RESPONSE OF EIGHT ONION VARIETIES TO FOUR PLANT POPULATIONS

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Introduction

New onion varieties and changing market opportunities for smaller size onion bulbs necessitate evaluations of yield and bulb size response to plant population. These evaluations can aid growers in making planting rate decisions. The objective of this trial was to evaluate the response of eight onion varieties to four plant populations.

Methods

In 2010, onions were grown on a Greenleaf silt loam previously planted to wheat. In the fall of 2009 the wheat stubble was shredded and the field was irrigated and disked. A soil sample taken in the fall of 2009 showed: pH 7.9, organic matter 1.8 percent, 40 ppm phosphorus (P), 416 ppm potassium (K), 17 ppm sulfate (SO_4), 2,310 ppm calcium (Ca), 608 ppm magnesium (Mg), 60 ppm sodium (Na), 2.3 ppm zinc (Zn), 1.7 ppm copper (Cu), 6 ppm manganses (Mn), 11 ppm iron (Fe), and 0.9 ppm boron (B). The soil analysis indicated the need for 100 lb phosphate (P_2O_5)/acre, 24 lb sulfur (S)/acre, 2 lb Mn/acre, 4 lb Zn/acre, and 1 lb B/acre. These nutrients were broadcast in the fall of 2009 after disking. The field was then moldboard-plowed, groundhogged, roller-harrowed, and bedded at 22 inches. The field was not fumigated due to a shortage of product.

On March 16, seed of eight varieties (Table 1) was planted in double rows spaced 3 inches apart at 17 seeds/ft of single row. Each double row was planted on beds spaced 22 inches apart. Planting was done with customized John Deere Flexi Planter units equipped with disc openers. Immediately after planting, the onions received a narrow band of Lorsban 15G® at 3.7 oz/1,000 ft of row (0.82 lb ai/acre), and the soil surface was rolled. Zeba® was applied at 5 lb/acre on April 5 for prevention of soil crusting. Onion emergence started on April 15. On May 20, alleys 4 ft wide were cut between plots, leaving plots 23 ft long.

Table 1. Onion varieties submitted to four plant populations.

	Variety	Company
1	Centerstone	A. Takii
2	Calibra	Bejo
3	Crockett	Bejo
4	Legend	Bejo
5	Gunnison	Bejo
6	Esteem	Crookham
7	Granero	Nunhems
8	Belmar	Seminis

The experimental design was a randomized complete block with varieties as the main plots and four plant populations as split plots. Each variety plot had 4 double rows 23 ft long. Each population split plot was 4 double rows wide by 5.75 ft long. From June 7 to June 9, the seedlings were hand thinned to the four populations (Table 2). Thinning was delayed by late approval of the project followed by unfavourable weather.

Table 2. Onion plant populations and plant spacing.

Plant population	Spacing in single row
plants/acre	inches
120,000	4.75
160,000	3.56
200,000	2.85
240,000	2.38

The onions were managed to minimize yield reductions from weeds, pests, diseases, water stress, and nutrient deficiencies. Weeds were controlled with an application of Roundup® at 1 lb ai/acre on April 9 prior to onion emergence. On April 19, Prowl H_2O® at 0.95 lb ai/acre was applied for weed control. On May 14, Goal® at 0.16 lb ai/acre, Buctril® at 0.19 lb ai/acre, and Volunteer® at 0.25 lb ai/acre were applied for weed control. On July 1, Prowl H_2O at 1 pt/acre was applied.

On May 25 and June 14, Movento® at 5 oz/acre was applied for thrips control. Volunteer at 0.13 lb ai/acre was applied for weed control on May 25. The field received three aerial applications of Lannate® at 0.9 lb ai/acre for thrips control on July 12, July 26, and August 23. On July 22, grass weeds were spot sprayed with a backpack sprayer containing a 1.5 percent v/v solution of Poast®.

The field was sidedressed with 100 lb N/acre and cultivated on May 26. On July 7, 100 lb N/acre were water-run as uran. A root tissue sample taken July 22 showed a slight deficiency of potassium and magnesium. Corrective measures were not taken.

The trial was furrow irrigated when the soil water tension at 8-inch depth reached 25 cb (1 cb = 1 kPa) (Shock et al. 2005). Starting in mid-June, soil water tension was monitored by six granular matrix sensors (GMS, Watermark Soil Moisture Sensors Model 200SS, Irrometer Co. Inc., Riverside, CA) centered at 8-inch depth below the onion row. The sensors were automatically read three times a day with an AM-400 meter (Mike Hansen Co., East Wenatchee, WA). The last irrigation was on August 26.

The onions were lifted on September 10 to field cure. Onions from the center 5 ft of the middle 2 rows in each split plot were topped by hand and bagged on September 17. Onions were graded on September 23.

During grading, bulbs from each split plot were counted and separated according to quality: bulbs without blemishes (No. 1s), split bulbs (No. 2s), neck rot (bulbs infected with the fungus *Botrytis allii* in the neck or side), plate rot (bulbs infected with the fungus *Fusarium oxysporum*), and black mold (bulbs infected with the fungus *Aspergillus niger*). The No. 1 bulbs were further graded according to diameter: small (<2.25 inches), medium (2.25-3 inches), jumbo (3-4 inches), colossal (4 – 4.25 inches), and supercolossal (>4.25 inches). Bulb counts per 50 lb of supercolossal onions were determined for each plot of every variety by weighing and counting all supercolossal bulbs during grading. Marketable yield consists of No.1 bulbs larger than 2.25 inches.

Treatment differences were compared using analysis of variance. Means separation was determined using Fisher's least significant difference test at the 5 percent probability level, LSD (0.05). Regressions between actual plant population and onion yield were run for each variety.

Results

Based on bulb counts during grading, the differences in actual plant populations were according to the experimental plan, but all populations were below the targets (Table 3). Actual populations ranged on average from 100,000 to 168,000 plants per acre. Averaged over varieties, marketable yield increased with increasing plant population up to the highest tested (Table 3). Averaged over varieties, jumbo bulb yields only showed a decrease when population increased from 133,000 to 168,000 plants per acre. Averaged over varieties, both medium and small sized bulb yields were more responsive to plant population; increasing with increasing plant population (Table 3, Figs. 1a and 1b).

For varieties Calibra, Crocket, Legend, Esteem, and Gunnison, marketable yield was not responsive to plant population, but jumbo bulb yields decreased with increasing plant population (Figs. 3-6, 9). For varieties Granero and Belmar, jumbo yields were not responsive to plant population, but marketable yield increased with increasing plant population (Figs. 7 and 8). For variety Centerstone, jumbo and marketable yields were not responsive to plant population (Figure 2).

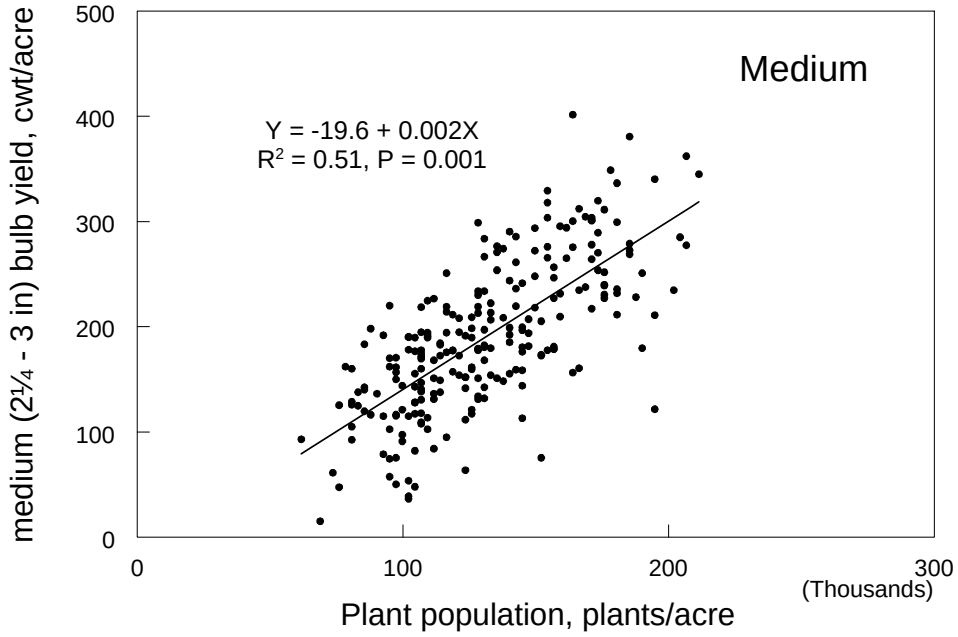
References

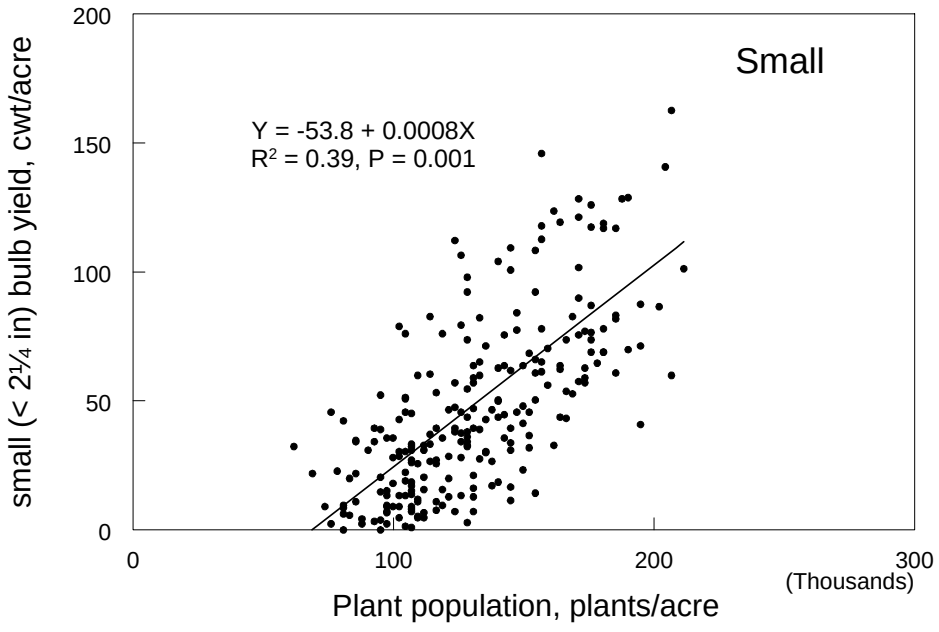
Shock, C.C., R. Flock, E. Feibert, C.A. Shock, A. Pereira, and L. Jensen. 2005. Irrigation monitoring using soil water tension. Oregon State University Extension Service EM 8900.

Table 3. Onion yield in response to plant population for eight varieties. Malheur Experiment Station, Oregon State University, Ontario, OR, 2010.

	Plant population			Marketable yield by grade						
Variety	Target	Actual	Total	Total	4-4¼ in	3-4 in	2¼-3 in	No. 2	Small	Rot
	plants/acre		---------- cwt/acre ----------							%
Centerstone	120,000	98,010	356.5	287.1	0.0	99.7	187.5	0.0	27.7	11.1
	160,000	134,244	410.9	321.7	0.0	61.3	260.4	0.0	65.9	5.3
	200,000	149,094	426.8	325.3	0.0	76.2	249.1	0.0	72.6	7.0
	240,000	185,328	464.4	317.0	0.0	54.3	262.7	0.0	111.0	7.4
	average	141,669	414.7	312.8	0.0	72.9	239.9	0.0	69.3	7.7
Calibra	120,000	106,029	412.4	329.1	0.0	181.3	147.8	0.0	24.2	15.1
	160,000	115,830	428.7	337.0	0.0	183.7	153.3	0.8	26.8	14.7
	200,000	135,135	465.3	376.7	0.0	200.7	176.0	0.0	48.2	8.5
	240,000	164,835	495.3	364.7	0.0	129.8	234.9	0.0	77.8	10.5
	average	130,457	450.4	351.9	0.0	173.9	178.0	0.2	44.3	12.2
Crockett	120,000	105,435	445.3	408.1	0.0	231.8	176.3	0.0	19.7	3.8
	160,000	136,917	519.9	432.2	0.0	206.0	226.2	0.0	66.1	4.4
	200,000	144,639	504.5	409.1	0.0	155.1	254.0	0.0	84.3	2.4
	240,000	180,279	539.1	432.7	0.0	124.8	307.9	0.0	96.2	2.1
	average	141,818	502.2	420.5	0.0	179.4	241.1	0.0	66.6	3.2
Legend	120,000	100,683	473.6	427.5	0.0	306.8	120.7	2.0	10.0	7.3
	160,000	124,146	509.8	445.0	0.0	273.4	171.6	0.0	30.1	6.8
	200,000	133,650	529.0	451.9	0.0	242.4	209.5	0.0	34.8	8.0
	240,000	160,083	563.2	485.7	0.0	203.9	281.9	0.0	48.6	5.0
	average	129,641	518.9	452.5	0.0	256.6	195.9	0.5	30.9	6.8
Esteem	120,000	99,198	377.0	316.4	0.0	152.2	164.1	0.0	34.2	7.1
	160,000	126,225	405.3	326.6	0.0	110.8	215.8	0.0	49.8	7.2
	200,000	129,492	422.6	326.2	0.0	123.9	202.3	0.0	56.3	9.7
	240,000	161,568	463.1	360.6	17.4	109.4	233.8	0.0	78.8	5.3
	average	129,121	417.0	332.4	4.4	124.1	204.0	0.0	54.8	7.3
Granero	120,000	100,320	575.0	528.1	7.8	446.5	73.8	0.0	10.6	6.3
	160,000	128,040	638.4	582.6	2.2	457.8	122.7	0.0	23.4	5.5
	200,000	128,832	645.1	587.1	11.7	441.7	133.7	0.0	24.8	5.4
	240,000	170,016	742.6	661.4	0.0	461.5	199.8	0.0	50.6	4.2
	average	131,802	650.3	589.8	5.4	451.9	132.5	0.0	27.3	5.3
Belmar	120,000	103,526	487.8	420.6	0.0	290.1	130.5	0.0	20.0	9.8
	160,000	128,983	554.7	480.3	0.0	306.9	173.4	0.0	42.6	5.8
	200,000	139,845	556.3	491.5	0.0	263.7	227.8	0.0	40.1	4.4
	240,000	183,971	631.8	537.9	0.0	252.3	285.6	0.0	72.6	3.3
	average	139,081	557.6	482.6	0.0	278.2	204.3	0.0	43.8	5.8
Gunnison	120,000	84,051	286.1	219.7	0.0	66.6	153.1	0.0	39.9	9.1
	160,000	105,732	297.5	209.6	0.0	62.9	146.7	0.0	52.9	12.0
	200,000	110,484	333.8	236.5	0.0	75.1	161.3	0.0	64.5	9.8
	240,000	147,609	339.6	200.8	0.0	19.8	181.0	0.0	107.2	9.8
	average	111,969	314.3	216.7	0.0	56.1	160.5	0.0	66.1	10.2
Average	120,000	99,713	432.8	374.2	1.2	232.6	140.4	0.3	22.8	8.5
	160,000	124,384	476.0	398.3	0.3	220.1	177.8	0.1	43.0	7.9
	200,000	132,700	490.8	407.1	1.8	208.4	197.0	0.0	51.7	6.9
	240,000	167,904	536.1	429.0	2.3	180.6	246.1	0.0	77.9	5.9
	average	131,175	483.9	402.2	1.4	210.4	190.3	0.1	48.8	7.3
LSD (0.05)										
Variety		9,962	43.1	50.6	3.8	51.2	24.4	NS	17.3	2.5

Population	6,174	17.6	19.1	NS	21.9	16.4	NS	10.8	1.6
Var. X Pop.	NS	NS	NS	NS	NS	46.4	NS	NS	NS





Figures 1a and 1b. Onion plant population effect on the yield of small and medium bulbs averaged over varieties. Malheur Experiment Station, Oregon State University, Ontario, OR, 2010.

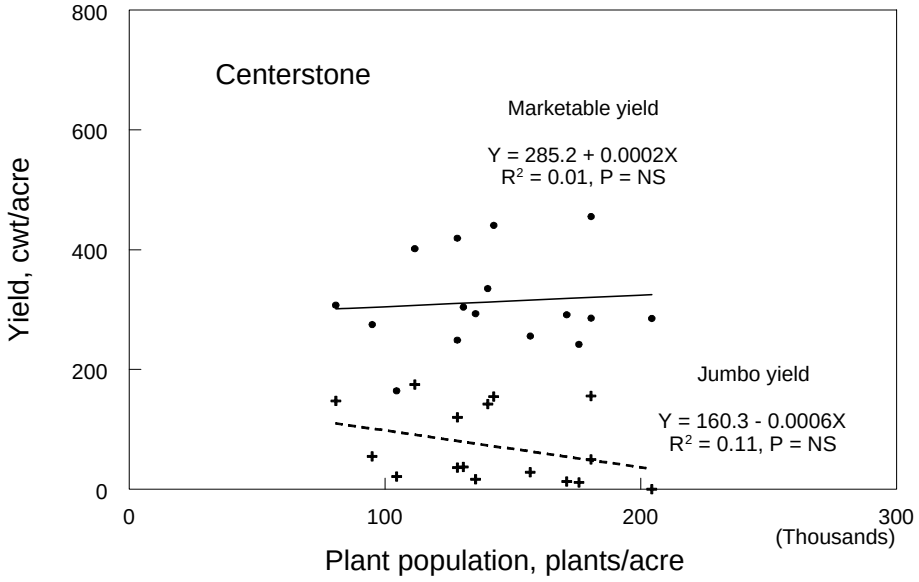


Figure 2. Marketable and jumbo onion yield response to plant population for Centerstone variety. Malheur Experiment Station, Oregon State University, Ontario, OR, 2010.

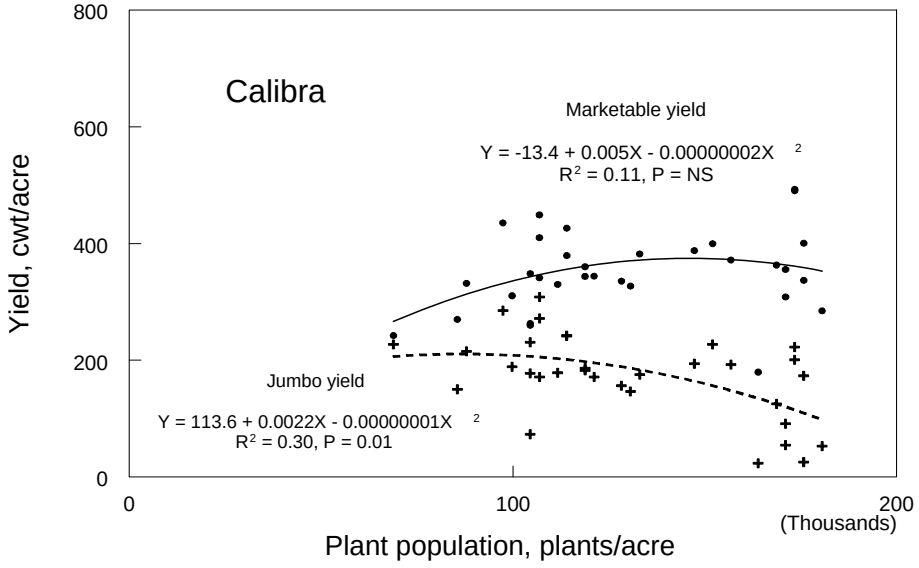


Figure 3. Marketable and jumbo onion yield response to plant population for Calibra variety. Malheur Experiment Station, Oregon State University, Ontario, OR, 2010.

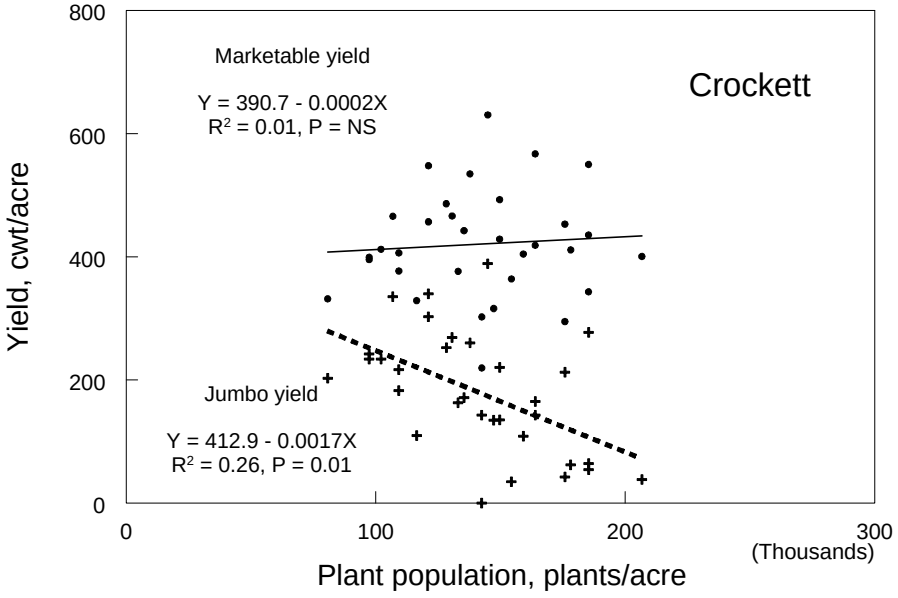


Figure 4. Marketable and jumbo onion yield response to plant population for Crockett variety. Malheur Experiment Station, Oregon State University, Ontario, OR, 2010.

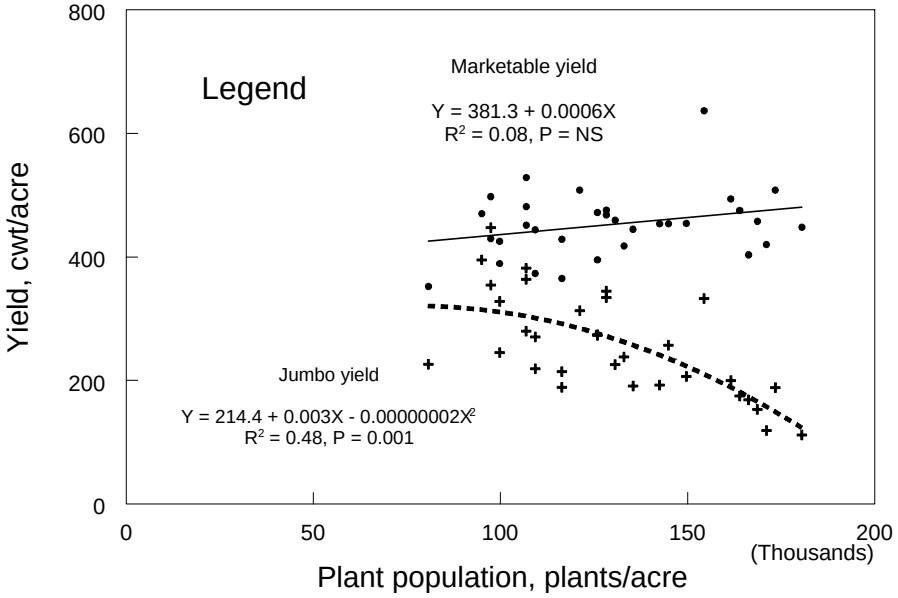


Figure 5. Marketable and jumbo onion yield response to plant population for Legend variety. Malheur Experiment Station, Oregon State University, Ontario, OR, 2010.

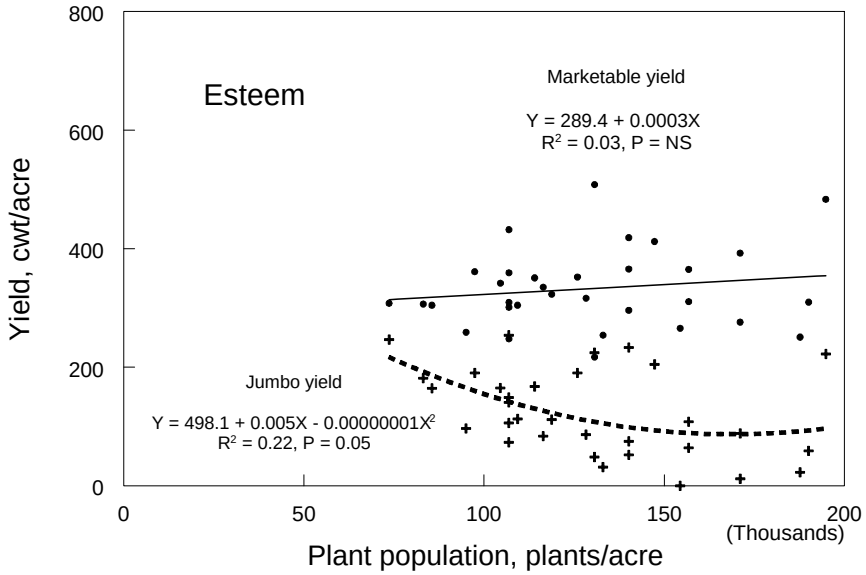


Figure 6. Marketable and jumbo onion yield response to plant population for Esteem variety. Malheur Experiment Station, Oregon State University, Ontario, OR, 2010.

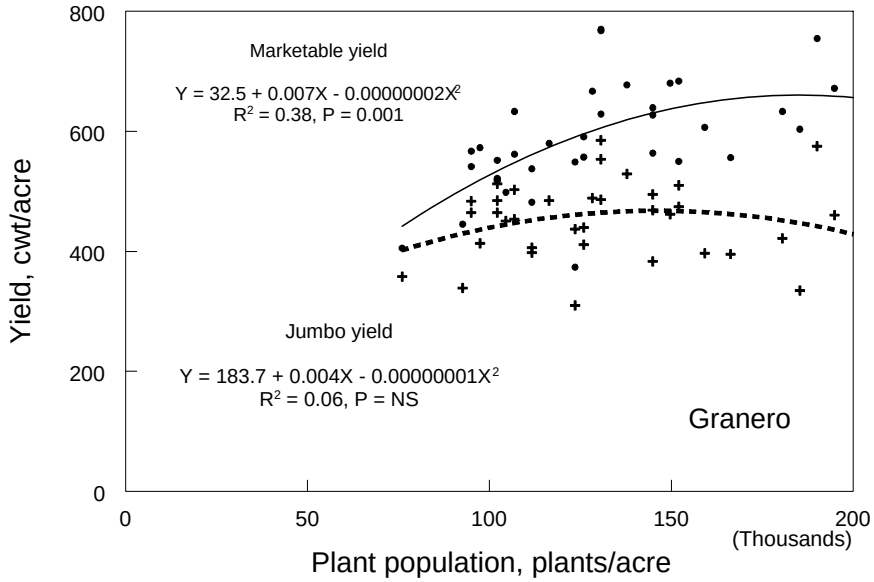


Figure 7. Marketable and jumbo onion yield response to plant population for Granero variety. Malheur Experiment Station, Oregon State University, Ontario, OR, 2010.

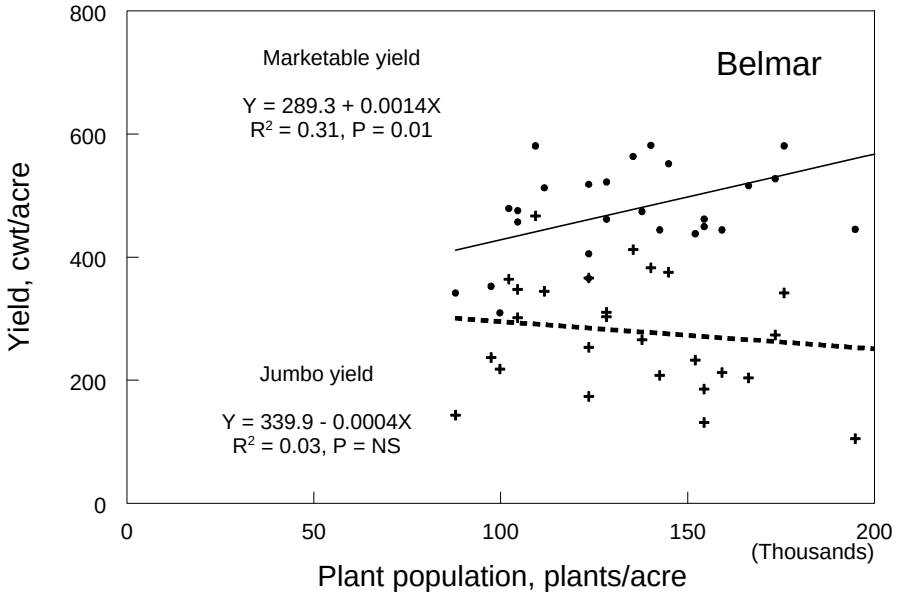


Figure 8. Marketable and jumbo onion yield response to plant population for Belmar variety. Malheur Experiment Station, Oregon State University, Ontario, OR, 2010.

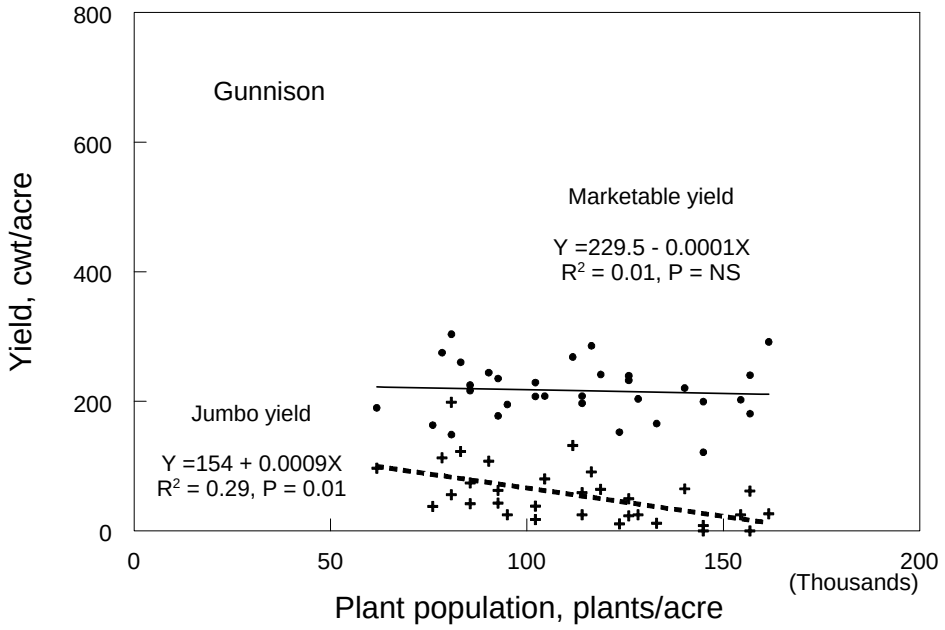


Figure 9. Marketable and jumbo onion yield response to plant population for Gunnison variety. Malheur Experiment Station, Oregon State University, Ontario, OR, 2010.