

EMR Model Hudson Valley Honeycrisp Bitter Pit Prediction Post-Storage Report for 2021

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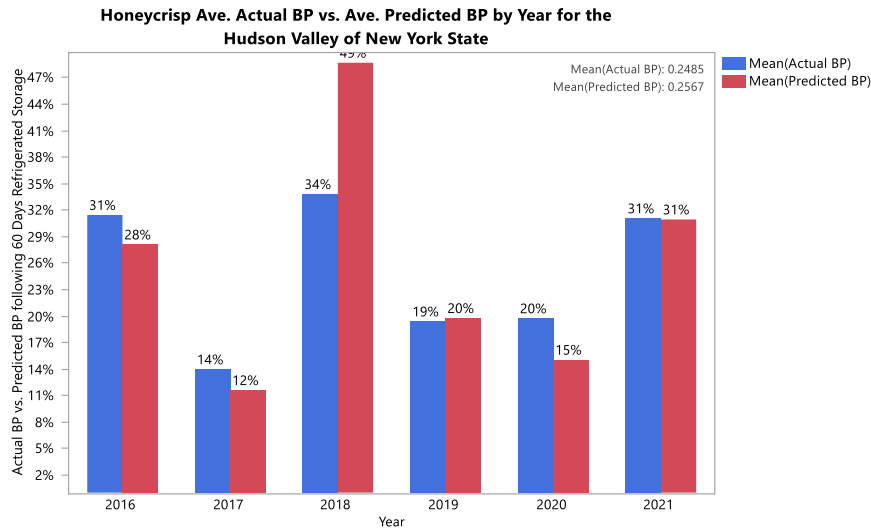


Figure 1. Summary EMR model bitter pit (BP) prediction performance for nineteen Honeycrisp orchards in the Hudson Valley of New York State from 2016 through 2021. As predicted, 2021 was a troublesome year for Honeycrisp, similar to our experience in 2016, not quite as bad as 2018. From a “global” perspective, the EMR model has performed well in predicting BP for the Hudson Valley region as a whole.

The data presented in Figure 1 are from 19 Hudson Valley (HV) M.9 clone, M.26 and Bud.9 blocks that have been monitored annually since 2016. Blue bars represent observed bitter pit (BP), red bars represent EMR (Environment, Mineral profile, and Rootstock model) predicted values. In this "view from 10,000 feet", the EMR model has been reasonably accurate in predicting the HV BP trend in five of the six seasons, while over-predicting BP in 2018. As a practical matter, for a prediction model to be useful it must emphasize accuracy in the range of 0-20% BP incidence. Once BP levels are predicted to be high, say over 20%, the difference between 34% and a predicted 48% as observed in 2018 is interesting, but academic as levels this high are simply trouble all around. The EMR model predicted a troublesome BP storage season for the HV crop in 2021, and this turned out to be correct with average BP incidence observed in our long-term commercial orchards of 31%. Unfortunately this season, BP wasn't our only problem as defects such as skin cracking, black rot, bitter rot, and russetting combined with BP to push many packouts below 50%.

While this data provides a general overview of what we are facing, actual BP incidence in a specific HV orchard depends on rootstock and crop load (very light vs over-set) followed by your orchard management decisions. According to our historical published data, Honeycrisp produced on the Bud.9 rootstock express significantly less BP. However, only one of the four Hudson Valley Bud.9 blocks in our 2021 monitoring program produced a typical prediction for low BP incidence.

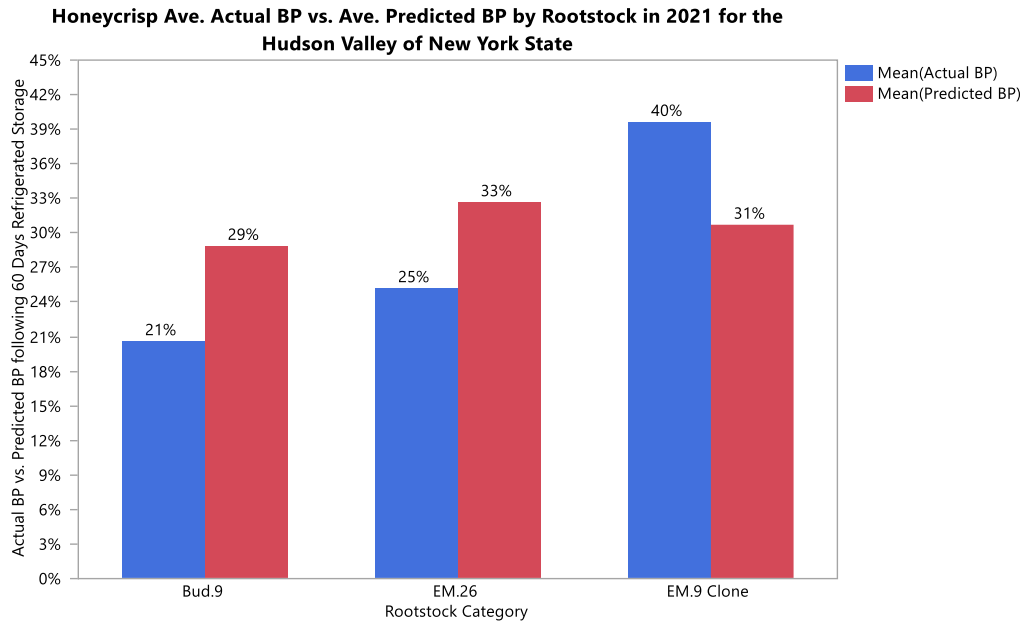


Figure 2. Summary EMR model bitter pit prediction performance, by rootstock in 2021 for nineteen Honeycrisp orchards in the Hudson Valley of New York State from 2016 through 2021. While once again Bud.9 orchards produced the fruit with the least bitter pit incidence after 60 days of refrigerated storage (38F), the improvement was not as significant as that observed over the previous 5 seasons. An important note is that 3 of the 4 Bud.9 orchards evaluated were moderately lightly cropped, in contrast to the well to over-cropped M.26 orchards in this sample.

The data presented in Figure 2 suggests that while once again Bud.9 orchards outperformed EM.9 and EM.26, the margin was relatively less in 2021. One possible explanation was the influence of crop load and sample size. Of the four Bud.9 orchards sampled, three experienced moderately-light crop loads. EM.26 orchards did surprisingly well in 2021, however several orchards experienced moderately-heavy crop loads with one being severely over-cropped. The EM.9 orchards in this sample for the most part experienced acceptable and sustainable commercial crop loads.

The data in Table 1 provides additional detail at the orchard level.

Honeycrisp EMR Model BP Prediction Performance by Hudson Valley Orchard in 2021					
Block Code	Rootstock Category	Predicted % BP Inc.	Actual % BP Inc.	EMR Model Performance	Observations
1	EM.9 Clone	17.6%	6.1%	Missed Storage Opportunity	Overcropped, expect poor return bloom
2	EM.9 Clone	10.8%	11.5%	Correct - Good for Long-Term Storage	Overcropped, expect poor return bloom
3	EM.9 Clone	41.5%	74.0%	Correct - High Risk for Long-Term Storage	
4	EM.9 Clone	20.1%	36.0%	Correct - High Risk for Long-Term Storage	
5	EM.9 Clone	28.6%	28.0%	Correct - High Risk for Long-Term Storage	
6	EM.26	20.3%	20.4%	Correct - High Risk for Long-Term Storage	
7	Bud.9	7.4%	4.0%	Correct - Good for Long-Term Storage	Always historically acceptable, but significantly improved this season
8	EM.26	14.5%	11.5%	Correct - Acceptable for Long-Term Storage	A real surprise, heavy crop but this doesn't fully explain the low BP, best results observed over 6 seasons, was it the grower's spray, fertilizer, and thinning program?
9	Bud.9	27.7%	20.0%	Correct - High Risk for Long-Term Storage	Moderately light crop. I was sceptical of the original prediction but it turned out to be correct.
10.5	Bud.9	39.9%	18.0%	Correct - High Risk for Long-Term Storage	Moderately light crop. I was sceptical of the original prediction but it turned out to be correct.
11	EM.26	41.6%	38.0%	Correct - High Risk for Long-Term Storage	
12	EM.9 Clone	58.4%	54.0%	Correct - High Risk for Long-Term Storage	
13	Bud.9	40.5%	40.4%	Correct - High Risk for Long-Term Storage	Moderately light crop. I didn't trust the original prediction but it turned out to be correct.
14	EM.9 Clone	35.6%	45.1%	Correct - High Risk for Long-Term Storage	
15	EM.26	34.9%	42.0%	Correct - High Risk for Long-Term Storage	
16	EM.9 Clone	15.2%	30.0%	Correct - High Risk for Long-Term Storage	
17	EM.9 Clone	48.6%	72.0%	Correct - High Risk for Long-Term Storage	
18	EM.26	57.2%	27.5%	Correct - High Risk for Long-Term Storage	
19	EM.26	27.5%	11.8%	Missed Storage Opportunity	Overcropped, expect poor return bloom
62	EM.9 Clone	48.0%	16.0%	Correct - High Risk for Long-Term Storage	
202	EM.9 Clone	37.2%	62.0%	Correct - High Risk for Long-Term Storage	Lightly cropped trees in a test block. BP performance was much worse than the historical record. No pink Apogee (Kudos) or foliar calcium applications.
204	G.41	81.2%	100.0%	Correct - High Risk for Long-Term Storage	Lightly cropped trees in a test block. BP performance was much worse than the historical record. No pink Apogee (Kudos) or foliar calcium applications.
206	EM.9 Clone	54.3%	100.0%	Correct - High Risk for Long-Term Storage	Almost-blank trees in a test block. BP performance was worse than the historical record. No pink Apogee (Kudos) or foliar calcium applications.
203	G.41	85.5%	100.0%	Correct - High Risk for Long-Term Storage	Almost-blank trees in a test block. BP performance was worse than the historical record. 100% BP was observed at harvest. No pink Apogee (Kudos) or foliar calcium applications.

Table 1. Bitter pit performance for 24 Hudson Valley orchards in 2021. Ten percent BP incidence was considered to be the acceptable threshold for long-term storage. 10-15% was considered to be tolerable. The fruit from over-cropped trees routinely express less BP, while the fruit from lightly-cropped trees express high levels. Within the “good crop” range, rootstock choice is the most important variable. The EMR model loses precision as BP becomes more severe. From a storage management and marketing point of view, there is no practical difference between excessive BP and really excessive BP.

Green highlighting indicates an accurate EMR recommendation, yellow indicates a missed storage opportunity. Overall, only 5 of the 24 orchards evaluated would have been suitable for long-term storage in 2021.

The EMR model performed well in 2021. Most importantly, the model did not make the major mistake of recommending long-term storage when the actual result was bitter pit above 15% or higher with the ensuing financial loss. The model also had exhibited a degree of sensitivity to crop load in the Bud.9 orchards, but less so for the EM.26. Samples (Block Codes 202, 203, 204, 206) taken from a commercial orchard that has hosted multiple research trials since 2016 once again reinforce the poor BP performance of the G.41 rootstock. The crop here ranged from light to non-existent, and prohexadione calcium (Apogee or Kudos) was not applied at pink stage, nor were any foliar calcium sprays applied. Tough conditions for any rootstock and the EM.9-337 performed poorly as well. In contrast, in a 2020 trial with trees managed to a standard commercial crop load, EM.9 fruit expressed 10% BP while the G.41 fruit expressed 22%.

Using digestive tissue analysis (no sap), fruit peel mineral content at the end of July in the HV was found to be as follows:

- Manganese was 45% below the previous 5-year average
- Calcium, Potassium, Magnesium, and Boron were 35-36% below the 5-year average.
- Copper, Iron, and Zinc were close to average.

Peel samples were taken on July 30. The current version of the EMR model uses the magnesium/calcium ratio as one of the variables considered for the M.9 and M.26 rootstocks (calcium only for the Bud.9). The Hudson Valley experience above average rainfall this season, especially heavy in July. The pattern of frequent rains continued through August and into the September harvest window. Fruit size this season is estimated to be larger than average. All the above factors appear to have contributed to the high BP levels observed this season. This has been an initial report for the 2021 season and there will be more analysis to come through the winter with specific management recommendations as we approach the 2022 growing season.