Evaluation of new nematode resistant rootstocks for table grape producton

Jennifer M. Hashim-Buckey, Donald Luvisi and Peggy L. Schrader

UC Cooperative Extension, 1031 S. Mt. Vernon Avenue, Bakersfield, CA 93307, U.S.A,

INTRODUCTION

Plant parasitic nematodes are the primary root pests of grapevines grown in warm, table grape growing regions of California and several species (*Meloidogyne* spp.) cause significant economic damage (Anwar et al., 2000; Anwar et al., 2002c). A common management practice to overcome the damaging effects of nematodes is to use resistant rootstocks. Prior to selection, rootstocks are subjected to rigorous tests in which they are screened against a variety of nematode species and populations (Anwar et al., 2002c). While rootstock resistance is generally determined from laboratory and greenhouse experiments, it is difficult to know how they will respond in a field situation. Furthermore, resistance to one species of nematode does not guarantee resistance to all other species or to populations of the same species (Anwar et al., 2002c); and many other nematode species feed on and can cause serious damage to the root system of grapevines, including the dagger nematode (*Xiphinema index* and *Xiphinema americanum*), the ring nematode (*Mesocriconema xenoplax*), the citrus nematode (*Tylenchulus semipenetrans*), the root-lesion nematode (*Pratylenchus vulnus*) and several other less common species (McKenry et al., 2004).

Moreover, new government mandates to improve air quality in the San Joaquin Valley may force significant reductions in emissions by soil fumigants and increase the role that resistant rootstocks play in vineyard establishment. The questionable availability of effective fumigants and post-plant nematicides coupled with weak resistance mechanisms of commonly used rootstocks to some *Meloidogyne* species have driven plant breeders and nematologists to focus their efforts on developing plant materials with broad and durable nematode resistance (Anwar et al., 2002a,b,c; Walker, 2005). However, once a research program develops new resistant rootstocks, they must be evaluated for horticultural characteristics they impart to the scion including vine vigor, yield, fruit quality and mineral nutrition. These studies were initiated to evaluate rootstock effects on horticultural characteristics of table grape cultivars and to follow and document their performance in the presence of various nematode species and population levels over time.

MATERIALS AND METHODS

Vineyard sites and experimental design. Two sites were selected in Kern County, California to evaluate the field performance of new nematode resistant rootstocks USDA 10-17A, USDA 10-23B, USDA 6-19B, RS-2, RS-3, RS-9, 89-1302 and 8913-21 and the conventional rootstocks Freedom, 1103 Paulsen, Schwarzmann and Ramsey. The studies were conducted in commercial table grape vineyards and the scion cultivars examined were Thompson Seedless and Princess. The Thompson Seedless site was fumigated with methyl bromide (336.8 kg/ha) prior to establishing the vineyard in 1999. The vines were bilateral cordon trained with a combination of spurs and short canes, trellised on a double crossarm system and spaced 2.4 m (between vines) X 3.7 m (between rows). The soil texture at this site was described as a sandy loam and the vineyard was drip irrigated. The Princess site was established in 2002. The soil was not fumigated at this site as the area was previously non-agricultural rangeland. The vines were drip irrigated, cane pruned, trained on an open gable trellis system and spaced 1.8 m (between vines) X 3.7 m (between rows). The soil texture at this site was described as a fine, sandy loam. Both sites were established as completely randomized block designs and were approximately 0.35 hectares in size. Each site consisted of ten rootstock treatments, five replications and six to nine vines per replicate.

Sample collection, analyses and statistics. Rootstock effects on mineral nutrition were determined by petiole sampling at full-bloom for plant tissue analysis (NO_3-N, P, K, Zn, Na, Cl). Berry size and composition were determined at harvest from 100 berry samples collected from random clusters on data vines. Fruit yield was determined by pre-harvest cluster counts and by weighing pre-graded marketable and cull (inferior) fruit at harvest. Pruning weight measurements and soil core sample (0- to 60-cm depth) collection for nematode population analysis were performed during the dormant period. Four years (2003

to 2006) of data in the Thompson Seedless study and two years (2004 to 2005) of data in the Princess study were accumulated and analyzed to assess the performance of rootstocks over time. Data were subjected to analysis of variance and significant differences in means were separated using DMRT (SAS Institute Inc., Cary, NC).

RESULTS AND DISCUSSION

Rootstock effects on vine vigor and fruit yield. Rootstock selections 10-23B and 6-19B significantly reduced scion vigor. Additionally, 6-19B was not suitable for grafting to moderate vigor cultivars due to poor canopy development and subsequent discoloration of ripening white fruit. In contrast, vine vigor typically increased when grafted to 1103 Paulsen, Ramsey, Freedom or RS-3. At the Thompson Seedless site, vines grafted to Freedom and Schwarzmann performed best in terms of marketable yield, producing on average 2,103 and 2,077 10-kg boxes per hectare, respectively. 10-23B and 10-17A were superior performers compared to own root vines and other rootstock treatments in terms of marketable yield at the Princess site, producing on average 2,751 and 2,497 10-kg boxes per hectare. Princess vines on their own roots and those grafted to other rootstocks exhibited poor fruit set, early bunch stem necrosis (EBSN) and significantly reduced yield in 2005. Cluster number was reduced by ≥ 45% in all rootstock treatments except for those grafted to 10-23B. Vines grafted to 1103 Paulsen, 6-19 B and RS-9 were severely affected, with ≥ 75% crop lost due to the disorder. The only rootstocks resulting in adequate yields in 2005 were 10-23 B and to a lesser extent 10-17 A, with approximately 18 kg (2,691 10-kg boxes/ha) and 11 kg (1,645 10-kg boxes/ha) of fruit harvested per vine respectively. Results of this study suggest rootstock may influence the incidence of EBSN.

Rootstock effects on mineral nutrition. Nutrition status of the scion variety was influenced by rootstock selection. Rootstocks which resulted in higher levels of petiole nitrate-nitrogen values included Freedom, Ramsey and 6-19B, while own root vines resulted in the lowest values. Ramsey, 1103 Paulsen, Schwarzmann, RS-2 and RS-3 increased tissue phosphorus levels while Freedom and 6-19B increased potassium levels. Sodium and chloride levels were highest in own root vines. Own root vines typically had the highest zinc values, while vines grafted to Freedom had generally lower zinc levels.

Rootstock effects on nematode populations. The dagger nematode (*X. americanum*) was the primary soil pest at both trial locations. At the Thompson Seedless site, *X. americanum* levels began to build following planting in 1999 and by 2002 the own root vines hosted an average of 312 nematodes per 250 mL^3 of soil sampled. The population peaked on nearly all rootstock treatments (except 10-17A) in 2004 and 2005 and then decreased to lower numbers in 2006 and 2007. Population densities of *X. americanum* were highest on own root vines and lowest on vines grafted to 10-17A.

ACKNOWLEDGEMENTS

The authors would like to thank the California Table Grape Commission and the California Grapevine Rootstock Improvement Commission for funding this study.

REFERENCES

1. Anwar, S.A. & McKenry, M.V., 2000. Penetration, development and reproduction of *Meloidogyne arenaria* on two new resistant *Vitis* spp. Nematropica 30, 9-17.
2. Anwar, S.A. & McKenry, M.V., 2002a. Developmental response of a resistance-breaking population of *Meloidogyne arenaria* on *Vitis* spp. J. of Nemat., 34, 28-33.
3. Anwar, S.A. & McKenry, M.V., 2002b. Penetration and development of *Meloidogyne arenaria* on two new grape rootstocks. J. of Nemat. 34, 143-145.
4. Anwar, S.A. McKenry, M.V. & Ramming, D., 2002c. A search for more durable grape rootstock resistance to root-knot nematode. Am. J. Enol. Vitic. 53, 19-23.
5. McKenry, M.V., D., Anwar, S.A., Schrader, P & Kaku, S., 2004. Eight-year nematode study from uniformly designed rootstock trials in fifteen table grape vineyards. Am. J. Enol. Vitic. 53, 19-23.
6. Walker, A. Moving forward with new table grape rootstocks. In: Proc. of the SJV Table Grape Seminar. Feb., 2005.