

3-14-2022

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Recommended Citation

Rohwer, Charlie and Hoidal, Natalie, "Chile Pepper Variety Evaluation" (2022). *Midwest Vegetable Trial Reports*. Paper 234.
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Chile Pepper Variety Evaluation

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Producing chile peppers for fresh and dried markets has garnered special interest from Latino growers in Minnesota, and remains of interest to all growers. To increase understanding of market potential, we performed a single-location replicated variety trial. We measured yield, fruit size, and Scoville heat units on harvested fruit from 10 chile varieties representing jalapeños, serranos, poblanos, and habaneros.

Materials and Methods

The trial was conducted at the University of Minnesota Southern Research and Outreach Center in Waseca, MN in 2021. Habaneros were sown on 2 April and other varieties were sown on 8 April in 20-row seedling flats at the University of Minnesota Plant Growth Facilities in St. Paul. Seedlings were transplanted into 50- or 72-cell trays on 23 April. In mid-May, impatiens necrotic spot virus (INSV) infection was confirmed by the University of Minnesota Plant Disease Clinic and many plants were symptomatic. Transplants were moved to harden off outside in Waseca, and symptomatic plants were culled over the next 2 weeks. Remaining (non-symptomatic) plants were planted in 3 to 4 replicated sets of 5 to 9 plants each on 4 June.

The previous crop was sweet corn and soil was Nicollet-Webster clay loam. A pre-plant soil test (0–6 inches) revealed 35 mg Bray-P / kg, 141 mg K / kg, pH = 7.2, and 4.7% organic matter. Prior to shaping 4-inch raised beds on 5-ft centers, each bed was fertilized with the following per 100 ft of row: 6.4 lbs Sustane® 8-2-4 (Sustane Natural Fertilizer, Cannon Falls, MN), 6.4 lbs Sustane® 4-6-4, 1.4 lbs ESN-urea (44-0-0, slow-release; Nutrien Ltd., Saskatoon, SK), 0.46 lbs urea (46-0-0), and 0.56 lbs KCl (0-0-60). After fertilization and bed shaping, drip irrigation and BioTelo plastic mulch were applied. Transplants were spaced at 15 inches between plants within each row, with 2 rows staggered on the bed (16 plants total per 10 total linear feet of raised bed; 13,939 plants per acre). Plants were not staked.

Harvest began 56 days after transplant (30 July). All mature green marketable jalapeños, serranos, and poblanos were harvested, counted, and weighed collectively from 1 to 4 plants per plot; habaneros were harvested when orange. Occasional (<8%) red jalapeños, serranos, and poblanos were harvested but not counted separately. Up to 5 fruits were selected randomly and weighed individually from each plot, then measured for length (not including stem) and maximum width. Three to four harvests were conducted per plot, on the same plants each time. Occasionally, a branch would break during harvest; plants with branches broken during harvest were not included in future harvests. Because yield per plant was averaged over the number of

plants harvested per plot on each harvest date, removal of one plant was not likely to substantially impact outcome.

A ChilliPot device (Zimmer and Peacock Ltd, Royston, UK) was used for rapid assessment of Scoville heat units (SHU) in fruits from a subsample of plots harvested on numerous dates. This is an electrochemical method and device that should be correlated with the standard HPLC method, but this has not been proven (Rohwer et al., 2020). Electrochemistry is simpler and more rapid than HPLC, with no need for organic solvents. We cut the caps off (and for poblanos, removed the large septum), weighed, and homogenized 75–350 g from at least 3 peppers or half-peppers per plot with 10% v/w distilled water using a commercial bullet-style blender for 10 to 30 seconds. One part (v/w) ChilliPot buffer was added to ~2 g weighed homogenate in a small test tube. This was inverted multiple times to mix, and rested for 10 minutes. A subsample (100–300 μ l) of this mixture was taken using a pipette with the tip cut off to avoid blockage from particulates, and diluted with 2 (poblano) or 9 (other peppers) parts (v/v) ChilliPot buffer. The ratio was recommended by the manufacturer but appropriate ratios have not been published. The mixture was vortexed briefly and measured directly (without regard for particulates in the mixture) on the ChilliPot using the FoodSense app on an iPod Touch™ according to manufacturer instructions. The resulting measurement was multiplied by (1.1 \times 2) to account for the fruit and homogenate dilution, resulting in Scoville heat units (SHU) of the chiles themselves (the app accounts for the final dilution).

Separate mixed-effect analysis of variance was used to analyze yield and fruit size varietal differences within each pepper type (jalapeño, serrano, or poblano) using R software. Post-hoc Tukey tests were performed to test for differences between jalapeño or poblano varieties, and Wald χ^2 tests distinguished differences between serranos. SHU were analyzed using t-tests within and between pepper types, and p values were compared to Holm-Bonferroni-adjusted critical p values ($\alpha = 0.05$). Comparisons with habanero were one-sided and assume unequal variance. Marginal means and standard errors (emmeans) are reported here, except raw means are reported for time-to-harvest.

Results and Discussion

Total number and pounds of fruit per plant are shown in Table 1. Fruit size (n per pound, width, length, and oz per fruit) are shown in Table 1 and Figure 1. PS11435810 was the largest jalapeño, and El Jefe was the smallest. Total pounds of fruit from these two was greater than from Jalafuego. Sandoval and Hot Rod serranos yielded similarly, but Hot Rod width and per-fruit weight were smaller. Ranchero was the widest poblano, yielded the most pounds of fruit, and measured the largest per-fruit weight, but Baron was longer. Grower-collaborators have commented that Ranchero's physiology was not standard for a poblano pepper and looked more like a bell pepper, and that it might not be accepted by their customers who expect longer, slimmer fruits. All four poblanos studied yielded a similar number of fruit per plant, but Ancho Poblano was the overall lowest-yielding and smallest poblano. Habanero Orange was not compared to other fruit, but matured to orange relatively late (Fig. 2). The majority of habaneros were harvested after 29 September. The median first frost date in Waseca is 1 October. Habanero fruit numbers were similar to or smaller than the green jalapeños studied, but pounds per plant was the lowest of all chiles studied.

Poblanos were the largest fruit (Table 1; Fig. 1). The per-fruit harvest time of poblanos was longer than jalapeños or serranos, because of the effort to locate mature fruit (Table 2). However, more pounds of poblanos could be harvested per minute than the other types.

Habaneros had the highest SHU among all chiles studied (Table 3). There were differences between jalapeño varieties as well, with El Jefe having the highest SHU. Anecdotally, there was variation in perceptible heat among fruit within the same plant.

Literature Cited

Rohwer, C., N. Hoidal, Cala Farm, Agua Gorda Farm Cooperative, and Jarl's Produce. 2020. Chile Pepper Variety Evaluation at Four Sites across Minnesota and Wisconsin, 2020. Midwest Vegetable Trial Reports. Paper 30. <https://docs.lib.purdue.edu/mwvtr/30>

Table 1. Means (\pm standard error of the mean) of yield (number and pounds per plant) and size (n of fruit per lb) parameters for chiles grown in 2021. Analyses of variance were performed separately within type (jalapeño, serrano, or poblano) and marginal means and errors are shown. Fruit per pound data are aggregate (total fruit n / total lbs).

Pepper type, variety, and seed source ^z	yield per plant				fruit per pound	
	n ^y	\pm SE	lbs ^y	\pm SE	n ^y	\pm SE
jalapeño						
PS11435810 ^{JOR}	50.1 ^b	6.3	4.9 ^a	0.37	10.2 ^b	0.67
Jalafuego ^{HMS}	61.0 ^{ab}	6.3	3.5 ^b	0.37	17.3 ^a	0.67
El Jefe ^{JHN}	86.7 ^a	7.3	4.7 ^{ab}	0.42	18.3 ^a	0.77
serrano						
Sandoval ^{HOL}	116	22.6	4.0	0.77	30.9 ^b	2.03
Hot Rod ^{JHN}	124	21.0	3.0	0.69	40.8 ^a	1.76
poblano						
Ranchero ^{HOL}	16.8	2.0	4.2 ^a	0.29	4.0 ^c	0.21
Bastan ^{HMS}	19.1	2.0	3.5 ^a	0.33	5.4 ^b	0.21
Baron ^{JHN}	17.5	2.4	3.1 ^{ab}	0.29	5.6 ^b	0.24
Ancho Poblano ^{HMS}	14.6	2.0	1.8 ^b	0.29	8.0 ^a	0.21
habanero						
Habanero Orange ^{JOR}	56.3	10.2	1.2	0.25	45.6	0.98

^zHMS = High Mowing Seeds, HOL = Holmes Seed Company, JHN = Johnny's Seeds, JOR = Jordan Seeds

^yWithin a chile type, means that are similar are labeled with the same letter ($p > 0.05$). Means without letters indicate no difference at $\alpha = 0.05$.

Table 2. Time to harvest for jalapeño, serrano, and poblano peppers. Fruits were harvested from 1 to 3 plants per plot. Total number of fruits and total pounds per plot from each harvest was divided by the time to harvest. Raw means from 8 to 15 plots per pepper type are shown here. The same person harvested each time, and time only included removing fruits from plants into a bulk tote or bag.

	n harvests measured	fruit per minute		lbs per minute	
		mean	\pm SE	mean	\pm SE
jalapeño	15	21.7	1.4	1.2	0.15
serrano	8	27.2	2.1	0.7	0.04
poblano	11	15.3	1.4	2.8	0.27

Table 3. Average Scoville heat units (SHU) measured in 10 chile varieties of 4 chile types. The average (marginal mean) SHUs for each type of chile are reported in the shaded rows. Standard error and number of samples measured is reported.

	SHU ^z	±SE	n
jalapeño	5,523 ^B	268	22
PS11435810	4,384 ^b	331	6
Jalafuego	5,740 ^a	333	8
El Jefe	6,159 ^a	467	8
serrano	4,784 ^{BC}	240	9
Sandoval	5,083	582	3
Hot Rod	4,635	240	6
poblano	4,278 ^C	297	25
Ranchero	4,629	530	7
Bastan	4,870	705	5
Baron	4,401	762	5
Ancho Poblano	3,524	472	8
habanero	9,612 ^A	1,056	4
Habanero Orange	9,612	1,056	4

^zBetween chile types, a capital superscript of the same letter indicates mean similarity. Within a chile type, lowercase superscripts of the same letter indicates mean similarity. No differences between serranos or poblanos were found at $\alpha = 0.05$.

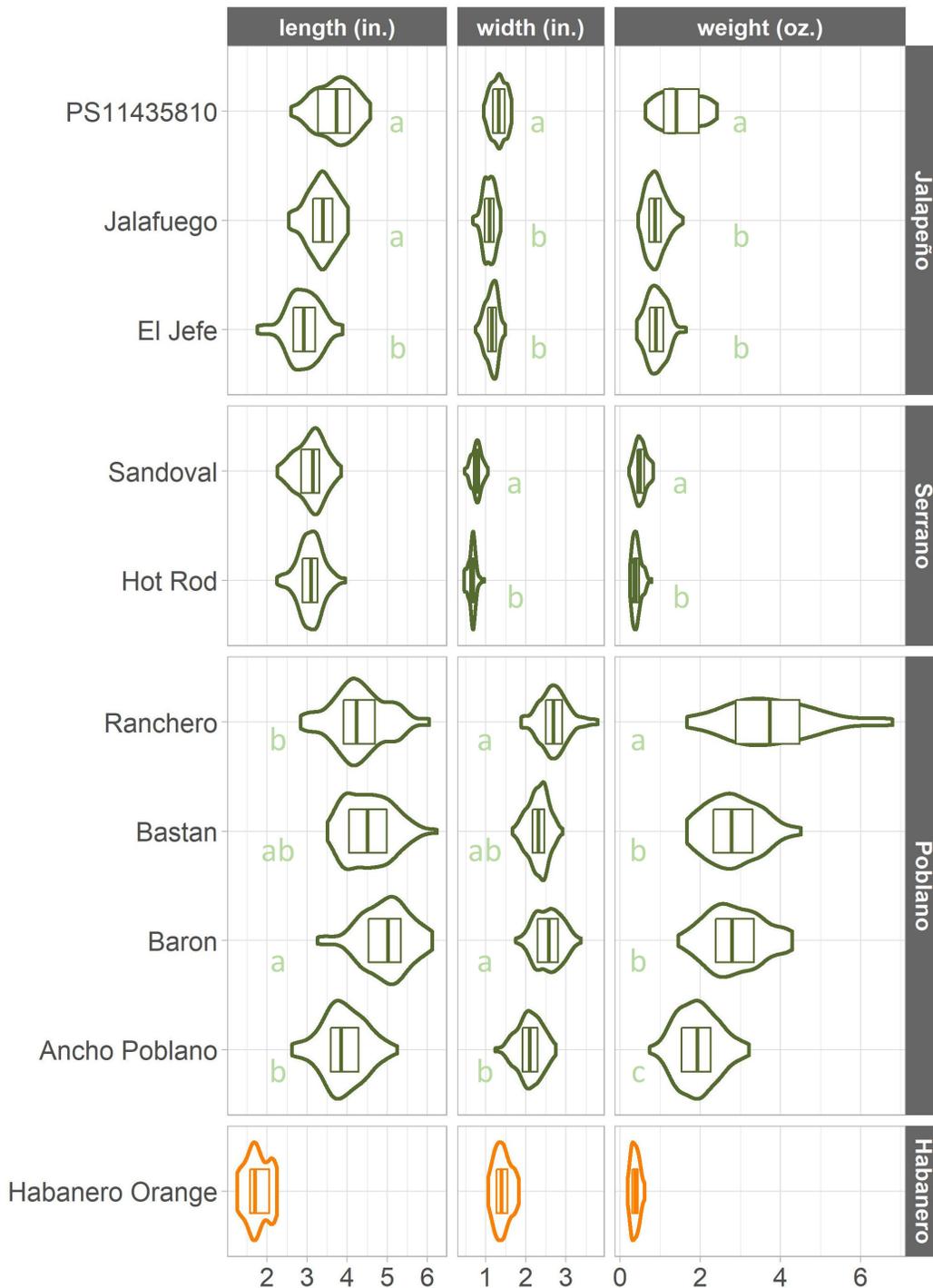


Figure 1. Per-fruit length, width, and weight of four types of chiles (10 varieties) grown in Waseca, MN in 2021. Violin plots represent distribution of raw data (n = 41 to 80 per variety). Boxplot displays median, 25th, and 75th percentiles. Varieties with the same letter within chile type are not substantially different based on Wald χ^2 (serrano) or post-hoc Tukey's tests (jalapeño, serrano; $\alpha = 0.05$). Means separation of weight per fruit is based on aggregate data (Table 1). Habaneros were harvested orange, the rest were generally harvested green.

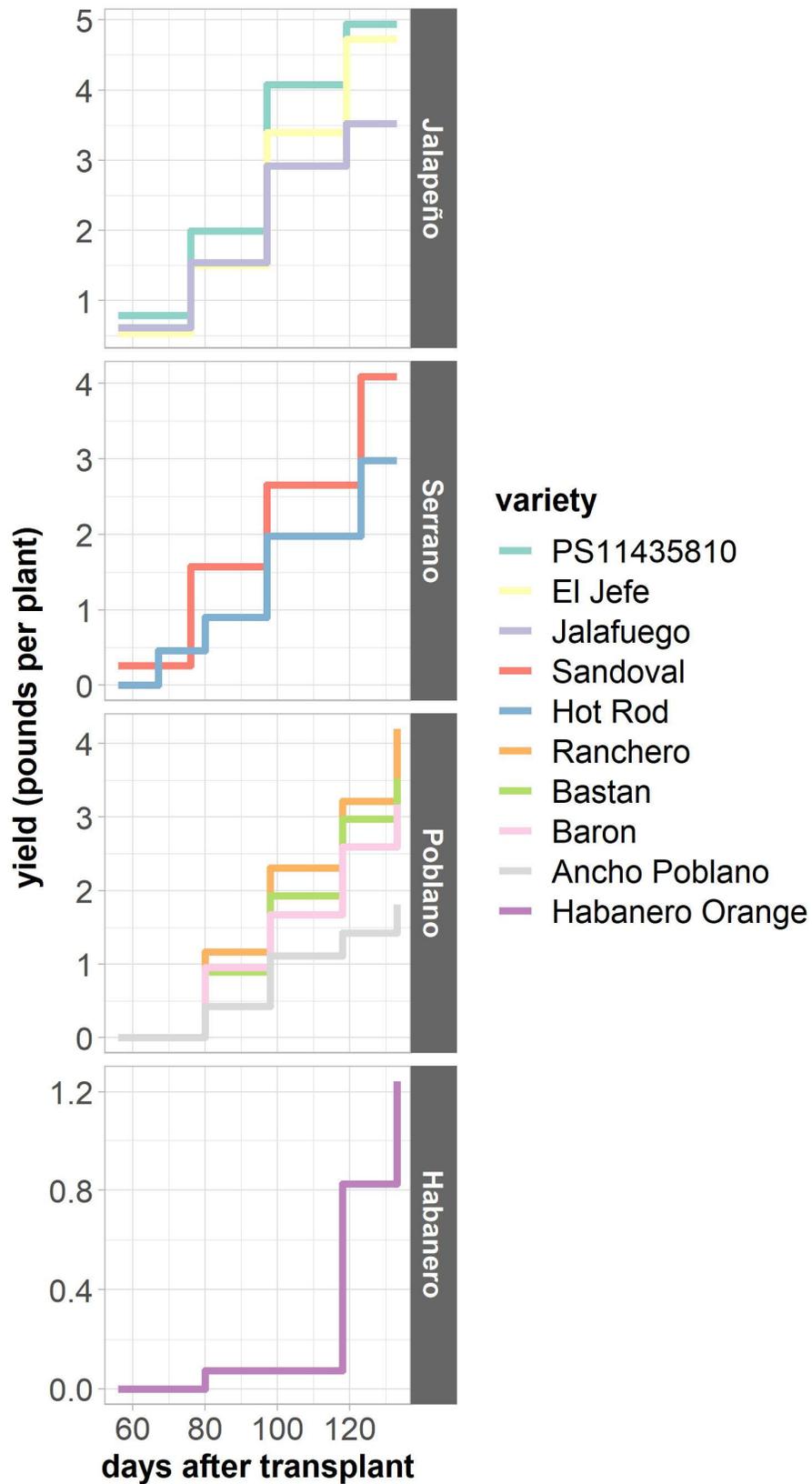


Figure 2. Cumulative yield (pounds) per chile variety (n = 3 to 4 replicates). Transplant was 4 June, 2021.