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MANGO DECLINE DISORDERS PREVAILING IN PAKISTAN

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ABSTRACT

Mango decline is a general term, which is used for several diseases. Out of which collar/stem rot of mango commonly known as quick decline is becoming very destructive in Pakistan. To know the status of this disorder in Pakistan, a thorough survey of six districts of Punjab viz. Multan, Khanewal, Muzaffargarh, Lodhran, Bahawalpur and R.Y.Khan as well as four districts of Sindh viz. Hyderabad, Mir Pur Khas, Sangar and Nawab Shah was carried out. A parallel study was also initiated to assess other mango decline disorders and their extent of contribution in causing collar/stem rot of mango. It was found that different decline disorders viz. tip dieback, twig blight, gummosis, stem bleeding/cankers, wilting and bark cracking/splitting were also prevailing in the mango orchards of Pakistan with 4.2, 3.2, 0.82, 0.52, 0.65 and 1.47 percent disease incidence respectively. It was noted that all these disorders have comparable symptoms, etiologies and predisposing factors. Drying/death of the mango plant were the main characteristic symptom of all these disorders at initial or advance stage. Injuries through insects or physical damage were observed as the major facilitating factors for the development of all these disorders. Amongst other associated fungi, *Botryodiplodia theobromae* was the most common and frequent isolated fungus from the entire diseased samples collected from the plants infected with these disorders individually.

Keywords: *Mangifera indica*, collar rot, predisposing factors, *Botryodiplodia theobromae*, insects.

INTRODUCTION

Mango (*Mangifera indica* L.) an important fruit crop, is widely grown in tropical and sub-tropical regions of the world. Globally, mango production is 26.19 million metric tones from an area of approximately 3.44 million hectares. In Pakistan, the area under mango cultivation is 0.099 million hectares with an annual production of 1.0371 million tones (Anonymous, 2004). Enjoying so much popularity, yet this industry has many challenges. There are so many problems from nursery stage to bearing of mango. Due to these problems, this industry is becoming unsustainable. Out of these problems mango decline is gaining significant proportion by which mango plants collapse slow or sudden (Sial, 2002).

Mango decline is a general term which is used for several diseases and these are generally referred as decline disorders. Amongst different decline disorders of mango, collar/stem

rot generally known as quick decline is becoming the most destructive hazard in mango orchards of Pakistan (Mahmood et al., 2002). Declining plants of mango already present in the orchards are inoculum sources for this malady (Malik et al., 2004). This study raised the question that what type of declining plants of mango to what extent might be responsible for inoculum load. Hence, this question urged to conduct a parallel and comprehensive study to assess decline disorders of mango prevailing in Pakistan other than collar/stem rot of mango. Because these wide spread problems are not well understood or researched and their estimation has not yet been enumerated seriously in Pakistan.

MATERIALS AND METHODS

A thorough survey of six districts of Punjab viz. Multan, Khanewal, Lodhran, Bahawalpur, R.Y.Khan and Muzaffargarh as well as four districts of Sindh viz. Hyderabad, Mir Pur Khas, Nawab Shah and Sangar was carried out to know the status of mango decline disorders in Pakistan. The basic and relevant information's about the visited orchards were recorded on a prescribed proforma.

Data Collection

A total of 100 locations in these two provinces were visited. The gardeners were surveyed at random. During visit, in addition to estimation of collar/stem rot of mango, other plants showing decline symptoms were examined carefully. These plants were noted with the vigilant observation of forty plants, 10 in each direction around the randomly selected one plant infected with collar/stem rot of mango. They were categorized in their respective disorder according to the following characteristic symptoms of each disorder.

Dieback

Drying of twigs/branches from top to downwards. Defoliation, blackening of the barks of twigs/branches and shredding of the outer bark of the twigs/branches (Prakash and Singh, 1976).

Twig blight

Drying of the twigs/branches with scortchy appearance. Attachment of leaves with twigs/branches (Ragab et al., 1971).

Gummosis

Profuse oozing of the cell sap of honey color from the trunk and larger branches. Droplets of cell sap trickle down on the surface (Prakash, 1996).

Bark splitting/cracking

Visible longitudinal cracks or splits in the barks of main limbs or trunk (Rios-castano and Reuther, 1967-68).

Stem bleeding/cankers

Cankers formation with oozing of reddish brown substance from the main limbs or trunk which later forms black crust (Ploetz and Prakash, 1997).

Wilting

Drying of the whole plant with defoliation or attachment of flaccid leaves similar to collar/stem rot symptoms but no infection on collar/stem portion of the plant (Malik et al., 2004).

Samples Collection

Fifteen samples of infected portion from three different diseased plants of each disorder were collected to ascertain the most common entity amongst all the samples. Five pieces 3-5mm long were excised from every sample making total of 75 pieces of each sample. These samples were surface disinfected in 1% sodium hypochloride solution for two minutes and placed in petridishes containing PDA medium. PDA medium was prepared from potato starch (20g), glucose (20g), agar (20g) and distilled water (1000ml). All these plates were incubated at 25^0C with 12 hrs of alternate periods of light and darkness for 7 days with daily observation.

The most common fungus colonized on baits was purified and identified after reference to Booth (1971), Ellis (1971 & 1976) and Sutton (1980). The frequency of the isolated fungus from each part was calculated using the following formula.

$$\text{Colonization \%} = \frac{\text{Number of pieces colonized by the pathogen}}{\text{Total number of pieces}} \times 100$$

Estimation of Facilitating Factors

Injuries through insects like mango hopper, midge, thrips, scales, termites and beetles and physical damages through pruning of diseased/dried branches, malformed inflorescences and mechanical injuries to the main limbs/trunk and roots, were kept as the main parameters to record the common facilitating factors to the pathogen in all the disorders.

RESULTS AND DISCUSSION

During the assessment of mango decline disorders other than collar/stem rot, it was noted that tip dieback, twig blight, gummosis, bark splitting/cracking, stem bleeding/cankers and wilting were the common decline disorders with 4.2, 3.2, 0.82, 1.47, 0.52 and 0.65 percent incidence respectively. While their prevalence in these orchards varied from 12 to 55% (Table 1). Maximum prevalence of tip dieback (55%) was noted while twig blight ranked 2nd with 50% prevalence. Gummosis and stem bleeding/cankers as individual and independent disorder were observed with very low percentages of incidence because these were characterized by the presence of profuse oozing of cell sap or any other substance on the surface of the bark of main branches or trunk without cracks. It intimated that these disorders might had high percentages in association with other disorders particularly bark splitting/cracking. So, the gummosis in association with bark splitting/cracking was noted as maximum i.e. 0.225%. While the combination of stem bleeding disorder with bark splitting disorder existed at lower level (0.025%).

Similarly, manifestation of other combined disorders were also observed but maximum combinations of gummosis disorder were noted with other disorders like dieback, wilting and even with stem bleeding (Table 2).Which indicated that all these mango disorders might share their inoculum or facilitating lines of pathogen and resultantly, a complex mango decline form was produced. On the other hand, gummosis might be the characteristic symptom of severe dieback, wilting and bark splitting/cracking as already described by Prakash and Singh (1976), Rios-Castano and Reuther (1967-68).

Almost all the traditional and commercial mango cultivars were found more or less affected with all the decline disorders. Chaunsa cultivar proved to be the most susceptible cv. to all disorders but was highly prone to tip dieback, twig blight and stem bleeding/cankers showing 1.125, 0.8 and 0.2% disease incidence respectively.

Similarly, cultivar Sindhri was found more susceptible to gummosis, bark splitting and wilting with 0.3, 0.475 and 0.75% disease incidence respectively. Only two disorders viz. tip dieback (0.025%) and bark splitting (0.15%) were observed on ungrafted mango plants (Desi). It means ungrafted mango plants had some sort of defense mechanism against decline disorders. This should be evaluated. Cultivar Dusehri in case of tip dieback (0.70%), Langra in twig blight (0.55%) and wilting (0.175%), Chaunsa in gummosis (0.2%), SSIII in bark splitting (0.35%) and Anwar Ratole with respect to stem bleeding/cankers (0.125%) remained on 2nd position while scoring their susceptibility (Table 3).

In fact, the examination of infected parts of the mango plants revealed the association of different fungi but majority of the selected samples yielded one common fungus i.e. *Botrydiplodia theobromae*. This was isolated from all infected parts. Infestation percentage of this fungus in 75 tissues of 15 samples of each disorder varied from 6.66 to 56.0%. Maximum infestation of this fungus (56%) was noted in the samples of twig blight followed by stem

bleeding/cankers (52%). While minimum infestation percentage (6.66) was observed in the samples of the plants showing only gummosis disorder followed by bark splitting/cracking samples (14.66%) as given in (Table 4). The frequency and association of this fungus in the infected tissues of different decline disorders in the present study almost confirm the possible role of this fungus in causing different decline disorders. In other words, it is easy to say that inoculum load of this fungus is increasing through different manifestation on mango plants and infecting collar/stem of the healthy looking mango plants. These findings are also collaborated by the available literature. Prakash (1996) associated *B. theobromae* with gummosis and girdling of the stem of mango plants. Ragab et al. (1971) described *B. theobromae* as an aggressive and vigorous pathogen causing various type of disease symptoms like tip dieback and twig blight. Similarly, Mahmood et al. (2002) reported the extent of *B. theobromae* fungus from roots, stem and branches of declining plants. Al-Adawi et al. (2003) also reported the incidence of this fungus with the declining plants of mango. Some of the predisposing factors i.e. the factors which facilitate the pathogen to come in contact with the host plants were also evaluated in this study. Insect injury and physical damage were kept as key points to explore the facilitating lines of the pathogen associated in these different mango decline disorders. Resultantly, only these two facilitating factors were found as common amongst all of them. It was noticed that role of insect damage was maximum (42.50%) in case of wilting disorder followed by stem bleeding/cankers development (40.83%). Such type of role by termites and beetle in declining plants have already been reported (Javaid and Afzal, 2001; Malik et al., 2004; Al-Adawi et al., 2003). Share of physical damages in causing different mango decline disorders reflected that stem bleeding/cankers might be attributed by 43.33% followed by twig blight by 30.93% with this factor (Table 5). The role of physical damages in causing different mango decline disorders have already been well documented by Edmond et al., (1977) and Malik et al., (2004).

The role of other contributing factors like nutritional deficiencies, high soil pH and hard pan in the soil in causing these disorders were calculated as 57.67%, 57.59 and 55.88% in case of gummosis, bark splitting and dieback respectively. Which intimated that these disorders might have high incidences due to nutritional deficiency, high soil pH or hand pan of the soil.

It is concluded from this study that different mango decline disorders viz. tip dieback; twig blight, gummosis, stem bleeding/cankers, wilting and bark splitting as independent or in combination with each other are prevailing in mango orchards of Pakistan. Amongst other associated fungi, *Botryodiplodia theobromae* is the most common and frequent isolated fungus from all the diseased samples of these disorders. The injuries through insects or physical damages are the main facilitating lines of this fungus for penetration and then further propagation of this fungus in the host plant. The plants affected with these problems are not properly managed and resultantly, the inoculum load of this fungus is increasing day by day and becoming very aggressive when it infects collar or stem portion of the mango plant and resultantly, healthy looking plant dies within couple of days.

The nature of survived/spread of the pathogen and pre-disposing factors demands integrated management for this malady. Hence, evaluation of integrated approach to combat this problem is the dire need of time.

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TABLES

Table 1: Prevalence & Incidence (%) of different mango decline disorders in different districts of Pakistan

Disorder	MN	KW	LD	BWP	MG	R.Y.K	HYD	M.P.K	N.S	SR	Av. Incidence	Prevalence
Tip Dieback	4.0	5.0	4.25	3.25	3.25	3.25	5.25	5.5	4.25	4.0	4.2 (3.25-5.5)	100 (55)
Twig Blight	3.25	3.25	2.25	3.25	2.0	2.75	3.75	2.25	4.5	4.75	3.2 (2.0-4.5)	100 (50)
Gummosis	0.5	1.0	0.75	0.25	1.0	1.0	1.5	0.5	1.25	0.5	0.82 (0.25-1.5)	100 (25)
Bark Splitting	0.75	0.5	0.75	3.0	1.75	1.0	0.75	1.0	2.5	2.75	1.47 (0.5-3.0)	100 (25)
Stem Bleeding	0.25	0.25	0.75	0.25	0.25	0.5	0.75	1.0	0.5	0.75	0.52 (0.25-1.0)	100 (16)
Wilting	0.25	0.25	0.0	1.0	0.25	0.25	1.5	0.75	0.75	1.5	0.65 (0.25-1.5)	100 (12)
Combined disorders	0.75	1.0	0.75	0.25	0.75	0.5	1.75	1.0	0.0	0.75	0.75 (0.25-1.75)	100 (19)

Table 2: Types of combined mango decline disorders

Sr. No	Combined disorders	Incidence (%)
1	Gummosis + Bark splitting	0.225
2	Gummosis + Dieback	0.075
3	Gummosis + Wilting	0.15
4	Gummosis + Stem bleeding	0.025
5	Wilting + Bark splitting	0.125
6	Wilting + Stem bleeding	0.025
7	Stem bleeding + Bark splitting	0.025
8	Gummosis + Dieback + Stem bleeding	0.025
9	Gummosis + Wilting + Bark splitting	0.075

Table 3: Cultivars susceptibility in percentage to different mango decline disorders

Sr. No	Variety	Tip dieback	Twig blight	Gummosis	Bark splitting	Stem bleeding	Wilting	Combined disorders
1	Chaunsa	1.125	0.8	0.2	0.25	0.2	0.1	0.125
2	Langra	0.65	0.55	0.0	0.15	0.0	0.175	0.125
3	Dusehri	0.70	0.525	0.05	0.0	0.0	0.125	0.225
4	Anwar Retual	0.275	0.45	0.125	0.0	0.125	0.0	0.0
5	Sindhri	0.55	0.5	0.3	0.475	0.0	0.75	0.1
6	S-S-I	0.125	0.225	0.0	0.0	0.1	0.0	0.0
7	S-S-III	0.10	0.05	0.0	0.35	0.0	0.0	0.0
8	Malda	0.3	0.05	0.15	0.0	0.075	0.0	0.175
9	Fajri	0.35	0.05	0.0	0.1	0.025	0.175	0.0
10	Desi	0.025	0.0	0.0	0.15	0.0	0.0	0.0

Table 4: Association of the most common fungus with different decline disorders of mango

Sr. No	Disorder	Sample collected	The common fungus	Infestation (%)
1	Tip dieback	Twig	*Botryodiplodia theobromae*	46.66
2	Twig blight	Twig	do	56.0
3	Gummosis	Twig/branches/stem	do	6.66
4	Bark splitting	Main limbs/stem	do	14.66
5	Cankers/stem bleeding	Stem	do	52.0
6	Wilting	Root	do	32.0

Table 5: Share of different facilitating factors for different mango decline disorders

Sr. No	Disorder	Insect damage (%)	Physical damage (%)	Other factors (%)
1	Tip dieback	26.70	17.42	55.88
2	Twig blight	24.76	30.93	44.31
3	Gummosis	27.83	14.50	57.67
4	Bark splitting	25.91	16.50	57.59
5	Stem bleeding	40.83	43.33	15.84
6	Wilting	42.50	27.50	30.0