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Weed management in sugar cane: critical periods of weed competition and mechanisms of interference from *Paspalum paniculatum* and *P. urvillei*

By

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Submitted in fulfilment of the requirements for the degree PhD (Agronomy) in the

Department of Plant Production and Soil Science

Faculty of Natural and Agricultural Sciences

UNIVERSITY OF PRETORIA

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October 2008

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DECLARATION

I declare that the thesis, which I hereby submit for the degree of PhD (Agronomy) at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

Signature 1 October 2008

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to the following people for their support and assistance throughout my study:

Prof Charlie Reinhardt for promoting my study; his continuous availability, both for academic and administrative purposes, has never make me feel distant from the campus. Moreover, for the guidance and sharing of his experience on allelopathy for making this study more complete.

Dr Peter Lutman for his supervision, guidance, highly pertinent suggestions and critical evaluation throughout the whole duration of this thesis. Dr Lutman has also showed great patience in reading and reviewing the manuscripts.

Dr Jean Claude Autrey, Director of the Mauritius Sugar Industry Research Institute (MSIRI) till June 2007, for his support in undertaking this study and making all necessary resources available.

Dr René Ng Kee Kwong, Director of MSIRI as from July 2007, for the continuing support and facilities for completing this thesis.

My wife Shashi, my daughter Swarna and my son Salil for their love, support, patience and caring over the years.

My colleagues of the Cultural Operations and Weed Agronomy Department, namely Messrs C. Barbe, A. Gaungoo and F. Ismael for their assistance in implementing and monitoring of some trials. The trials would have not been completed without the invaluable help of Messrs F. Nagen, R. Padichy and S. Tajah, Field Assistants in the department.

Among other colleagues at the Institute, Mrs Chinta Ramnawaz for regular statistical assistance, and Mrs Aneeza Soobadar for her help with respect to the chemical analysis.

All the Managers, Field Managers and Agronomists of sugar estates involved in the field trials for their usual and kind support in making land, labour and other resources available.

And anybody I missed who deserves a mention.

LIST OF ABBREVIATIONS

a.e. - acid equivalent

a.i. - active ingredient

AYL - acceptable yield loss

CPWC - critical period of weed competion

CV - coefficient of variation

GDD - growing degree days

IWM - Integrated Weed Management

L_w - relative leaf area

MSIRI - Mauritius Sugar Industry Research Institute

MUR - Mauritian rupee

q - relative damage coefficient or relative competitiveness value

TD - transplanting date

WAH - weeks after harvest

WAP - weeks after planting

WAS - weeks after spraying

WAT - weeks after transplanting

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ABSTRACT

The aim of this project was to provide sound scientific underpinning for the development of new weed management strategies in sugar cane by exploring competition from the major weeds, and explaining the different mechanisms of weed interference from *Paspalum paniculatum* and *P. urvillei*.

Critical periods of weed control (CPWC) were studied in six field trials. In ratoon cane, CPWC with natural weed infestations started between 228 and 916 growing degree days (GDD), and ended between 648 and 1311 GDD, depending on the site and cane variety. These results represented a maximum CPWC of 12 to 28 weeks after harvest (WAH). In plant cane, the CPWC started earlier (6 WAP) and was longer than those in ratoon cane.

Relative competitiveness 'q' values of eight common weed species showed that sugar cane was a stronger competitor than most of the weeds tested. The adverse effect of weed competition in sugar cane is not experienced before several weeks following weed emergence. Weeds transplanted 10 WAP caused no significant change in cane yield response as compared to those transplanted 4 WAP. *Paspalum paniculatum* was often found to be more competitive than *P. urvillei*, although the latter produced more leaf area and grew taller to intercept more light within the canopy. This indicated that other mechanisms of weed interference were involved and competition for light was more important during the earlier (tillering) growth stages. Root competition was shown to be as important as shoot competition. Root competition effects were observed several weeks after imposing competition, suggesting that it was more important than competition for light in the post-tillering phase. Application of root exudates from the two grasses to sugar cane confirmed an allelopathic effect on the

root biomass of sugar cane. One chemical identified in the leachates from both *Paspalum* species for the allelopathic effects was 2-propenoic acid, 3-(4-methoxyphenyl).

The main implications of the above findings for the Mauritian sugar industry would involve a change in the timing of application of herbicides. A new tank-mix consisting of trifloxysulfuron + ametryn and amicarbazone has been found to meet this objective. This strategy will enable a saving of at least one herbicide treatment per season.

Key words: relative competitiveness, shoot competition, root competition, allelopathy, herbicide