Table 9. Mortality of life stages, weight of larvae and pupa, days-to-pupation and adult emergence for fall armyworms fed as 4-day-old larvae on clippings of bermudagrass cultivars in Spring 1998.

Bermudagrass	% Mortality[1,5]				Weight (mg)[2,3]				Days to[4]			
Entry	7 d	10 d	Pupa	Adult	10 d		Pupa		Pupa		Adult	
4200W 74-3	0[ns]	0[ns]	18.2 abc[6]	27.3 bcd	25.5	abc	104.8	fgh	36.7	a	50.6	a
4200W 49-17	0	0	28.6 ab	52.4 a	28.9	bcd	109.9	e-h	35.3	ab	49.3	abc
Greg Norman-1	0	4.2	17.6 abc	23.5 bcd	20.2	a	108.2	e-h	35.2	abc	49.5	abc
CCB 10-8	0	0	4.6 c	9.1 d	31.4	cde	144.0	bc	34.4	bcd	49.2	abc
4200W 53-1	0	0	39.1 a	52.2 ab	22.6	ab	109.4	e-h	34.2	cd	48.6	a-d
4200W 51-14	0	0	4.6 c	13.6 cd	34.2	d-g	120.5	def	33.8	cde	48.1	c-f
Midlawn	4.2	4.2	13.0 abc	21.7 bcd	38.5	fg	143.8	bc	33.6	de	48.3	bcd
4200W 47-7	0	0	0.0 c	0.0 d	30.7	cde	149.1	b	33.5	de	48.7	abc
Tifton 94	0	12.5	20.9 abc	25.0 bcd	40.5	g	155.7	b	33.0	def	48.2	cde
ERS-Turf	0	4.2	16.7 abc	16.7 cd	51.6	h	145.1	bc	32.6	ef	47.8	c-f
CCB 25-6	0	0	16.7 abc	16.7 cd	39.2	fg	138.6	bcd	32.4	efg	47.6	c-f
4200W 56-14	4.2	8.3	13.6 bc	22.7 cd	52.1	h	127.6	cde	31.7	f	46.4	d-g
4200W 47-1	0	0	5.9 c	11.8 d	49.9	h	118.1	ef	31.1	g	46.0	efg
4200W 55-5	0	0	31.6 abc	42.0 abc	48.4	h	116.7	efg	31.0	g	45.9	fg
CCB 24-4	4.2	4.2	4.2 c	4.2 d	70.5	I	189.9	a	28.6	h	44.6	g

[1] Mean % of larvae alive at 7 and 10 days after egg hatch, % pupation and % that emerged as adults.
[2] Mean weight of surviving 10-day-old larvae after feeding on each genotype for 6 days.
[3] Mean pupa weight for only individuals that pupated (weight taken within one day after pupation).
[4] Mean number of days from egg hatch to pupation and to adult emergence for surviving insects.
[5] Analysis was made on arcsine transformation of the % mortality; % mortality is presented.
[6] Means in a column not followed by the same letter are significantly different by Waller-Duncan k-ratio t test (k = 100, P = 0.05). ns = not significant.

A Turfgrass Genome Project: Integration of Cynodon Chromosomes with Molecular Maps of the Cereals

University of Georgia

Andrew H. Paterson

Start Date: 1999
Number of Years: 5
Total Funding: $125,000

Objectives:

1. *Establish a primary molecular map for the chromosomes of Cynodon.*
2. *Align the chromosomes of Cynodon with those of the major cereals, gaining access to much genetic information.*

We will combine new DNA probes for *Cynodon*, with tools that have been previously mapped in other *Poaceae*, to develop a primary molecular map of the *Cynodon* chromosomes. The map will be useful for investigating many aspects of turfgrass population biology and genetics, and a molecular conduit for turf improvement to benefit from the large body of genetic information now accumulated about cereals and other grasses. *Cynodon* is chosen as a focal point for turf genome analysis due to its importance across the southern United States, and abundance of phenotypic variation. Dr. Wayne Hanna will assist in population development and maintenance.

To our knowledge, this project is the first effort to enable turf improvement to benefit from extensive genetic information available for well-studied grains such as maize and rice. The *comparative approach* will reduce costs, and leverage existing information and tools. Our experience in molecular analysis of complex populations, such as sugarcane and buffelgrass, as well as grain crops such as rice, maize, and sorghum, together with our extensive repertoire of molecular tools, puts us in a strong position to efficiently develop a *Cynodon* molecular map useful for turf improvement.

Progress to Date. While the genetic crosses are being developed for making the maps, we have made significant progress in characterizing DNA clones from bermudagrass and other grasses (especially *Pennisetum* and Sorghum), for their effectiveness in detecting DNA markers in bermudagrass. There exists a high level of DNA polymorphism in bermudagrass, and the establishment of DNA fingerprints unique to individuals will be routine. We have prepared more than 1,000 cDNA clones (mapped in other taxa) to be applied to bermudagrass. DNA extraction protocols for bermudagrass have been optimized. We have initiated screening of these DNA clones on

genomic Southern blots of DNA from the bermudagrass parents being used in this study. The specific parents used in crossing have been clonally propagated, so that we can greatly increase our supply of DNA and blots, and accelerate accumulation of data.

The data accumulated to date suggests that we will be able to not only meet, but also significantly exceed the proposed goal of 300 mapped loci. The comparative mapping of bermudagrass will draw heavily upon a prior map of sorghum that now includes more than 2,000 DNA loci, and a new map of buffelgrass (Jessup et al., in preparation) that now includes about 400 loci.

Plans for Continuation. The focus of year two will be the scale up of identifying DNA polymorphism, and the beginning of genetic linkage mapping. New lab facilities and personnel will facilitate this. We are anticipating that individual seedlings from most, if not all, of the required genetic populations will be large enough to begin sampling of tissue for DNA during year two. Full-scale genetic mapping will be done in year three. By the end of year three, we expect to meet the formal goals proposed for the full five years (data analysis may continue into year four). We will then apply the map to identify quantitative trait loci (QTLs), identify DNA markers of agriculturally important traits, and develop a small bacterial artificial chromosomes (BAC) library for bermudagrass.

Once the accumulation of genetic differences and DNA markers is proceeding smoothly, as time permits we will begin to explore the development of large-DNA clones of bermuda in BACs. Our prior successes with sorghum (Lin et al, submitted), papaya (Ming et al, in preparation), cotton (Abbey et al, in preparation; Rana et al., in preparation), and peanut (Burow et al., unpubl. results) have led to optimization of BAC technology that should be easily transferable to bermuda.

Leveraging Opportunities Realized. Plant genomics in the United States was recently stimulated by the infusion of nearly $85 million in federal grants through the National Science Foundation. The US Golf Association designated Dr. Paterson's turfgrass genome project to be *matching support of a comparative grass genomics initiative* that Dr. Paterson proposed, together with seven colleagues at three universities. Dr. Paterson's proposal was funded at a level of $3.2 million. This award will provide molecular conduits that will enable improvement of bermudagrass and other turfgrasses to benefit from the rapid progress that is anticipated for grass genomics as a result of the USGA-sponsored project.

Other Significant Events, and their Consequences. Dr. Paterson has recently accepted a Senior Professorship in Plant Biotechnology and Genomics, at the University of Georgia's main campus in Athens, GA. He has the *right of first refusal* to be named the director of the AGTEC Plant Division, to be created in 1999. This will result in a major scale-up of genomics activities in Georgia, and will be a significant expansion of the capabilities that Dr. Paterson's lab can bring to bear on bermudagrass. In the first year (before AGTEC is created), Dr Paterson will occupy about 4,800 square feet of renovated space, fully and newly-equipped for genomics research. When the AGTEC Center is completed in early 2000, around 2,600 square feet of additional lab space, as well as shared core facilities of 5,000 square feet for genomics. About $2.1 million is available for equipping the genomics core facility.

While this move has caused some delays, specifically preventing Dr. Paterson from hiring a person dedicated solely to the bermudagrass project during the first year, by leveraging the activities of other people in the lab they have stayed on schedule. The expanded space and equipment available will greatly accelerate our rate of progress, and we emphasize that we expect to exceed the proposed objectives. Texas A&M has agreed to release Dr. Paterson's extramural grants and funds remaining on these accounts to the University of Georgia. The University of Georgia has agreed to honor the terms of existing contracts.

One advantage of Dr. Paterson's move is that he will be at the same university where Dr. Wayne Hanna is a faculty member. Drs. Paterson and Hanna have already jointly offered an assistantship to Mr. Russell Jessup to focus on the bermudagrass project. Mr. Jessup is presently completing M.S. studies with Dr. Paterson and Dr. Mark Hussey at TAMU, working on *Pennisetum*. The offer remains pending, and contingent on the student's formal acceptance into the University of Georgia graduate school. Consequently, the short-term delays resulting from this move are expected to yield great rewards in long-term progress and capabilities.

Development of Improved Bentgrass Cultivars with Herbicide Resistance, Enhanced Disease Resistance and Abiotic Stress Tolerance through Biotechnology

Rutgers University/Cook College

Faith Belanger

Start Date: 1998
Number of Years: 5
Total Funding: $250,000

Objectives:

This project seeks to conserve golf course natural resources while providing quality playing surfaces by improving creeping bentgrass through transformation. We have concentrated on important bentgrass varieties and selections developed for Northeast golf greens.

The goals of this project are to produce improved creeping bentgrass cultivars through a combination of genetic engineering and breeding. Our aim is to provide golf course managers with more effective and selective weed control with herbicides by developing herbicide resistant cultivars. We are also attempting to produce cultivars with improved disease resistance and abiotic stress tolerance that can be maintained in a more environmentally-sound and cost-effective manner.