

HISTORY AND FUTURE CHALLENGES AND OPPORTUNITIES IN CONSERVATION TILLAGE FOR A SUSTAINABLE AGRICULTURE: RESEARCH AND EXTENSION PERSPECTIVE

Raymond N. Gallaher

Agronomy Department, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL, 32611-0730. USA.

Corresponding author's e-mail: rngallaher@mail.ifas.ufl.edu

INDIVIDUALS

Mistakes are always made when writing about history. Therefore, I apologize for mistakes that may be made in writing this paper. I am sure that important people, places and events will be overlooked. Much of this paper deals only with the factors that led to the beginning of these conservation tillage conferences, those who have participated, and research and extension efforts that we have reported in our proceedings. From this background and analysis we should be able to draw some conclusions and make predictions for our future.

In the 1960's the world experienced the "Green Revolution," a revolution that helped ward off starvation in many parts of the world. During the past 25 years the world has experienced another revolution called the "Conservation Tillage Revolution." Those of us involved with these conferences in the southern USA have played a major role in the advancement of this revolution. In the beginning we faced opposition at every turn including comments like: its trash farming, it takes more chemicals, you have to burn the crop residues because insects and diseases will eat up the crops, we need better and more workable equipment, all of our present crops are not bred for short season multiple cropping systems, it won't work on my farm, the fertilizer won't work on top of the ground, we can't control perennial grasses like Johnsongrass or bermudagrass, and the list of bone picking by the buzzards goes on and on. Of course questions are always good, but when the negative attitudes are coming from your own academic colleagues, who are ignorant on a subject, they can pose the biggest drag on the advancement of new and important technology. Although some of these questions still come up when conservation tillage is first introduced to new locations, it doesn't take long until successes cause these new people to begin repeating the same virtues of the practice as if they are the ones to make the initial discovery. I always tried to practice

advice by Shirley Phillips, with whom I sought council in 1973. One week after I began work at the Georgia Experiment Station, Experiment, GA., he advised me, "If someone tells you 'it won't work' quickly remove yourself from that individual and move on to someone who has an open attitude. Don't waste your time with all the negative people you will face." I have repeated his comment hundreds of times over the past 29 years. A positive attitude is the key to providing solutions to the opportunities we face.

By the 1970s all of the southeastern states had some research history and experience with no-till crop management. Some states were also emphasizing multiple cropping systems research and the advantages for such farming practices in the Southeast. The coupling of no-till planting of the summer crop in succession systems resulted in more efficient use of land as well as savings in labor, equipment and fuel, and reduced soil erosion. These concepts were the results of research projects being carried out by university and USDA-ARS research personnel. For example, Dr. Lloyd R. Nelson wrote the first Hatch project in Georgia, dedicated solely to this subject and initiated some field research at Griffin, GA in 1972. The title of the project was "Minimum Tillage Multiple Cropping Systems for the Southeast." In the summer of 1973 Dr. Raymond N. Gallaher was hired at the Georgia Station at Griffin to take over this project. In the summer of 1975, Gallaher was Chairman of a program at the Georgia Experiment Station, Experiment, GA entitled "Feeds and Feeding Research Day." This was a one-day program that involved research scientists presenting research information in an extension format and included a display of posters and no-tillage equipment, oral presentations, and a field tour of no-till multiple cropping research at the Georgia Station. Those who participated and especially the administration and

Table 1. Past conferences, chairmen, and citations of proceedings.

Year	Location	Program Chairman or Co-Chairmen	Proceedings
1978	Griffin, GA	J.T. Touchton Agronomy Department University of Georgia 1109 Experiment St. Griffin, GA 30223-1797	Touchton, J.T., and D.G. Cummins (eds.). 1978. Proc. First Annual Southeastern No-Till Systems Conference. Experiment Georgia 29 November 1978. Georgia Exp. Sta. Special Pub. No. 5 Univ. of Georgia, Agri. Exp. Stn., Experiment, GA.
1979	Lexington, KY	Shirley Phillips Agronomy Department University of Kentucky Lexington, KY. 40546	No Proceedings Published
1980	Gainesville, FL	R.N. Gallaher PO Box 110730 Agronomy Department University of Florida Gainesville, FL 32611	Gallaher, R.N. (ed.). 1980. Proc. 3 rd Annual No-Tillage Systems Conference. Williston, Florida 19 June 1980. Inst. Food & Agri. Sci., Univ. of Florida, Gainesville, FL
1981	Raleigh, NC	A.D. Worshum, W.M. Lewis & G.C. Naderman Crop Science Department NC State Univ. Raleigh, NC 27650	Lewis, W.M. (ed.). 1981. No-Till Crop Production in North Carolina – Corn, Soybean, Sorghum, and Forages. North Carolina Agri. Extension Service AG-273, Raleigh, NC.
1982	Florence, SC	J.H. Palmer Agronomy Department Clemson University Clemson, SC 29634	Palmer, J.H., and E.C. Murdock (eds.). 1982. Proc. 5 th Annual Southeastern No-Till Systems Conference. Florence, SC 15 July 1982. Agronomy and Soils Extension Series No. 4. Clemson Univ. Clemson, SC.
1983	Milan, TN	E.L. Ashburn & T. McCutchen Univ. of Tennessee West TN Agic. Exp. Stn. Jackson, TN	Jared, J., F. Tompkins, and R. Miles (eds.). 1983. Proc. 6 th Annual Southeastern No-Till Systems Conference. Milan, TN 21 July 1983. Univ. of Tennessee Inst. of Agri., Knoxville, TN.
1984	Headland, AL	J.T. Touchton Agronomy Department Auburn University Auburn, AL 38301	Touchton, J.T., and R.E. Stevenson (eds.). 1984. Proc. 7 th Annual Southeast No-Tillage Systems Conference. Headland, AL 10 July 1984. Alabama Agri. Exp. Stn., Auburn Univ., Auburn, AL.
1985	Griffin, GA	W.L. Hargrove Agronomy Department University of Georgia 1109 Experiment Station Griffin, GA 30223-1797	Hargrove, W.L., F.C. Boswell, and G.W. Langdale (eds.). 1985. Proc. 1985 Southern Region No-Till Conference. Griffin, GA. 16-17 July 1985. Georgia Agri. Exp. Sta., Univ. of Georgia, Athens, GA
1986	Lexington, KY	R.E. Phillips and K. L. Wells Agronomy Department Univ. of Kentucky Lexington, KY 40546	Phillips, R.E. (ed.). Proc. Southern Region No-Till Conference. Lexington, KY 18 June 1986. Kentucky Agri. Exp. Stn., Southern Region Series Bulletin 319. Univ. of Kentucky, Lexington, KY
1987	College Station, TX	T.J. Gerik and B.L. Harris Blackland Research Center Temple, TX 76501	Gerik, T.J., and B.L. Harris. (eds.). 1987. Proc. Southern Region No-Tillage Conference. College Station, TX 1-2 July 1987. Texas Agri. Exp. Stn. MP-1634, Texas A & M Univ. System. College Station, TX
1988	Tupelo, MS	N.W. Buehring & J.E. Harrison Mississippi State Univ. NE Miss. Branch Stn. Verona, MS 38879	Hairston, J.E. (ed.). 1988. Proc. 1988 Southern Conservation Tillage Conference. Tupelo, MS 10-12 August 1988. Mississippi Agri. and Forestry Exp. Stn., Special Bulletin 88-1. Mississippi State Univ., Mississippi State, MS.

Table 1. continued

Year	Location	Program Chairman or Co-Chairmen	Proceedings
1989	Tallahassee, FL	D.L. Wright and I.D. Teare University of Florida N. Florida Res., & Educ. Ctr. Rt. 3 Box 4370 Quincy, FL 32351	Teare, I.D. (ed.). 1989. Proc. 1989 Southern Conservation Tillage Conference. Tallahassee, FL 12-13 July 1989. Inst. of Food and Agri. Sci. Special Bulletin 89-1. Univ. of Florida, Gainesville, FL.
1990	Raleigh, NC	M.G. Waggoner NC State University Raleigh, NC 27650	Mueller, J.P., and M.G. Waggoner (eds.). 1990. Proc. 1990 Southern Region Conservation Tillage Conference. Raleigh, NC 1990. NCSU Special Bulletin 90-1. North Carolina State Univ., Raleigh, NC.
1991	N. Little Rock, AR	S.L. Chapman & T.C. Keisling University of Arkansas Soil Testing & Res. Lab. P.O. Drawer 767 Marianna, AR 72360	Keisling, T.C. (ed.). 1991. Proc. 1991 Southern Conservation Tillage Conference. North Little Rock, AR 18-20 June 1991. Arkansas Agri. Exp. Sta. Special Report 148, Univ. of Arkansas, Fayetteville, AR
1992	Jackson, TN	J.F. Bradley & M.D. Mullen University of Tennessee P.O. Box 1071 Knoxville, TN 37901	Mullen, M.D., and B.N. Duck (eds.). 1992. Proc. 1992 Southern Conservation Tillage Conference. Jackson and Milan, TN 21-23 July 1992. Tennessee Agri. Exp. Sta. Special Publication 92-01. Univ. of Tennessee, Knoxville, TN.
1993	Monroe, LA	P.K. Bollich Louisiana State Univ. LA. Agric. Exp. Stn. P.O. Box 1429 Crowley, LA 70527-4129	Bollich, P.K. (ed.). 1993. Proc. 1993 Southern Conservation Tillage Conference for Sustainable Agriculture. Monroe, LA 15-17 June 1993. Louisiana Agri. Exp. Stn. Ms. No. 93-86-7122. Louisiana State Univ., Baton Rouge, LA.
1994	Columbia, SC	W.J. Busscher & P.J. Bauer USDA-ARS Coastal Plains Res. Ctr. Florence, SC 29501-1241	Bauer, P.J., and W.J. Busscher (eds.). 1994. Proc. 1994 Southern Conservation Tillage Conference for Sustainable Agriculture. Columbia, SC 7-9 June 1994. USDA-ARS Coastal Plains Soil, Water, and Plant Research, Florence, SC.
1995	Jackson, MS	N.W. Buehring & W.L. Kingery Mississippi State Univ. NE Miss. Branch Stn. Verona, MS 38879	Kingery, W.L., and N. Buehring (eds.). 1995. Proc. 1995 Southern Conservation Tillage Conference for Sustainable Agriculture. Jackson, MS 26-28 June 1995. Mississippi Agri. and Forestry Exp. Stn. Special Bulletin 88-7., Mississippi State Univ., Mississippi State, MS
1996	Jackson, TN	P. Denton, J.H. Hodges, III, & D. Tyler Univ. of Tennessee Plant & Soil Sci. Dept. Knoxville, TN 37901	Denton, P., N. Eash, J. Hodges, III, and D. Tyler (eds.). 1996. Proc. 19 th Annual Southern Conservation Tillage Conference for Sustainable Agriculture. Jackson and Milan, TN 23-25 July 1996. Univ. of Tennessee Agri. Exp. Stn. Special Public. 96-07. Univ. of Tennessee, Knoxville, TN.
1997	Gainesville, FL	R.N. Gallaher & D.L. Wright PO Box 110730 Agronomy Dept. Univ. of Florida Gainesville, FL 32611	Gallaher, R.N., and R. McSorley. 1997. Proc. 20 th Annual Southern Conservation Tillage Conference for Sustainable Agriculture. Gainesville, FL 24-26 June 1997. IFAS Coop. Extn. Service, Special Series SS-AGR-60, Univ. of Florida, Gainesville, FL.
1998	North Little Rock, AR	S.L. Chapman & T.C. Keisling Univ. of Arkansas P.O. Box 391 Little Rock, AR 72203	Keisling, T.C. (ed.). 1998. Proc. 21 st Annual Southern Conservation Tillage Conference for Sustainable Agriculture. North Little Rock, AR 15-17 July 1998. Arkansas Agri. Exp. Stn. Special Report 186, Univ. of Arkansas, Fayetteville, AR.

Table 1. continued

Year	Location	Program Chairman or Co-Chairmen	Proceedings
1999	Tifton, GA	J.E. Hook Univ. of Georgia-NESPAL Coastal Plain Exp. Sta. P.O. Box 748 Tifton, GA 31793-0748	Hook, J.E. (ed.). 1999. Proc. 22 nd Annual Southern Conservation Tillage Conference for Sustainable Agriculture, Tifton, GA 6-8 July 1999. Georgia Agri. Exp. Sta. Special Pub. 95. Univ. of Georgia, Athens, GA.
2000	Monroe, LA	P.K. Bollich Rice Research Station, Louisiana Agric. Exp. Stn., LSU AgCenter, P.O. Box 1429, Crowley, LA 70527- 1429	Bollich, P.K. (ed.). Proc. 23 rd Annual Southern Conservation Tillage Conference for Sustainable Agriculture. Monroe, LA 19-21 June 2000. Louisiana Agri. Exp. Sta., LSU Agri. Center Manuscript No 00-86-0205, Louisiana State Univ. Crowley, LA 70527-1429.
2001	Oklahoma City, OK	J.H. Stiegler Plant & Soil Sci. Dept. Oklahoma State Univ. Stillwater, OK 74078	Stiegler, J.H. 2001 (ed.). Proc. 24 th Annual Southern Conservation Tillage Conference for Sustainable Agriculture, Oklahoma City, OK 9-11 July. Oklahoma Agri. Exp. Sta. Misc. Pub. MP – 151. Oklahoma State Univ. Stillwater, OK.
2002	Auburn, AL	D.W. Reeves, R.L. Raper, and K. Iversen USDA-ARS-NSDL 411 S. Donahue Dr. Auburn, AL 36832	E. van Santen (ed.) 2002. Making Conservation Tillage Conventional: Building a Future on 25 Years of Research. Proc. of 25 th Annual Southern Conservation Tillage Conference for Sustainable Agriculture. Auburn, AL 24-26 June 2002. Special Report no. 1. Alabama Agric. Expt. Stn. and Auburn University, AL 36849. USA.

related industry hailed this program a great success. Proceedings of the research day presentations were also published (Gallaher and Baird, eds. 1975). Gallaher's chapter in the proceedings was entitled "All Out Feed Production by Multiple Cropping" (Gallaher, 1975). Preliminary data on a large number of double and triple cropping systems using no-till planting of summer crops was presented from field studies in north, central, and south Georgia that illustrated the tremendous potential for no-till multiple cropping management for helping solve the feed grain deficit in Georgia. Gallaher remained at the Georgia Station for three years until the summer of 1976, at which time he was employed by the University of Florida to establish and coordinate a program similar to the one in Georgia. Dr. Joe Touchton, a recent graduate of the University of Illinois, was hired by the University of Georgia to replace Gallaher in the fall of 1976. Dr. Touchton's research project continued to emphasize no-till multiple cropping with significant emphasis being placed on soil fertility management. It is ironic that like Gallaher, Dr. Touchton remained with the University of Georgia for only three years because of an offer by Auburn University, who wanted someone to establish and coordinate a project on no-till multiple cropping for that state. Dr. Touchton's replacement at Georgia, Dr. W.L. Hargrove, was a graduate of Kentucky, had training in no-tillage and continued to

emphasize no-till multiple cropping and soil properties. Dr. Hargrove also left the University of Georgia after a few years and moved into international agriculture. Dr. Terry Keisling was another research scientist employed by the University of Georgia in the early years of no-till multiple cropping emphasis. He moved to the University of Arkansas and has played an important role in the advancement of no-till multiple cropping in that state. Some other scientists involved with our early progress who were graduates from institutions with no-tillage histories include: Dr. David L. Wright, Professor at the University of Florida and graduate from VPI, Dr. Don Tyler, Professor at the University of Tennessee and graduate of the University of Kentucky, Dr. Paul Denton, Professor at the University of Tennessee and graduate of North Carolina State University, and Dr. Normie Buehring, Professor at Mississippi State University and graduate from Oklahoma State University. The author apologizes for leaving names of other important leaders out of the list. However, their names are documented in Table 1.

In addition to research and extension work by scientists in their respective states, most have been involved in international activities. We have been invited to all continents as consultants, participants in no-till and multiple cropping conferences and field days, as well as teachers of short and long courses to farmers, college students, and employees of industry and research and extension institu-

tions. In addition to our travels to other countries, we have been host to visiting farmers and scientists from all over the world as well. Many of us collectively have also trained hundreds of graduate students, both from the USA and foreign countries, who have been and are actively involved with conservation tillage multiple cropping.

STRIP-TILL PLANTER INVENTION

One of the major hindrances to the progress of no-till in the coastal plains states was poor seed establishment and crop failures due in many cases to soil compaction. An expert on this subject was Dr. A.C. Troupe, Jr., USDA-ARS, located at the National Tillage Machinery Laboratory, Auburn, AL. Dr. Troupe interacted with the Harden's, a farm family from Banks, AL, during the early 1970s, the results of which was the invention of the no-till plus planter by Mr. J.C. Harden. Mr. Tony Rutz, Chevron Chemical Co., and Dr. R.N. Gallaher traveled to Banks, AL in 1975 to see the invention and discuss the possibility of its manufacture with the Hardens and with Brown Mfg. Co. In 1976 Dr. Troupe, Dr. Gallaher, the Harden's, and the Brown family were part of a news release program announcing this new invention and plans for its production. The national news release program was held in Troy, AL and was sponsored by Chevron Chemical Co. We stressed the potential of the new no-till plus planter for possible solutions to many of the no-till failures in the coastal plains states. Other farmers like Mr. Danny Stevens of Florida, and companies like Cole Mfg. and Kelly Mfg. soon came out with their versions of the no-till plus planters. These actions gave proof that the new invention was being implemented in no-till management. Names of this invention changed over time from "no-till plus," "no-till plus in-row subsoil," "row-till," and today it is known as "strip-till." The earlier versions of strip-till planters did not include the subsoil or in-row subsoil unit on their planters, but at least one version used small tillers to till small strips of rows for planting into established sod crops. The invention of the strip-till planter by the Harden family has played a major role in the progress of no-till farming in the South and many other places in the world.

CONFERENCES

The above gives some background setting the stage for a mechanism to meet the need to share information on the progress of no-till and multiple cropping systems among interested parties in the southeastern states. The idea of establishing annual southeastern conferences was initiated from conversations with Mr. Tony Rutz, a former representative of Chevron Chemical Co., while returning from the above-mentioned trip to Troy, AL in 1976. Ideas we discussed included having a program similar to the research day held at Experiment, GA in 1975 that would be hosted

by a single state, but involve interested parties on the program from each of the southeastern states. We received endorsement of the general idea from Mr. Shirley Phillips at Kentucky. We wanted to involve all interested parties on the program by having them give oral or poster presentations, trying to have successful no-till multiple cropping farmers on the program, gearing information exchange toward the extension of our work, and having a proceedings of presentations that would be published using English units. We felt that the proceedings would not only provide documentation of information for extension but also provide additional justification to administrators for approval of participants to travel and participate. There were, at that time, and are even more today, dozens of refereed scientific publication outlets for exchange of research among scientists, but the numbers of outlets directed to the public (farmers) were limited at the time and still are today. A comment by Touchton in the preface of the seventh Southeastern No-Tillage Systems Conference was one of the main bases for publication of the proceedings. Touchton wrote, "Generally, there is a 2- to 5-year delay in transmitting data from the researcher to the agricultural community. Since there is a critical need for the limited conservation tillage data that are available, the Southeastern No-Tillage Systems Conference was established to provide a rapid means for communication among researchers and the community. The proceedings associated with this conferences are one method being used to rapidly transmit research data" (Touchton, 1984 see citation in Table 1.).

By 1977, discussions with other no-tillage and multiple cropping systems leaders in the Southeast led to an agreement for each of the seven states to host the conferences on a rotating basis. Because Georgia had an already established history of no-till multiple cropping systems research, we decided to begin the conferences at Experiment, GA, and to rotate the remaining conferences north and south to give states like Florida, South Carolina, and Alabama more time to establish research and extension programs.

We agreed on a name for the conferences entitled "Southeastern No-Tillage Systems Conference." This name emphasized the Southeast as the area of the country on which the conference was focused, on planting directly into sods, cover crops or crop residues without plowing, on tillage and cropping systems-especially multiple cropping, and the word conference to imply information exchange. We were successful in completing the original plan for the seven original conferences (Table 1.).

Dr. Shirley Phillips had begun suggesting that the conferences include all of the southern states prior to the completion of the original plan. There was also an interest by the Southern Experiment Station and Cooperative Extension Directors to formalize the conferences into a working group

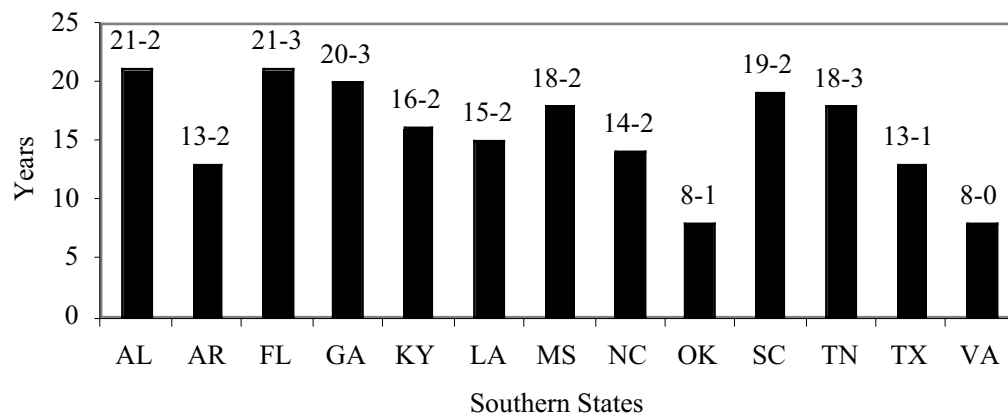


Fig. 1. Number of years each state participated in the 25 tillage conferences. The second number is the number of times a state has hosted this conference.

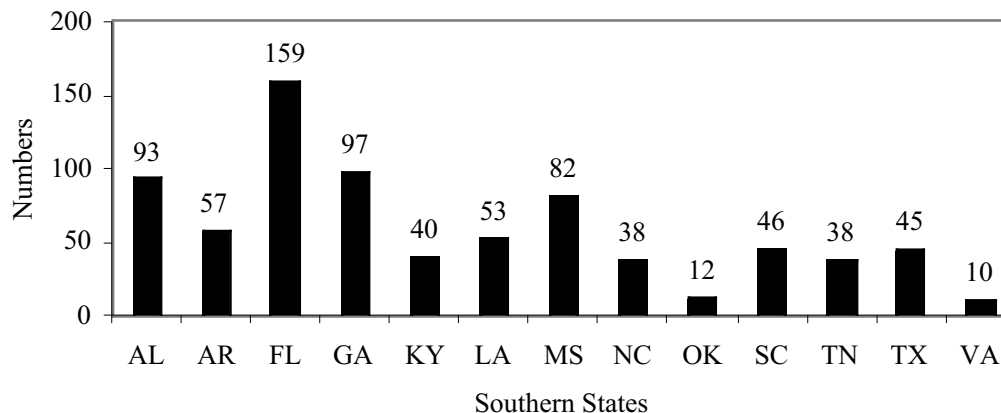


Fig. 2. Number of papers from each state in the 24 proceedings of the 25 tillage conferences

under their direction. With this in mind, Georgia again became the host of the eighth conference under the new name entitled “Southern Region No-Till Conferences” (Table 1). By 1988, participants were encouraging broader participation by changing the name of the conference to include the word “conservation tillage” instead of no-till or no-tillage. The apparent thought in this was that we would get greater participation by organizations who stressed conservation tillage since no-till/no-tillage, along with other types of minimum tillage were all parts of conservation tillage. Therefore in 1988, Mississippi State University was the first state to host the conference with the new name “Southern Conservation Tillage Conference” (Table 1). This name lasted until 1993 when the words “Sustainable Agriculture” were added to the title of the conferences. Therefore, Louisiana State University was the first state to host the conference with the new name “Southern Conservation Tillage Conference for Sustainable Agriculture”

(Table 1). This latter name has lasted to the present time and appears to continue to be relevant to today’s activities. This does not mean, however, that we have been exclusionary over the years because we have also had guest speakers from Washington, DC, several other states, and from abroad.

CONFERENCE PROCEEDINGS

All host states have published a proceedings of papers presented with the exception of the second conference in 1979 in Kentucky (Table 1). States who have hosted the conferences three times include Florida, Georgia, and Tennessee. Most other states have hosted the conference twice except for Oklahoma and Texas who have been host one time and Virginia who never hosted a conference (Table 1).

Publications in the conference proceedings reveal numerous items regarding our history. Based on the proceed-

ings, five of the original seven states have participated in the conferences 18 or more times (Fig. 1). Mississippi participated more times than any of the other southern states outside of the original seven states. Oklahoma and Virginia have had the least representation in the proceedings (Fig. 1). Of the almost 800 total articles and abstracts published, Florida is the leader with 159 followed by Georgia with 97 and Alabama with 93 (Fig. 2). Again leadership and interest from Mississippi is evident by having the most publications outside the original seven states (Figure 2). The lower ranking for Tennessee does not reflect activities of that state. They published separate proceedings of their “Milan No-Till Field Day” tours each of the three times they hosted the conference, as well as the conference proceedings. The field day was considered a part of the conference.

Publications from all states placed more emphasis on

crop growth and soil variables compared to emphasis on specific commodities (Fig. 3). The exceptions are Louisiana and Virginia, where the two categories are about equal. When the publications in the proceedings were viewed for four reporting periods of 1978 to 1984, 1985 to 1992, 1993 to 1997, and 1998 to 2002, one could observe changes in research emphasis. For example, among the commodities, greatest emphasis in the early years was on corn and soybean research compared to forages and sorghum (Fig. 4). Research on all these commodities peaked during the 1985 to 1992 period and has begun to decline, with no reports on sorghum during the 1998 to 2002 period. On the other hand, commodities of cotton, peanut, and vegetables received limited attention in the early years but appear to be gaining in interest during the latter periods (Fig. 5). No-till peanut research from Florida and Georgia was reported

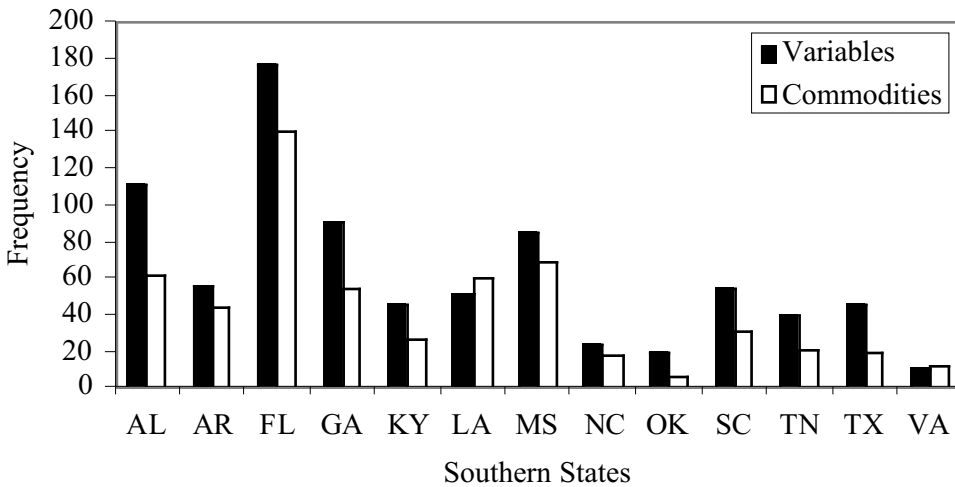


Fig. 3. Proceedings papers for past 25 years with emphasis on crop growth and soil variables vs. papers with emphasis on crop commodities.

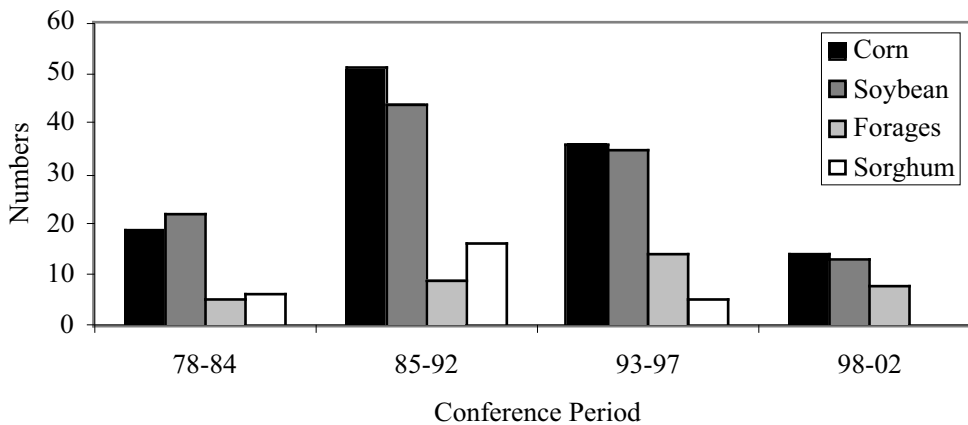


Fig. 4. Proceedings publications with emphasis on corn, soybean, forages, and sorghum for four publishing periods.

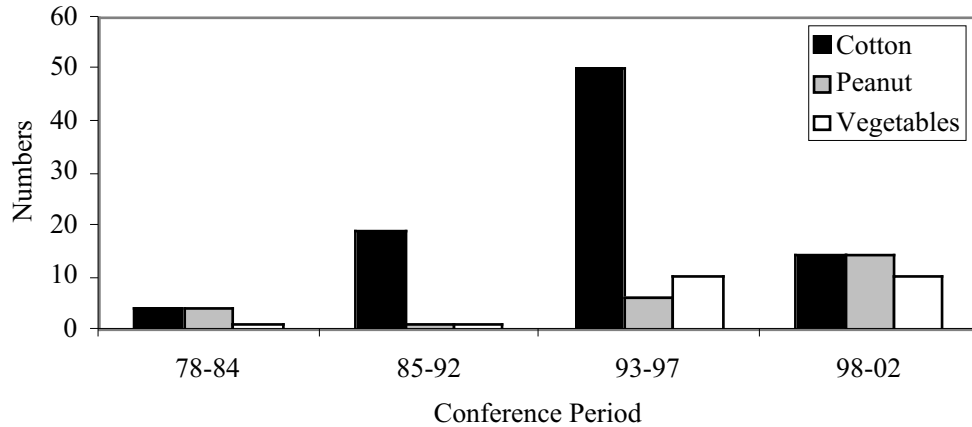


Fig. 5. Proceedings publications with emphasis on cotton, peanut, and vegetables for four publishing periods.

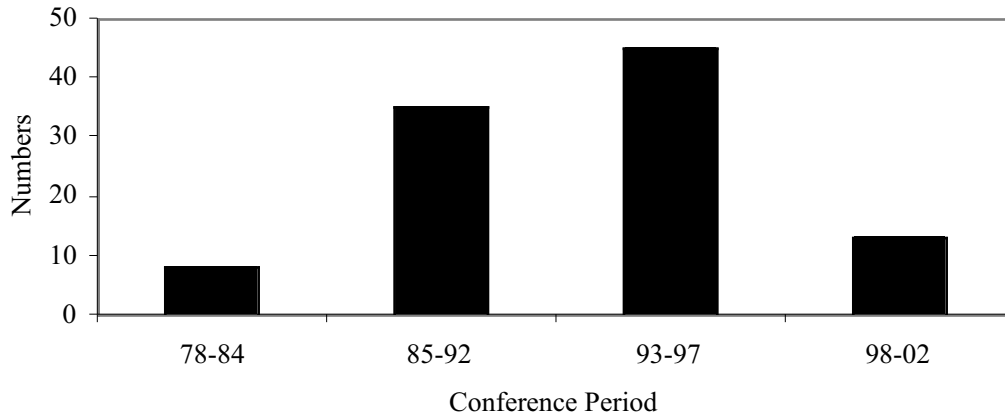


Fig. 6. Proceedings publications with emphasis on winter cover crops and new crops for four publishing periods.

four times in the first seven years but this research was dropped due to lack of farmer interest. It is noted that strip-till peanut is one of the hottest research items today (Fig. 5). The reason for this is just like the application of no-till technology to other commodities over the years, economic survival of the farmers. There has also been a low, but increasing interest in no-till vegetables over the years as well. Published reports on other commodities peaked in the 1993 to 1997 period (Fig. 6). Reports have been published on small grains, winter and summer legumes, and several minor crops.

Reports of experiments comparing forms of conservation tillage with conventional tillage have dominated the variables that impact crop growth (Fig. 7). While many of us believe we have successfully proven that conservation tillage should be considered conventional tillage, the statistics of our reporting in our proceedings shows that we are not yet ready to go all the way. Significant research reports

comparing tillage methods are still routinely reported in our proceedings. Research on soil chemical and physical properties and related plant nutrition relationships have received significant priority (Fig. 7). Emphasis on multiple cropping, soil erosion, and water issues appear to be correlated with the interest in tillage variables as well (Fig. 7). Published reports regarding weed control, insects and diseases, including nematodes, are likely not representative of research that has been reported in these areas over the 25-years (Fig. 8). Many weed scientists report their work in state research reports and at their own professional meetings. Greater participation of pest management researchers along with economists would likely have made our goal of information exchange to the public a greater success.

CHALLENGES AND OPPORTUNITIES

We have fought a good fight and have won many races set before us over the past 25 years. We are at the peak of the

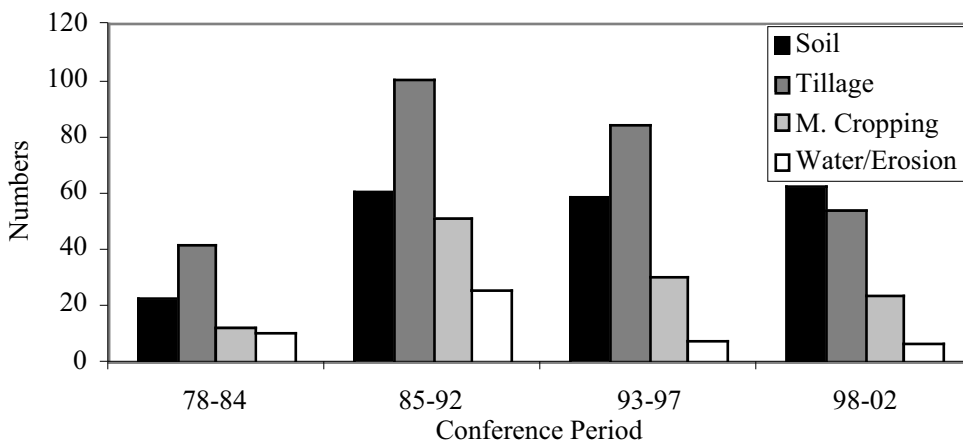


Fig. 7. Proceedings publications with emphasis on soil properties, tillage, multiple cropping systems, water and erosion for four reporting periods.

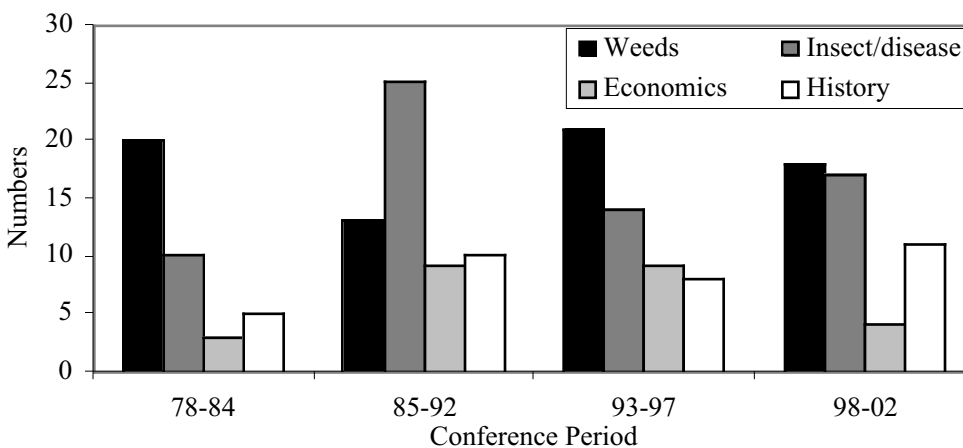


Fig. 8. Proceedings publications with emphasis on pest problems, economics and history for four publishing periods.

new “Conservation Tillage Revolution.” We have done an outstanding job of documenting our research findings and in extending that research to the public as evidenced in almost 800 articles in the proceedings of our conferences. In addition, we have held hundreds of field days, short and long courses, lectures, etc., in the promotion of conservation tillage, its possibilities when coupled with multiple cropping, and its environmental and economic advantages. Our research information has been extended worldwide.

Our work in the past has emphasized conservation tillage management for many of the major crops like corn, soybean, grain sorghum, cotton, and forages. We are rapidly expanding conservation tillage for peanut as well. While we can look at the great strides in conversion of land to conservation tillage farming we should ask the question, Why, with all the answers we have now, are there so many farmers still practicing conventional tillage management on

these major crops? With few exceptions most vegetable crops have been neglected. Why have we not done more research on conservation tillage vegetables? Why, in most cases, are we still only practicing no-till planting on the summer crops in multiple cropping systems? Over the years we have lost many of the chemicals traditionally used for weed, insect and disease control. Others like Atrazine are being challenged now. Few remain that are approved for use against nematodes. What are our alternatives to chemical pest control in conservation tillage cropping systems? What is the future of precision agricultural technology for conservation tillage farming practices? GMO crops have obviously promoted no-till management and easier control of specific pests. Will the world community become more accepting of these new technologies? Will pest resistance become a major opportunity for solutions as more GMO varieties and crops are introduced. Have we solved all the

erosion problems in farming? Which system has the greatest potential for a sustainable agriculture, the highly erosive conventional tillage farming way or conservation tillage farming practices? Do we still have a problem in transferring technology from the researcher to the farm? How well will the new computer technology be utilized to extend information on conservation tillage and its agricultural sustaining principles to the public? As I look at the list of aging, retired, and deceased leaders of these conferences in Table 1, I also note a very good mix of research and extension expertise. Many of us either now hold or have held joint appointments in both research and extension. This mix has aided in extending research to the public. However, I wonder what these aging leaders are doing to help ensure that our organizations will continue to emphasize conservation tillage research and extension efforts when we are gone? Present trends look great for the future of conservation tillage for greater sustainability in agricultural production. The above comments are just a few of the challenges and opportunities that face those of us involved with the Southern Conservation Tillage Conferences for Sustainable Agriculture. Past history of the dust bowl of the midwestern U.S.A, severe erosion from cotton farming in the southern piedmont U.S.A, intensive farming of the sloping land in Parana, Brazil, etc., show that conventional tillage farming is not sustainable; conservation tillage is our hope!

ACKNOWLEDGMENTS

Our accomplishments over the past 25 years have been due to the joint effort by Experiment Stations, Cooperative Extension Services, USDA-ARS scientists, federal and state agencies, and especially the partners from the equipment, chemical, fertilizer, and seed industries. It has been a rewarding and great partnership. Conservation tillage multiple cropping is a part of the Florida FIRST initiative by the Institute of Food and Agricultural Sciences, University of Florida. This paper was supported by the Florida Agricultural Experiment Station and is approved for publication as Journal Series No R-08801.

LITERATURE CITED

- Gallaher, R.N., and D.M. Baird (eds.). 1975. Proc. Feeds and Feeding Research Day, "Efficient Energy Use." Experiment, GA 15 July 1975. Georgia Exp. Sta. Departments of Agronomy and Animal Science Volume 1. The Georgia Experiment Station, Experiment, GA and the Georgia Coop. Extn. Service, Athens, GA.
- Gallaher, R.N. 1975. All out feed production by multiple cropping. pp. 29-36. *IN* R.N. Gallaher and D.M. Baird, (eds.). Proc. Feeds and Feeding Research Day, "Efficient Energy Use." Experiment, GA 15 July 1975. Georgia Exp. Sta. Departments of Agronomy and Animal Science Volume 1. The Georgia Experiment Station, Experiment, GA and the Georgia Coop. Extn. Service, Athens, GA.