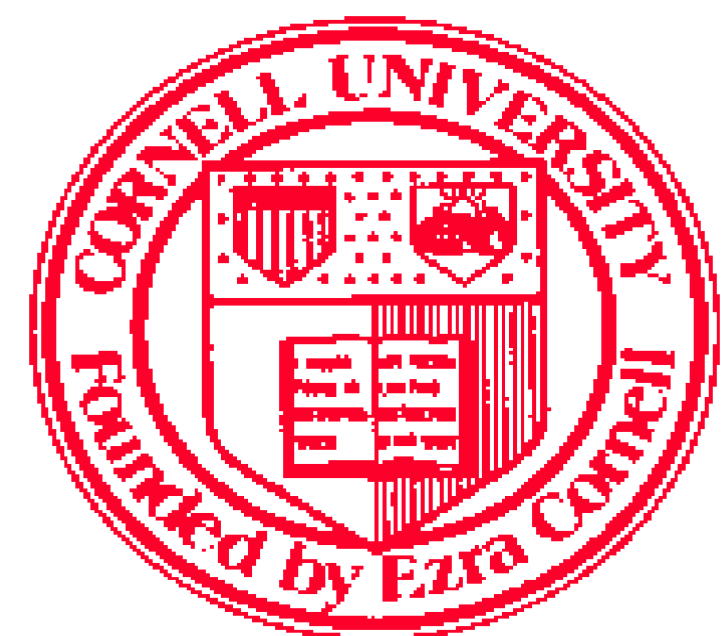


Breeding Designer Apple Rootstocks to Match Nutrient Parameters under Organic Management



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INTRODUCTION

Rootstocks are the foundation of a healthy, productive and profitable organic apple orchard but can also be the weak link if fire blight infects or cold temperatures damage the orchard. Our goal is to identify and deploy improved apple rootstocks for organic apple growers with a range of vigor levels, that have high productivity, high fruit quality, resistance to several important diseases, improved fruit mineral nutrient uptake, reduced fruit disorders related to mineral nutrient imbalances and resiliency to climate change.

MATERIALS AND METHODS

We are conducting field trials of rootstock performance of released and unreleased Geneva® rootstocks at three orchards (Two are at the NYS Agricultural Experiment Station and one at an organic grower's farm in Appleton NY.). We have recorded tree survival, vigor, productivity, fruit size and fruit quality. We have also measured fruit mineral concentrations. Rootstock genotype means resulting from these analyses were used in a multivariate analysis to generate correlation matrices and two-way similarity cluster diagrams based on genotype and variable similarities.

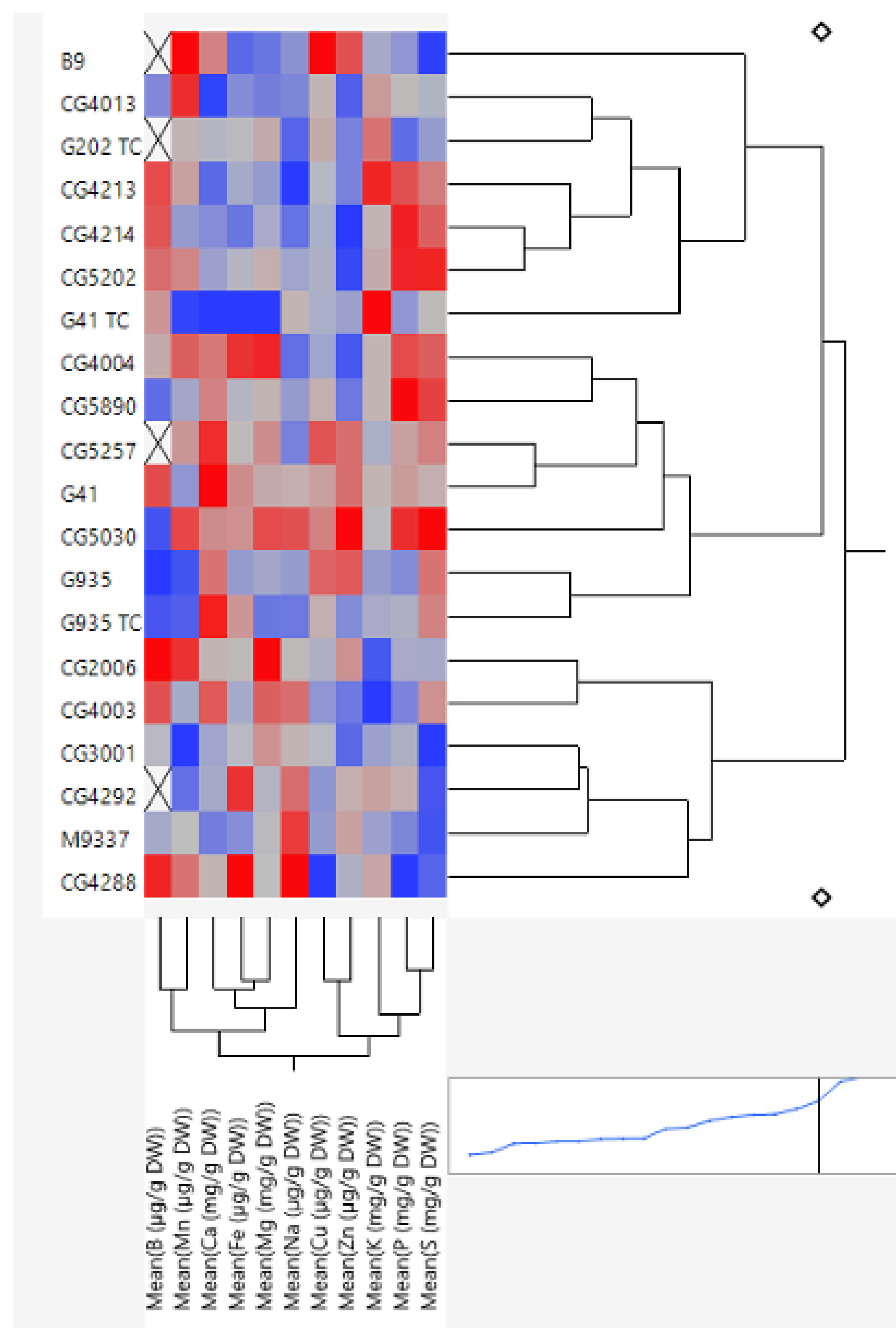
We are using the data on productivity and mineral nutrient profile to identify new rootstocks suited for organic production from among newly released and unreleased advanced test selections from the Geneva® apple rootstock breeding program (jointly operated by Cornell University and USDA-ARS).

We also will deploy trees on improved rootstocks to interested organic apple growers. We will extend the results of the project by deploying an online smart rootstock recommendation tool that considers the location, soil, and cultivar of the new orchard to then provide rootstock recommendations for organic apple growers.

RESULTS

We have assembled an extensive database of nutrient absorption and translocation potential in conventionally managed apple orchards and at first inspection some rootstocks seem to behave very differently in organic management. For example, in the grower plot we collected samples from 20 rootstock types and the leaf nutrient data showed that G.935 rootstock imparted low values of boron (Figure 1), which we know from datasets we developed from conventional management plots, is usually in the top 20th percentile of all rootstocks. An unreleased rootstock genotype, CG.4004, (G.484) seems to have had the best concentration of sulfur (which is synonymous with nitrogen) and one of the best K/Ca ratios (medium K and higher Ca) than most other rootstocks (Figure 2). These nutrient absorption characteristics will make it a great rootstock for 'Honeycrisp' apple cultivar in organic production. Another unreleased rootstock that has performed very well is G.257.

Because of their good performance we have named and released for commercial use both of these outstanding rootstocks as G.484 and G.257 (Fazio and Robinson 2023). Other named Geneva® rootstocks which have shown superior performance in our organic field plots are G.935, G.969, G.41 and G.66.



Honeycrisp on G.484

DISCUSSION

Through this project we are identifying rootstocks suited for organic production from among disease resistant Geneva® apple rootstocks. The best rootstocks we have identified have a range of vigor levels, high productivity, high fruit quality, resistance to several important diseases, improved fruit mineral nutrient uptake, reduced fruit disorders related to mineral nutrient imbalances and resiliency to climate change affecting organic apple production.

To accelerate the adoption of these new rootstocks by organic apple growers, we are extending this information through publications, presentations at grower meetings, field days, and an online, smart rootstock recommendation system that will allow organic apple growers to receive a specific recommendation of the best rootstock choice considering climate, soil, cultivar and location.

We also are in the process of producing trees on the 6 promising rootstocks which we plan to distribute to organic apple growers free of charge so they can see their performance on their own farm. These trees will feature two scab resistant scion cultivars (Story and Triumph) and the best fire blight and replant disease tolerant rootstocks we have identified (G.257, G.484, G.66, G.41, G.935 and G.969).

The online smart rootstock selection tool will consider soil type, scion cultivar vigor, climate vigor and grower nutrient input plan to select/recommend the best rootstocks for each new organic orchard. To develop the tool, we have compiled information from our field trials on rootstock productivity, nutrient uptake profile, nitrogen supplying power of various soils, scion cultivars vigor and heat-unit for various apple growing regions.

CONCLUSIONS

Through this project we have identified and released several new Geneva® apple rootstock that have improved performance in organic orchards compared to traditional rootstocks. We are fast-tracking the extension of this information to organic apple growers via an online, smart rootstock recommendation system and by providing trees on the new rootstocks to organic apple growers to try on their farm.

REFERENCE

G. Fazio and T. Robinson. 2023. New releases from the Geneva® apple rootstock breeding program. Fruit Quarterly 31:(1):29-33.