

Methods and Factors to predict Bitter Pit in Honeycrisp Rich Marini

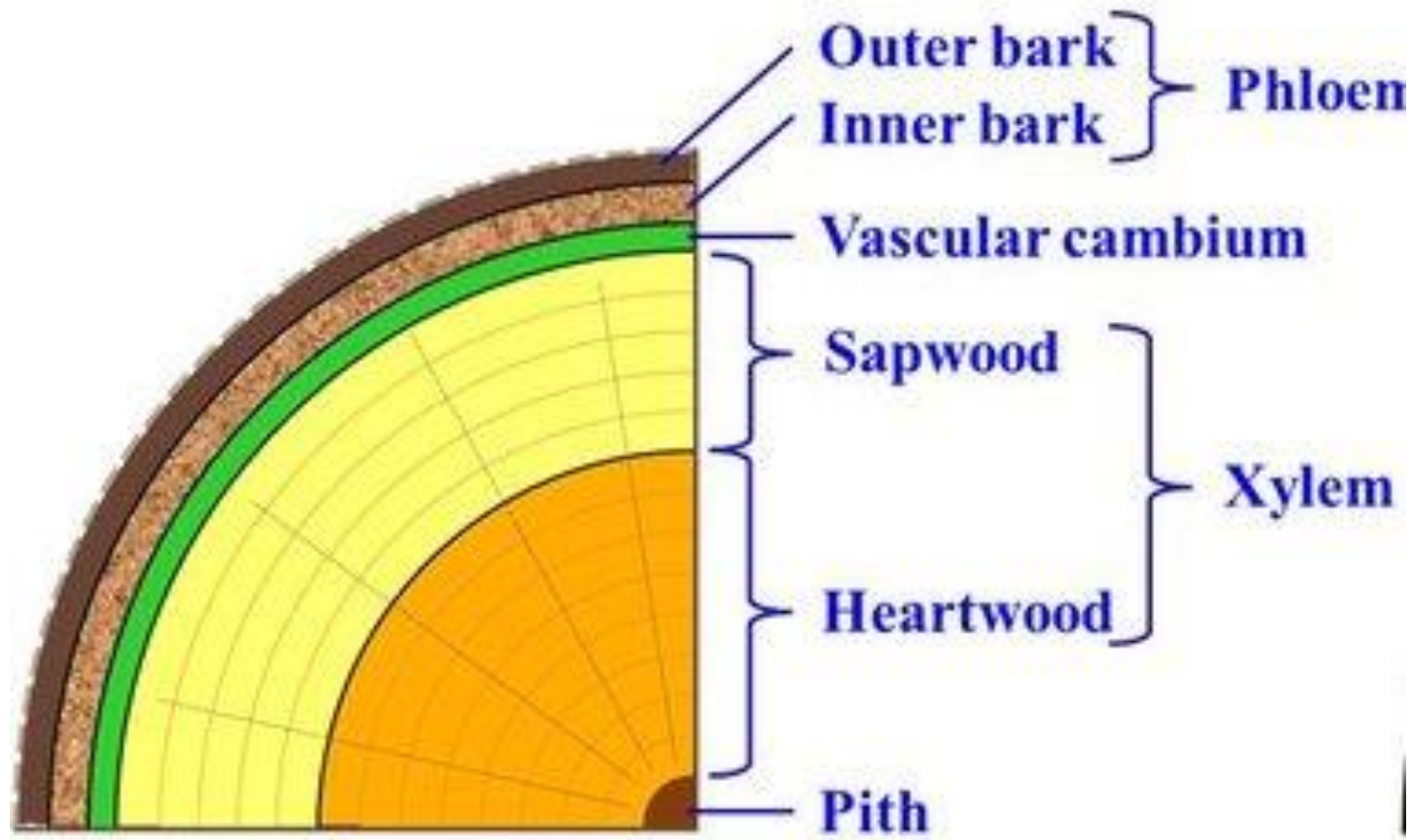


Bitter Pit

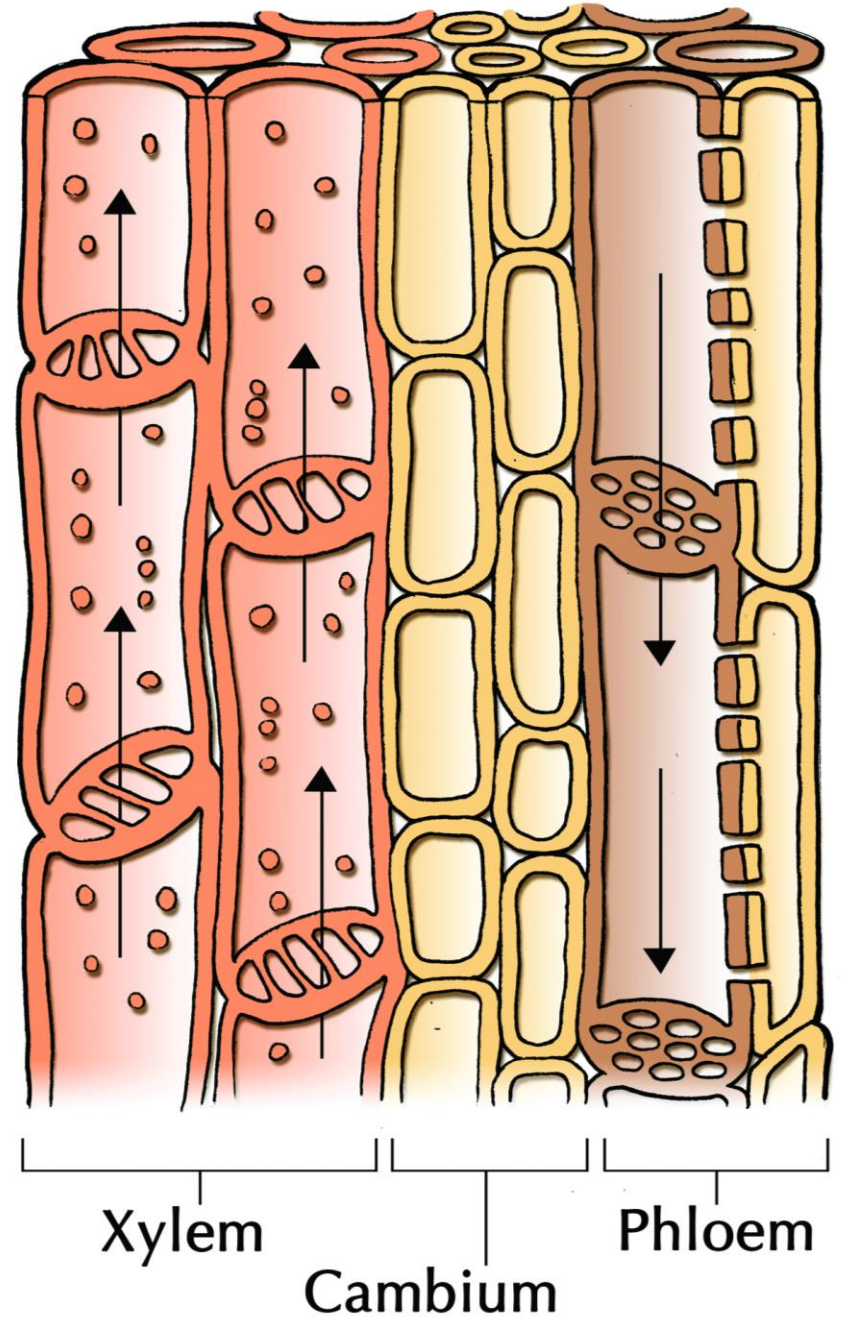


- Usually develops after storage
- 'Honeycrisp' may develop on the tree
- Most severe at calyx end
- Traditionally thought to be a localized imbalance of cations ($K^+ + Mg^+ / Ca^{++}$)

Also related to high N and P



(a)



Staining of fine vascular tissues

Braeburn



Granny Smith



PSU 'Honeycrisp' Project

Baughner, Marini, Schupp and Watkins 2017

- 3 years
- 6 orchards in Adams County, PA
- 18 trees/orchard: low, moderate, high CD
- Measured length of 10 shoots per tree
- Analyzed fruit peels from 15 fruit/tree 3 weeks before harvest
- Recorded average fruit weight and bitter pit incidence at harvest and following storage on 20 fruit/tree

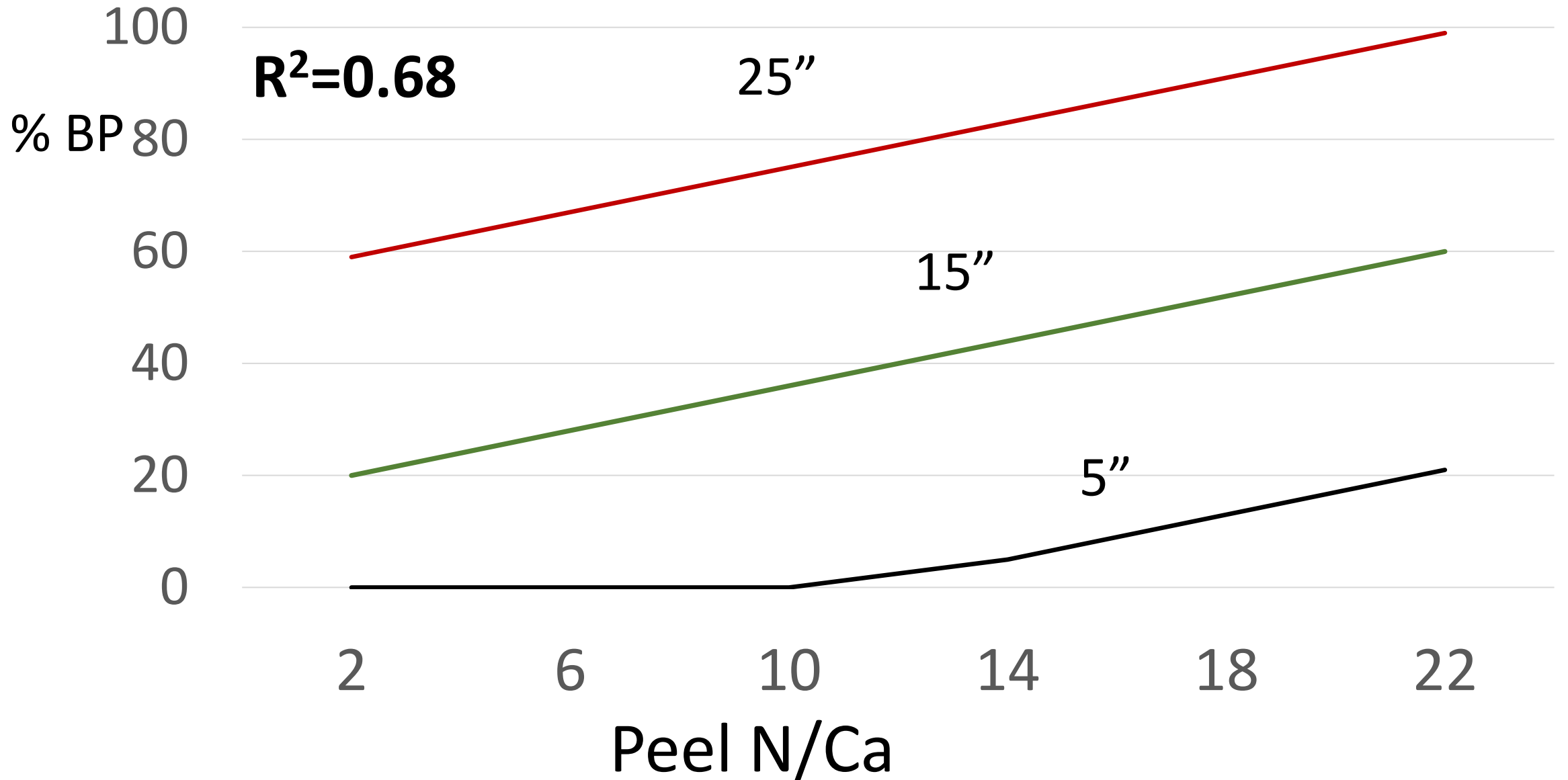


m.26

Variation in Bitter pit Incidence (%)

Orchard	2014	2015	2016
1	22	16	52
2	7	21	49
3	9	17	74
4	16	18	35
5	6	3	39
6	0	4	0

Effect of SL (inches) and N/Ca on bitter pit (%)



Concerns About Our Model

- Model was validated with 3 methods, but
- This was still experimental
- Only PA orchards
- Inconsistency from year to year and orchard to orchard
- The model explains less than 70% of the variation in BP, so we have not identified all the important factors

Verified the Model in 2018 & 2019

- Obtained peel tissue from 8 orchards 3 weeks before harvest
- Winchester and Piney River, VA
- Pittstown, NJ
- Fisherville, Biglerville, Berks, Rock Springs, PA
- **Model: $BP(\%) = -44.3 + (SL * 0.8) + (4.13 * N/Ca)$**
- **Cornell is using a K/Ca ratio of about 23**

2018 Results-can separate high vs. low BP

	Orchard	SL (in)	N/Ca	Predicted	Observed
1	M.26	14	6.7	12	22
2	Nic.29	12	6.0	5	6
3	M.26	18	10.4	35	43
4	M.26	19	8.2	28	57
5	M.9	13	6.8	8	6
6	B.9	8	6.0	2	8
7	B.9	7	4.4	-13	5
8	M.9Paj.2	15	10.0	30	41

Why do only some apples on a tree develop bitter pit?

- **Large Fruit**
- **Crop Load**
- **Fruit with high N+K+Mg/Ca ratio**
- Canopy position - Transpiration?
- Shoot length or Leaf area/spur?
- Distance from trunk or terminal bud?
- Number of fruit/spur?

Aspers Experiment – spur sampling

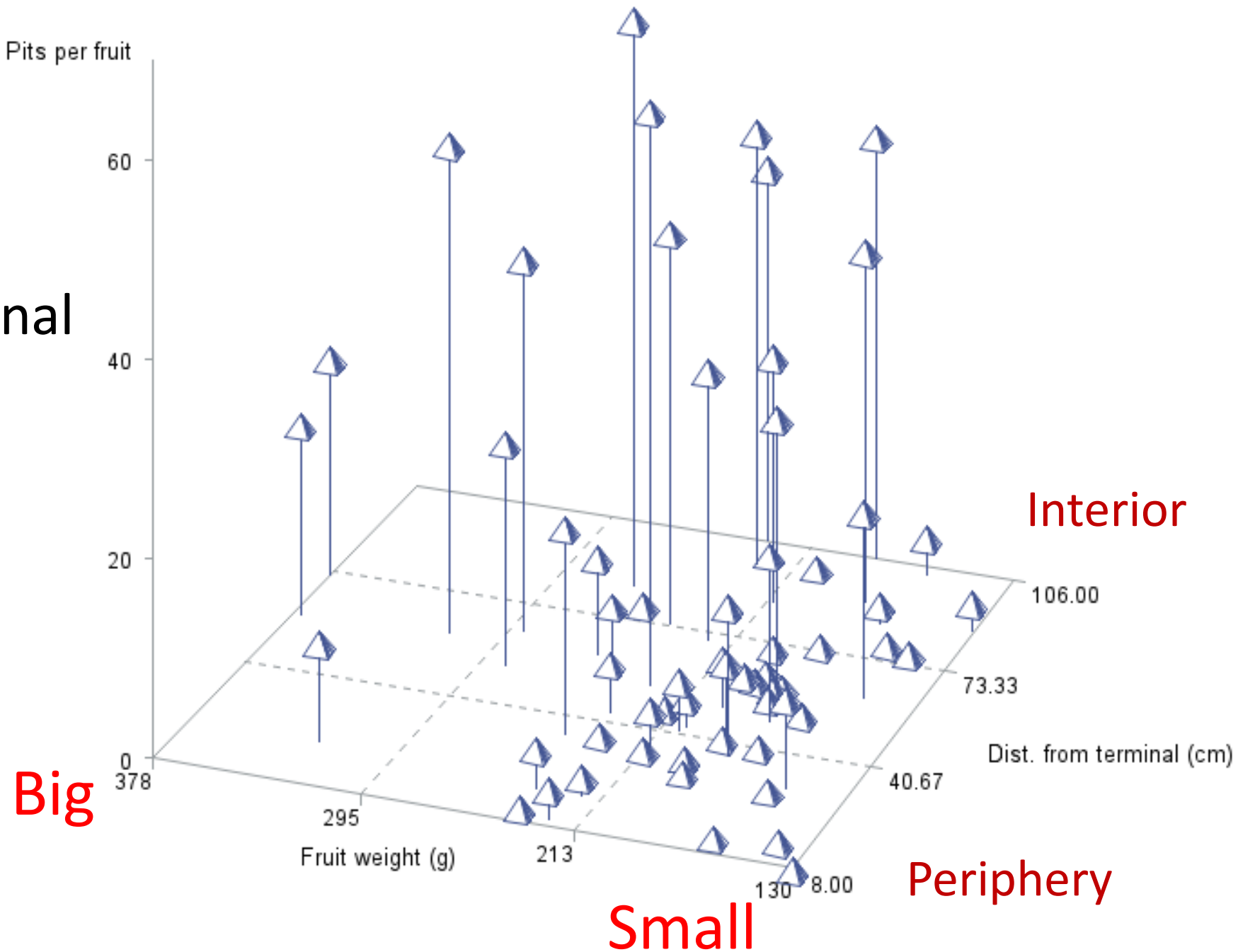
- Sampled Branches on trees with Low & high crop load
- High & low canopy position
- 4 sides of tree
 - shoot length/spur
 - No. leaves/spur
 - FW
 - % Red color

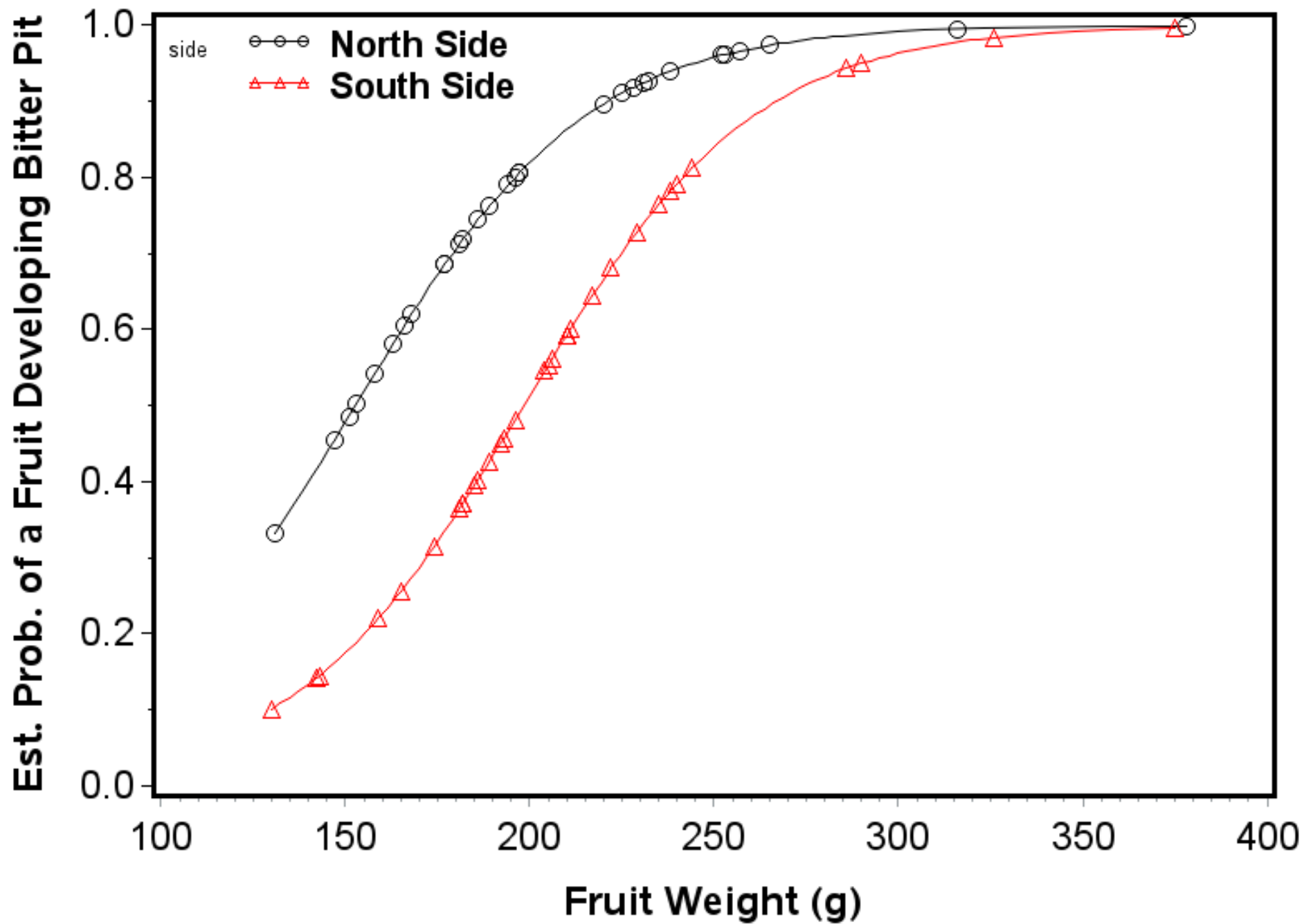
Recorded pits/fruit

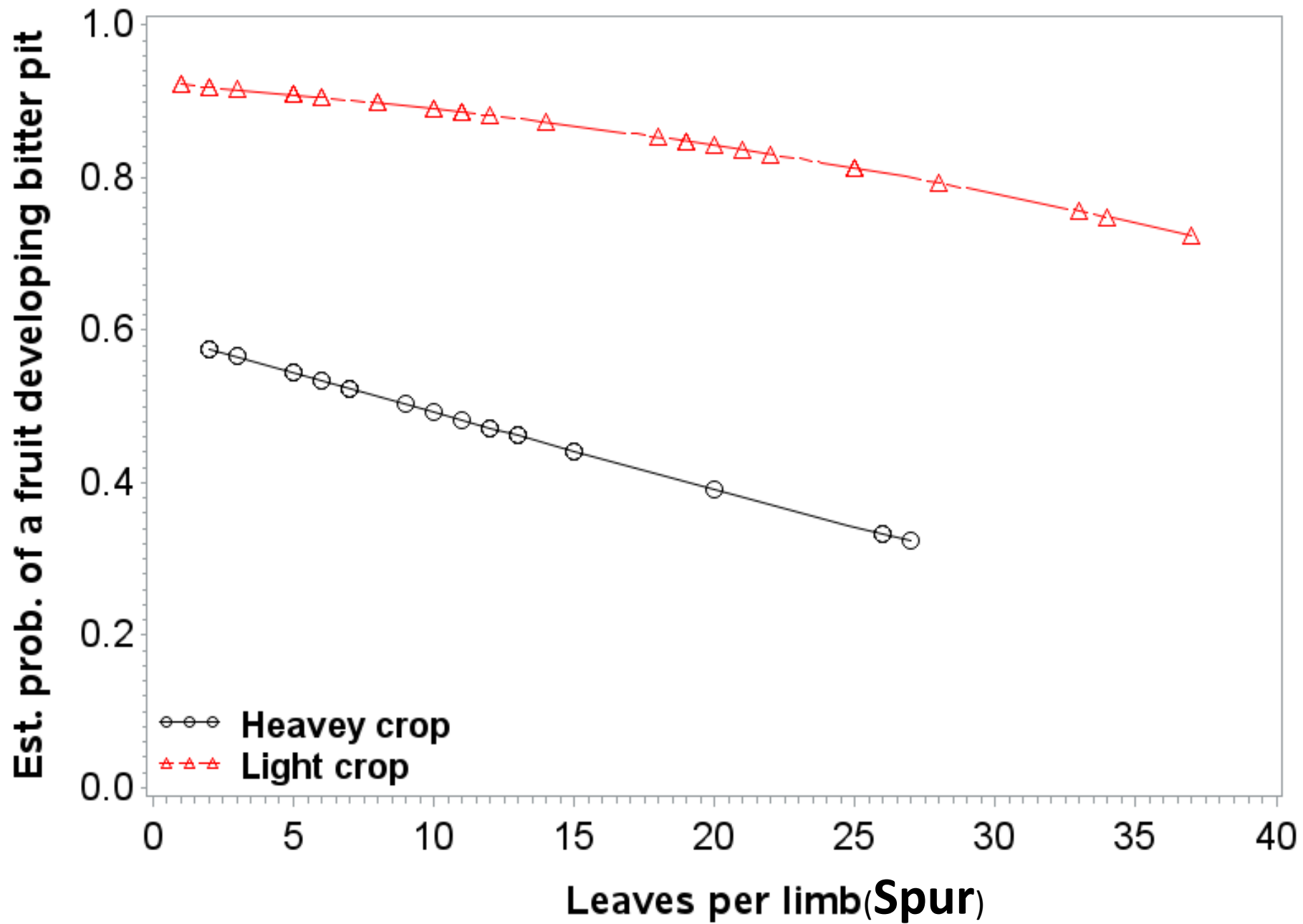


Logistic regression to estimate probability of a fruit developing bitter pit

Pits/fruit increase
with FW &
Distance from terminal



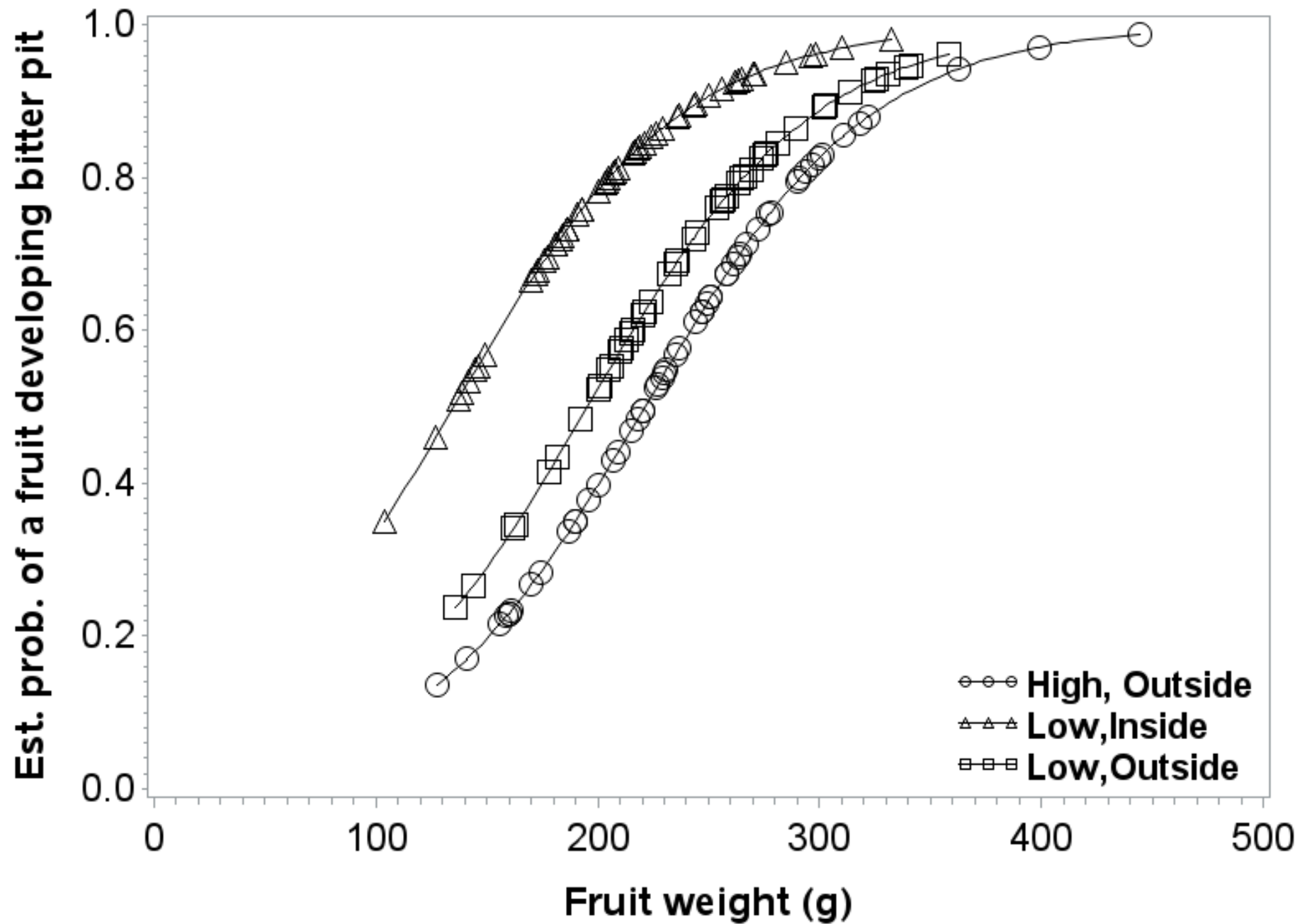


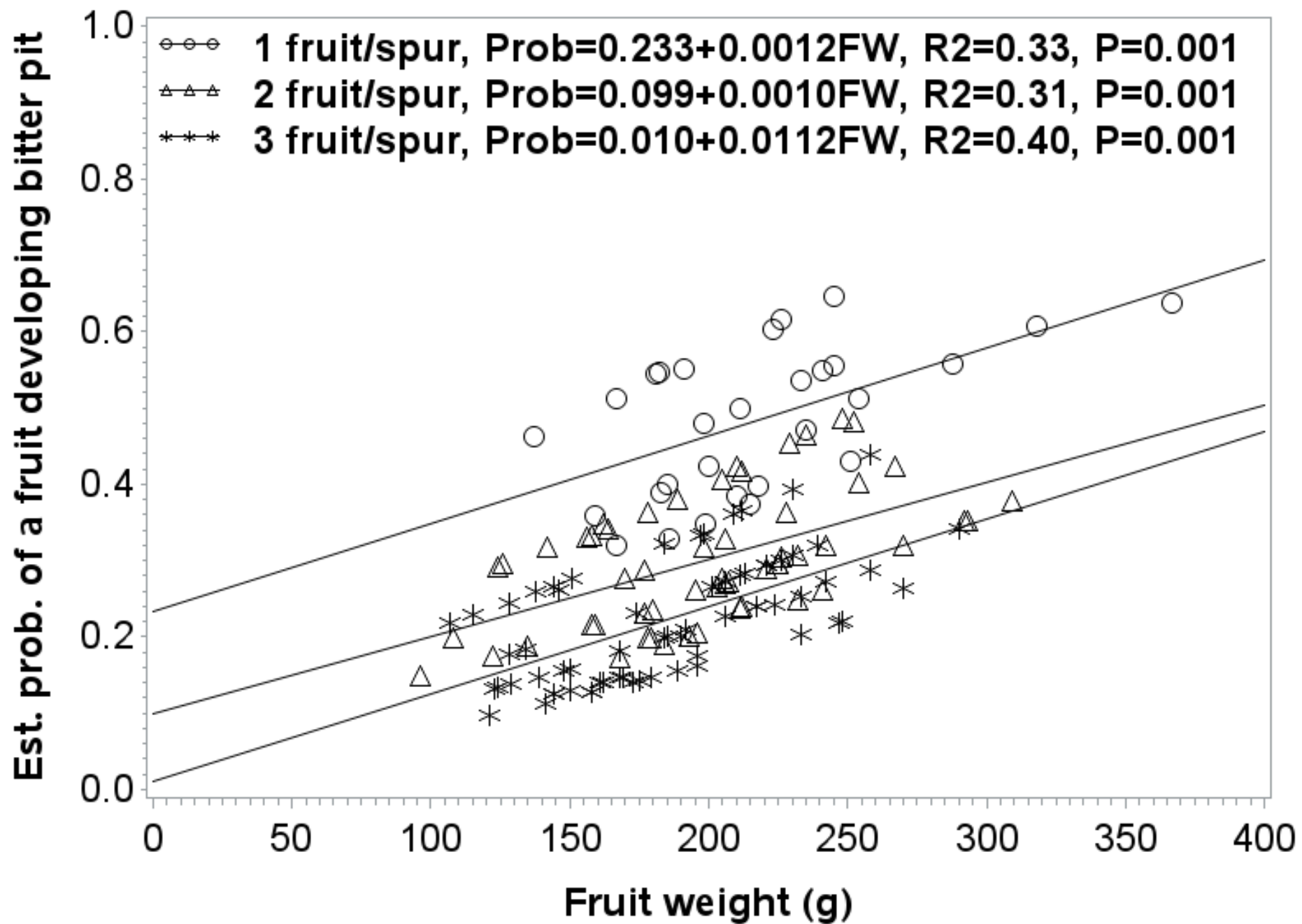


Rock Springs Experiment

Sampled spurs with varying numbers of fruit/spur from:
Inner vs. outside canopy on north & south side of tree,
plus high outside on south side

Recorded FW, shoot length/spur, no. fruit/spur, no. of pits/fruit
Estimated probability of a fruit developing bitter pit





Trees most likely to develop bitter pit

Light crops

High vigor (SL > 10")

High peel N/Ca > 10

Fruits most likely to develop bitter pit

Large fruit

Fruit on spurs with 1 fruit

Fruit from low shaded regions of canopy

Fruit on spurs with short bourse shoots (few leaves)

Considerations for Orchard Nutrition

- BP worse in dry years – poor Ca uptake
- Avoid excessive vigor – rootstock, manage crop load, avoid heavy pruning & N application
- Apply K and Mg judiciously
- Maintain soil pH to 6.5 to 7.0 with calcitic lime rather than dolomitic lime unless Mg is low
- Calcium sprays: 10 to 14 lbs actual Ca/A in 6 to 8 cover sprays
- **At labelled rates, many Ca products contain too little Ca, so make sure you are applying 10 to 14 lbs of actual Ca/A/season**

Rootstock Influences Bitter Pit

- Donahue et al. (2021) in NY: M26>M9 >B9
- Robinson & Fazio (2022) in NY: G210, M7, G814, B118 G41 >B9, G65, G214, M9
- Islam et al. (2022) in VA: B.10 had least of 14 stocks, V.6 & V.7 were highest
- Valverdi & Kalcsits (2021) in WA: M9=B9>G41=G890
- Kalcsits (2022 NC140 Rept.): G814, G890, G5257>G969
- Cowgill (personal com): G214 low BP
- Variable results due to many factors including crop load, fruit size, water stress

A large number of apples, many with dark spots, arranged on a dark surface. The apples are in various stages of ripeness, with some being mostly red and others mostly yellow or green. The dark spots are scattered across the apples, particularly on the yellow and green ones. The background is dark and out of focus.

Thank You!

Questions?