible way to reach a number of respondents large enough to allow statistically analyses to be conducted (Batjes and Cummings, 2003).

The questionnaire was first prepared in English and then its Fijian translation was also constructed to help Fijian farmers better understand the questions. Considering the ethical aspects of this kind of research, the survey questionnaire was cleared in accordance with the ethical review guidelines and processes of The University of Queensland, Australia. Approval was granted by the Head of the Agriculture Extension Department in Fiji's central division to conduct the survey and engage the agriculture extension officers in the field survey. Assistance was also sought from the office of the Sugarcane Growers Council in Rakiraki, Tavua, Ba, Nadi and Lautoka to facilitate in distributing questionnaires to sugarcane growers. The Agriculture Extension and Sugarcane Growers Council staff work closely with farming communities and have good knowledge of the number and status of farmers in their localities including acreage they have and crops they produce. Staff engaged in the survey were briefed on the questionnaire protocol to ensure they understand the requirements of the survey and have confidence in assisting farmers on the technical aspects of the questionnaires when needed. The questionnaires were hand-delivered to the farmers and collected from farmers by the staff. Due to unreliable postal and communication services in the surveyed areas, hand distribution of the questionnaires approach was chosen over a postal survey. A total of 320 questionnaires were randomly distributed to farmholders in Naitasiri, Tailevu and Serua/Namosi provinces and 275 to sugarcane growers around Rakiraki, Tavua, Ba, Lautoka and Nadi. As part of the questionnaire documentation, the participants' declaration and consent form was included where farmers signed their names, dated and countersigned by respective surveyors.

Survey results were processed using Microsoft Excel and Microsoft Access.

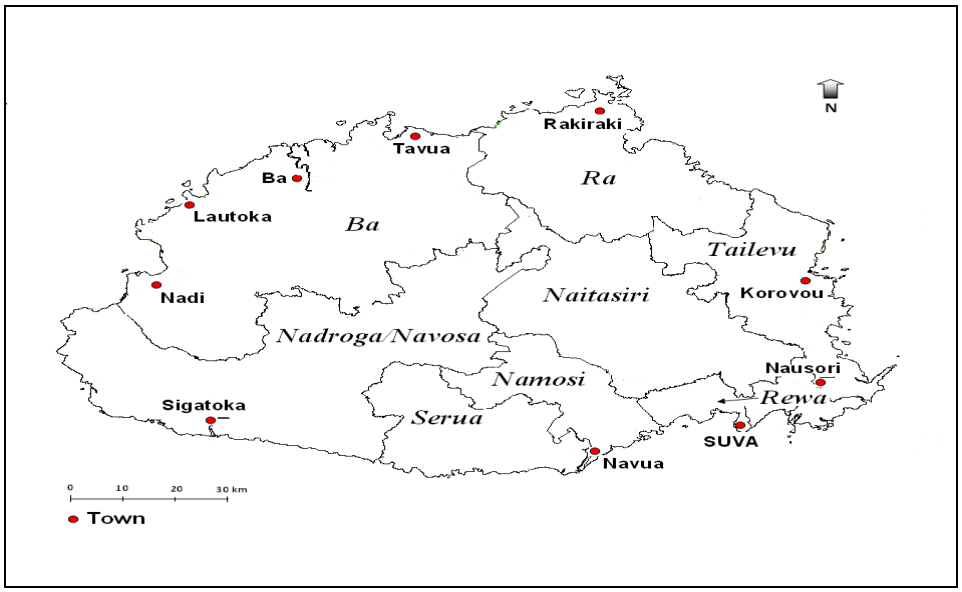

Figure 1. Map of Viti Levu, showing the regions surveyed. Sugarcane farming areas surveyed covering parts of Ra and Ba provinces which includes areas around Rakiraki, Tavua, Ba, Lautoka and Nadi towns and root crop production areas covering parts of Serua, Namosi, Naitasiri and Tailevu provinces.

RESULTS

Of the 320 questionnaires sent to farmers in root crop areas, 164 (59%) responses were received while 92 (40%) were received from the 275 questionnaires sent out to farmers in the sugarcane areas.

Mikania Occurrence and Land Information

A large proportion of respondents (25.5%; n = 42) in root crop areas indicated that mikania plants have been growing on their land for 20-50 years, with 64% (66) of respondents indicating that mikania affects the profit of their farm. In sugarcane areas, 25% (n = 23) of respondents state that mikania has been existing on their farms for 20-50 years, with 84.8% (n = 78) of respondents reporting that mikania affected the profit of their farm

Mikania Density and Extent Of Infestation

Forth-six percent (n = 76) of 164 respondents) of respondents in root crop farming areas reporting that over the past five years, the

area infested with mikania has decreased. Similarly, in sugarcane farming areas 45% (n = 41) indicating that over the past five years the area infested with mikania has increased.

Farmers' Perception on Control

In the root crop areas, 100% (n = 160) of respondents indicating that they control mikania in production areas. About 58% (n = 81) did not control mikania in non-production areas. About 74% (n = 91) did not control mikania in natural reserve and *c*. 2 % (n = 2) were not sure. About 63 % (n = 78) did not control mikania in other public areas and *c*. 1% (n = 1) was not sure. In sugarcane areas, 92% of respondents (n = 85) indicated that they control mikania in production areas. About 56% (n = 47) indicated that they control mikania in non-production. About 66% (n = 48) did not control mikania in natural reserve and *c*. 52 % (n = 38) did not control mikania in other public areas.

Perception on Reasons For Control

In root crop production areas, 98% (n = 155) of respondents indicating that they control mikania in production areas to prevent crop loss and 99% (n = 127) of respondents control mikania in production areas to prevent its spread to other areas. In the non-production areas, 96% (n = 52) of respondents indicated that they control mikania in non-production areas to prevent its spread to production areas and 76% (n = 32) control mikania in non-production areas to maintain the environment. In sugarcane areas all respondents (84) indicated that they control mikania in production areas to prevent crop loss and 97% (n = 73) of respondents indicated that they control mikania in production areas to prevent its spread to other areas. In the non-production areas, 98% (n = 44) of respondents indicating that they control mikania in non-production areas to prevent its spread to production areas and 95% (n = 35) control mikania in non-production areas to maintain the environment.

Perception on Methods of Control

Respondents used a number of methods to control mikania and herbicides was the most common method used in both production and non-production areas in root crop and sugarcane cropping regions (Table-1).

Farmers' Perception on Costs Incurred

Respondents estimated that costs to control mikania increased with the level of infestation irrespective of the region. Costs increased from c. \$30 ha^{-1} for light infestation in root crop areas to over \$45 ha^{-1} for heavy infestations (Figure 2).

Farmers' Perception on Other Benefits

Mikania is perceived to have other benefits such as its uses for traditional medicine, soil improvement and livestock feed. Ninety four

percent (n = 135) of respondents in root crop areas and 42% (n = 31) in sugarcane areas indicating that mikania is useful as a traditional medicine. Sixty eight percent (n = 44) of respondents in root crop areas and 21% (n = 15) in sugarcane areas indicating that mikania is useful for soil improvement. Fewer respondents in root crop (21%; n = 16) and sugarcane (34%; n = 24) specified that mikania is useful as a livestock feed.

Table-1. The percentage of respondents who use different control methods in production and non-production areas in both root crop and sugarcane regions.

Weed control method	Responses (%)			
	Root crop		Sugarcane	
	Production areas (n = 158)	Non-production areas (n = 45)	Production areas (n = 85)	Non-production areas (n = 44)
Herbicides	79	89	85	86
Physical	72	69	85	80
Fire	18	44	29	41
Grazing	0	2	0	2

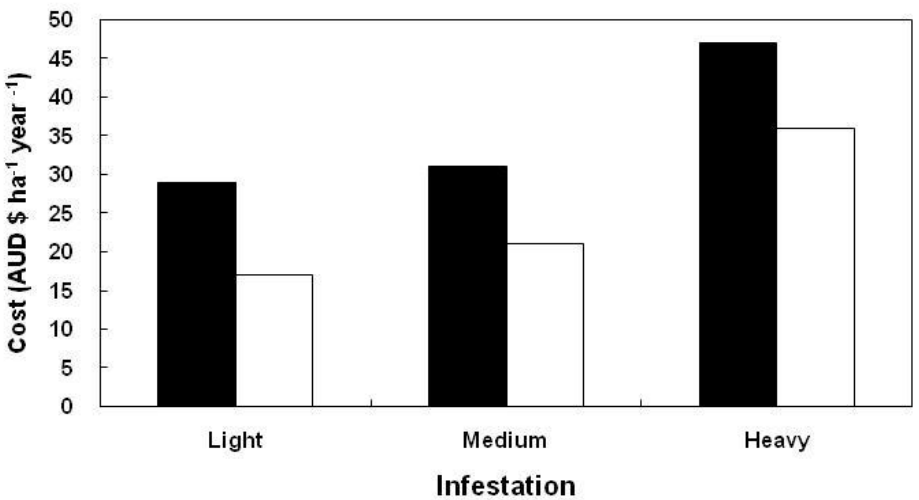

Figure 2. The average cost of controlling light (10,000 plants ha^{-1}), medium (20,000 plants ha^{-1}) and heavy (> 30,000 plants ha^{-1}) infestation of mikania in root crop (■) and sugarcane (□) farms in Viti Levu Fiji.

DISCUSSION

Farmholders' Land Information and Mikania Occurrence

Mikania has been occurring in root crop, banana and sugarcane farms for around 50 years. This suggests that mikania is well known to the respondents and is compatible with soil and environmental conditions in these regions. Not all fields were infested with mikania as the survey showed that *c*. 38 and 52% of existing land area cultivated with root crops and sugarcane respectively were not infested. This implies that the extent of spread of mikania in the high rainfall region is more prevalent than in the moderate rainfall region of Viti Levu.

Farmers' Perception on Control

There were more respondents that did not control mikania in public areas, natural reserves and public areas in the root crop region than in the sugarcane region. This may be attributed to the higher proportion of respondents in the root crop areas (high rainfall) indicating the significance of the weed for traditional medicine and soil fertility than respondents in sugarcane region (moderate rainfall). Herbicide was the most commonly used control method in both crop and non-crop areas in both root crop and sugarcane regions. This is probably due to the better control achieved from the use of herbicide, as opposed to other methods such as slashing where the remnants of the plant can regrow. In the root crop region, some respondents have specified that they used glyphosate and paraquat, two non-selective herbicides, for controlling mikania on their farms whereas sugarcane farmers used numerous selective herbicides including 2,4-D, diuron, MCPA and 2,4-D + dicamba which can kill mikania but are ineffective on sugarcane (Szmedra, 1999).

This study has demonstrated that there is a substantial cost associated with mikania infestations in crop production in the surveyed areas and cost farmers on average *c*. AUD \$31 ha^{-1} in root crop and AUD \$22 ha^{-1} in sugarcane production. The majority of respondents in both root crop and sugarcane regions do not control mikania in non-crop areas, natural reserve and other public areas because they perceived control activities to be a waste of time and financial resources. However, there are some who perceived benefits of the species which caused them not to actively control the weed in non-crop areas. They perceived benefits include improvement of soil fertility and use of mikania for traditional medicine, livestock feed and ground cover. These areas could then be a reservoir for mikania and if these are not managed, will continue to be a source for new infestations in crop areas via fragmented stem sections and wind-blown seeds. It is essential that a cost-effective and sustainable management strategy is considered to reduce and maintain mikania

populations. The outcomes of this study could form part of a suit of information that may be required for an integrated weed management strategy involving all control options, including biological control and legislation. Further investigation into the extent, distribution and spread potential of mikania in the whole country also needs to be explored.

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