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CARIBBEAN FOOD CROPS SOCIETY

44

**Forty Fourth
Annual Meeting 2008**

Miami, Florida, USA

**Vol. XLIV – Number 2 Continued
Poster Session Abstracts
With Some Posters Expanded as Full Papers**

MEETING HOST:



Poster #70

***In Vivo* Study of Cogongrass (*Imperata Cylindrica* L.) Rhizome Production**

Oghenekome U. Onokpise, James J. Muchovej, and Susan K. Bambo. College of Engineering Sciences, Technology and Agriculture, Florida A&M University, Tallahassee, Florida 32307. susan.bambo@famuedu

ABSTRACT.

Cogongrass is an aggressive, rhizomatous, invasive perennial grass that is scattered throughout the tropical and subtropical regions of the world, and has become a serious problem in Florida and other Gulf Coast States. A greenhouse study was conducted to evaluate the growth and spread of rhizomes of grass species grown in combination with other native grass species. Native grass species used included: switchgrass (*Panicum virgatum* L), maidencane (*Panicum hemitomom* Schult.), and muhlygrass (*Muhlenbergia capillaries* (Lam) Trin.). All plants were raised in tubbets and then transplanted to 7.6 L greenhouse pots in different combinations with cogongrass. Data on rhizomes of cogongrass and maidencane (rhizomatous species) were recorded during the harvest periods (6, 12, 18 or 24 weeks). The mean number and mean total length of cogongrass rhizomes ranged from 3 to 8 and 0.06 to 0.14 m at 6 weeks to 40 to 94 and 8.37 to 20.39 m at 24 weeks, respectively. Similarly, the mean number and mean total length of maidencane rhizomes ranged from 0.01 to 3 and 0.05 to 0.27 m at 6 weeks to 11 to 26 and 1.57 to 3.31 m at 24 weeks, respectively. There were 51 to 74% and 47 to 74% reductions in the mean total length of cogongrass rhizomes grown in combination than those grown individually at 12 and 18 weeks, respectively. The mean number of cogongrass rhizomes had 54 to 71% reductions when in combination than individually at 12 weeks. Likewise, at 18 weeks the mean number and mean total length of rhizomes of maidencane were reduced by 51 to 65% and 20 to 75%, respectively, when grown in combination with others grasses than alone. The number and spread of rhizomes explain cogongrass' invasiveness and competitiveness. The reduction of cogongrass in combination with native species shows a prospect that some Florida native grasses could reduce the invasiveness of cogongrass in the Gulf Coast States.

KEYWORDS: Cogongrass, rhizomes, native grasses

INTRODUCTION

Cogongrass is considered "the seventh worst weed in the world" (Dozier et al. 1998; Holm et al. 1997). It is an aggressive, rhizomatous, perennial grass that is distributed widely in the tropical and subtropical zones of the world. It occurs in 73 countries and has infested more than 500 million hectares of plantation and agricultural land worldwide (Holm et al. 1977). It was first introduced into the USA both accidentally (into Mobile Alabama through a packaging material in a shipment from Japan) in 1911 and intentionally (into Alabama, Mississippi and Florida as a forage plant and soil stabilizer) from the 1920s to 1940s (Patterson et al. 1980; Dickens 1974; Tabor 1952;

Tabor 1949). Unfortunately, the purpose of its introduction was not achieved, as its evaluation in these states in the 1920 to the 1940s was only acceptable as a short-term forage crop and soil stabilizer. From 1940s to date, it has developed into a major invasive noxious species and serious weed problem in Florida, Georgia, Alabama, Louisiana, Mississippi, and some recent reports include S. Carolina and Eastern Texas (Bolfrey-Arku et al. 2006; Miller 2000). The spread of cogongrass in these areas was by illegal plantings and inadvertent transport in forage and in soil contaminated with cogongrass rhizomes during roadway constructions (Holm et al., 1977; Dickens, 1974). It has become established in the southeastern United States within the last fifty years, with Alabama, Mississippi and Florida having extensive acreage of roadway and pasture infested with cogongrass (Gaffney 1996). It is commonly found along roadways, in forests, parks, residential areas, grasslands, less cultivated agronomic lands, mined areas, and natural areas, and has been reported to be a serious problem in these areas (Dozier et al. 1998; Bryson and Carter 1993; Coile and Shillings 1993; Holm et al. 1977).

Cogongrass has numerous attributes that contribute to its extremely invasive nature. Cogongrass produces new rhizomes readily, even with rhizome fragments. The persistent and aggressive rhizome of *I. cylindrica* is the main mechanism of survival and spread, while its resilience makes it difficult to control. Established stands may produce over 7 tons of rhizomes per hectare (Soerjani 1970). These rhizomes can also spread up to 3 to 4 m forming a mat of internodes with potential to produce hundreds of new plants. Cogongrass has received extensive research attention due to its agriculture, economic and social implications in various regions of the world. It has little advantages including short-term poor forage production, erosion control, thatch and to a limited extent it has been used in paper making (Coil and Shilling 1993). On the other hand, it has caused injury to tuber crops, inhibited desirable perennial grass species to establish, produced poor habitats for wildlife animals, and increased fire hazards that destroy most fire intolerant species (Lippincott 2000; Shilling et al. 1995; Boonitee and Ritdhit 1984).

In the Western Hemisphere, cogongrass weedy habit outweighed its usefulness and over fifty years ago, Pendleton (1948) stated that steps should be taken at once to completely eradicate this noxious weed. After several years, many considerable research efforts have been underway to understanding the spread of cogongrass, throughout many habitats, and management for its control and possible eradication as a noxious weed and an invasive species (Chikoye et al. 1999; Shilling et al. 1997; Holm et al. 1997). Control measures included mechanical, chemical, biological control, and some combination of mechanical, chemical, or biological treatments (Onokpise et al. 2007; Dozier et al. 1998; Shilling and Gaffney 1995). Different methods of integrated approaches have been used to control cogongrass, and different levels of successes have been achieved (Chikoye et al. 2005). However, cogongrass finally begins to re-infest, regardless of the control measure. It is essential to introduce desirable vegetation as quickly as possible to avoid cogongrass from re-infesting the area, once a stage of good management is achieved. Some of these desirable species are native species to the Gulf Coast States. To eliminate cogongrass, control strategies should include limiting or destroying the rhizome production. It is important to study which native species can grow in association or reduce the spread of cogongrass rhizomes. Therefore the objectives of this study were to evaluate the performance of rhizomes of cogongrass grown in combination with Florida's

native grass species, and also evaluate the growth of maidencane (a native grass species) rhizomes in such combinations.

MATERIALS AND METHODS

The experiment was conducted in the George Connolly greenhouse on Florida A&M University campus, Tallahassee, Florida in the USA. The grass species used for this study were cogongrass and three native species, which included switchgrass (*Panicum virgatum* L), maidencane (*Panicum hemitomon* Schult.), and muhlygrass (*Muhlenbergia capillaries* (Lam) Trin.). Cogongrass materials used were obtained from a naturally infested site on Tram Road in Tallahassee, Florida. Muhlygrass was harvested from its natural habitat at St. Marks National Wildlife Refuge, St Marks, Florida. A shovel was used to dig up the cogongrass and muhlygrass plants. ‘Citrus’ maidencane (*Panicum hemitomon* Schult.) and switchgrass (*Panicum virgatum* L.) were obtained from the United States Department of Agriculture - Natural Resources Conservation Service, Plant Materials Center (USDA-NRCS PMC) Brooksville, Florida.

Rhizomes of cogongrass and maidencane were cut into pieces of about 4 cm segments. These pieces of rhizomes were planted in plastic trays (pro-tray) that were filled up with Jungle Grow® potting mix. Muhlygrass and switchgrass were divided into smaller clumps that were potted into 5.5 cm diameter tubetts using the same potting mix. Both cogongrass and the native species were placed on greenhouse benches where they were watered daily for about 6 weeks before transplanting into larger pots.

The pots used for the study were the Accelerator® Model AP-3 (7.6 L) that had a series of slots on the sides to allow for aeration. Pots were filled up with a potting mix purchased from Graco Fertilizer Company, Cairo, Georgia. Potting mix was composed of 80 % bark, 10 % sand and 10 % peat (Graco Fertilizer Co, Cairo, GA). Plants were planted into the mix either alone or in all possible combinations with cogongrass. This study was laid out in a randomized complete blocked design with nine treatments and four replications. Each pot received one table spoon of Osmocote® (19-6-12) every 4 weeks. Destructive sampling was conducted at 6, 12, 18, and 24 weeks after planting (WAP) in 7.6 L greenhouse pots. During harvest or sampling, the content of each pot was removed and the plant material was separated from the peat. Data on rhizomes of cogongrass and maidencane (rhizomatous species) were recorded. Data collected included the number of rhizomes and length of rhizomes produced by each plant species. Data was analyzed using SAS 9.1 (SAS 2002). Means were separated using LSMEANS statement.

RESULTS AND DISCUSSION

The mean number of rhizomes of cogongrass varied from one harvest period to another, although, at 6 and 24 WAP, there were no significant differences among cogongrass mean number of rhizomes growing alone or in combination with native species (Figures 1). The number of rhizomes range from 3 to 8 and 40 to 94 at 6 and 24 WAP, respectively. The mean number of rhizomes were not significantly different, except at 12 ($P = 0.005$) WAP, where all cogongrass grown in combination with native species was reduced by 53 to 71 % (Figure 1). At this harvest period the reduction in the number of rhizomes occurred in all combinations compared cogongrass alone. At the first harvest, there was an indication that cogongrass rhizomes did not encounter the

competition from the native species. However, at the 24 WAP, despite the greater number of rhizomes produced by cogongrass growing individually, there was an overlap in the range between the treatment combinations.

The mean total length of cogongrass rhizomes did not vary at the first and last harvest periods and the range was from 0.32 to 0.88 m and 8.37 to 20.40 m at 6 and 24 WAP, respectively. On the other hand, the mean total length of rhizomes of cogongrass varied among treatment combinations at 12 ($P = 0.003$) and 18 ($P = 0.01$) WAP (Figure 2). There was 51 to 74% and 47 to 74% reduction in the mean total length of cogongrass rhizomes grown in combination than those grown individually at 12 and 18 WAP, respectively. Cogongrass rhizomes growing in combination with any native species were similar throughout the sampling periods. Native grasses were selected on the basis of their growth habit, resistance to adverse environmental conditions, and their ability to grow with the invasive cogongrass (Evans 1991). The mean number and total length of cogongrass rhizome indicated that muhlygrass alone may not compete effectively with cogongrass. The presence of switchgrass in the planting combination generally reduced cogongrass rhizome production. Employing biological control strategies to manage cogongrass is especially pertinent in natural ecosystems and low maintenance areas where the cost of chemical and mechanical control methods would be prohibitive and/or impracticable. The ability of these native species to compete and grow with cogongrass in a short term was viewed possible. Field experiments are needed to validate these native species as a valuable biological control mechanism to control cogongrass.

Considering treatments with maidencane and their rhizome performance, variability occurred from one harvest period to the next. The mean number of maidencane rhizomes ranged from 1 to 3 and 11 to 26 at 6 and 24 WAP, respectively (Figure 3). Likewise, the mean total length of maidencane rhizomes ranged from 0.01 to 0.03 m and 1.57 to 3.31 m at 6 and 24 WAP, respectively (Figure 4). It was observed that maidencane had similar mean total length of rhizomes and the mean number of rhizomes throughout the sampling periods, except at 18 WAP (Figures 3 and 4). At this sampling period, the mean number and mean total length of rhizomes of maidencane were reduced by 51 to 65% and 20 to 75%, respectively, when grown in combination with others grasses than alone. Maidencane generally had a stable performance in the treatment combinations. The presence of switchgrass in the planting combination occasionally reduced maidencane rhizome production.

It is remarkable to note that the 4 cm segmented pieces of rhizomes from each species were able to produce the number and length of rhizomes reported. This study confirmed the earlier studies on cogongrass which suggested that shoots may form from the smallest of rhizome segments (Hubbard et al. 1944). During this study, rhizomes of cogongrass grew both from apical buds and along the length of the rhizomes from axillary buds (Figure 5). Other researchers, for instance, Ayeni (1985) and Wilcut et al (1988) report that rhizomes are apically dormant; while English (1998) investigation reported that cogongrass does produce axillary buds. The rhizome system of cogongrass is undoubtedly a competitive strength of the species as reported by Ayeni and Duke (1985).

It can be concluded that the number and spread of rhizomes explain cogongrass' invasiveness and competitiveness. The performance of maidencane in maintaining its rhizome growth with other species in most of the sampling periods indicated its potential

to grow in association with cogongrass. The presence of switchgrass had large impact on cogongrass rhizomes than on maidencane rhizomes. The reduction of cogongrass in combination with native grass species showed a prospect that some of these native grasses could grow in association with cogongrass or reduce the invasiveness of cogongrass in the Gulf Coast States. Controlling cogongrass requires persistence and diligence by the land manager but will be well worth the effort for protecting our natural resources from this very serious exotic invader.

ACKNOWLEDGEMENTS

Funding for this project is principally from USDA-CSREES 1890 capacity Building Grant # 2005 38814 – 16377. These funds are gratefully acknowledged. Special thanks are extended to Dr. Mimi Williams, Ms. Anne-Marie Gunter and all the staff at the USDA-NRCS PMC Brooksville, Florida for their tremendous assistance in these studies.

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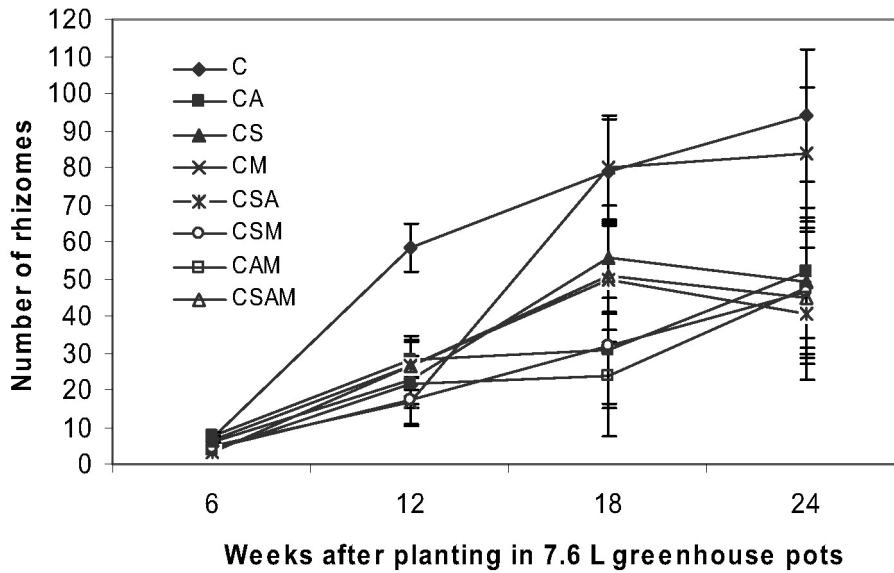


Figure 1. Mean number of rhizomes of cogongrass in response to competition from different native grass species combinations. C, cogongrass; CS, cogongrass and switchgrass; CA, cogongrass and Maiden cane; CM, cogongrass and muhlygrass; CSA, cogongrass, switchgrass and maiden cane; CSM, cogongrass, switchgrass and muhlygrass; CAM, cogongrass, maiden cane and muhlygrass; CSAM, cogongrass, switchgrass, maiden cane and muhlygrass. Vertical bars are the standard error of the mean.

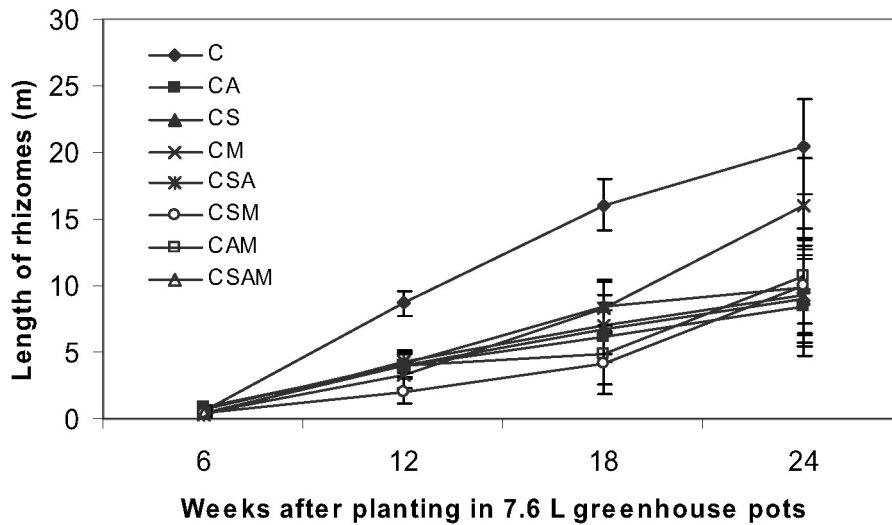


Figure 2. Mean total length of rhizomes of cogongrass in response to competition from different native grass species combinations. C, cogongrass; CS, cogongrass and switchgrass; CA, cogongrass and Maiden cane; CM, cogongrass and muhlygrass; CSA, cogongrass, switchgrass and maiden cane; CSM, cogongrass, switchgrass and muhlygrass; CAM, cogongrass, maiden cane and muhlygrass; CSAM, cogongrass,

switchgrass, maidencane and muhlygrass. Vertical bars are the standard error of the mean.

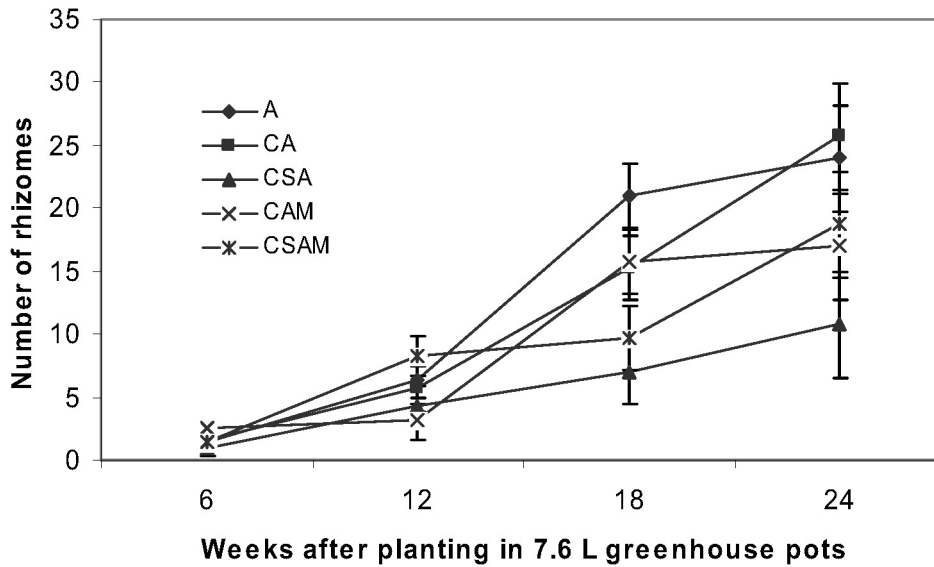


Figure 3. Mean number of rhizomes of maidencane in response to competition from cogongrass and different native grass species combinations. A, Maidencane; CA, cogongrass and maidencane; CSA, cogongrass, switchgrass and maidencane; CAM, cogongrass, maidencane and muhlygrass; CSAM, cogongrass, switchgrass, maidencane and muhlygrass. Vertical bars are the standard error of the mean.

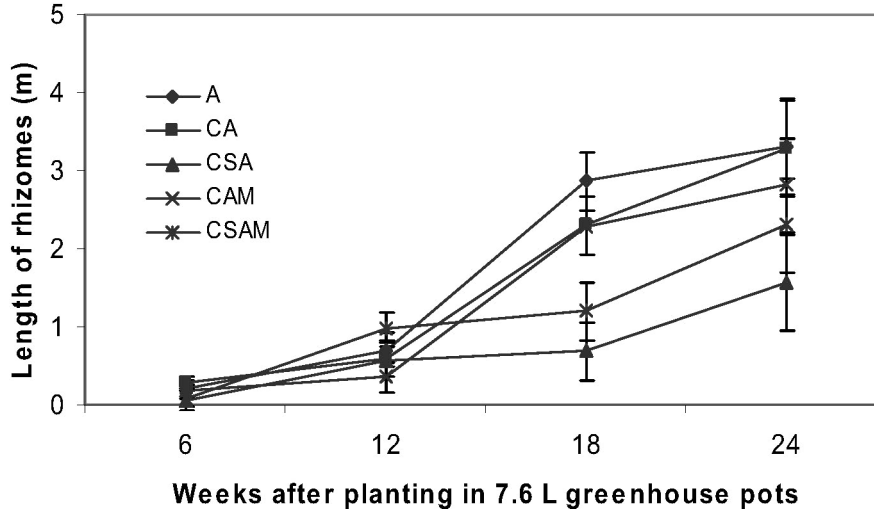


Figure 4. Mean total length of rhizomes of maidencane in response to competition from cogongrass and different native grass species: A, Maidencane; CA, cogongrass and maidencane; CSA, cogongrass, switchgrass and maidencane; CAM, cogongrass, maidencane and muhlygrass; CSAM, cogongrass, switchgrass, maidencane and muhlygrass. Vertical bars are the standard error of the mean.

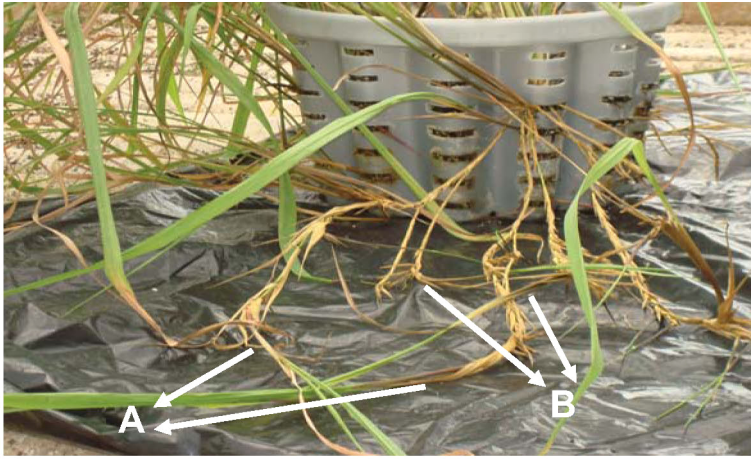


Figure 5. Cogongrass rhizome development at both apical (A) and auxiliary (B) buds