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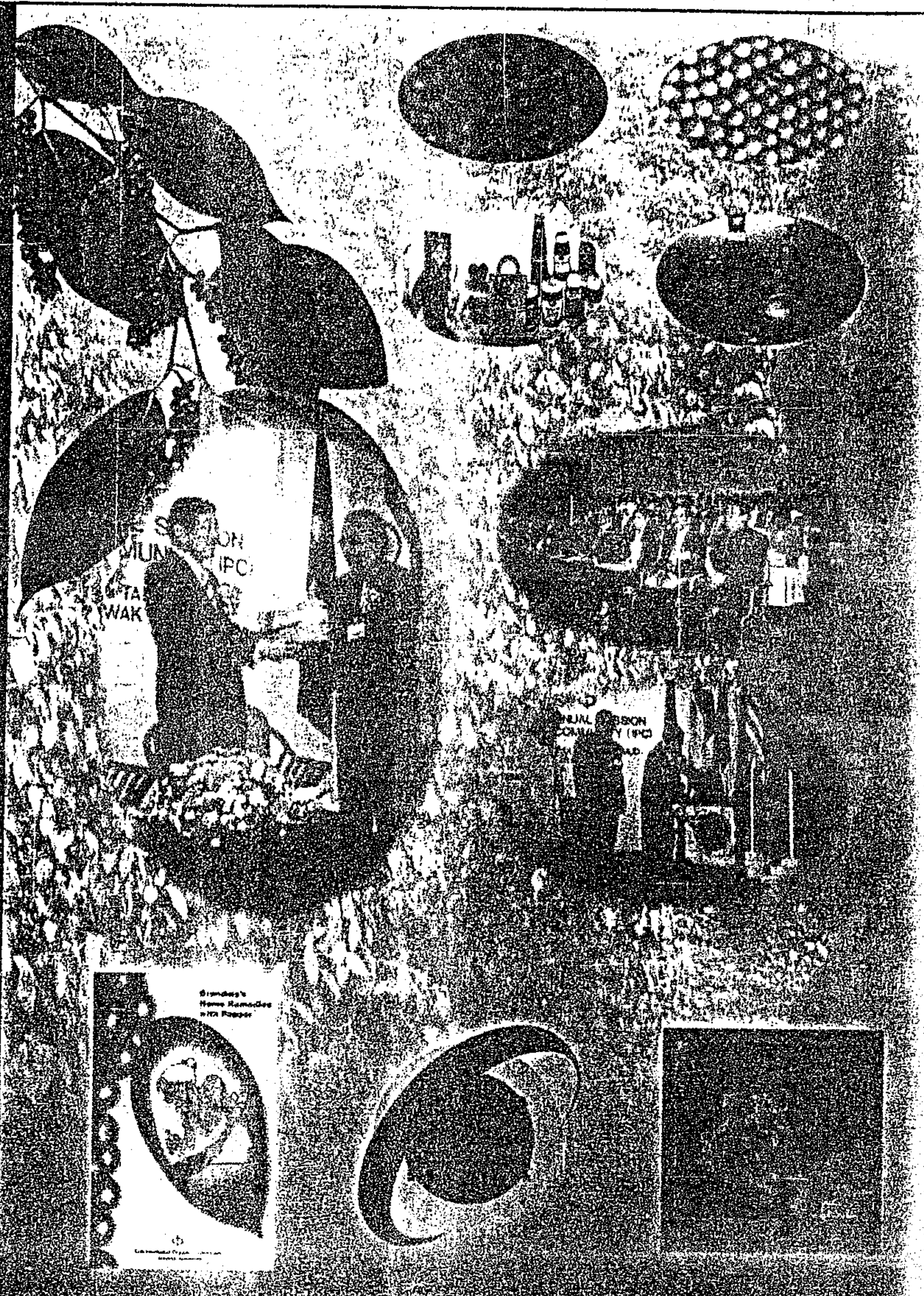

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GLOBAL SCENARIO OF DISEASE AND PEST MANAGEMENT IN BLACK PEPPER

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Increase in production & productivity and decreasing cost of production in black pepper remain as watch words to become globally competitive for any black pepper producing country. Though the geographical condition and cultivation / cropping system differ from country to country, the biotic and abiotic stresses continue to be major production constraints which need to be addressed and prioritized in the research programmes of thrust areas. Insect pests though are important, diseases take a heavy toll of the crop and are serious. *Phytophthora* foot rot caused by *Phytophthora capsici*, slow decline, a disease complex involving two important plant parasitic nematodes i.e., *Radopholus similis* and *Meloidogyne incognita* either alone or in combination with *P. capsici*, Anthracnose caused by *Colletotrichum* sp. and stunted disease of viral in nature continue to incur severe crop losses, in all the pepper growing countries. Besides in Brazil, root rot and stem blight caused by *Nectria haematococca* Berk and Br. F. sp. *Piperis* Albiq (Fusarium solani (Mart) Sacc. F. sp. piperis Albuq is another important disease and is not seen in other pepper producing countries.

Black pepper originated from Western Ghats of India and has spread adjacent South East Asian countries and the secondary spread to Brazil and other African countries occurred over years. The common disease profile in all the pepper growing countries except for Fusarium root rot and stem rot in Brazil, points to two possibilities.

1. Black pepper would have become susceptible to already available pathogens in the given country.

2. Pathogens associated with black pepper in India would have gone to other countries through planting material since it is vegetatively propagated and no quarantive regulations would have existed during those earlier days. These pathogens would have taken strong hold in the new countries of introduction.

Irrespective of the source and origin of diseases the research programmes undertaken in IPCC member countries and the workshops conducted in India, Indonesia and Malaysia (Sarma and Premkumar, 1991, Ibrahim *et al.* 1993) and recently again at Sarawak by IPC (Anon, 2002) did help substantially in our present understanding of these diseases and their management.

Phytophthora foot rot and slow decline diseases

These two take a heavy toll of the crop and the pathogens involved *P. capsici, R. similes, M. incognita* overlap under field condition depending on the cropping system, and as such there is no definite spatial segregation of these in the field (Sarma *et al.*, 1992). The former is a killer and the later two are debilitating. A necessity of holistic approach was stressed in order to check these three pathogens to boost up the vigour and productivity of the vines.

Cultural practices like provision of good drainage, shade regulation, minimum tillage to avoid root damage and above all phytosanitation, to reduce the soil inoculum build up and consequent reduction of the disease, are components of integrated disease management strategies.

Chemical control

Chemical control with copper as contact fungicides and systemic fungicides like phenylamides (metalaxyl) and phosphonates (Fosetyl A and Potassium phosphonate) were found effective in all the member countries (Ramachandran and Sarma, 1990, Duarte *ét al.* 2002, Wong, 2002). Efficacy of root feeding with phosphorous acid though reported from Sarawak (Wong 2002), has practical problems for large-scale field adoption specially the likely possibility of feeder root damage during the operation of the method. However, soil drenching and foliar spraying swith potassium phosphonate was found effective in checking root *Phytophthora* infection of black pepper in India. Specially for the suppression of nematodes, selective application of compounds like phorate and furadan though effective are not practical and cost effective besides the environmental hazards these chemicals pose. However, recently in India large scale field demonstration with an integrated approach involving cultural practices and application of pre and post monsoon prophylatic application of copper fungicides, were found highly effective in reducing foot rot. This programme was implemented during 1994-98 in an area of 87,650ha at a cost of Rs. 28crores (US $ 5.8 million) showed a decrease of disease (vine death) from 25.7% to 3-7%, which showed a benefit cost ratio of 2.3

Biocontrol:

The fact that *P. capsici* was found in the soils of undisturbed Western Ghats of India in Silent Valley, the place of origin of black pepper and absence of disease, points to the fact that there is a co-evolution of *P. capsici* with *Piper nigrum*. The disease problem started under its domestication and intensive cultivation where the natural ecological balance got disturbed. As such this became a point of interest and investigation in to the microbial component of the soil to exploit the bio-control potential, if any. Potential of biological control of nematodes with *Verticillium chlamydosporium*, *Paecilomyces lilacinus*, *Pasteuria penetrans*, *Trichoderma* spp., *Glomus fasciculatum* and fluorescent pseudomonads (Anandaraj *et al.*, 1993, Santhosh *et al.*, 1997, Sarma *et al*, 2000, Eng 2002) has been established but needs intensive large scale field testing. Besides in recent years the fluorescent pseudomonads in suppression of *P.capsici* and nematode points to the feasibility of large-scale field adoption (Sarma et al. 2000). Intensification of research programmes on biological control and large scale field testing for disease suppression of *Phytophthora* foot rot and slow decline in black pepper are warranted and need be incorporated in integrated disease management.

Nursery management

Since these soil borne pathogens infect the roots right at the nursery stage but go unnoticed, it is all the more important to standardize disease management in nurseries in black pepper. Solarization of nursery mixture and fortification of the same with VAM, *Trichoderma harzianum* and *Pseudomonas fluorescens* ensured healthy robust rooted cuttings which ensured high field establishment under Indian conditions (Sarma and Anandaraj 2000).

Ecofriendly crop protection as a major component of integrated disease management is gaining importance in view of its potential in organic farming and sustainable agriculture. In India the feasibility of this biocontrol technology in management of spices disease and in black pepper specially involving *Trichoderma harzianum* and *Glomus fasciculatum*, a VAM fungus has been well established (Sarma and Anandaraj, 2000). Incidentally VAM found to have a dual role of suppressing *Phytophthora* and nematodes. Disease suppression of root rot of black pepper caused by *P. capsici* through soil application of *T. harzianum* has been demonstrated in farmer's field and impact analysis survey revealed that 80% of the practicing farmers found it effective (Sarma and Anandaraj, 2000).

Incidentally these biocontrol agents like *Trichoderma* are compatible with potassium phosphonate chloropyriphos etc. indicating their potential for IDM (Rajan and Sarma, 1997, Stephen *et al.* 2000). Thus Integrated Disease Management (IDM) with a major emphasis on ecofriendly biocontrol agents with dual mode of action of suppressing both pathogenic fungi and plant parasitic nematodes and with growth promotion are of great relevance in black pepper in all pepper growing countries.

Host resistance for major diseases in all the countries appears little except for the high degree of multiple resistance in *Piper colubrinum* to *P. capsici*, *R. similis* and *M. incognita* which need exploitation through conventional and biotechnological approaches (Sarma and Anandaraj, 1996). Root stock of *P. colubrinum* though abandoned in all countries, recent field studies in India are successful where root stocks are tried in areas of high soil moisture. Pepper on *P. colubrinum* root stocks on slightly marshy areas are now yielding for the last 3 years and till date are normal. Fruiting laterals on *P. colubrinum* root stocks as old as 10 years are normal. This need be tried in other countries, too.

Anthracnose / Black burry disease

Exclusive anthracnose caused by *Colletotrichum glocosporoides* leads to leaf spot as well as poor berry development when immature berries are infected. This also leads to spike shedding in India (Sarma et al. 1994) However, this fungus in combination with red alga *Cephaleuros viriscens* is reported as important problem causing black berry disease both in Malaysia and Brazil (Kueh 1990, Duarte, M.L.R. *et al* 2001).

In India spray with 1% Bordeaux mixture is recommended. In Brazil fenomyl tridimefon was found effective (Duarte *et al* 2001). In Malaysia prochloraz manganese chloride was found effective besides cyproconozole. However, wherever systemic fungicides used monitoring the pesticide residue is important to avoid residues in the produce.

Viral diseases

Stunt disease of black pepper and pepper yellow mottle virus are reported to be prevalent in all pepper growing countries. Association of cucumber mosaic (CMV) with the former and a strain of badna with the latter have been reported. Transmission of badna virus by *Ferrisia vargata* has been reported in India (Lockhart *et al,* 1997, Sarma et al. 2001, Duarte et al. 2001, Bhat et al 2003. Even though death of the plant is not reported due to these, decline in vigour and productivity is noticed and are serious. In the cases of pepper yellow mottle virus in South East Asia insect transmission by *Planococcus citri* has been reported (Lokhant et al 1997). However, in the case of Brazil *P.elisae* has been suspected (Duarte *et al* 2001). In the case of CMV though aphid association (*Toxoptera auraunti*, *T. citricidus*) is noticed successful insect transmission of the virus is yet to be established. In India combined infection of both CMV and badna are suspected and investigation are in progress.

Even though insect transmission can be ascribed for the spread of the disease, vertical transmission of the disease through planting material appears to be the major mode of disease spread, since black pepper is vetatively propagated. Since in many cases the plants show very mild symptom, detection of the disease visually would be difficult for farmers. Hence, there is an urgent need to develop serodiognostic method as well as molecular methods to detect the virus in the parent nursery stock, so that such contaminated source can be totally avoided for vegetative multiplication. However micropropagation protocols of black pepper can be made use of for production of disease free plants, once confirmed healthy source is available.

Insect pests

Insect pest damage is comparatively less in all the countries. In India damage to new flush and tender berries due to *Longitarsus nigripennis,* a beetle, results in damage as high as 30-40%. Scales (*Lepidosaphes piperis* and *Aspidiotus destructor*) and root mealybug (*Planococus* sp.) are becoming increasingly serious. *Ferrisia vargata* also is a known vector of Badna virus. An integrated approach involving botanicals like neem products, insecticides, parasites and predators, and entomopathogens like *Beauveria bassiana*, *Verticillium lecanii, Metarzhium anisopliae* and BT formulations though found effective are to go for large scale field testing (Devasahayam and Abdulla Koya, 1999, Devasahayam and Leela, 1997).

Similar approaches are adopted in Malaysia for insect pests specially for Tingid bug (*Diconcoris hewitte*) green pepper bug (*Dasynus piperis*) and pepper weevil (*Lophobaris piperis*) which are considered to be important in the region. Pest problems in Brazil appear to be less serious and the pepper weevil and mealybug (*Pseudococcus elisae*) are some of the pests recorded in the region (Duarte *et al.,* 2002). In Sri Lanka thrips (*Gyanakothrips karnyai*) shoot borer (Lasperesia hemidoxa) and lace bug (*Diconocoris distants*) are some of the pests recorded (Kularatne, 2002).

In general, approach of insect pest management should focus on integrated approach with major emphasis in cultural, biological control along with botanical which would ensure 'O' pesticide residues in the produce, which is the demand of importers.

Recent report of expert system on diagnosing diseases and pests in black pepper is of great practical importance (Fathima Othang *et al.,* 2002) in management of disease pests and needs large scale evaluation in all member countries.

Under the auspices of International Pepper Community (IPC) all the pepper growing countries, should intensity cooperation and exchange of information on management of pests and diseases to address these practical production constraints.

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Plate 1. Major diseases of Black Pepper

a) *Phytophthora* foot rot b) Root rot

c) Isolates of *P. capsici* d) Stunted disease of Black Pepper

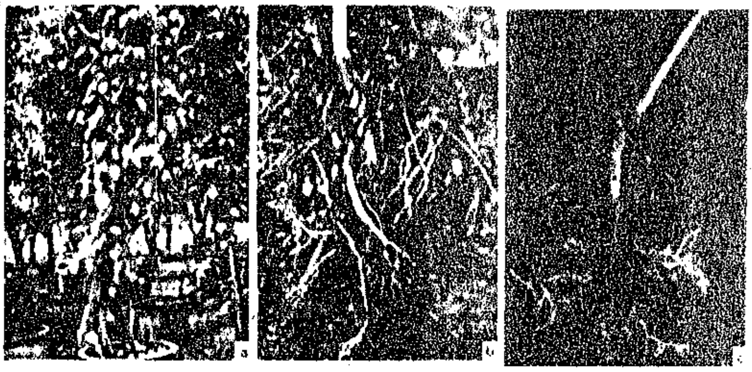

Plate 2. Slow decline disease of black pepper

a) Foliar symptom

b) Feeder root damage by

c) Root damage by

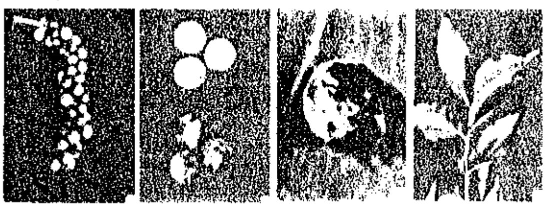

Plate 4. Pollu beetle of black pepper

a) Black pepper berries damaged by 'pollu' beetle

b) Antifeedant activity of neem products top-sprayed; bottom-unsprayed)

c) *Strychnos nuxvomixa*, a plant species with antifeedant principles

d) Bioassay of *Beauveria bassiana*, a potential entomophagous fungus

Plate 5. Scale insect of black pepper

a) Black pepper vines infested with scale insect

b) *Chilocorus nigrita* p potential biocontrol agent of scale insect

c. & d.) Mass rearing of C. *nigrita*