

## **Study Tour for Three Participants from Turkey on alternatives to Methyl Bromide for Floriculture**

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### **INTRODUCTION**

As part of the project MP/TUR/03/108 - “Phase-out of methyl bromide in protected tomato, cucumber and carnation crops”, implemented by UNIDO and which is presently ongoing, a study tour for three participants from that country to Colombia was organized. This investment project will signify complete phased-out of MB in the flower sector of turkey by the year 2007 and flower growers are in need of information and practical experience on alternatives, particularly production in substrates. Colombia was selected for this study tour given that this country does not use any MB for flower growing and yet is the second flower exporter in the world, with over 6000 Ha under production.

A description of the alternatives observed and the agenda followed during this tour follows.

### **ALTERNATIVES TO METHYL BROMIDE FOR FLORICULTURE WHICH HAVE BEEN COMMERCIALY ADOPTED IN COLOMBIA**

Colombian flower growers do not use MB and have never relied on this chemical; thus, observation of practices in place to control and manage soil borne pests and diseases that can threaten production was of particular interest. A description of the alternatives observed for this purpose follows below. It should be stressed that results obtained are only optimal if these alternatives are implemented with an integrated approach, also analyzed.

#### **1. Integrated Pest Management**

Substituting or avoiding methyl bromide requires a grower to take a new approach towards producing flowers. There is no single replacement for this product; rather, a whole program, involving different measures which together lead to disease reduction is the answer.

In different parts of the world, several alternatives to methyl bromide are already in use in cut flower production, often with excellent results. Depending on circumstances related to environmental conditions, supplies, infrastructure available and others, one or another of these alternatives might be more suited for a particular grower. However, the best option is to combine them in a program so that together, they lead to the best results. In simple terms, an Integrated Management approach is the answer.

In essence, IPM involves making use of all possible resources - not just chemical control - to reduce and prevent the incidence and effects of a given disease or pest. Crop sanitation, disease-free plant material, physical and cultural controls, disease or pest resistant varieties, scouting for diseases and record keeping among others, are thus very important ingredients of

IPM, all of them in some way contributing to pest reduction, and leading to far less usage of chemical pesticides. To many authorities, IPM is at present the only real and long lasting solution to severe diseases and pests attacking many crops.

It is essential to detect pests and diseases at the earliest possible stage, treating foci as soon as they appear and using options different to chemicals as presented above, whenever feasible. In summary, IPM requires a grower to learn to recognize symptoms caused on plants by pests or diseases, understand the life cycle of a pathogen, its epidemiology and dissemination, surviving forms, alternate hosts and others.

In its practical application IPM leads to excellent results not only by improving the efficiency of the business but because over time, it represents significant savings as for example less pesticides are used; natural resources are better preserved. This is much in line with stringent demands from international markets, wanting to buy environment friendly flowers; in fact, that many supermarket chains in Europe are buying only flowers grown under environmentally sustainable conditions. The main components of an Integrated Pest Management Program are presented in Table 1.

**Table 1. THE MAIN COMPONENTS OF INTEGRATED PEST MANAGEMENT**

<p><b>1. Monitoring (scouting)</b></p> <ul style="list-style-type: none"><li>• Human resources - Trained personnel that can detect and identify problems in the field</li><li>• Mapping - Identification of affected areas (foci) and pests or diseases present as soon as possible</li><li>• Collecting information - establishing an action threshold, interpreting results</li><li>• Evaluation and decisions – whether, when and where to apply control measures, which may range from “no action” to pesticide use. Creating a pest or disease history</li></ul> <p><b>2. Control by exclusion</b></p> <ul style="list-style-type: none"><li>• Plant quarantines and revisions – of all plant material entering production areas</li><li>• <u>Disease-free plant material – is of vital importance.</u> This includes propagation facilities</li></ul> <p><b>3. Cultural Control</b></p> <ul style="list-style-type: none"><li>• Avoiding weeds and other plants that act as alternate hosts</li><li>• Crop rotation – when possible</li><li>• Good ventilation that reduces disease (caused by fungi for example)</li><li>• Keeping greenhouse covers in good condition and growing areas clean</li><li>• Choosing fertilization and watering practices that discourage pest development</li><li>• Restricting passage of workers and vehicles from diseased to healthy areas</li></ul> <p><b>4. Physical control</b></p> <ul style="list-style-type: none"><li>• Insect traps (yellow, blue) to reduce and monitor populations</li><li>• Screens and other barriers that restrict insect entrance</li><li>• Aspirators or vacuum cleaners that trap flying insects</li><li>• Rouging diseased plants and treating localized infestations to reduce pest or disease pressure</li></ul>
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- Soil sterilization with steam before planting
- Disinfestation of shoes, tools and others by which problems can be disseminated
- Soil-less substrates
- Solarization (not generally suited for floriculture due to long periods of time when the land must remain fallow)

#### 5. Biological control

- Biopesticides (many are now commercially available)
- Biocontrol agents many times used at an experimental level but with good perspectives
- Incorporating compost and/or beneficial organisms (*Bacillus*, *Trichoderma*, *Actinomyces* and others) to the soil

#### 6. Genetic Control

- Resistant varieties, available for some pests and diseases (e.g. Fusarium wilt of carnations)

#### 7. Chemical control

- Soil fumigants (metam sodium, dazomet, 1,3-dichloropropene plus chloropicrin) and specific pesticides (fungicides, nematicide)
- Disinfectants (to prevent pest or disease dissemination)

## 2. Steam sterilization (Pasteurization)

Pasteurization or steam sterilization of the soil is a process by which pests, diseases and weeds present in the soil at a given time are killed by heat. In very simple terms, this involves injecting or otherwise diffusing hot water vapour into the soil with the aid of a boiler and conductors. As a general rule, it is recommended to carry out treatment so that the coldest spot in the soil or substrate is held at 90°C for ½ hr. If carried out properly, steam is probably the best alternative to methyl bromide, proving equally effective.

Steaming was observed and discussed at **Flexport de Colombia**, a 16 Ha carnation farm that has been producing successfully with this method of soil treatment for the past 12 years. Some important issues identified with respect to steam were:

- Many variables influence the success and cost effectiveness of steam, for example the type of boiler and diffusers used, the type of fuel, soil type and structure and soil preparation. In this particular farm, high pressure (80 psi) mobile boilers that run on coal are used.
- The depth or volume of soil or substrate to be treated directly influences costs of this alternative; thus, steam can be made economically feasible when disease incidence is maintained at a low level when it is part of an Integrated Pest Management system. The system was explained and mainly involves scouting regularly to detect presence of carnation wilt (*Fusarium oxysporum* f.sp. *dianthi*) as early as possible, treating disease foci if found, using resistant varieties in areas previously affected by the disease, using disease-free planting materials, observing hygienic measures and others.
- Because this careful system is in place, they can even perform strip treatment (growing beds only) saving 40% of the costs. Beds are confined with thick, 6-grade black polyethylene, but the bottom is still comprised by the natural soil.

- Just like fumigants, steam is a biocide, killing all living organisms within the soil. To correct this problem, compost and/or beneficial organisms such as *Trichoderma* and beneficial bacterial cultures are added right after steaming.
- Some problems may arise in association with steaming itself, such as accumulation of soluble salts (particularly manganese), ammonium toxicity and recontamination.
- Steam has other benefits when compared to fumigants, as these usually require a waiting period – around 14 days but sometimes more - before replanting can occur, while steamed soils can be replanted immediately. This sole fact adds extra flower production to steamed areas, representing about 135,000 exportable carnation flowers per hectare and per month.
- Fuel used for steaming has a very significant impact on the economic feasibility of this alternative, with a 40 – 50% share in total operational costs. In the farm visited for example, coal has replaced fuel oil as the latter became prohibitively expensive. Locally manufactured coal boilers, with special filters to comply with environmental regulations have been designed.

### **3. Soil-less substrates**

Cultivation of cut flowers on raised beds or containers and in artificial or soil-less substrates (sometimes called hydroponic production) has been widely used for many years in countries such as Holland and Israel. The reasons for using them have generally been associated to the presence of poor soils that are not suited for flower or vegetable production.

In recent years soil-less production has increased due to several reasons, mostly associated with avoiding soil fumigation. Wide-spectrum fumigants either will not be available or are restricted in their use by other environmental or health concerns Steam is too costly as a control measure for soils already containing high populations of pathogens.

A good substrate should fulfill four functions:

- ❖ Provide an anchor for plant roots
- ❖ Hold nutrients
- ❖ Hold water
- ❖ Provide good gas exchange (aeration).

Often, a substrate by itself does not provide all four conditions so mixtures are used. Of these properties, only the first of these functions (anchorage) is inherent to a substrate. The other functions – aeration, water holding capacity and nutrient retention - are influenced by factors like compaction, watering and pH and should be managed by the grower. Although in some cases the actual weight or “bulk density” of the substrate is also important to prevent plants from toppling over, plants growing in light substrates may be supported with wires or nets.

Physical and chemical properties of the soil can be found in other materials and nutrients and thus supplied to plants in other ways, generally together with irrigation. However, soil is a good buffer and can make up for fertilization mistakes since it usually contains at least some of the nutrients needed by plants. Soil-less systems require much closer control of nutrient levels but this can be achieved with the help of electrical conductivity (EC) and pH meters and soil and foliar analyses.

Traditionally, many kinds of substrates have been used by the greenhouse industry. Of these, peat moss, sand, bark and inert materials such as vermiculite and rock-wool are the most common. They are often used together in different combinations and proportions.

Production of cut flowers and propagation materials in substrates has rapidly expanded in Colombia, especially since growers successfully adapted this system to rice hulls, a locally available, cheap substrate. Presently, an estimated 40% of all carnations produced in Colombia (around 500 Ha) are produced in substrates and this tendency is expanding to other flower types

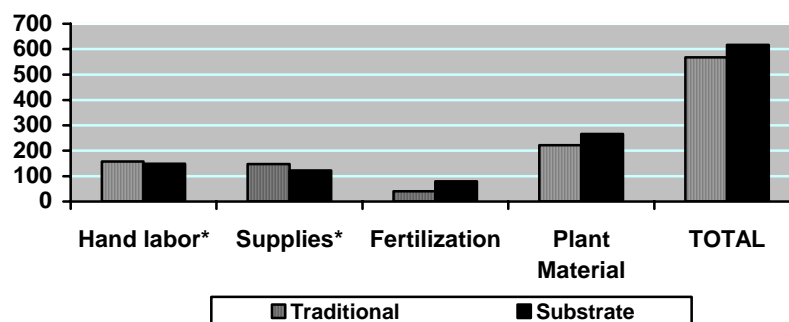
such as roses, gerberas, lilies and more. The main reason why growers shift to substrates is to avoid losses caused by soil-borne diseases and pests (e.g. fusarium wilt of carnations), but also because higher yield and quality can be achieved, especially where soils have become compacted or nutritionally unbalanced.

Substrate production was observed at **La Gaitana Farms** a 26 Ha operation growing many kinds of flowers and which has been in operation for nearly 20 years; at **Agrícola Cardenal** a carnation farm that has been in operation for over 20 years and has found it necessary to convert half of the growing area to substrates; and at **Flores Sagaró** a 60 Ha farm exporting mainly carnations and roses. The following points were identified as particularly important with regard to this production system:

- Although setting up a soil-less production system is expensive, growers are able to compensate the extra cost through significantly better yields (20-25%) that result from higher planting density, optimum plant nutrition and better pest and disease control as can be seen in the examples below (Figures 1 and 2).
- Modifications and adaptation must be made in consideration of the flower species to be produced and its production cycle, the substrate used and the climatic conditions among others. For example, typical root depth of a plant influences the amount of substrate that should be used.
- Substrate production requires close monitoring of the plant's nutritional and water requirements. It also allows for better ventilation between plants, which generally reduces incidence of certain diseases such as foliar fungi.
- A substrate material that is not expensive is critical in order to guarantee economical feasibility of this alternative.
- Environmentally speaking, closed systems (where the fertigation solution circulates and is not disposed into the soil or water bodies) are ideal. However, disposal can be minimised sufficiently by giving short, low volume waterings several times a day.

**Figure 1. Carnation production costs: Traditional vs. Substrate (rice hulls). 2- year cycle**  
Per Ha. Figures in 100 USD. \*Includes herbicide application and fumigation with Telone C-17.

Source: La Gaitana Farms, 2004

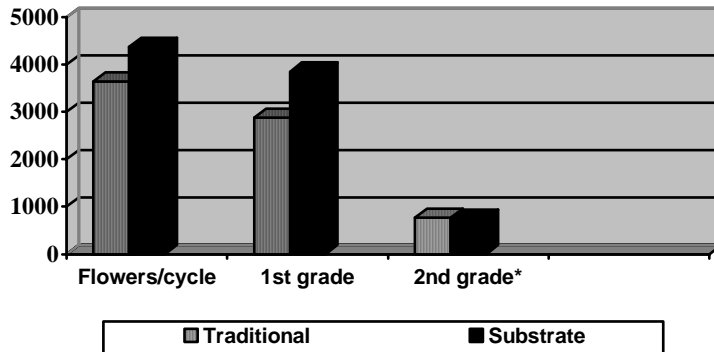


Production costs are about 8% higher when growing in substrates as compared to traditional production in ground beds, where the soil is fumigated with Telone C-17. However, when yields and quality are considered (Fig. 2), it is clear that more and better quality flowers are harvested, and the higher investment pays off.

**Figure 2. Carnation yield and quality: Traditional vs. Substrate (rice hulls)**

Per Ha. Two year cycle. Figures in 1000 USD. \*Includes non/exportable flowers.

Source: La Gaitana Farms, 2004



**4. Compost**

Compost is not only an excellent fertilizer but also contains high amounts of beneficial organisms that prevent and help control soil-borne diseases. Further, it contributes to restoring natural soil flora and increases water retention capacity. Compost enriched with beneficial organisms such as *Trichoderma*, yeasts and beneficial bacteria provides very good control of soil fungi such as *Phoma* and *Pythium*, in *Dendranthema* (chrysanthemum) and *Alstroemeria* ranges. These fungi are often associated with monoculture, poor soil structure and aeration and deficient water management. Addition of compost can virtually eliminate these problems and some growers even report that after some time there is no longer need of steaming or fumigating the soil.

Composting is a process that should be done carefully but which nevertheless is quite simple. Table 2 summarizes the actions that need to be taken:

**Table 2.** The composting process

PROCESS	COMMENTS
1. Chop (cut) plant material	Small, uniform pieces will decompose more rapidly and evenly. Size however depends on the amount of water in the plants and the machinery available.
2. Build piles	Make layers starting with sand or another material providing good drainage; follow with alternate layers of plant material, rice hulls or other porous material such as sand for good aeration, and a source of nitrogen (i.e., cow or pig manure; if these are not available, a liquid formulation of nitrogen and even urea also bring good results).
3. Cover	Place polyethylene film directly on top of piles or place piles under a plastic roof. Some growers place piles out in the field. The objective of this step is to keep a good level of humidity inside the piles. If your location is rainy a roof is a good idea. If film is used, holes should be opened to allow for gas exchange to take place.
4. Turnover	About every four weeks according to temperature evolution. This is essential to ensure proper aeration of piles.
5. Harvest	After three or four turnovers (about 3 or 4 months) according to flower type and environmental conditions.

Environmental conditions (temperature, pH, oxygen aeration, humidity) are of great importance. Depending on the plant types processed, composting will take between 4 and 5 months.

As soon as composting starts taking place, the temperature inside the piles will go up, reaching around 60°C; this leads to a natural pasteurization process, killing most of the harmful fungi or bacteria which may be present in the plants, an additional benefit.

The processes above require important considerations within the company's infrastructure: there should be an adequate place reserved for chopping the plants, ample, well aerated areas where compost piles can be placed, and above all, an excellent waste classification program. Materials of different origin - plastics, wires, rubber bands and others - will obviously not decompose and may cause problems further down the process.

Use of compost and beneficial organisms was observed at **Jardines de los Andes** where along with these a strict IPM program is followed. Continuous scouting is essential to this program so much that 10% of the work force (or 250 employees) is assigned to this task. This requires permanent training and clear guidelines as to what actions to take when a pest or disease is found. Important elements of the IPM program which were highlighted include using disease-free planting material, using resistant varieties whenever available and suitable for marketing needs, establishing action thresholds upon which management decisions can be taken, cultural controls and very strict hygienic measures.

This company, which in total comprises 120 Ha of flower production is able to produce highly profitable yields with very little need of soil sterilisation. Presently, only spot treatments with steam and sometimes fumigants such as Basamid or Telone are carried out on some alstroemeria ranges severely affected by nematodes. Root-knot (*Meloidogyne* sp) and lesion (*Pratylenchus* sp) nematodes are the genera most frequently found.

Jardines de los Andes which has been in operation for over 35 years, processes 150,000 Tons of plant refuse per year, which convert to 7000 T of compost. These are entirely incorporated into the soil, both at the pre-plant stage and during production, according to the growing cycle of the flower species involved.

The following summary describes compost and beneficial organism application at Jardines de los Andes:

**Table 3. Plant health and nutrition management with compost in *Dendranthema***

• <b>Amount of compost applied:</b>	20 - 30 Tons/Ha
• <b>Frequency of application:</b>	Pre-plant (every 16 weeks)
• <b>Beneficial organisms (suspension):</b>	50 L/ 30m <sup>2</sup> bed
• <b>% Substitution of chemical fertilizer</b>	(in growing cycle): 50%
• <b>Water retention capacity:</b>	Increased by 30 - 40%
• <b>Soil sterilization:</b>	None, except for sporadic disease outbreaks which are spot treated with steam, in certain cases chemicals.
• <b>Overall cost reduction:</b>	15 - 20%
• <b>Estimated cost per Ha:</b>	USD \$4950

Source: Valcárcel, F. and Jaramillo, F. 2002, 2004, Jardines de los Andes, Bogotá, Colombia

## **5. Fumigants**

Trials and experiences with soil fumigants in floriculture have shown that their effectiveness varies with factors like the pathogens to be controlled, soil characteristics and crop species. These chemicals have been combined together or with other options such as steam with variable results. Several fumigants are used in Colombia depending on the soil-borne problem encountered, the flower species being produced, the soil type and climate and others. The most promising results have been obtained with metam sodium, dazomet and 1,3 dichloropropene + chloropicrin.

Use of fumigants was discussed at **Agrícola Cardenal** where trials with different fumigants have been conducted over the years. Telone C-17 (1,3-D with 17% Pic) is the preferred product at present. It is injected directly by the supplier and tarped. Results are very satisfactory with yield losses kept at very low levels.

- Efficiency of fumigants is highly dependent on soil conditions (e.g. soil temperature, whether the soil is heavy or not, soil moisture and others) and the application system used
- Fumigants combined with other alternatives (e.g. Biofumigation + Metam Sodium) can be successful and allow for shorter treatment times plus lower fumigant dosages.

## **6. Biocontrol**

Within an IPM program, use of beneficial organisms and biocontrol agents can be very successful. An extensive biocontrol program was observed at **Flores Suasuque** a 13 Ha farm producing flower types that are not traditional for Colombia, such as *Anigozanthos* (kangaroo paw), *Eryngium* and *Amaryllis* as well as alstroemerias and gerberas. All production is carried out in the natural soil and the farm has been working on recuperating organic matter content and a balanced soil microflora for about a decade. Losses due to soil-borne pests and diseases are presently very low and problems are treated only at the strictly local level. The farm has a small lab where organisms like *Trichoderma*, *Beauveria*, *Bacillus* and others are constantly being produced, from strains collected directly in the field.

## **THE FLORVERDE PROGRAM**

As a complementary activity, the group visited the Colombian Association of Flower Exporters - ASOCOLFLORES in order to learn about FLORVERDE, its social and environmental program initiated in 1996. Participation in this program is open to members of the Association and is voluntary. Participating growers are evaluated with respect to their performance in two general areas – sustainability of production/ environment friendly practices and social welfare. They are also benchmarked on their performance with respect to other participating growers. A group of advisors, experts in different areas considered in the program's Code of Conduct- e.g. IPM, water and soil management, occupational health – visits each farm periodically and after evaluating performance also makes suggestions for improvement. The Code of Conduct for this program, which has been permanent under revision and improvement since the program began, can be found at [www.asocolflores.org](http://www.asocolflores.org). Methyl Bromide use is not permitted to members of FLORVERDE and in fact this chemical has been banned in Colombia for all uses except QPS since 1995.

Presently, FLORVERDE has 147 members which amount to about 45% of the flower production area in Colombia. An group of 56 farms have already been certified by the Société Générale de Surveillance or SGS, a Swiss auditing company and a other companies are awaiting certification. Although as members of FLORVERDE growers need to make investments which are on occasion substantial and must pay a fee, they are generally in agreement that membership is beneficial since consumers in importing markets are increasingly requiring flowers that have been

produced in observance of adequate environmental and social standards. It is well possible that soon, consumers will reject products that cannot be guaranteed in this sense.

Programs such as FLORVERDE often referred to as eco-labels, help support methyl bromide phase-out. Presently, several other eco-labels are in operation in international floriculture, for example the Dutch MPS, the German FLP or the British/ European EUREPGAP standard.

## **DISCUSSION AND RECOMMENDATIONS**

The mission seems to have provided useful information that can be applied at the practical level to aid in phasing-out of methyl bromide in the Turkish flower sector. Some points that were discussed and are suggested for consideration are,

- Training and information transfer has been a central part of the project and should continue to be a permanent activity. The IPM concept should be sufficiently explained, with practical examples that specifically relate to pests and diseases that are common in Turkish flower farms.
- There is a need for information and training materials that will help growers understand the alternatives and their practical application better. The manual “Floriculture and the Environment – Growing Flowers Without Methyl Bromide” published by UNEP in 2001 is suggested as a useful source of information.
- The importance of using healthy propagation material cannot be overemphasized. Plant material (cuttings, seedlings) can be apparently healthy and still carry low pest or disease levels. When planted into soil that has been sterilized with steam or fumigants, these pests and diseases reproduce rapidly sometimes making the problem worse than it was before. Information of proper propagation needs and precautions would be useful to the growers.
- Substrates appear as an interesting option for certain flower types. Local materials that are available and suitable should be evaluated in Turkey.
- Options that help make steam more feasible, particularly with respect to costs should be considered (e.g. boiler types, fuel, possibilities of strip treatment). Strategies to avoiding recontamination should be clearly explained.

## **ANNEX 1**

### **A. Persons attending the study tour**

Mr. Suat Yilmaz – National Project Coordinator  
Mr. Halit Ulas – Flower grower  
Sr Ramazan Ercin – Flower grower  
Ms. Marta Pizano, Consultant, in charge of tour organization

### **B. Persons visited**

1. Rosario Carulla – FLEXPORTE DE COLOMBIA [rcarulla@flexportdecolombia.com.co](mailto:rcarulla@flexportdecolombia.com.co)
2. Alejandro Cavelier – LA GAITANA FARMS [acavelier@lagaitanacol.com](mailto:acavelier@lagaitanacol.com)
3. Fabiola Valcárcel – JARDINES DE LOS ANDES [invest2@jarandes.com](mailto:invest2@jarandes.com)
4. Juan Carlos Isaza – ASOCOLFLORES [juan@asocolflores.org](mailto:juan@asocolflores.org)
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7. Antonio Trujillo – AGRÍCOLA CARDENAL [acfacgerencia@unete.com](mailto:acfacgerencia@unete.com)