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Assessment of Mango Malformation in Eight Districts of Punjab (Pakistan)

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ABSTRACT

This study was conducted to assess the prevalence and severity of mango malformation during the year 2001. Forty locations were visited in eight districts of the Punjab province with the objective to confirm the status and update the existing statistics for future planning and management. The disorder was found widely distributed with 100 percent prevalence. The maximum severity of 66.23% was recorded in Jhang district followed by 24.67 and 24.57% in Multan and Vehari respectively. All the varieties were found more or less affected. Cultivars susceptibility showed varying frequencies. Maximum disease severity (42.93%) was recorded in seedling mango (ungrafted) while Sindhri and Anwar rataul showed 36. 24 and 31.02% infected panicles respectively. Susceptibility of promising cultivars suggests the need to devise suitable control strategies to tackle the crux which has ever defied solution.

Key Words: *Mangifera indica*; Malformation; Cultivar susceptibility; Punjab; Pakistan

INTRODUCTION

Mango *(Mangifera indica* L.) is a unique species with respect to growth, nature and peculiar characteristics. In Pakistan area and production are 97000 ha and 989800 tones respectively (Anonymous, 2004). Like other crops, it is affected by many physiological and pathological stresses. Malformation is the most threatening malady among several biotic stresses of mango. This century's old problem inflicts enormous losses every year. Malformation is noticed on seedlings, saplings and floral organs. Floral malformation attacks inflorescences on mature plants. The malady is one of the most destructive in nature because the economic losses faced every year vary between 5-30% (Srivastava, 1998). According to Singh *et al.* (1961), trees between 4 to 8 years age suffer the most (90.9%) from vegetative malformation. Since first record by Maries from Bihar (Watt, 1891), it has been reported from Pakistan, India, Egypt, South Africa, Brazil, Israel, Central America, Mexico, U.S.A, Sudan, Cuba, Australia, Bangla Desh and UAE. Maximum loss in India due to this deformation is 86%. In South Africa 73% of the mango farms are affected and severity varies from 1-70% (Kumar *et al*., 1993*).* As malformed inflorescence fails to produce fruits, the damage of individual tree may vary from 50-80% and in severe cases the loss may be almost total (Summanwar, 1967). Cultivar susceptibility varies greatly depending upon the variety, age of the tree and prevailing environmental conditions. In Pakistan, Khan and Khan (1960) observed that no variety is completely resistant. Among the grafted varieties, Collector, Langra and Neelum (2-8%) were found tolerant while Anwar rataul (45-50%), Alphanso (70-95%), Dusehri (15-69%), MaIda (50-90%), Samar Bahisht (20-98%), were classified as susceptible. Ali (1977) noted that out of 21 grafted varieties of mango observed so far in various gardens of Pakistan, none was found free from the disease. The relative susceptibility to flower malformation was assessed in eight years old trees of 12 cultivars. The mean number of malformed panicles was lowest in cv. Langra (9.37%) followed by Totapuri (16.53%) and Alphonso (17.25%), and highest in Amrapali (57.12%), Bombay Green (56.25%) and Mallika (55.0%) (Badliya & Lakhanpal, 1990). About 10% of the total area cultivated with Tomyatkin variety in the main counties of Bahia state, Brazil, was assessed. The flower malformation amounted to 54% with malformation severity of 17% (Sao-Jose *et al*., 2000).

Malformation is the major impediment to the establishment of economically profitable orchards. It is intriguing the scientists because of its destructive and widespread nature. Gradual and steady dissemination has made it an insuperable obstacle. The major objectives of the present study were: to assess the distortion in diversity of orchards, evaluate cultivar's status in mango growing areas of the Punjab province, simplify the scientific rating and estimation and provide a base for future experimental designing.

MATERIALS AND METHODS

Survey and evaluation of mango malformation were done on complete differentiation of healthy and malformed panicles during the growing cycle (March- April, 2001). Five orchards were assessed in each district. A total of 40

Table I. Disease rating scale for mango malformation

Grade	Disease index	Level of resistance/ susceptibility
1	Free from disease	Resistant.
3	0.1 - 1.0 % DI	Moderately resistant.
5	1.0 - 10 % DI	Tolerant.
7	10.1- 20 % DI	Moderately susceptible.
9	> 20 % DI	Susceptible.

locations were visited in mango growing areas of eight districts of the Punjab Province (Fig. 1). Cross method was employed for assessment depending upon the field design and type of orchard. A Performa was designed to record limb and tree wise data at different locations. Sampled plants in different orchards ranged from 3 to 9 depending upon the orchard size with a total of 612 limbs and 204 trees. This took fortuitously 10% of orchard area (Sao-Jose *et al*., 2000). Three limbs having many small and large branches were selected on each tree at random. Diseased, healthy and total number of inflorescences was counted on each limb. Percent severity was calculated quantifying number of panicles affected with the objective to explore quantitative estimation of cultivar susceptibility.

Disease index was calculated according to the following simplified formula to get the true disease picture:

$$\left[Disease \quad incidence \quad (DI) \frac{N1}{N2} \right]$$

Where N_1 and N_2 represent the number of infected plants and total number of plants of each assessed variety respectively

$$Diease \quad severity \quad (DS) = \frac{D}{T} \times 100$$

Where D and T are diseased and total number of panicles of each variety

$$Disease \quad Index \quad (DI) = DS \times \frac{N1}{N2}$$

RESULTS

Assessment of mango malformation in 40 different orchards of eight districts of the Punjab revealed that it is widely distributed with 100% prevalence. No orchard was found free of malformed heads. Maximum severity was observed in Jhang district ranging from 26.86-85.18% (av = 66.23%). Multan ranked second with 24.67% infected panicles followed by Vehari (24.57%) (Table II). Least severity was observed in the orchards of Khanewal (12.16%) followed by T.T. Singh (16.35%).

All the traditional mango cultivars were more or less affected. Seedling mango proved to be highly susceptible showing 42.93% severity while Sindhri, Anwar rataul and Dusehri showed 36.24, 31.02 and 26.83% disease severity, respectively.

Five varieties viz. Seedling mango, Sindhri, Anwar rataul, Dusehri and MaIda with 9 disease rating proved to be susceptible. Four varieties i.e., Fajri, S.S.-I, Chaunsa and Langra appeared to be moderately susceptible with 7 disease rating (Table III). Langra, although not tolerant, proved to be least affected with less number of diseased panicles.

DISCUSSION

Malformation is a serious problem of mango industry and has become a limiting factor in the establishment of economically viable orchards. Despite hectic efforts, complete control has not been achieved yet. Floral malformation is most important because it directly hits the yield of the plants leaving unproductive inflorescences.

The present studies were conducted on full bloom (March-April) wherein 100% prevalence in orchards of the Punjab was recorded. Survey of mango orchards to assess the extent of damage during the same months in Lucknow and Varanasi districts and West Bengal revealed that malformation was present in all the orchards (Chadha *et al*., 1979a; Chakrabarti *et al*., 1997). The districts surveyed in our study fall in the same ecological zone but severity showed much variation from district to district. The extent of malformation varies not only from variety to variety but also in trees of different age groups. Majumdar and Sinha (1972) observed the incidence to vary from season to season depending upon the climatic conditions. There is wide difference in cultivars for susceptibility depending upon the cultivars, age of the plant and agro climatic conditions of the area (Azzous, *et al*., 1978; Srivastava, 1998). Our results don't conform to the findings of some earlier workers (Singh *et al*., 1961) who reported that most of the mid to late

Fig.1. Surveyed locations of the Punjab.

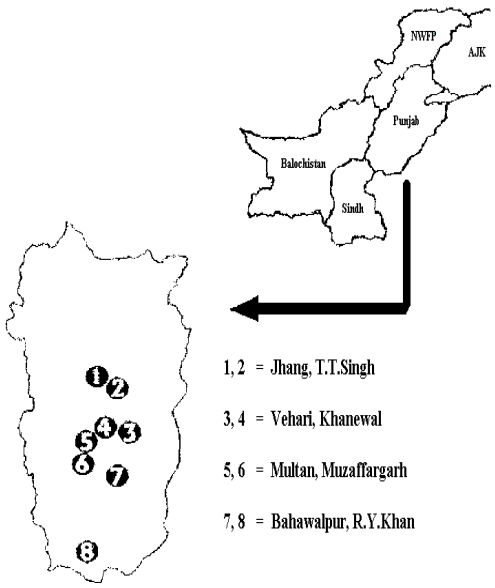

Table II. Prevalence and severity percentage of mango malformation in eight different mango growing districts

	Area	No. of trees assessed	Prevalence	%(Severity) ± S.E.
1.	Multan	20	5 (100)	24.67 (11.79- 43.52) 0.95
2.	Rahim Yar Khan	21	5 (100)	18.86 (8.06-39.37) 0.76
3.	Muzaffargarh	21	5 (100)	20.86 (6.19-41.30) 1.01
4.	Bahawalpur	23	5 (100)	19.51 (5.40-36.26) 0.89
5.	T.T. Singh	30	5 (100)	16.35 (8.93-58.27) 0.54
6.	Vehari	32	5 (100)	24.57 (4.76-86.76) 0.67
7.	Jhang	26	5 (100)	66.23 (26.86-85.18) 1.10
8.	Khanewal	31	5 100)	12.16 (5.79-30.57) 0.49

t-test: Values exhibit severity of malformed panicles of different districts which were taken into account (± S.E.). Test shows significance at P< 0.0001.

Table III. Cultivar susceptibility to mango malformation

Sr. No.	Variety	Inflorescence count			(%) Severity ± S.E.
		Diseased	Healthy	Total	
1.	Desi	325	432	757	42.93 1.80
2.	Sindhri	519	913	1432	36.24 1.27
3.	A. rataul	613	1363	1976	31.02 1.04
4.	Dusehri	502	1369	1871	26.83 1.02
5.	Malda	135	402	537	25.13 1.87
6.	Fajri	126	386	512	24.60 1.90
7.	S.S.-I	168	661	829	20.26 1.39
8.	Chaunsa	2074	9075	11149	18.60 0.37
9.	Langra	686	3621	4307	15.92 0.56

Values are percentages of panicles severity and are followed by standard errors. Results of t-test are significant (P < 0.0001).

Table IV. Expression of different mango cultivars

Cultivar	Maturity (Season)	Disease Index	Rating	Level of resistance/ susceptibility
Seedling mango	Early	42.93	9	Susceptible(S)
Sindhri	Early	36.24	9	Susceptible(S)
A. rataul	Mid	31.02	9	Susceptible(S)
Dusehri	Mid	25.33	9	Susceptible(S)
Malda	Early	25.13	9	Susceptible(S)
Chaunsa	Mid to late	18.60	7	Moderately susceptible(MS)
Fajri	Late	18.45	7	Moderately susceptible(MS)
S.S.-I	Late	16.57	7	Moderately susceptible(MS)
Langra	Early to mid	14.10	7	Moderately susceptible(MS)

season varieties are more or less free from the disease. In our studies, mid season cultivars i.e. Anwar rataul and Dusehri were regarded susceptible. Even Fajri and Chaunsa being mid to late and S.S.-I late, could not escape the attack. The observation of the former authors is also contradicted by Parashad *et al.* (1965) who found no correlation between the intensity of the disease and the variety. Dusehri, Langra, Malda, Sufeda and Chaunsa had 40-100% infection. Badliya and Lakhanpal (1990) studied 12 cultivars for their relative susceptibility. Lowest percentage was recorded in Langra. Khan and Khan (1960) noted minimum infection in Langra. In our studies, same variety showed least severity. Dusehri proved to be susceptible in the present work attained the same status in the findings of Kumar and Beniwal (1987a). Maximum floral malformation was observed in Dusehri, followed by Malda, Chaunsa and Langra. This is the same descending order as in respect of these varieties was found in the current study. Some mid to late ripening cultivars are worst affected (Kulkarni, 1979). So no correlation between the time of maturity and susceptibility of malformation may be established as suspected by earlier workers elsewhere. Chakrabarti *et al.* (1997) concluded that environmental parameters and mangiferin content result in seasonal variation in disease incidence.

Kumar *et al.* (1993) tested 100 mono and poly embryonic varieties. Only one variety "Bhaduran" was found disease free. In the present study nine local monoembryonic cultivars were assessed and no one was observed malformation free. Complete resistance has not been observed in anyone variety in Pakistan (Schlosser, 1971). Variation in assessment in different flowering cycles may be observed due to alternate year flowering habit, lack of uniformity in occurrence, temperature fluctuation,

diversifying susceptibility from branch to branch and variety to variety. The severity of the disease varies from variety to variety and tree to tree in the same variety. Seasonal variations in the occurrence and severity of problem correlate with ambient temperature at flowering (Majumdar & Sinha, 1972). In Egypt panicles appearing on spring shoots are most severely affected (Shawky *et al.*, 1980). In Florida the heaviest infection occurs under unusually wet conditions (Campbell & Marlatt, 1986). The degree of malformation varies within each cultivar and from cycle to cycle (Azzous *et al*., 1978; Nath *et al*., 1987). The environmental parameters, host metabolites and mangiferin content cause seasonal variation in disease incidence (Chakrabarti *et al*., 1997; Chakrabarti & Kumar, 1998). Most of the Pakistani and Indian cultivars are alternate bearer having uneven fruit set. Symptom expression in malformed panicles may be different and is dependent on type of cultivar, level of hypertrophy and extent of infection.

Good orchard management occupies paramount importance in this context and plays a vital role in checking the disorder (Noriega-Cantu *et al*., 1999). Maximum severity (66.66%) was recorded in the orchards of Jhang district. Severity ever peaks in severely neglected orchards. Good management strategies exhibited comparatively less symptom manifestation. Least severity ranges of 4.76 and 5.40 (Table IV) in Vehari and Bahawalpur districts respectively were due to recommended management practices adopted in specific orchards.

The present studies were aimed to record the prevalence, disease position; severity percentage and disease index of mango malformation, consolidate up-to-date information, evaluate cultivar susceptibility, identify and specify future areas of research. The results of these studies will be helpful for future statistics, management, forecasting and experimental designing.

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