Grafting Eggplant for Verticillium Resistance

Michael D. Orzolek* and Guoyang Lin+
*Director, PSU Center for Plasticulture
+ Dept. of Horticulture, The Pennsylvania State University
University Park, PA 16802  mdo1@psu.edu

The benefits of using rootstocks for improving plant characteristics have been reported many decades ago. The success of utilizing rootstocks for grafting has resulted in increased yields, increased fruit quality, and an increased tolerance to abiotic and biotic stresses. Grafting to generate a somatic hybrid will significantly reduce the duration and the cost of traditional plant breeding due to evaluating and breeding rootstock independently. This technique will also adopt quickly to meet the challenge from new and constant mutations of soil-borne disease pathogens. However this crop improvement technique has been limited in the past to perennial fruit trees, forest trees and ornamental plants. There was limited research on annual vegetable crops until the last several decades when the grafting vegetable crops movement started in Asian and Europe. In 1990 in Japan which utilizes extensive grafting in their vegetable industry, 59% of the production area of watermelon, cucumber, melon, tomato and eggplant had used grafted transplants in their field production. The percentage has gone up to 92% for watermelon in 1999. Asian researchers have demonstrated success in overcoming tissue damage and/or plant mortality caused to vegetable crops by the soil-borne diseases Fusarium wilt (there are some varieties resistance to Race 0 and 1, but there is not commercial variety resistance to Race 2 and 3), Verticillium wilt and bacterial wilt as well as nematodes. Unfortunately there are very few reports of using vegetable rootstock grafting techniques in the United States. One report from USDA-ARS discussed the affect of rootstock on watermelon fruit quality and resistance to the soil borne fungi Fusarium. Some preliminary reports have shown a potential increase of up to 30% lycopene content in some grafted seedless watermelon varieties. However, there is an emerging interest in the United States in grafting vegetables in the last several years. A paper by King and Davis, (2007) discussed results on “hot topics for watermelon research including “A survey of the industry” in which growers prioritized grafting as the second priority just below Gummy Stem Blight on the importance list.

There is currently no commercial eggplant variety that is resistant to Verticillium Wilt caused by the fungus *Verticillium* spp. in the United States. Verticillium wilt causes stunting of eggplant, interveinal chlorosis, wilting of generally half the eggplant and in some cases plant mortality. Even if Verticillium does not kill the eggplant, it will significantly reduce marketable fruit yield. This soil borne disease is able to persist in the soil for many years. Even growing eggplant on raised beds with plastic mulch and drip irrigation will not prevent Verticillium wilt from reducing marketable fruit yield by 25% to 30% per acre. Typically plants become infected within 3 to 5 weeks after being transplanted in the field. The earlier an eggplant is infected with Verticillium wilt, the greater potential for yield loss and reduction in fruit quality. Because of the severity of this disease, a crop rotation interval of 5-7 years is required before eggplant can be grown again in a previously infected field of Verticillium.

In 2007, fifty eggplant scions were grafted onto tomato rootstock that was resistant to Verticillium Wilt. The cleft grafting method was used for this trial conducted at the Department of Horticulture’s greenhouses in early spring. Instead of using clips to secure the scion/rootstock
of the grafted plant, a natural rubber latex tube was used to secure the graft. In cleft grafting, the stem of the scion and the rootstock are cut at right angles, each with 2-3 leaves remaining on the stem. The tube is placed to the cleft cut rootstock. The stem of the scion is cut in a wedge, and the tapered end fitted into a cleft cut in the end of the rootstock. The graft is held firm with the tubing. This method of grafting also reduces water lose. After the eggplant scion has been grafted onto the tomato rootstock (almost all tomato hybrids are resistant to Verticillium Wilt-V), the grafted plant is then placed in a grafting chamber to heal and acclimate the graft to environmental conditions and increase the potential for the graft to take (about 10-14 days). The standard grafting tunnel is covered with materials which provide shade and maintain a high internal humidity. Generally, a silver/white cheese-cloth is used to cover the outside of the structure and transparent plastic film inside the graft chamber. During acclimatization, it is recommended to keep light levels low and humidity high (90%).

Figure 1. Grafting chamber that is 4’ wide x 8’ long x 3’ high and made of PVC pipe and 3 layers of material: bottom – transparent, UV-resistant polyethylene film, middle material– black shade cloth (70% shade), and top material – silver shade cloth (70% shade).
After 7 to 9 days, most scion and rootstock grafts have grown together and can be moved out of the grafting tunnel to a greenhouse or high tunnel. These grafted plants should than be acclimated (hardened-off) for 3 to 4 days to the temperature, wind and moisture extremes they will be exposed to once transplanted into the field.