

# ASSESSING NITROGEN MANAGEMENT AND IRRIGATION SYSTEMS OF FRESH ONIONS PRODUCED IN CALIFORNIA LOW DESERT

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## 1. INTRODUCTION AND GOAL

California has diverse agroecosystems throughout the state including low desert irrigated areas in Imperial County. California is the largest onion producer in the nation with a farm gate value of almost \$340 million [1]. Imperial county yields 42% of total onion production in CA [1]. Growers in the Imperial Valley are adopting more efficient irrigation systems (sprinkler and drip) and scientific-based irrigation scheduling methods (soil moisture, weather-based techniques) motivated by themselves and through the Imperial Irrigation District On-Farm Efficiency Conservation Program [2].

The main goal of this project was to evaluate the effects of water management techniques and nitrogen fertilization rates on yield and quality of fresh bulb onion production in arid regions.

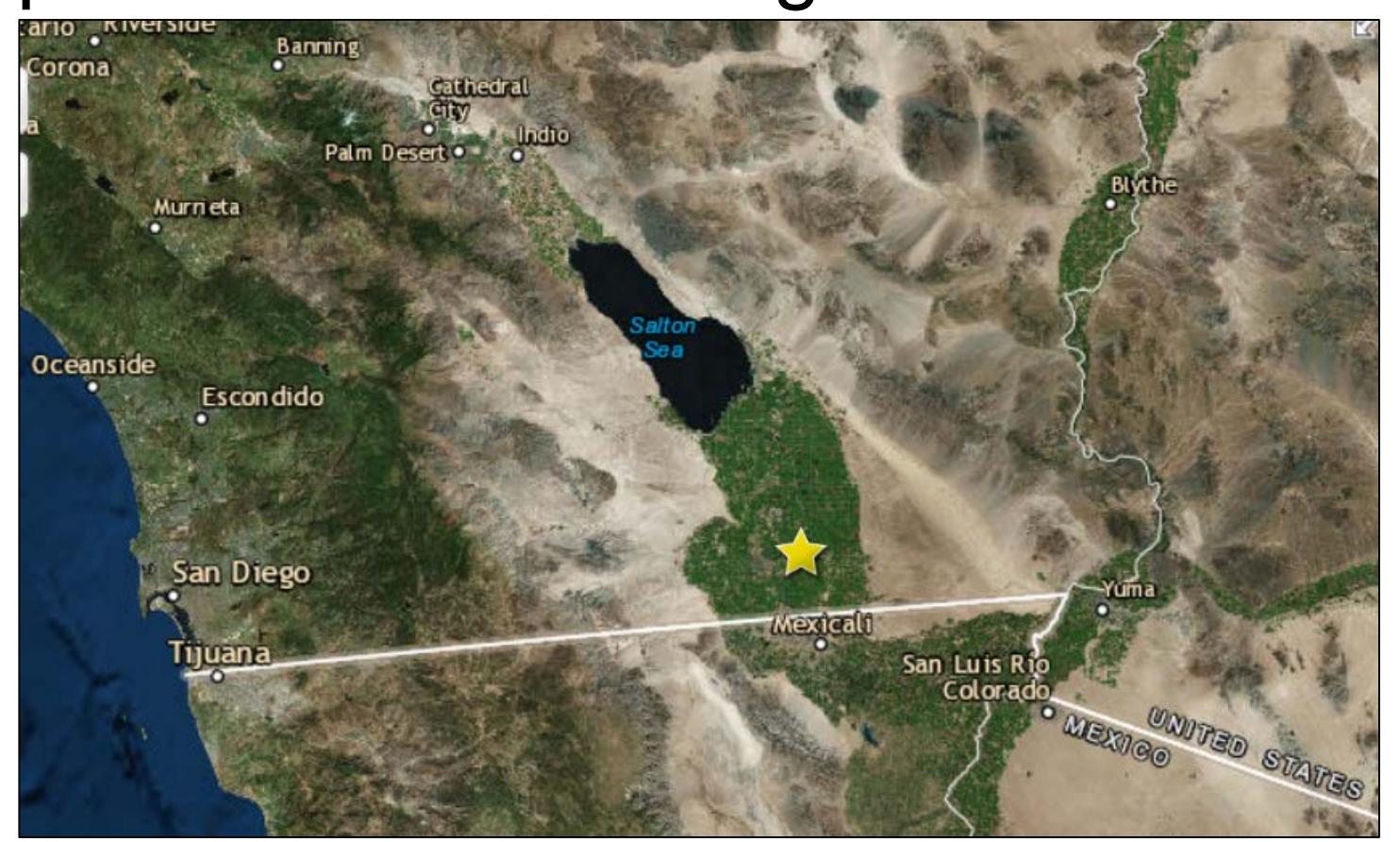


Figure 1. Location of study area (★)

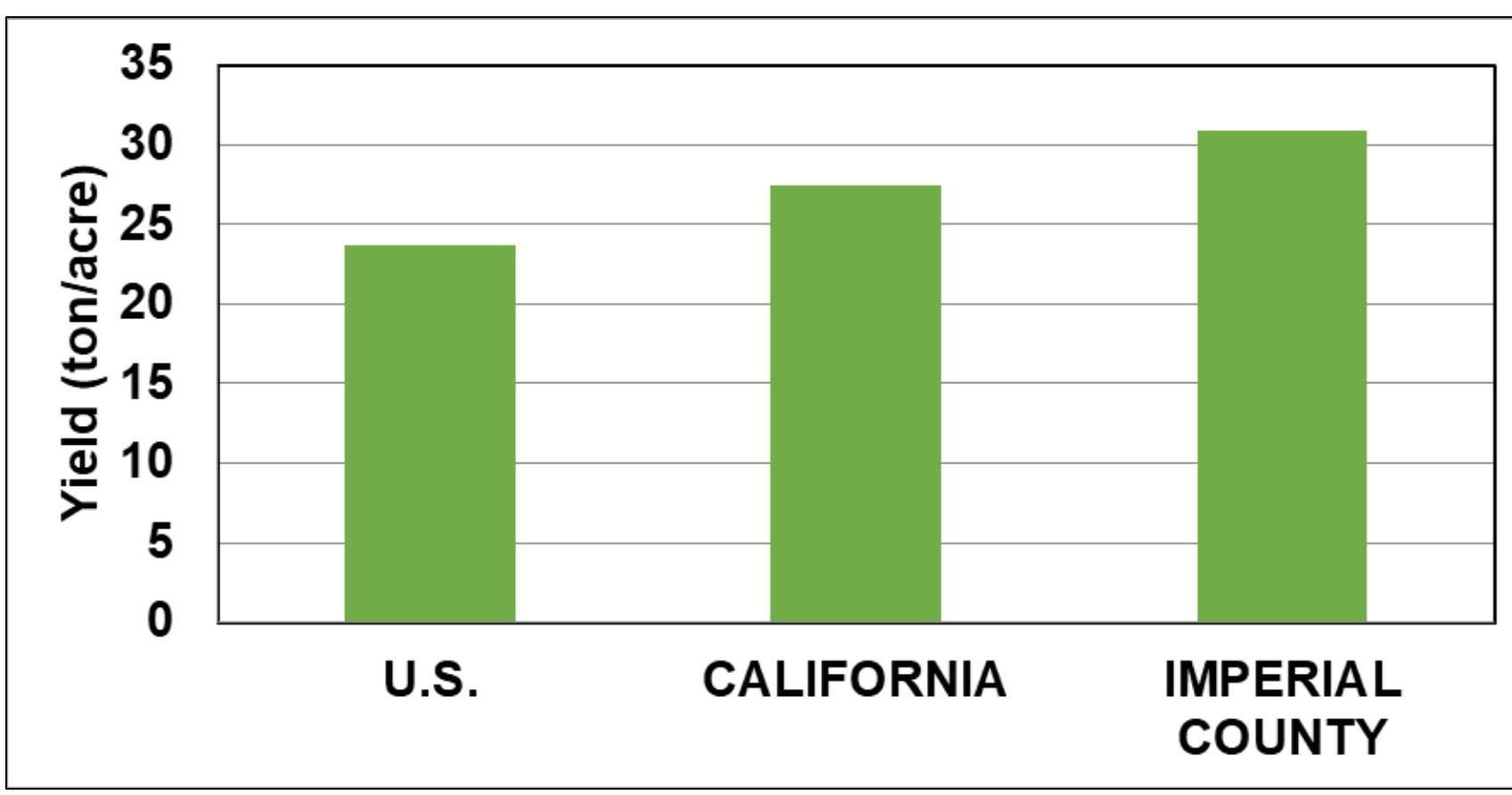


Figure 2. Comparison of fresh-market bulb onion yields [1,3]

## 2. 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 Rows:</b>	Four onion rows per bed.
<b>Irrigation:</b>	Sprinklers for germination and establishment, gated pipe furrow and drip irrigation 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 Design:</b>	Split plot design with irrigation treatments in the main plots and 3 fertilization rates at the subplot level. Three replications.
<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).</li> <li>The surface irrigation treatment was evaluated using one irrigation level (100% ETc), three equally spaced ponds along the furrow length, and no tail runoff. Furrow slope was 0.14%.</li> <li>Irrigations from week of January 16 to 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 in the drip trials: pre-plant plus 150 lbs N per acre; pre-plant plus 200 lbs N per acre; and pre-plant plus 250 lbs per acre.</li> <li>In the surface irrigation treatment, one fertilizer rate (pre-plant plus 200 lbs N per acre) was tested.</li> <li>Fertilizer program from week of January 23 to 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.



## 3. RESULTS AND DISCUSSION

Table 1. Water use efficiency - WUE by irrigation treatment

Treatment	Water Applied (ft)	Yield (ton/acre)	WUE (lb/ft <sup>3</sup> )	Relative WUE	Water Use (%)	Relative Yield (%)
D70	2.4	27	0.57	1.05	83	87
D100	2.9	31	0.54	1.00	100	100
D130	3.4	30	0.45	0.83	117	97
F100	3.3	36	0.55	1.02	114	116

Table 2. Onion yields by nitrogen treatment

Treatment	Yield (ton/acre)
N1-150	29
N2-200	29
N3-250	30

Table 3. Average volumetric water content (ft<sup>3</sup>/ft<sup>3</sup>) by irrigation treatment in replicate #3 with N2-200 application

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

Table 4. Average soil water tension (cb) by irrigation treatment in replicate #3 with N2-200 application

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

Figure 3. Average nitrate values from suction lysimeters in top foot in replicate #3 with N2-200 application

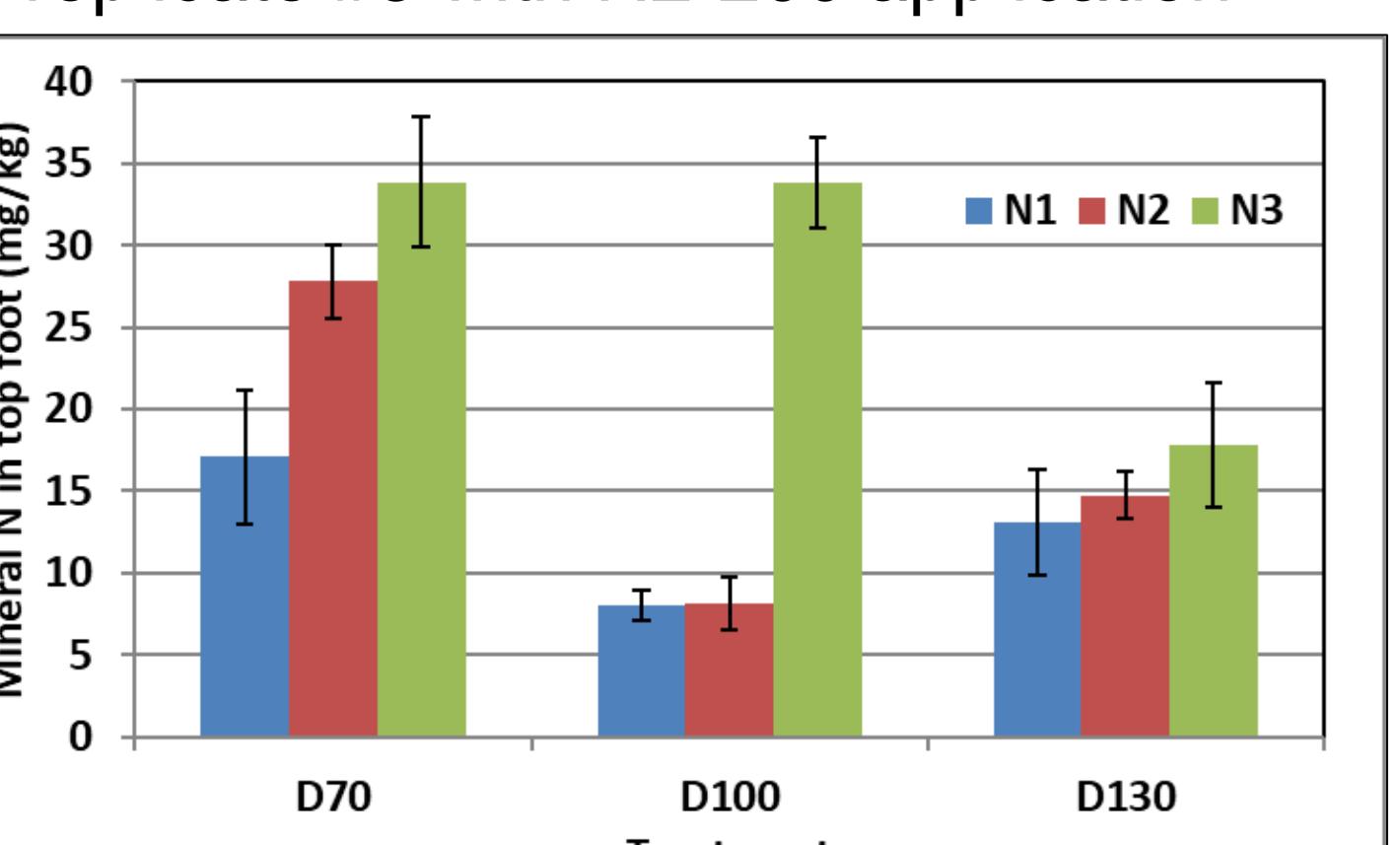


Figure 4. Mineral N in top foot, March 14, 2017

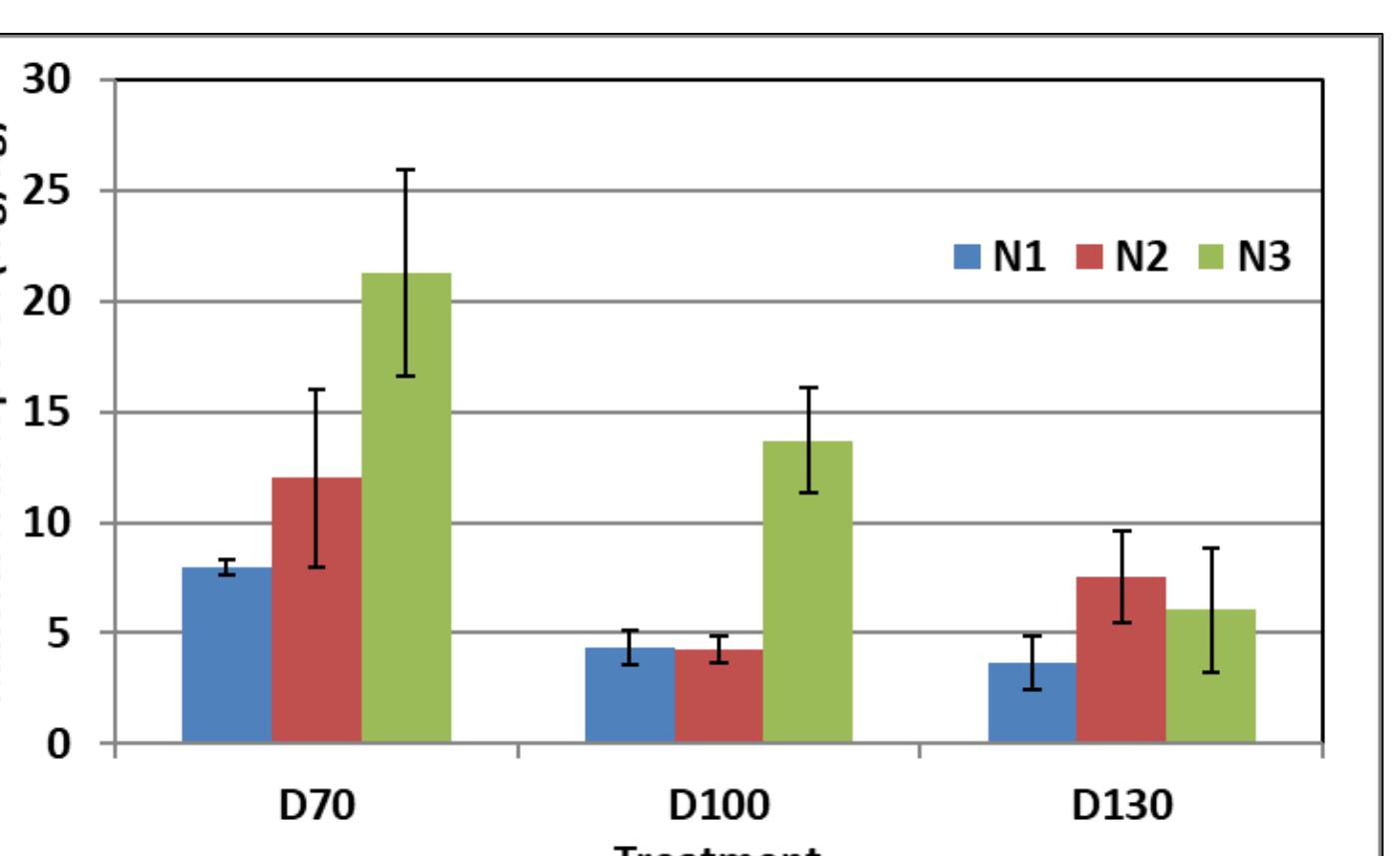


Figure 5. Mineral N in top foot, May 1, 2017 (post harvest)

Table 5. Onion quality results by nitrogen and irrigation treatment

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

## 4. CONCLUSIONS AND FUTURE RESEARCH

Overall, 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 in the first year of the study.

We are scheduling to conduct a second-year trial in the 2017-2018 growing season. In addition, we are planning 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% ETc treatment with drip irrigation; evaluate a traditional furrow irrigation; and test 80-in bed with 12 onion rows and 3 drip lines.

- In the first year of this study (November 2016 to May 2017), yield differences were not statistically different between drip irrigation (27 to 31 ton/acre) and fertilizer (29 to 30 ton/acre) treatments.
- The total applied water in the drip irrigation treatments ranged from 2.4 ft (in the 70% ETc trial) to 3.4 ft (in the 130% ETc trial).
- Applied water in the surge irrigation trial (3.3 ft) was similar (at the 0.05 probability level) to the drip treatment with 130% ETc.
- Yields in the surface irrigation treatment (36 ton/acre) were significantly higher ( $P < 0.05$ ) than the yields recorded in the drip treatment with 130% ETc and 200 lbs N per acre (30 ton/acre).
- Water use efficiency - WUE was affected by irrigation treatment. The lowest WUE was achieved under the drip irrigation treatment at 130% ETc.
- Soil moisture values were close to field capacity levels at 6- and 12-in depths. Average soil water tension data were in the range of optimal plant growth.
- Water quality samples from ceramic cup suction lysimeters in replicate #3 with N2-200 application showed similar pH (7.80 - 7.91) and conductivity (3.24 - 4.09 mS/cm) values in the top foot.
- Nitrate in the soil solution and water applied were negatively correlated.
- Mineral nitrogen values were high throughout the season. Total mineral N in the top foot at midseason varied between irrigation treatments and ranged from 7 to 37 mg/kg.
- Onion size distributions (prepack, medium, jumbo, and colossal) were not statistically different ( $P < 0.05$ ) among drip and fertilizer treatments.
- Jumbo and colossal onion size distributions were higher in the surge irrigation trial than the other treatments.
- Measured onion quality parameters were not statistically different between drip and fertilizer treatments.

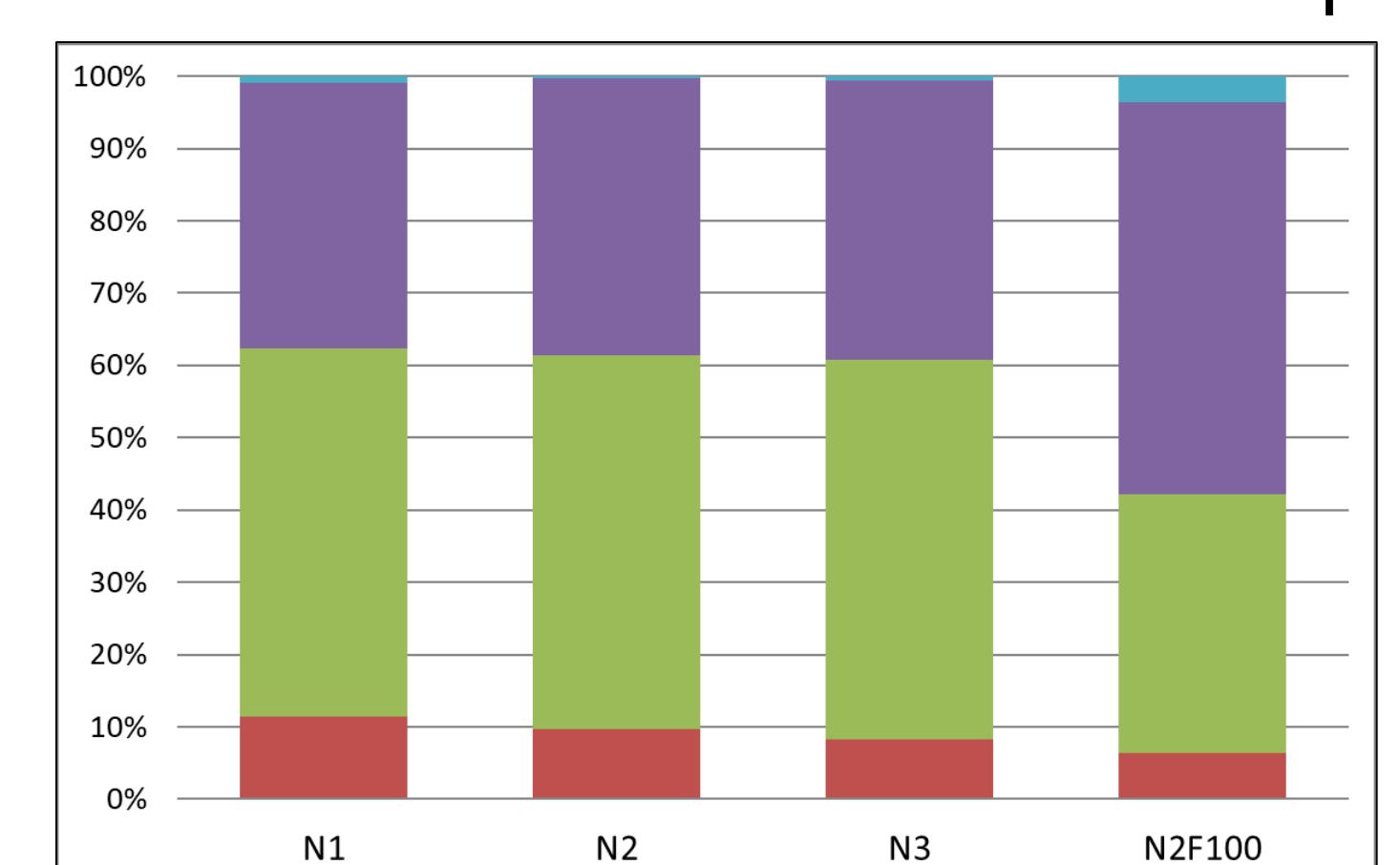


Figure 6. Onion size distribution by nitrogen rate

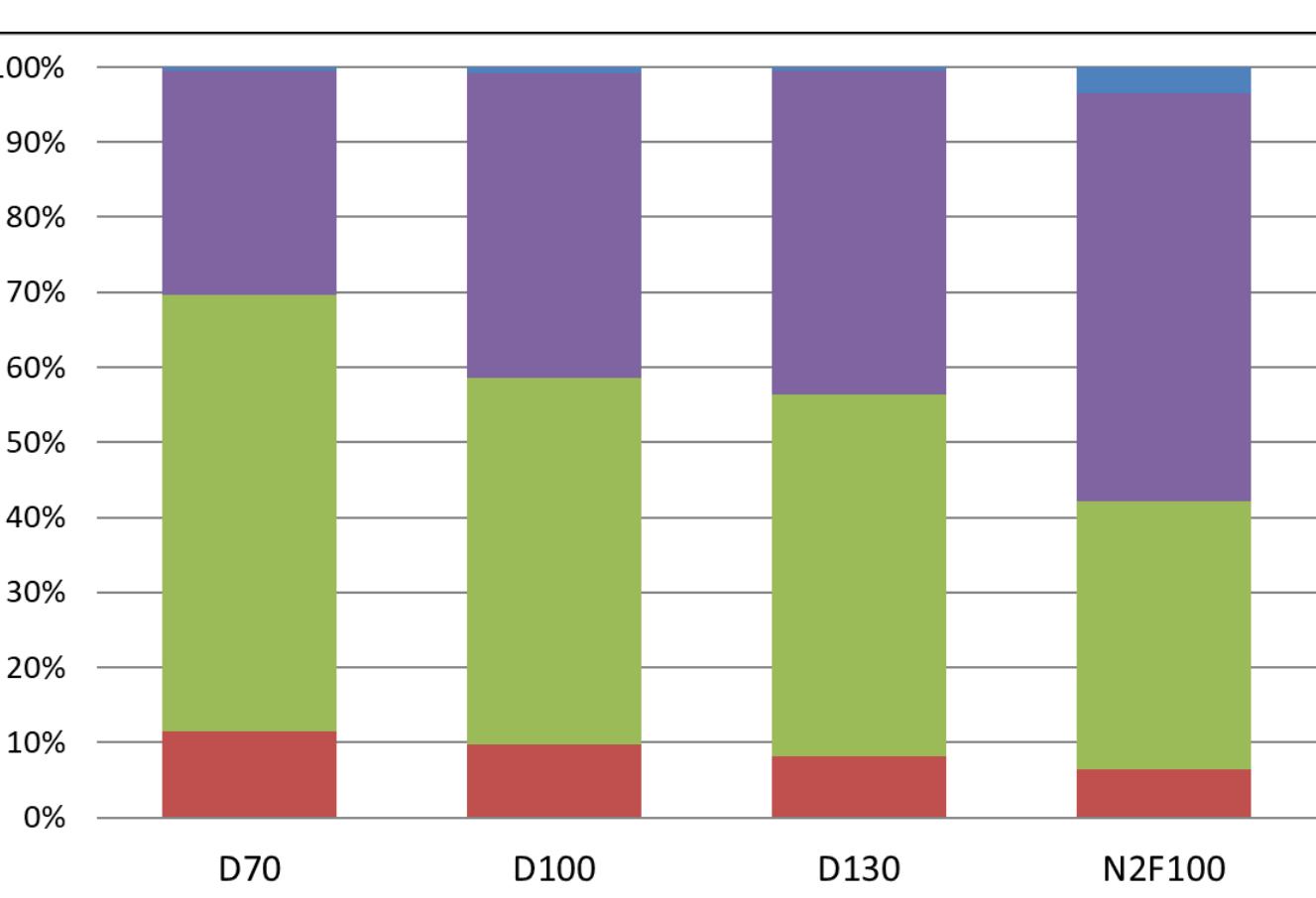


Figure 7. Onion size distribution by irrigation treatment

## 5. REFERENCES

- California County Agricultural Commissioners' Reports Crop Year 2014-2015. 2016. California Department of Food and Agriculture.
- Imperial Irrigation District - IID. 2015. On-Farm Efficiency Conservation Program.
- United States Department of Agriculture. National Agricultural Statistics Service.

## 6. ACKNOWLEDGMENTS

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