INFLUENCE OF TWO CONTRASTING CASSAVA (*Manihot esculenta* Crantz) CANOPIES ON WEED CONTROL AND CASSAVA YIELD

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We certify that this work was done by OLA Oluwaseun Temitope in the Department of Crop Production and Protection in partial fulfillment of the requirements for the award of the degree of Master of Science in Plant Science, Obafemi Awolowo University, Ile-Ife.

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DEDICATION

This work is hereby dedicated to the Almighty God.

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ABSTRACT

The study assessed the effect of cassava canopy on weed biomass reduction and determined its effect on weed floral composition. It also evaluated the relative effect of weed incidence on the yield of two varieties of cassava with a view to evaluating the influence of two contrasting cassava canopies on weed control and cassava yield.

Two cassava cultivars with contrasting canopy architectures (TMS 30572 and TME 1) were selected for this study in two locations of different soil characteristics at the Teaching and Research Farm, Obafemi Awolowo University, Ile-Ife, Nigeria using a randomized complete block with a split plot arrangement laid in three replications. The weed control treatments (hand-weeded, herbicidal treatment, unweeded check) constituted the main plot while cassava cultivars (TMS 30572, TME 1) were the sub-plots. The weed control treatments were separated from one another by 1 m spacing while an alley of 2 m separated the replicates. The cassava cultivars were planted 1 m × 1 m to have 12 rows per sub-plot with 288 plant density. This amounted to 5,184 per hectare. Each sub-plot was separated by 1 m. Crop data collected were establishment count, crop height, canopy diameter, stem diameter, number of sprouts per stand, number of leaves, and leaf area. Data taken on weeds were fallow weed species composition, weed density, frequency of occurrence, fresh weight and dry weight. These data were collected at monthly interval until nine months after planting. Data taken at harvest were total number of tubers, total number of rotten tubers, fresh root weight, shoot fresh weight, root dry matter, Similarity Index and Shannon Wiener index (*H′*). Data collected were subjected to analysis of variance (ANOVA) to analyze main plot effect, sub-plot effect and interaction between the main plot and sub-plot

effects. The significant effect mean values were compared using the Least Significant Difference (LSD) and the Duncan Multiple Range Test (DMRT) at 5 % level of probability, where appropriate.

The results of the study revealed that in Location 1, the canopy diameter of TMS 30572 was broader than that of TME 1 by 45.4%. TMS 30572 significantly ($P<0.05$) lowered weed flora (species) composition by 55.5% but not the frequency of weed occurrence in the unweeded plots. TMS 30572 suppressed weed growth by 20% in unweeded plots when compared to TME 1. The weed interference in unweeded TMS 30572 reduced cassava fresh root yield by 63% when compared to the yield in the hand-weeded plots. In the same location, TME 1 reduced weed flora (species) composition by 44% but not the frequency of weed occurrence. The root fresh yield of TME 1 was reduced by 70.8% in the unweeded plots when compared to the yield in the hand-weeded plots. In Location 2, the canopy diameter of TMS 30572 was broader than that of TME 1 by 42.4%. TMS 30572 significantly ($P<0.05$) reduced weed flora (species) composition by 53.3% but not the frequency of weed occurrence in unweeded plots. TMS 30572 in the unweeded plots suppressed weed growth by 30% when compared to TME 1. The fresh root yield of TMS 30572 was reduced by 68.5% due to season-long weed interference when compared to the yield in the hand-weeded plots. However, in the same location, TME 1 lowered weed flora (species) composition by 33.3% but not the frequency of weed occurrence which was generally high. The root fresh yield of TME 1 was reduced by 77.5% in the unweeded plots when compared to the yield in the hand-weeded plots.

The study concluded that TMS 30572 has a better weed-suppressing ability than TME 1. The broader canopy architecture of TMS 30572 enabled the cultivar to intercept maximum solar radiation for greater assimilate supply to the storage roots and higher fresh root yield than TME 1, even when weeds were left to grow with the crop throughout the season.

CHAPTER ONE

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is a perennial shrub which serves as one of the common food crops grown and consumed in many parts of Africa (James *et al.*, 2000; El-Sharkawy, 2004). Recent research report reconfirmed that cassava originated in the lax forests of the Central Brazilian State of Goiás (Allem, 2002). It is an important source of energy in the diet of about 600 million people in the tropical countries. The global production in 2010 was 229,540,896 t from 18,457,612 hectares of land (FAO, 2012). The annual cassava production in Africa was 95,336,232 t from 11,013,777 ha of land in 2000 however, annual production increased to 121,360,638 t from 11,870,412 ha of land in 2010 (FAO, 2012). Nigeria was the fourth largest producer of cassava in 1961 after Brazil, Indonesia and Congo with 7,384,000 t from 780,000 ha of land (FAO, 2012). However, Nigeria became the world's largest producer of cassava in 2000 with 32,010,000 t from 3,300,000 ha of land while in 2010, 37,504,100 t was produced from 3,125,340 ha of land (FAO, 2012).

The cassava crop has recently undergone a change from just a mere subsistent crop found on the field of peasants to a commercial crop grown in large quantities in plantations. This development is due to the discovery of cassava as an economical source of edible carbohydrate which could be processed into different forms of human delicacies such as *gari*, *fufu* and *akpu*. (Okorji *et al.,* 2003). These cassava products are in high demand due to the continuous increase in population in Africa.

The average production of cassava in Africa is currently below the world average due to some limitations such as diseases, pests, weeds, soil factors, agronomic factors, and socioeconomic factors (IITA, 1990). Weeds interfere with crop growth and reduce their yield. This interference includes competition with crops for nutrients, light and water (Akobundu, 1987; James *et al.*, 2000). Generally, cassava yield loss due to weed infestation is up to 65% in Nigeria (Akobundu, 1987). However, specific weeds like *Convolvulus arvensis* L. compete with all crops for water (Stahler, 1948) while the shading of crops by weeds leads to reduction in the maximum rate of crop's photosynthesis and earlier senescence of leaves (Puckridge and Donald, 1967; Bowes *et al.,* 1972). Speargrass [*Imperata cylindrical* (L) Raeuschel] commonly found in cassava has been estimated to cause yield losses as high as 80% (Koch *et al.,* 1990; Chikoye *et al.,* 2001) if not controlled.

The tropical cassava farmers spend about 41% of their time on weed management (Ezumah and Okigbo, 1980). This measure of interest is given to weeds not only because they compete with crops for limited resources but because they also promote disease problems and harbor pests and diseases that are deleterious to crops (Oudhia, 2004). This yield loss and time consumption caused by weed interference therefore call for a judicious weed management. However, there are ways by which weeds are being controlled in cassava farms. Some of the weed control methods that have been implemented in cassava farms are mechanical, cultural, chemical, and integrated management (Akobundu, 1987; IITA, 1990).

These weed control methods have been observed to have some limitations despite their good level of success. For example, hoe-weeding is time-consuming and can consume at least 70% of the total labour budget (Sauerborn and Kroschel, 1996; Chikoye *et al.,* 2002). Furthermore, labour is in short supply and therefore expensive; causing weeds to remain a very difficult problem to deal with in Nigeria (Ogunwolu, 2004). The use of mulching such as melon [*Citrullus lanatus* (thumb.) Matsum & Nakai] is not very effective against grasses such as *I. cylindrical* (Melifonwu, *et al.,* 2000). Chemical control has some short-comings such as development of herbicide-resistant weeds, prohibitive economic cost of herbicides, environmental pollution and non-biodegradable characteristic of some herbicides (Kim *et al.,* 2001; Swanton and Weise, 1991; Olabode and Adesina, 2007).

The canopy of crops has been reported to suppress weeds. For example, Hock *et al.* (2006) reported reduction in weed density under soybean canopy closure. The weed density in 76 cm row spacing was 1.296 m^3 plant $^{-1}$ while it was reduced to 0.680 m^3 $plant^{-1}$ in 19 cm row spacing. Likewise, spring wheat 'Clearfield BW755' canopy without herbicide application was able to reduce weed biomass to as low as 10 g m^{-2} while canola (rapeseed, *Brassica napus* L.) 'Clearfield 46A76' under the same condition reduced weed biomass to 12 g m^{-2} and field pea (*Pisum sativum* L.) reduced weed biomass to 4 g m^{-2} (Szumigalski and Acker, 2005). In the same vein, cassava canopy when fully formed also has potential to control weeds when cultivated at optimum density (Onwueme and Sinha, 1991; Dahniya and Jalloh, 1998). However, the level of control and the specific influence on the weed species dynamics have not been adequately documented. Ross and Lembi (1985) stated that it was unfortunate that the contribution that crop competition makes to weed control is often ignored. Hence, knowledge on the level of control of weeds in cassava using crop canopy (i.e. without supplementary chemical application) is therefore desirable in order to fully take advantage of the canopy potential. Sit *et al.* (2007) reported that the nature of crop, cultural practices and cropping pattern/system, soil type, moisture availability, location and season cause variations in the abundance or distribution of weed species in cultivated fields. It was further emphasized that a vivid knowledge of the existence of various weed flora under the shade of different crops is essential in order to ensure the use of appropriate herbicide(s) and formulate other appropriate management strategies. The specific objectives of this study are to

a. determine the influence of cassava canopy on weed flora composition;

b. assess the influence of cassava canopy on weed biomass reduction and cassava yield; and

c. evaluate the relative influence of weed incidence on the yield of two varieties of cassava.