**Interim Progress Report for CDFA Agreement Number 17-0331-000-SA**

**Project Title**: Identification of grape cultivars and rootstocks with resistance to vine mealybug

**Principal Investigator**:
Rachel P. Naegele,
USDA ARS
9611 S. Riverbend Ave.
Parlier, CA 93648

**Cooperator**:
Monica Cooper,
UCCE
1710 Soscol Ave. Suite 4
Napa, CA 94559-1315

**Cooperator**:
Kent Daane,
UC Berkeley & UCCE
9240 S. Riverbend Ave.
Parlier, CA 93648

**Time period covered by report:** 10/4/18 to 2/22/19

**Introduction:**
Mealybugs are soft-bodied, sap-sucking insect pests of grapevines and other plants. Besides the direct losses attributed to damaged leaves and fruit in grape, mealybugs can transmit the economically important Grapevine Leaf Roll Associated Virus (GLRaV). It is estimated that GLR disease control costs growers $12,106 to $91,623 per acre annually in California (Ricketts et al., 2015). Of that expenditure, mealybug control costs are estimated at $50 per acre, in vineyards with small mealybug populations and many natural predators, to $500 per acre for vineyards with moderate populations and few parasitoids (Ricketts et al., 2015). Vine mealybug (VMB) (*Planococcus ficus*) is one of six mealybug species that threaten the California grape industry. This introduced (ca. 1994) pest can rapidly reproduce and spread, outcompeting other mealybug species and making it the most important mealybug pest of grape in CA (Daane et al., 2012).

Few sources of natural resistance to mealybug have been identified in grape. In Brazil, one study identified a single rootstock with lab-based resistance to mealybug (Filho et al, 2008). This resistance was described as a reduction in the number of viable offspring produced per female compared to susceptible cultivars, Cabernet Sauvignon and Isabel (Filho et al, 2008). This was later confirmed in a similar lab experiment performed by a different lab group (Bertin et al, 2013). These results, while promising, are based on mealybug species (*Dysmicoccus brevipes* and *Planococcus citri*) of minor importance to California vineyards. The only other report of mealybug resistance in grape comes from observations by Michael McKenry and David Ramming (unpublished), suggesting that rootstock RS-3 has resistance to an unknown species of mealybug in addition to nematode resistance. Identification of vine mealybug resistant grape material is the first step in breeding VMB-resistant plants.

**Objective (s):**
*Objective 1: Evaluate grape materials with identified resistance to vine mealybug.*
*Objective 2: Multi season sustainability of resistance to vine mealybug in identified grape rootstocks and varieties*

**Description of activities conducted:**
- Objective 1:

- Planted dormant cuttings of cultivars and species (10-17A, RS-3, IAC 572, Cabernet Sauvignon, Chardonnay, Autumn King, Valley Pearl, and Freedom for summer 2019 evaluations)

Fig 1. Dormant cuttings planted in a growth chamber

- Analyzed summer 2018 data for mealybug numbers (RS-3, IAC 572, Chardonnay, Cabernet Sauvignon, Flame Seedless, Valley Pearl and Autumn King)
- Maintained insect colony in the lab for inoculations in spring/summer 2019

Fig 2. Vine mealybug colonies maintained on organic butternut squash in the lab

- Objective 2:
  - Analyzed summer 2018 data for mealybug numbers (IAC 572, 10-17A, PCO-349, USDA 1-1, USDA 1-2, Cabernet Sauvignon)

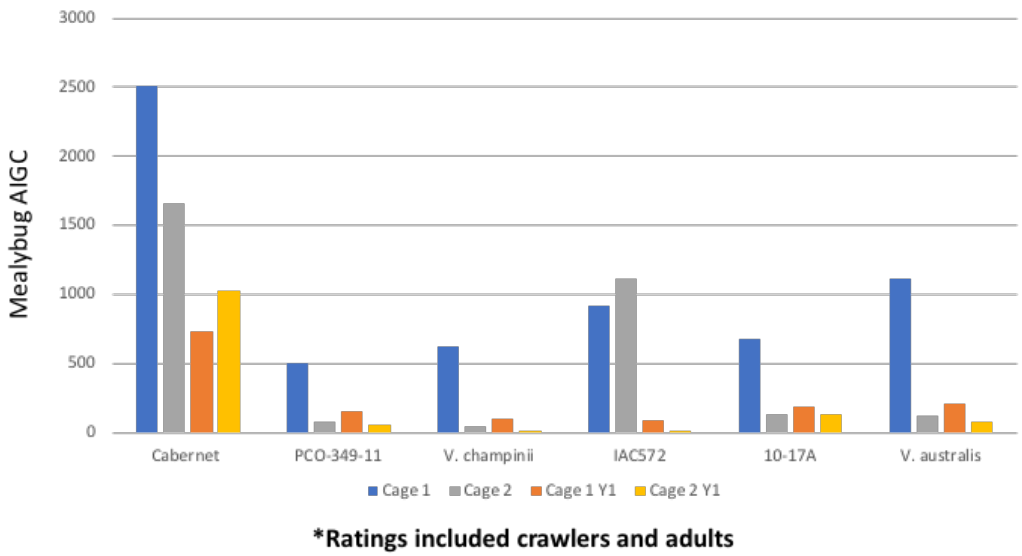


Fig 3. Vine mealybug AIGC (Area Under the Insect Growth Curve, i.e. a measure for population growth) for six cultivars evaluated over two years replicated across two cages. Y1 indicates year 1, orange and yellow. Year 2 data are represented by blue and gray bars.

**Publications produced and presentations:**

- Presented research updates to the CDFA PD/GWSS at the December 2018 meeting (oral and poster), and wrote the accompanying proceedings paper

**Relevance statement**

This project has identified up to four potential sources of resistance to vine mealybug. At least one source is currently available as a rootstock. In addition, crosses have been made between one of the potential sources of resistance and *V. vinifera* to work towards the long-term goal of breeding mealybug resistant grapes.

**Layperson summary**

Based on our work, some grape rootstocks and species appear to be resistant to vine mealybug. Further work is needed to confirm these results.

**Status of funds**

To date, approximately $18,355.79 have been spent. These monies have been spent on labor (counting mealybugs, propagating and maintaining plants and mealybug colonies), lab supplies (maintaining mealybug colonies in the lab), irrigation supplies (maintaining plants in field in greenhouse).

**Summary and status of intellectual property**

No intellectual property has been generated through this project.

**Literature cited**

Bertin A., Bortoli L.C., Botton M., and Parra J.R.P. 2013. Host Plant Effects on the Development, Survival, and Reproduction of *Dysmicoccus brevipes* (Hemiptera: Pseudococcidae) on Grapevines. Annal Ent Soc Amer 106:604-609.

Daane K.M., Almeida R.P.P., Bell V.A., Walker J.T.S., Botton M., Fallahzadeh, M., and Mani M. 2012. Chapter 12: Biology and Management of Mealybugs in Vineyards in Arthropod management. In. Bostanian N.J., Vincent C., and Isaacs R. (*Eds*) Vineyards: Pests, Approaches, and Future Directions. (Eds) Springer, Dordrecht pp.271-307

Filho M., Grutzmacher A.D., Botton, M., Bertin A. 2008. Biology and fertility life table of *Plannococcus citri* in different vegetative structures of grape cultivars. Pesq. agropec. bras. Brasilia. 43:941-947.

Ricketts K.D., Gomez M.I., Atallah S.S., Fuchs M.F., Martinson T.E., Battany M.C., Bettiga L.J., Cooper M.L., Verdegaal P.S., Smith R.J. 2015. Reducing the Economic Impact of Grapevine Leafroll Disease in California: Identifying Optimal Disease Management Strategies. Am J Enol Vitic 66:2 pp 138-146.