Imperial County Agricultural Briefs

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Features from your Advisors

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AGRICULTURAL DRAINAGE IN ARID AND SEMI-ARID REGIONS

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One must bear five factors in mind when planning to irrigate her / his land, including (1) the adequacy, reliability, and quality of the water supply; (2) the control and conveyance of water; (3) crop water consumption and irrigation scheduling; (4) application of water and irrigation efficiency; and (5) drainage for removal of excess water and leachates to control salinity buildup in the crop root zone and soil profile. It should be known that *drainage* is complementary to irrigation and is viewed as an essential component of irrigated agriculture in arid and semi-arid regions.

The management goal of drainage systems in arid and semi-arid regions is primarily to maintain a salt balance in the crop root zone, because, salinity is one of the most severe environmental factors limiting the productivity of agricultural crops. Agricultural losses caused by salinity are difficult to assess but estimated to be substantial and expected to increase with time.

Salt accumulation, also referred to as salinization, commonly occurs as an outcome of agricultural practices when salts build up in the root zone because the drainage of water from the sub-soil is insufficient to prevent saline waters rising into the root zone. Irrigation practices may result in consumptive uses of water, leaving behind salts concentrated in a smaller volume of water. Thus, salinization tends to be common in arid and semi-arid regions where leaching of salts is poor due to insufficient rainfall.

Figure 1. A field ditch drainage (top) and sub-surface drain tile (bottom).

Agricultural drainage usually consists of surface and sub-surface systems. At the field scale, sub-surface drain pipes and field ditches normally exit to an open main or collector drain (Figure 1).

Surface drainage is often achieved by land forming and smoothing to remove isolated depressions, or by constructing parallel ditches. Ditches are gently graded and discharge into main drains at the field boundaries. Although the ditches are intended primarily to convey excess surface runoff, there is some seepage through the soil to the ditches, depending on the water table position. Surface drainage alone is seldom sufficient to remove excess water from the crop root zone. Deep ditches or sub-surface pipe drainage systems enable a more rapid water table drawdown. The downstream ends of the laterals are normally connected to a collector drain. The required diameter of the pipe collectors increases with the area to be drained. Drain spacing is usually dependent upon soil hydraulic conductivity and a design drainage rate coefficient. Depending on topography, land formation and proximity of water receiving body, the collector may outlet by gravity to an open main drain or into a sump.

Sub-surface drainage systems are used in irrigated arid and semi-arid regions to reclaim saline and waterlogged lands, and to maintain favorable long-term salt and water balances in the crop root zone. Salinity and waterlogging are caused by a buildup of the water table due to deep percolation of normal excess water and canal seepages. Buried pipe drains for control of salinity are generally buried deeper in arid regions than in humid regions. Irrigation water is always unavoidably applied in excess of plant evapotranspiration (ET) needs to leach out excess salt. This additional quantity of water applied is known as the leaching factor. Naturally occurring as well as applied salts are then leached from the root zone by this water and removed from the field via the pipe drains. Deeper drain installation ensures that salts do not rise too rapidly to the soil surface due to capillary action.

Conceptual flow paths for drainage systems are shown in Figure 2. The flow from the drain is continuous and the water table depth is either maintained or lowered, thus reducing potential upward flow that may support crop water use. The flow paths are deep into the soil profile and the depth increases with increasing salinity salt load of the drainage water. Deeper water tables also allow increased deep percolation from irrigation which translates to increased drainage flow.

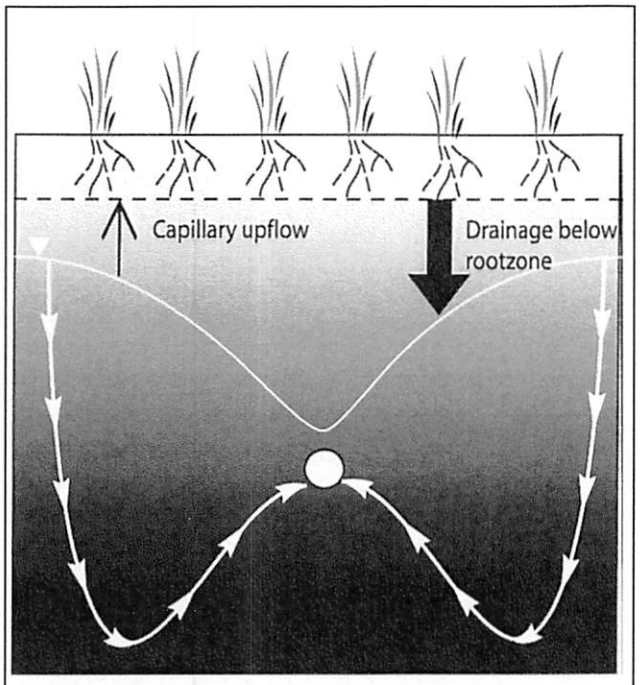

Figure 2. Conceptual flow paths in sub-surface drainage.

Drainage water from irrigated agriculture is normally degraded compared with the quality of the original water supply. Drainage water that flows through the soil will pick up a variety of dissolved and suspended substances including salts, organic compounds and soil particles. Management for

safe re-use and disposal requires an understanding of the characteristics of the drainage water, and a matching of those characteristics to the environmental protection needs of the re-use or disposal area. Both surface and sub-surface drainage effluent contains substances that are potential pollutants. These pollutants may include:

Salinity and major ions: In arid irrigated areas, irrigation practices mobilize naturally occurring salt in the soil and concentrate those salts already present in the supply water. The salts captured by a sub-surface drainage system are often highly concentrated with the major cations, such as Na^{+}, Ca^{++}, Mg^{++} and, to a lesser extent, K^{+}. The major anions are Cl, SO_4, HCO, and NO. Most sub-surface drainage waters are $NaSO_4$ and NaCl dominated. These are common non-toxic elements that only become problematic when concentrated in the soil profile. Sub-surface drainage water from arid areas always has higher salinity than the supply water, a higher proportion of Na and Cl, an increased hardness and a higher sodium adsorption ratio (SAR).

Pesticides: Numerous types of pesticides may end up in drainage water. This makes it difficult to assess their potential impacts on water quality. Most pesticides are synthetic, organic compounds and there are documented instances where organic pesticides in irrigation runoff have caused downstream water quality problems. High pesticide concentrations in sub-surface drainage water are less probable because of the natural filtering action of the soil.

Nutrients: The two major nutrients in drainage water are N and P. Nitrogen can be in either the organic form (ammonium) or the inorganic form (nitrate). Nitrate is the dominant form of N in sub-surface drainage water. High nitrate concentrations in sub-surface drainage can originate from a number of sources: geologic deposits, natural organic matter decomposition and deep percolation of nitrate resulting from nitrogen-based fertilizer applications. Agricultural drainage water also contains phosphate in both organic and inorganic forms. Most of the phosphate in surface drainage is in the organic form. Little phosphate has been found in sub-surface drainage water because of its strong adsorption to arid zone soil particles and immobility.

Sediment: Irrigated agriculture may also cause erosion directly through application of irrigation water, or indirectly through sub-optimal land management. Sediment contained in surface runoff from agricultural lands may carry phosphates (P) and certain pesticides to surface waters where they may contaminate the food chain or affect other beneficial uses of water. Excess sedimentation can also degrade the stream environment, diminish the health and diversity of fish and wildlife habitats, limit recreational uses and add to the costs of flood management and drinking water treatment.

Toxic trace elements: Inorganic trace elements are different from synthetic organic compounds (pesticides) in that they are commonly present at low levels in nature and there is already a natural level of tolerance. It is

essential to have good information on the concentration of trace elements in the drainage water in order to develop safe re-use and disposal methods. High concentrations of inorganic trace elements in irrigated soils pose a threat to the environment if they are mobilized by irrigation and drainage practices.

Bacteria: Bacteria are a potential pollutant where surface return flows come from land that has received applications of animal waste. Bacterial pollution may also originate from wetland discharges. The focus of a bacteriological contamination assessment is on the measurement of coliform and fecal coliform levels in the water. A normal irrigated farming operation would not be expected to produce adverse bacteriological levels in surface drainage water.

IMPERIAL VALLEY CIMIS REPORT AND UC WATER MANAGEMENT RESOURCES

Ali Montazar, Irrigation & Water Mgmt Advisor, UCCE Imperial & Riverside County

The reference evapotranspiration (ET_o) is derived from a well-watered grass field and may be obtained from the nearest CIMIS (California Irrigation Management Information System) station. CIMIS is a program unit in the Water Use and Efficiency Branch, California Department of Water Resources that manages a network of over 145 automated weather stations in California. The network was designed to assist irrigators in managing their water resources more efficiently. CIMIS ET data are a good guideline for planning irrigations as bottom line, while crop ET may be estimated by multiplying ET_o by a crop coefficient (K_c) which is specific for each crop.

There are three CIMIS stations in Imperial County include Calipatria (CIMIS #41), Seeley (CIMIS #68), and Meloland (CIMIS #87). Data from the CIMIS network are available at: http://www.cim is.water.ca.gov. Estimates of the average daily ET_o for the period of November 1 to January 31 for the Imperial Valley stations are presented in Table 1. These values were calculated using the long-term data of each station.

Table 1. Estimates of average daily potential evapotranspiration (ET_o) in inch per day

Station	December		January		February	
	1-15	16-31	1-15	16-31	1-15	16-28
Calipatria	0.09	0.09	0.09	0.10	0.12	0.13
El Centro (Seeley)	0.10	0.09	0.10	0.11	0.13	0.15
Holtville (Meloland)	0.09	0.08	0.09	0.10	0.12	0.14

For more information about ET and crop coefficients, feel free to contact the UC Imperial County Cooperative Extension office (442-265-7700). You can also find the latest research-based advice and California water & drought management information/resources through link below:
http://ciwr.ucanr.edu/.

University of California
Division of Agriculture and Natural Resources

2019 California Plant & Soil Conference

Dates: View Complete Calendar | Return to UC Cooperative Extension | Agricultural Experiment Station
February 5, 2019 - February 6, 2019

Time: 8:00 AM - 5:00 PM

Contact: Matthew Quinton

Sponsor: American Society of Agronomy

Event Details

Register for the 2019 California Plant & Soil Conference
February 5 - February 6 (T-W)

Follow the web link below to register online:

- **Link to conference registration website:** CA-ASA_2019_registration
- **Online registration is open now through February 4, 2019**
- Continuing education units (CEU's) will be offered
- Questions contact: ellison.calasa@gmail.com

Registration Fees

Please note that the student pricing listed for early registration below is available only when logging in as a student member of ASA, CSSA, or SSSA. Undergraduates can join the societies for $22 and graduate students for $42. Membership is strongly encouraged! Join here:

www.agronomy.org/join-renew

www.crops.org/join-renew

www.soils.org/join-renew

CA-ASA Conference Registration Fees

Early registration fees through Monday, January 29th:

- Full (both days) professional: $195
- Full (both days) student: $20
- First day only (Feb. 5th) professional: $115

- Second day only (Feb. 6th) professional: $80
- First or second day only student: $20

Late (after January 29) and walk-in registration fees:

- Full (both days) professional: $220
- Full (both days) student: $20
- First day only (Feb. 5th) professional: $130
- Second day only (Feb. 6th) professional: $90
- First or second day only student: $20

Lunch is provided to all registrants both days of the conference.

Refund Policy

For persons who pre-registered for the conference but cannot attend due to extenuating circumstances, a refund of pre-registration fees may be requested. Refunds can be requested prior to the first day of the conference. No refunds will be issued for requests received after the conference has begun. All requests will be reviewed by the governing board and should be made by email to the current CA-ASA Board President, Dan Munk, at dsmunk@ucanr.edu. Please do not attempt to contact the National American Society of Agronomy that manages the registration website since they do not handle requests for refunds.

Notice to students and student poster presenters:

Students presenting a poster will receive complimentary registration and are not required to register for the conference on line. A name badge will be provided at the registration desk the day of the conference and is valid both days.

Students attending as part of a class assignment but not including lunch are not required to register on-line, but must obtain a name badge at the registration desk.

Webmaster Email: jewarnert@ucanr.edu

New Livestock Section Next

LIVESTOCK RESEARCH BRIEF

UC CE University of California
Agriculture and Natural Resources | Cooperative Extension

1050 E. Holton Rd.
Holtville, CA, 92250
(442) 265-7700

December 11, 2018

Welcome to the Livestock Research Brief!

Through this monthly leaflet I hope to provide an overview of relevant research and developments centered around livestock production, with special focus on issues experienced in hot, arid environments. Occasionally I will include meeting notices or other information from University of California Cooperative Extension that may be of interest to readers.

If you have any comments, questions, recommendations, or know someone who would like to be included on the mailing list, please feel free to contact me.

Have a happy and safe holiday season.

Best wishes,

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EFFECT OF PEN SPACE ON CALF-FED HOLSTEIN STEERS

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Livestock Advisor

Introduction

Having adequate pen space for calf-fed Holstein steers is a critical management decision for feedlots. With Holsteins having larger frame size and increased water intake (leading to increased urination and increased pen moisture) compared to beef breeds, maintaining the correct stocking density can improve production.[1,2] This study aimed to identify what pen space and/or shade space was most beneficial to the growth performance of calf-fed Holstein steers.

Methods

Fifty-four calf-fed Holstein steers at the UC Desert Extension and Research Center were sorted into pens with 7.2, 14.4, or 21.6 m^2/steer of pen space after a 112-d receiving-growing period. The shade provided was 3.7, 7.4, and 11.1 m^2/steer respectively. Each treatment had three replicates (9 total pens) with six steers per pen. Steers were fed a typical feedlot ration ad libitum (Table 1). Pens had automatic waterers and 400 cm/steer of feed bunk space. Temperatures during the study ranged from 0-34°C and a relative humidity of 20-60% (Table 2).

Results and Implications

Providing greater than 7.2 m^2/steer pen space and/or 3.7 m^2/steer overhead shade did not enhance cattle growth performance (Table 3). Steers in this study experienced a greater ADG than predicted based on equations for implanted calf-fed Holstein steers. This reflects the increased feed intake seen in the study compared to predicted values, as observed energy intake was in close agreement with expected based on dietary NE concentration and steer ADG.

These results do not reflect other factors that may be limiting performance of the steers. Further research into the warmer months of the low desert may give more insight into performance factors of cattle provided greater pen space per steer.

Table 1. Composition of experimental diet (DM basis)

Ingredient Composition, % DM	
Sudangrass Hay	8.00
Alfalfa Hay	4.00
Tallow	2.50
Molasses, cane	4.00
Distillers Gr.	7.00
Steam Flaked Corn	71.002
Urea	1.15
TM Salt	0.40
Limestone	1.68
Dicalcium Phosphate	0.10
Magnesium Oxide	0.15
Rumensin 90	0.018

Table 2. Weather data during study

	Pen Space, m^2/steer		
Item	7.2	14.4	21.6
Number of Animals	18	18	18
Weight, kg			
Initial	250	250	250
Final	454	455	448
ADG, kg	1.72	1.72	1.69
DMI, kg/d	8.43	8.22	8.15
ADG/DMI	0.203	0.209	0.208
Obs/Exp dietary NE	0.99	1.01	1.01

Table 3. Growth performance treatment effects

Month	Average Maximum Temperature (°C)	Average Minimum Temperature (°C)	Average Humidity (%)	Solar Rad (W/in^2)
December*	22.8	3.0	44	125
January**	24.6	7.1	43	133
February**	24.0	6.0	38	169
March**	26.3	10.2	35	223
April**	32.1	13.0	32	298

* 2017
** 2018

References

1 R. A. Zinn, Nutrition and management of calf-fed Holstein steers. 2015. J. Anim. Sci., Vol 93.

2 G. C. Duff and C. P. McMurphy. Feeding Holsteins from start to finish. 2007. Veterinary Clinics Of North America: Food Animal Practice, Vol. 23.