GRAFTING AS AN ALTERNATIVE TO MB IN VEGETABLE PRODUCTION IN TURKEY

Yilmaz, S*., Göçmen, M., Ünlü, A., Firat, A.F, Aydinşakir, K.,. Cetinkaya, S., Kuzgun, M., Çelikyurt, M.A., Sayin, B., and Çelik, I.
Bati Akdeniz Agricultural Research Institute, Antalya, Turkey.

Protected horticulture started in 1940 in Turkey in the region of Antalya; presently, total vegetable production is about 26 million tonnes, which places Turkey as the fifth largest producer in the world after Brazil, China, India and the USA (Mediterranean Fresh Vegetable and Fruit Exporter Union, 2006, pers. comm.). The main crops produced are tomato, with a 40% share of the horticultural sector, watermelons (15%), onions (9%), peppers (7%) and melons (7%) (Titiz, 2004). Vegetable exports were valued at $225 million USD (274.000 tonnes) in 2006.

MB was one of the traditional, preferred options for controlling soil-borne pathogens in horticulture. In 2000 Turkey reported a consumption of 487.6 tonnes of MB in this sector including floriculture. After two demonstration projects on alternatives had been undertaken with funding from the Multilateral Fund by UNIDO and the World Bank, which helped determine the alternatives most suited to Turkish conditions (Öztürk *et. al*, 2002), an investment project *"Phase out of MB for soil fumigation in protected horticulture and cut flower production in Turkey"* was started with UNIDO as implementing agency in 2003. The project calls for complete and advanced phase-out of MB by the end of 2007. Consumption has been decreasing in accordance to the phase-out schedule established through the project (Table 1).

Over the past decade, adoption of the seedling grafting technique in the vegetable sector in Turkey has been very significant: from a mere 70,000 grafted plants in 1998 to over 51 million plants at present (Fig. 1). The technique has proven particularly successful in field grown watermelons, where about 50% of the growing area presently uses this technique. It is also being increasingly used in tomatoes (32% of the area), where combined with solarization it gives excellent results; and in eggplant, which has started to expand more recently when suitable rootstocks were introduced (Yilmaz *et al.,* 2006, 2007).

Although grafted plants are expensive (USD $0.6-0.8 per unit), the total cost of this alternative is lower than MB ($2,680/ Ha in comparison with $3,350/ Ha for MB) (Yilmaz *et al.,* 2006, 2007). The increase in seedling cost is offset by lower planting densities and higher yields, often accompanied by better quality; in watermelons, for example, the planting density was cut by more than half when using grafted plants (2,500-3,000 grafted plants/ Ha vs. 7,000-8,000 non-grafted). Yields increased from two to 3.5 times according to the rootstock used, mainly as a result of disease control (namely *Fusarium oxysporum* f.sp. *niveum,* which affected between 10 and 30% of the non-grafted plants) and increased fruit weight and number (Yilmaz *et al.,* 2006, 2007).

Yields in grafted eggplants increased by 25-30% in comparison to non-grafted plants. Notably the quality of the fruits in grafted plants was much higher than the quality of the fruits in non-grafted plants and they achieved better prices on market. The planting density (16,000-25,000 plants/ Ha) does not vary significantly due to the particular structure of the plant; however, some growers are finding it possible to leave grafted plants in production for several years. Losses from diseases and nematodes are minimum (Yilmaz *et al.,* 2007).

Yields in grafted tomato increased by about 35% when using grafted plants, depending on the rootstock. With the aid of solarization (6 to 8 weeks, during the summer months of June, July and August), damage due to *Fusarium o.* f. sp. *lycopersici, Fusarium o.* f. sp. r*adicis-lycopersici* and root-knot nematodes (*Meloidogyne spp.*) was avoided. Planting density was again reduced by half when using grafted plants (15,000-17,000 grafted plants/ Ha vs. 28,000-32,000 non-grafted) (Yilmaz *et al.,* 2006, 2007).

Grafting trials for the second year will soon be finished and will be followed by a third year for further confirmation of results. Since its inception, the project has worked with model farms that agree to work with alternatives and implement them under commercial conditions. Once the model farms are having success, a larger group of growers is supported with technical assistance and necessary materials (rootstock seedlings, plastic and others) so they can also implement the technique. An even larger group is monitored and offered technical assistance, to ensure dissemination and proper adoption of the alternatives. Overall, 48 model farms have participated in the grafting seedling technique; 2270 growers were supported and more than 12.000 people have been trained through the project on MB alternatives, where IPM and GAP were an essential part of training.

REFERENCES

Mediterranean Fresh Vegetable and Fruit Exporter Union, (2006) Personal communication

Ozturk, A., Yilmaz, S., Kececi, M., Unlu, A., Deviren, A., Ozcelik, A., Cetinkaya, S., Cevri, H., Akkaya, F. And Ozkan, C. F. (2002). Alternatives to methyl bromide for tomato and cucumber production in Turkey. *Proceeding of Alternatives to Methyl Bromide*. Sevilla, Spain. pp. 194-199.

Titiz, Ş. (2004). Modern Seracılık Yatırımcıya Yol Haritası. Antalya Sanayici ve İş adamları Derneği. Antalya.

Yılmaz, S.,Ünlü, A., Gocmen, M., Mutlu, M., Aydinsakir, K., Fırat, F. F., Kuzgun, M., Celikyurt, M. A., Sayın, B. And Çelik, İ. (2006). Phase out of methyl bromide for soil fumigation in protected horticulture and cut flower production in Turkey. Final Report, 2006. Antalya, Turkey.

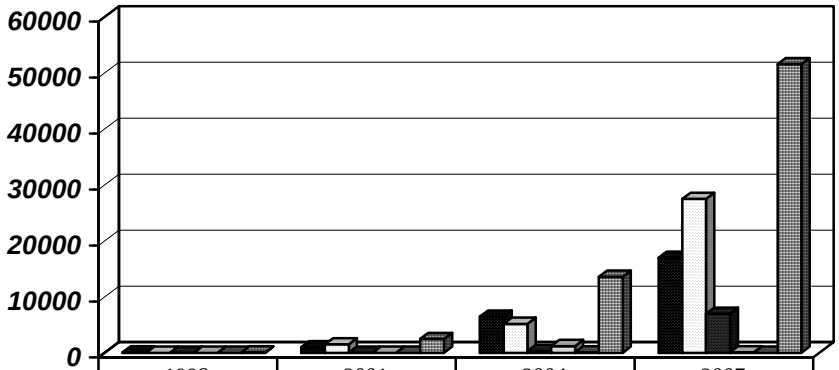
Yılmaz, S., Gocmen, M., Ünlü, A., Aydinsakir, K., Baysal, O., Kuzgun, M., Celikyurt, M. A., Sayın, B. And Çelik, İ. (2007). Phase out of methyl bromide for soil fumigation in protected horticulture and cut flower production in Turkey. First Progress Report, 2007. Antalya, Turkey.

Table 1. MB Phase-out Schedule in Agricultural Sectors in Turkey

Horticulture and Cut-flower Sub-Sectors				Total Methyl Bromide Consumption* Including Horticulture and Cut-Flower Sub-Sectors	
Year	**Expected Reduction (ODP tons)**	**Consumption (ODP tons)**	**Consumption (tons)**	**Consumption (ODP tons)**	**Consumption (tons)**
2000	0.0	292.2	487.6	342.6	571.0
2001	0.0	292.2	487.6	332.6	554.3
2002	29.3	263.6	439.3	293.4	489.0
2003	58.6	204.7	341.1	225.4	375.7
2004	58.6	146.1	243.5	167.4	279.0
2005	87.9	58.2	97.0	78.4	130.6
2006	58.6	00.0	00.0	20.4	34.0

*****MB consumption for quarantine, pre-shipment and laboratory use is not included

Figure 1. Commercial adoption of grafting in vegetable crops in Turkey



	1998	2001	2004	2007
Tomato	70	1000	6500	17000
Watermelon	0	1500	5200	27500
Eggplant	0	0	300	7000
Melon	0	0	1200	80
Cucumber	0	0	100	0
TOTAL	70	2500	13600	51580

Figures in thousands of units