Report to the California Pepper Commission for the 2019 funding year (Mar '19-Feb '20)

Evaluation of pepper varieties for suitability for mechanical harvest

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Methods

Four variety trials were conducted within commercial pepper fields (Lodi, San Joaquin Co.; Gilroy, Santa Clara Co.; Helm, Fresno Co.; and Ventura Co.). Seed was provided by the participating seed companies, each of which was asked to submit two selections. Transplants for each trial were produced by local commercial transplant greenhouses in the trial region. Plots were established with a mechanical transplant operation and with the plug density used in the growers' field. Plot length varied by trial, but was around 15 to 20 feet. There were three or four replicate blocks in each trial, again depending on trial location. The trials were managed by the grower similarly to the rest of the field.

Just prior to commercial harvest of mature red peppers, we selected mature, marketable pods from numerous different plants and detached them from the plant using a torque meter (Tohnichi Model BTG150CN-S, see figure 1). We recorded the maximum torque required for detachment of each pod, as well as pedicel diameter measured with a caliper. We also made notes about where the pod detached (e.g. whether it separated at the joint, tore the pedicel or tore off a branch, such that the branch was still attached to the pod). We made measurements on 60 pods of each variety when feasible. Our methods were informed by consultation with Allen Van Deynze and Theresa Hill in the Plant Science Department at UC Davis, and we greatly appreciate their time and advice. Our method is similar to what they use to measure force required for "decapping" jalapeno pods in various breeding lines to determine their suitability for mechanical harvest.

At two of the trial locations (Ventura and Santa Clara counties), the modified paint shaker was also used to evaluate two plants per plot (so six to eight plants per variety depending on trial location). Similar to what the commission did in 2018, we counted harvestable pods that came off with shaking, those that stayed on the plant and those that came off but still had a branch attached to them. Fruit color, size and quality were also recorded.

Location	Cooperator	Transplant date	Assessment date(s)	Field details
Flag City/Lodi, San Joaquin Co.	Morada Produce	May 24	Sept 11, 12 & 17 (torque)	drip tape, double row 60”
Gilroy	B & T Farms	May 28	Oct 11 (torque) Oct 16 (shaker)	Buried drip tape
Ventura Co.	Terry Farms, Ramelli Ranch	June 3	Oct 18 & 21 (torque) Nov 1 (shaker)	drip tape, double row
Helm	Terra Nova	June 20	mid-Nov	buried drip, double row 60”

Results

Torque evaluation

Torque measurements were higher in Ventura than at the other three sites (Fig. 2) but there was no significant variation in mean torque measurements between varieties. We also learned that torque is not well correlated with pedicel diameter (Fig. 3), so other factors must be more important in determining ease of detachment (e.g. perhaps the density of the pedicel tissues is important, or the angle of attachment of the pedicel to the branch). We do not recommend this method for assessing ease of detachment in bell peppers.

Shaker test

With the shaker, we recorded the percentage of the pods that came off the plant “clean”, with no branches attached. Varieties tested ranged from 51 to 77 percent of pods coming off clean (see Figure 4). However, the variability between replicates was high enough to obscure those differences. From the analysis of variance, location was a significant factor, with 71 percent of pods coming off clean at Gilroy site versus 54 percent coming off clean at Ventura site. This matches what we saw with the torque measurements, with higher torque required to detach pods in the Ventura trial. From the analysis, variety was not a significant factor ($P = 0.346$) and there was no location by variety interaction ($P = 0.572$).

Figure 1. Torque meter used to twist pods off the plant. On right is attachment we used with the meter.

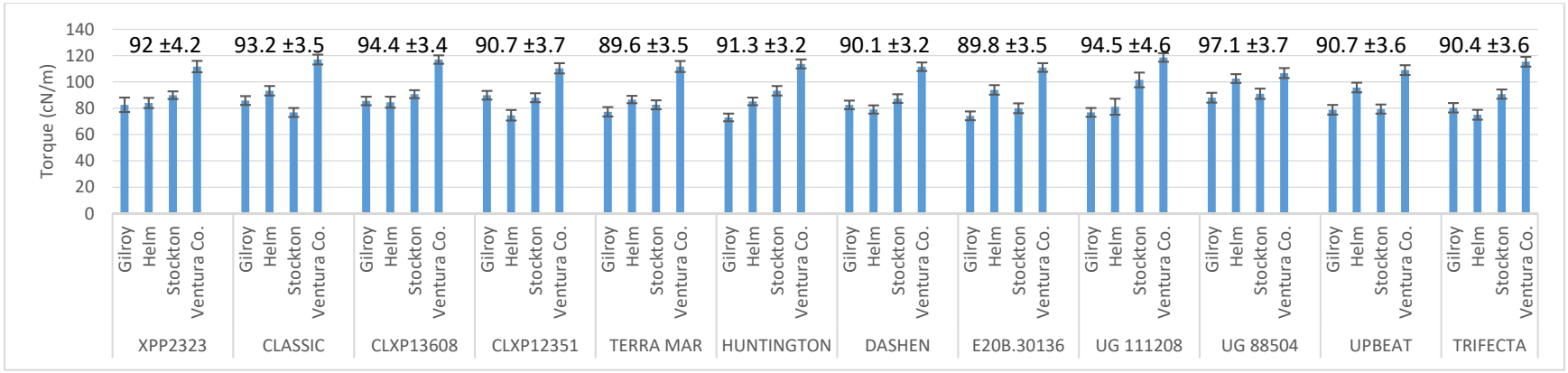
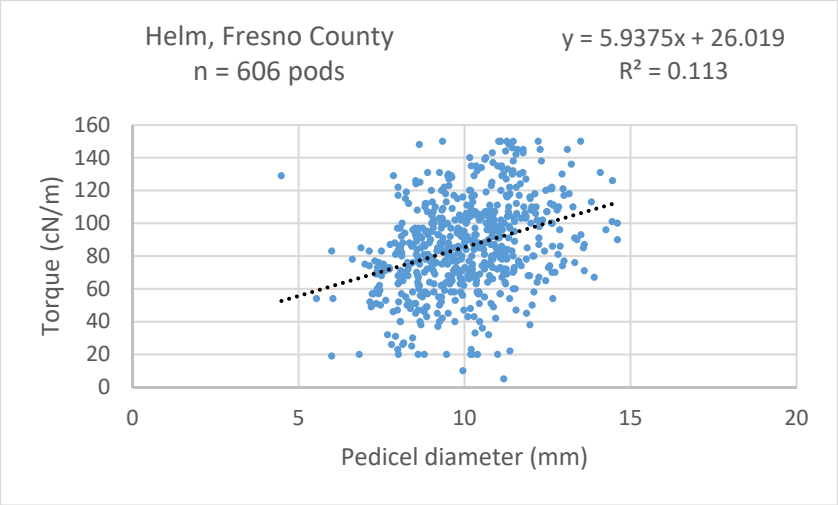
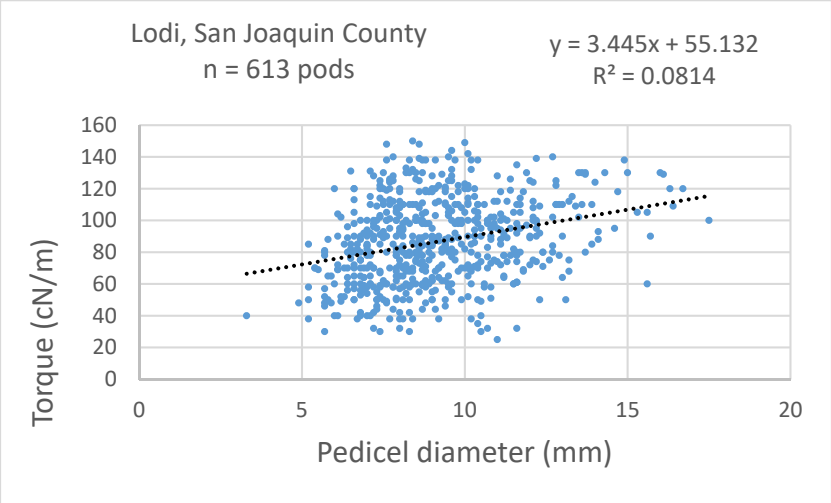
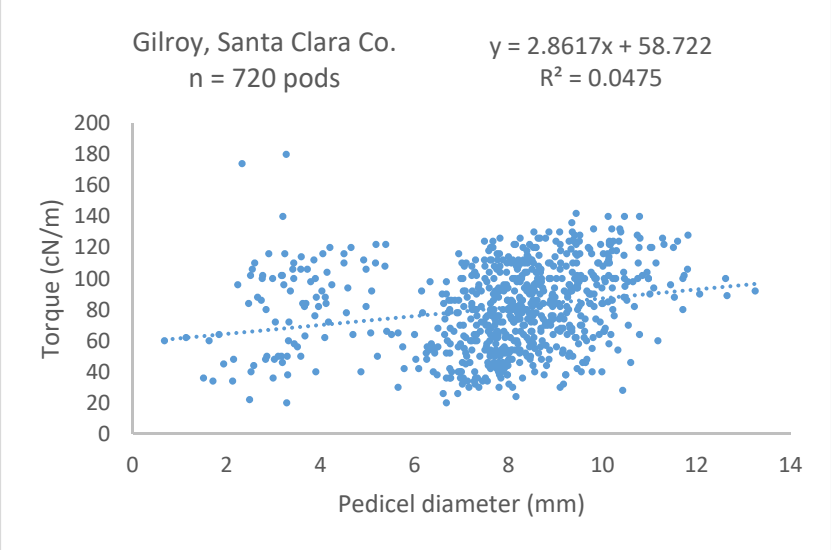


Figure 2. Torque (twisting force) required to detach pods from the plant as described in methods. Each bar represents the mean of 45 to 60 pods measured at each trial location. Numbers above the bars represent the mean (± standard error) of all four locations for that variety (200 to 250 torque measurements for each variety).







Figures 3a-c. Detachment torque compared with pedicel diameter. The relationship between these two variables is fairly weak, as evidenced by the low R-square values and shallow slope of these lines.

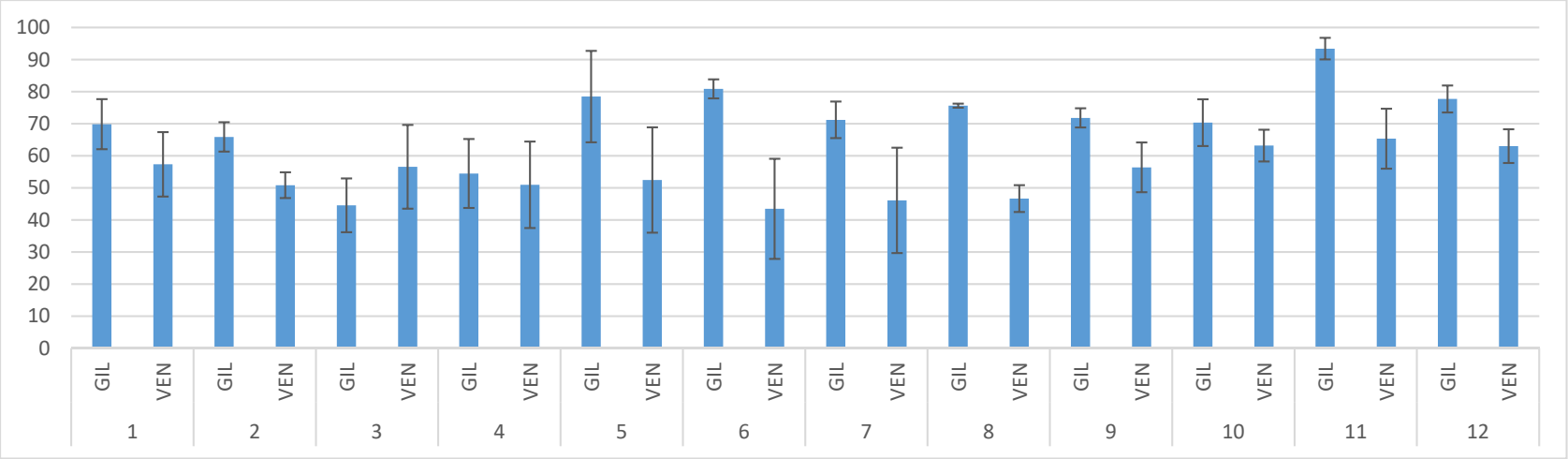


Figure 4. Percent pods shaking off "clean" (no branches attached). Gil = Gilroy trial, Ven = Ventura trial. See variety codes below. The percentages varied between trial sites, but not between varieties.

Table 1. Same data as in chart above, but with the two locations averaged.

Variety	# of plants shaken	Percentage of pods shaking off clean (no branches attached) ± standard error
1. CLASSIC F1 HYBRID	14	62.7 ± 6.6
2. CLXP12351 F1	14	57.3 ± 4.1
3. CLXP13608 F1	14	51.4 ± 8.0
4. DASHEN F1	14	52.4 ± 8.3
5. E20B.30136 F1	14	63.6 ± 11.6
6. HUNTINGTON	14	59.5 ± 11.3
7. HYBRID XPP2323	14	56.8 ± 10.4
8. TERRA MAR	14	59.1 ± 6.3
9. TRIFECTA	14	63.0 ± 5.3
10. UG 88504	14	66.2 ± 4.1
11. UG 111208	14	77.4 ± 7.7
12. UPBEAT	14	69.3 ± 4.4