Pest Control In Protected Vegetable Cultivation In The Near East Region

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Abstract

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Protected vegetable cultivation in the Near East Region has markedly flourished during the last two decades. Total area of vegetables grown under covers is estimated at 43000 hectares. Incentives to such an expansion are simplicity and affordable price of structures used, availability of high yielding cultivars, local and foreign demand for off-season vegetables, and rewarding market prices. Pest problems emerge after few years of cultivation as the main limiting factor for profitable production. Pest problems are enhanced by repeated cultivation of the same or related crops, favourable environment provided by structures in use, and lack of sufficient research on pest control in protected cultivation. Pest problems are mainly dealt with presently in the Near East Region through the use of pesticides. The harmful side effects of such exercise are evident. The paper reviews the circumstances which contribute to the pest problems in protected vegetable cultivation in the Near East Region and proposes strategies for development of integrated pest management programmes.

Introduction

The Near East Region in general enjoys a climate that permits outdoor production of important vegetables such as tomatoes, cucumbers and sweet peppers, over a reasonably lengthy period of the year. However, the cool climate prevailling in winter and spring is a limiting factor for growing these vegetables, thereby creating an availablity gap in the market for these crops. To overcome such a situation, attempts have been made to take advantage of suitable geographical locations, e.g. oases where climatic conditions allow production of these vegetables during winter and spring. However, availability and transport costs are also constraining factors on the viability of these operations. A different approach to this situation has been the development of storage facilities to extend the availabilty of these vegetables. Here again, due to the short durability of such perishable goods, the quantities to be handled are limited and still fall short of economically viable quantities. The only resort to enable steady year-round production of such vegetables lies in the provision of suitable climate conditions during winter and spring. In northern Europe, where the period with a favourable climate for vegetable production is extremely short, glasshouse production has provided a proportion of the vegetables needed in these countries in the off-season. The system is based on sufficient light and efficient heating to develop a favourable environment for growth and production of vegetables such as tomatoes and cucumber. Production of vegetables in glasshouses was very costly at the outset. However, provision of optimum production inputs, i.e. correct conditioned environment, appropriate irrigation and fertilizers, and high-yielding varieties, has resulted in a high production rate per unit area, which can never be matched in outdoor cultivation. Hence, glasshouse production of high value crops in northern Europe expanded and has resulted in acceptably priced consumer produce.

Development of Protected Vegetable Cultivation in the Near East Region

Glasshouse vegetable production was tried out for the first time in Kuwait in 1962, to challenge nature which denied appropriate climatic, soil and water conditions for production of vegetables in some parts of the country. The establishment of a climatically-controlled hydroponic glasshouse heralded the start of a new era in production of vegetables under cover in the arid areas. Soon this production system expanded to other Gulf States. However, due to the high cost of this type of glasshouse, only a small number were established in the Near East Region, mainly for experimental/extension purposes. Simpler and cheaper greenhouse structures, using disposable polyethylene covers were introduced into the Near East in the early 1970 s from northern Mediterranean countries. Such structures did not require heating systems to ensure profitable production under the Near East climate. The demand for these structures from small-scale farmers increased and soon green-

houses for vegetable production sprang up in most countries of the Region. Local industries providing greenhouse structures and polyethylene covers (a petrochemical product) have flourished in the Near East to meet the increased demand on small greenhouse production. It is normal nowadays to find a vegetable greenhouse(s) in almost every farm in the vicinity of cities, a situation resulting in the ready availability of off-season vegetables. Government support to greenhouses for vegetables has extended from encouragement of local production of greenhouses and a subsidy on greenhouse prices, to support for public sector projects on vegetable production under cover. Many projects funded by governments, bilaterally or through international agencies, have been established in the Region, contributing to the expansion of this type of production system. The classical vegetable crops produced under this system were cucumber, tomato, and sweet pepper, which constitute the principal vegetables grown under covers. However, melon, hot pepper, watermelon, eggplant, beans, courgette, okra and strawberry are also cultivated. Protected vegetable cultivation is now a common phenomenon in Algeria, Bahrain, Cyprus, Egypt, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Syria, Tunisia, Turkey, the United Arab Emirates, and the practice has been introduced into almost all other countries of the Region. In most of these countries, the vegetables produced provide the off-season requirements of the local market and, in many cases, are exported within the Region or the northern European countries. The hectarage devoted to protected vegetable cultivation (Table 1), according to 1985-90 statistics, is 42. 639 ha, comprising glasshouses, rigid plastic (fibreglass) houses and high polyethylene tunnels, but not low polyethylene tunnels. This area represents around 25% of the total world area devoted to greenhouse vegetables, which was estimated in 1988 at around 150 000 hectares.

Growers' interest in production of vegetables under cover is stimulated by the high productivity per unit area, which is usually ten to twenty times that of outdoor production, and with rewarding market prices. The high productivity is attributed to quasi-optimal production conditions for vegetable growth and production, and the advancement in the unit productivity of high-yielding hybrids. Vegetable seeds used for production under protected cultivation are mostly of imported, highly productive hybrids. Also, seeds are produced locally by government or private organizations. In many cases, growers use seeds from previous crops. Local nurseries have also been established to supply seedlings to farmers. High productivity and the acceptance of certain varieties on local or export markets are the major criteria for growing vegetables under covers. Disease resistance is not always a factor taken into consideration in the choice of the crop variety.

Table 1. Area of Protected Vegetable Cultivation in the Near East (in Hectares)

Country	Date of statistic	Crop				Total area
		Tomato	Cucumber	Pepper	Others	
Algeria	1989	1650	557	1986	508	4701
Bahrain	1990	6	7		13	26
Cyprus	1988	68	75	2	37	182
Egypt	1990	20	250	180	20	470
Iraq	1985	12	40	2	3	57
Jordan	1985	167	1006	252	168	1593
Lebanon	1988	528	453	33	252	1266
Libya	1990	300	300	300	100	1000
Marocco	1990	1780	30	110	110	2030
Qatar	1990	1	4		1	6
Syria	1990	225	225	75	225	750
Saudi Arabia	1988	420	860		56	1336
Tunisia	1990	313	50	653	149	1165
Turkey	1990	5457	3616	2698	16286	28057
UAE	1990					150
Grand Total		10947	7473	6291	17928	42639

★ Estimate.

Structrues Used for Protected Vegetable Cultivation

As indicated earlier, the first greenhouse structures introduced into the Region had metal frames covered with glass sheets, and were equipped with all climatic controls. The use of this type of greenhouse is generally limited to the public sector and rich farmers, and represents a small percentage of the greenhouses in the area. Less expensive greenhouses using rigid plastic (fibreglass) were also introduced, but again they constitute only a low percentage of greenhouses in the Region. Another type of classic greenhouse that exists in the Region is the wood-framed greenhouses (or in a few cases cement-framed) covered with polyethylene. This type prevailed in the early 1970 s when glasshouses became expensive to purchase, but they are now less widely used. The prevailing structures in the Region, which constitute more than 80 % of the greenhouses used, are those known as plastic tunnels. These are made of galvanized steel structures and covered with polyethylene. Tunnels are either high or low. The latter are used to achieve growth before climatic conditions become favourable, and are removed when outside conditions become suitable. High tunnels, the main subject of this paper, are the predominant structures used in the Region by both small and largescale farmers. They are mostly single tunnels but, in some cases, multi-span tunnels exist. Generally they have no ventilation outlets apart from the doors or side windows. The size of the structures can be adapted to the area used. However, they usually range from 5 to 13 m in width, 30 to 100 m in length and 2 to 3.2 m in height.

Status of Management and Cultural Practices in Greenhouses

Heating of greenhouses in the Near East Region is considered costly and unnecessary by farmers. In places where it is used, it accounts for around 30 % of the production cost, and usually farmers can get reasonable produce by avoiding the very cold period. However, heating is used in only a few countires, such as turkey and Syria, during periods when temperatures fall below 0° C at night. wherever heating is used, it is mostly generated by stoves or combustion motors/engines connected to perforated polyethylene tubes running the length of the greenhouse or by geothermal energy. Flooding is the principal irrigation method currently practised in most countries of the Region. This system contributes to oxygen deficiency in the rhizosphere leading to poor growth, and encourages attack by soil fungi. Sprinkle-irrigation is also a major practice in some other countries. Drip-irrigation has been recently introduced into the Region. This is the main irrigation system in some countries and, in general, is gradually replacing other irrigation practices in the Region. As most of the vegetables grown under protective covers belong either to the Solanaceae or Cucurbitaceae families, there is little room for crop rotation. Continuous cultivation of the same crop is very common. This usually contributes to the build-up of soil-borne pests. Due to the hot weather prevailing in the Region during the summer period, and because production of indoor vegetables is not economically rewarding compared with outdoor production during summer, greenhouses are generally left uncultivated between June and September. Most of the farmers take advantage of this period to prepare the land for the next season. Land is usually ploughed and rotivated, and fertilizers applied. One of the tasks during this period is soil fumigation for soil pest control. More and more growers are realizing that fumigation is essential for successful production, and its use is becoming more widespread. However, in some cases, the high price of fumigants, the difficulties and hazards associated with their application, and their unavailability, are among the factors limiting soil fumigation. Among chemicals frequently used in fumigation are methyl bromide, metham-sodium, dichloropropane-dichloropropene (DD), and dosmate. Results achieved vary according to target pest, length of exposure period and efficiency of application. The most effective but most hazardous fumigant is methyl bromide. Soil solarization has been recently introduced and is now gaining ground as an alternative safe efficient means of soil sanitation. Another system practised in some countries in the Region to avoid build-up of soil pests is moving greenhouses structures from one location to another.

Pest Problems in Different Vegetable Crops

Geenhouses are intended to provide a microclimate favourable for plant growth and production. However, if this microclimate is not properly managed, it will also provide favourable conditions of plant pests to attack and inflict severe losses. Management of greenhouses should be geared towards optimal production conditions via provision of appropriate environmental and production inputs, whilst avoiding conditions that favour reproduction and development of plant pests. Therefore, temperature, ventilation, soil sanitation and irrigation, and plant protection measures play an important role in the growth and production of plants as well as controlling pest problems in the greenhouse. As indicated earlier, the most common type of greenhouse used by small-scale farmers in the Near East Region is the high (walk-in) plastic tunnel that are usually not heated or properly ventilated. Large fluctuations between night and daytime temperatures in these structures does not favour optimal growth. In adddition, high humidity resulting from poor ventilation, and water condensation on plants in the early morning, act as ideal predisposing factors for disease infection. The warmth of the greenhouse compared with the outdoor temperature invites insects from outside, and the continued cultivation of the greenhouse contributes to the build-up of soil pest populations. More pest problems are added by the usually uncontrolled health of imported vegetable seeds or transplanted seedlings. The above pest build-up in the greenhouse results in invasion and/or infestation of cultivated crops, causing losses ranging from complete crop failure due to attack by seed-and soil-borne pests, to varying degrees of damage to vegetative parts or fruits. Some pests, e.g. downy mildew of tomatoes or cucumber, tomato yellow leaf curl virus, nematode, aphid or mite attack, could cause complete destruction of the crop. A list of economically important pests and diseases of the main vegetables grown under protection is shown in Table 2. Pest incidence in greenhouses over the first few years after establishment is markedly low, and crop production under covers is most rewarding in these years. However, in the long term, the increasing amount of overwintering pest populations causes marked incidence of infestation/infection during the growing season, thereby increasing the cost of plant protection measures and reducing production levels.

Present Control Measures

It is beyond the scope of this paper to illustrate the various vegetable pest problems and present means of control and consequences of such measures in each vegetable crop. Farmers rely on their experience of chemical control of outdoor pests when controlling greenhouse pest problems. As the two situations are not totally comparable, equivalent results are not necessarily the case due to differences in environmental conditons. Pest problems of vegetables grown under cover are not as satisfactorily controlled by conventional control methods as they are in outdoor conditions. Reports from various Near East countries indicate that over-use, misuse and indiscriminate application of pesticides, i.e. excessive doses of pesticides, pesticide «cocktails», high frequency of application (up to 30 applications per season in the case of cucumber), are common features of greenhouse vegetable production in the Region. However, complete reliance on pesticide use has not solved the problems. On the contrary, it

Table 2. Major pests of main greenhouse vegetables in the Near East

Pest		Vegetable			Source of pest problem*
		Tomato	Cucumber Melon	Pepper	
A. Fungi					
Alternaria cucumerina	(Alternaria leaf blight)		•		2.3
Alternaria solani	(Early blight)	•			1.2.3
Botrytis cinerea	(Grey mould)	•	•	•	2.3
Didymella lycopersici	(Canker, Stem rot)	•			1.2.3
Erysiphe cichoracearum	(Powdery milew)		•		3
Fusarium oxysporum	(Fusarium wilt)		•		2
F. *oxysporium* f.sp. *lycop.*	(Fusarium wilt)	•			2
Fusarium solani	(Fusarium wilt)		•		2.3
Leveillula taurica	(Powdery mildew)	•		•	3
Mycosphaerella sp.	(Gummy stem blight)		•		2.3
Phytophthora capsici	(Stem rot)			•	2
Phytophthora infestans	(Late blight)	•			2.3
Phytophthora parasitica	(Phytophthora root rot)	•			2.3
Phytium spp., Fusarium spp., Rhizoctonia solani, Phyt. spp., Sclerotinia spp.	(Root rot, Damping off)	•	•	•	2
Pseudoperonospora cubensis	(Downy mildew)		•		3
Sclerotinia sclerotiorum	(Sclerotinia stem rot)	•	•	•	2.3
Sphaerotheca fuliginea	(Powdery mildew)		•		3
Verticillium dahliae	(Verticillium wilt)	•	•	•	2
B. Bacteria					
Corynebacterium michiganense	(Bacterial canker)	•			1.2.4
Pseudomonas syringae pv. lachrymans	(Angular leaf spot)		•		1.4
P. syringae pv. tomato	(Bacterial speck)	•			1.2
C. Viruses					
CMV	(Cucumber mosaic virus)	•	•	•	4
CVYV	(Cucumber vein yellowing)		•		4
CYMV	(Cucumber yellow mosaic)		•		4
PVY	(Potato virus Y)			•	4
TYLC	(Tomato yellow leaf cur)l	•			1.4
WMV-2	(Watermelon mosaic virus 2)		•		4
ZYMV	(Zuchini yellow mosaic virus)		•		4
D. Nematodes					
Meloidogyne spp.	(Root knot nematodes)	•	•	•	2
E. Insects and mites					
Aphis spp., Myzus spp., etc.	(Aphids)	•	•	•	3
Bemisia tabaci	(Whitefly)	•	•	•	3
Tetranychus spp.	(Red spider mites)	•	•	•	3
Thrips tabaci	(Thrips)		•		3
Vasates lycopersici	(Tomato russet mite)	•			3

* 1 = Seed borne 2 = Soil borne 3 = Air borne 4 = Vector borne

has created further and more complicated problems such as inflated production costs; increased hazards to man and the environment; and excessive pesticide residues on vegetable produce, which result in reticence on the part of local consumers towards off-season vegetables, also loss of exports, and developed resistance of pests to pesticides (Table 3). Integrated pest management approaches in greenhouses in the Near East are still generally untried. Research on pest control under covers in the Region is also very limited and pest control is mostly confined to the use of pesticides.

Table 3 - Pests suspected of increased pesticide tolerance or resistance

Pest	Pesticides used	Country
Botrytis cinerea	Benzimidazole compounds	Turkey, Marocco and Tunisia
	Dithiocarbamates	Turkey
	Thiophanate-methyl	Morocco
Cladosorium spp.	Benzimidazole compounds	Turkey
	Dithiocarbamates	Turkey
Leveillula taurica	Pyrimidin	Jordan
Phytophthora infestans	Anilide	Morocco
Rhizoctonia solani	Benzimidazole compounds	Turkey
	Dithiocarbamates	Turkey
Sclerotinia sp.	Benzimidazole compounds	Turkey
	Dithiocarbamates	Turkey
Verticillum dahliae	Benzimidazole compounds	Tunisia
	Thiophanate-methyl	Tunisia
Spodoptera littoralis	Carbamoyl-oxime	Jordan
Tetranychus spp.	Tin compounds	Jordan
Thrips	Organophosphorus compounds	Jordan
	Pyrethroids	Jordan
Whiteflies	Organophosphorous compounds	Jordan, Turkey
	Pyrethroids	Jordan

Factors Contibuting to Pest Problems

Availability of knowledge and information on the life-cycle of pests, factors favouring infection, infestation, optimal conditions for their propagation, and their host range and transmissibility, is of paramount importance in establishing sound measures. Such information and knowledge are currently lacking in most countries. The greenhouse environment is managed in such a way as to favour plant growth and production, but not to inhibit the introduction, survival and development of pests. Inadequate cultural practices, i.e. weed management, crop rotation, crop sanitation, crop density, taining and pruning of plants, elimination of sources of infection, harvesting techniques, disinfestation of greenhouse structure or support materials, etc. are major contributary factors to pest problems. Vegetables grown in greenhouses apparently have a more delicate cuticle and, due to their isolation and short growing period, they are deprived of the beneficial presence of predators and parasites. This situation makes them more vulnerable to pest attack. Furthermore, pesticides currently used in greenhouses are those intended for outdoor crops. As no consideration is given in their use to the greenhouse environment and the rapid build-up of pest populations, their efficiency in controlling pest problems is uncertain. An ill-proportioned structure (either too long or too narrow) will lead to pest problems since it does not allow adequate ventilation. Lack of research programmes for integrated pest control in greenhouses is a principal factor. The majority of these programmes are hampered by inefficient planning, inadequate facilities and /or staffing. Lack of training of the trainers, training of farmers, technology transfer, and weak links between institutions involved in plant protection education, research and services, are further constraints contributing to the present status of pest problems. In many countries there is still no efficient extension service to make frequent visits to greenhouse sites, hold farmer meetings, organize demonstration trials and produce the required audio-visual aids on pest control, and to provide farmers, as and when necessary, with available knowledge on sound pest control approaches. Inadequate exchange of information among countries of the Region and minimum contact with developed countries contribute towards the low profile of knowledge of the problem and progress towards a solution. Inadequate quarantine measures on imported seeds, sowing seeds harvested from previous crops and/or introduction of seedlings from unknown sources and of unknown health status, are contributary factors to the pest problems in the greenhouse. Knowledge and advice on existing resistant/tolerant vegetable varieties to important greenhouse pest problems are lacking. The unavailability and/or difficulty of application or high cost of effective pest control products contribute to inefficient plant protection measures.

Control Measures Undertaken in Developed Countries

Production of vegetables under covers has been initiated and is flourishing in northern European countries, e.g. the Netherlands, the United kingdom, Germany, etc. Structures used are glasshouses, and in all cases the climate is fully controlled. In most cases the use of soil is avoided, and peatmoss cushions, which are fumigated at the end of each season, are used instead. Drip irrigation is the watering system adopted, with balanced nutrients being provided through the drip-line. The main pest problems in these structures are caused by insects and mites. The incidence of plant diseases is very low compared with the situation in plastic tunnels used in the Near East. Disease problems are satisfactorily resolved by controlling humidity, temperature and sanitation of the structure in such a way as to avoid propagation and infection of plant pathogens. In addition, the use of healthy planting material, resistant cultivars and protective

selective fungicides is a regular pratice in glasshouse vegetable production. The control of pest problems is based on integrated pest management with heavy reliance on the use of predators and parasites. Table 4 illustrates the IPM programmes for common pests of tomato, cucumber and pepper in Europe. Full control of the environment, maximum production inputs and IPM have created optimal conditions for plant growth and production, and pest control .Record yields per unit area have been achieved, e.g. 500 t/ha in tomatoes.

Table 4 - IPM programmes for common greenhouse vegetable pests in Europe (Van Lenteren & Woets, 1988)

Pests	Commercial programme	Experimental programme
A. Tomato		
Trialeurodes vaporarium	*Encarisia formosa*	Resistant tomato cultivars and *E. formosa*
Tetranychus urticae	*Phytoseiulus persimilis* and chemical control	*P. persimilis*
Liriomyza bryoniae	*Dacnusa sibirica* and natrual control	Other parasites
Liriomyza trifolii	*Diglyphus isaea* and natural control	Other parasites
Aphids	Chemical control and natural control	*Aphidius matricariae, Aphidioletes aphidimyza*
Lacanobia oleracea	*Bacillus thuringiensis*	
Chrysodeixis chalcites	*Bacillus thuringiensis*	
Botrytis cinerea	Fungicides	
B. Cucumber		
Trialeurodes vaporarium	*Encarsia formosa* and chemical control	*Aschersonia aleyrodis, Verticillium lecani* and resistant cucumber cultivars
Tetranychus urticae	*Phytoseiulus persimilis*	
Thrips tabaci	Chemical control	*Amblyseius spp.*
Aphis gossypii, Myzus persicae, Macrosiphum euphorbiae	Natural and chemical control	*Aphidius matricariae, Aphidioletes aphidimyza, Verticillium lecanii*
Sphaerotheca fuliginea	Fungicides	Resistant cultivars
Botrytis cinerea	Fungicides	
Dydimella bryoniae	Fungicides	
C. Pepper		
Tertanychus urticae	*Phytoseiulus persimilis*	Resistant pepper cultivars
Thrips tabaci	*Amblyseius cucumeris*	
Myzus persicae	Natural control and chemical control	See cucumber
Lacanobia oleracea	*Bacillus thuringiensis*	
Chrysodeixis chalcites	*Bacillus thuringiensis*	
Trialeurodes vaporarium	*Encarsia formosa*	
Liriomyza spp.	See tomato	
Tarsonemid mites	Chemical control	Sulphur dust
Botrytis cinerea	Fungicides	
Rhizoctonia solani	Fungicides	

Pre-Requisites for Successful IPM Programmes

Concerted efforts on the part of policy-makers, research institues, extension services, growers and consumers are essential for the development of intergrated pest management programmes for protected vegetable cultivation. Policy-makers' support is the cornerstone for the development of a successful programme. Their backing is a pre-requisite for any progress tc be achieved in this field since they determine the provision of required funding and technical support, enactment of legislation/regulations, administrative and staffing support, etc. On-site research by a multidisciplinary team is fundamental to the achievement of the necessary technological changes in an affordable and acceptable way. Research requires adequate incentives, operational funds, technical facilities, and well-trained scientists and adequate technical staff. The success of programmes developed by research lies ultimately in the transfer of the knowledge and experience gained to growers. Therefore, an efficient extension service, staffed by subject matter specialists, who have regular and effective contact with growers, is required. Extension activities must be able to evaluate the standard of education on farmers and prioritize/organize information

systems accordingly. Needless to say, adequate funding, facilities, personnel, and quality training are essential for the success of extension programmes. Stimulation of growers' interest is of paramount importance for the success of IMP programmes. Educational training on the implementation and advantage of IPM, the hazards of pesticides for man and the environment, and the establishment of associations of growers for protected vegetables under cultivation, will help to gain growers' confidence and stimulate their interest in IMP programmes. Consumer orientation towards IMP programmes and awareness of the potential hazards of consumption of off-season vegetables produced through total reliance on pesticides, will play a role in increasing demand on IMP-produced vegetables and lead towards grower interest in providing such produce.

FAO Activities in Developing IPM for Protected Vegetable Cultivation in the Near East

The continuing expansion in production of vegetables under cover in the Near East reflects that a) there is a place for off-season vegetables on local and foreign markets, and b) production of vegetables under cover is an econmically rewarding production system. The increasing incidence of pest problems in greenhouses caused by the build-up of pest populations has resulted in reduced yield and the increased cost of plant protection measures, mainly for pesticide applications. Such a situation makes pest problems the main limiting factor/constraint in protected vegetable cultivation. Furthermore, the intensified application of pesticides has in the long run become costly and inefficient, resulting in resistance of pests to pesticides; hazardous effects on man and the environment; and residual problems on produce, especially those vegetables to be harvested at short, regular intervals, such as cucumbers. FAO realizes the importance of protected vegetable cultivation in the Region, and is aware of the dimensions of pest problems and the impact of control measures. In an effort to recify this situation, in 1987 a cross-section study was undertaken in the Region on pest problems of vegetables under covers and existing control measures. The study comprised reports on the situation in Marocco, Tunisia, Egypt, Jordan, Turkey and Syria. The country reports, prepared by national scientists, were synthesized in a regional study. This study was the subject of a workshop held in Wageningen, the Netherlands, in May 1990 and attended by scientists from the Region, FAO Headquarters staff and Dutch experts. The regional study was discussed and a pest control strategy based on integrated pest management was formulated and endorsed. Based on this strategy, FAO is preparing a regional project document for development of integrated pest management programmes for vegetables grown under covers. The regional project will be submitted to potential donors for funding. FAO is also ensuring that an IPM element is always included in the various projects it funds or implements on vegetable production under protection. Through such projects, consultancies are provided to assess the pest situation and plant protection practices, and assist governments to develop IPM programmes. Study tours and training are also provided to technical personnel of the countries concerned.

Possible Strategies for Development of IPM for Protected Cultivation in the Near East

The pre-requisites for a disease to develop are the presence of a susceptible host, a virulent pathogen and a favourable environment. Insect problems occur when an insect identifies a host to supply it with food for nutrition, and a suitable environment which provides shelter for survival and reproduction. Any disturbance to these formulae will affect the incidence of a disease tr of an insect. Therefore, any successful strategies for control have to be based on full knowledge of life-cycles of plant pests and conditions favouring their survival and infection or infestation, and must focus on the most efficient and the simplest means and meaures required to prevent invasion or infestation by such pests. Accordingly, to develop a strategy for the development of integrated pest management for protected vegetable cultivation, a list of sources of pest problems (based on Table 2) would probably be the first approach to tackle the problems. Therefore, the following categorization of sources could be made: i) seed-borne, ii) soil-borne, iii) air-borne, iv) vector-borne, v) insects and mites, and vi) weeds. Factors enhancing pest problems also require listing, and here the list may include: i) susceptible host (s), ii) uncontrolled seedbed or nursery, iii) infested greenhouse structrue and/or support material, iv) inadequate cultural practices, v) favourable climatic conditions, i.e. temperature and/or humidity, vi) favourable irrigation system, and vii) abuse or misuse of pesticides. Once these two lists have been draw up, available control measures for each item on the list should be counter-listed against the appropriate item. When this is accomplished, a choice of the more efficient, simple, practical and economic measures should be grouped together for experimentation and development of suitable IPM packages to be adopted for various crops in different areas or countries. A diagram illustrating the proposed approach is shown in Figure 1. Once the most suitable package for a particular situation is identified, the full commitment of research institutes in the Region to test such packages is required. Government/donor support to such institutions in terms of facilities, personnel and training, is a pre-requisite for the success of the undertaking. Recommendations should be made on packages developed in the Region that have proved successful. Such recommendations should be transferred to the farmers in a simple manner be the Extension Services through group training, leaflets, demonstration trails, audio-visual means, etc. It is not appropriate to transfer technology from temperate glasshouse experience directly to the Region without evaluation. Constant monitoring of established packages should continue in order to ensure their efficiency, and for acquaintance with developing problems and upgrading of the efficiency of the package. Exchange of information on problems and progress on pest problems and their control is an essential element in developing IPM packages.

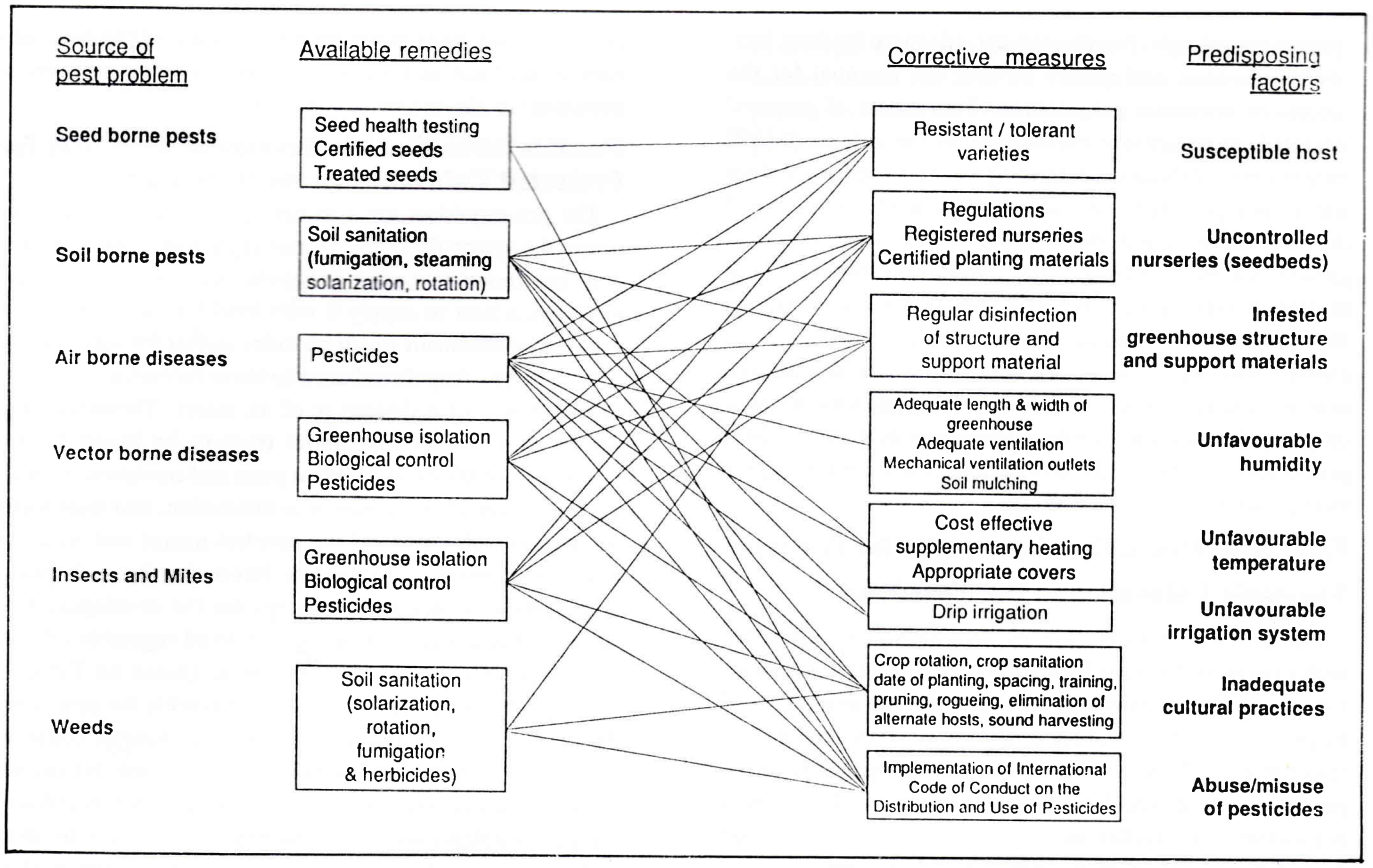

Figure 1. Elements for development of IPM packages for vegetables grown under covers.

Recommendations

Based on the above pest situation and present control measures of protected vegetable cultivation in the Near East and their impact on sustainability of protected vegetable cultivation on the one hand, and on man and the environment on the other, it is recommended that Member Countries:

Develop an awareness programme for policy-makers, consumers and growers, through seminars, consumer and grower meetings, newspapers and audio-visual media, on pest problems in protected vegetable cultivation and the impact of present control measures, and the need for the development of an integrated pest management approach.

Launch research programmes to develop integrated pest management packages suitable for crops grown in various geographical locations. Such programmes should consider what is possible as opposed to what is desirable when developing packages.

Promote extension services in such a way as to enable transfer of research findings to growers. This requires strengthening communications between research and extension; providing training facilities; improving communication with growers; and supplying the necessary facilities and funds for establishing and running efficient delivery systems.

Enforce quarantine measures on imported seeds and implement the International Code of Conduct on the Distribution and Use of Pesticides.

Develop specifications for greenhouse structures and covers, enforce registration of varieties for use in greenhouses, establish/strengthen facilities for pesticide residue analysis, and control reidues on vegetable produce.

Promote national, regional and international exchange of information on pest problems for protected vegetables cultivation and their control.

Seek assistance from international organizations and donors to promote IPM in protected vegetable cultivation.

Support regional projects on IPM for protected vegetable cultivation with the objectives of establishing a regional network on IPM for protected vegetables; formulating and testing IPM packages for the main vegetable crops; upgrading national capabilities in terms of extension, training, and development of information material; setting up a database on pest and disease problems and their control; and transfer of technology from outside the Region to concerned institutions within the Region.

الملخص

طاهر، محمود محمد. 1992. مشاكل الآفات في الزراعة المحمية للخضار في اقليم الشرق الأدنى وآفاق برامج المكافحة المتكاملة. مجلة وقاية النبات العربية 10 (1) : 68-76.

ازدهرت زراعة الخضر المحمية في اقليم الشرق الأدنى خلال العقدين الماضيين، وبلغت المساحات المخصصة لها ما يقرب من 43000 هكتار. ومن الحوافز التي أدت إلى هذا التوسع بساطة الهياكل المستخدمة ومناسبة كلفتها، وتوافر الأصناف ذات الإنتاجية العالية، وتزايد الطلب على الإنتاج في الداخل والخارج، والعائد المجزي للمحصول. وتبرز مشاكل الآفات بعد سنوات قليلة من الزراعة كعامل محدد للإنتاج المربح ويسهم في تفاقم هذه المشاكل كل من الزراعة المتوالية للمحصول نفسه أو محاصيل العائلة الواحدة، والبيئة المناسبة التي توفرها الهياكل المستخدمة، وعدم توافر البحوث الكافية في مكافحة الآفات في الزراعة المحمية. ويتعامل الإقليم في الوقت الراهن مع هذه المشاكل اساساً باستخدام المبيدات الكيماوية. وقد بدأت الجوانب الضارة لهذا الإستخدام تظهر بصورة جلية. ويتناول هذا البحث العوامل التي تسهم في تفاقم مشاكل الآفات في الزراعة المحمية في اقليم الشرق الأدنى كما يقترح طرق الانتقال من أسلوب المكافحة الكيماوية الى برامج المكافحة المتكاملة.

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