AN INVESTIGATION OF IPM PRACTICES FOR PEST CONTROL IN SUGARCANE

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ABSTRACT

The current state of Integrated Pest Management (IPM) in Pakistan sugar industry and emphasizes the need to consider the specific challenges faced by farmers. The study is structured around six key stages to provide a holistic understanding of the subject matter. A thorough compilation of industry pests was conducted, categorizing them into five weed species, 11 arthropods, 11 pathogens and three nematodes. An inventory of current pest control methods was established. This inventory encompassed 15 agronomic, three biological, and four chemical control methods, along with three regulatory approaches. To assess the practicality of these methods for managing 30 distinct pests, an applicability matrix was created, and a specific focus was placed on the suitability of these methods for adoption by farmers. Agronomic methods emerged as the versatile and widely applicable means of pest control in sugarcane production. While regulatory and biological control options showed potential for all farmers, certain techniques within the agronomic and chemical control categories were found to be less feasible for emerging farmers, primarily due to cost-related constraints, such as the application of agrochemicals. This study identified research gaps and recognized eight pests as potential bio-security risks that require dedicated research efforts. Nine prospective pest control methods were highlighted, which could augment and refine existing IPM strategies in sugarcane cultivation. The study culminated in the practical demonstration of IPM principles on a whole-farm scale. By addressing the unique challenges faced by emerging farmers and identifying ways to enhance IPM strategies, this research contributes to the sustainability and success of the Pakistan sugar industry.

Keywords: Sugarcane, IPM, Farmers

INTRODUCTION

Sugarcane may be affected by insects, pathogen, weed and nematode pests (Leslie, 2009). Pests studied in this paper include weeds and pathogens. Some pests have serious economic consequences, reducing the value of crops to below economic thresholds. For example, eldana (Eldana saccharina Walker) can totally destroy the crop (Leslie, 2009), rust (Puccinia melanocephala H&P Sydow) and smut (Ustilago scitaminea H&P Sydow) reduce yields on average by 30% (Rutherford *et al*., 2013), Cynodon dactylon (L) Pers can reduce yields by up to 50% (Campbell et al. 2007) and high nematode populations can cause 60-80% yield losses (Bhuiyan et al. 2019). Control methods are available for these pests, but are often used in isolation rather than being integrated in an optimum manner. In this paper, the feasibility of an integrated management approach is investigated. Integrated Pest Management (IPM) is the knowledge-based integration of all methods that reduce pest levels in crops (Conlong & Rutherford, 2009). As such, IPM covers a wide range of pest control methods, including chemical, biological, agronomic, and regulatory practices that growers can use to mitigate the impact of pests on yields and quality. However, some control methods are not readily adopted by emerging farmers, an increasingly important sector in the industry (Eweg, 2005). This should be quantified to determine how well the needs of this sector are currently being addressed, and to guide future research. The aims of this study were (i) to produce comprehensive lists of the current and potential pests in the industry, (ii) to list the available control methods, (iii) to analyse the suitability of control methods for each pest, and (iv), to illustrate the use of IPM on a whole-farm and area-wide scale.

MATERIAL AND METHODS

This study comprised six stages. 1) researchers drew up a list of industry pests; 2) current control methods affecting pest levels were identified; 3) the control methods were tabulated for each pest, highlighting the suitability for emerging farmers; 4) a matrix was developed that indicated the control methods applicable for each identified pest. Scores were then allocated for each control method depending on the number of pests that could be controlled by the method; 5) research gaps were identified; 6) IPM was demonstrated on a whole-farm and area-wide scale.

RESULTS AND DISCUSSION

A list of 11 arthropod, 11 pathogen, three nematode species and five weed categories was compiled (Figure 1). For stage 2, 15 agronomic methods, three biological control methods, four chemical control methods, and three regulatory approaches were identified (Figure-1).

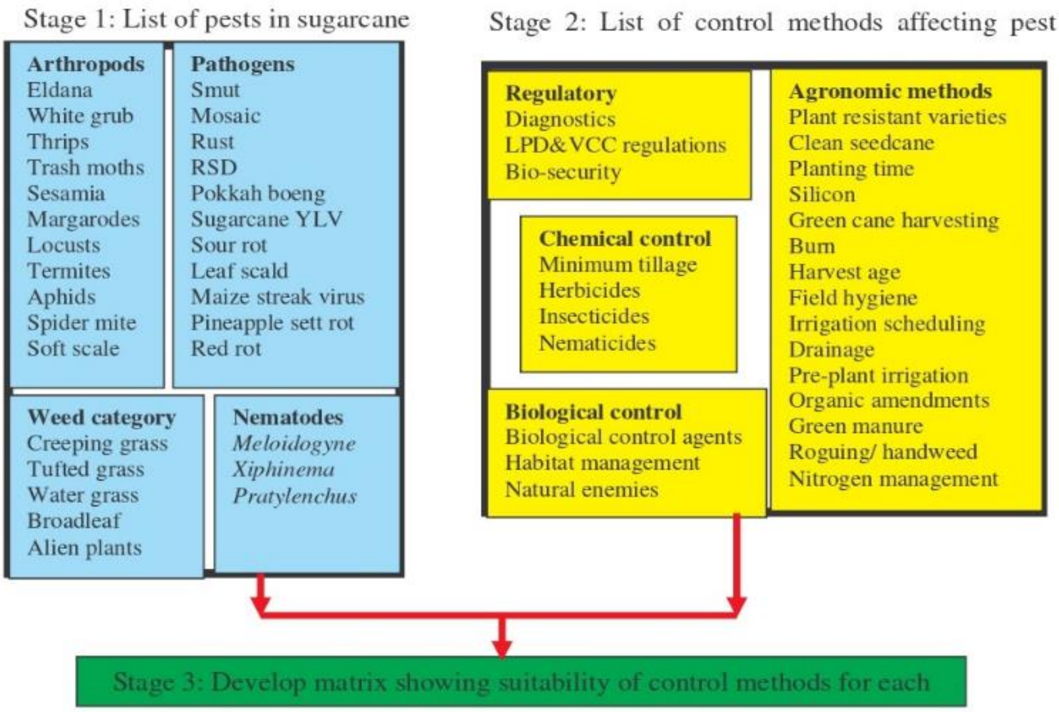

Figure 1. Lists of identified pests and control methods used to develop a suitability matrix.

Agronomic methods include those that improve soil health, thereby increasing crop resistance to pests such as weeds and nematodes (van Antwerpen, 2005; Berry and Rhodes, 2006; Rhodes et al., 2009). Regulatory approaches by Local Pest, Disease and Variety Control Committees (LPD&VCCs) include diagnostics (threshold values and surveillance) and regulations governing orders for plough-out and seedcane transport, as well as bio-security (prevention of the introduction of new pests). For the latter, imported varieties are screened before permitting external sugarcane consignments from being planted, thereby becoming a control method that prevents pests spreading into the local industry (van Antwerpen *et al*., 2005). Biological control methods include release of agents for alien plant control, natural enemies (e.g. parasitoids) for eldana, and habitat management. The latter includes the judicious planting of ‘push-pull’ species (BT maize, Melinis minutiflora, Cyperus dives) that attract or repel eldana away from sugarcane (Conlong and Rutherford, 2009). Chemical control methods include application of herbicides to control weeds

(Campbell, 2008) or for cane stool eradication (minimum tillage), fungicides to control diseases such as smut and sett rots, Fastac® for eldana control in carry-over sugarcane and nematicides to control root-feeding nematodes in sugarcane (Donaldson, 1985).
A summary of scores from the pest x control method matrix tables is presented in Table 1, highlighting their applicability to commercial and emerging farmers. Agronomic methods were the most frequently used approaches to pest control in sugarcane. Highest scoring agronomic practices used to control all 30 listed pests in sugarcane were: planting of pest resistant varieties, practicing field hygiene, selecting the best planting time, and planting clean seedcane. Regulatory and biological control methods were applicable to all farmers, whereas seven agronomic and eight chemical control methods were not currently suitable for emerging farmers. This was primarily cost-related, e.g. chemical control in Table-1.

Table-1 Summary of total scores from the pest x control method matrix tables

Control method	Commercial farmer	Emerging farmer	Difference
Agronomic	79	72	-7
Regulatory	34	34	0
Chemical	18	10	-8
Biological	6	6	0
Total	137	122	-15

Here, eight pests were regarded as potential biosecurity risks, requiring future research efforts. These included one pathogen (orange rust, Puccinia kuehnii EJ Butler), three arthropods (Chilo sacchariphagus, Sesamia spp., Busseola spp.) and four weeds (Digitaria spp., Conyza, Parthenium and Cyperus rotundus). Nine potential control methods were identified for possible future research: four agronomic, four chemical and one biological approach. It was recognized that further research efforts should consider suitability for use by emerging farmers. An integration of methods for seven important industry pests was illustrated with a whole farm scale map, based on its land-use plan, with timetables for action (e.g. harvesting). For example, the damage from eldana was expressed as percentage stalk length red (%SLR) on a per field basis (Figure-2a). Recommended treatments for eldana control were related to the severity of the damage (Refer to Figure 2b). Options were to (a) leave the field (eldana levels were below the economic threshold), (b) harvest the field (agronomic control) rather than 'carrying over' the sugarcane after mill closure, (c) habitat management (biological control) or (d) aerial application of Fastac® (chemical control) to carry-over fields (Figure 2b). Use of such recommendations need to be adapted to local conditions, as discussed by McElligott (2008). Some control methods would not be restricted by farm boundaries, and are well suited to area-wide use, e.g. release of biological control agents, habitat management, diagnostics and LPD&VCC regulations (Conlong and Rutherford, 2009).

CONCLUSIONS

While many of the control methods presented can be adopted by emerging farmers, suitability for adoption was constrained largely by cost, for example, chemical control. Future research should consider this factor, as this is recognized as an increasingly important industry sector.
High-ranking pests do not always have a commensurate number of control options. For example, white grub, rust, purple water grass.
Pests identified as potential bio-security risks will require timely research effort.
Agronomic methods of control were shown to be the most widely applicable to control pests in sugarcane. Highest scoring agronomic practices for pest control were: planting of pest-resistant varieties,

practicing field hygiene, selecting the best planting time, and planting clean seedcane. An holistic approach that implements IPM for all pests on a farm-scale and even areawide scale is considered to be more cost-effective, more environmentally friendly, more sustainable and more easily adopted by all farmers.

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