Field Performance of Subsurface Drip Irrigation (SDI) in Kansas

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Introduction: Drip irrigation has proven to be an effective irrigation method for water saving and better return for high dollar cash crops, however, as a surface drip system it does not lend to the field cropping system practiced in the Central Great Plains. Kansas State University's research on suitability of using drip method as subsurface drip irrigation (SDI) has shown that it is a feasible technology for irrigating field crops like corn (Lamm, Manges, Stone, Khan, & Rogers, 1995). More than 2 million acres out of 3 million irrigated in Kansas depends on groundwater from the Ogallala aquifer. The producers are experiencing decline in water level and the pumping cost is rising due to greater depth of pumping and increasing fuel cost. Economic comparison of systems indicated that a well managed SDI system with a promise of fifteen or more years of life is economically competitive (O'Brien, Rogers, Lamm, & Clark, 1998), although it requires a high investment at the start. Extension demonstration in producer field has helped a steady increase in the acreage irrigated by subsurface drip irrigation starting in 1997. Initially many of these systems were installed in small farms with limited water where a part of the water supply was diverted from existing flood or center pivot sprinkler irrigation systems. Lately, producers with large acreage under flood irrigation have started switching to SDI. The state wide SDI acreage is estimated at 20,000 acres, most of which is in western Kansas represents about 1% of irrigated crop land. Although no major concern regarding failure of system has surfaced, it was felt necessary to evaluate the present operational condition of these systems to provide field performance information to farmers intending to adopt SDI in their irrigation operation. The objective of the study was to assess the operational condition of the existing subsurface drip irrigation (SDI) systems and the level of satisfaction of the producers. Information would help address clientele needs and keep the service providers informed.

Methods: A survey questionnaire was sent out to producers using SDI system. The sample questionnaire is shown in Appendix A. The mailing list of producers was prepared from sign up lists of farmers attending educational meetings conducted by cooperative extension on use of SDI and a list obtained from Kansas State Division of Water Resources that show producers reporting use of microirrigation. The recipients of survey forms were requested to return the survey form even if they were not SDI users. Survey forms numbering 297 were mailed out.

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Results: The return rate of survey was 31% (returned 92) out of which 53% (49 responses) were from actual SDI users. The others either heard of SDI and wanted to comment or are using some other form of microirrigation. The response from surface drip users amounted to five percent (5 responses).
SDI acreage totaled from responses received amounts to 8,022 acres out of 323,260 acres irrigated (about 2.5%) by the responding farmers.

Although some started using surface drip for trees and orchards in small acreage as early as 1975, the subsurface drip for field crop was installed in 1994. There was no appreciable installation until 1998. The peak number of system installation according to the survey response was in 2000 and continued steadily at a somewhat reduced number to the present. The numbers from the survey response are shown in Table 1.

Table 1. Yearly installation of SDI systems starting in 1994 according to survey response from producers in western Kansas.

1994	1997	1998	1999	2000	2001	2002	2003
1	3	9	4	10	7	5	7

All of these systems are currently in use, except for one self-installed system of 2001. This system of 22 acres was used for alfalfa and the producer was unable to keep up with the rodents and field gophers. More detailed information is necessary to determine present status.

Majority of the SDI systems were installed jointly by producers and contractors (54%) according to survey response. Contractors installed systems account for 19% and the remainders - 27% were self-installed by the producers.

When asked about if the producers received an “as-built” drawing or diagram of the system from the contractors, thirty four responses were in the affirmative and fourteen were in the negative. The response on receiving operational and maintenance instructions or procedures for the SDI system was similar, thirty three received and fifteen did not receive operational procedures. Names of eight contractors were mentioned as installers and one of them located in Garden City, Kansas, came up as an installer of maximum number of systems.

Crops irrigated by SDI systems were corn (43 responses), soybeans (24 responses), cotton and alfalfa (5 responses each), and sorghum (3 responses). Besides these the systems were also used for wheat, oats, and sorghum silage.

In response to the level of satisfaction with the system performance in a scale of 1 to 5; where 1 indicates as very satisfied and 5 being unsatisfied, the majority of the responses were between 1 and 2. The responses are shown in Table 2.

Table 2. Responses indicating the level of satisfaction with the performance of the SDI system being used by the producers in a scale of 1 to 5.

1	2	3	4	5
Very satisfied	Satisfied	Almost satisfied	Somewhat satisfied	Unsatisfied
17	19	4	4	2

Survey response to a question on whether the SDI users are planning to expand acreage under SDI was that the majority plan to do so (30 responses), however a good number (19) responded in the negative. The overwhelming concern was about rodent damages and filtration. The major concerns were,

- Rodents, gophers, and other vermin damages requiring many hours of repair. (37)
- Filtration is a concern, but with a good system and maintenance there was no problem. Some asked if there were better filtration systems. Should one oversize to avoid frequent cleaning. (15)
- Clogging due to iron bacteria and calcium precipitation is a concern. Some reported clogging concern from drip oil used in pump. Clogging from drip oil is more evident in pumps with low capacity or fluctuating water levels. (15)
- Cost of the system, especially worried about the life of the system. (8)
- Wetting up of the top soil for germination. (3)
- Hard to visualize soil water condition.

Finally, answering to what are information needs that Kansas State Research and Extension might be able to address, the responses from the producers were as follows:

- Rodent control – how and what to use.
- Fertilizer use through SDI including micro-nutrients.
- More educational meetings, seminars on management - both pre and post season included. Field tour to visit systems and exchange information with other operators.
- Drip tape spacing for crops other than corn. More research for alternative crops under SDI.
- More information about planting alfalfa under SDI.
- How to germinate seed in dry soil. Conserving moisture in surface soil for planting.
- How to unclog drip lines. How to keep system clean with different water supplies.
- System capacity, how much water to use, and limited water issues.
- Comparisons of crop yield advantage from SDI over sprinkler.
- Any improvement to cut down cost, better filtration, less maintenance system for this area.
- Property Taxation classification for SDI needs to be developed to avoid over taxation where currently the producers are being penalized for conserving water.
- Why assistances are unavailable to conservation conscious farmers who want to install SDI, whereas it is available to non-conservative circle irrigation?

Discussion: A closer look of the survey response reveals that the owners of systems installed earlier than 1994 are experiencing some difficulties. K-State Research and Extension was still in the process of researching SDI and was not promoting the method. Most of these systems were installed by producers themselves or inexperienced contractors, some of these contractors are probably not in business currently. It is evident that more research and extension education program are necessary. Individual owners will be contacted for further evaluation.

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Literature Cited:

1. Lamm, F. R., Manges, H. L., Stone, L. R., Khan, A. H., & Rogers, D. H. (1995). Water requirement of subsurface drip-irrigated corn in northwest Kansas. *Transactions of the ASAE.* 38 (2): 441-448. ASAE, St. Joseph, MI 49085.
2. O'Brien, D., Rogers, D. H., Lamm, F. R., & Clark, G. A. (1998). An economic comparison of subsurface drip and center pivot sprinkler irrigation systems. *Applied Engineering in Agriculture.* 14 (4): 391-398. ASAE, St. Joseph, MI 49085.

Appendix A

Subsurface Drip Irrigation (SDI) Field Survey

The individual information collected will be kept confidential. The compiled information is for Kansas State University Research and Extension educational purposes only.

County_____

1. Do you have a buried subsurface drip irrigation (SDI) system? ____ Yes. ____ No. **Please return survey even if you do not have an SDI system.**
2. Number of acres in SDI. _____Number of total irrigated acres._____
3. Year of installation of oldest system. _____
4. Is the oldest system in use? _____ Yes _____ No
5. Who installed your SDI system? _____ Self-installed_____ Contractor _____ Both
6. Name of the contractor _____
7. If the contractor designed or installed your SDI system:
    a. Did you receive an "as-built" drawing or diagram of your system? ____ Yes. ____ No.
    b. Did you receive an operational and maintenance instructions or procedures for your SDI system? ____ Yes. ____ No.

8. Crops grown with SDI: corn _____ soybeans _____ cotton _____ other _____, please list.
9. Please indicate your level of satisfaction with the system performance in a scale of 1 to 5; where 1 indicates as very satisfied and 5 being unsatisfied. Please circle a number: 1 2 3 4 5
10. Are you planning to expand SDI acreage? ____ Yes. ____ No.
11. What are your concerns about the system (such as filtration, clogging of drip lines, rodent damage, etc.)? Please list and comment.

    _____
    _____
    _____

12. What are information needs that Kansas State Research and Extension might be able to address?_____
    _____
    _____

If you would like to participate in an evaluation of your system (provided funding is available from the university) please indicate so by signing below.

_____

If the system is operated by someone else on your behalf, please provide the name and address of that person below.

Name: _____ Phone Number:_____

Address: _____

City, State and ZIP _____

Thank you for your time and input. The survey is complete. Please return using the envelope provided. If you have any questions about this survey, please contact Dan Rogers at 785-532-5813 or drogers@ksu.edu. Or Mahbub Alam at 620-275-9164 or malam@ksu.edu SDI survey 2005-100a.