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Commercial yield response of iceberg lettuce (*Lactuca sativa* L. var *capitata*) to water irrigation at a cool semi-arid climate of Maipo Valley. Santiago. Chile

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Introduction

- Lettuce is the most popular vegetable with the highest rate of consumption and economic relevance in the world (Coelho et al.. 2005).
- Cropped in approximately 7000 ha = 9% of vegetables cultivated in Chile Metropolitan Region of Santiago (RM) has nearly 3250 ha of lettuce.
- Basic factors affecting lettuce commercial yield: temperature. relative humidity and soil humidity (Van Bruggen et al.1990).
- Climate change in Chile limits water availability (Cifuentes and Meza. 2008).
- An adequate amount of water applied is highly related to growth and yield:
  It increases in response to the level of water applied (Sanchez.. 2000).

- Extremely sensitive to water deficit: yield detriment
- Sensitive to excess of water: Increase of diseases (Yazgan et al.. 2008).

Objetive

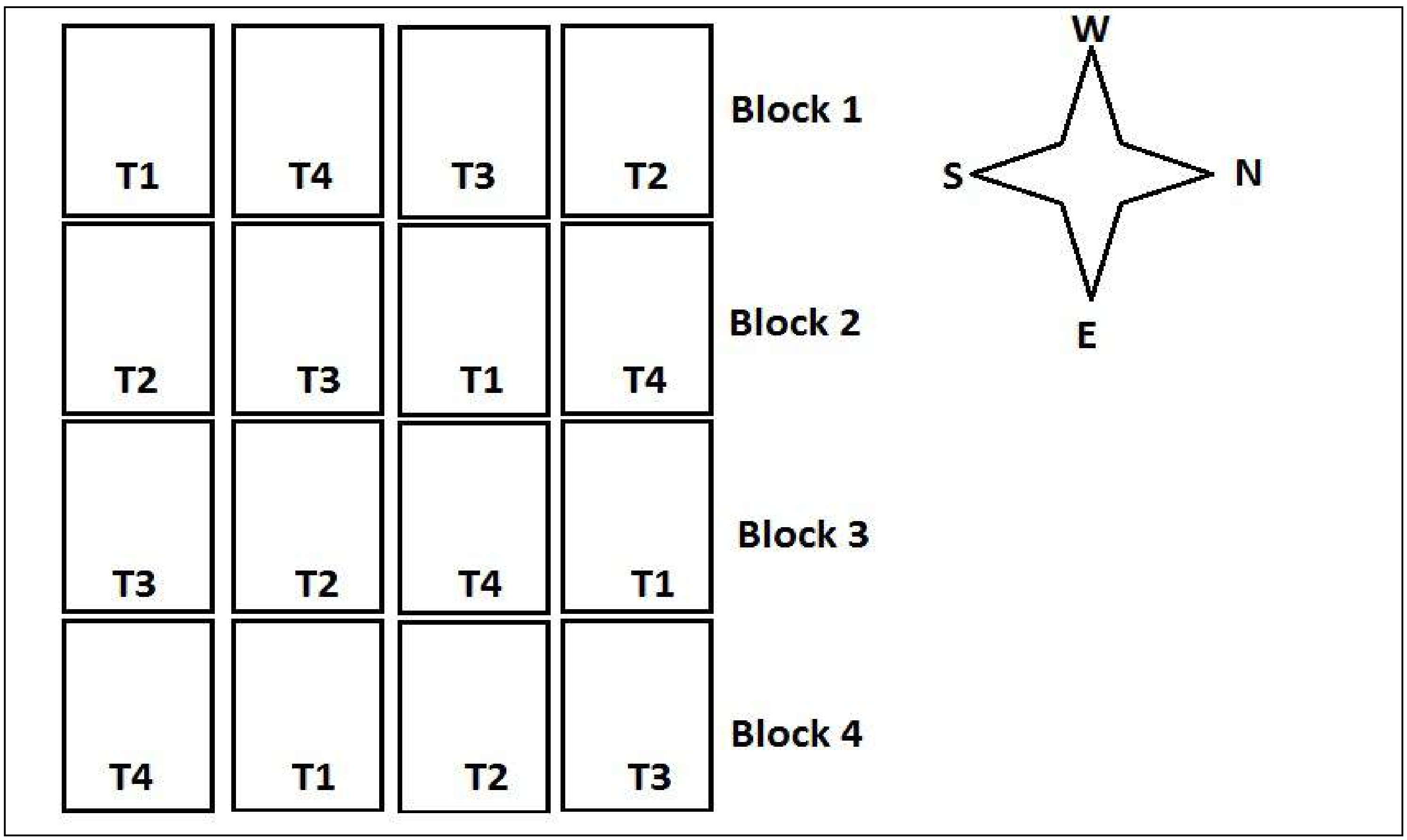
- To unveil the effect of irrigation water applied to the yield and quality of iceberg lettuce cropped at Santiago, Región Metropolitana,Chile.

Materials and Method

- Lettuce var capitata (Iceberg type):
- First season:
  - Transplanted: December 14th 2016
  - Harvested: February 10 2017
- Second season:
  - Transplanted: March 26th 2018
  - Harvested: July 16th 2018
- Transplanted on wide beds (100 cm) with three rows per bed and two polyethylene lines in the bed

- Polyethylene 16 mm diameter pipe
- Self compensated anti-drain drippers (PCJ-LCNL drippers. Netafim. Israel; working pressure: 0.7-4.0 Bar; shut off pressure: 0.12 Bar) spaced at 0.2 m between drippers.
- Irrigation treatments (dripper PCJ-LCNL. Netafim):
  - T1:40% ETc replenishment (1.2 L/h)
  - T2: 67% ETc replenishment (2.0 L/h)
  - T3: 100% ETc replenishment (3.0 L/h)
  - T4: 130% ETc replenishment (4.0 L/h)
- Same amount of time per watering event.

Completely randomized design with experimental units
(10 m length × 1.4 m wide)
4 treatments × 4 repetitions
Lateral and border rows considered.



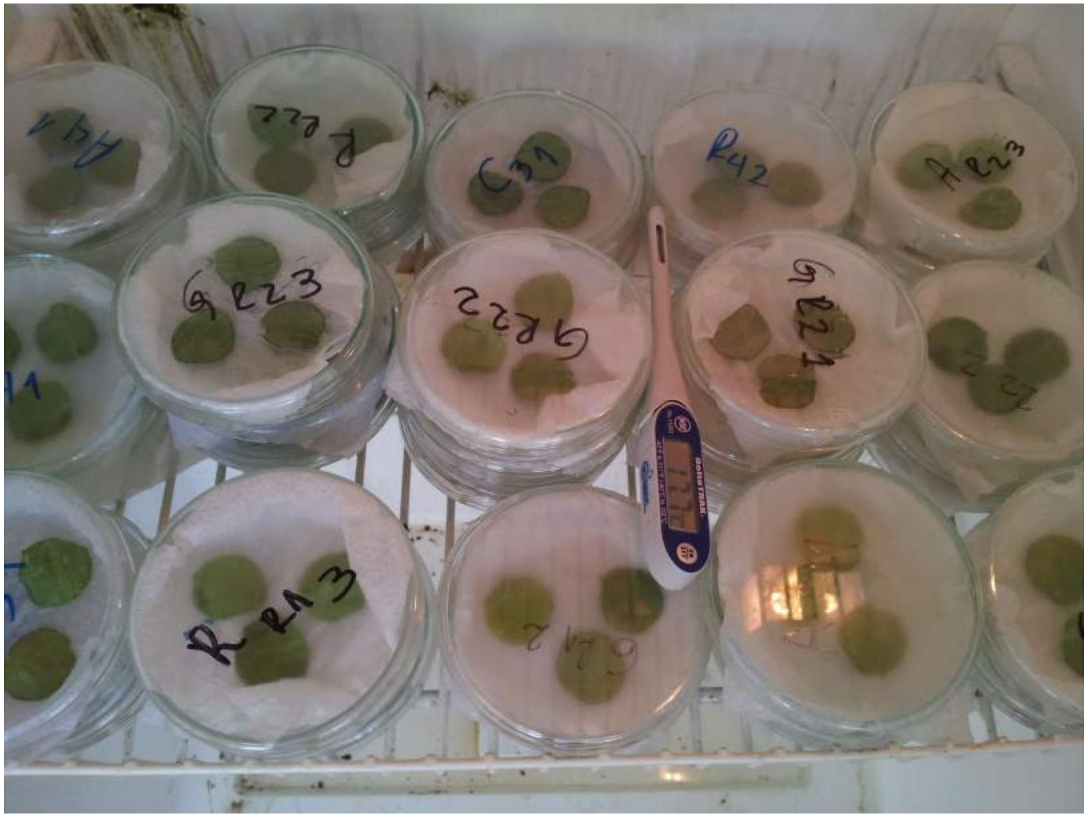
- ***Water balance***
  - ***Irrigation water*** (mm). multiplying the flow rate of the specific dripper of the treatment by the time of each irrigation event.
  - ***Precipitation*** (mm). recorded by a nearby weather station.
  - ***Crop evapotranspiration*** (mm). multiplying the reference crop evapotranspiration (ETo) recorded by the weather station by the crop coefficient (Kc ini 0.7: Kc mid 0.9; Kc end 1.0) for Cucumis melo (Allen. et al.. 2006).
  - ***Runoff*** was not considered since no runoff was expected on drip irrigation
  - **Deep percolation** was calculated as the difference between the components of the water balance.

Main Parameters

- ***Fresh and dry mass:*** Sampling of 3 plants per treatment and repetition along the growth season.
- ***Head's diameter:*** after harvest
- ***Stomatal conductance and relative water content:*** twice a week at noon
- ***Commercial yield:*** Discarding lettuce heads under 500 g
- ***Commercial yield function:*** A function of irrigation water applied versus commercial yield was obtained. considering only commercial categories.

Bulk and clean Lettuce Mass

Stomatal conductance and RWC



Results and Discussion

Irrigation water applied

Irrigation Treatment	Water applied (mm)	
	Season 2016/2017	Season 2018
T1 (40%)	76.9	80.6
T2 (67%)	128.1	134.4
T3 (100%)	192.2	201.6
T4 (130%)	256.3	268.8

Lettuce's heart

Average lettuce head mass

Treatment	Fresh head mass (g)	
	Season 2016/2017	Season 2018
T1 (40%)	332.22 a ±22.7	435.68 a ±21.4
T2 (67%)	764.24 b ±22.8	440.53 a ±21.5
T3 (100%)	688.79 b ±24.5	432.88 a ±21.9
T4 (130%)	698.51 b ±25.2	427.84 a ±22.1

Only during 2016/2017 T1 < T2. T3 and T4

Similar results reportes in the literature by Acharya et al. (2013) and Karam et al. (2002).

Tarqui et al. (2017) found no differences onf fresh mass between 75% and 100% ET_c but affected by 50%.

Lettuces were affected when cropped with 25% of FC (Tsabedze and Wahome 2010).

Average lettuce head diameter

Treatment	Head diameter (mm)	
	Season 2016/2017	**Season 2018**
T1 (40%)	64.54 a ±1.62	134.8 a ±2.4
T2 (67%)	89.46 b ±1.63	131.4 a ±2.5
T3 (100%)	89.41 b ±1.75	137.2 a ±2.5
T4 (130%)	91.81 b ±1.80	133 a ±2.5

Only during 2016/2017 T1 < T2,T3 and T4

Stomatal conductance and RWC

Treatment	gs ($mmol\ CO_2\ m^{-2}\ s^{-1}$)	RWC (%)
T1 40%	84,73 a ±8,98	87,54 a ±0,90
T2 67%	109,34 a ±8,96	92,35 b ±0,92
T3 100%	123,54 b ±8,93	92,46 b ±0,91
T4 130%	121,53 b ±8,81	91,79 b ±0,93

Water stressed plants showed an affected gs.

RWC was significantly different on T1,

Lettuce comercial yield

Treatment	Commercial yield units/ha	
	Season 2016/2017	Season 2018
T1 40%	9 415	56 220
T2 67%	73 513	71 875
T3 100%	60 459	56 250
T4 130%	53 457	62 500

Only during 2016/2017 T1 < T2,T3 and T4

Treatment 40%

No Commercial underweight units. Deformities. Soft hearts.

Treatment 67%

Improves commercial units and firmness of the heart.

Fungal diseases must be under control.

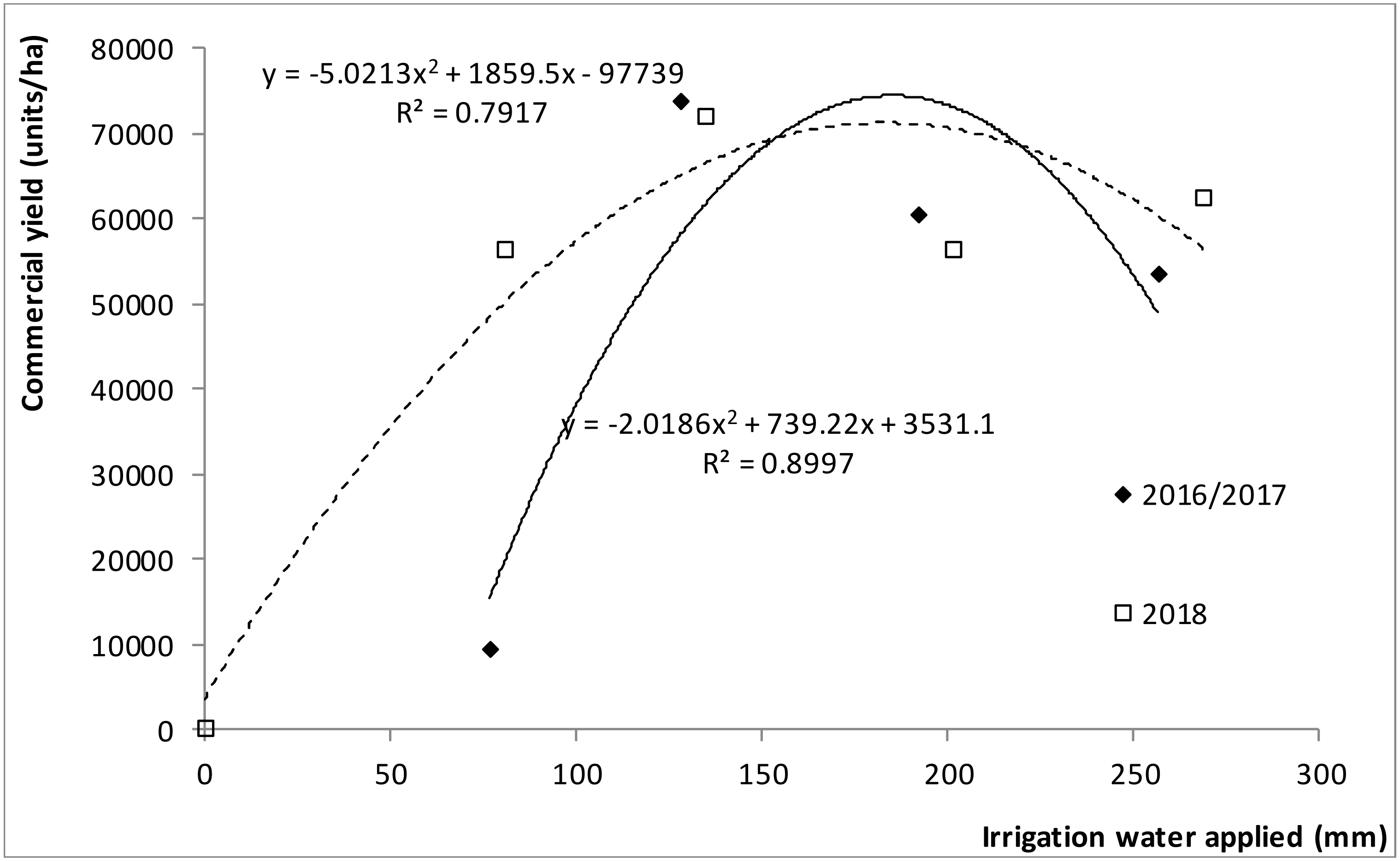
Treatment 100%

Maximum commercial yield

Tratamiento 130%

Commercial yield is reduced. Oidium.Heart softness.

Commercial yield production function



Maximum Yield: 183 to 185 mm = 1840 m^3/ha

Conclusions

- Water stress in lettuce => low yield related with low fresh mass and low diameter of the head.
- Excess of water triggered commercial yield detriment liked with fungal diseases.
- Water replenishment is related to heart softness and fungal diseases.
- The highest number of commercial units were produced with water irrigation depth close to 184 mm per season.

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Thank you…

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MARIE CURIE ACTIONS

RISK-UNCERTAINTY-COLLABORATION