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Screening of mango cultivars against important insect-pests of mango

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Abstract
The field experiment was conducted at Regional Horticultural Research Station, Navsari Agricultural University, Navsari (Gujarat) during 2009-2011. The result indicated that lowest hopper population (1.26 hoppers/twig or panicle) was observed in Totapuri followed by Dashehari and Ratna which were also considered less susceptible. The remaining entries were considered moderately susceptible wherein highest hoppers (9.28) were recorded in Mallika followed by Sonpoari and Alphonso. However, highest population of thrips (17.00/ twig or panicle) was recorded in Alphonso followed by Kesar. They were considered as highly susceptible entries. The remaining entries were found moderately susceptible indicating lowest thrips (5.43) in Totapuri. Moreover, all the mango genotypes suffered heavily from mango leaf gall midge damage and were considered highly susceptible entries, however lowest damage (12.40%) was observed in Totapuri, while it was highest (53.78%) in Mallika. Whereas, most of the mango genotypes were found less susceptible to leaf webber oriented damage wherein highest webbing (8.33/tree in pooled result) was found in Alphonso which was considered as moderately susceptible entry followed by Rajapuri and Kesar which also found place in the same basket. The lowest webbing (1.50 in pooled result) was observed in Neelam which was considered as less susceptible entry. Fruit fly damage was highest (28.07% in pooled results) in Alphonso followed by Kesar and were considered as highly susceptible entries. The remaining entries were found moderately susceptible to the pest indicating lowest damage (5.74% in pooled results) in Totapuri.

Keywords: Important insect-pests, hopper, thrips, leaf gall midge, leaf webber, fruit fly mango, varietal screening

Introduction
Mango (*Mangifera indica* Linnaeus) is national fruit of India and known as "King of fruits" due to its wide adaptability, excellent taste, exotic flavour, exemplary nutritive value, richness in variety, attractive colour, appearance and popularity among the masses. The major mango producing countries in the world are India, China, Pakistan, Mexico, Thailand, Indonesia, Brazil, Philippines, Nigeria and Viet Nam. India ranks first in production of mango in the world. Various insect-pests of mango viz., hoppers, mealybugs, leaf gall midges, shoot gall psylla, fruitfly, thrips, leag webber, stem borer. Among the insect pests, mango hoppers are major, serious and wide-spread throughout the year in south Gujarat mango ecosystem. Hoppers species viz., *Amritodus atkinsoni* (Lethierry), *Idioscopus clypealis* (Lethierry) and *Idioscopus nitidulus* (Walker) remains active and damage each crop stage of mango from emergence of new flush to flowering cum fruit setting stages [6, 16] and causes up to 100 per cent losses. Both nymph and adult hoppers are observed sucking cell sap from young leaves, tender shoots, inflorescences or panicles and rachis of the young fruits which results in non-setting of flowers and dropping of immature fruits. Hoppers also excretes huge quantities of honey dew results in sooty mould formation, thus affects the photosynthesis of the plant. Other than hopper, thrips are major yield limiting factors in south Gujarat and elsewhere [4, 7, 17]. It is a polyphagous, cryptic mannered pest having short life cycle, high mobility towards development of insecticide resistance and infest a wide variety of host plants [9, 18]. Nymph and adult thrips suck cell sap from tender leaves, shoots, inflorescence and fruits of the mango which results in silvery shine with leaf edges, curling upwards, stunted growth, discoloration of buds and panicles, malformed, premature drops and bronzing of the fruit surface with feeding scars on fruits, thus adversely affects the quality of the marketable produce. Fruit flies, *Bactrocera dorsalis* (Hendel), *B. zonata* (Saunders) and *B. correcta* (Bezzi) are considered to be major bottleneck in economical mango production [5, 33]. It assumes great significance as a quarantine pest.

During ripening stage of mango, female fruit fly lays eggs in the fruit skin with the help of ovipositor and after hatching, the maggots start feeding inside the fruit pulp and causes internal discoloration, emits off flavours, pulp rotting and fruit drop and lastly, pupates in the soil. It causes up to 80 per cent yield loss in mango [32] and total Rs 29, 460 million annual losses in mango, guava, citrus and sapota [20]. Patel *et al*. [22], reported that fruit flies cause up to 40 per cent yield loss in heavy rainfall zone of south Gujarat. Other pests viz., shoot borer, leaf webber, stem borer, mealy bug, leaf gall midge, leaf damaging insect (ash grey beetle and leaf miner), scale insect, mite, red ants, hairy caterpillar, bark eating caterpillar, semi-looper and fruit borer are recorded as a minor or sporadic pest of mango [10, 22, 24, 32]. So the present investigation on screening of mango cultivars against important insect-pests was carried out at the Regional Horticultural Research Station, Navsari Agricultural University, Navsari.

Material and Methods

A field experiment was conducted at Regional Horticultural Research Station, Navsari Agricultural University, Navsari, Gujarat during 2009-2011 with two replications. For this purpose, thirteen mango cultivars viz; Alphonso, Kesar, Dasheri, Rajapuri, Totapuri, Banarasi-langra, Vashibadami, Neelum, Neelphonso, Amrapali, Mallika, Sonpari and Ratna were screened against important insect-pests of mango. For recording observations, twenty six experimental trees at fortnightly interval throughout the experimental period of two years i.e. 2009-2010 and 2010-2011. Ten terminal twigs from lower canopy of each of experimental tree were selected randomly during vegetative stage (April-December) for counting mango hopper and thrips populations (nymphs and adults or both). During flowering stage (January- March), ten panicles were selected randomly from lower canopy of each experimental tree for counting hopper and thrips. For recording the observation of leaf gall midge number of healthy as well as damaged leaves was counted on each of the ten terminal twigs from the lower canopy of each experimental tree and was calibrated as per cent leaf damage. Total number of webs was counted on each selected trees for leaf webber. Number of damaged fruits was counted out of total dropped fruits on each experimental tree for fruit fly. Simultaneously, number of damaged fruits was also counted out of ten plucked fruits on each tree. All the experimental trees were kept free from insecticidal spray during the course of investigation.

Infestation/Incidence ratings of major insect-pests of mango.

Category of susceptibility	Ratings	Major insect-pests of mango				
		Hopper	Thrips	Leaf gall midge	Leaf webber	Fruit fly
		Population/twig or panicle		(% Leaf damage /twig)	No. of webs/ tree	Fruit infestation (%)
Free (F)/Escape/Resistant (R)	0	--	--	--	--	--
Less susceptible (Low)	1	Up to 5 nymphs or adults or both		5	5	5
Moderately susceptible (Medium)	2	6-15		6-10	6-10	6-20
Highly susceptible (High)	3	> 15		> 10	> 10	> 20

Result and Discussion

1. Mango Hopper

The lowest number of hopper population (1.26 /twig or panicle) was observed in Totapuri and it was significantly lower than the rest of entries. On the other hand, highest number of hoppers was observed in Mallika (9.28/twig) followed by Sonpari (8.56), Alphonso (8.50), Neelphonso (8.04) and Neelam (7.36) which were at par with it (Table-1). The genotypes in decreasing order of susceptibility were ranked as: Mallika >= Sonpari >= Alphonso >= Nelphonso >= Neelam >= Rajapuri >= Banarasi-Langra>= Vashibadami > Amrapalli > Kesar > Ratna > Dashehari > Ratna. So, Mallika was found most susceptible and Totapuri as resistant genotypes. Nachiappan and Bhaskaran (1984) on the basis of natural population during flowering season categorized Baneshan, Chinasaram, Banglora and Khadar as resistant and Padin, Neelum, Mulgoa, Peter and Sindhu as highly susceptible to hopper. Amrapalli, Dashehari and Neelum highly susceptible and Banglora highly resistant to mango hopper [25]. Similarly, Raymaha and Vanraj least susceptible to *I.clypealis* [15].

Alphonso was found most susceptible variety against all the reported species of mango hopper in south Gujarat [2,3]. Various mango hybrids were evaluated on the basis of natural infestation of hopper in field conditions and categorized Sonpari as highly susceptible to mango hoppers [28]. In Pakistan, lesser incidence of mango hopper indicated in Dashehari cultivar [29]. In the present investigation, mango hybrid Sonpari was ranked second most susceptible mango genotype which recorded as high as 8.56 hoppers per twig or panicle, though it was not significantly different from Mallika wherein highest hoppers (9.28) were recorded. So, the results obtained in this investigation are in close agreement with those of [28], while hoppers in the present investigation were lower in number in the Dashehari cultivar as compared to other genotypes. These results are slightly different from those of [29] who reported Dashehari as most susceptible entry. It might be due to variation in agro-climatic conditions and the dominant variety grown in the respective regions. Banganapalli and Dashehari varieties were also found to be the less preferred varieties by recording 8.4 and 1.07 hoppers, respectively while Suvarnarekha and Totapuri varieties occupied the intermediate position with 14.5 and 14.8 hoppers, respectively [34].

2. Thrips

The lowest thrips population (4.44 to 6.43 thrips/twig or panicle) was observed in Totapuri which was followed by Dashehari (6.27 to 8.03), Ratna (6.38 to 8.44) and Mallika (7.25 to 9.43) which were at par with it. The highest thrips population (17.00 thrips/twig or panicle) was recorded in Alphonso which did not harbour significantly higher population than Kesar (15.24) and Neelam (13.30) (Table- 2). The mango varieties and hybrids in the decreasing order of susceptibility were ranked as: Alphonso >=Kesar >= Neelam > Neelphonso > Sonpari > Rajapuri > Banarasi-Langra > Vashibadami > Amrapalli > Mallika > Ratna > Dashehari > Totapuri. So, Alphonso was considered as most susceptible

and Totapuri as most resistant or tolerant genotype. Alphonso was found most susceptible variety against mango thrips in south Gujarat [2.3].

3. Leaf gall midge

Lowest leaf damage (11.65 to 13.15%) was observed in mango cv. Totapuri. Next in order of susceptibility were Banarasi-Langra (17.78) and Ratna (21.59) which were at par with it; however the damage observed in these entries was significantly lower than rest of the mango entries, wherein the highest leaf damage (52.13 to 55.44%) was observed in Mallika which was statistically similar to Sonpari (50.03), Amrapalli (43.01) and Alphonso (41.42). The mango genotypes in decreasing order of sucseptibility were: Mallika >= Sonpari >=Amrapalli >=Alphonso > Neelam > Kesar > Neelphonso > Vashibadami > Dashehari > Rajapuri > Ratna > Banarasi-Langra > Totapuri (Table- 3).

Leaf gall incidence in Bombay green, Kishanbhog and Dashehari to the tune of 84, 46 and 33 per cent, respectively reported in [8]. In a similar study, damage caused by leaf gall midge in Alphonso, Kesar and Rajapuri varieties was the tune of 47.70, 27.71 and 25.80 per cent, respectively [12]. Out of twenty mango hybrids tested for multiple pest resistance to major insect-pests, Amrapalli, Arka Punit, HY-165, Mallika, Mehmood Bahar, Neeleshan, Neelgoa, Neeluddin, Prabhashankar, Sangareddy-mango, Sonpari and Suvarnjahangir were found highly susceptible to mango leaf gall midge [28]. Lowest leaf damage (9.91 per cent) was recorded in [23].

4. Leaf webber

The damage (web number/tree) caused by leaf webber or tent caterpillar in each mango genotype revealed lowest damage (1.50 webs/tree) in Neelum followed by Totapuri (1.77), Ratna (2.05), Neelphonso (2.18), Amrapalli (2.28), Vashibadami (2.28), Mallika (2.50), Sonpari (2.77) and Banarasi-Langra (3.11) which was at par with whereas, highest damage (8.33) was observed in Alphonso followed by Rajapuri, Kesar and Dashehari showing 6.98, 5.76 and 4.27 webs per tree, respectively (Table- 4). The mango genotypes with respect to webbing were categorized as: Alphonso >= Rajapuri >= Kesar > Dashehari > Banarasi-Langra > Sonpari > Mallika > Vashibadami > Amrapalli > Neelphonso > Ratna > Totapuri > Neelam (Table 4). Low incidence of leaf webber in Neelam, while Bangalora showed severe infestation and Neeleshan, Cherakurasam, Mulgova, Rumani, Baneshan and Swarnajahangir had moderate infestation [14].

5. Fruit fly

A significant difference was observed in infestation of fruits among various entries of mango considered in this investigation. The overall infestation ranged from 5.74 (Totapuri) to 28.07 (Alphonso) per cent. The lowest fruit infestation in Totapuri (5.74%) was not statistically different from Sonpari (7.43), Ratna (7.68), Neelphonso (7.74), Amrapalli (7.90), Neelam (8.38), Mallika (8.67) and Rajapuri (9.73), while highest damage in Alphonso (28.07%) was followed by Kesar (24.99) which was at par with it. So, it is evident from the results that Totapuri and Alphonso were least and most susceptible entries with respect to fruit fly infestation, respectively. Overall, mango genotypes were ranked in the decreasing order of susceptibility as: Alphonso >= Kesar > Vashibadami > Dashehari > Banarasi- Langra > Rajapuri > Mallika > Neelam > Amrapalli > Neelphonso > Ratna > Sonpari > Totapuri (Table-5).

Looking to the level of infestation during different maturity periods, a significant difference in susceptibility was observed between two early maturing varieties wherein significantly lower infestation was recorded in Dashehari (13.20 per cent) as compared to Alphonso (28.07 per cent). In mid late varieties, Rajapuri (9.73 per cent), Banarasi-Langra (11.19) and Vashibadami (15.27) recorded significantly lower infestation than Kesar (24.99). It was further observed that early variety Dashehari (13.20 per cent) as well as mid late varieties *viz*; Rajapuri (9.73 per cent), Banarasi Langra (11.19 per cent), Dashehari (13.20 per cent), Vashibadami (15.27 per cent) and Kesar (24.99 per cent) recorded significantly lower infestation than Alphonso (28.07 per cent) which matures during the same period. Thus, among four commercial varieties of Gujarat, Alphonso indicated highest susceptibility to fruit fly. Alphonso was more susceptible in comparison to Dashehari, Kesar and Rajapuri cultivars were found [19].

It is also revealed that among mango hybrids, Sonpari (7.43 per cent), Ratna (7.68 per cent), Neelphanso (7.74 per cent), Amrapali (7.90 per cent), Neelum (8.38 per cent) and Mallika (8.68 per cent) were found less susceptible to fruit fly exhibiting low (< 10 per cent) infestation. In a similar study on screening of commercial varieties of mango against *D. dorsalis*, Dashehari, Langra, Rumani and Bombay green were found least susceptible [1]. Screening of commercial varieties of mango against *D. dorsalis*, identified Dashehari, Langra, Rumani and Bombay green least susceptible [1], while Amrapali was found less susceptible to *D. dorsalis* than Mallika in field condition [13]. Higher fruit fly infestation (26.66%) and its larval population (2.73 larvae/damaged fruit) in Alphonso than Kesar, Rajapuri and Dasheri were reported [28]. In the present findings, Alphonso was identified as most susceptible entry with highest fruit fly infestation (28.07%), while Totapuri was identified as least susceptible entry indicating lowest damage (5.74%).

Conclusion

Alphonso was considered most susceptible mango genotype followed by Kesar whereas, Totapuri was considered as least susceptible cultivar.

Table 1: Screening of mango varieties and hybrids against mango hopper

S. No	Name of the cultivar	Hopper/twig or panicle		
		2009-10	2010-11	Pooled
1	Kesar	2.35* (5.14)	2.14* (5.36)	2.38* (5.25)^{bcdefghij}
2	Dashehari	1.79 (2.74)	2.30 (4.84)	2.07 (3.79)^{ghijkl}
3	Rajapuri	2.72 (6.89)	2.71 (6.85)	2.71 (6.87)^{abcdef}
4	Alphonso	3.03 (8.75)	2.95 (8.26)	2.99 (8.50)^{abc}
5	Totapuri	1.18 (0.93)	1.43 (1.58)	1.31 (1.26)^{m}
6	Banarasi Langra	2.58 (6.17)	2.69 (6.77)	2.64 (6.47)^{abcdefg}
7	Vashibadami	2.46 (5.81)	2.64 (6.47)	2.56 (6.14)^{abcdefgh}

8	Neelam	2.88 (7.86)	2.69 (6.85)	2.80 (7.36)^{abcde}
9	Neelphonso	2.93 (8.22)	2.84 (7.86)	2.89 (8.04)^{abcd}
10	Amrapali	2.32 (5.17)	2.51 (5.83)	2.43 (5.50)^{bcdefghi}
11	Mallika	3.13 (9.42)	3.09 (9.14)	3.11 (9.28)^{a}
12	Sonpari	3.01 (8.82)	2.97 (8.31)	3.00 (8.56)^{ab}
13	Ratna	1.78 (2.84)	2.36 (5.35)	2.14 (4.09)^{ghijk}
	S.Em ±	0.32	0.25	0.20
	C.D. at 5%	1.000	0.781	0.627
	C.V. (%)	18.55	13.88	11.32

* √x + 0.5 values and those in the parenthesis indicate original values

Table 2: Screening of mango varieties and hybrids against mango thrips

S. No	Name of the cultivar	Thrips population/twig		
		2009-10	2010-11	Pooled
1	Kesar	3.82 (14.14)	4.10 (16.34)	3.96 (15.24)^{ab}
2	Dashehari	2.60 (6.27)	2.92 (8.03)	2.77 (7.15)^{ghijkl}
3	Rajapuri	3.13 (9.37)	3.50 (11.84)	3.33 (10.60)^{def}
4	Alphonso	4.11 (16.46)	4.24 (17.54)	4.18 (17.00)^{a}
5	Totapuri	2.22 (4.44)	2.63 (6.43)	2.43 (5.43)^{jklm}
6	Banarasi Langra	3.11 (9.24)	3.34 (10.81)	3.24 (10.02)^{defg}
7	Vashibadami	2.99 (8.63)	3.28 (10.33)	3.16 (9.48)^{defgh}
8	Neelam	3.57 (12.23)	3.85 (14.37)	3.71 (13.30)^{abc}
9	Neelphanso	3.40 (11.13)	3.72 (13.36)	3.57 (12.24)^{d}
10	Amrapali	2.92 (8.29)	3.12 (9.47)	3.02 (8.88)^{ghi}
11	Mallika	2.76 (7.25)	3.13 (9.43)	2.95 (8.34)^{ghij}
12	Sonpari	3.33 (10.75)	3.59 (12.46)	3.48 (11.60)^{de}
13	Ratna	2.62 (6.38)	2.99 (8.44)	2.81 (7.41)^{ghijk}
	S.Em ±	0.26	0.24	0.17
	C.D. at 5%	0.798	0.738	0.527
	C.V. (%)	11.74	9.91	7.37

* √x + 0.5 values and those in the parenthesis indicate original values

Table 3: Screening of mango varieties and hybrids against mango Leaf gall midge

S. No	Name of the cultivar	Leaf damage (%)		
		2009-10	2010-11	Pooled
1	Kesar	35.99 (34.67)	36.97 (36.24)	36.49 (35.45)^{cdef}
2	Dashehari	32.04 (28.24)	33.29 (30.36)	32.67 (29.30)^{defghi}
3	Rajapuri	30.81 (26.33)	31.93 (28.33)	31.39 (27.33)^{defghij}
4	Alphonso	39.16 (39.93)	40.84 (42.91)	40.05 (41.42)^{abcd}
5	Totapuri	19.89 (11.65)	21.17 (13.15)	20.54 (12.40)^{klm}
6	Banarasi Langra	24.45 (17.63)	24.95 (17.93)	24.72 (17.78)^{jkl}
7	Vashibadami	34.26 (31.83)	34.39 (32.03)	34.40 (31.93)^{cdefgh}
8	Neelam	36.69 (35.84)	40.64 (42.46)	38.73 (39.15)^{cde}
9	Neelphonso	34.50 (32.32)	36.43 (35.35)	35.56 (33.83)^{cdefg}
10	Amrapali	39.98 (41.36)	41.97 (44.67)	40.97 (43.01)^{abc}
11	Mallika	46.22 (52.13)	48.13 (55.44)	47.18 (53.78)^{a}
12	Sonpari	44.15 (48.52)	45.88 (51.54)	45.01 (50.03)^{ab}
13	Ratna	26.65 (20.24)	28.55 (22.94)	27.61 (21.59)^{hijk}
	S.Em ±	3.42	3.33	2.53
	C.D. at 5%	10.532	10.254	7.792
	C.V. (%)	14.13	13.15	10.21

* √x + 0.5 values and those in the parenthesis indicate original values

Table 4: Screening of mango varieties and hybrids against mango Leaf webber

S. No	Name of the cultivar	No. of webs/tree		
		2009-10	2010-11	Pooled
1	Kesar	2.41* (5.31)	2.59* (6.21)	2.50* (5.76)^{abc}
2	Dashehari	2.19 (4.31)	2.17 (4.23)	2.18 (4.27)^{cd}
3	Rajapuri	2.60 (6.34)	2.85 (7.62)	2.73 (6.98)^{ab}
4	Alphonso	2.80 (7.35)	3.12 (9.32)	2.97 (8.33)^{a}
5	Totapuri	1.42 (1.53)	1.58 (2.00)	1.50 (1.77)^{efghijkl}
6	Banarasi Langra	1.83 (3.00)	1.93 (3.23)	1.88 (3.11)^{de}
7	Vashibadami	1.62 (2.23)	1.68 (2.34)	1.67 (2.28)^{defgh}
8	Neelam	1.35 (1.50)	1.41 (1.50)	1.39 (1.50)^{efghijklm}
9	Neelphonso	1.61 (2.13)	1.64 (2.23)	1.63 (2.18)^{efghij}
10	Amrapali	1.64 (2.22)	1.68 (2.34)	1.66 (2.28)^{defghi}
11	Mallika	1.69 (2.51)	1.68 (2.50)	1.69 (2.50)^{defg}

12	Sonpari	1.74 (2.53)	1.87 (3.00)	1.80 (2.77)^{def}
13	Ratna	1.58 (2.00)	1.58 (2.11)	1.58 (2.05)^{efghijk}
	S.Em ±	0.22	0.19	0.18
	C.D. at 5%	0.674	0.598	0.547
	C.V. (%)	16.43	13.83	12.95

* √x + 0.5 values and those in the parenthesis indicate original values

Table 5: Screening of mango varieties and hybrids against mango fruit fly

S. No	Name of the cultivar	Fruit infestation (%)		
		2009-10	2010-11	Pooled
1	Kesar	29.53 (24.31)	30.43 (25.67)	29.98 (24.99)^{ab}
2	Dashehari	22.15 (14.25)	20.36 (12.15)	21.27 (13.20)^{cd}
3	Rajapuri	18.41 (10.12)	17.65 (9.35)	18.03 (9.73)^{def}
4	Alphonso	31.11 (26.71)	32.85 (29.44)	31.99 (28.07)^{a}
5	Totapuri	14.18 (6.16)	13.10 (5.33)	13.65 (5.74)^{fghijklm}
6	Banarasi Langra	20.33 (12.24)	18.37 (10.14)	19.37 (11.19)^{cde}
7	Vashibadami	23.74 (16.21)	22.24 (14.33)	23.00 (15.27)^{c}
8	Neelam	17.16 (8.72)	16.35 (8.05)	16.78 (8.38)^{defgh}
9	Neelphanso	16.55 (8.13)	15.51 (7.36)	16.08 (7.74)^{efghij}
10	Amrapali	16.46 (8.15)	16.04 (7.64)	16.27 (7.90)^{efghi}
11	Mallika	17.67 (9.22)	16.55 (8.13)	17.12 (8.67)^{defg}
12	Sonpari	15.88 (7.55)	15.61 (7.31)	15.74 (7.43)^{efghijkl}
13	Ratna	16.27 (8.03)	15.71 (7.34)	16.02 (7.68)^{efghijk}
	S.Em ±	1.55	1.63	1.49
	C.D. at 5%	4.767	5.034	4.581
	C.V. (%)	10.96	11.98	10.71

* √x + 0.5 values and those in the parenthesis indicate original values

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