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PESTS AND DISEASES OF CHILLI CROP IN PAKISTAN: A REVIEW

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ABSTRACT

Chilli is economically very important and valuable crop through out the world. The native home of chillies is considered to New Mexico. Portuguese brought chillies in Indo-Pak subcontinent from Brazil before 1585. The world's total production of chilli is approximately around 3.47million tonnes. India is the world's largest producer, consumer and exporter of chillies in the world. Other major chillies producing countries are China, Bangladesh, Peru, etc. Chilli is also an important cash crop of Pakistan. Approximately 0.2 million tonnes chilli are produced by Pakistan. Sindh province is the major chilli producing province and its share in the total domestic production is about 82%. According to 2007 Pakistan Agriculture Research Council (PARC), report Pakistan was the fifth largest exporter in the world but according to there is continuous decline in the production of chillies in Pakistan. The reasons of this reduction are various and many but the major threat in chilli production are various pests and pathogens which cause considerable losses every year. Major insects which attack on chilli plant are Aphids, Mites, Thrips etc beside pests, different pathogens also cause various diseases in chilli crop and reduce yield of the plant e.g. fungi, viruses, bacteria and nematodes. Among other pathogens the fungal diseases are more destructive than diseases cause by other pathogens. Common fungal diseases are Damping off, *Phytophthora* root rot, Powdery mildew, *Fusarium* wilt, Anthracnose etc.

Key word: Chilli, Pest and Diseases, Control.

INTRODUCTION

Chilli is a common crop and cultivated all over the world. It is reported that Chilli is raised over an area of 1776 thousand hectares in the world, with a production of 7182 thousand tons. Chilli is known as economically very important and valuable cash crop of Pakistan. It belongs to family Solanaceae, as are potatoes, tomatoes and egg plants. Botanically, it is named as *Capsicum annum/ C. frutescens.* There are about 25 varieties are commonly cultivated through out the world. The plant of Chilli is usually bushy 60-80cm high. It requires warm and humid climate for growth and dry weather during maturity. It is semi-perennials also grown as annual in cultivation.

ORIGIN:

Chilli is originated from the Latin American tropical regions of the South (New Mexico and Guatemala) approximately 7500BC. The Mexico is considered the native home of Chillies. Portuguese's prior to 1585 brought hot chillies from Brazil to Indo-Pak subcontinent.

USES:

Chilli plays very important role in commercial sector. Specially, it is used in pharmaceutical industries, cosmetics, preparation of oleoresin and other industrial resources. Chilli extensively grown for dry Chilli (powder) is also harvested green. There are many nutritional, medicinal and economic benefits of its production. Chilli is not only an important ingredient in food but it is also used for culinary applications. It is used in foods for pungency and red colour while it also contributes in part to the flavor of ginger ales. It comprises numerous chemicals including steam-volatile oils, fatty oils, capsaicinoids, carotenoids, vitamins, protein, fiber and mineral elements (Bosland and Votava, 2003). It is also excellent source of Vitamins A, B, C (340mg per 100 gram), E and P. Fresh green chilli peppers contain more vitamin C than citrus fruits and fresh red Chilli has more vitamin A than carrots (Osuna-Garcia *et al*., 1998; Marin *et al*., 2004). It is also used in food industry as Chillies paste, curry powder and other resources of food and bakers.

WORLD SCENARIO:

World market for chillies: India is the largest producer of chillies in the world contributing 25 per cent of the total world production, of which only four percent is exported because of high domestic consumption. Chilli is exported in difficult forms: fresh chillies, stalk less chillies, green chillies, chilli powder (Generally 0.7 per cent

capsaicin is the minimum level for the extraction market) and also as oleoresin. Beside India some other and major chilli producing countries are:

Table 1. Top ten Chilli producer countries of the World.

Country	*Production Million (Tonnes)*	*Percentage (%)*
India	1.25 m	36%
China	0.39 m	11%
Bangladesh	0.27 m	8%
Peru	0.27 m	8%
Pakistan	0.2 m	6%
Ethiopia	0.17m	5%
Ghana	0.13 m	4%
Vietnam	0.12 m	4%
Mexico	0.1 m	3%
Myanmar	0.1 m	3%

PAKISTAN SCENARIO:

Chilli is known as both vegetable and spice crop of significant economic value in Pakistan. It is beneficial cash crop of Pakistan. There are two species are commonly cultivated in Pakistan which are *C. annum* and *C. frutescens.*

Domestic Production and economic value: Chillies are grown on an area of 38.4 thousand hectares with production of 53.7 thousand tones, with an average yield of 1.7 tons per hectare with 1.5 per cent share in the GDP. Sindh is the major producer of chillies followed by Punjab and Balochistan.

Major importers of chillies from Pakistan are Gulf States, the US, Canada, Sri Lanka, the UK, Singapore and Germany. Pakistan earned Rs 1.127 billion during 2003-2004 by exporting red chilli powder, whereas export earnings from all fruits were Rs 5.912 billion during the same period. This reveals the potential of this non-staple crop. Despite its importance the yield has declined from 86.5 (1994-95) to 55.8 thousand tons (2003-04). This decline in yield is due to a number of factors including poor quality seed, mal-cultural practices and diseases like viruses, collar rot and *Phytophthora* root rot.

According to a report of Pakistan Agriculture Research Council (PARC), there has been a progressive decline in area and production of chillies in Pakistan. Since 1999-00 to 2004-05, the area under chilli crop has decreased from 86.8 to 48.7 thousand hectares and production from 115.5 to 90.5 thousand tonnes. The yield of chillies obtained in Pakistan is for less than the potential exists.

Table 2. Pakistan Chilli producer provinces

Province / Year	**Area (Hectares)**				**Production (tonnes)**			
	2003-2004	2004-2005	2005-2006	2006-2007	2003-2004	2004-2005	2005-2006	2006-2007
Sindh	46,917	40,449	54,229	36,684	82,156	77,716	105,570	53,171
Punjab	6,400	5,223	7,025	4,752	10,828	8,546	11,609	5,847
Balochistan	2,082	2,333	2,493	1,687	2,973	3,372	4,581	2,307
K.P.K	392	719	853	577	437	840	1,141	575
Pakistan	55,791	48,724	64,600	43,700	96,394	90,474	122,900	61,900

Lower regions of Sindh province including Kunri, Umerkot, Mirpurkhas, New Koat and some other towns are main source of chilli. It is grown on an area of 38.4 thousand hectares with production of 53.7 thousand tons. The average yield of 1.7 tons per hectare contributes 1.5 per cent of the country's GDP. In Pakistan, Kunri, a small town of Umerkot district is the home of red chillies. It contributes around 85% of Pakistan red chilli production and is

known as one of the largest production centres for red chillies in Asia. Three major types of chillies grown in the chilli cluster of Kunri are Maxi, Desi and Nageena.

As per the recently introduced European Union (EU) regulations, only 5 μg kg^{-1} of aflatoxin B1 and 10 μg kg^{-1} of total aflatoxin are allowed in chillies. Aflatoxin and chemical residues are two major constraints in the export of chillies to Europe, Japan and the US as buyers expect a high degree of hygiene and sanitation in processing and preparing chillies for export. The European countries and Japan banned the import of chilli from Pakistan due to the presence of high aflatoxin contamination.

According to the international survey (European & Japanese) that, the cultivated chillies of Pakistan having about 80% aflatoxin in it Whenever 10% aflatoxin usually allow in internationally market. So, Pakistan is not internationally able to compete and export chillies in the international marketing due to the high level of aflatoxin. (Russell and Paterson, 2007)

According to PHDEB (Pakistan Horticulture Development and Export Board) that the export of red dried chillies from Pakistan has declined from Rs 1.127 billion (during 2003-2004) to Rs 846 million after European Union food authorities have detected the presence of aflatoxin.

This cash crop is continually ignored and devalued due to the dangerous fungal, bacterial, viral, nematodes and other resources of destruction. Beside different diseases which cause heavy losses.

PESTS AND DISEASES:

Chilli is affected by a number of pests and diseases which cause heavy losses. It can be categorized by the following ways.

A. Pests:

Pests typically are more mobile and multiply more quickly than beneficial insects. Chilli is affected by number of pests attack on chillies crop during the growing season. For example aphids, thrips, leaf hoppers, ear wigs, crickets, mites, root grubs, pod borers, cut worms, flea Beatles, etc damage or destroy the crop.

Table 3. Pests attacking on chilli plant at different crop stages

Crop Stage	*Possible pests*
Vegetative stage	
Seedling	Root Grubs, Mites, Aphids, and Thrips.
Branching	Thrips, Mites, Aphids, Ragi cut worm.
Reproductive stage	
Flowering	Thrips, Mites, Aphids, Cut worm.
Fruiting	Fruit borers, Gram Caterpillar.

CONTROL:

- If any sucking insects is found in any part of the plant should be killed by hand or agricultural tool.
- Affected plant should be discarded and buried approximately one meter deep in the earth.
- Read the label before using any pesticide.
- Always used standard and agricultural registered pesticide spray.
- Try to protect the beneficial insects.
- Insecticides applied to the crop before, during or after planting can reduce insect damage.

B. Pathogens:

Beside different pests, pathogens are also a serious threat for chilli crop such as fungi, bacteria, viruses, nematodes etc.

(i) Fungal Diseases:

Commonly fungal diseases cause more damage than diseases cause by other pathogens. Several fungi cause various diseases in chilli plants. Some time these fungi can cause similar symptoms and confused to one another. There are some pre-harvesting fungal diseases such as; Anthracnose, Cercospora (frogeye) leaf spot, Charcoal rot, *Choanephora* blight (wet rot), Damping-off root rot, Downy mildew, *Fusarium* stem rot, *Fusarium* wilt, Gray leaf

spot, Gray mold, *Phytophthora* blight, Powdery mildew, Southern blight, *Verticillium* wilt and White mold are grown in chilli crop.

Table 4. Fungal diseases and their causal agents attacking on chilli plant at different crop stages

Crop Stage	*Disease*	*Causal Agent*
Vegetative stage		
Seedling	Damping off, *Phytophthora* Blight, *Fusarium* wilt.	*Pythium spp., Phytophthora capsici, Fusarium oxysporium f.sp.capsici.*
After Transplantation	Frog eye leaf spot, Damping off, *Fusarium* wilt	*Cercospora capsici, Pythium spp., Fusarium oxysporium f.sp.capsici.*
Root Diseases	*Phytophthora* root rot, *Verticillium* wilt, *Rhizoctonia* root rot	*Phytophthora capsici, Verticillium wilt* sp., *Rhizoctonia solani*
Reproductive stage		
Flowering	Powdery mildew	*Leveillula taurica*
Fruiting	Anthracnose, Powdery mildew, *Phytophthora* pod rot, Black mold.	*Colletotrichum capsici, Leveillula taurica, Phytophthora capsici, Alternaria spp.*

1) Damping off (*Pythium spp.*):

Damping off is a very common disease in nurseries seedling beds show irregular patches. *Pythium spp.* causes this disease which is basically a soil-borne fungus. This disease is more severe in soils with poor drainage.

2) Anthracnose/ Die back/ Fruit rot (*Colletotrichum capsici*):

Anthracnose caused by *Colletotrichum spp* is a major problem of ripened fruit (Hence, it is also called as ripe fruit rot) occurs world wide wherever chillies are grown. (Poulos, 1992), is severly infected by anthracnose which may cause yield losses up to 50% (Pakdeevaraporn *et al*., 2005). It is seed-borne fungus. It produces dark spot, water-soaked lesions that rapidly expand. In some cases, the lesions are brown, and then turn black from the formation of setae and sclerotia (Roberts *et al*., 2001). Infections spread rapidly during periods of excess irrigation or rain on immature pods.

3) Powdery mildew (*Leveillula taurica*):

Powdery mildew caused *Leveillua tourica* (asexual stage of fungus). It usually occurs in warm climates (65-95˚F) both dry and humid weather. It affects on the lower leaf surface, where the lesions are covered with a white to gray powdery growth. Disease progress from the older leaves to younger leaves and defoliation is a prominent symptom which reduces in size and number of fruits.

4) *Fusarium* wilt (*Fusarium oxysporium f. sp. capsici*):

Fusarium is a soil-borne fungus and can survive for several years. It is usually grown in wet soil and high temperature. It causes wilting of the plant and upward and inward rolling of the leaves as result leaves turn yellow and die. It is also discolored the vascular system of plant, particularly in the lower stem and roots.

5) *Cercospora* Leaf Spot (Frog eye) (*Cercospora capsici*):

The leaf lesions due to this disease are circular about 1cm in diameter with brown border and light gray centers. Lesions are also appearing on stem, petioles, and peduncles. It is a seed-borne fungus. It is also spreads by water, wind and leaf to leaf contact. Severely infected leaves turn yellow and drop from the plant. The fungus usually survives from one season to another on crop debris.

6) *Phytophthora* Blight (*Phytophthora capsici*):

This disease is also known as *Phytophthora* root rot. Fungus affected all parts of plant. Seedling It is commonly create problem when soils are excessively wet either over irrigation, heavy rain or both. The most common symptom is a stem or collar rot by sudden wilting without foliar yellowing.

CONTROL:

- Crop rotation.
- Discard the weeds from the crop.
- Disease resistant variety should be used.
- Chilli should be not planted in the same field more than once every 3 years.
- Excessive irrigation prior to seedling emergence should be avoided and, after establishment, water should not stand in the field for more than 12 hours.
- Before sowing, the seed should be dried by artificial (machine) method or sun light method.

CHEMICAL CONTROL:

- Disinfect containers, seed trays, propagators thoroughly. Dettol is good but tea-tree oil and camomile tea make good alternatives and are safe to use on plants.
- The strobilurin fungicides azoxystrobin (Quadris), trifloxystrobin (Flint), and pyraclostrobin (Cabrio) have been labeled for the control of anthracnose fungus in chillies crop.
- Spray twice at 10-15 days interval with 2.5g Mancozeb or 1g Carbendazim/lit of water for the controlling of *Cercospora* Leaf spot.
- Soil sterilization by drenching the soil 4" deep with Formaldehyde diluted 50 times with water or with some other effective chemical soil sterilant.
- Soil drenching with 1% Bordeaux mixture or 3g Copper Oxychloride like Blue copper per litre of water at 12 and 20 days after sowing is also useful.
- Seed treatment with 3g Captan or Thiram per kg seed.
- Seed treatment with 4g Trichoderma viride formulation combined with 6g Metalaxyl is highly effective.
- Spraying with Captafol at 0.2% followed by Copper Oxychloride at 0.25% and Carbendazim at 0.1% during the causing of anthracnose disease.

(ii) Bacterial Diseases:

The bacterial diseases are also affected the chilli crop. Some common bacterial diseases are Bacterial spot, Bacterial wilt, Bacterial canker, Syringe seedling blight and leaf spot.

Table 5. Bacterial diseases and their causal agents attacking on chilli plant at different crop stages

Crop Stage	*Disease*	*Causal Agent*
Vegetative stage		
Seedling	Bacterial leaf spot. Syringe seedling blight	*Xanthomonas campestris pv. vesicatoria*
After Transplantation	Bacterial wilt	*Ralstonia solanacearum*
Reproductive stage		
Flowering	Bacterial leaf spot	*Xanthomonas campestris pv. vesicatoria*
Fruiting	Bacterial soft rot, Bacterial leaf spot	*Erwinia carotovora pv. carotovora, campestris pv.vesicatoria.*

1) Bacterial leaf spot (*Xanthomonas campestris pv. vesicatoria*):

It has world wide distribution. It is a seed-borne bacterium and survives in crop debris. It is commonly affected the leaves, stems and fruits of the plants. In early stage of disease the Leaf spots are circular, water-soaked and dark that becomes necrotic with brown centers and yellowish borders in later stage of disease. Affected leaves turn yellow and dropped. In the stem, usually narrow, elongated lesions may be developed.

2) Bacterial Wilt (*Ralstonia solanacearum*):

This is caused by *R. solanacearum.* It has wide range of hosts and survives in the soil for long period. The warm condition and high soil moisture are favorable for disease. This disease wilted plant without yellowing of leaf due to the entry through natural root wounds or wounds created by insects and nematodes.

CONTROL:

- Always used pathogen free seeds.
- Avoid excessive use of nitrogen fertilizers.
- Crop should be sown according to given measurement.
- Chose suitable bactericide and proper doze should be applied.
- All plant debris should be turned under soil after harvest, particularly in the presence of diseases which can survive on plant debris.
- Pods should be picked when they are dry, injury should be avoided, and harvested pods should be kept in cool storage.

(iii) Viral Diseases:

These are about 17 viruses which cause diseases in chilli crop. Mostly, viruses are spread or transmitted by infected seeds, insects and or by the mechanical tools. Most of the viral diseases are very difficult to diagnose due to the heavy overlap of symptomatology. Symptoms produce by different viruses are mosaic pattern on leaves, yellowing, ring spots, leaf deformation, curling of leaves and stunting of plants. Common viral diseases are; Alfalfa mosaic, Beet curly top, Cucumber mosaic, Pepper mottle, Tobacco mosaic, leaf curl and Pepper Gemini Virus.

Table 6. Viruses attacking on chilli plant at different crop stages

Crop Stage	***Possible Viruses***
Vegetative stage	
Seedling	Beet curly top virus (BCTV)
Reproductive stage	
Flowering	Leaf curl
Fruiting	Pepper Mottle Virus, Alfalfa Mosaic Virus, Cucumber Mosaic Virus, Tobacco Mosaic Virus (TMV), Pepper Gemini Virus.

1) Leaf curl:

It is most serious disease among other viral diseases of chilli crop. It is transmitted by white fly. Chilli leaf curl complex is the major problem resulting in heavy yield losses up to 53% or more, especially during *yala* season (Gunawardena, 2002). Previous report indicated that the viruses responsible for chilli leaf curl complex are virus vein-cleaning virus, leaf mottle virus, tobacco mosaic virus and leaf curl virus. (Pieries 1953; Fernando and Peries, 1957; Sujiura *et al*., 1975). The characteristic symptoms are curling and yellowing of the leaves and severe stunting of the plants. Reduction in size with their margins curled upward giving them a boat shape and clustering of leaves may be caused by leaf curl.

2) Mosaic viruses:

The mosaic viruses included Tobacco mosaic virus (TMV), Cucumber mosaic virus (CMV), Alfalfa mosaic virus (AMV) cause destruction in chilli crop. These viruses mostly transmitted by whiteflies and aphids (Pleris, 1953). They produce light and dark green patches on leaves. Yellowing and chlorotic rings are commonly appeared on the leaves and fruits of chilli plant. Stunted plant growth also occurs during early stages of mosaic viruses.

CONTROL:

- Use suitable pesticide for whitefly and other vectors.
- The affected plants should be discarded from the field as soon as possible.
- The seeds should be properly mixed in copper Oxichloride before sowing.

- Avoid overwatering.
- Expelled the weeds from field.
- Avoid the using of tobacco or smoking the cigarette in field.
- Don't irrigate same time in healthy and infected crop.

(iv) Nematode Diseases:

Various plant parasitic nematodes cause damage to chilli plants all over the world. (Brown, 1962; Qamar *et al*., 1985; Khan and Bilqees, 1989; Khan *et al*., 1991; Shaukat & Khan, 1993; Siddiqui *et al*., 199), but no proper survey has been conducted in the important chilli producing area of lower Sindh. Common nematodes are Root knot (*Meloidogyne incognita, Meloidogyne hapla, Meloidogyne javanica, Meloidogyne arenaria),* Sting nematodes (*Belonolaimus longicaduatus)* and other nematodes (*Paratrichodorus* spp., *Trichodorus* spp., *Pratylenchus penetrans,Nacobbus aberrans,Dolichodorus heterocephalus,Helicotylenchus dihystera, Hemicycliophora arenaria Radopholus similis)* which effect and devalued chilli crop.

Root knot Nematode (*Meloidogyne spp.*):

Among other nematodes, the root knot nematodes (*Meloidogyne spp.*) are more destructive and have wide host range. They affected the roots of chilli plant and blocked the movement of nutrients and water in the plant system as a result plants show wilting which leads to death of plant. If the effected plant pulled out from the soil, the roots can be seen to be distorted, swollen and bearing knots (galls). So, infested roots rot and affected plants will die.

CONTROL:

- The affected plants should be removed from the field as soon as possible.
- The seeds should be properly mixed in copper Oxychloride before sowing.
- There are currently no nematode-resistant cultivars available.
- Crop rotation is not an effective management tool.
- Frequent disking of fields during late fall and early winter can reduce nematode numbers through environmental exposure.

CONCLUSION:

The yield of chilli is reducing gradually every year due to different pests and pathogens which cause heavy losses. Our objective is to find out different effective methods for the control of these diseases and reduce crop losses. Due to the use of improper methods of drying different fungi particularly *Aspergillus* sp. grow on chilli fruits and produce toxic compound, (Mycotoxins) which are harmful for human health. Due to the presence of high percentage (%) of these Mycotoxins in our chilli products, European Union countries & Japan governments have banned import of our chilli products in their countries. Our objective is to improve drying methods to prevent the growth of fungi during drying and reduce the percentage (%) of Mycotoxins in chilli products which increase our chilli products export and country will get more foreign exchange.

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