UNIVERSITI PUTRA MALAYSIA

IMPACT AND MANAGEMENT OF WEED FLORA IN CASSAVA IN WEST COAST REGION OF PENINSULAR MALAYSIA

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FP 2018 74

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By

ABDULLAHI MUSA A'IHI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirements for the Degree of Doctor of Philosophy

May 2018

DEDICATION

This is exceptionally dedicated to:

My blessed late Mother and Father who led a successful farming life together.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Doctor of Philosophy

IMPACT AND MANAGEMENT OF WEED FLORA IN CASSAVA IN WEST COAST REGION OF PENINSULAR MALAYSIA

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May 2018

Chairman : Professor Abdul Shukor Juraimi, PhD
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Cassava (*Manihot esculenta* Crantz) is an important root crop providing carbohydrate for more than 200 million people mostly in Africa and to some extent in Asia and Latin America. Cassava production in the tropics is confronted with several problems of which weed is the most significant because it causes yield loss. Weeds affecting cassava adversely by competing for light, nutrients, water and space. This research work is embarked upon with the objectives; i. To identify weed species that infest cassava crop, ii. To estimate the yield loss in cassava caused by weed infestation and competition, iii. To determine the critical periods of weed competition in cassava and, iv. To evaluate the most appropriate and efficient weeds management strategy in cassava.

Weed survey was conducted in the cassava fields across west coast of Peninsular Malaysia. A total of 55 weed species were identified in the survey; 22 species belonging to 14 families in Selangor, 16 species belonging to 14 families in Johor and 17 species belonging to 15 families in Perak. The additional one (1) species observed in Perak was the spiderwort species of Commelinaceae family. Poaceae (29.1%) and Asteraceae (27.3%) families dominated cassava fields in peninsular Malaysia. Other families were Cyperaceae (9.1%), Euphorbiaceae and Rubiaceae (5.5% each), Convoluvolaceae, Amaranthaceae and Mimosaceae (3.6% each), Malvaceae, Acanthaceae, Leguminaceae, Boraginceae, Capparidaceae, Portulacaeae and Commelinaceae (1.8% each).

Study on the competition between three varieties of cassava- Sri Kanji 2, Sri Pontian and Sri Medan versus weed species showed that cassava yields were significantly reduced in the weedy plot as follows: Sri Medan (79.4% yield loss) > Sri Kanji 2

(74.9.% yield loss) > Sri Pontian (69.7% yield loss). The results of critical periods of weed competition study showed that weed free period in cassava is between 20-170 days after planting at 5% tolerable yield loss and 30-155 days after planting at 10% tolerable yield loss. Study on weed management showed that herbicide treatments are better than mechanical in efficacy and systemic herbicides are better than the contact herbicides. It also showed that diuron is the overall best herbicide for controlling weeds in cassava field.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

KESAN DAN PENGAWALAN RUMPAI DI KAWASAN UBI KAYU DI PANTAI BARAT SEMENANJUNG MALAYSIA

Oleh

ABDULLAHI MUSA A'IHI

Mei 2018

Pengerusi : Profesor Abdul Shukor Juraimi, PhD
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Ubi kayu (*Manihot esculenta* Crantz) merupakan tanaman akar atau ubi yang penting dalam menyediakan sumber karbohidrat kepada lebih dari 200 juta orang seluruh dunia terutamanya di Afrika, Asia dan Amerika Latin. Pengeluaran ubi kayu di kawasan tropika behadapan dengan berbagai masalah terutamanya persaingan rumpai yang menyebabkan kehilangan hasil ubi kayu yang segnifikan. Rumpai memberi kesan yang buruk kepada ubi kayu kerana bersaing untuk mendapatkan sumber cahaya, nutrisi, air dan ruang. Kajian dilakukan dengan objektif; i. Untuk mengenal pasti sepsis rumpai yang tumbuh di kawasan ubi kayu, ii. Untuk menganggarkan kehilangan hasil ubi kayu yang disebabkan oleh persaingan rumpai, iii. Untuk menentukan tempoh persaingan kritikal bagi rumpai di kawasan ubi kayu dan, iv. Untuk menilai strategi kawalan rumpai yang paling baik dan berkesan di kawasan ubi kayu.

Kajian survei rumpai dijalankan di ladang ubi kayu di kawasan pantai barat Semenanjung Malaysia. Sebanyak 55 spesies rumpai telah dikenalpasti, di mana sebanyak 22 spesis rumpai tergolong dalam 14 famili di Selangor, 16 spesis rumpai tergolong dalam 14 famili di Johor dan 17 spesis rumpai tergolong dalam 15 famili di Perak. Satu (1) spesis rumpai yang dikenalpasti di Perak adalah 'Spiderwort' daripada famili Commelinaceae. Rumpai dari famili Poaceae (29.1%) dan Asteraceae (27.3%) mendominasi tanaman ubi kayu di seluruh semenanjung Malaysia. Famili lain ialah Cyperaceae (9.1%), Euphorbiaceae dan Rubiaceae (5.5% masing-masing), Convoluvolaceae, Amaranthaceae dan Mimosaceae (3.6% masing-masing), Malvaceae, Acanthaceae, Leguminaceae, Boragnaceae, Capparidaceae, Portulacaeae and Commelinaceae (1.8% masing-masing).

Dalam kajian persaingan rumpai dan ubi kayu didapati hasl ubi kayu telah berkurang secara signifikan di dalam plot berumpai mengikut aturan berikut: Sri Kanji 2 (74.9%) >Sri Pontian (69.7%) > Sri Medan (79.4%). Kajian tempoh kritikal persaingan rumpai dan ubi kayu mendapati rumpai perlu dikawal dalam tempoh 20-170 hari selepas tempoh penanaman dan 30-90 hari selepas tempoh penanaman (5% dan 10%, TYL). Kajian pengurusan rumpai menunjukkan kawalan kimia adalah lebih berkesan berbanding kawalan fizikal, kawalan racun sistemik lebih berkesan berbanding racun rumpai sentuh.

ACKNOWLEDGEMENTS

All thanks, all praises and all exaltations are solely due to Almighty Allah, The Lord of the universe, who made this task a reality and successful. Alhamdulillahi Rabbi l Alamin.

I must afterwards register my appreciation and lifelong gratitude to my amiable supervisor, Professor, Dr. Abdul Shukor Juraimi for his continuous support, invaluable guidance, care and encouragements especially, when I feel like opting out due to domestic challenges. Infact any success recorded of this study is largely as a result of his step by step guidance and enlightments in collaboration with my supervisory committee.

My profound gratitude also goes to every member of my supervisory committee, Dr.Mohd Ridzwan Abdul Halim, Dr. Md. Abdul Hakim and Dr. Mohammad Saiful Ahmad Hamdani.

I also pay special respect and tributes to various authors, writers and senior researchers whose literatures were reviewed or consulted in this work. I also express my profound gratitude to all the Professors and Lecturers in the Department of Crop Science, Faculty of Agriculture, Universiti Putra Malaysia for their good teachings, encouragements and invaluable suggestions. I am also indebted to all technical staff especially Mr Muhammad Yunus Abdul Wahab, Laboratory Assistant attached to weed science laboratory for all his timely attention and assistance, especially during my Survey of cassava fields in west coast region of peninsular Malaysia.

I am also indebted to Mr P. N. Ojo, My Agric. science teacher in secondary school who laid this foundation for me, Mr Ononamadu E.O., Dr. Agunsoye, J.K. and Mall. Okomanyi, O.A., all of the Agricultural Education Department of Federal College of Education Okene. I am also very much indebted to Professor M. A. K Smith of the Federal University of Technology Akure, Nigeria who set me on my Academic life journey. I thank the Tertiary Education Trust Fund (TETFUND) of the Federal government of Nigeria, as well as the management of Federal College of Education Okene for their financial support. I am indeed grateful to my wives, children, brothers and sisters of the Muslim Ummah of Nigeria (M.U.N), Ogaminana for all their supports.

As a hopeful Scholar, I humbly accept responsibility for whatever defect found in this work. All praises are solely due to Allah Subhanahu Wa Ta'ala, The All Knowing All Wise.

This thesis was submitted to the Senate of the Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ABL	Annual Broadleaf
AG	Annual Grass
AI	Active ingredient
ANOVA	Analysis of Variance
AS	Annual Sedge
AY	Actual Yield
AYL	Actual Yield Loss
CON	Controlled
CPWC	Critical Period of Weed Competition or
Critical	Period of Weed Control
CNPY	Canopy
CW	Canopy width or canopy girth
D	Density
DF	Degree of Freedom
DAE	Day after Emergence
DAP	Day after Planting
F	Frequency
FU	Field Uniformity
MFD	Mean Field Density
PBL	Perennial Broadleaf
PG	Perennial Grass
PS	Perennial Sedge
PSW	Perennial Spiderwort
RA	Relative Abundance

RD	Relative Density
RF	Relative Frequency
RIV	Relative Importance Value
SDR	Sum Dominance Ratio
TRT	Treatment

CHAPTER 1

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is an important root crop that provides carbohydrate for over 200 million people mostly in Africa and to some extent in Asia, the Pacific and Latin America (Abdullahi et al., 2014). It is the third largest source of food carbohydrates in the tropics, after rice and maize (Fauquet & Fargette, 1990) and a major staple food in the developing world, providing a basic diet for every household though in diversified manners depending on accorded values and localities. According to Aung (2018), it is one of the major staple foods in the developing world that provides a basic diet for more than half a billion people and required raw materials for the teaming agro allied industries and confectionaries. Evangelio (2000) observed that these and many more potentials of cassava are being jeopardized by the menace of weed flora in our arable lands in the tropics and sub tropics, which call for urgent and adequate attention for sustainable production and maximization of the benefits of the crop.

Weed infestation is a serious problem in the regions because its development is favoured by high humidity, high average temperature and heavy rainfall (around 1900mm) per annum. They are the most common and most prevalent pests of crops in the world especially in the tropics where annual rainfall and relative humidity favours all plant species. Weeds cause more losses to farmers in the tropics than in any other part of the world because of their relative abundance almost all the year round (Moura et al., 2014) and compete with crops for water, light, nutrient and space (Akobundu, 1987).

Weeds are vegetation or plants growing where they are not wanted. They are plants adapted to disturbed or undisturbed habitats (Gorsi et al.,1991) affecting the agricultural crops adversely by competing with them for light, water and nutrients. They compete with crops for these production resources to the disadvantage of the crops (Chauhan et al., 2012).

Apart from economic loss, rising cost of production, waste of labour and time, they also place limitation to the sizes of farm holding and specializations in the tropics (Smith & Akande, 2000). Weed is the most serious pest of cassava plant on the field. It is the number one enemy the farmer has to contend with if he means to sustain production. A weed free cassava field is a healthy environment for viable and vigorous root storage output.

Hitherto, weed science was not accorded befitting significant attention other than general crop agronomy. But the consequences of invasion of weed flora and their menace in tropical agriculture especially in food crop production recently, makes it

now a universal discourse with crop specifications. However there is still scanty information on tropical weeds of arable croplands in the humid and sub humid tropics. This study is therefore focused on Cassava (*Manihot esculenta* Crantz), its' assuming status among staple food crops in Africa, Asia and the Pacific as being jeopardized by the menace of tropical weed flora. Cassava farmers are gaining too little from their efforts because of the competition and impacts of weed flora in yield reduction. About 54% cassava yield loss were recorded in Umudike, Nigeria (Melifonwu, 1994) and 69% in Brazil (Albuquerque et al., 2008). Weed could lead to total yield loss in cassava if not checked timely and properly.

Cassava is becoming realistically more acceptable and economically valuable day by day, but the challenges of pests, diseases and weeds in particular constitute fear and setbacks for the development of cassava production business in the tropics (Aung, 2018). For optimum yields, cassava requires prompt and effective weed control, especially during establishment phase of the crop. According to Tan et al., (1995) and Nweke (2004), the constraints in cassava production includes a wide range of technical, institutional and socio economic factors such as crop management problems, land degradation, shortage of necessary inputs, unstable food policies, access to markets, limited processing and storage facilities, inefficient and ineffective extension services for most localized farmers and problems posed by pests and diseases. However the adverse effect of weed species infestation and competition in crop reduction cannot be scored low. The problem of weeds in cassava fields is a major setback to the farmers, right from the onset of production function (Chauhan et al., 2012).

The scanty documentation on Cassava weeds, especially in Asia and Malaysia in particular, prompt the main motive of this study as a little stride for suggesting possible ways of curbing the problems posed by weed flora in cassava fields with the intent of making a blue print as a basal document for weed managers and prospective researchers in the area of study. Weed communities vary differently and also adapt differently to variety of crops depending on agro-ecozone (Akobundu, 1987). Many proficient cassava producers in the zone are toiling day and night to optionally produce the crop for himself, his family and immediate market, but their efforts are almost rendered wasteful by the infestation of unwanted flora of different species. It has been observed that not much is realized from the very much intensified efforts of the farmers to boost production even when they exhaust all available agronomic, cultural , chemical inputs and managerial skills because of the exerting pressure of pests especially weeds (Melifonwu et al., 2000; Nweke, 2004).

Different types of weeds occur in cassava fields causing considerable losses to the farmers apart from increasing the overall cost of production and labour wastages in different areas and localities. Weeds alter the health, vigour, quality and quantity of cassava tubers and crop by competing with the crops for light, water, nutrients and other inputs intended to boost production. According to Albuquerque et al., (2008) the management of these weed flora incures economic losses and increases cost of

production as well as waste of labour when they become critical. Weeds infestation significantly alters the ecology of the crop and the entire ecosystem in a diversified manner. In most cases weeds are hazardous in our environment even though we consider them useful in some ways.

Previous studies carried out in Africa, Brazil and Canada revealed that cassava is also occasionally damaged by weeds of allelopathic influence and some parasitic weed species. Numerous kinds of weeds were associated with cassava in the regions previously studied which included *Imperata cylindica*(Spear grass), *Cynodon dactylon* (Bermuda grass), *Panicum maximum* (guinea grass), *Pennisetum polystachion* (the feathery Pennisetum) etc. The sedges occurring on cassava fields include *Mariscus alternifolius* and the purple nut sedge, *Cyperus rotundus*. The broadleaved weeds are either herbs, creepers, climbers or shrubs whose stems are solid and irregular in shape, their leaves are broad, expanded, single or subdivided into leaflets to form compound leaves and highly competitive. They include *Chromolaena odorata* (Siam weed), *Euphorbia heterophylla* (Wild poinsettia), *Mimosa invisa* (giant sensitive weeds), *Tridax procumbens* (Tridax weed), *Ageratum conyzoides* (goat weed), *Talinum fructicosum* (Waterleaf), *Amaranthus spinosus* (Wild Amaranth), and *Commelina benghalensis which are* tropical spiderworts (Smith & Akande, 2000).

Atser et al., (2017) declared that prompt and adequate weed management is the only reassuring trend for successful crop production in the tropics. Thus, the justification of this study includes the need to identify the dominant weed species in the cassava fields and their peculiar characteristics which usually give them edges over our cultured crops; It is also necessary to develop appropriate control measures and weed management technology for minimizing their population in cassava fields if their total elimination is proven difficult. This study is thus necessitated by the need to identify the weed species causing yield loss in cassava plantation, quantifying the quantum of yield loss due to weed competition and the need to make a little effort to reduce the problem of scarce information on cassava weeds and their management strategies in the region for sustainable production. Therefore the research work was embarked upon with the following objectives:

i. To identify weed species that infest cassava crop,
ii. To estimate the yield loss in cassava caused by weed infestation and competition,
iii. To determine the critical periods of weed competition in cassava and,
iv. To evaluate the most appropriate and efficient weeds management strategy in cassava.

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