Future Recommendations

Performances of these machines could be improved by several changes in the machines and/or tree design. All machines would benefit from smaller trees and canopy sizes. Trunk shaker fruit removal performance could probably be improved with larger displacements at lower frequencies. In addition, increased trunk heights would improve shaker leverage and would help alleviate bark damage caused by shaker clamps on many of the existing short trunks. Improved shaking patterns may also alleviate bark damage in Valencia trees. With the canopy shaker, fruit removal performance can be improved by better matching the machine and the tree canopy—a solid hedgerow in which the spokes penetrate the entire canopy volume. This will probably involve increasing the size of the machine and controlling the canopy size and shape by pruning. In a similar manner, improving the fruit removal performance of the Crunkelton machine will require canopy sizes which can be completely penetrated by the tubes. The Crunkelton machine, however, does not require hedgerow conditions to be effective.

Literature Cited

Crunkelton, W. 1992. Mechanical citrus and other fruit picker. United States Patent No. 5161358.

Florida Citrus Commission. 1993. Proceedings of the Harvesting Symposium—If we do nothing. PO Box 148, Lakeland, FL 33802. 46 p.

Florida Citrus Commission. 1994. Citrus Harvesting Think Tank Report. PO Box 148, Lakeland, FL 33802. 22 p.

Miller, W. M., J. K. Burns and J. D. Whitney. 1995. Effects of harvesting practices on damage to Florida grapefruit and oranges. Appl. Engr. Agr. 11(2):265-269.

Peterson, D. L. 1997. Mechanical harvester for processed oranges. Proc. of the 5th International Symposium on Fruit, Nut, and Vegetable Production Engineering. Davis, CA.

Whitney, J. D. 1995. A review of citrus harvesting in Florida. Trans. Citrus Eng. Conf., Florida Section, ASME, Vol. 41, 33-59.

Whitney, J. D. 1996. Field test evaluations of DOC funded citrus harvesting methods. Final report on DOC Contract 95045. Florida Department of Citrus. Lakeland, Florida.

Whitney, J. D. 1997. Mechanical orange harvesting developments in Florida. Proc. of the 5th International Symposium on Fruit, Nut, and Vegetable Production Engineering. Davis, CA.

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ACQUIRING WEATHER INFORMATION VIA A DECISION MAKING SYSTEM (DISC)[1]

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Additional index words. Decision making system, frost warning, weather information, citrus production information, citrus networking, expert systems, knowledge engineering.

Abstract. **Information is increasing at a rate that makes acquisition of information seem like drinking from a fire hose. Privatization of weather information dissemination has made the information marketplace seem voluminous if not chaotic. Hope to resolve this situation for citrus led to the development of DISC [Decision Information System for Citrus]. A proposal to develop such a system was funded by the Florida Citrus Production Research Advisory Council. The system is expected to contain a number of weather sensitive production, harvesting and marketing modules. The links through which weather information may flow to various weather sensitive models are diagrammed. Potential users are represented in the development team. Their participation promises a system that is tailored to their needs and for which they feel ownership. Their enthusiasm for weather information provides encouragement to the VARs [value added retailers] of weather information. The role private enterprise may play in a system created in part in the public domain is a manifestation of privatization in the information marketplace. Potential users of such a system have an opportunity to play a critical role in designing the system for their use.**

The manner in which agriculturists, more specifically citrus growers, acquire and use weather information in weather sensitive decisions they make is changing rapidly [Martsolf, 1997]. This is due in part to the recent demise of the Federal-State Frost Warning Service in Florida, which had been in existence since 1935 [Martsolf, 1995a]. These changes include not only the manner in

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which frost warnings are developed and disseminated but also the way weather information is moving to and from the users throughout the year. These changes spurred the development of DISC [Decision Information System for Citrus] (Beck, 1997; Martsolf & Peart, 1997; Martsolf, 1995b, 1996; Spyke, 1996b, 1997; Spyke & Martsolf, 1998).

One of the mechanisms identified in the demise of the Federal-State Frost Warning Service was privatization [Martsolf, 1997]. Private Enterprise [PE] argued convincingly that it could supply weather information to special interest groups more effectively than can the public organizations, but only if the public sector ceases to appear to be supplying such information at no cost. PE often upgrades equipment and methodology rapidly to remain competitive. Public institutions are less likely to find resources for upgrades. The value of the information sustains the dissemination either through subscription or advertisements. The larger the audience, the smaller the cost to the individual participant. Some suggest these changes are driven by competition in the information marketplace (Dertouzos, 1997). Privatization is playing a key role in the flow of the weather information into DISC [Fig. 2].

The Internet is rapidly becoming easier and less expensive to use in the dissemination of weather information (Martsolf, 1997). If one searches the Internet for weather information, there seems to be more available than one would ever need [Hunt and Smith, 1997]. Florida Citrus Mutual has recommended DTN [Data Transmission Network Corp.; www.DTN.com], a satellite linked service. It takes appreciable time to develop the skill necessary to find and interpret the products found. Also the speed varies with which the various sources are able to update their files. Those who tailor their services to special interest groups find it necessary to charge for their services. The nature of tailored services varies and is in rapid change as the PE test the market for their products [Getz, 1997]. Competition is driving down the cost in many cases. Several county citrus specialists continue to operate weather services. Members receive a phone number in return for a share of the cost of the answering machine. Members call and hear the voice of their extension citrus specialist describing what he is seeing and hearing and perhaps what he recommends the listener do. One of these agents, John Jackson, has led the implementation of a program called the Florida Agricultural Weather Network or FAWN [Jackson, 1997], through which the number of automated weather stations operated and networked by IFAS is increasing. There is a lot going on, things are happening fast, and the changes are likely to continue (Fig. 1).

The purpose of this paper is to describe what is materializing as the weather front end of DISC, with an eye more to philosophy than to technical detail. The philosophy, if true, will persist, whereas technical details are changing so fast they seem to get in the way of deciding what to do beyond knowing something about the feasibility and ultimately the cost [Spyke, 1997].

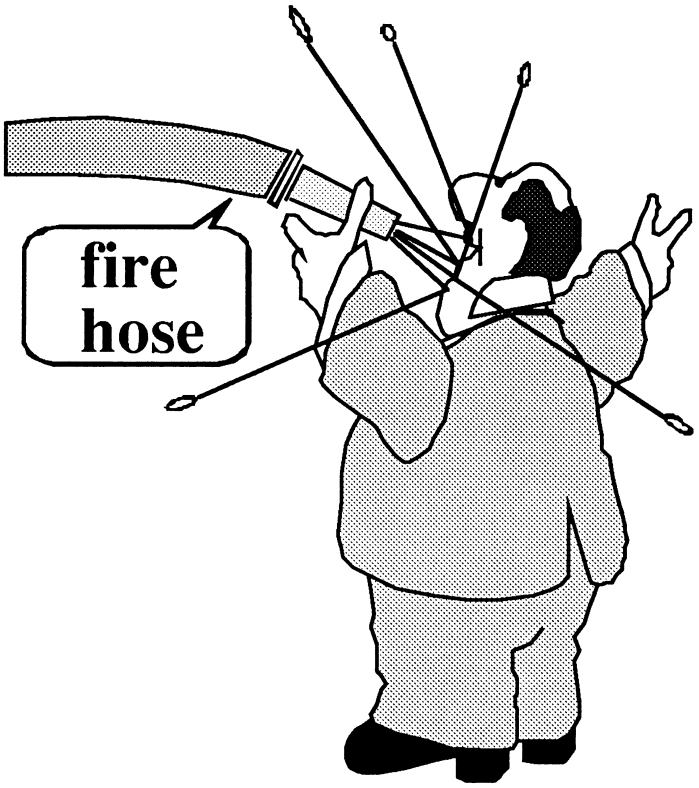

Figure 1. Information flow quite often seems like a flow from a fire hose. Weather information on the Internet seems to fit this description. This is the view that many citrus production managers indicate that they have for the flow of information into the decision making process.

Materials and Methods

Personnel: The materials at this point in the development of DISC are primarily the personnel. What is unique to DISC is the knowledge and experience of those who have affiliated themselves in one way or another with the development. It is a team effort.

The team members fall into two broad classes, i.e., developers [scientists if you will] and potential users [growers, but also marketing and harvesting people]. Table 1 lists those named in a project funded by the Florida Citrus Production Research Advisory Council [Martsolf & Peart, 1997]. Table 2 lists those who are affiliated in some manner with DISC but not mentioned directly in the

Table 1. List of Investigators as declared in the DISC Proposal to the Florida Citrus Production Research Advisory Council.

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Ferguson, James J., UF/IFAS Horticultural Sciences
Jones, Jim W., UF/IFAS, Agricultural Engineering
Muraro, Ronald P., UF/IFAS, Citrus REC
Schueller, John K., UF, College of Engineering
Wheaton, T. Adair, UF/IFAS, Citrus REC
Zazueta, Fedro S, UF/IFAS Information Technologies

C. Industry Coordinators:

Peter D. Spyke, Arapaho Citrus Mngt, Inc., Ft. Pierce
Norman Todd, Bob Paul, Inc., La Belle
Chet Townsend, Turner Foods Corporation, Immokalee
Maurice Gebhardt, Turner Foods Corporation, Punta Gorda

Table 2. List of additional [beyond those in Table 1] workers who have in one way or another indicated interest in supporting the DISC activity.

Allen, Jon, UF/IAS, Entomology, Gainesville
Blokland, P. J. van, UF/IFAS, Economics, Gainesville

Table 2. List of additional [beyond those in Table 1] workers who have in one way or another indicated interest in supporting the DISC activity.

Browning, Harold, UF/IFAS, CREC, Entomology, Lake Alfred
Chan, Chee Wan, UF/IFAS, Yield Monitoring, Gainesville
Cantliffe, Dan, UF/IFAS, Horticulture, Gainesville
Davidson, Jim, UF/IFAS, Modeling, Gainesville
Hornsby, Ar, UF/IFAS, GIS/Soils, Gainesville
Jackson, Larry, Consultant, Weather, Lakeland
Jackson, John, UF/IFAS, Citrus Agent, Weather, Tavares
Jones, Pierce, UF/IFAS, Agricultural Engineering, Gainesville
Lee, Richard, UF/IFAS, Research Teams, Gainesville
Miller, Bill, UF/IFAS, CREC, Yield Monitoring, Lake Alfred
Obreza, Tom, UF/IFAS, Hydrology, AREC, Immokalee
Oswalt, Tom, UF/IFAS, Citrus Agent, Weather, Bartow
Parsons, Larry, UF/IFAS, Water Relations, AREC, Lake Alfred
Semer, Chuck, UF/IFAS, Pathology, Gainesville
Syvertsen, Jim, UF/IFAS, Stress Modeling, AREC, Lake Alfred
Timmer, Pete, UF/IFAS, CREC, Disease Models, Lake Alfred
Valiente, Juan, UF/IFAS, Horticulture, Gainesville
Whitney, Jody, UF/IFAS, CREC, Yield Monitoring, Lake Alfred

proposal. Anyone can become affiliated with the DISC process. IFAS has shown appreciable interest in this concept [Billups, 1996].

Communications: While members of the team have met periodically in Gainesville, Lake Alfred, Lakeland and LaBelle, most of the communication takes place over the Internet. Early in the project, a server linked the members with broadcast messages. But as the project matured, much of the e-mail communication became one-to-one or involved a small portion of the total team and the list server support was redirected toward FAWN development (Jackson, 1997).

A homepage [http://members.aol.com/chettown/disc/disc.html] was developed and maintained by industry member Chet Townsend. The Internet was used to demonstrate the Postbloom Fruit Drop [PFD] model developed with collaboration among Pete Timmer, Bob Peart, and Larry Miller [http://www.agen.ufl.edu/webpfd.html]. The Internet is expected to link the various servers on which elements of the system are developed and from which the service is provided (Dertouzos, 1997).

Methodology: The organization of those participating in DISC is flat with the exception of the election of a chairman, Peter D. Spyke, the President of a citrus consulting firm, Arapaho Citrus Management, Inc., Ft. Pierce, Florida [Spyke, 1996a]. "Flat" means all members of the team hold the same rank.

A key mechanism in the development of DISC has been the merging of the efforts of the development team members with the insights of representatives of the potential users of the system [Martsolf & Peart et al. 1997]. A healthy dialog has taken place between the users regarding their needs and what they are likely to accept and utilize in the future. Norman Todd, Production Manager, Bob Paul, Inc., La Belle, has headed an effort to interface DISC development with the Production Manager's Association [PMA]. Much of the philosophy about handling the weather information links developed during a survey funded by GTE in which Ted Sekula [represented GTE] and this author met, often one-to-one, with those having a reputation of being able to envision the future needs of the citrus industry. The survey provided some insight into what the growers might support in the marketplace. The results of the survey have had a significant influence on the design of the weather front end of DISC (Martsolf, 1997). It also intensified the dependence on input from the industry early in the design. The industry owns DISC and holds the key its future.

Results and Discussion

Interface with industry representatives: The Production Managers' Association has produced a committee to respond to questions and proposals from the DISC developers as to the rules, relative importance and configuration of decision making steps. Norman Todd and Chet Townsend on the DISC team are coordinating this linkage [Table 1]. The goals are to reduce the volume of information with which producers cope and to associate the weather information with particular decisions the growers are expected to make when the integrated information reaches documented thresholds [Fig. 1; Martsolf et al., 1997]. The rules are expected to be identified by the industry members of DISC (Spyke & Martsolf, 1998).

Acquisition of Weather Information: Figure 2 describes the flow of weather and climate information into DISC. The diagram suggests a number of sources of information and implies liberal use of the Internet in moving the information from various sources through servers to DISC. Information is expected to originate from three main sources but not be limited to those sources: the NWS [National Weather Service] Family of Services, the Climate Prediction Center, and numerous automated weather stations [AWS]. Information will not be limited to these sources, however, and it is anticipated that links to these services may be through several Value Added Retailers [VARs]. The Water Management Districts are expected to share weather data, and are doing so in some cases, through a mesonet that Charlie Paxton described at the '97 FACTS [Paxton & Nash, 1997]. Gathering these data in a reliable fashion and in an operational manner is likely to occur on dedicated servers linked by the Internet and likely operated by Value Added Retailers [VARs], i.e., private sector components of the system. The exact routes through which the weather and climate information may flow are likely to change from time to time as new services become available and as competition in the marketplace takes place. It

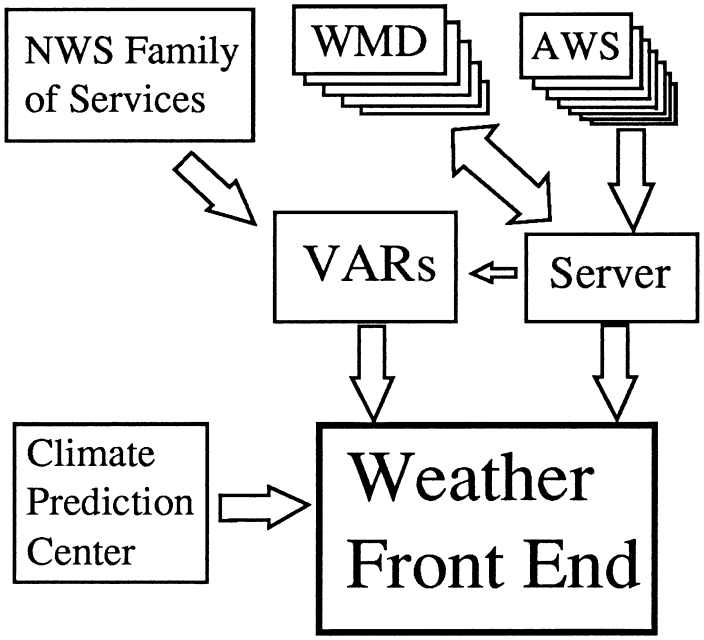

Figure 2. The flow of weather and climate information into the Weather Front End of DISC is visualized as coming from the National Weather Service [NWS] through at least one Value Added Retailer [VARs], from the Climate Prediction Center, and from Automated Weather Stations [AWS] such as FAWN and those of the Water Management Districts [WMD].

seems possible that a majority of the functions of the weather front end of DISC may take place on a high speed server in preference to taking up time and space on the user's PC.

Experiences with Weather Information on the Web: When one searches for weather information on the Internet, there seems to be a never ending series of sources of information, some that persist in much the same configuration as they were initially found, but others that come and go or change what they offer. The illustration in Fig. 1 comes from Pete Spyke's suggestion about how growers feel about the amount of information that flows their way (Martsolf et al., 1997b), but it also illustrates how many feel about the amount of weather information on the Web. If one commits some time to the effort, and certainly it takes time even with a high speed link to the Internet, one finds there is great redundancy in the information with only cosmetic modifications, and that it seems to have been selected to fit the design the provider either can accommodate with their sources and equipment or feels his particular clientele are interested in seeing. In cases in which universities are maintaining the pages the content seems to be in support of students taking particular courses, and the viewer is left to imagine how the professors may use the information in their courses.

During a Seminar on Agricultural Weather [the Weather Story, Oct. 7, '97, at the CREC in Lake Alfred, organized by John L. Jackson and Tom Oswalt] Deeley Hunt and Squire Smith demonstrated how easy it is to find weather information on the World Wide Web (Hunt & Smith, 1997). They had compiled a list of 27 weather sites, 4 precipitation sites, 20 radar sites, and 13 satellite image sites, and provided copies for those present [Hunt & Smith, 1997]. The implication may not have been intended but seemed to be that one could find all sorts of valuable information on the Web with little effort. This leads to the age-old contention between adept computer users and the less experienced users [e.g., Spyke, 1996a]. The day when machines become more adept at interfacing with their users in a more human-like fashion is approaching rapidly [Dertouzos, 1997]. The intention was to provide a rather long and, at the time compiled, up-to-date, listing of sites one could find on the network. Three problems with such lists led to the demise of the list which would have been Table 3 in this publication. One was that the list is rather voluminous and much of the information is redundant. The other is that it is time consuming to type in addresses from a list. Often errors are made in the process. It is more effective to find such addresses with a browser or via e-mail. Then the site can be visited by simply clicking on the address. The third problem is some of the addresses change frequently enough to date such lists rapidly.

Back on April Fool's Day of 1996, the NWS ceased to supply specialized services to Agriculture [Martsolf, 1995a]. One of the local teams that tried very hard to defeat this decision was led by Roger Getz, on the campus of Auburn University. On that day his team ceased to be paid by NWS and became a private concern under the same name they had in the public domain, i.e. AWIS [Getz, 1997]. The close relationship between the privatization of AWIS and the development of DISC has been described in previous publications [Martsolf, 1995b, 1996, 1997] so it will not belabored further here other than to point to their homepage [http://www.awis.com/about_awis.html].

The survey that GTE funded, mentioned earlier [in the Methodology Section], developed out of an interest shown by WELS [http://www.weatherpro.com] in a civilian market for a sophisticated weather system developed for the U.S. Air Force and later for Sweden under contract to GTE. With reorganization within GTE and the retirement of at least one of the key players, Ted Sekula, interest on the part of WELS has continued in the form of a "terrain following" model that seems to give adequate recognition to the effect of lakes, slopes, and other microclimatic features of the terrain on the temperature near such features (Cooper et al., 1997). This author is privileged to test their software which runs on a portable WinTel microcomputer supplied through a grant parallel in some ways to the DISC grant (Jones et al., 1997). This is but one example of how DISC development may benefit from close collaboration with developers of other crop models.

If one links to the site maintained by the NWS personnel at Ruskin [http://www.marine.usfedu:80/nws/] one of the first things that one sees is a rather long list of other weather information sites with which the forecasters at Ruskin are affiliated or which they feel visitors to their site may wish to know about. Chet Townsend, one of the DISC members, maintains an excellent list on his homepage [http://members.aol.com/chettownrmdex.html#weather]. The University of Michigan has maintained what they refer to as "The Weather Underground" [http://groundhog.sprl.umich. edu/] which may be their way of countering the privatization of such information. Other universities, e.g. [http://www.met.fsu.edu/metdata.html, http://meawxl.nrrc.ncsu.edu/index.html, http://wxp.eas.purdue.edu/, etc] also provide access to weather information and provide links to other weather sites. These links invariably include links to http://www.intellicast.com/ which is the network arm of WSI [http://www.wsicolp.com/l. Bernard N. Meisner of the NWS Regional HQ in Ft. Worth, TX, maintains a list of links to numerous sites [http://www.srh.noaa.gov/ftproot/ssd/htmVwx-links.htm#Weather].

The Weather Channel provides forecasts tailored to a location, [e.g., http://www.weather.com/weather/us/cities/FL_Gainesville.html] to those who fill out a questionnaire online. Linking to AccuWeather [http://www.accuweather.com/web/index.htm] can lead to a process through which one can see the general nature of the weather, including the maximum and temperature forecasts 5 days in the future. Model outputs of the maximum and minimum temperatures are color coded into maps for the US and these are provided by a number of the websites. Agriculture Online [http://www.agriculture.com/] is one of these. But since their software has not been ported to the Macintosh as yet, this author's experience with their approach is largely secondhand. American Weather Concepts [http://www.weatherconcepts.com/] provides very rapid updates on weather radars. When there is a squall line traveling over Florida some of the free sources seem to bog down with traffic so it seems worthwhile to some to sustain a monthly charge to be able to get to a server that has limited clientele.

But the point here is that not everyone will find or take the time necessary to develop, much less maintain, a broad spectrum of links to weather information on the Web. So there seems to be a need for a service that will provide the desired weather information in a manner in which it can be easily brought to bear upon local decisions. It would be better if it could aid in providing impacts of the past, current, and future weather on the growth, development, yield, harvesting and marketing of citrus. Vendors of weather information indicate that if the rules describing how each of these activities depend on weather are provided they will write those rules into their software. Then they will be in a more competitive position to provide what the growers need and therefore will purchase.

Role the Users Play: It is expensive, in both time and money, to guess what the targeted clientele will support in the marketplace by conventional methods, i.e., the creation of a product, testing it in the marketplace, and refining it or redesigning it based on its acceptance there. Users often play a rather passive but desirable role in this process, i.e., they try their best to make good decisions in

regard to what they buy and the educational system attempts to help by evaluating various products and passing on these evaluations in [hopefully] unbiased communications. Market surveys are used to anticipate the reception that a particular product is likely to have. The problem is to make contact with the users in such a manner that they return a real indication of what they are likely to purchase in the future. They are prone to indicate they are not sure but they will know when they see the product.

The development of a strawman that is sufficiently attractive to draw from its viewers constructive comments is expensive and time consuming. A strawman is a system that on the outside looks like a fully implemented system but on the inside is made of straw, i.e., simulated in such a manner that it produces products that a real system is expected to produce in the future. It serves to get a dialog started on the subject and worked well in the survey that GTE funded. Strawmen do not have to be in fully tangible form, e.g., Fig. 2 in many ways is a strawman. However, the DISC team discarded the possibility of developing a strawman. Rather, resources were committed to the development of links with the industry that permit the exchange of concepts, ideas, assessments, and expectations in what is thought to be an educational environment. In return for their time the representative of the potential user gets an opportunity to stand on the shoulders of the developers and look into the future, a long heralded educational concept.

Summary

The way horticulturists acquire and consume weather information is changing rapidly. In part this is due to the departure of the National Weather Service from the agricultural weather service. In greater part, changes are being made to capitalize on new decision making tools and electronic networking of information. The tools include the networking of information that is expected to result from an increase in the number of automated weather stations through FAWN [Florida Agricultural Weather Network]. A weather front end of DISC [Decision Information System for Citrus] is under development through which weather information may be acquired and presented to numerous modules in which weather sensitive processes are described as a set of rules and from which outputs are presented to the user. DISC is a flat structure in which developers and potential users of the system interact on a flat playing field to integrate voluminous information into a tool that may efficiently bring the timely elements of information to the attention of the manager when the rules suggest the information is critical in making decisions.

Literature Cited

Beck, Howard W. 1997 Decision Information System for Citrus. FACI S Citrus and Vegetable Proceedings, Pro 109:11-13.

Billups, Andrea L. 1996. Turning Swords into Plow shares. IFAS Impact 13(1):24-27.

Cooper, Harry J., Eric A. Smith and J. David Martsolf. 1997. Spray irrigation effects on surface-layer stability in an experimental citrus orchard during winter freezes. J. Appl. Meteorol. 36, 155-166.

Dertouzos, Michael L. 1997. What will be: how the new world information will change our lives. HarperCollins Publ. 336 pages. [http://www.harpercollins.com]

Getz, Roger R. 1997. Commercial Weather Services and Products. FACTS Citrus and Vegetable Proceedings, Pro 109:52-53.

Hunt, Deeley and Squire Smith. 1997. Weather Sites on the Internet. A demonstration at the Weather Story, Lake Alfred, FL, 7 Oct., 2 page listing.

Jackson, John L. 1997. Florida Automated Weather Network [FAWN]. A presentation at the Weather Story, Lake Alfred, FL, 7 Oct., 8 pages.

Jones, J. L., R. M. Peart and J. D. Martsolf. 1997. Integrated Crop Management System [ICMI], A Decision Information System for Crops [DISC]. Agricultural Technology Utilization and Transfer Project [ATUT]. In conjunction with the ATUT office in Cairo, Egypt. $300,000 for 3 years to be shared equally between the two partners.

Martsolf, J. David. 1995a. The end of the agricultural weather service. Citrus Industry 76(10):14.

Martsolf, J. David. 1995b. Citrus production decisions may be aided by network resources. Proc. Fla. State Hort. Soc. 108:118-121.

Martsolf, J. David. 1996. Weather information dissemination and its role in decision making. FACTS Citrus and Vegetable Proceedings, Pro 514:32-34.

Martsolf, J. David. 1997. Perspectives on Weather Services in Florida. FACTS Citrus and Vegetable Proceedings, Pro 109:46-48.

Martsolf, J. D. and R. M. Peart, et al. 1997. Development of decision information system for Florida Citrus. Grant funded by the Florida Citrus Production Research Advisory Council for $35,000/yr potentially for two years.

Martsolf, J. D., R. M. Peart and P. D. Spyke. 1997. What is DISC and How It Came Into Existence. Preprint, Biological Systems Simulation Group, 27th Year, Mar 17-19 Meeting in Univ. Center Hotel, Gainesville, page 36 and a poster [on display in Fifield Hall].

Paxton, Charles and Andrew Nash. 1997. The Florida Meso-network: High Resolution Meteorological Observations in Florida. FACTS Citrus and Vegetable Proceedings, Pro 109:49-51.

Spyke, Peter D. 1996a. Computers in citrus. Citrus Industry 77(11):30-32.

Spyke, Peter D. 1996b. Decision information systems for citrus. Citrus and Vegetable Magazine. FACTS Proceedings Pro 514 Citrus Crop Proceedings, pages 35-36.

Spyke, Peter D. 1997. The role and future of precision agriculture. Plenary Session III. The Future of Science and Technology in Florida: Trends and Indicators. Sponsored by The State of Florida and the American Association for the Advancement of Science, Hyatt Hotel, Orlando, 29 September.

Spyke, Pete and David Martsolf. 1998. DISC group making strides toward precision agriculture: new objectives added for second year of project. Citrus Industry Magazine. Vol. 79: [in press].