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Comparison of Ramet and "Wild Type" Establishment for Cogongrass, *Imperata cylindrica*

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The establishment of *Imperata cylindrica* was compared by planting greenhouse grown ramets and field collected tillers (wild type). The ramets were collected taking rhizomes from a single plant, cutting them in pieces that contained two nodes, and then planting these in a composted pine bark potting mix. The wild type was produced by harvesting field-grown cogongrass, trimming the roots to 2 cm, and planting individual tillers in the same potting mix. All plants were then placed under mist until they had become established. The ramets and wild types were then potted in a mixture of 80:10:10 bark:sand:peat (v:v); in 30-cm-diameter pots. The pots were then placed on greenhouse benches. Data collected every 2 weeks for tillers per plant indicated that the wild type group had a significantly better production. At the later stages of development (6, 12, 18, or 24 weeks), wild type produced plants had greater length of tillers; and dry weights of tops, rhizomes and roots.

Cogongrass (*Imperata cylindrica*) is an invasive, rhizomatous, aggressive C_4 perennial grass that has become one of the most serious invasive species in Florida and other Gulf Coast States (Langeland and Craddock-Burks, 1998; Onokpise, 2000; Shilling et al., 1997) (Fig. 1.). The persistent and aggressive rhizome remains the main mechanisms for survival and spread, while its resilience makes it difficult to control (Shilling et al., 1997). Rhizomes are underground stems (Beard, 1972; Esau, 1977) and therefore would have the same genotype. Ramets are vegetative parts that come from the same genetic individual and therefore have the same genetic content (Barbour et al., 1999; Hartmann, et al., 2002).

The objective of this study was to determine differences in growth of cogongrass in a greenhouse study, using genetically identical material taken from a single plants (ramets) and material taken from and established invasion (wild type).

Materials and Methods

Cogongrass was harvested from a natural infestation in Tallahassee, FL. Plants were dug up with adherent rhizomes and as little soil as possible. The roots and rhizomes were then trimmed to approximately 1 cm in length and the leaves (culms) were trimmed to approximately 15 cm in length. These were then placed into #72 pro trays (3.8-cm diameter × 5.9 cm deep, Landmark Plastic Corporation, Akron, OH) and filled with commercial potting mix (Jungle Grow® (composted pine bark, peat moss, vermiculite, perlite, horticultural grade charcoal, 0.25–0.12–0.12 N–P–K, Piedmont Pacific, Statham, GA).

Fig. 1. Cogongrass (*Imperata cylindrica*) grown in the greenhouse. Cogongrass is an invasive, rhizomatous, aggressive perennial grass that has become one of the most serious invasive species in Florida and other Gulf Coast States. The persistent and aggressive rhizome remains the main mechanisms for survival and spread.

Alternately, ramets were obtained from a single plant that had been potted into a 30-cm diameter pot (Accelerator model AP-3 [20-cm height; 10-L capacity], Nursery Supplies, Inc., www.nurserysupplies.com). This plant was planted in 2006 and was allowed to grow into the beginning of 2007. At the time of the

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experiment, 2-cm-long pieces of rhizome containing two nodes were removed from rhizomes that extended outward from the pot. These pieces were planted into #72 protrays filled with potting medium.

All plants were placed under mist (5 s every 15 min) for 7 d and then moved to greenhouse benches where they were watered daily. Plants were grown for approximately 4 weeks in these smaller containers before being used in the potted study. Single ramet or wild type plants were potted in Accelerator model AP-3 pots filled with 80% bark, 10% sand, and 10% peat (Graco Fertilizer Co, Cairo, GA).

Every 2 weeks during the study, the number of "tillers" or "stems" was counted for each pot, as were the number of rhizomes that emerged from the slots in the sides of the pots. Since pots were planted for four harvest dates, the values for each plant type were combined, i.e., on the first sample date, the pots for each of the four harvest dates were counted and the data combined. Plants were watered every other day during the study; however, water was withheld 3 d before harvest.

Plants were fertilized with 1 tbsp of Osmocote® (19–6–12) per pot on week 1 and every 4 weeks thereafter. On the harvest date, the plant mass was removed from the pot, the potting mix removed by pulling the root ball apart and shaking the dry mix out. The tops, rhizomes, and roots were air dried for 10 d on the greenhouse bench, separated, and then weighed. Four pots were harvested per date.

The potted experiment was started on 5 June and the harvest dates were 17 July, 28 Aug., 9 Oct., and 20 Nov. There was no additional light provided during the experiment.

Statistical analysis. The number of "tillers" or "culms" were regressed against the time of the data collection. To do this, all of the values for either ramets or wild type were pooled and a single line was calculated. The slopes of the calculated lines were then compared (Sokal and Rolfs, 1994).

The mean dry weights of tops, rhizomes and roots, and the mean length of rhizomes were compared using the Students *t* test.

Results and Discussion

The number of tillers formed by wild type was described by the equation $y = 0.506x - 9.744$ $R^2 = 0.926$ ($n = 60$) while the number of tillers formed by ramets described by the equation $y = 0.466x - 8.48$ $R^2 = 0.85$ ($n = 60$). There was a significant difference in the slopes of these equations at $P = 0.05$. This indicates that the rate of tiller formation was greater for plants from wild type than for those from ramets.

Table 1. Mean length in cm, and mean weights in grams of shoots, rhizomes and roots of wild type and ramets of cogongrass at 6, 12, 18, and 24 weeks, grown in a pot study.

		6	12	18	24
Length (cm)	Wild type	51.5 a[z]	886 a	1981 a	2852 a
	Ramets	58.5 a	847 a	1229 b	1226 b
Shoot wt (g)	Wild type	4.03 b	65.5 a	85.2 a	85.8 a
	Ramets	5.6 a	54.1 b	63 b	59.1 b
Rhizome wt (g)	Wild type	0.25 a	20.9 a	50 a	72.8 a
	Ramets	0.64 b	18.6 a	41 b	45.7 b
Root wt (g)	Wild type	0.63 b	6.7 a	17.2 a	20.5 a
	Ramets	1.31 a	4.1 b	10.2 b	14.2 b

[z]Mean separation in the same unit at each harvest date by Students *t* test, 5% level.

Similarly, there was an increase in weights of shoots, rhizomes. and roots throughout the time of the experiment (Table 1). In most cases, the weight of the shoots, rhizomes, and roots were equivalent or superior in the plants from wild type than the values of the plants from ramets. Interestingly, at the last harvest date (24 weeks) the weight of the rhizomes was more than 3 times that of the roots and 75% of that of the shoots.

The length of the rhizomes for the wild type was much greater than the ramets by the 18th week, and by the 24th week was more than 2 times the value of the ramets.

Rhizomes were harvested separately from roots since rhizomes are defined as underground stems and are not absorptive in nature (Esau, 1977). The rhizomatous spread of the plant will permit it to explore a greater volume of soil, and at the same time, permit the production of new shoots. Measurement of the internode of rhizomes demonstrated that nodes were produced on the average every 1.58 cm ($n = 45$) with a range from 1.2 to 2 cm. The greater the length of the rhizome, the more nodes that would be produced, and therefore the greater the number of tillers that could be produced. The great amount of rhizome produced: 2852-cm average for the wild type and 1226 for the ramets is one of the best indicators for how this plant can spread so aggressively. The other interesting concept is that the absorptive root weight is only a small fraction of the total plant weight at harvest. Kanno et al. (1999) indicated that the root biomass of five tropical grasses was 53% to 76% of the total plant biomass. Cogongrass must therefore be highly efficient at mineral and water absorption.

The ramet "mother" plant was selected from a previous pot experiment due to its prolific production of rhizomes. In that experiment, the number and length of tillers formed was astounding. Even in this study, the wild type produced an average of 28.5 meters of rhizomes from a single tiller in 6 months. Alternatively, in the previous experiment, there were tillers that did not produce rhizomes during the length of the study. The assumption was that there would be similar amounts of variability in plants from wild type when compared to plants from ramets. However, this did not occur during this study as both wild type and ramets produced an astonishing amount of rhizomes.

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