Key points

- Effective IPM techniques for tomato, which reduce production costs, have been well-researched but this knowledge does not often reach farmers.
- Ecological production is based on a combination of control methods requiring good management, skills and knowledge.
- Participatory approaches provide the knowledge and confidence for farmers to make their own crop management decisions.

developing technologies and approaches for Integrated Pest Management (IPM), much of the information and know how has not extended to farmers.

After Farmer Field School (FFS) IPM training on vegetables in Ghana, the 74 farmer participants stopped using chemical pesticides, and achieved a 70% rise in their incomes. The average yield was 112% higher. Furthermore, farmers were clear that the quality of the crop improved by producing more wholesome fruit with a longer shelf life, better taste and fewer pesticide residues. An evaluation foundthat these farmers had a remarkable understanding of the factors of crop production, from soil fertility management to pest control. All the farmers knew the pests that threatened their crops as well as friendly bugs to control pests.

The evaluation recommended that the FFS curriculum should incorporate a marketing strategy, particularly for crops like tomato, where farmers need to be able to deal effectively with middlemen or women.

Other recent FFS IPM training programmes for vegetables include the FAO regional Vegetable IPM Project for Asia and national projects in Africa. The approach is being extended.

Resources

Crop Protection Compendium', (2000) CAB International An interactive CD ROM based database of a wide range of science-based information on all aspects of crop protection.

'Tomato Integrated Pest Management: An ecological Guide'(2000).Prasterink, F. FAO Intercountry Programme for Development and Application of IPM in Vegetable Growing in South and Southeast Asia.

Appropriate Technology Transfer for Rural Areas: Organic Tomato Production

http://www.attra.org/attra-pub/tomato.html

On-line Tomato Vine
http://www.kcinter.net/~mule/Tomato/tomlink/problems.htm

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PESTICIDE ACTION NETWORK *UK*

Ecoplogical tomato production, PMN Nº 13, May 2002.This briefing is one of a series prepared by Pesticide Action Network UK(PANUK), which is responsible for its contents, as consultants to DG Development of the EC. PAN UK is an independent charity working to reduce pesticide problems in developing countries. Its quarterly journal Pesticides News reports on pesticides and IPM.

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PEST MANAGEMENT NOTES *No.13*

Sustainable tomato production

A briefing for the IPM in Developing Countries Project funded by the European Commission (Environment in Developing Countries budget).

The tomato plant

The tomato (Lycopersicon esculentum) belongs to a large family of plants called the Solanaceae, which contains many important food crops, including potatoes and aubergine (egg plant). Originally from the Andean region of South America, which covers parts of what is now Bolivia, Chile, Ecuador, Colombia and Peru, it was probably the Aztecs and the Incas, living in modern day Mexico, who domesticated the crop over 1500 years ago.

There are basically two types of tomato: Determinate types that produce flowers at almost every internode until terminal flowers are formed. Plant growth stops at this point. Determinate tomatoes usually have a quite bushy appearance and are hence often referred to as 'bush tomatoes. Indeterminate types continue growing almost indefinitely and need staking and pruning.They produce flowers at every third internode.

Children applying hazardous pesticides. Photo:Adelia Araujo and Lia Augusto.

Tomato production

Tomatoes are one of the most popular and widely grown vegetables in the world. Leading tomato producing countries include China, USA, Turkey, Russia, Italy, Egypt, India, Spain and Mexico. However farmers in most countries grow tomatoes, often in peri-urban areas, to supply local demand. In Latin America, for example, tomatoes are one of the main vegetable crops grown for sale.

In 1999, global production was about 94 million tonnes, from 5.5 million ha of land under tomato cultivation, and has increased rapidly over the last decade, both in terms of tonnage and area. Fresh tomatoes are key ingredients in cuisines from all around the world, and processed tomatoes are used to make soup, juice, ketchup, puree and other products.

Tomatoes can be grown either in the field or under greenhouse conditions. Most greenhouse production is in North America and Europe, where production systems are extremely intensive and can give very high yields (up to 700 tonnes/ha). Field production is much less intensive, and is the most common system in tropical and subtropical areas.

Tomato production problems

Pesticides are widely used by tomato growers in developing countries, generally without training in application or identification of need. Pesticides classified as extremely hazardous by the World Health Organisation (WHO), such as monocrotophos, are commonly used.The combination of the importance of tomatoes in diets and high levels of pesticides, particularly in developing countries, makes reduction in pesticide use important both for occupational health and safety and consumer safety. A number of studies have found it common practice to spray tomatoes in the afternoon and harvest the following morning.The development of Integrated Pest Management (IPM) training for farmers has shown that it is possible to reduce pesticide application and increase farmer income.

Unsafe production methods

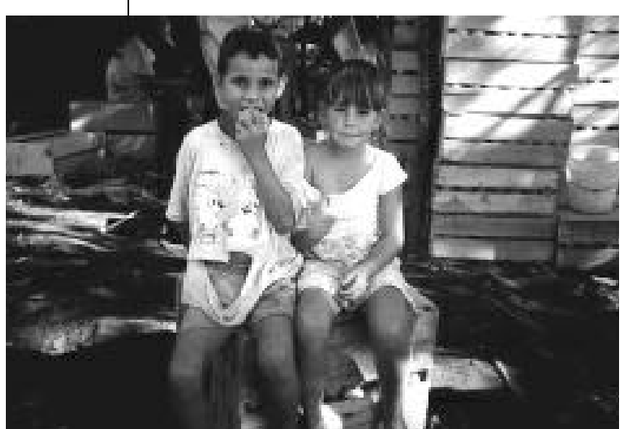
The importance of tomatoes in many national diets and high levels of pesticide use create concern about the health and safety of workers, small scale farmers, and consumers.

In Brazil, the Pernambuco region supplies 35 per cent of the demand for tomatoes. One study of 32 producers, who employ 500 agricultural labourers, found that the pesticide Maximum Residue Levels (MRLs) were regularly exceeded: methamidophos was found in 25 per cent of samples, a breakdown product of ethylene dithiocarbamate in 78 per cent, and endosulfan in 28 per cent. All members of agricultural worker families work in the tomato fields, and children frequently spray pesticides. Workers indicated many health problems: itching skin, sore eyes and nose, fever, muscular problems, dizziness, numbness and vomiting. Information and training was minimal and 64 per cent wore no personal protective equipment.The average working period of a pesticide sprayer was three years.

In Ghana, where production is largely in the hands of small scale farmers, pesticide problems are of equal concern. Among the farmers of Akumadan, who sell to traders from Kumasi, application methods are extremely hazardous, including mixing with bare hands. Any sign of a pest increases spraying frequency to twice a week.The economic returns are often negligible as farmers spend can spend around US$300 an acre on pesticides, and on some occasions earn less than this from the sales. Farmers are aware of acute health problems and have also noted an increase in infertility, miscarriages and stillbirths, but no studies have investigated these concerns. Elsewhere in Ghana, a vegetable IPM training has helped farmers to dramatically reduce their dependence.

Sustainable options for pest management in tomato

More sustainable production methods are readily available, but not widely disseminated in developing countries. One research project developed a 22 point programme for white fly control and associated viruses that reduced insecticide sprays from 30 to 12, greatly increasing grower profits. Biological controls and improved cultural practices can reduce pesticide use dramatically.



Tomatos contain high levels of banned pesticide residues. Photo: Adelia Araujo and Lia Augusto.

Raising and transplanting healthy seedlings

Tomato can be directly seeded. However raising seedlings in a nursery and transplanting in the field enables growers to achieve greater uniformity and manage pests and diseases more easily. Strong, healthy seedlings that are free of pests are important.The use of clean seed is crucial. If possible, certified seed should be used, but if it is unavailable or too expensive, hot water treatments can control many seed borne diseases.

Clean soil helps avoid many soil-borne pest and disease problems such as damping-off, rootknot nematodes, southern blight, and Verticilium and Fusarium wilts. The use of subsoil, and soil solarisation or sterilisation are effective. In Kenya, the traditional practice of burning trash on the seedbeds prior to planting manages some soil pests, especially rootknot nematodes.

During transplanting, care should be taken to avoid damaging the seedlings, as that provides an entry point for diseases. Screening the nursery with a fine mesh against aphids and whiteflies can reduce attack and delay or prevent the transmission of any viruses.

Cultural control

Cultural control is a generic term for pest management methods based on the way the crop is grown. Crop hygiene is extremely important in managing most pests. It can involve removal and destruction of: crop residues; heavily infested individual plants; volunteer plants left in the soil after the previous harvest; soleanacous weeds.

Ploughing can bring the larvae and pupae of soil dwelling insect pests, such as cutworms, to the surface where they are exposed to predators including birds and ground beetles. Crop rotations that leave at least three years between soleanous crops can help to manage many problems. Some diseases, such as southern blight and Fusarium wilt, can survive for many years in the soil in the absence of the host plant, and therefore longer rotations are required.

Use of resistant varieties

Resistant cultivars are known for certain diseases, including early blight, many wilts, and insect pests including whiteflies, leafminers, some species of rootknot nematode.

Minimal pesticide use

Many seed treatments are available for diseases. These are more efficient than spraying, as quantities of pesticides are greatly reduced and effects on non-target organisms are minimised. Once in the field, some diseases are more difficult to control by non-chemical methods, and a contact fungicide may be unavoidable. Applications of pesticides must be minimised, for example by spraying only when the weather conditions are favourable and when an initial infection has been observed.

Insecticide applications are ineffective against many insect pests. Application can actually increase leaf miner populations because once inside the leaf the insect is protected, while spraying often destroys natural enemies. Cutworms are only exposed for a brief period when they leave the soil to feed. Whiteflies and fruitworms are well known for their resistance to insecticides.

Biological control

In greenhouse systems of Europe and North America biological control systems are highly developed. Natural enemy species are released against the key insect pests aphids, spider mites and whiteflies. In the field releasing parasitoids of leafminers, can be effective. The beneficial fungi from the genus Trichoderma, can also be applied for biological control of various soil pathogens.

Biopesticides like Bacillius thuringiensis (Bt) can be effective against many caterpillar pests, Nuclear Polyhedrosis Virus (NPV) has been tried against Spodoptera with variable success.

Soil and water management

Growing a healthy, vigorous crop is fundamental, and helps the plant to resist or tolerate attack. Soil and water management are crucial. Crop rotation; cover crops, green manures, organic manures and composts help to maintain well-structured soils and balanced nutrients. Nutrients can be supplemented.This helps prevent nutritional disorders.

Avoiding overhead irrigation helps restrict the spread of some diseases. Improved drainage through raised seedbeds can help manage diseases like bacterial wilt and southern blight, while drip or flood irrigation during dry periods can control cutworms.

Farmer training for sustainable production

One of the important lessons of recent years is that all stakeholders need to be involved in a partnership for sustainable crop production. While a great deal of work has been carried out in

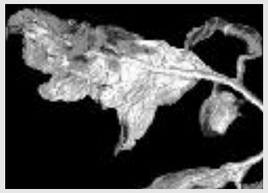
Tomato pests and diseases

Diseases

Leafspots This is a large group of diseases caused by both fungi and bacteria. Late blight, caused by the fungus Phytophthora infestans spreads fastest under cool, humid conditions and can lead to complete crop loss. Early blight, caused by Alternaria solani is a problem in cooler, wetter climates. Bacterial leaf spot is caused by a strain of the bacteria Xanthomonas campestris is serious in warm, humid climates.

Wilts Bacterial wilt is caused by Ralstonia solanacearum, a soil borne bacterium that spreads most quickly in warm, wet climates. The infection disrupts water intake. Younger plants wilt in heat but recover, while in older plants the wilting is permanent. Southern blight is a fungal disease caused by Sclerotium rolfsii, which mainly attacks mature plants, attacking roots, leaves and fruit.It can survive in the soil for many years. Damping-off diseases can be caused by several soil-borne pathogens, including Rhizoctonia, Pythium and Fusarium fungi, and will kill seedlings. The fungus Verticillium alboatrum is common and a severe infection is fatal. Fusarium oxysporum survives in the soil for long periods and causes fusarium wilt.

Viral Diseases A number of viruses cause mottling or mosaic symptoms on the leaves. Tomato Mosaic Virus (TMV), can be transmitted mechanically, while others (Cucumber Mosaic Virus [CMV] are transmitted by aphids, thrips, whitefly and other insects.

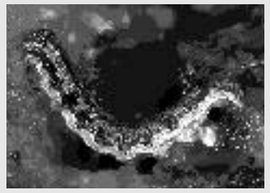


Distortion of tomato leaves caused by CMV. Nigel Cattlin/Holt Studios.

Nematodes

Small, worm-like plant parasitic nematodes mainly attack roots. The most significant for tomato are from the family Meloidogyne. Infected plants are less vigorous with fewer fruits. Rootknot nematodes interact with bacterial and fungal wilts, increasing the damage.

Insect and mite pests



Helicoverpa armigera attacking tomato fruit (CSL).

Fruit pests The larvae of the fruitworm Helicoverpa armigera is a significant pest, boring into fruit, and attacking leaves and flowers. It is highly resistant to many insecticides.

Leaf pests Several whitefly species attack tomato but Bemisia tabacci (the tobacco whitefly) and Trialeurodes vaporariorum (the glasshouse whitefly), are the most common. Heavy infestations can kill the plant. Leafminers attacking tomato are the larvae of small flies that 'mine' by boring into the leaf and eating tissues between the upper and lower surfaces. Important species include Liriomyza trifoli and Liriomyza sativae. Armyworms are caterpillars of Spodoptera species, which occasionally form large groups and 'march'in search of food. A severe attack will leave only the main veins and the stalk. Spider mites can breed extremely quickly and in large numbers: Tetranynchus species is the most common on tomatoes.

Bemisia tabacci adults (Ian D. Bedford)

Stem pests Cutworms (Agrotis species) curl around the stem and cut it off at soil level.They mostly live in the soil, only venturing out to feed for short periods usually at night.