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Berry Times

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Gulf Coast Research and Education Center, 13138 Lewis Gallagher Road, Dover, FL 33527 (813) 744-6630 SC512-1160 Website: http//strawberry.ifas.ufl.edu
Editors: Dan Legard (legard@ufl.edu) & Craig Chandler (ckc@.ufl.edu); Design, Layout & Distribution: Christine Manley (cmanley@ufl.edu); Director: Jack Rechcigl

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Water Movement in Raised Beds - John R. Duval and Eric Simmone

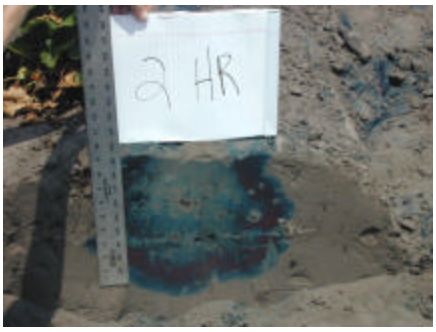
With increasing concern about water usage and irrigation efficiency, a better understanding of water movement through raised beds is needed. Where does water go in the bed when the pumps are turned on? How long does it take to get there? Many factors determine the answer to these questions and need to be considered when choosing irrigation supplies and run times for irrigation.

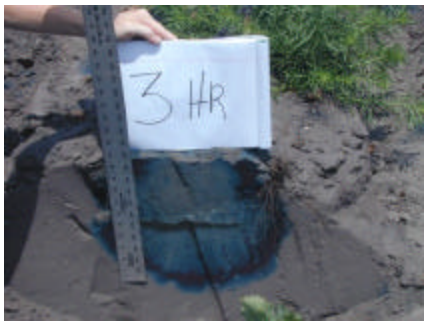
The major factor that determines water movement in soil is macro- and micro- pore space. Pores in soil are simply free space not occupied by soil particles. This can be visualized as air filled spaces between soil particles. Macro-pores are generally considered to be larger than 0.06 millimeter in diameter and anything smaller is considered a micro-pore. Sandy soils usually have a porosity of 35-50%, and finer textured soils have a porosity of 40-60%. With larger soil constituents, sandy soils will have greater numbers of macro pores. Water movement through macro-pores is usually accomplished via mass flow, the movement of water due to gravity, generally in a downward direction. In micro-pores, water movement is more commonly a result of capillary action, which can move water laterally. The distribution of macro- and micro-pores depends on several factors: soil compaction, aggregation and type. Soil compaction and aggregation can be altered to some degree, while soil type is a location specific factor that can only be changed by changing location or by moving large quantities of soil.

Soil compaction may be the easiest factor to control in a field setting. The use of deep tillage to break up compacted layers in soil can improve the drainage of a field. This is because macro-pore volume of the compacted layer is increased, thus allowing water to move downward more freely. If this is true, then the reverse should also be true to improve the lateral movement of water in a planting bed. A more compacted bed will have fewer macro-pores and more micro-pores, due to the forcing of soil particles together, improving movement to the sides or shoulders of the bed. In a "loose" bed, water from a drip tape will preferentially move downward, whereas in a "tight" bed water movement will still move downward, but not at as great a rate, with more water being moved towards the side of the bed through capillary action of the micro-pores.

Soil aggregation is the binding or flocculation of soil particles to one another. Soil aggregates are naturally occurring clumps of soil and help increase the numbers of micro-pores present in the soil. There are four factors that control soil aggregation: physical movements of soil particles, organic matter content of the soil, cation concentrations in the soil, and tillage. Organic matter in the soil is the major factor contributing to aggregate formation. As organic materials break down, bacteria and fungi will produce gels and other products which bind soil particles together. Physical movement of soil particles can be accomplished through natural freeze - thaw and wetting - drying cycles, action of soil organism, and root growth. These actions force soil particles together promoting aggregation. Some cations (positively charged ions) such as calcium and magnesium (which both have a +2 charge) can help bind negatively charged soil particles together in a process called flocculation. However, cations such as sodium (+1 charge) can cause the dispersal of soil particles. Tillage can have both a positive and negative impact on soil aggregation. Incorporation of organic materials uniformly in the soil (from crop residues or cover crops) enhances soil aggregation in the short term. However, in the long term, repeated tillage operations speed up the break down of organic matter in the soil reducing aggregation, and movement of machinery through the field can break stable soil aggregates.

What does this mean to a strawberry grower? If the physical properties of a soil are known, determinations can be made on the amount of water needed to irrigate to a certain depth or to wet a given volume of the bed. In the sandy soils surrounding Plant City, lateral movement of water in the soil



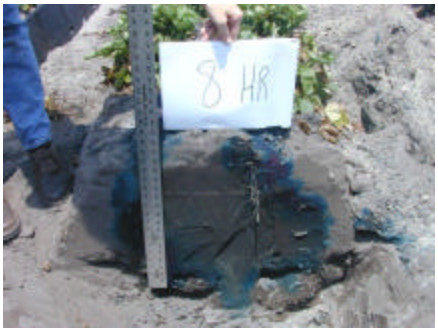


Cross sections of the beds after 1, 2 and 3 hours of irrigation with drip tape that has a 4 inch emitter spacing and a flow rate of 32 gal/100 ft/hr.

is poor. Recently, Dr. Eric Simmone and I performed tests using dyes to determine water movement in raised beds. We used different drip tapes with different flow rates and emitter spacing. On a commercial farm, two tapes with 12 inch emitter spacing and flow rates of 24 and 27 gal/100 ft/hour were tested. At the GCREC-Dover a tape with 4 inch emitter spacing and a 32 gal/100 ft/hour flow rate was tested. Both test areas contained living strawberry plants spaced 15 inches apart, and had received no irrigation for a month. All beds in this study were "tight" beds, formed with 3 passes of bedding equipment. Treatments consisted of irrigation run times of 1, 2, 3, 4, 6, and 8 hours. During the first 20 minutes of each irrigation treatment, a blue indicator dye was injected to follow the path of water in the soil. At the end of each irrigation treatment, beds were dissected both length and cross wise to determine where water had moved. The distance that the dye moved downward, lengthwise, and crosswise across the bed was measured (Table 1.) Lengthwise movement would be the horizontal distance water has traveled along an imaginary vertical plant that is parallel to the direction of the bed and intersects the drip tape.

There is not much difference between the 24 or 27 gal/100 ft/hour tapes. It takes both of these tapes 6 hours for the wetting pattern of two adjacent emitters to converge. However, the wetting pattern of the 32 gal/100 ft/hour tape with 4 inch emitter spacing converges after only an hour. This tape also allowed for deeper penetration of water and provided less water movement to the sides of the beds than the other two tapes. This is due to the fact that on the commercial farm a very distinguishable compacted layer existed at a depth of 17 inches. No irrigation with any of these tapes was successful in wetting all the way to the shoulders of the bed (figures 1-6). In future studies at GCREC-Dover, the effect of pulsing irrigation through the drip system will be explored as a means of moving water to the edges of the bed and getting more uniform coverage for fertilizer or any other chemicals supplied through the irrigation system.

More pictures of these tests can be found at http://strawberry.ifas.ufl.edu.



Cross sections of the beds after 4, 6 and 8 hours of irrigation with drip tape that has a 4 inch emitter spacing and a flow rate of 32 gal/100 ft/hr.

Table 1. Downward (D), lengthwise (L), and crosswise (C) movement of water (in inches) in a raised bed planted with strawberries after 1, 2, 3, 4, 6, and 8 hours of irrigation.

	Flow rate (gal/100 ft/hour)								
Hours of Irrigation	24			27			32		
	D	L	C	D	L	C	D	L	C
1	10.3	10.0	9.0	9.2	10.5	10.5	7.2	4.0	11.6
2	11.0	11.0	14.5	11.9	11.5	15.0	9.2	4.0	11.6
3	15.8	11.3	15.5	14.0	11.3	16.0	10.2	4.0	14.8
4	14.5	11.3	18.5	13.1	11.3	16.5	12.7	4.0	16.0
6	16.5	11.3	19.5	16.9	11.8	19.5	17.5	4.0	18.5
8	16.3	11.8	23.0	16.5	11.8	22.3	21.5	4.0	20.1

USDA / IR-4 Methyl Bromide Alternatives Program for Strawberry 2002 - Jim Gilreath, Joe Noling and Erin Rosskopf

The USDA/IR-4 Methyl Bromide Alternatives Program for strawberry began approximately three years ago and has worked to identify possible alternatives to methyl bromide for fruiting berries in Florida and California. The program is managed on a national level by Dr. Jack Norton and is funded by the IR-f project and participating manufacturers. The program has grown to include 18 different treatments during the past strawberry season at two sites in Florida. Some of these treatments represent new chemistry, while others are comprised of older products, and combinations of products. The Florida experiment focused primarily on sting nematodes and soilborne pathogens. A second experiment is being conducted at the Gulf Coast Research and Education Center - Bradenton and has sting nematodes and weeds as the principal pests.

Although the primary objective of the program was to identify possible alternatives to methyl bromide as a soil fumigant, data being generated will be of considerable value to growers in the event the industry attempts to obtain a critical use exemption for methyl bromide on strawberry. Not only will these data demonstrate the efficacy of methyl bromide in scientific assessments, but the IR-4 program will go a long way toward satisfying two of the requirements of the critical use exemption process: 1) demonstration of the efficacy of products relative to methyl bromide to determine if any is a viable alternative in unbiased research and 2) an on going research program to continue evaluation of new and existing alternatives in support of industry critical-use exemption requests.

Fumigation process

A key focus of the IR-4 program is outreach. In a recent tour, participants clearly saw the effect of sting nematodes and soilborne pathogens on fruiting plants at Dover. Results were quite dramatic when treatments were viewed against nontreated control plots where strawberry plants were either dead or close to it. Interestingly, even methyl bromide treated plots suffered some damage from sting nematodes and crown rot in this trial. One of the more successful treatments was a combination of chloropicrin and metam sodium. Telone C-35 provided good results in most plots in this experiment. Iodomethane, formerly referred to as methyl iodide, was among the better treatments. A significant population of Carolina geranium (a weed) was observed at Bradenton. At that location even methyl bromide treated plots suffered from poor winter annual weed control. Some new products provided some control of winter annuals and a few treatments controlled nutsedge.

New chemistry is constantly being sought for inclusion in these trials. Products identified as successful candidates have the advantage of access to and support by the IR-4 registration program and award of methyl bromide alternative status in the EPA registration process. Recognition of a pesticide as a methyl bromide alternative advances a product in the time frame of the registration process. Hopefully, this valuable program will continue in Florida and growers will benefit from it.

Strawberry Production in Spain - Dan Legard

During my recent trip to Europe I had the opportunity to visit the Spanish strawberry production region near Huelva in southern Spain. Currently, Spain is the second largest producer of strawberries in the world after the USA.

Small tunnels in Spain

This season there are over 17,000 acres of fruiting fields (7000 hectares) in Spain. All strawberry fruit are produced in plastic tunnels in Spain (80% inside of single bed tunnels and 20% under multiple bed tunnels using the same two-row raised bed culture system used in Florida). However, the Spanish are currently fumigating their beds with 50:50 methyl bromide: chloropicrin. The fruiting season in the Huelva area runs from mid-January to mid-May, and 'Camarosa' is the primary cultivar being grown (95% of the plantings).

Jose Manuel Aranda, Breeder, in large Spanish tunnel

During my trip I had the opportunity to visit with several excellent researchers working in Spain. The strawberry breeders showed me several promising new strawberry selections being developed by a joint Spanish government / private sector program. Two of these selections will soon be named and released for commercial use. Spanish strawberry producers have many of the same disease problems we have in Florida, although the drier climate and tunnels helps to reduce disease problems. Every year they have epidemics of Botrytis fruit rot and this season they had problems with *Colletotrichum acutatum* (Colletotrichum root rot and anthracnose fruit rot).

Spotlight on Diagnosis – Jim Mertely

The Strawberry Diagnostic Lab is now entering its usual summer dormancy period. Only a few strawberry samples from Bradford County have been processed recently. This time of year, strawberry growers occasionally bring in vegetable or melon samples for diagnosis. This practice is discouraged since our lab is neither equipped nor authorized to handle such samples. Growers experiencing problems with crops other than strawberry should contact Erin Rayfield at the Hillsborough County Extension Office (813) 744-5519 Ext. 105. She may help with the problem directly or refer a sample to the appropriate clinic at the University of Florida in Gainesville. Drs. Bob McGovern and David Schuster are other sources of assistance at the Gulf Coast Research and Education Center in Bradenton. Dr. McGovern (914) 751-7636 Ext. 299 is a plant pathologist specializing in ornamental and vegetable crops. Dr. Schuster, Ext. 247, is an entomologist who works with insect pests of vegetables.

Additional Ways to Earn CEUs – Erin Rayfield

The Hillsborough County Extension Office has recently acquired computer disks that will allow growers to earn CEUs in the Core and Private applicator categories. Growers can earn 2 core CEUs and/or 4 private applicator CEUs. The disks are loaded on a computer in the Extension office. Please contact Dave Palmer if you are interested in using the disks (813)744-5519 x103.

'Carmine' Strawberry – Craig Chandler and Dan Legard

On April 9th the University of Florida's cultivar release committee unanimously approved the release of FL 95-256 strawberry as 'Carmine' (pronounced Kar-men, a word for deep red or crimson). There is a need in west central Florida and other winter strawberry production areas for an early ripening cultivar to replace or be an alternative to 'Sweet Charlie'. 'Sweet Charlie' has benefited the Florida strawberry industry through its high production of fruit early in the season, when market prices are typically high. But the texture of 'Sweet Charlie' fruit is relatively soft, making its shipment and shelf life problematic. 'Carmine' has produced high early-season (Dec. through Feb.) yields of firm, deep red fruit at GCREC-Dover and in several commercial fields in west-central Florida. It is recommended for trial in areas with mild winter climates.

Overview of Spring 2002 Strawberry Entomology Field Research in Dover - Jim Price

Entomological fieldwork at Dover emphasized two main areas of interest: Pesticide development and integration of biological control of spider mites into common strawberry culture.

In the area of pesticide development, we performed three large experiments to learn the best patterns of use for two newly registered miticides, Acramite? (bifenazate) and Savey? (hexythiazox). In addition, we performed extensive work on two emerging miticides, Mesa? (milbemectin) and acequinocyl (no trade name yet). Each of these four compounds performed very well and offers growers reasons for confidence in mite control success for some years to come.

Mesa? likely will be registered for use in strawberry fields this fall, but it possesses a mode of action similar to that of Agri-Mek?. We shall recommend that growers choose only one of them.

In the second area of emphasis, we studied the compatibility of Mesa?, Danitol? (fenpropathrin), Switch? (cyprodinil/fludioxonil) fungicide and experimental formulations of thiram fungicide with *Phytoseiulus persimilis* predators. Mesa? appears to reduce motile form predators to about the degree we are accustomed to with Agri-Mek?. We were pleased to discover that the pyrethroid, Danitol?, may not be as hazardous to the predators we used as it had been in the past. Apparently, the biological control products industry is beginning to select and propagate mites that possess some tolerance to certain pyrethroid insecticides. Switch? and the experimental formulations of thiram appear to be compatible with our biological mite control.

Additional details of results from this season of work will be published in future issues of the *Berry Times Newsletter*.

Congratulations to Dr. Craig Chandler on his recent promotion to full professor as well as on the release of the new cultivar 'Carmine'.