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LESSONS LEARNED DURING UNIDO'S PROJECT IMPLEMENTATION IN THE METHYL BROMIDE SECTOR

INTRODUCTION

1. UNIDO started its activities on alternatives of methyl bromide projects in 1997. UNIDO has in 26 countries over the world demonstrations projects. In addition, three investment projects have been approved, making UNIDO the first Implementing Agency within the Montreal Protocol in submitting investments projects for this ODS.

2. UNIDO contacted ozone officers and government authorities in about forty-two Article(5) countries and found a good level of awareness of methyl bromide issues. We did not experience particular difficulties in discussing methyl bromide (MeBr) issues and Montreal Protocol mechanisms for demonstration projects and investment projects with government authorities in Article(5) countries.

3. The strategy of UNIDO in promoting alternatives is based on discussions held in the country among all the agents concerned: methyl bromide importers, government officers, farmers and farmers' associations. Sometimes, Universities and Research Institutes were also invited to participate.

4. The mechanism used to have such discussions are workshops, seminars or simple lecturers or UNIDO staff visiting all the agents concern in searching alternatives to the use of methyl bromide. The mechanism would depend on the amount of methyl bromide consumed, the number of consumers in the country and/or the grade of organization of the farmers.

5. When conferring with individual farmers, farmers' associations and agro-enterprises, UNIDO's officers found a high level of awareness of, and information on, MeBr issues, as well as a great readiness to test alternatives and to phase out use of the fumigant.

6. A possible reason for this high level of awareness, lies in the fact that most of the participants involved are closely linked to the exporting sector and therefore the information flows freely and quickly from the markets to the producers and vice-versa. Knowledge of the recent agreement between several large European hypermarket chains, setting standards of pesticide and nitrate residues as well as on the use of methyl bromide in their purchases of fruits and vegetables.

7. UNIDO has established a range of demonstration projects in horticulture, cut flowers and tobacco in African, Latin American and East European countries. In Asia most of the

demonstration projects have been done mainly in storage excepting China. (See Table 1)

TABLE 1. **OVERVIEW OF CROPS AND ALTERNATIVES SUCCESSFULLY TESTED**

Alternative	Tomatoes	Melons	Strawberries	Tobacco and Vegetable Seedbeds	Flowers	Grains	Palm Dates
Bio-fumigation	China Guatemala	Guatemala	China			-	-
Solarization plus organic amendments	Morocco Syria		Argentina	Brazil Guatemala		-	-
Metham sodium	Argentina Guatemala	Guatemala	Argentina			-	-
Metham sodium and Solarization	Guatemala Morocco	Guatemala		Zimbabwe		-	-
Dichloroprene	Morocco					-	-
Dazomet	China Guatemala	Guatemala	Argentina	Brazil China		-	-
Avamectin	China					-	-
Resistant cultivars	China		Turkey		Syria	-	-
Steam			Argentina China	Zimbabwe Guatemala	Syria Guatemala	-	-
Soilless cultivation in floating trays/ band or in pots	China		China Argentina	Brazil Croatia Zimbabwe	Guatemala	-	-
Grafting		Guatemala				-	-
Phosphine						Syria	

Alternative	Tomatoes	Melons	Strawberries	Tobacco and Vegetable Seedbeds	Flowers	Grains	Palm Dates
CO^2 at 1 bar							Tunisia

COMMENTS ON MOST SUCCESSFUL ALTERNATIVES

1. Steam has been successful in all demonstration projects implemented up to date. From the ecological and technical point of view the alternative is excellent but very expensive.

2 Solarization results obtained so far, have been very good but irregular. Good results have been obtained in tomato crops in Morocco and with strawberries in Argentina, but mixed results were obtained in tobacco seedbeds in Brazil. Preliminary results in Syria are encouraging.

8. Solarization with biofumigation combines the benefits of producing lethal gases and the increase of soil temperature. The use of plastic covering helps to keep the fermentation gases in close contact with the soil.

9. Metham sodium plus solarization: The effect of this technology is similar to biofumigation and has been successfully tested in (a) tomatoes in Guatemala and Morocco, and (b) melons in Guatemala. Overall, Metham sodium plus solarization worked much better than Metham sodium alone.

10. Dazomet has been used successfully in (a) tomatoes in China and Guatemala, (b) melons in Guatemala, and (c) strawberries in Argentina. However, Dazomet negatively affected tobacco seed germination in Brazilian experiments and is therefore not considered suitable for tobacco seedbeds. It is also very costly in many Article (5) countries.

11. Soilless substrates for seedbeds have been successfully tested for tobacco in Brazil, Croatia, Zimbabwe and Senegal. The results are very good and the floating system is one of the most reliable alternatives. However, it is expensive.

12. Substrates in bands have been tested with great success in covered tomato cultivation in China. Substrates in bags and pots have been used successfully for strawberry cultivation in Argentina.

13. Resistant cultivars and IPM. Wherever possible, UNIDO used resistant cultivars and implemented a good Integrated Pest Management

system in all demonstration projects.

14. Table 2, shows as example an estimation of the new equipment costs needed to implement some of the most successful alternatives tested so far. These estimates have been calculated based on international prices plus average transport prices.

15. Training in the selected alternative technology is one of the most critical activities in the MeBr phase-out programme. Any training programme should include two components, namely:

- Training of supervisors (trainers)
- Training of farmers or field personnel of agro-enterprises

16. Regarding the incremental costs, it is relatively easy to reach a consensus in identifying the inputs needed to implement any chosen new alternative. However, it is much more difficult to agree on the unitary costs of these inputs, due to large price variations among Article (5) countries. Table 3 shows a summary of incremental costs.

TABLE 2 EQUIPMENT COSTS OF DIFFERENT ALTERNATIVES

Alternative	Equipment	Unitary Cost US$	Cost Per Hectare US$
Low-dose chemicals	Trailed pesticide sprayer (for 20 Ha)	2,800.0	140.0
TOTAL CHEMICALS			**140.0**
Pesticides and solarization	Trailed pesticide sprayer (for 20 Ha)	2,800.0	140.0
TOTAL PESTICIDES PLUS SOLARIZATION			**140.0**
Bio-fumigation	Trailed pesticide sprayer (for 20 Ha)	2,800.0	140.0
	Rotovator (for 20 Ha)	4,500.0	225.0
TOTAL BIO-FUMIGATION			**365.0**
Steam pasteurization	Boiler with water softener on a mobile platform including injection equipment (for 15 Ha)	24,500.0	1,663.0
	Protective heat resistant cover	260.0	260.0
TOTAL STEAM PASTEURIZATION			**1,923.0**
Soilless floating trays in micro-tunnels	100 EPS trays of 200 cells	1.0	100.0
	64 m^2 of 200 , UV-protected polyethylene	0.3	19.2

Alternative	Equipment	Unitary Cost US$	Cost Per Hectare US$
	44 m^2 of 150 black polyethy.	0.2	8.8
	18 galvanized steel bowls	0.8	14.4
	1/20 compacting tool	12.0	0.6
	1/20 of a manual seeder for pelletized seeds	28.0	1.4
	2.2 m of elastic bidders		0.4
	3 m of nylon cord		0.1
	Bricks	Nil	Nil
TOTAL FLOATING TRAYS FOR SEEDBEDS			**145.0**
Soilless in bands	Nil		Nil
TOTAL SOILLESS IN BANDS			**Nil**
Solarization	Nil		Nil
TOTAL SOLARIZATION			**Nil**

TABLE 3 ESTIMATION OF THE INCREMENTAL OPERATING COSTS OF SOME ALTERNATIVES (US$ PER OPEN-FIELD HECTARE)

Alternative	Crop

	Strawberries	Tomatoes	Melons	Tobacco Seedbeds	Vegetable Seedbeds
Solarization					1
Bio-fumigation	1,825	2,468	1,640		
Metham sodium	2,457	1,948	1,591		103
Metham sodium plus solarization		1,171	1,071		
Avemectin		1,314			
Dazomet	2,584	2,500	2,993		
Steam	4,178				82
Soilless floating				-92	
Soilless in bands	3,368	2,760			

UNIDO EXPERIENCE IN IMPLEMENTING PROJECTS: CONCLUSIONS

1. Public or private enterprises dealing with the fumigation of stored commodities usually had poor knowledge of the phase-out plan for MeBr and most of them did not understand why the use of the fumigant for stored commodities should be restricted and its use for pre-shipment fumigation allowed.

2. Most of the crops produced with methyl bromide are cash crops for export to Article (2) countries. It is also certain that only in few instances are farmers by themselves.

3. There is one alternative, namely soilless floating trays, which is widely used in Article (2) countries in seedbeds, which also works very well, (also in seedbed), in Article (5) countries where the climate is not extreme.

4. The most reliable alternatives have been steam and soilless substrates followed by chemical alternatives. Bio-fumigation has also given acceptable, consistent results. The less reliable method, for large surfaces, has been solarization that only works well under very strict conditions and climatic environments.

5. The choice of an alternative in a given country depends on: crops, markets, climatic conditions and rotation of crops, average size of the farms, number of farmers, effectiveness of the farmers' associations or supervising institutions

6. The main constraint in implementing demonstration projects arises from the deadlines imposed by nature. Small deviations from the agreed plan of activities may result in missing the planting season and delaying the whole project for one year.

7. In general, the study tours have been one of the most successful tools to convince farmers and enterprises that it is possible to phase out MeBr and remain competitive. Farmers are more prone to believe in what they touch and see than in what they read.

8. Considering the number of demonstration projects being implemented, which cover the most important crops and climatological areas, it would make little sense to multiply them. Article (5) countries should focus their efforts on the forthcoming freeze target.

9. In general, farmers and agro-enterprises are accustomed to the use of modern technologies and favorably absorb the new technological alternatives proposed. However, this absorption process requires time and good training. In UNIDO's view, this is the most delicate step in implementing demonstration projects and will be critical in phase-out projects.

10. One of the most critical components in investment projects is the training component. Training costs are directly proportional to the number of farmers and not to the surface cultivated. The training costs are also greatly influenced by the presence of an executing and efficient technical assistance network.

11. Many alternatives already tested in the field have low or nil investment costs but positive incremental operating costs

12. Some alternatives work well but give comparatively lower yields. Others give higher yields compared with the average yield using MeBr. in a particular crop or country, but lower with compared with yields in Article (2) countries. Yields are not only dependent on the alternative selected but on many other factors inherent to agriculture practices.

13. As a rule, ODS costs estimations depend more on incremental operating costs than on capital costs. Therefore, local labor costs, currency exchange rates and cost of inputs will have a great influence on the final cost-effectiveness figure. Variations of the costs could reach up to 30%.