



**The University of Georgia College of Agriculture**  
**Coastal Plain Experiment Stations**

P.O. Box 748  
Tifton, Georgia 31793-0748



**DEPARTMENT OF AGRONOMY**

912/386-3360  
GIST 342-3360

October 24, 1986

Mr. William H. Bengeyfield  
National Director  
USGA Green Section  
Box 3375  
Tustin, CA 92681

Dear Bill:

My very efficient secretary has just reminded me that it is time to write another report on the research that we are doing with the help of the USGA grant. As you know, our emphasis in this with some other support is to try to increase the winterhardiness of the Tif turf bermudagrass hybrids that have been so well received across the South and in other parts of the world.

We are continuing to receive very excellent reports on the performance of Tifway II, the radiation induced mutant of Tifway (419) that we created back in 1971 and evaluated in various ways for more than 10 years. You will be interested to know that a contractor in California called me this past summer indicating that he had a job establishing turf on a large housing development and that the specifications called for the use of a bermudagrass that would shed no pollen. You are probably aware that bermudagrass pollen is one of the worst for people who suffer from asthma and hay fever. I was pleased to tell him that any of our Tif turf bermudagrass hybrids are sterile, produce no pollen and could be used to satisfy his needs. I suggested that Tifway or preferably Tifway II would be the best that he could plant and assured him that pure material could be found in California that could be used to plant the turf on the development.

You will recall that Tifgreen II is a mutant of Tifgreen (328) that resulted from irradiating sprigs of 328 in 1971. It was released because it came through a severe winter with much less loss of stand than Tifgreen and it did not develop the undesirable purplish plant color that characterizes Tifgreen in the winter time even when not frosted. We felt this character should make it more useful in south Florida on golf courses where they overseed with ryegrass primarily to give them good color. Dr. Phil Busey had indicated in correspondence before it was released that it had done well for him in his experiments. We knew that it was not as good as 328 in putting quality but felt that there would be a place for it. My son Tom, has had it on a problem green that has too much shade at Sea Island now for two years. His other greens are Tifdwarf, which of course makes the best putting surface of any of the bermudagrasses when properly managed. I have observed Tifgreen II on his problem green and have observed that it was a little lighter green and did not make a putting surface comparable to

Tifdwarf. Tom, however, tells me that he has been able to have better turf on this problem green with Tifgreen II than he was ever able to have with Tifdwarf. He also stated that he has heard very little criticism from the people playing on the green. It is, of course, overseeded with ryegrass as are the other greens in the winter time.

Dr. Bob Lynch, USDA entomologist, who is spending some of his time trying to explore the possibility of producing armyworm resistance in bermudagrass turf has not made any earth-shaking discoveries to date. In our collection of some 500 bermudagrass introductions from outside the United States, mostly from Africa, he has found one that has some armyworm resistance. He is still trying to develop a better screening procedure but I must report at this time that no progress has been made in transferring what little resistance is present in this introduction to the triploid hybrids with Cynodon transvaalensis.

We have still received no C. transvaalensis germplasm from South Africa. We have contacted the people that Jim Watson advised us to contact and have not been able to get any living material of the C. transvaalensis. You will recall in my last report that on August 12, 1985, we received a letter from Mr. D. W. Kirby, Top-Turf and Associates C.C., P.O. Box 260, Alberton 1450, South Africa that stated:

"Please find enclosed 2 samples of Cynodons which have been located at + 7000 ft. above sea level by a contact of mine. He harvested them in summer and as it is now mid-winter, they are all dormant. I suspect that it is the finer grass which is the one you want and if so, I will collect live material and send it to you in October.

I have also located another source at ThabaNchu and as we are going to work in that area quite soon, I will collect specimens of these for you as well."

To date we have received nothing from Mr. Kirby as his letter suggested that we would. It may take someone interested in getting this material to contact Mr. Kirby in person at the time living material could be collected in order to get germplasm that should be very useful in our program.

In my last report, I indicated that I had made many pollinations about sunup between our most winterhardy selections from the Berlin bermudagrass with the C. transvaalensis that had been most winterhardy in New Jersey in the winter of 1983-1984. From this effort we did get a few plants and were able to get them planted for observation in the summer of 1986. We hope to put these under golf green management as soon as we can and develop a screening procedure for their winterhardiness.

We hope that we will be able to successfully screen for our new hybrids and mutants on the Country Club at Blairsville, Ga., where the mountain elevation gives us temperatures below 0 usually with little if any snow cover. As you know, snow cover which will be commonly experienced in Michigan for example, can protect grass at very low temperatures.

In my report last year, I indicated that a number of the mutants that Dr. Hanna had selected from Midiron bermudagrass and had maintained in 13 x 13 foot plots here at Tifton had much better quality than Midiron. Plugs of these were planted on the golf course at Blairsville and were mowed at 2 heights in 1985 and 1986. This past winter, we did not have low enough temperatures to destroy any of the mutants that Dr. Hanna planted at the Mountain Station two years ago.

On the golf course at Blairsville, I prepared with the help of our Experiment Station people nearby, a 25 x 50 foot area and planted it to Pencross bent. The greens keeper tells us that he will mow this the same time he mows the golf green that is close by. We plan to set 8 inch plugs of a number of the best mutants and our new hybrids in this bentgrass when it becomes established and hope that we will have a winter severe enough to kill or severely damage most of them.

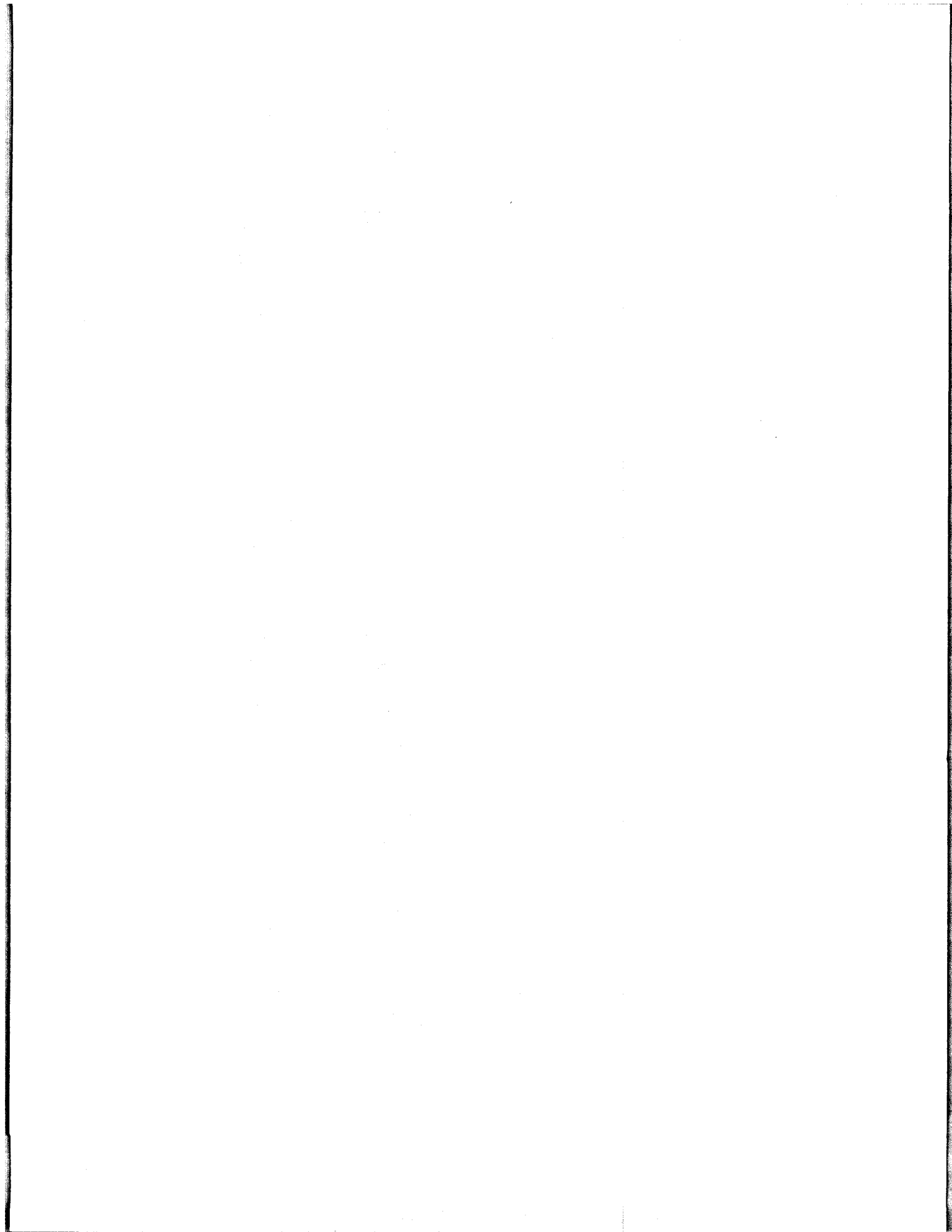
I was on the Michigan State campus last week giving an invited lecture as part of the dedication of the new Agronomy-Horticulture Building there. While there, I had an opportunity to visit with Dr. Ken Payne and obtain from him some planting material of the C. transvaalensis plant that has survived at Lake City. He also indicated that when we have eliminated most of the new mutants and hybrids that he would be glad to make a planting in Michigan to give us perhaps more critical testing. He indicated, however, that the snow cover that they so frequently have might make the screening effort ineffective.

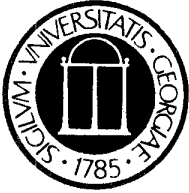
If you have questions concerning this report, I shall be happy to try to answer them.

Sincerely,



Glenn W. Burton  
Research Geneticist





The University of Georgia College of Agriculture

Experiment Stations • Georgia Station

EXPERIMENT, GEORGIA 30212

404/228-7272

DEPARTMENT OF AGRONOMY

October 31, 1986

Mr. William H. Bengeyfield  
USGA Green Section  
Box 3375  
Tustin, CA 92681

Dear Bill:

Enclosed are the Annual Report, Executive Summaries, and two slides.

Slide 1 - Illustrates the development of the research units used in both studies.

Slide 2 - Shows the application of one of the cultivation treatments on the second study.

Concerning your request for a short statement to show where our projects directly contribute to the overall objective of Minimal Maintenance Turfgrass Development:

Project I -- Three types of information will evolve from this study that will aid in water conservation: (a) This project provides data on water use of three major species under non-limiting soil moisture to stressed conditions. Information on the latter aspect is limited in the literature but much of our turf grows under limited moisture. (b) When irrigation is reduced, there comes a point when the grass starts to exhibit unacceptable growth and quality responses. Identification of specific growth vs. water reduction relationships will aid growers in determining how much water would be conserved plus the adverse plant responses for a chosen irrigation regime; and (c) quantification of plant responses (morphological, etc.) of these three species under well watered to stressed conditions will provide insight into their various drought tolerance/avoidance mechanisms. This information is very much needed by breeders for selection criteria when breeding for grasses with low water use.

Project II -- In addition to the grass species/cultivar and irrigation regime there are other factors that influence water use such as nitrogen fertilization, mowing practices, etc. The one factor on recreational turf that influences water use more than all the others is soil compaction, which often increases water use by 25 to 50% above similar non-compacted sites. Yet, specific information on the relative effectiveness of different cultivation methods in reducing water use is very limited. Our study will provide very detailed information on water use under different cultivation

Mr. William H. Bengeyfield  
October 31, 1986  
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methods and why (such as better root growth, better soil oxygen status, higher infiltration, etc.) Growers could immediately start to use the most effective techniques. Also, researchers/industry manufacturers could use the data to develop even better techniques and programs (the use of different cultivation methods together) for further water conservation.

Thank you for your support.

Sincerely,

A handwritten signature in dark ink, appearing to read "R N Carrow". The signature is fluid and cursive, with the first letters of the first and last names being capitalized and prominent.

R. N. Carrow  
Associate Professor

RNC:n

UNIVERSITY OF GEORGIA -

Dr. Robert N. Carrow  
Principal Investigator

Influence of Soil Moisture Level  
on Turfgrass Water Use and Growth

1986 Grant - \$10,000 (first year  
of support)

One means of conserving water on turfgrasses is to reduce irrigation frequency; thereby, allowing the turfgrass to undergo a greater degree of drought stress before irrigation. By evaluating turfgrass performance under non-limiting to moderate moisture stress conditions, minimum water use requirements for a given level of turfgrass quality can be formulated. Also, the measurement of physiological and morphological plant responses will provide insight into drought avoidance and tolerance mechanisms for the three warm-season grass species in this study.

During 1986, 27 research units were installed under field conditions. Each unit had individually controlled irrigation capability. Moisture sensing probes were installed at three soil depths to monitor water extraction relative to rooting patterns. The three grasses (Tifway bermudagrass, Meyer zoysiagrass, and common centipedegrass) were established with each species irrigated under a range of soil moisture from non-limiting ( $\psi_{\text{soil}} = -0.40$  b) to moderate stress ( $\psi_{\text{soil}} = -9.0$  b). Detailed measurements of water use and growth parameters were initiated several times starting in mid-July. However, the TDR unit used to determine soil water content did not function properly and was returned to the manufacturer for upgrading. Intensive data collection is scheduled by 1987 and 1988 growing seasons. All scientific equipment to be provided by the University of Georgia in this joint project has been obtained and a graduate research assistant has been assigned to the project.

UNIVERSITY OF GEORGIA - Dr. Robert N. Carrow  
Principal Investigator

Cultivation Methods on Turfgrass  
Water Relationships and Growth  
Under Soil Compaction

1986 Grant - \$5,000 (first year  
of support)

Soil compaction can increase water use on recreational turfgrass sites by 25 to 50%, primarily by promoting light, frequent irrigation due to low water infiltration rates. Evaporation losses are enhanced by the moist soil surface in conjunction with an open canopy that is often warmer from solar radiation absorbed by the soil. Also, water losses may occur by greater runoff or leaching beyond the shallower root systems compared to noncompacted turf-grasses.

The primary cultural tool to help alleviate soil compaction is cultivation. During 1986, we initiated a research project to study the relative effectiveness of five cultivation techniques in alleviating compaction stress with particular emphasis on factors influencing water use efficiency. Since compaction affects water relations, each treatment/replication combination required a research plot that could be irrigated separately from all others. This system was installed and grassed with Tifway bermuda. Respective plots have been subjected to compaction several times and cultivation treatments applied twice. These treatments will be continued with intensive data collection in 1987 and 1988. In this joint project between the University of Georgia and USGA, all scientific equipment and technician support to be provided by University of Georgia has been obtained.



FIRST YEAR PROGRESS REPORT

for

- I. Influence of Soil Moisture Level on Turfgrass Water Use and Growth
- II. Cultivation Methods on Turfgrass Water Relationships and Growth Under Soil Compaction

Submitted by:  
Dr. Robert N. Carrow  
Turfgrass Physiology and Soils  
University of Georgia

Jointly Sponsored  
by  
United States Golf Association  
and  
University of Georgia Agricultural Experiment Station

October 29, 1986

## I. INTRODUCTION

The projects reported on were initiated on February 1, 1986 and this report covers the first year period from February 1, 1986 until November 1, 1986. Included is information on implementation, status of the first year plan of work, budget summary, and publicity concerning this research.

## II. IMPLEMENTATION

### A. Site Preparation

Both studies required the development of field research units that could be individually irrigated separate from all other units. In anticipation of funding by the USGA, the University of Georgia with assistance of The Toro Company initiated the establishment of such a system in fall 1985. Forty-eight units were installed in the Cecil sandy clay loam soil typically of the Piedmont region. These were grassed as follows:

#### Project I

- 9 units sprigged to 'Tifway' bermudagrass
- 9 units sprigged to 'Meyer' zoysiagrass
- 9 units sprigged to 'Common' centipedegrass

#### Project II

- 21 units sprigged to 'Tifway' bermudagrass

In June 1986 the common centipede plots were sodded due to severe winter injury.

Into each unit, a 30 x 30 x 60 cm box with lid was installed in the center area. These boxes provided access sites for soil moisture probes, which were placed to monitor soil moisture in the depths of 0 to 10 cm, 10 to 20 cm, and 20 to 60 cm.

### B. Equipment Acquisition

The USGA support for these projects was primarily for technician costs, while the UGA funding was mainly for equipment aspects. Equipment needed for these studies was acquired and included.

- \* Time domain reflectrometer (TDR) to measure soil water content
- \* Delta-T area meter to determine root length and leaf area
- \* Oxygen diffusion ratemeter to determine soil oxygen diffusion
- \* Infrared thermometer to measure canopy temperatures
- \* Thermocouple psychrometer unit for determination of plant water potentials
- \* Diffusive resistance porometer capable of measuring stomatal responses
- \* Semi-automatic root washing device

### C. Personnel

Mr. Greg Wiecko was employed on July 1, 1986 as an Agricultural Technician III to devote full time to these two studies. Mr. Wiecko has a M.S. degree from the Department of Agriculture, University of Bydgoszcz, Poland. During the past 1 1/2 years, he has worked under Prof. Ward Voorhees at the USDA-ARS facility at Morris, Minn., on a soil compaction project. Prof. Voorhees is one of the best known soil physicists in the world.

Two state supported technicians (ARA III and Farm Worker I) also assist in data collection or plot maintenance as needed. From May 1 until October 1, 1986, a temporary employee devoted some time to routine maintenance operations.

### III. STATUS OF FIRST YEAR ANNUAL PLAN OF WORK

#### A. OBJECTIVES FOR INFLUENCE OF SOIL MOISTURE LEVEL ON TURFGRASS WATER USE AND GROWTH

1. To determine the annual and seasonal water requirements of major turfgrass species in the Southeast under non-limiting to moderate moisture stress conditions.
2. To evaluate turfgrass performance -- quality, shoot responses, root alterations -- under non-limiting to moderate moisture stress conditions.

Status - Our preliminary plans were to establish the research units and initiate irrigation treatments so the grasses could acclimate. We did not anticipate obtaining much data until 1987.

By early July, we were able to start the irrigation treatments. In August and September, intensive data collection periods were attempted during dry-down after an irrigation. Unfortunately, our TDR unit (plus a loaner unit in September) malfunctioned and necessitated its return to the supplier. Without the TDR unit the plots could not be accurately scheduled for irrigation nor water extraction by soil depth determined. Thus, instead of being 2-3 months ahead of schedule, we are now on schedule, which includes intensive data collection starting in 1987.

The TDR manufacturer indicates to us that they have identified the problem with our unit (as well as all their other units). It is currently at the manufacturer for adjustment. We should note that during the times it was functioning the TDR unit was much more accurate than any other currently available technology.

B. OBJECTIVES FOR CULTIVATION METHODS ON TURFGRASS WATER  
RELATIONSHIPS AND GROWTH UNDER SOIL COMPACTION

1. To determine on a compacted soil the effects of different cultivation methods on turfgrass - soil - water relationships, particularly water use.
2. To identify any important acclimation responses of the turf to compaction and how cultivation may alter such responses.

STATUS - The anticipated time sequence was to develop the plots, initiate compaction on the appropriate units, and apply cultivation treatments. We also hoped to conduct one intensive data collection period.

Compaction was applied to those research units requiring compaction. This was repeated periodically to insure maintenance of a compacted soil situation. In July and September, the following cultivation treatments were imposed on compacted plots: core aeration with 1.3 cm diameter hollow tines with cores returned and 5 cm centers; core aeration with 1.6 cm diameter solid (shattercore) tines with 5 cm centers; deep drill coring to 25 cm with 1.3 cm diameter holes at 13 cm centers; Aerway slicing to 18 cm at 10 cm spacing; slicing with a Ryan unit to 10 cm at 15 cm spacing.

In September all plots were brought to saturation to start a 7 to 10-day period of intensive plant-soil-atmospheric monitoring. As discussed under Project I, the malfunctioning of the TDR unit prevented these plans. Cultivation treatments will be repeated in late spring 1987 and data obtained throughout the growing season.

#### IV BUDGET

Expenditures to date have been very close to budget estimates with the salaries of the Agricultural Technician III and temporary position accounting for 80% of the funding.

#### V. PUBLICITY

Several opportunities have occurred during the year to discuss these two research projects to audiences concerned with water conservation in the turfgrass industry. In each instance, we have credited the USGA for their support and noted their overall goal of water conservation.

##### A. Talks Presented

###### National Conferences:

Carrow, R. N. The influence of soil compaction on water use. International Turfgrass Conference of GCSAA, San Francisco, Calif., Jan. 1986.

###### Regional and State Conferences:

Carrow, R. N. Water management on compacted soils. North Carolina Turfgrass Conference and Show, Winston-Salem, N.C., Jan. 1986.

Carrow, R. N. Compaction - the subtle stress. VPI Turf Conference and Show. Richmond, Va., Jan. 1986.

Carrow, R. N. Water management for compacted soils. Univ. of Massachusetts Turfgrass Conference and Show, Springfield, Mass., March 1986.

Carrow, R. N. Soil factors affecting water use. Iowa State Turf Conference and Show. Des Moines, Iowa, March 1986.

Carrow, R. N. Soil cultivation and water use studies. Univ. of Georgia Turf Field Day, Griffin, Ga., Aug. 1986.

Carrow, R. N. Shatter - coring of turf. Auburn Turf Conference and Field Day. Auburn, Ala., September 1986.

Carrow, R. N. Water management and soil compaction. Kentucky Turfgrass Conference and Field Day. Owensboro, Ky., Oct. 1986.

Carrow, R. N. Cultivation techniques. Kentucky Turfgrass Conference and Field Day. Owensboro, Ky., Oct. 1986.

**B. Television:**

On July 9, 1986, the Cable News Network (CNN) science editor and film crew spent 4 hours filming and interviewing on the USGA sponsored Project II (Soil cultivation methods on turf water use and growth). The segment was aired six times on the CNN News in Science program the week of September 1-7, 1986.