



Official publication of Pakistan Phytopathological Society
Pakistan Journal of Phytopathology

ISSN: 1019-763X (Print), 2305-0284 (Online)
<http://www.pakps.com>



MANGO QUICK DECLINE MANIFESTATION ON VARIOUS CULTIVARS AT PLANTS OF PARTICULAR AGE IN THE VICINITY OF DISTRICT MULTAN

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ABSTRACT

Quick decline of mango caused by various species of fungi viz. *Lasiodiplodia theobromae*, *Ceratostyxis fimbriata* and *Phomopsis* sp. is said to be the most serious disease reportedly present in mango orchards of Pakistan. The present survey was conducted to evaluate disease intensity of quick decline in the heart of mango zone of Punjab i.e. Multan, its varietal prevalence, age response of various cultivars and predisposing factors prevailing in the mango orchards to facilitate the disease. Survey results showed highest disease intensity (15.02%) in the visited orchards of North zone followed by West zone (14.10%), East zone (13.33%) and minimum disease severity index (9.88%) was recorded at South plane. The mango cultivar, Chaunsa was found to be the most susceptible to disease, recorded to be the most predominant variety in the orchards. Maximum prevalence of disease (32.20%) was calculated on cultivar Chaunsa followed by Fajri, Malda, and Langra. The minimum disease severity (0.83%) was noted on Almas followed by Sensation, Mahmood Khan, Shan e Ali and Armughan which proved to be the tolerant cultivars against the disease. Considering a possible variation in age response of mango plants, two particular age levels were evaluated on the basis of symptom characterization. The findings showed that some varieties have the ability to overcome the disease at the specific age. Variability in severity of disease in different mango cultivars at varying age could be attributed to possible natural tolerance against the disease. The investigations showed predisposing factors to play the key role in the development of disease. This study provides fresh information on the core issue, prioritization for cultivation of a particular variety at optimal age limits.

Keywords: Quick decline, occurrence, Mango, Cultivars, Age response.

INTRODUCTION

Mango (*Mangifera indica* L.) is universally regarded as superb fruit and one of significant fruit crop in tropical and subtropical areas of the world. India, Pakistan, Brazil, Australia, South Africa, Egypt and the USA are the major producers of mango (FAO, 2010). Mango is the national fruit of Pakistan, India, and Philippines whereas the national tree of Bangladesh. Pakistan produces 1732 thousands tones of mango annually being the second major fruit crop of country to earn foreign exchange by exporting to Middle East and Europe, hence ranked fourth in the world for its production (Govt. of Pakistan, 2014). Mangos of Pakistan are considered to be the best due to excellent flavor, luscious taste and high nutritive value (Muhammad *et al.*, 1999). Mangos are nutritionally

rich in proteins, carbohydrates, vitamins, fatty acids and amino acids (USDA, 2010). Fruit yield can be drastically decreased due to various biotic and a-biotic factors and the negligence of mango growers. A total of eighty three diseases of mango fruit and tree have been reported in the world consisting of fifty two fungal, three bacterial, three by parasitic nematodes and twenty five are listed as miscellaneous diseases and disorders (Pernezny and Simone, 2000). Twenty seven diseases of mango tree and fruit have been reported to be present in Pakistan (Ghaffor and Khan, 1976).

Among these diseases, quick decline of mango caused by *Botryodiplodia theobromae* is the most holistic one to cause heavy losses upto 50% in mango grooves of Punjab and Sindh (Mahmood *et al.*, 2002). Al-Adawi *et al.* (2003) reported quick decline as a new disease of mango affecting 60% of the trees in Al Batinah region in Oman. Similarly, Mahmood (2008) reported that Quick decline

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showed 100% prevalence in surveyed orchards in 7 Districts of the Punjab province. Khanzada *et al.* (2004) described the onset of quick decline of mango by the discoloration and darkening of twigs from tip to downward. Prakash (1996) described the symptoms of disease as dying of twigs/ branches from top to downward, defoliation, blackening and shredding of the outer bark of twig and branches. Die back decline complex can be observed as twig blight, tip die back, gummosis, and bark splitting (Malik *et al.*, 2005). Tip die back, discoloration and darkening of bark, exudation of gum, bark splitting and cracking are the common symptoms of disease, these symptoms can be observed alone or in combination of two or more symptoms (Ploetz, 2003; Iqbal *et al.*, 2007).

Numerous research workers have isolated and reported *Ceratocystis fimbriata* Ellis and Halst, as the first plant pathogen associated with quick decline affected plants in Brazil, Oman and Pakistan (Malik *et al.*, 2005; Al Adawi *et al.*, 2006; Saeed and Moasood, 2008; Masood *et al.*, 2010). Shahbaz *et al.* (2009) reported *Lasiodiplodia theobromae* (Pat.) Griffon and Maubl was most frequently isolated fungus from the mango trees showing the typical symptoms of quick decline in Pakistan. Leghari (2005) isolated twelve different species of the fungi belonging to ten different genera from the mango plants showing the typical decline symptoms. Exudation of gum was found to be the most common symptom of die back affected plant due to the involvement of *Botryodiplodia theobromae* (Khanzada *et al.*, 2005; Saleem *et al.*, 2006; Fateh *et al.*, 2006). Previous research showed the establishment of pathogen in soil due to the die back of shesham which is also caused by the same specie of the fungi (Ploetz, 2003). Reachus and Adamous (1987) found that water stress was the primary predisposing factor for the onset of disease.

Masood *et al.* (2008) expressed that improper irrigation and severe injuries to plants may enhance the opportunity for the disease to be established. The disease was observed commonly in the plants of different age in Punjab and Sindh and found a complex problem due to result of anthracnose, die back, root rot, gummosis and drying of twigs and branches (Jaskani, 2007). Keeping in view the above mentioned status of quick decline of mango and taking into consideration the magnitude of this disease and its drastic losses, the present study was conducted to evaluate the infection dynamics of the pathogen on various cultivars at the

plants of different age in the mango grooves of Multan, Punjab.

MATERIALS AND METHODS

Disease survey: An extensive random survey was conducted during the spring season and early summer of 2013 in the mango groves of Multan region by following X method (30° 11' 52" N, 71° 28' 11" E, 410 ft elevation above sea level), divided into four separate zones viz. East, West, North and South zones. In each zone, four worst hit areas of disease were randomly selected, set as target and thoroughly surveyed to obtain a fresh status of the disease in the mango growing belt of Punjab. East site included Faiz Pur (30.270 °N and 71.250 °E), Qadir Pur (30.272 °N and 71.246 °E), Tataay Pur (30.273 °N and 71.244 °E) and Kukkar Hatta (30.276 °N and 71.252 °E). West side comprised of Nawab Pur (30.264 °N and 71.488 °E), Head Muhammad Wala (30.262 °N and 71.492 °E), Umer Pur (30.260 °N and 71.486 °E) and Mouza Nandla (30.261 °N and 71.487 °E) while North side covered Lutfabad (30.263 °N and 71.485 °E), Band Bosan (30.268 °N and 71.495 °E), Salar Wahan (30.260 °N and 71.502 °E) and Nawan Shehr (30.258 °N and 71.504 °E). Shershah (30.267 °N and 71.498 °E), Shujabad (30.266 °N and 71.494 °E), Muzaffarabad (30.0703 °N and 71.1933 °E) and Doaaba (30.0705 °N and 71.1928 °E) were surveyed in the south zone of Multan. On the whole, 48 mango orchards were randomly visited i.e., 12 orchards in each zone and 03 orchards in each locality covering 30 mango plants of various varieties in individual orchard were examined by X method for the quick decline disease intensity and severity.

Disease severity and intensity: The most evident symptoms of quick decline of mango i.e. drying of twigs, drying of branches, gummosis, bark splitting, root rotting, blackening of vascular bundles, and curling or drying of leaves were examined to determine the disease severity percentage and overall disease intensity by the scale for quick decline of mango in the field experiments. Quick decline of mango was rated on the basis of 0-to-7 scale where class 0 was the highly resistant response with no disease infestation. Class 2, 3, 4, 5 and 6 were consisted of 1-10, 11-20, 21-30, 31-40, 41-50 and 51-60% infestation of the disease on plants. Similarly class 7 was the highly susceptible response of the plant towards disease with > 60% infection (Masood *et al.*, 2010). Disease severity and intensity was calculated by the formula developed by McKinney (1923) which was further simplified with respect to disease symptoms.

$$\text{Disease severity index} = \frac{\text{Sum of all the score of individual plants}}{\text{Total No. of Plants observed}} \times 100$$

Cultivar susceptibility: During the survey all the main mango cultivars viz. Chaunsa, Dusehri, Fajri, Sindhri, Malda, Langra, Anwar Ratole, Ratole No. 12, Mahmood Khan, Shan-e-Ali, Shan-e-Mustafa, Armughan, Tota Pari, Sensation and Almas were taken into account to find out the cultivar susceptibility in Multan region. During

the critical inspection of orchards, only those plants of particular variety were observed showing the symptoms of disease irrespective of any stage of pathogenesis. Disease severity was calculated by the formula using the above mentioned scale for quick decline of mango.

$$\text{Disease severity index} = \frac{0(n) + 1(n) + 2(n) + 3(n) + 4(n) + 5(n) + 6(n) + 7(n)}{7} \times 100$$

Age response of mango plants: Assuming the possible variation in age response of mango plants of different varieties to disease, two particular age levels viz. 20 ± 5 and 30 ± 5 year old plants were also observed to determine the occurrence of disease at various cultivars viz. Chaunsa, Dusehri, Fajri, Sindhri, Malda, Langra and Anwar Ratole on plants of varying age.

Predisposing factors: Soil texture, sub soil, soil pH, irrigation, fertilizer, intercropping and pruning were considered to be the factors which facilitate the pathogen to come in contact with the host plant were also evaluated during the survey according to the mango grower's information to evaluate the disease incidence of quick decline in Multan region. For this purpose, a questionnaire was developed at department of Plant Pathology, Bahauddin Zakariya University Multan, to get all the particulars about the grower's farm to analyze the disease in view of the farmer's perceptions.

Statistical analysis: Data regarding disease severity percentage of all surveyed locations, cultivar susceptibility and age response of different cultivars were subjected to statistical analysis using the analyses of variance (ANOVA). Treatments means were compared by the New Duncan's Multiple Range test (DMRT) at ($P \leq$

0.05) through statistical analysis system, (SAS® 2002).

RESULTS

Disease survey: Data in the Figure 1 indicated that highest infection (24.44%) of disease was recorded in Tataay Pur followed by Kukkar Hatta (13.33%) which was statistically at par with Faiz Pur and Qadir Pur while minimum disease incidence (4.44%) was observed at Qadir Pur in the East zone of Multan. Results of the West zone showed the highest disease severity (24.44%) at Head Muhammad Wala and minimum disease severity (7.00%) was observed at Nawab Pur (Figure 2). Data in Figure 3 showed the maximum disease severity (27.88%) at Nawan Shehr and minimum infestation (8.33%) of disease was noted at Salar Wahan in the North plane of Multan. In the South plane, maximum disease severity (15.55%) was calculated at Shujabad followed by SherShah (12.33%) and minimum disease severity (4.44%) was observed at Muzaffarabad (Figure 4). In four planes of Multan region, the overall maximum disease intensity (15.02%) on all surveyed locations was recorded at North plane followed by West plane (14.10%) and South plane (13.33%) while minimum disease severity index (9.88%) was recorded at South plane (Figure 5).

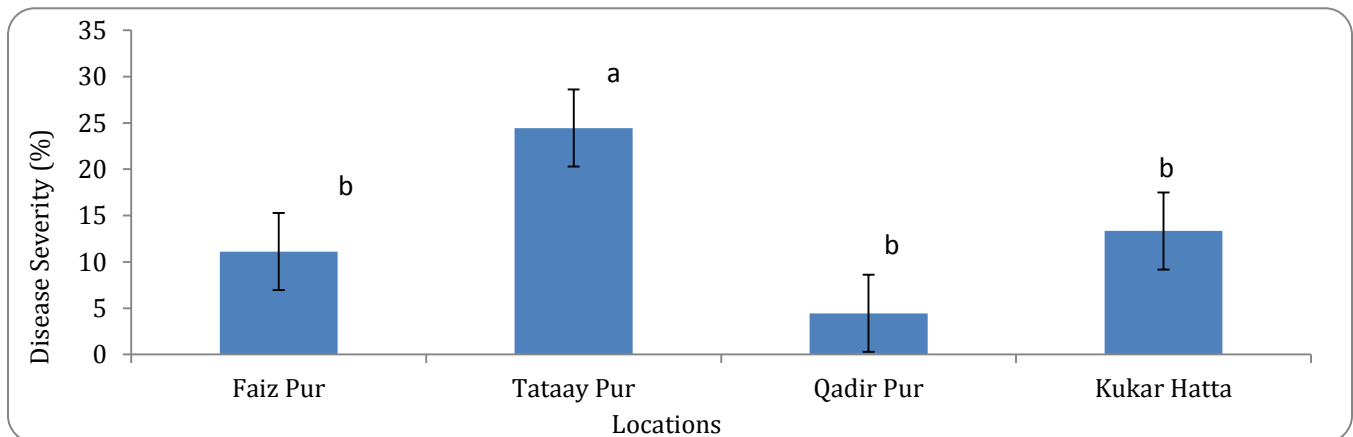


Figure 1. Disease severity (%) of quick decline of mango on different surveyed areas of East zone of Multan region.

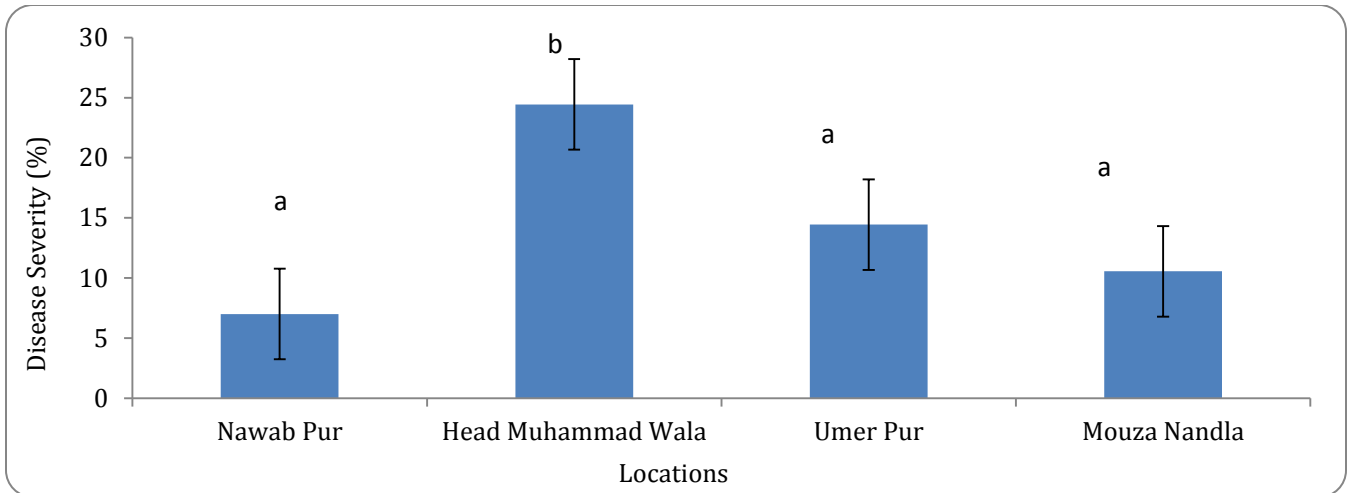


Figure 2. Disease severity (%) of quick decline of mango on different surveyed areas of West zone of Multan region.

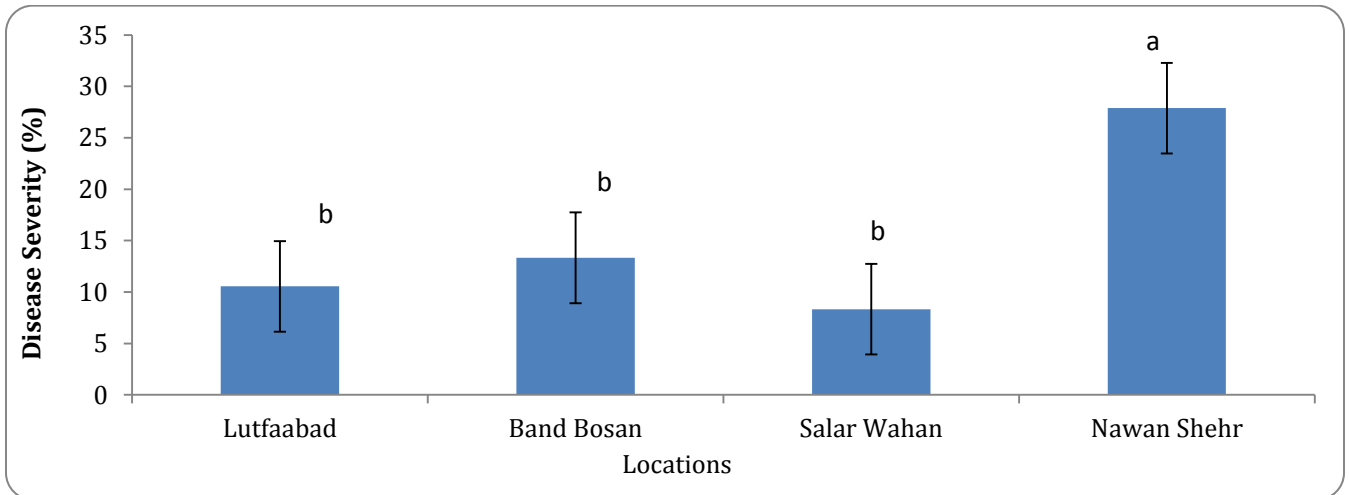


Figure 3. Disease severity (%) of quick decline of Mango on different surveyed areas of North zone of Multan region.

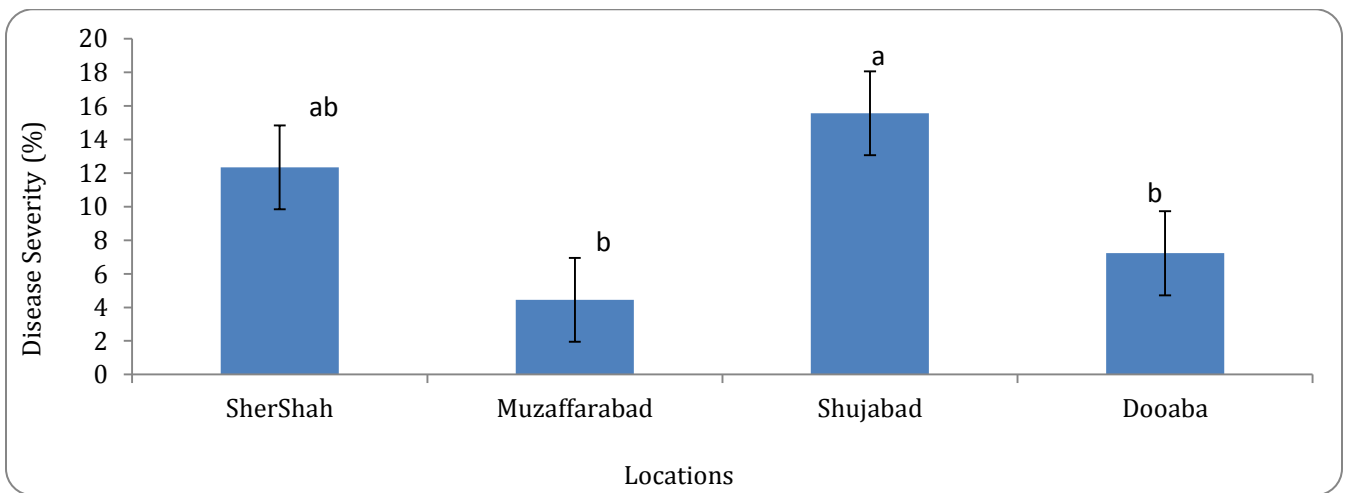


Figure 4. Disease severity (%) of quick decline of Mango on different surveyed areas of South zone of Multan region.

Cultivar susceptibility: The results of cultivar susceptibility with reference to the quick decline of mango indicated the maximum prevalence of disease (32.20%) on cultivar Chaunsa followed by Fajri, Malda,

Langra and Anwar Ratole, respectively. The minimum disease severity (0.83%) was noted on Almas followed by Sensation, Mahmood Khan, Shan e Ali and Armughan, respectively (Figure 6).

Age response of mango plants: Two different age groups of mango plants were observed on seven different varieties to record the occurrence of quick decline of mango. Highest occurrence of disease severity (25.70%) was recorded on Chaunsa cultivar of the age group of 20 ± 5 years old plants (Figure 7). On the other hand, the highest disease prevalence (37.44%) was recorded on Chaunsa cultivar (Figure 8) of the age group of 30 ± 5 which showed significant increase in percent disease severity of quick decline of mango.

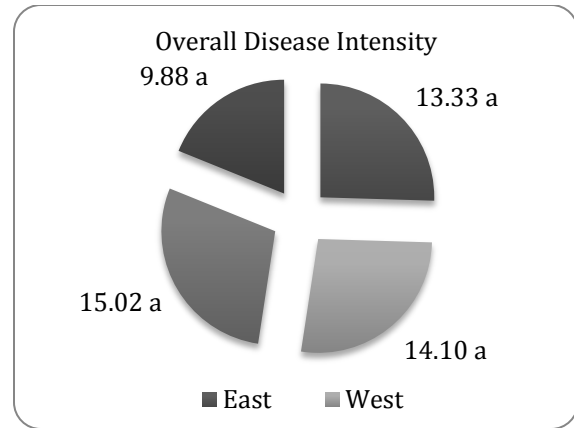


Figure 5. Overall disease intensity of quick decline of Mango in four planes of Multan Region.

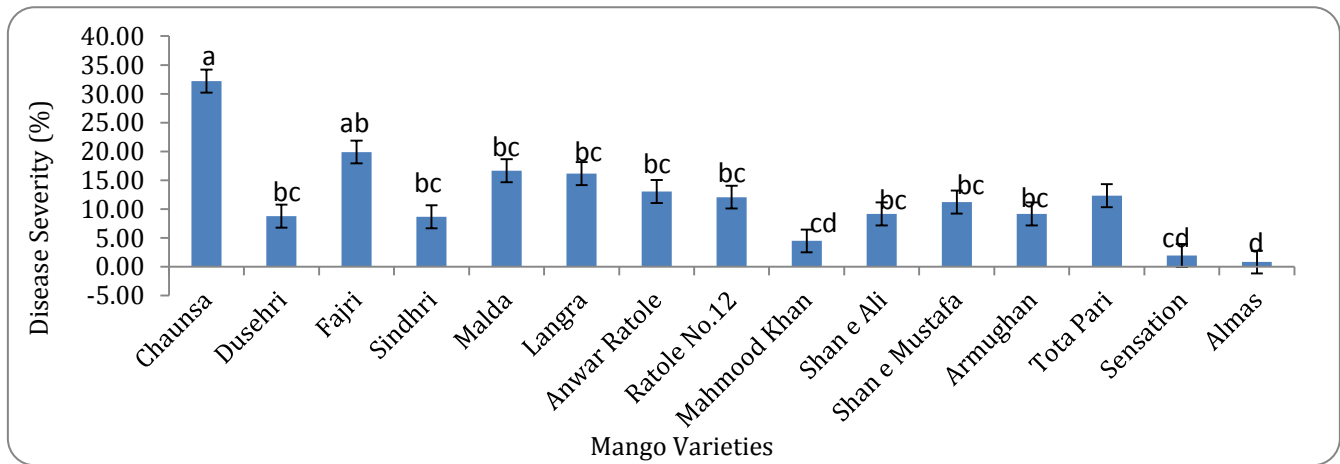


Figure 6. Disease severity (%) of Die Back of Mango on different varieties at surveyed locations of Multan region.

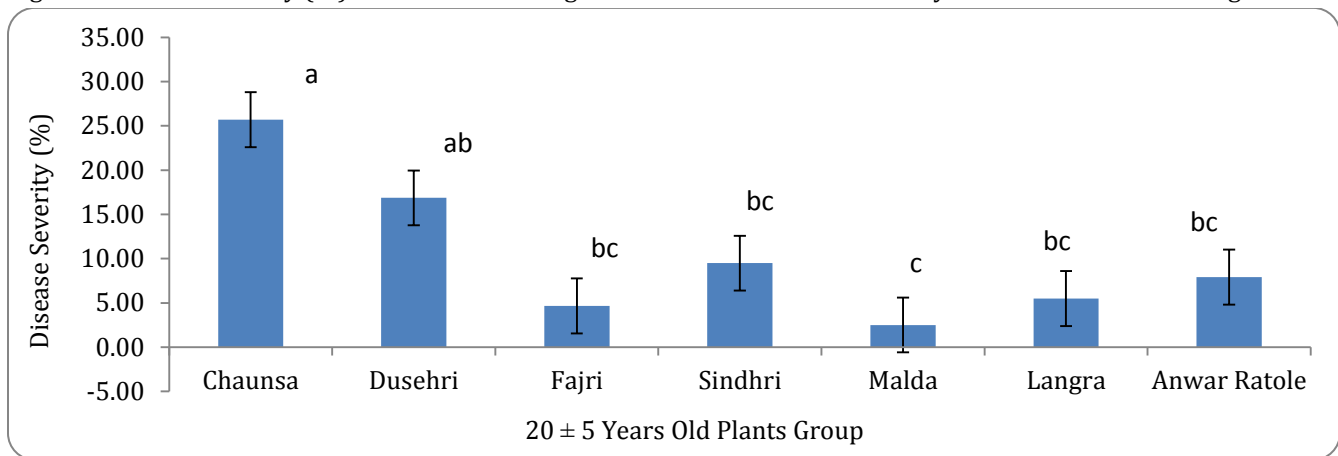


Figure 7. Occurrence of Mango quick decline at different varieties of 20 ± 5 years old plants on surveyed locations of Multan region.

Predisposing factors: The socio-demographic features of the respondents belonging to the different localities of Multan are shown in (Table 2). The farmer's information's provided a mile stone to prove the role of predisposing factors in facilitating the

disease. Abnormal soils, High soil pH, inundated irrigation, unbalanced use of fertilizer, intercropping in the mango grooves and zero pruning was the preliminary issues which enhanced the disease severity.

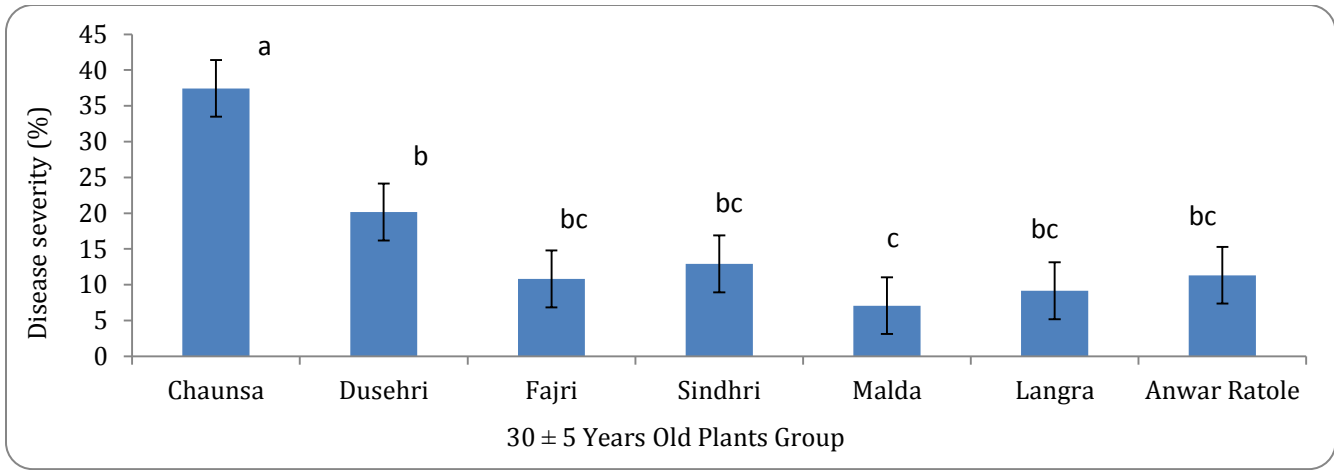


Figure 8. Occurrence of Mango quick decline at different varieties of 30 ± 5 years old plants on surveyed locations of Multan region.

Table 2. Information regarding the farmer’s perceptions about the predisposing factors.

Sr. No.	Predisposing Factors	Sub Factor	N* (%)	Disease Incidence (%)			
				East Zone	West Zone	North Zone	South Zone
1	Soil Texture	Normal Soil	4(0.4)	14.66	20.66	15.18	15.15
		Light Soil	3(0.3)	16.66	16.33	33.33	0.00
		Heavy Soil	6(0.6)	21.66	26.66	50.00	13.33
2	Sub Soil	Normal Soil	3(0.3)	3.66	16.66	16.66	6.66
		Hardpan	7(0.7)	13.33	17.66	17.99	11.55
		Sandy Subsoil	3(0.3)	14.36	26.33	26.66	16.66
3	Soil pH	7.5-8.0	4(0.4)	19.99	13.33	25.00	27.08
		8.0-8.5	6(0.6)	11.33	36.66	33.25	35.55
		8.5-9.0	5(0.5)	21.66	46.66	56.00	46.66
4	Irrigation Source	Canal	2(0.2)	11.66	23.33	16.66	11.66
		Tubewell	4(0.4)	21.66	21.33	26.66	23.33
		Tubewell & Canal	3(0.3)	11.88	24.66	36.99	21.58
5	Fertilizer	NPK	3(0.3)	18.99	20.99	23.99	17.38
		FYM	3(0.3)	21.77	21.99	23.33	21.90
		Gypsum	2(0.2)	10.66	19.99	24.16	18.33
6	Intercropping	Field Crops	6(0.6)	31.10	24.66	36.99	21.22
		Fodder Crops	5(0.5)	23.91	31.92	28.62	31.66
		Vegetable crops	4(0.4)	6.66	6.67	11.66	21.91
7	Pruning	Once in Year	4(0.4)	11.99	9.33	6.66	11.99
		After two Year	3(0.3)	18.33	21.66	23.66	31.66
		No Pruning	7(0.7)	26.66	31.66	35.55	31.66

N*= frequency of growers

DISCUSSION

Quick decline of mango is one of the complex diseases of the mango crop inflicting substantial losses to mango orchards and the vast spread of disease indicated that the mango plantation in Punjab province especially in Multan is under the striking attack of disease (Mahmood *et al.*, 2002). The death of the young and the

adult plants showed a serious threat and its consequences of future are nightmare for the mango growers (Mahmood and Gill, 2002). The plant infected with quick decline of mango showed the characteristics symptoms of gummosis, bark splitting, drying of branches, drying of twigs and curling of leaves (Masood *et al.*, 2010; Al Adawi *et al.*, 2006, Al Subhai *et al.*, 2006).

The disease was found in all surveyed locations of four planes of Multan region with the varying degrees. However, disease was more severe in the visited locations of North plane viz. Lutfabad, Band Bosan, Salar Wahan and Nawan Shehr followed by West plane and East plane whereas the severity of the disease was minimal in South plane of the Multan region. It seemed that the predisposing factors specifically soil texture; sub soil, soil pH, and irrigation, for the establishment of disease were more favorable in the North zone as compared to the other planes.

All the mango cultivars found in the orchards viz. Chaunsa, Dsehri, Fajri, Sindhri, Malda, Langra, Anwar Ratole, Ratole No. 12, Mahmood Khan, Shan e Ali, Shan e Mustafa, Armughan, Tota Pari and Sensation showed the disease symptoms of quick decline of mango. All the varieties were evaluated at each mango orchard individually and the difference on the basis of disease severity among all the varieties at surveyed areas was found highly significant at the probability level ($P \leq 0.05$). The maximum disease severity was calculated on cultivar Chaunsa (32.20%) followed by Fajri (19.91%) whereas Malda (16.68%) was statistically at par with Langra (16.16%) and Anwar Ratole (13.05%). These five varieties proved to be the most susceptible varieties to the disease. Beside these varieties, all the other cultivars were considered to be tolerant to disease. During the survey, the mango variety, Chaunsa, the susceptible one, was recorded to be the predominant variety planted in mango orchards, thus, accounting for the overall high disease intensity values. The occurrence of quick decline in different varieties at two distinct age levels viz., 20 ± 5 and 30 ± 5 in the vicinity of surveyed areas showed cultivar Chaunsa to be the most susceptible one with (25.70 and 37.44%) respectively among all the varieties followed by Dusehri (16.86 and 20.16%) and Sindhri (9.49 and 12.91%) respectively. Some varieties were cultivated at very low intensity in the mango orchards, it was possible that if the number of visited plants may increased than it might be possible that the percentage of diseases trees decreased and become near to the other varieties. The minimum disease severity was observed in Malda (2.50 and 7.07%), Langra (5.49 and 9.16%), and Anwar Ratole (7.91 and 11.32%) respectively. The age group of 20 ± 5 showed significant difference in the occurrence of quick decline of mango.

Predisposing factors are those which facilitate the pathogen to attack on host plant. Grower's information's

were collected on a questionnaire to evaluate the disease severity with reference to predisposing factors. The data set collected about the Soil texture; including normal soils consisting of equal proportions of sand (28-51%), silt (28-50%) and clay (7-27%). In soil texture, the mean maximum disease incidence was observed in North plane followed by West plane. Subsoil included three categories viz. sandy sub soils (layer below the top soil, less fertile and poorer in texture), Normal sub soils (layer below the top soil also called substrata) and hard pan (cemented or compacted often clayey layer in soil that cannot be penetrated by roots); mean maximum disease incidence was observed in North and West zone respectively.

Soil pH was consisted of three levels viz. 7.5 to 8 (slightly alkaline soils), 8.1 to 8.5 (Medium alkaline soils, high in sodium contents) and 8.5 to 9.0 (Strongly alkaline soils, the nutrients present in the soil become locked up for the plant); the mean maximum disease incidence (56 %) was noted in soils having pH 8.5-9.0. According to the grower's information, the mean maximum disease incidence was observed in North and West planes where the both means of irrigation were used. Fertilizer is the one of the crucial need for the plants, in our survey mean maximum disease incidence was observed in West, North and South plane where the blind use of NPK was in practice without recommendation. During the survey intercropping was noted with fodder crops, field crops and vegetable crops, the analysis of data set showed maximum incidence with the intercropping of fodder and field crops in the mango orchards. Pruning of plants was important to be questioned, the analysis of data showed the maximum disease incidence was found in the category of zero pruning and minimum disease incidence was observed in the orchards where the regular pruning was in practice.

CONCLUSION

On the basis of findings, simple suggestions forwarded are: farming community should adopt regular pruning of the orchards which will definitely enhance good aeration and sun light penetration in the plants, avoid intercropping, proper sanitation of the orchards, avoid inundated fertilization application and a recommended schedule of spray should be followed to minimize the inoculums in the orchards. The investigations revealed that some cultivars possess the ability to overcome the disease at a particular age due to natural resistance.

ACKNOWLEDGEMENTS

Grateful acknowledgements are due to Mr. Mwema Felix, Research Scientist, Tropical Pesticide Research Institute, Tanzania for critically reviewing the manuscript.

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