



*Imperial County*

*Agricultural Briefs*



**University of California**  
Agriculture and Natural Resources

## Features from your Advisors

*December 2017*

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## **PROBLEMATIC WEEDS AND MANAGEMENT CHALLENGES FOR ONION PRODUCTION IN THE IMPERIAL VALLEY**

*Pratap Devkota, Weed Science Advisor, UCCE Imperial and Riverside Counties*

Onion (*Allium cepa* L.) is a biennial crop by nature, but it is grown primarily as annual crop for harvesting leaf and bulb. It is relatively a slow growing & long-season crop, has narrow & upright leaves, and shallow root system. California's low desert region is one of the primary area for onion production. Onion is an important crop for the Imperial County and it was ranked the fourth agricultural commodity after cattle (first), alfalfa (second), and leaf lettuce (third) in 2016. If we look at the crop value, market and processing onion was harvested from 4,000 and 10,000 acres with the gross value of 61.4 and 67.1 million dollars, respectively in 2016.

**Onion Yield Loss from Weeds:** One of the major yield limiting factor for onion production is pest infestation. Weeds are serious pest for onion and yield primarily depends upon the severity of weed infestation during the crop's growing season. Onion leaves are narrow and upright which makes it less competitive to weeds. Weeds can establish and outcompete onions for water, nutrients, sunlight and other resources essential for crop growth. Onion is very susceptible to weed interference at about 1- to 3-leaf stage. If weed control is not effective, yield will be reduced significantly depending upon the weed pressure. For green onions, the season-long weed interference can result about 96% yield reduction. In bulb onions, weed interference for the entire growing season can reduce more than 50% crop stand. Weed interference can also delay fall-over of the onion tops, increase percentage of thick-necked onions, and extreme weed pressure can result in the lack of bulb formation which result in the lower yield. Weeds may also serve as reservoir host for disease and insect pests, resulting in enhanced infestation on onions. Therefore, weed control is very critical for securing optimum yield in onion production.

**Problematic Weeds for Onion in the Imperial Valley:** Winter and early emerging summer weeds are problematic for onion production in the low desert region. Some of the problematic broadleaf weeds for onion production in Imperial Valley are nettleleaf goosefoot (*Chenopodium murale* L.), common purslane (*Portulaca oleracea* L.), clover species (*Trifolium* spp.), annual sowthistle (*Sonchus oleraceus* L.), wild beet (*Beta vulgaris* ssp.). Grass weeds such as annual bluegrass (*Poa annua* L.), Mexican sprangletop (*Leptochloa fusca* L.) and canarygrass



(*Phalaris* spp.) are also common problems in Imperial Valley's onion fields. Nutsedge species (*Cyperus* spp.) are commonly found perennial weeds in onion production.

Mustard weeds such as London rocket (*Sisymbrium irio* L.) and shepherd's-purse (*Capsella bursa-pastoris* L.) are also problematic weeds in the low desert onion production. In recent years, swinecress species have become a major weed problem in onion fields throughout the Imperial Valley. There are two species of swinecress, greater swinecress (*Coronopus squamatus* L.) and lesser swinecress (*Coronopus didymus* L.), found in the Imperial Valley. However, the greater swinecress has become a major problem. Onion growers and PCA's have noticed that most of the herbicides labeled for onion have less effect on swinecress. Greater swinecress is believed to have been introduced into the valley through contaminated onion seeds, eventually spread throughout the valley and became a major weed in onion production.

Here are some pictures showing some of the problematic weeds which are commonly found in the onion fields at Imperial Valley.

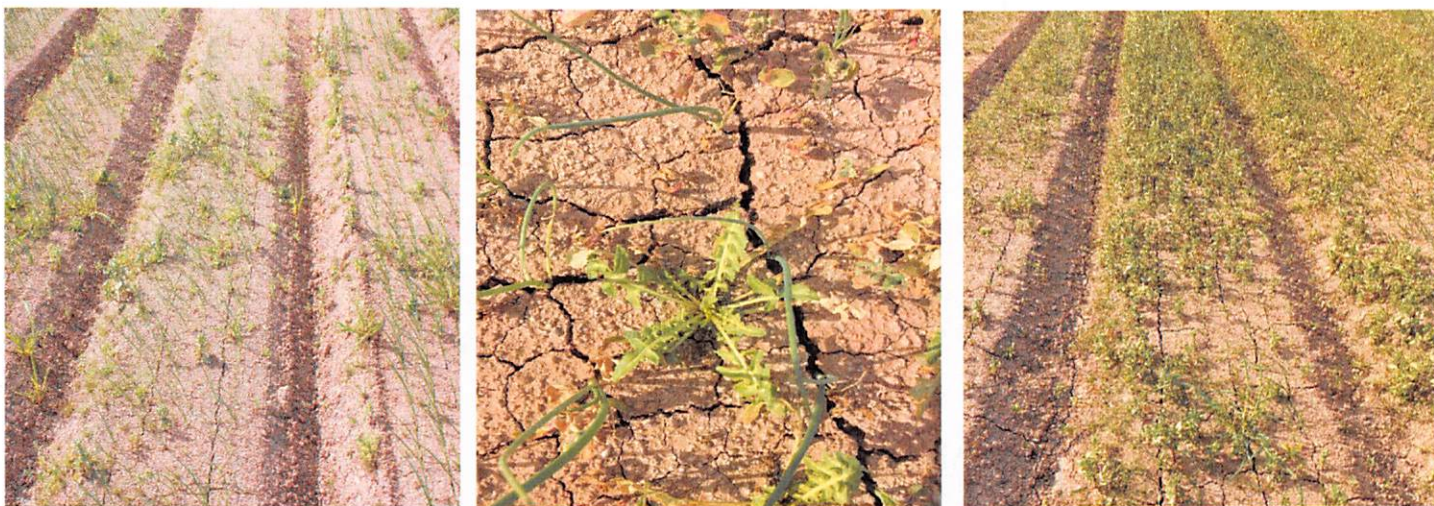


Picture 1: Greater swinecress infested onion fields early in the season (top) later in the season (bottom)



Picture 2: Little mallow infested onion field





Picture 3: Onion field infested with littleseed canarygrass (left); London rocket (middle); nettleleaf goosefoot (right).

**Weed Management challenges for Onion Production in Imperial Valley:** While early season weed control is very critical, follow-up maintenance weed control during the entire growing season is important for a successful onion production. If onion is kept free of weed interference for about 8-10 weeks after emergence, later emerging weeds would cause less problem. Therefore, implementation of weed management program from the early stage of onion growth is very important.

Even though weeds are the primary pest for onion yield loss, implementing effective weed management program is often challenging. Non-chemical weed control methods in general are costly, takes longer time for implementation, and are often less effective than chemical control. Weed control by cultivation in onion beds is not feasible because crop is planted at very high density; usually, 4 to 6 seed lines on 22 to 24 inches bed tops on a 40 inches beds. Hand weeding is also not practical because of very high planting density and can result in significant crop stand loss because of shallow root system. In Imperial Valley, organic growers have been practicing soil solarization technique as a tool for weed control. Soil solarization is effective on many weed species; however, there are certain weeds which are left uncontrolled by this technique. Further research is needed to optimize this technique for controlling some of the problematic weeds, such as little mallow (*Malva parviflora*), common purslane, nutsedge species etc.

Presently, herbicide application is the primary weed control method for onion production in the Imperial Valley. Weed control programs may consist of preemergence; early-postemergence (POST), mid-POST, late-POST; and layby herbicides for maintaining season-long weed control. Despite several applications, it is often challenging to maintain effective control of some tougher weeds from herbicides currently labeled for onion in California. For

example, effective control of greater swinecress is often not achieved because most of the herbicides registered for onion in California are less effective on this weed. Therefore, it is very important to evaluate newer herbicides (newer herbicide compound or products registered for onion production in other states) and if they have a good fit in California's low desert onion production system. Future research project is underway to evaluate newer herbicides under field condition. Findings will be shared as they become available.

For more information on weed control in onion, please visit the UC Statewide Integrated Pest Management Program from California Agriculture & Natural Resources at this link:  
<http://ipm.ucanr.edu/PMG/selectnewpest.onion-and-garlic.html>

## SALINITY ISSUE AND MANAGEMENT PRACTICES IN THE LOW DESERT REGION

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

### Irrigation water and soil salinity

Salt management is a critical component of agriculture in the low desert region. Successful crop production cannot be sustained without maintaining an acceptable level of dissolved salts in the crop root zone. Salts reduce the osmotic potential of water, increase the energy that plants use to extract moisture from soil, and make them more susceptible to wilting. In addition to contributing to the water stress, some constituents of salts such as sodium, chloride and boron, are toxic to plant if they accumulate in the leaves and stem. High sodium levels can also reduce water infiltration rate into soil. Soil irrigated with a high bicarbonate water may reduce availability of micronutrients such as iron, copper, manganese, and zinc. Salts can also affect irrigation equipment by plugging of drip line emitters or by corroding metal fittings.

Thresholds of salinity (irrigation water and soil) that cause yield loss for the major crops produced in the low desert region are listed in Table 1 and Table 2. These thresholds should be used as an estimate, since actual values could vary significantly depending on soil type, irrigation method, growth stage of the crop, and salt constituents. Crops often can tolerate higher levels of salinity if calcium, magnesium, sulfate, and/or bicarbonate represent a significant portion of salinity in the water. This is because calcium and magnesium tend to precipitate out of the soil solution as the soil dries. Plants can often tolerate higher salinity levels in climates with low evapotranspiration demands, such as near the coast, but not in the low desert region. Also, mature plants are usually more tolerant to salinity than seedlings.

Tissues where the most water loss occur will often show toxicity symptoms first. Many vegetables (short season crops), may not show toxicity symptoms to sodium and chloride while perennial crops may develop symptoms of

Table 1. Irrigation water salinity tolerances for different crops of the low desert region (dS/m)		
Crop	100% yield potential	90% yield potential
	EC water	EC water
Alfalfa	1.3	2.2
Wheat	4.0	4.9
Sudan grass	1.9	3.4
Bermuda grass	4.6	5.7
Sugar beet	4.7	5.8
Spinach	1.3	2.2
Onion	0.8	1.2
Lettuce	0.9	1.4
Carrot	0.7	1.1
Broccoli	1.9	2.6
Pepper	1.5	2.2
Cabbage	1.2	1.9
Cantaloupe	1.5	2.4
Sweet corn	1.1	1.7
Date palm	2.7	4.5
Avocado	0.9	1.2
Lemon	1.1	1.6
Grape	1.0	1.7
Adapted from FAO Irrigation and Drainage Paper 29 (1985)		

toxicity after several seasons. Chloride toxicity often appears in leaves as interveinal chlorosis (yellowing) and marginal burning as the toxicity becomes more severe. Leaf burning can also be caused from absorption of these ions through the leaves during sprinkler irrigations. We should try to avoid overhead sprinkling during periods of high evaporations, such as windy or hot conditions.

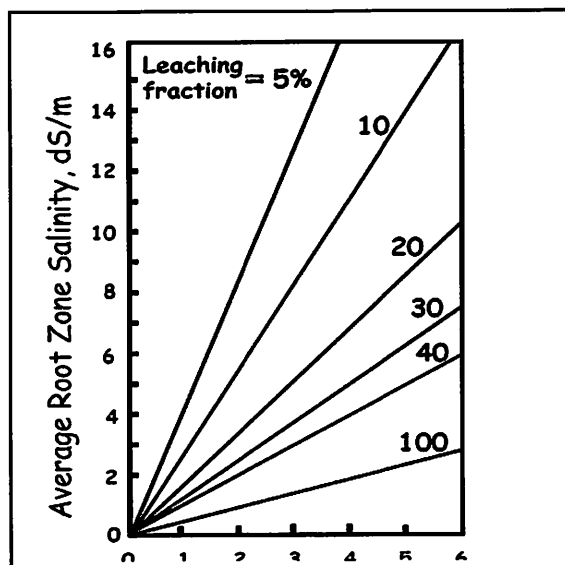
Due to the amount of salt in Colorado River water, four crops: onion, lettuce, carrot and avocado could be at risk for yield reduction if proper management practices are not adhered to. These crops can tolerate lower salinity levels thereby maximizing production.

Techniques for controlling salinity that require relatively minor changes are more frequent irrigations, selection of more salt-tolerant crops, additional leaching, pre-plant irrigation, bed forming and seed placement. Alternative techniques that may require significant changes in management are changing the irrigation method, altering water supply, land-leveling, modifying the soil profile, and installing subsurface drainage.

### Leaching for salinity management

Salts that accumulate in soils must be leached below the crop root zone to maintain soil productivity. Leaching is the basic management tool for controlling salinity. Water is applied more than the total amount used by the crop and what is lost through soil evaporation. The strategy is to keep the salts in solution and flush them below the root zone. The leaching fraction is the amount of extra irrigation water that must be applied above the amount required by the crop evapotranspiration in order to maintain an acceptable root zone salinity depending on the salinity of the soil and the water used for irrigation.

Table 2. Soil salinity tolerances levels for different crops of the low desert region (dS/m)		
Crop	100% yield potential	90% yield potential
	EC <sub>soil</sub>	EC <sub>soil</sub>
Alfalfa	2.0	3.4
Wheat	6.0	7.4
Sudan grass	2.8	5.1
Bermuda grass	6.9	8.5
Sugar beet	7.0	8.7
Spinach	2.0	3.3
Onion	1.2	1.8
Lettuce	1.3	2.1
Carrot	1.0	1.7
Broccoli	2.8	3.9
Pepper	1.5	2.2
Cabbage	2.2	3.6
Cantaloupe	2.2	3.6
Sweet corn	1.7	2.5
Date palm	4.0	6.8
Avocado	1.3	1.8
Lemon	1.7	2.3
Grape	1.5	2.5
Adapted from Ayers and Westcott (1976)		





To estimate the needed leaching fraction, first decide on what soil salinity level is acceptable. Then, find the EC (electrical conductivity, dS/m) of the water you are irrigating with (mainly Colorado River water with an average EC of 1.1 dS/m). The section where these two lines intersect (see Figure 1) is the percent of water over and above the crop requirements that must be applied to maintain the desired EC around the root zone. For example, Cantaloupe can tolerate a root zone salinity (EC) of 2.2 dS/m. Considering water quality of Colorado River, one will need to apply about 10% more water than the crop needs to keep from exceeding 2.2 dS/m in the root zone. For carrots, one of the most sensitive crop to salinity in the desert region, this number might raise up to 30-40%.

Excess water for salinity management in the low desert region can be always considered beneficial water use. A 3-inch annual rainfall of the region is insufficient to accomplish salinity management. To determine the amount of additional irrigation water to drain salt from the effective crop root zone more accurately, one needs to look at the soil characteristics, water distribution uniformity of irrigation system, and soil salinity tolerances levels for individual crops.

### **More frequent irrigations**

The timing of irrigations would help prevent water stress and improve the chances for success when using higher salinity water. The goal of irrigation timing is to reduce salinity and avoid water stress between irrigations. As water is extracted by the crop, salt concentrations of the soil increases. Typically, salt concentrations are lowest following irrigation and becomes higher just before the next irrigation. Increasing irrigation frequency maintains a more constant moisture content in the soil and keeps more of the salts in solution which aids the leaching process. Surge flow irrigation is often effective at reducing the minimum depth of irrigation that can be applied with furrow irrigation systems. Therefore, a larger number of irrigations are possible using the same amount of water. With proper placement, drip irrigation and subsurface drip irrigation is very effective at flushing salts with continuous water supply. New generation irrigations, such as lateral move and center pivots systems offer similar efficiencies as drip irrigations in salinity control. For fields where driplines are laid-out at a deeper depth, the salt accumulated above driplines need to be leached using either flood or sprinkler irrigation runs.

Increasing the frequency of irrigations may not always produce the desired salinity control. For example, with furrow and other conventional flood irrigation methods, a change to more frequent irrigation may result in unacceptable increase in depth of applied water, a corresponding decrease in water use efficiency and consequent drainage problems. These irrigation methods are generally less efficient because the depth of water applied per irrigation cannot be as easily adjusted as with sprinkler or drip irrigations.



## **Pre-plant irrigation**

Salts often accumulate near the soil surface during fallow periods, particularly when water tables are high. Under these conditions, seed germination and seedling growth can be seriously reduced unless the soil is leached before planting. Pre-plant irrigation is highly recommended in the low desert region as a salinity management strategy.

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For more information on salinity management, please visit the link below:

<http://ucanr.edu/sites/Salinity/>

More information can also be found in Fipps, Guy, Irrigation water quality standards and salinity management strategies. Texas A&M AgriLife Extension Service.

<http://soiltesting.tamu.edu/publications/B-1667.pdf>

## Evaluation of Water Management Techniques and Fertilizer Rates in Onion Production in California's Low Desert Region.

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<sup>1</sup>UC ANR Desert Research and Extension Center; <sup>2</sup>UC Davis, Department of Land, Air and Water Resources; <sup>3</sup>UC Davis, Department of Biological and Ag Engineering.

The main goal of this project was to evaluate different water management techniques and fertilizer rates in onion production. The methods we used and the preliminary results for the 2016-2017 trial season are provided in this newsletter.

### Methods

<b>Trial Location:</b>	Desert Research and Extension Center, Holtville, CA.
<b>Soil Type:</b>	Holtville silty clay.
<b>Variety:</b>	Taipan – early short-day light brown skinned.
<b>Plot size:</b>	Drip: four, 40 inch rows by 70 ft. Furrow: four, 40 inch rows by 225 ft.
<b>Number of Onion Rows:</b>	Four per bed.
<b>Irrigation:</b>	Sprinklers for germination and establishment, gated pipe furrow and drip irrigation for the subsequent irrigations.
<b>First Irrigation:</b>	November 3, 2016.
<b>Pre-plant Fertilizer:</b>	300 lbs/ac of 11-52-0 and 20 gal/ac of 10-34-0.
<b>Study plot Design:</b>	Split plot design with irrigation treatments as the main plots and 3 fertilization rates at the subplot level. Each treatment was replicated three times.
<b>Irrigation Treatments:</b>	<ul style="list-style-type: none"><li>• Three irrigation levels were established in drip treatments: 70, 100, and 130% of crop evapotranspiration (ETc). Drip tape: 0.36 gph, 6 in spacing, and installed at 5 in depth.</li><li>• The surface irrigation treatment was evaluated using one irrigation level (100% ETc), three equal irrigation intervals per event, and three equally spaced ponds along the furrow length with no tail runoff. Slope of the furrow was 0.14%.</li><li>• Irrigations were delivered from the week of January 16 to the week of April 10, 2017.</li><li>• Daily ETc was estimated by using reference ET from the CIMIS weather station at DREC (Meloland # 87) and onion crop coefficients.</li></ul>
<b>Fertilizer Treatments:</b>	<ul style="list-style-type: none"><li>• Three fertilizer treatments were assessed for the drip trials: pre-plant plus 150 lbs N per acre (N1); pre-plant plus 200 lbs N per acre (N2); and pre-plant plus 250 lbs per acre (N3).</li><li>• In the surface irrigation treatment, only one fertilizer rate (pre-plant plus 200 lbs N per acre) was tested.</li><li>• Fertilizer application was from the week of January 23 to the week of March 6, 2017.</li></ul>
<b>Harvesting:</b>	April 27, 2017.
<b>Statistical Analysis:</b>	Analysis of variance was performed with SAS. Duncan test at 5% level was used to find any significant difference between treatment means.

### Results and Discussion

In the first year of this study (November 2016 to May 2017), yield differences were not statistically different between drip irrigation and fertilizer treatments (Table 1 and 2). Overall, the furrow irrigation

treatment with 200 lbs N per acre, three surges and zero tail runoff produced the highest yield (Table 1 and 2). The maximum onion productivity ratio (water use efficiency – WUE) was obtained in the drip irrigation treatment at 70% ETc (0.57 lb of onions / ft<sup>3</sup> of water) followed closely by the furrow trial and drip irrigation treatment at 100% ETc . WUE was significantly lower in the drip irrigation treatment at 130% ETc (Table 2).

Table 1. Averaged onion yields by nitrogen treatment

Treatment	Yield (50 Lb Sack/acre)
<b>N1-150</b>	1,284
<b>N2-200</b>	1,277
<b>N3-250</b>	1,304

Table 2. Water Use Efficiency - WUE by irrigation treatment

Treatment	Total Water Applied (ft)	Averaged Yield (50 Lb Sack/acre)	Water Use Efficiency - WUE (lb/ft <sup>3</sup> )	Relative Yield (%)
<b>D70</b>	2.4	1,194	0.57	87
<b>D100</b>	2.9	1,347	0.54	100
<b>D130</b>	3.4	1,330	0.45	97
<b>F100</b>	3.3	1,583	0.55	116

Soil moisture values were close to field capacity levels at 6- and 12-in depths (Table 3). Average soil water tension data were in the range of optimal plant growth (Table 4).

Table 3. Average volumetric water content (ft<sup>3</sup>/ft<sup>3</sup>) by irrigation treatment (replicate #3)

Depth (in)	D70	D100	D130	F100
<b>6</b>	0.31	0.39	0.34	0.34
<b>12</b>	0.32	0.33	0.33	0.33
<b>24</b>	0.28	0.26	0.29	0.26

Table 4. Average soil water tension (cb) by irrigation treatment (replicate #3)

Depth (in)	D70	D100	D130	F100
<b>6</b>	7.29	8.86	2.94	10.34
<b>12</b>	8.53	5.80	1.96	7.95
<b>24</b>	5.70	6.72	3.66	8.51

Onion size distributions (prepack, medium, jumbo, and colossal) were not statistically different ( $P > 0.05$ ) among drip and fertilizer treatments (Figure 1 and 2). Jumbo and colossal onion size distributions were higher in the surge irrigation trial than the other treatments (Figure 2).



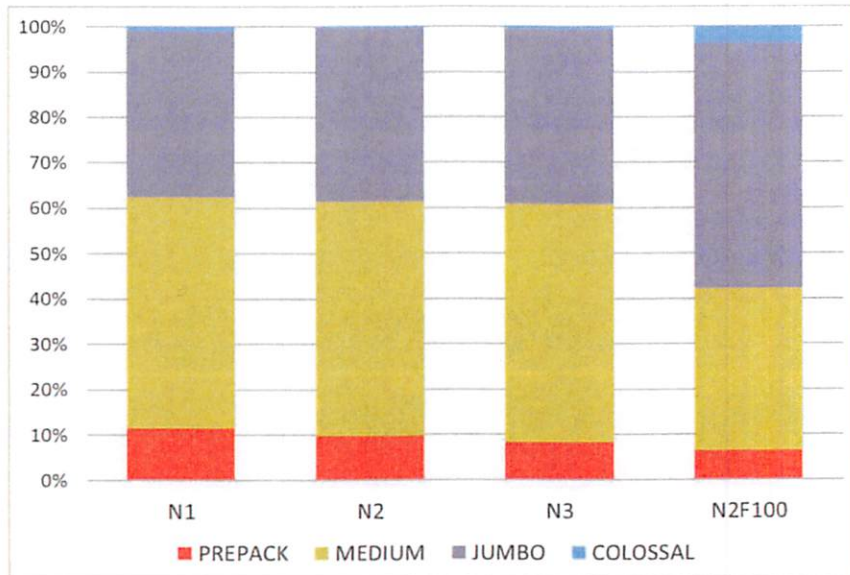


Figure 1. Averaged onion size distribution by nitrogen rate

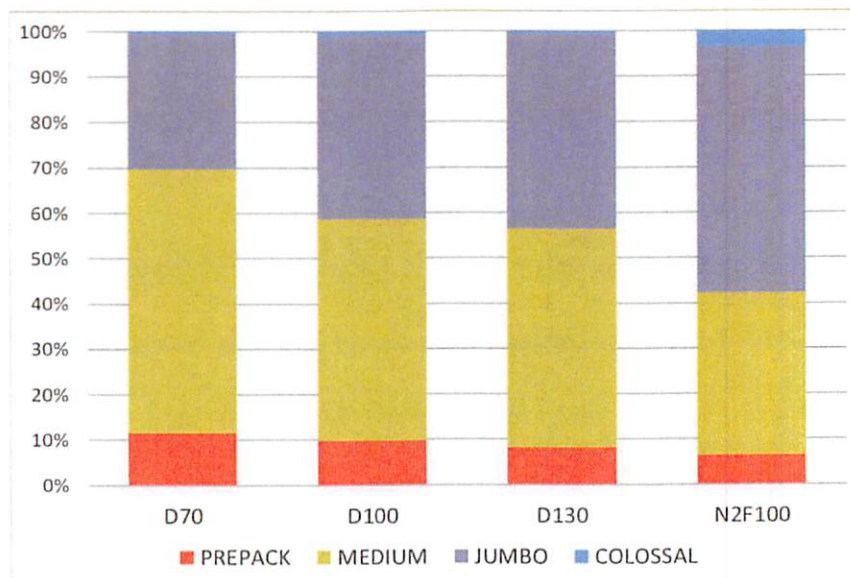


Figure 2. Averaged onion size distribution by irrigation treatment

Most measured onion quality parameters were not statistically different between all drip and fertilizer treatments (Table 5), except for firmness and moisture under different drip treatments. Onions from furrow treatment were larger and heavier than those yielded from the drip and nitrogen treatments.

Table 5. Onion quality results by nitrogen and irrigation treatment (average values from 5 random onion samples)

Treatment	Weight (g)	Diameter 1 (mm)	Diameter 2 (mm)	Firmness (Kg)	Mold (0-10)	Quality (0-10)	Moisture	Brix
<b>N1</b>	256.4 a	82.6 a	82.5 a	10.1 a	0 a	8 a	90.94 a	9.97 a
<b>N2</b>	266.7 a	82.3 a	84.5 a	10.2 a	0 a	8 a	90.48 a	10.01 a
<b>N3</b>	274.8 a	82.6 a	85.8 a	10.4 a	0 a	8 a	91.16 a	9.98 a
<b>D70</b>	253.6 a	80.7 a	83.0 a	9.8 b	0 a	8 a	91.31 a	9.98 a
<b>D100</b>	286.7 a	84.6 a	86.7 a	10.3 ab	0 a	8 a	90.71 b	9.22 a
<b>D130</b>	257.6 a	82.1 a	83.1 a	10.6 a	0 a	8 a	90.57 b	10.13 a
<b>ALL DRIP</b>	266.0 b	82.5 a	84.3 b	10.2 a	0 a	8 a	90.86 a	10.0 a
<b>N2F100</b>	307.3 a	85.7 a	89.3 a	10.5 a	0 a	8 a	89.97 b	9.9 a

Within columns, means followed by the same letter are not significantly different according to Duncan (0.05)

### Conclusions and Future Work

No significant differences were observed between drip irrigation and nitrogen treatments. The drip irrigation treatment set at 70% crop evapotranspiration (ET<sub>c</sub>) showed the highest water use efficiency (0.57 lb of onions / ft<sup>3</sup> of water) followed closely by the furrow trial and drip irrigation treatment at 100% ET<sub>c</sub>. The furrow irrigation treatment with 200 lbs N per acre, three surges, three equally spaced ponds along the furrow length, and zero tail runoff produced the highest yield (1,583 50-lb Sack/acre).

We are conducting a second-year trial in the 2017-2018 growing season. We also plan to:

- monitor N crop uptake;
- assess soil, water, and plant diagnostic tools at the plant and plot level through the growing season;
- add a 40% ET<sub>c</sub> treatment with drip irrigation;
- evaluate the traditional furrow irrigation;
- and test an 80-in bed with 12 onion rows and 3 drip lines.

### Acknowledgments

We thank the UC ANR Desert REC staff, local growers, and contract labor for their expertise and support.

### Contact Information

For more information on onion irrigation and nutrient management, please contact Jairo Diaz, at 760-791-0521 or [jdiazr@ucanr.edu](mailto:jdiazr@ucanr.edu).



## **MANEJO DEL RIEGO Y NITRÓGENO EN CEBOLLA EN EL DESIERTO DE CALIFORNIA**

Jairo Díaz<sup>1</sup>, Roberto Soto<sup>1</sup>, Daniel Geisseler<sup>2</sup>, Gail Bornhorst<sup>3</sup>, e Irwin Donis-Gonzalez<sup>3</sup>

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<sup>2</sup>UC Davis, Department of Land, Air and Water Resources

<sup>3</sup>UC Davis, Department of Biological and Ag Engineering

### **OBJETIVO**

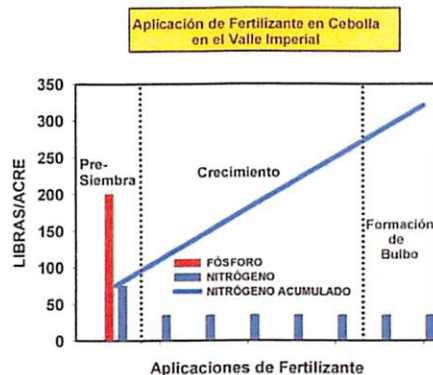
El objetivo principal de este proyecto es presentar herramientas para un mejor manejo del riego y la fertilización de cebolla en zonas desérticas de California. En este boletín se presentan a continuación, los métodos y resultados preliminares del ciclo 2016-2017.

### **MANEJO AGRONÓMICO DE CEBOLLA DE BOLA**

- ❖ **Germinación.** La cebolla de bola en el Valle Imperial se germina con riego por aspersión y luego se riega con agua rodada o riego por goteo.
- ❖ **Periodo de cultivo:** Octubre – Mayo.
- ❖ **Variedades:**
  - **Amarillas:** Teresa , Madelyn , Gabriella, Sweet Sunrise, Amadora, Taipan.
  - **Rojas:** Matahari, Red Duke.
- ❖ **Método de Siembra:**
  - Camas de 40 pulgadas: 4 a 6 líneas de cebollas (separadas entre 2.5 a 4.5 pulgadas).
  - Camas de 80 pulgadas: 12 líneas de cebollas (separadas entre 2.5 a 4.5 pulgadas).
- ❖ **Método de riego por gravedad:** Riego rodado en cada surco sin escorrentía (procurar que el agua moje bien las camas).
- ❖ **Método de riego por goteo.**
  - Camas de 40 pulgadas: Una línea de goteo en el centro de la cama a 2 pulgadas de profundidad.
  - Camas de 80 pulgadas: Tres líneas de goteo a 2 pulgadas de profundidad.
- ❖ **Cantidad de agua a aplicar.** La cebolla requiere entre 2.5 a 3.5 ft de agua.
- ❖ **Cantidad de Fertilizante a aplicar.** La cebolla requiere aproximadamente entre 150 a 250 lb de nitrógeno por acre.
- ❖ **Curado.** Una vez cosechada, se cura en el campo por una semana en costales de 50 lb.

### **MANEJO DEL FERTILIZANTE.**

- ❖ **Presiembra:** Es importante el realizar análisis de la cantidad de nutrientes del suelo (N-P-K) para que existan buenas disponibilidades de nutrientes para el cultivo (aproximadamente el equivalente a 75 libras de nitrógeno y 200 libras de fósforo por acre). Estos nutrientes se agregan al suelo aplicando los fertilizantes: Fosfato monoamónico (**11-52-0**) y solución de Polifosfato Amónico (**10-34-0**).
- ❖ **Crecimiento y Desarrollo del Cultivo.** Se aplica solamente nitrógeno. A partir de enero y por un período de siete semanas aproximadamente (crecimiento a formación de bulbo). Se aplican de 150 a 250 libras de nitrógeno por acre. El fertilizante más utilizado es la solución de Urea-Nitrato de Amonio (**UAN 32**).



### PROGRAMACIÓN DEL RIEGO

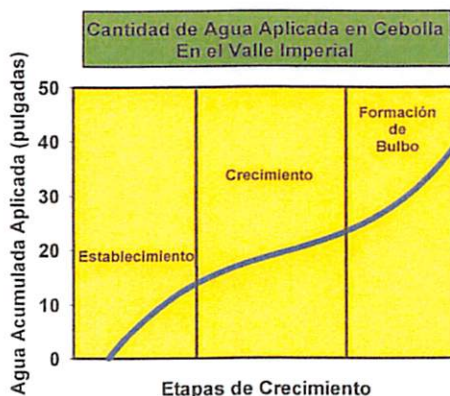
Es importante que conozca los requerimientos generales de agua del cultivo, clima, suelos y sistemas de riego.

- ❖ Para cebollas en el Valle Imperial se requieren entre 2.5 a 3.5 ft de agua.
- ❖ Por etapas: la cebolla requiere cerca de 1 ft para germinación y establecimiento (alrededor de 2 meses) y entre 1.5 a 2.5 ft para crecimiento, formación de bulbo (alrededor de 4 meses).

**Cuando regar:**

- ❖ Germinación: El primer riego por aspersión y con una duración de 24 horas. Posteriormente aplicar riegos diarios hasta germinación (aproximadamente de 20 a 25 días).
- ❖ Establecimiento: Aplicar riegos por aspersión cada tercer día con una duración de 3 a 4 horas (aproximadamente durante 40 a 50 días).
- ❖ Crecimiento y formación de bulbo: Riego semanal para riego en surco y dos veces por semana para riego por goteo.

**Lleve la contabilidad (Registro) de los riegos!!!**



### MEDICIÓN DE HUMEDAD DEL SUELO

Es importante que conozca en todo momento el contenido de humedad de su suelo. Para esto, existen diferentes dispositivos tales como:

- ❖ **Tensiómetros.** De fácil manejo e instalación. Miden la tensión del agua del suelo, generalmente expresada en centibares (cb). Con una adecuada calibración, los tensiómetros nos proporcionan una medida indirecta de la cantidad de humedad aprovechable para el cultivo en el suelo. **Para cebollas, se recomienda regar cuando la tensión de humedad del suelo se encuentra entre 10 y 20 centibares (cb).**



- ❖ **Sensores de Humedad.** Existen diferentes marcas en el mercado, miden la humedad volumétrica del suelo. Tienen la ventaja de realizar mediciones permanentes que pueden ser almacenadas en un registrador de datos (*data logger*). *En general, no dejar que baje la humedad aprovechable en el suelo, más del 50%.*

Para hacer una mejor interpretación de la lectura de los sensores. No olvide la importancia de conocer la textura de su suelo.

## RESULTADOS DE INVESTIGACIÓN

A continuación, se muestran resultados obtenidos en el primer año de evaluación (Noviembre 2016 a Mayo 2017). En la evaluación de riego por goteo se establecieron tres niveles de riego: 70, 100, y 130% de la evapotranspiración del cultivo (ET<sub>c</sub>) y tres dosis de fertilización nitrogenada: presiembra más 150 libras de nitrógeno por acre; presiembra más 200 libras de nitrógeno por acre; y presiembra más 250 libras de nitrógeno por acre. Se evaluó también un área de riego superficial (surcos), con las siguientes características: se utilizó el nivel de 100% de la evapotranspiración del cultivo (100% ET<sub>c</sub>), se aplicó el riego mediante tres pulsos de agua, dividiendo la longitud del surco en tres secciones iguales y eliminando la escorrentía al final del surco. Además, se aplicó únicamente la dosis de presiembra más 200 libras de nitrógeno por acre. El calendario de riegos fue del 16 de Enero al 10 de Abril de 2017 y el de aplicación de fertilizantes del 23 de Enero al 6 de Marzo de 2017.

La cantidad de agua aplicada por cada tratamiento se muestra en la siguiente tabla:

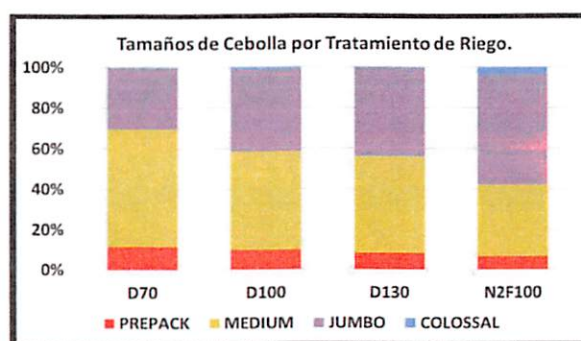
**Agua Aplicada (ft)**  
 70% ET<sub>c</sub> = 2.4  
 100 ET<sub>c</sub> = 2.9  
 130 ET<sub>c</sub> = 3.4  
 SURCO = 3.3

El tratamiento de riego en surcos y fertilizado con 200 libras de nitrógeno por acre, produjo el rendimiento más alto (36 ton/acre), superando al tratamiento de goteo con 200 libras de nitrógeno por acre (29 ton/acre). En relación a los tratamientos de fertilizante nitrogenado en riego por goteo, estos rindieron de manera similar (29 a 30 toneladas por acre), al igual que los diferentes tratamientos de riego (27 a 31 toneladas por acre). A pesar de las diferencias numéricas en rendimiento, desde el punto de vista estadístico todos los valores resultaron iguales.

	Rendimiento (ton/acre)	Rendimiento (saco de 50 lb/acre)
150 lb N/acre	29	1,284
200 lb N/acre	29	1,277
250 lb N/acre	30	1,304
70% ET <sub>c</sub>	27	1,194
100% ET <sub>c</sub>	31	1,347
130% ET <sub>c</sub>	30	1,330
PROMEDIO GOTEO	29	1,290
SURCO	36	1,583



Al igual que con el rendimiento, la distribución de la cebolla en tamaños (prepack, medium, jumbo, y colossal) no fueron estadísticamente diferentes entre los tratamientos de goteo y de fertilizantes. La distribución de tamaños jumbo y colossal fueron mayores en el riego en surcos que en los tratamientos de riego por goteo.



A continuación se muestra un esquema que resume los factores necesarios para obtener altos rendimientos y calidad de cebolla, desde el punto de vista del riego y la fertilización.



## AGRADECIMIENTOS

Agradecemos al personal de UC ANR Desert REC, productores locales, y mano de obra local, por sus conocimientos, habilidades y apoyo.

## INFORMACIÓN DE CONTACTO

Para mayor información en el manejo del riego y fertilizantes en cebolla, comuníquese con:

Jairo Díaz al teléfono: 760-791-0521 o al correo electrónico: [jdiazr@ucanr.edu](mailto:jdiazr@ucanr.edu).

## IMPERIAL VALLEY CIMIS REPORT AND UC WATER MANAGEMENT RESOURCES

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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.cimis.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/>.

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