IRRIGATION WATER MANAGEMENT SPRIN, SPRAY, AND DRIP VERSION 1.4 USERS GUIDE

Workbook Documentation

Irrigation Water Management (IWM) is a workbook that consists of the Sprin, Spray, and Drip worksheets. This workbook is based upon the irrigation water management principles in the Florida Irrigation Guide and Part 623 National Engineering Handbook, Chapter 2, Irrigation Water Requirements. This workbook has been developed to comply with the Natural Resources Conservation Service (NRCS) conservation practice standard Irrigation Water Management, Code 449.

Workbook Purpose and Description

SPRIN, SPRAY, and DRIP were developed as Microsoft Excel® worksheets to aid in the development of an Irrigation Water Management (IWM) Plan. SPRIN, SPRAY, and DRIP are for sprinkler irrigation systems, microirrigation systems with spray emitters, or drip emitters respectively.

Each program uses information on crop water requirements, root depth, available soil water holding capacity, management allowed deficit (MAD) and potential application efficiency to develop a monthly irrigation schedule. MAD is the percentage of available water holding capacity in the root zone allowed to be depleted before irrigation is scheduled. The irrigation scheduling guide developed using this workbook can be incorporated into the landuser's IWM Plan.

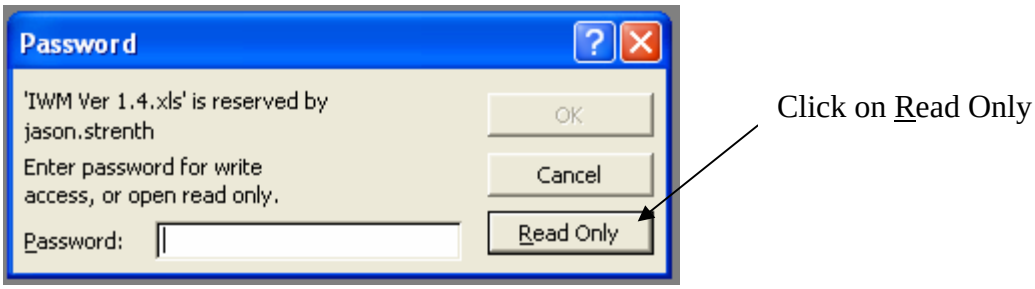
Since this workbook does not consider water that is available through capillary upflux from the water table, it is not applicable to high water table conditions.

Software Requirements

Use of this workbook requires that Microsoft Excel® be installed. This workbook works with Microsoft Excel 97® or later. The user should have a basic understanding of Excel®.

Installing the Workbook

Place the IWM workbook in the appropriate directory. Open the workbook by double clicking on the file or through the Excel program. Upon opening this workbook, a dialog box will appear. The “read-only” button must be clicked. This option allows user inputs, however, it prevents the overwriting of the original file by requiring the user to save the file as a different name. The program is password protected. The user may modify any value in a yellow cell. Since this workbook is protected, only the values in the yellow cells may be modified.



References

The SPRIN, SPRAY, and DRIP worksheets require several references available from the NRCS. The worksheets require values on the monthly consumptive use of the crop being irrigated and available soil water holding capacity. Monthly consumptive use values may be obtained from Part 652, National Irrigation Guide, Florida Amendment or computed using the computer software CON-USE. Available soil water holding capacity can be obtained from the Florida Irrigation Guide or from the appropriate county soil survey.

Disclaimer Statement

The USDA NRCS cannot assume liability for the use or maintenance of this workbook or any results it may produce.

User Notes

It is recommended that users save files which they may want to use again with a different file name.

SPRIN - HR. The user enters values for sprinkler spacing in feet, lateral spacing in feet, sprinkler discharge rate in gallons per minute, potential application efficiency, soil water holding capacity in inch/inch, root zone depth in inches, crop monthly water requirement in inches and MAD.

The worksheet output is on a monthly basis and includes the irrigation application rate in in/hr, the irrigation operating time in hours and minutes (rounded to 15 minutes), the irrigation depth in inches, the irrigation interval rounded to the nearest whole day, and irrigation delay days per 1/4 inch rainfall.

Delay Days for 1/4 inch of rainfall is the number of days that irrigation can be delayed for each 1/4 inch of measured rainfall. Delay days for each 1/4 inch of rainfall is equal to 0.25 inch divided by the monthly consumptive use in inches/day. Since the worksheet rounds the irrigation interval to the nearest whole day and the irrigation time to the nearest 15 minute increment, these values may not be sensitive to minor changes in the MAD.

See Exhibit 1 for sample output pages.

SPRIN - MIN. This worksheet performs the same functions as the SPRIN – HR except the operating time is calculated in minutes. This worksheet should be used if a more precise operating time is needed and for small irrigated areas that operate less than 15 minutes.

SPRAY. This worksheet is for microirrigation systems with spray type emitters. The user enters values for the wetted area in sq. ft. per tree, average emitter discharge rate in gallons per hour, number of emitters per tree, canopy area per tree in sq. ft, potential application efficiency, soil water holding capacity in inch/inch, root zone depth in inches, monthly crop water requirement in inches and MAD.

The worksheet assumes the canopy area is equal to the root zone area. If the irrigation area is larger than the canopy area, the worksheet only considers the volume of water applied to the canopy area as supplying the crop consumptive use.

The worksheet output is on a monthly basis and includes the irrigation system operating time in hours and minutes (rounded to the nearest 15 minutes), the irrigation interval in days, irrigation delay days per 1/4 inch rainfall and maximum delay days.

Delay Days for 1/4 inch of rainfall is the number of days that irrigation can be delayed for each 1/4 inch of measured rainfall. Delay days for each 1/4 inch of rainfall is equal to 0.25 inch divided by the monthly consumptive use in inches/day. Maximum Delay Days is the maximum length of time that irrigation can be delayed, without subsequent rainfalls and is the time required to deplete the MAD within the canopy area. Maximum delay days will be greater than the irrigation interval whenever the canopy area is greater than the irrigated area.

See Exhibit 2 for sample output pages.

DRIP. This worksheet is for microirrigation systems with drip emitters. This worksheet is applicable to crops grown with plastic bedding. No allowance for rain delay has been made. The user enters values for plant spacing in feet, row spacing in feet, percent canopy, average flow rate per emitter in gallons per hour, average wetted area per emitter in sq. ft., number of emitters per plant, potential application efficiency, soil water holding capacity in inch/inch, root zone depth in inches, monthly crop water requirement and MAD.

The worksheet output includes the water requirement in inches/day and gal/plant/day, the required irrigation time in hours and minutes per day, and the maximum irrigation time per irrigation in hours and minutes per day.

The maximum irrigation time per irrigation is the time required to replenish the MAD. If the maximum irrigation time is less than the required irrigation time, the land user should use multiple irrigations to avoid loss of water to runoff or leaching.

See Exhibit 3 for sample output pages.

Note: Excel is a copyright of Microsoft Corporation. Screen Shot reprinted by permission from Microsoft Corporation.

Exhibit 1, Sample SPRIN - HR Output Page 1 of 2

United States Department of Agriculture
NRCS Natural Resources Conservation Service

PUT YOUR ADDRESS HERE
YOUR STREET
YOUR CITY, STATE ZIP
(xxx) xxx-xxxx

IRRIGATION SCHEDULING GUIDE FOR SPRINKLER IRRIGATION SYSTEMS

Ver. 1.4

Cooperator:	Example	
Date:	08-27-03	
Field Number or Name:	Example	
Crop:	Citrus	
Sprinkler Spacing Along Laterals:	40.0	ft
Lateral Spacing:	40.0	ft
Average Sprinkler Discharge Rate:	4.00	gpm
Potential Application Efficiency:	79	%
Soil Water Holding Capacity:	0.050	in/in
Root Zone Depth:	36	in
Application Rate:	0.24	in/hr

		Irrigation			Rainfall
Month	Management Allowed Deficit (%)	Operating Time ** Hrs:Min	Irrigation Depth In	Irrigation Interval Days	* Delay Days per 1/4 Inch of Rainfall
January	30	02:45	0.66	10	4
February	30	02:45	0.66	8	4
March	30	02:45	0.66	6	3
April	30	02:45	0.66	5	2
May	30	02:45	0.66	4	2
June	30	02:45	0.66	3	2
July	50	04:45	1.14	6	2
August	50	04:45	1.14	6	2
September	50	04:45	1.14	7	2
October	50	04:45	1.14	9	2
November	50	04:45	1.14	12	3
December	50	04:45	1.14	16	4

* Delay days after a rainfall shall not exceed the irrigation interval.
** Operating time rounded to the nearest 15 minutes.

This guide was based on field conditions specific to the site. It provides estimated irrigation operating times and irrigation intervals for a specified management allowed deficit. The effect of the water table is not included. Irrigation is delayed until the water supplied by the water table is not adequate for the crop. This guide is the beginning step towards irrigation water management (IWM). As you evaluate your crop's response to this irrigation scheduling guide, refinements will need to be made. The most important aspect of IWM is evaluating and monitoring the plant and soil moisture relationship. This can be accomplished by following the method(s) described in your IWM plan. Contact the NRCS for assistance in implementing your IWM plan.

Exhibit 1, Sample SPRIN - HR Output Page 2 of 2

Cooperator:	Example
Date:	08-27-03
Field Number or Name:	Example
Crop:	Citrus

SCHEDULING GUIDE SUPPORTING DATA FOR SPRINKLER IRRIGATION

Month	Water Requirement In/Month	Water Requirement In/Day
January	1.74	0.06
February	1.79	0.06
March	2.59	0.08
April	3.17	0.11
May	4.17	0.13
June	4.67	0.16
July	4.91	0.16
August	4.65	0.15
September	4.04	0.13
October	3.24	0.10
November	2.29	0.08
December	1.80	0.06

Exhibit 2, Sample SPRAY Output Page 1 of 2

United States Department of Agriculture
NRCS Natural Resources Conservation Service

PUT YOUR ADDRESS HERE
YOUR STREET
YOUR CITY, STATE ZIP
(xxx) xxx-xxxx

IRRIGATION SCHEDULING GUIDE FOR SPRAY EMITTER IRRIGATION SYSTEMS
Ver. 1.4

Cooperator:	Example	
Date:	08-27-03	
Field Number or Name:	Example	
Crop:	Citrus	
Number of Emitters per Tree:	2.00	
Average Flow Rate per Emitter:	7.50	gph
Average Flow Rate per Tree:	15.00	gph
Wetted Area per Tree:	100.0	sq ft
Canopy Area per Tree:	120.0	sq ft
Potential Application Efficiency:	80	%
Soil Water Holding Capacity:	0.074	in/in
Root Zone Depth:	18	in

	Management	Irrigation		Rainfall	
Month	Allowed Deficit (%)	Operating Time ** Hrs:Min	Irrigation Interval Days	Delay Days per 1/4 Inch of Rainfall	Maximum Delay Days
January	30	02:00	6	4	7
February	30	02:00	6	4	7
March	30	02:00	4	3	5
April	30	02:00	3	2	4
May	30	02:00	2	2	3
June	30	02:00	2	2	3
July	50	03:30	4	2	4
August	50	03:30	4	2	4
September	50	03:30	4	2	5
October	50	03:30	5	2	6
November	50	03:30	8	3	9
December	50	03:30	10	4	11

** Operating time rounded to the nearest 15 minutes.

This guide was based on field conditions specific to the site. It provides estimated irrigation operating times and irrigation intervals for a specified management allowed deficit. The effect of the water table is not included. Irrigation is delayed until the water supplied by the water table is not adequate for the crop. This guide is the beginning step towards irrigation water management (IWM). As you evaluate your crop's response to this irrigation scheduling guide, refinements will need to be made. The most important aspect of IWM is evaluating and monitoring the plant and soil moisture relationship. This can be accomplished by following the method(s) described in your IWM plan. Contact theNRCS for assistance in implementing your IWM plan.

Exhibit 2, Sample SPRAY Output Page 2 of 2

Cooperator:	Example
Date:	08-27-03
Field Number or Name:	Example
Crop:	Citrus

SCHEDULING GUIDE SUPPORTING DATA FOR SPRAY EMITTERS

** Net Average flow rate per tree:	12.00	gph
Quantity of water per tree for 1/4 inch of rain:	18.70	gallons

**When the irrigated area is larger than the canopy area, the net average flow rate per tree is computed by multiplying the ratio of the canopy area and irrigated area times the flow rate per tree times the potential application efficiency.

Month	Water Requirement In/Month	Water Requirement In/Day	Water Requirement Gal/tree/day
January	1.74	0.06	4.2
February	1.79	0.06	4.3
March	2.59	0.08	6.2
April	3.17	0.10	7.6
May	4.17	0.13	10.1
June	4.67	0.15	11.3
July	4.91	0.16	11.8
August	4.65	0.15	11.2
September	4.04	0.13	9.7
October	3.24	0.10	7.8
November	2.29	0.07	5.5
December	1.80	0.06	4.3

Month	Irrigation Management Allowed Deficit Gallons	Rainfall Management Allowed Deficit Gallons
January	25	30
February	25	30
March	25	30
April	25	30
May	25	30
June	25	30
July	42	50
August	42	50
September	42	50
October	42	50
November	42	50
December	42	50

Exhibit 3, Sample DRIP Output Page 1 of 2

United States Department of Agriculture
NRCS Natural Resources Conservation Service

PUT YOUR ADDRESS HERE
YOUR STREET
YOUR CITY, STATE ZIP
(xxx) xxx-xxxx

IRRIGATION SCHEDULING GUIDE FOR DRIP EMITTER IRRIGATION SYSTEMS

Ver. 1.4

Cooperator:	Example	
Date:	08-27-03	
Field Number or Name:	Example	
Crop:	Tomatoes	
Plant Spacing:	2.0	ft
Row Spacing:	6.0	ft
Percent Canopy:	50	%
Average Flow Rate per Emitter:	0.17	gph
Wetted Area per Emitter:	2.0	sq ft
Number of Emitters per Plant:	2.0	
Potential Application Efficiency:	79	%
Soil Water Holding Capacity (in/in):	0.035	in/in
Root Zone Depth (in.):	15	in

Month	Management Allowed Deficit (MAD) (%)	Water Requirement In/Day	Water Requirement Gal/Plant/Day	Required Irrigation Per Day Hrs:Min		Maximum Time Per Irrigation Hrs:Min
January	30	0.00	0.0	00:00		
February	30	0.06	0.2	00:48		
March	30	0.13	0.5	01:47	*	01:27
April	30	0.17	0.6	02:18	*	01:27
May	30	0.16	0.6	02:14	*	01:27
June	30	0.00	0.0	00:00		
July	30	0.00	0.0	00:00		
August	30	0.12	0.5	01:43	*	01:27
September	30	0.20	0.8	02:48	*	01:27
October	30	0.17	0.6	02:20	*	01:27
November	30	0.08	0.3	01:05		
December	30	0.00	0.0	00:00		

*The required irrigation time per day exceeds the maximum time per irrigation, irrigation shall be split into multiple applications.

This guide is based on field conditions specific to the site. It provides estimated irrigation operating times for a specified management allowed deficit. This guide is an estimated irrigation requirement when it is determined that water from rainfall and the water table is depleted and irrigation is needed. This guide is the beginning step towards irrigation water management (IWM). As you evaluate your crop's response to this irrigation scheduling guide, refinements will need will need to be made. The most important aspect of IWM is evaluating and monitoring the plant and soil moisture relationship. This can be accomplished by following the method (s) described in your IWM plan. Contact the NRCS for assistance in implementing your IWM plan.

Exhibit 3, Sample DRIP Output Page 2 of 2

Cooperator:	Example
Date:	08-27-03
Field Number or Name:	Example
Crop:	Tomatoes

IRRIGATION SCHEDULING GUIDE SUPPORTING DATA FOR DRIP EMITTERS

Net average flow rate per plant:	0.27	gph
Net average flow rate per emitter:	0.13	gph

Month	Water Requirement In/Month	Irrigation Management Allowed Deficit (MAD) Gal/Emitter
January	0.00	0.00
February	1.61	0.20
March	3.98	0.20
April	4.98	0.20
May	4.98	0.20
June	0.00	0.00
July	0.00	0.00
August	3.83	0.20
September	6.04	0.20
October	5.22	0.20
November	2.34	0.20
December	0.00	0.00