



Impact of Shoot Pruning and Paclobutrazol on Incidence of Sooty Mould of Mango Cultivars

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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Abstract

Three mango cultivars viz., Himsagar, Bombai and Langra were selected against sooty mould under natural field condition without any control measures. The Sub-Himalayan Terai region of West Bengal is experienced with a high annual rainfall (2500-3500mm) along with high humidity particularly during rainy season which may causes more chance of pest and disease infestation. There is very meagre information on scientific literature regarding the incidence of diseases and pests as well as their prevalence after shoot pruning on this sub Himalayan Terai region of West Bengal. Disease severity of mango was measured at monthly interval after shoot pruning (30cm from the shoot tip) and paclobutrazol application of plants and the cultivars were grouped under different degrees of resistance on the basis of per cent disease index (PDI) using 0-4 scale. The observations on per cent disease index (August to July) were recorded. Pooled data of 2019-20 and 2020-2021 the maximum sooty mould severity was recorded in cv. Bombai (48.11% and 38.48%) in September, followed by Langra (40.97% and 34.21%) in July month. In Himsagar (35.57% and

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28.45%) disease recorded in (untreated and paclobutrazol treated plants) the month of September respectively. Where as minimum in cv. Himsagar (14.80% and 11.79%) in March followed by Langra in April month in control (15.65%) and in march month of PBZ treated plants (13.86 %). Among the all cultivars maximum average per cent disease index (Avg. PDI %) recorded in Bombai (34.93% and 25.94%) followed by Langra (27.16% and 22.84%). Whereas, minimum recorded in cv. Himsagar (26.38% and 20.05%) in control and PBZ treated plants in both the years 2019-20, 2020-21 respectively. PBZ treated plants of Himsagar showed moderate resistant reaction and control plants showed moderate susceptible reaction as well as PBZ treated plants of cultivars Langra and Bombai showed moderately susceptible reaction but control plants of same cultivars showed susceptible reaction.

Keywords: Mango; paclobutrazol; per cent disease index; shoot pruning; sooty mould.

1. Introduction

“Mango (*Mangifera indica* L.) is considered as one of the widely cultivated fruit crops of India and belongs to the family *Anacardiaceae*. It is indigenous to North East India and North Burma, in the foot hill of the Himalayas and is said to have originated in the Indo- Burma region”. “Mango has been cultivated for thousands of years in India” (Mukherjee, 1953; Kostermans and Bompard, 1993) and its cultivation is as old as Indian civilisation. Mango is one of the most relished fruits in India and remains unique, delicious crop; it is the part of Indian culture and religion since ancient time and thus, becomes 'National fruit'. Because of its sweet peerless test and richness in phytochemical and nutrient content, it is called as the *King of Fruit*.

“Anthracnose, powdery mildew, root rot, bacterial leaf spots, and leaf blight are some of the main diseases affecting mango.” Rangasawami (1972), and Stover (1975) have all reported “the presence of sooty mould on mango. They discovered a connection between mealy bugs and sooty mould. Mango leaves develop sooty mould during flowering and fruit development. Mango trees develop a sooty mass on their leaves as a result of the sooty moulds' rapid growth”. “Paclobutrazol acts by reducing the gibberellins biosynthesis, thus contributing to inhibit branch growth, promoting bud maturation and consequently favouring to flowering and also having fungicidal properties” (Chaney W R 2005). “Special practice of tip pruning in productive branches prevents continuous vegetative growth, which is a consequence of inappropriate climate conditions and has allowed for the high rate of flowering in axillary buds. Mango plants are infested with a range of pests diseases and the infestation is higher with high rainfall along with high humid areas”. “The Sub-Himalayan Terai region of West Bengal is

experienced with a high annual rainfall (2500-3500mm) along with high humidity particularly during rainy season which may causes more chance of pest and disease infestation. The several earlier workers conducted to study the effect of pruning for mitigating the problems of diseases and pests infestation on senile and old mango orchards” (Hasan *et al.*, 2009 and Das and Jana 2013). There is very meagre information on scientific literature regarding the incidence of diseases and pests as well as their prevalence after rejuvenation and shoot pruning on this sub Himalayan Terai region of West Bengal.

2. Materials and Methods

Present investigation was carried out at the Instructional Farm, Department of Pomology and Post-harvest Technology, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal during 2019-20 and 2020-21. Paclobutrazol (in the form of cultar 250 SC, Syngenta, 23 percent of active ingredient) was applied by soil drenching at 1 ml a.i paclobutrazol/meter canopy diameter of mango plant (Nartvaranant *et al.*, 2000). Before application of paclobutrazol, the exact quantity is estimated by measuring the canopy diameter. A required quantity of paclobutrazol was dissolved in plastic bucket containing 3 to 5 L of water. Twenty-five to thirty small holes were dug (10 to 15 cm deep) with the help of crowbar around the tree basin just inside the manuring ring, at uniform distance. Then the uniform quantity of prepared solution is drenched into holes. Shoot pruning was done after harvesting of previous seasons fruit 2019 and 2020 respectively by pruning measuring a length of 30cm from the tip and pruned with the help of secateurs. The recommended dose of fertilizers, manures and timely irrigation were provided.

Table 1. Disease scoring scale for sooty mould (0-4 scale) on leaves

Sl.	Disease Rating	Percentage of leaf area covered
1.	0	No infection on leaves
2.	1	1-10
3.	2	11-25
4.	3	26-50
5.	4	Above 50

(Prabhakar et al., 2012)

Disease severity was calculated by using the following formula.

$$\text{Percent Disease Index (PDI)} = \frac{\text{Sum of all the disease rating}}{\text{No. of shoots observe} \times \text{Maximum disease grade}} \times 100$$

Ten shoots were considered for screening on each variety and observations were recorded at monthly interval.

3. Results and Discussion

The observations on per cent disease index (August to July) were recorded and results are presented. In two years mean data (2019-20 and 2020-2021) the maximum sooty mould severity was recorded in cv. Bombai (48.11% and 38.48%) in September (Table 2), followed by Langra (40.97% and 34.21%) in July month. In Himsagar (35.57% and 28.45%) disease recorded in (untreated and paclobutrazol treated plants) the month of September. "On certain crops, significant correlations have been found between sooty mould and meteorological factors, including temperature, rainfall, and relative humidity" (Mondal and Timmer, 2002). Islam et al. (2015) found that "sooty mold had a positive association with temperature, a negative correlation with relative humidity, and a positive correlation with rainfall". "Similarly, the role of weather parameters on the disease development across different fruit crops" was reported by Chomnunti et al. (2014) reported that "sooty mould is more severe in warm climatic conditions like tropical and subtropical environment and may apparently grow faster under extreme climatic conditions. Where as minimum in cv. Himsagar (14.80% and 11.79%) in March followed by Langra in April month in control (15.65%) and in march month of PBZ treated plants (13.86%). Mango leaf mealy bug infestation were consistently linked to the occurrence of sooty mould". Stover (1975) described "the causal relationship between mealy bugs and sooty mold on bananas. For several years, mealy bugs and sooty mold were closely and thoroughly examined on mango

plants. The mealy bugs were found to emit a sticky, sugary substance when they settled on the lower surfaces of mango leaves. This substance flowed down and was deposited on the upper surfaces of the leaves directly beneath".

Among the all cultivars maximum average per cent disease index (Avg. PDI %) recorded in Bombai (34.93% and 25.94%) (Fig. 1) followed by Langra (27.16% and 22.84%). Whereas, minimum recorded in cv. Himsagar (26.38% and 20.05%) in control and PBZ treated plants in both the years 2019-20, 2020-21 respectively. Maria and Jalaluddin (2006) explained about "sooty mould, on leaves that remained trapped in the sugary substrate, air borne fungal spores were seen to be developing. Mango leaves' upper surfaces developed a dark, sooty mass as a result of the sooty molds' rapid growth. Over time, the number of mealy bugs increased, severely infesting mango leaves and causing sooty molds to develop widely and sooty masses to form on mango foliage. In severe instances, the sooty mass and sticky white slimy stuff trickled on the ground beneath the mango tree canopy as a result of the severe infection. The sooty mould and the resultant black cover reduce photosynthesis".

"It is cleared sooty mould severity in PBZ treated plants of Himsagar showed moderate resistant reaction and control plants showed moderate susceptible reaction as well as PBZ treated plants of cultivars Langra and Bombai showed moderately susceptible reaction but control plants of same cultivars showed susceptible reaction. From present study observed that the maximum sooty

Table 2. Impact of shoot pruning and paclobutrazol on incidence of sooty mould of mango cultivars (on leaves)

Months	Himsagar						Bombai						Langra					
	PDI			PDI			PDI			PDI			PDI			PDI		
	Control			PBZ+ Pruning			Control			PBZ+ Pruning			Control			PBZ+ Pruning		
	2019-20	2020-21	Mean	2019-20	2020-21	Mean	2019-20	2020-21	Mean	2019-20	2020-21	Mean	2019-20	2020-21	Mean	2019-20	2020-21	Mean
September	32.89	38.57	35.73	25.17	31.73	28.45	42.96	53.26	48.11	28.67	48.28	38.48	20.47	22.64	21.56	28.11	31.08	29.60
October	31.33	35.26	33.30	21.50	18.45	19.98	38.56	45.16	41.86	20.33	36.48	28.41	26.56	20.56	23.56	18.74	16.47	17.61
November	23.44	28.57	26.01	15.67	16.36	16.02	30.50	51.38	40.94	25.15	43.02	34.09	20.15	18.94	19.55	18.25	16.38	17.32
December	29.54	22.16	25.85	25.00	28.15	26.58	42.39	25.86	34.13	21.89	23.65	22.77	31.26	36.26	33.76	27.86	30.87	29.37
January	23.33	26.13	24.73	20.00	16.87	18.44	34.33	38.69	36.51	25.00	31.28	28.14	24.12	28.39	26.26	14.28	18.56	16.42
February	29.68	31.45	30.57	24.67	28.14	26.41	24.50	22.28	23.39	18.25	19.03	18.64	32.28	35.87	34.08	16.26	20.13	18.20
March	14.22	15.37	14.80	10.83	12.74	11.79	28.83	20.38	24.61	20.00	27.13	23.57	30.29	32.63	31.46	12.36	15.36	13.86
April	16.67	18.18	17.43	10.89	17.68	14.29	27.00	25.63	26.32	16.13	14.38	15.26	15.02	16.28	15.65	26.58	28.45	27.52
May	24.22	26.13	25.18	11.11	18.15	14.63	30.12	38.26	34.19	21.05	23.68	22.37	18.52	22.36	20.44	17.27	20.45	18.86
June	17.27	31.45	24.36	17.50	23.65	20.58	35.05	45.39	40.22	20.00	36.11	28.06	30.28	32.63	31.46	26.45	30.06	28.26
July	28.33	36.19	32.26	21.17	25.68	23.43	28.89	39.14	34.02	21.20	29.87	25.54	36.15	45.78	40.97	28.26	40.16	34.21
Avg. PDI	24.63	28.13	26.38	18.50	21.60	20.05	33.01	36.86	34.93	21.61	30.26	25.94	25.92	28.39	27.16	21.31	24.36	22.84

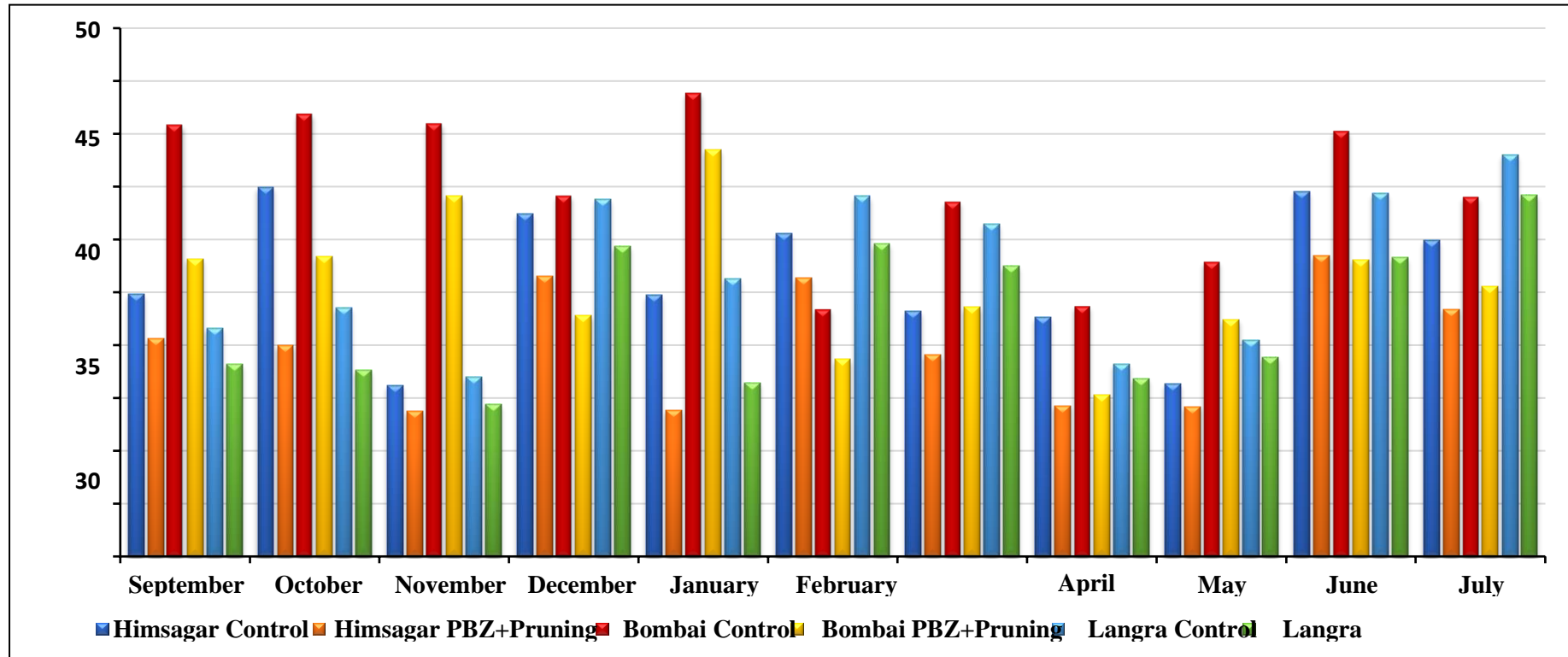


Fig. 1. Impact of shoot pruning and paclobutrazol on incidence of sooty mould of mango cultivars (on leaves)

mould severity coincides with maximum relative humidity. The maximum relative humidity may create congenial microclimate condition to sooty mould development on mango leaves” similar results are proposed by Singh and Singh (1972) and they reported that the high humidity more congenial for growth of the sooty mould fungus. “Sooty mould severity remained constant or decreased during the rainy season, followed by a further increase during the post-rainy season. A gradual decline in sooty mould severity during the dry season may be attributed to reduced humidity and decreasing temperatures. At this stage, the older growth of sooty mould likely exhausts the available honeydew sugars on the plant surface, leading to starvation of the mycelium and its eventual death under dry conditions. Crop phenological factors may also influence sooty mould development, as vegetative flushes are observed annually on mango trees, providing favorable conditions for renewed fungal growth. Sooty mould not only influences insect populations but also alters the total leaf area covered by sooty mould on the tree” (Shukla *et al.*, 2017). The frequency of sooty moulds is greater during the post-rainy season. During heavy rains, honeydew deposits may be washed off the leaf surface, whereas under dry conditions, honeydew persists for longer periods, thereby favoring the development and persistence of sooty mould.

4. Conclusion

The observations indicated that the development of sooty mould in mango orchards is directly influenced by honeydew production by sucking pests, rainfall, temperature, and crop phenological changes. The role of any single factor, apart from weather parameters (temperature, relative humidity, rainfall, sunshine, wind, and evaporation rate), insect populations (hopper, mealy bug, and scale insect), and crop phenology, could not be ruled out in this study. Rapid development of sooty mould was recorded during the months of February to June and September to October, identifying these periods as critical for effective sooty mould management. The results also indicated that paclobutrazol-treated mango plants exhibited moderate resistance to sooty mould compared to untreated plants.

Disclaimer (Artificial intelligence)

All Author(s) are hereby declared that NO generative AI technologies such as Large

Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have not used during the writing or editing of this manuscript.

Competing Interests

Authors have declared that no competing interests exist.

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