This is not a peer-reviewed article.
5th National Decennial Irrigation CD-ROM Proceedings
Phoenix Convention Center, 5 - 8 December 2010, Phoenix, AZ USA
M. Dukes ed. St Joseph Mich: ASABE
ASABE Publication Number 711P0810cd

2950 Niles Road, St. Joseph, MI 49085-9659, USA
269.429.0300 fax 269.429.3852 hq@asabe.org www.asabe.org

An ASABE Conference Presentation
Paper Number: IRR10-9683

What Will it Take to Get Irrigators to Use Advisory Programs? Lessons Learned from the Past 10 Years and Beyond

Thomas H. Marek, P.E.

Texas AgriLife Research, 6500 Amarillo Blvd. West, Amarillo, TX 79106, t-marek@tamu.edu

Thomas Scherer, Ph.D.

North Dakota State University, NDSU, Dept. 7620. PO Box 6050. Fargo, ND 58108-6050, Thomas.Scherer@ndsu.edu

Dana Porter, Ph.D., P.E.

Texas AgriLife Research and Extension Service, 1102 E. FM 1294, Lubbock, TX 79403, d-porter@tamu.edu

Danny Rogers, Ph.D., P.E.

Kansas State University, Seaton Hall Room 151, Manhattan, KS 66506, drogers@bae.ksu.edu

Joseph Henggeler, Ph.D.

Missouri State Extension Service, Delta Res Ctr. PO Box 160
Portageville, MO 63873, HenggelerJ@missouri.edu

Terry A. Howell, Ph.D., P.E.

USDA-ARS-CPRL, P.O. Drawer 10, Bushland, TX 79012, terry.howell@ars.usda.gov

Written for presentation at the
5th National Decennial Irrigation Conference
Sponsored jointly by ASABE and the Irrigation Association
Phoenix Convention Center
Phoenix, Arizona
December 5 - 8, 2010

Abstract. *Research and Extension personnel have developed irrigation advisory programs for decades. With irrigation sources evermore becoming limited, recent conservation and management strategies among numerous water conscious agencies include the development or redevelopment and strong promotion of irrigation scheduling and associated advisory programs as strategies to promote water conservation and increased water use efficiency. Previous attempts to promote and*

The authors are solely responsible for the content of this technical presentation. The technical presentation does not necessarily reflect the official position of the American Society of Agricultural and Biological Engineers (ASABE), and its printing and distribution does not constitute an endorsement of views which may be expressed. Technical presentations are not subject to the formal peer review process by ASABE editorial committees; therefore, they are not to be presented as refereed publications. Citation of this work should state that it is from an ASABE conference presentation. Irrigation Association 2010. EXAMPLE: Author's Last Name, Initials. 2010. Title of Presentation. IA10-xxxx. St. Joseph, Mich.: ASABE. For information about securing permission to reprint or reproduce a technical presentation, please contact ASABE at rutter@asabe.org or 269-932-7004 (2950 Niles Road, St. Joseph, MI 49085-9659 USA).

implement adoption of these programs and tools have realized only marginal success at best, even in intensively irrigated areas. This article addresses issues learned from several states in dealing with adoption of irrigation program tools and management technologies. Items such as multi-user and multi-viewpoint development, complexity of programs, ease of use, dissemination of multiple formats, informational timelines, and producer applicability are discussed.

Keywords: irrigation adoption, advisory programs, irrigation scheduling, irrigation, software development

The authors are solely responsible for the content of this technical presentation. The technical presentation does not necessarily reflect the official position of the American Society of Agricultural and Biological Engineers (ASABE), and its printing and distribution does not constitute an endorsement of views which may be expressed. Technical presentations are not subject to the formal peer review process by ASABE editorial committees; therefore, they are not to be presented as refereed publications. Citation of this work should state that it is from an ASABE conference presentation. Irrigation Association 2010. EXAMPLE: Author's Last Name, Initials. 2010. Title of Presentation. IA10-xxxx. St. Joseph, Mich.: ASABE. For information about securing permission to reprint or reproduce a technical presentation, please contact ASABE at rutter@asabe.org or 269-932-7004 (2950 Niles Road, St. Joseph, MI 49085-9659 USA).

Introduction

Developing and advocating the use of irrigation scheduling and advisory programs is not new for irrigated US agriculture. Dudek et al. (1981) conducted an analysis and concluded that irrigation scheduling was profitable and beneficial if producers could apply irrigation with sufficient precision, and that scheduling cost affected the acreage to which irrigation scheduling was applied. Irrigation scheduling surveys conducted in the late 1990s by Leib et al. (1998) resulted in the conclusion that irrigation scheduling was used when large acreages and high water costs were involved. Parker et al. (2000) determined that the California Irrigation Management Information System (CIMIS), operated by the California Department of Water Resources at a cost of $850,000 annually, saves water and has other benefits that far outweigh the cost of operation. Thus, irrigation scheduling has been known to be beneficial but has lagged in adoption when water is inexpensive, as has been the case for decades in the western US.

Several data management methods and techniques have been developed over time for numerous irrigation decision applications (AzSched, 2003; Vories and Tacker, 2006; CIMIS, 2010; CoAgMet, 2010; NPET, 2010; SPET, 2010; NDAWN, 2010; TXHPET, 2010; PIN [TWRI, 2008]; KanSched, 2010; Snyder, 2010 and Fipps, 2010). Widespread adoption however of these programs is another matter indeed and the majority of producers have not readily adopted the use of these programs for numerous reasons. Some of these include development without user involvement, failure to address user needs, excessive complexity of inputs, time management concerns and time required to learn or adopt the program. Some tools have been programmed without understanding the computer literacy limitations of many intended users. This article describes some of the “do’s and don’ts”, successes and failures of technology development and technology transfer regarding irrigation advisory programs and associated data management tools. These lessons have been learned from experience in several western states over a decade or more and from compiled feedback from end-users (irrigators and other agricultural professionals). This article addresses adoption by an audience of moderately progressive producers, crop consultants, irrigation and production management advisors and consultants.

Program Development

Ideally, an advisory program or application tool should be planned with involvement from research and extension collaborators and with clearly defined purpose, objectives and intended end-users. It is typically not warranted to involve user clientele too early in the process (framework stage) due to the potential for having too many diverse options/inputs which can in turn divert focus of the project. The development process should incorporate flexibility (as appropriate) to accommodate different types of irrigation systems and farm operations intuitively, using pull-down menus, reasonable defaults, and other options as applicable. Included development options should contain a comprehensive methodology for adequate representation of the irrigated user operations, yet be imbedded with appropriate defaults with easy selection choices for simplified operation and use. Since most advisory programs represent complex and multiple production or management systems in concept, they need to be simplified in user form with easy operation and navigation for producers and crop consultants to readily adapt and utilize them.

Program development should consider operation on multiple versions of computer operating systems, particularly if the programs have ancillary stand-alone operations or spreadsheet versions. Programs should have output(s) in multiple formats, if applicable. For instance, data

and program output(s) should be available in "printer friendly" or hardcopy formats for some users, who may not use PC computers in their daily operations or management yet may still be among the better managers, largest producers and most seasoned irrigation clientele. For more computer savvy and technologically adept users “one size does not fit all” either. The best method in development of advisory type programs and outputs involve an interactive process with the producers, crop consultants and other potential end-users. Default outputs need to be straightforward requiring no additional computations by the user but allow flexibility within the program(s) that include selections or parameter choices. Additionally, program output timeliness is of significant importance to producers in their adoption and operational use. Visual outputs (graphical summaries, maps, etc.) are generally very helpful (see example in figure 1) to the user, particularly in dealing with large amounts of data or large areas. Another graphical example involving an irrigation scheduler for quick assessment of soil water status (see figure 2) from an “in the background” spreadsheet can also be extremely beneficial to irrigators.

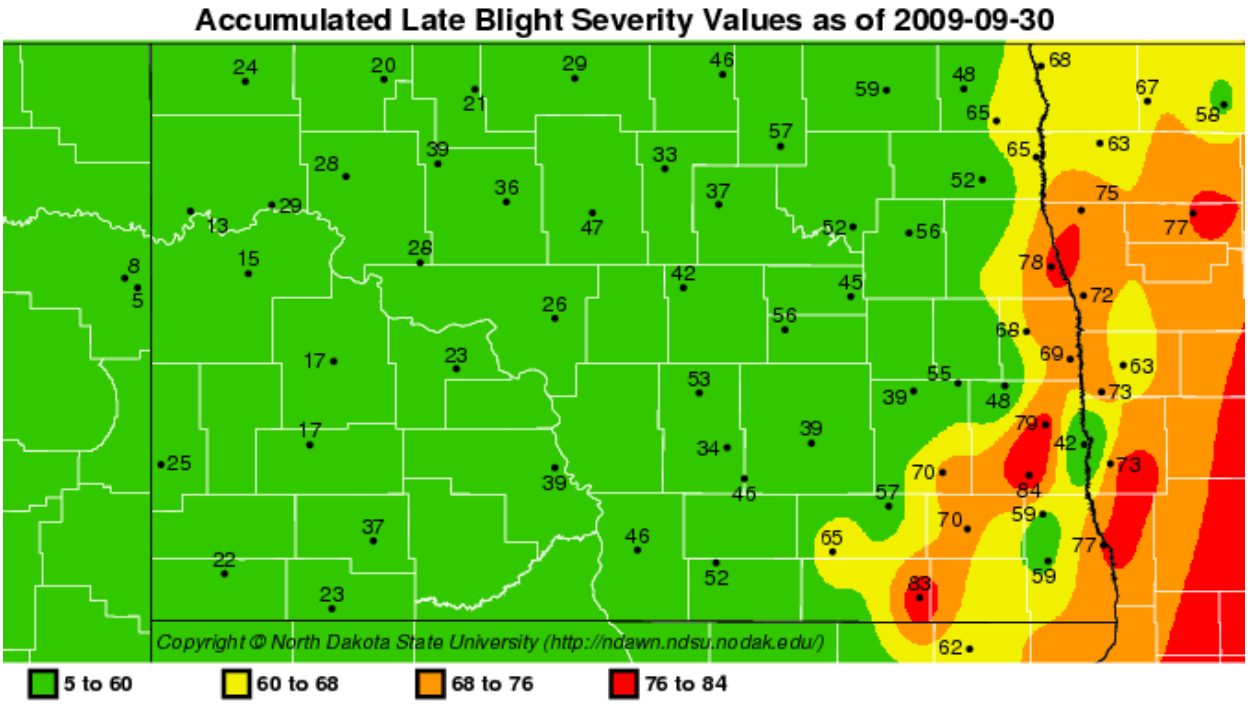

Figure 1. Example of visual mapping of volume data output for quick assessment and interpretation by user. (Source: NDAWN network).

Program development for growers and crop consultants should be derived from a viewpoint of simplicity, yet include adequate scientific and technological background” behind the scenes” and have quick computational speed and output. Excessively complex and computationally intensive models requiring high level specialized training and/or high end computer capabilities not typically seen in home office or small business applications are generally not appropriate for, and therefore would not likely be applicable for, agricultural producers and crop consultants. However, the underlying production models and theory, while “simple and quick” should be adequate to meet or exceed the producers or crop consultants’ expectations in terms of representation. In general, the producer, crop consultant or program user should not have to spend more than 10 to 15 minutes a day to update program inputs and have it return useful results.

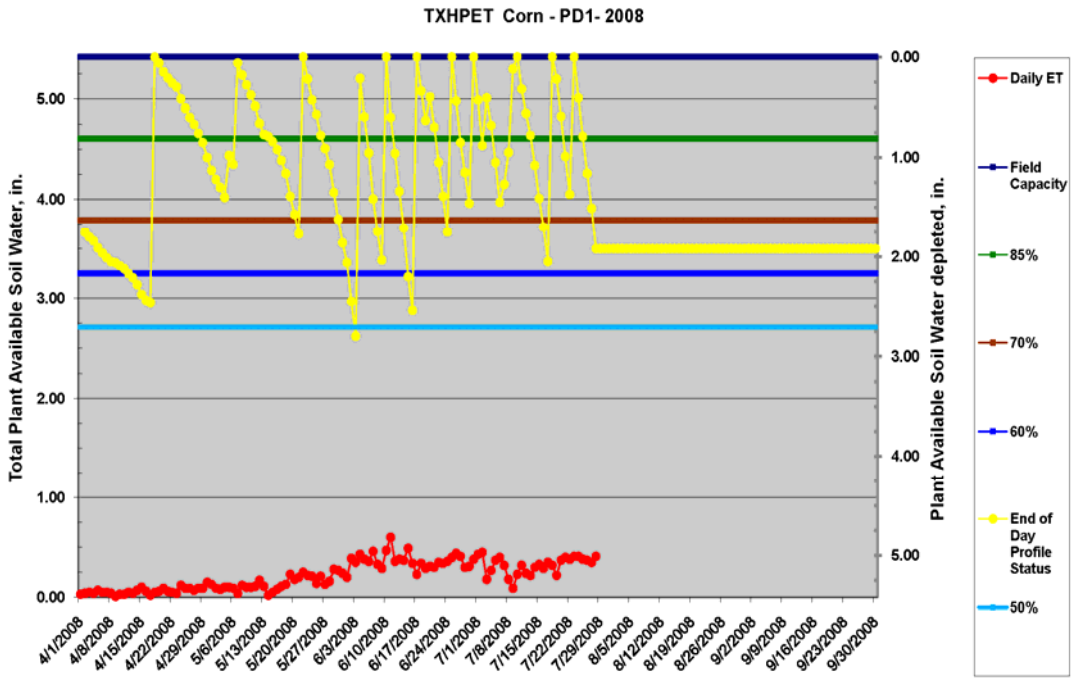

Figure 2. TXHPET irrigation scheduler for daily soil water status of corn through July using an April 1 planting date. (Source: Marek, 2008).

Program usefulness should not be confused or equated necessarily with automation. There has been research conducted on directly integrating input information and control data into programmed irrigation controllers, particularly with drip irrigation and potentially with electrically controlled center pivot systems. These systems typically require an ample irrigation water supply capacity to meet full or near full crop ET requirements – a condition known as “irrigation on demand” capacity which is seldom available on a large scale basis in the arid and semi-arid regions of the southwestern US. Drip irrigation systems have been more progressive with automated controllers in the past than center pivots and results even with these systems have been mixed. Control algorithms in these systems do not typically entail irrigation capacity lead times and rainfall probability. Producers and consultants truly want representative advisory and control programs that work and reduce their work load and are not just a collage of automated "bells and whistles". While these automated and integrated systems have been tested in research environments and some are beginning to be commercially available, no widespread use of these systems has been adopted by producers due to the fact that the required crop production functions and management relationships are not defined (particularly for the new genetics) and proven to the degree where large scale producers are willing to risk profits on this level of automation and integration. These systems in some cases also seem to producers to add undesired complexity to their operations, particularly for operators on lands and irrigation systems that are rented or leased. In effect, this level of autonomous automation and control is yet unproved to the degree needed for producers to adequately trust them.

User Integration and Feedback

An important early step in the development process (after definition of the framework but before coding of the program) is to enlist an advisory representative group of users (RGOU). These individuals should be identified and contacted, informed as to the objectives of the proposed effort, invited to comment and interact on the proposed program flow and on the program's user interface and output format(s). Incorporating their cumulative input assists programmatically to meet their needs in their daily operations. Simply put, if the RGOU are asked as to what they need, many are willing to tell development personnel exactly what they need and how they need it (i.e. in what exact form they want it in). This step is extremely important, as the outputs have to be easily integrated into the RGOU (differing) management operations. For most RGOU, time is a governing constraint of production and data that are not easily used and integrated may be deemed an unnecessary cost in time or burden to their operations. This is a significant fact for researchers to recognize as most research personnel have never cash flowed a farm in their careers and thus often ignore what is most important in a producers operation, particularly of a large scale production operation.

After drafting of the programming code and output products, the RGOU should be re-contacted to evaluate the programs in time and their feedback be used to enhance a revised version of the program. Including their input early in the process virtually ensures at least initial use and evaluation of the advisory program by the RGOU.

Need for Adequate Management Knowledge

In technology development, sales and promotion often can compete with development activities, and they are easy to get "the cart ahead of the horse". In the Texas High Plains in the decadal past, this is exactly what happened with the development of surge flow irrigation and the differing management programs on cycle times and the field application of the concept. Automation capability of the electronically programmed instrumentation and sales of components exceeded the known management science base at the time. Surge equipment sales personnel touted tremendous water savings with reduced management for irrigators, but when field results generally fell well short of producers' expectations, the enthusiasm of easy and improved water management and the hope of greater profits diminished accordingly. When the surge systems did not perform as sold on the scientific basis, producers abandoned the concept as being non-representative or non-integrative into their respective operations. The fact of the matter was that the sales hype far exceeded the known science base for the variety of soils and slopes common to most producers within the Texas High Plains region. The limited number of irrigation researchers available simply did not have the time or necessary resources to invest in adequately developing the management data and guidelines prior to the peaked commercial sales period. The subsequent bad experiences from producers led to a virtual total abandonment of the surge irrigation concept. An analogous situation can be made regarding some past irrigation scheduling programs and can be anticipated with automated irrigation schedulers, autonomous irrigation controllers and other fully integrated and automated decision support systems tools where the management guidelines are not adequately defined or known.

Expectations

Researchers and extension developers typically develop advisory programs to reduce water use or production costs and should recognize that most production clientele make significantly more

net profit than the scientists or engineers advocating the adoption of their respective advisory programs. In some cases, the program may actually cost the producer, whether it is in profit or time, which to them "time is money", particularly during the summer growing season. This is a fact that graduate students and scientific personnel typically fail to recognize. On the other hand, technology is where advances are generally made and no one is better educated than research scientists and engineers to develop the neutral type applications. It also has been recognized by producers that scientists generally have “no monetary stake in the game” (i.e. no product for sale) and they have little to no bias The producers in this production scenario are truly where “the rubber meets the road” or more appropriately where “science and technology meets the field”. However, use of an advisory program, particularly when developed by university or similar agency personnel, is not necessarily warranted for all purposes or uses. Thus, there is a “no-contract” with the user of the program and its use and result(s) generally having no consequence except to the producer and their pocketbook. In defense of scientific personnel, generally there is little to no purchase cost typically for the program(s). Thus, the producer can have a lot of profit potential riding solely on a scientific promoter’s word with no liability and thus there is hesitation by the producer as to the benefits of what will actually work and profit them in their operation; specifically given the number of programs that have been touted and previously promised to improve production and profit.

Commercial programs also have limitations on performance even with a contract. Typically, the commercial database does not guarantee performance either and requires condition verification through more traditional methods such as consultant ground truth scouting at regular intervals. Thus, if a consultant has to be in the field anyway, the past methods of observation, sampling and reporting seem to prevail, particularly with larger producers as much profit is viewed as being at risk without consultants.

Program Obsolescence

Production advisory programs that have been adopted in the past have difficulties as well in today’s electronic environment, as these programs were developed for past versions and generations of operating systems (OS). One author recalls irrigation scheduling programs that ran flawlessly on DOS (Disk Operating System was the predecessor of Windows) and early versions of Windows (that accommodated 16 bit DOS programs), but new driver calls and address routines in new OS’s no longer allow such operations and previous programs have had to be maintained on older version operating systems and machine architectures to function. These older OS’s become subject to hackers and computer virus attacks if connected to the World Wide Web. In addition, the older machine architectures and OS’s cannot handle the newer programs, code and applications; thus, requiring producers to maintain multiple machines with differing OS’s, architectures and software adding to costs both in support and dollars. Before the Internet, computer vulnerability against attackers was limited but nowadays web based OS architectures are continually being compromised, increasing the cost of operations for uptime operations, records and backups. Even advisory programs that were developed for Windows XP frequently will not work correctly on Windows Vista or on Windows 7. Thus, reprogramming and upgrading may become necessary, and the associated costs of upgrading generally extend beyond the original grant development period for researchers. It also adds additional expense for commercial programs and requires time (and typically computer downtime) for re-installation of updated software and security patches. Web based irrigation advisory programs, although not usually subject to changes in operating systems, must still be maintained and upgraded to work properly with new web browser patches. Similarly, web browser software upgrades for commercial firms add cost to the software applications. One of the worst things that can happen to producers and crop advisors is when an advisory program

they utilize and find useful ceases to function because of obsolescence and or where inadequate or no funding exists for upgrades and reprogramming. This leads to a significant disconnect between program providers, advocators and end-users.

Funding

The lack of funding is not a new problem among university based advisory programs that have been adopted. Typically, the lack of general operations and maintenance support is ongoing and all activities are subject to either full grant based support or termination. Examples of such widely known supporting ET and irrigation scheduling programs currently at risk due to the lack of sustained funds are those of TXHPET (2010), KanSched (2010) and CoAgMet (2010). Administratively this change classically occurs because of redirection or emphasis on new program directions (i.e., bio-technology, bio-energy, etc.) with operations and support subject to continuing grant support. Most grant support opportunities, however, are geared toward developing new tools, applications and infrastructure. Ongoing support for existing infrastructure in ET networks and advisory programs is much more difficult to achieve through grants.

Some university based water programs and offices have closed their doors in recent years due to a downturn in their state economy. Others cannot sustain operations and maintenance and sensor and data degradation occur leading to “bad” or erroneous data. A fee based support option is often mentioned regarding fiscally troubled networks but past U.S. experiences have illustrated that no more than 5% of operations and maintenance costs are typically generated. Additionally, fee based operations add a bookkeeping burden to most networks and programs further detracting from the scientific and quality aspects of the data. The most “successful” network and programs have been supported through stable appropriated funds, but given the current state of the general economy, it may be that more programs are downsized or terminated with re-prioritization to other areas and is the most likely outcome.

Results and Conclusions

Production advisory tools have been available for use by irrigated producers for decades. Many were developed with flaws in them and eventually become discarded or obsolete. In other cases, time and changes in computer operating systems have resulted in obsolescence. In today’s electronic development world, necessary computer security measures and sustained operations present advocates with new challenges for future adoption of advisory programs.

The development of advisory programs and support systems can be attained through grant based pursuits and knowledge of the aforementioned variables. However, sustainability of these programs and support systems presents a greater challenge in many western states and are not likely to be supported in current and future downturns of the economy even though they may be in the best interest of producers and water conservation efforts. It also appears from past experience that political based support for conservation based and advisory system tools will not occur until water balances or shortages reach a critical level within a state.

Table 1. Do's and don'ts of advisory program development and use.

Do	Don't
Include producers, crop consultants in preliminary planned software development.	Develop program without end user input.
Integrate user feedback into revised program versions.	Don't release a program that is not adequately backed by sound science and data.
Ask users as to output format needed for integration into their operation.	Don't unveil and distribute without technical support contacts.
Keep program simple in user form.	Don't isolate older or non- computer users with the programs.
Provide adequate, yet simple and concise, support for programs.	
Make software available for multiple operating systems, as needed.	
Program in and sustain programming support for applications.	
Involve competent and experienced Extension personnel in the use of the programs.	
Involve agricultural communications groups of developed programs.	
Keep it simple, but scientifically based.	
Make formats simple and easy to use for new users.	
Provide adequate information on system formats and outputs for users.	

References

AzSched, 2003. Arizona Irrigation Scheduling System. Available at: ag.arizona.edu/crop/irrigation/azsched/azsched.html. Accessed 10 September 2010.

CIMIS. 2010. California Irrigation Management Information System. Available at: cimis.water.ca.gov/cimis/welcome.jsp. Accessed 23 April 2010.

CoAgMet. 2010. Colorado Agricultural Meteorological Network. Available at: climate.colostate.edu/~coagmet/about.php. Accessed 26 April 2010.

Dudek, Daniel J., Gerald L. Horner and Marshall J. English. 1981. The Derived Demand for Irrigation Scheduling Services. Available at: ageconsearch.umn.edu/bitstream/32586/1/06020217.pdf. Accessed 23 August 2010.

Fipps, G. 2010. Texas ET Network. Available at: texaset.tamu.edu. Accessed 4/23/2010.

Leib, B.G., M. Hattendorf; T. Elliott; G. Matthews. 1998. Adoption and adaptation of scientific irrigation scheduling: trends from Washington, USA as of 1998. Available at: cat.inist.fr/?aModele=afficheN&cpsidt=13527219. Accessed 23 August 2010

KanSched. 2010. Kansas State Irrigation Scheduling Program. Available at: www.ksre.ksu.edu/mil/welcome.htm. Accessed 23 April 2010.

Marek, T. 2008. Irrigation Scheduler Program for use with the TXHPET network (unpublished).

NDAWN. 2010. North Dakota Agricultural Weather Network. Available at: ndawn.ndsu.nodak.edu. Accessed 22 April 2010.

NPET. 2010. North Plains ET Network. Available at: amarillo2.tamu.edu/nppet. Accessed 21 April 2010.

Parker, D., D.R. Cohen-Vogel, D.E. Osgood and D. Zilberman. Publicly funded weather database benefits users statewide. California Agriculture 54(3):21-25.

SPET. 2010. South Plains ET Network. Available at: lubbock.tamu.edu/irrigate/weatherdata.php. Accessed 24 April 2010.

Snyder, R. 2010. PMday.XLS - Daily ETos, ET_{rs} and HS ET_o Calculator using the ASCE-EWRI method (revised 2 Feb 2006). Available at: biomet.ucdavis.edu/evapotranspiration. Accessed 25 April 2010.

TXHPET. 2010. Texas High Plains ET Network. Available at: txhighplainset.tamu.edu. Accessed 20 April 2010.

Texas Water Resources Institute. 2008. Precision Irrigators Network. Available at: twri.tamu.edu/programs/precision-irrigators-network. Accessed 22 April 2010.

Vories, E.D. and P.Tacker. 2006. Effect of ET calculation method on irrigation scheduling in midsouth. (Arkansas Irrigation Scheduler) ASABE Paper No. 062205. St. Joseph, Mich.: ASABE.