Effect of Fenarimol Fungicide and Some Morpho-Anatomical Characteristics of Red Delicious Cultivar of Apple (*Malus pumila* Mill.)

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Apple (*Malus pumila* Mill.), the premier table fruit of the world, has been under cultivation since time immoral. It is a typical temperate tree fruit, more than 80% of the world's supply being produced in Europe (Tukey, 1982 c.f. Mitra, 1991). Apple cultivation is concentrated in areas where the environment is particularly favorable (Jackson, 1983). High yields of good quality fruits can only be obtained when the growing inputs result in clean, well structured orchards, where fruiting and growth are correctly balanced (White, 1984 c.f. Mitra, 1991). Cultivar Red Delicious is attacked by a large number of pests which cause huge economic losses to the fruit. Apple growers generally resort to pesticide sprays which have several consequences such as human health and environmental hazards, resistance by pests to pesticides and also elimination of vital biological control agents. Intensive apple cultivation including high-density orcharding is bound to make environmental problems more formidable and fruit culture less sustainable in case control of disease is effected exclusively by chemical means.

The present study were carried out at research farm of Pomology in Shalimar University (SKUAST) situated at 34.01^0 North latitude and 74.89^o East longitude, at an elevation of 1685m above the mean sea level. The maximum and minimum temperature ranges from 5.6^oC to 29.3^oC and 2.5^oC to 16.5^0C. The soil at the experimental site was silty clay loam, with pH 6.8 and electro conductivity 0.27 d sm^{-1}. The foliar treatment of Fenarimol fungicide were applied with foot sprayer on 12 years old Red Delicious apple trees, planted at a distance of 1.8 x 3 meters showing uniformity in size and vigour. The sampling was carried out after 20 days of treatment. The various concentrations of treatment are T_1 = 0.02%, T_2 = 0.04%, T_3 = 0.06%, T_4 = 0.08% the untreated plants were taken as control Tc.

The number of the fully opened leaves was counted and single leaf area per plant and total leaf area were measured graphically. Epidermal parts of mature leaves were boiled in hot HNO_3 as per the method of Ghouse and Younus (1972). The peels were dehydrated in ethanol series and stained with saffranine and mounted in DPX. Dimensions of the stomata were measured with the help of micrometry. The pieces of stem were fixed in formalin – acetic acid – alcohol (FAA) and preserved in 70% ethanol. These were later cut with blade in transverse plane. The sections were stained with saffranine and dehydrated in ethanol series and mounted in DPX.

The data on morphological and anatomical parameters (Table 1) reveal significant decrease in single leaf area, number of stomata, trichome density; length and width of

Table 1: Comparative data on morpho-anatomical parameters of Red Delicious cultivar of Apple (*Malus pumila* Mill) treated with different concentrations of fungicide. Parentheses include percent variation.

Parameter	Stage	Control T_c	T_1 (0.02%)	T_2 (0.04%)	T_3 (0.06%)	T_4 (0.08%)
Stomatal leaf Area (cm^2)	Pre-Flowering	11.51± 1.11	10.50 ± 0.51 (8.77)^{NS}	9.52 ± 0.53 (17.28)NS	9.25 ± 1.29 (19.63)*	8.52 ± 0.54 (28.32)*
Stomatal Density/ microscopic field	Pre-Flowering	97.91± 3.85	91.01 ± 3.55 (7.04)*	87.89 ± 7.02 (10.23)*	80.30 ± 3.24 (17.98)*	76.21 ± 4.45 (22.16)*
Length of Stomata (mm)	Pre-Flowering	20.19 ± 1.55	16.53 ± 1.64 (18.12)NS	15.28 ± 1.60 (24.31)NS	14.42 ± 2.59 (28.57)**	13.24 ± 1.55 (34.42)NS
Width of Stomata (mm)	Pre-Flowering	13.92 ± 1.68	11.01 ± 0.66 (20.0)NS	10.31 ± 0.45 (25.93)NS	9.96 ± 0.11 (28.44)NS	8.78 ± 0.34 (36.92)NS
Trichome density / microscopic field	Pre-Flowering	145.72 ± 12.50	143.16 ± 5.91 (1.75)*	149.11 ± 4.92 (2.74)*	155.55 ± 12.08 (6.74)*	159.92 ± 12.66 (9.74)*
Vessel density/ microscopic field	Pre-Flowering	349. ± 9.92	345. ± 12.65 (1.14)*	337. ± 5.80 (3.43)*	333. ± 31.52 (4.58)*	330 ± 2.91 (5.44)**
Length of Vessel element (mm)	Pre-Flowering	32.68 ± 1.78	30.17 ± 1.66 (7.68)NS	25.30 ± 1.36 (22.58)NS	24.55 ± 2.44 (24.87)**	20.33 ± 1.82 (37.79)**
Width of vessel element (mm)	Pre-Flowering	26.55 ± 1.44	20.20 ± 1.55 (24.67)NS	18.64 ± 1.33 (29.79)**	17.42 ± 2.45 (34.38)*	15.97 ± 1.80 (39.84)*

* Significant at 1% level ** Significant at 5% level NS Non significant

stomata were significantly reduced at the higher concentration of the pesticide. The comparative data on stem anatomy revealed a significant decrease in density, length and width of vessel. The stomatal dimensions (length and width) were significantly reduced under pesticide pollution and such results corroborate well with several similar earlier observations (Kozlowski, 1980; Gupta and Ghouse, 1987). Decrease in size of stomatal aperture resulting from an inhibitory action of pesticide may represent an avoidance mechanism (Iqbal *et al.*, 1996; Khudsar *et al.*, 2000; Shabeena *et al.*, 2006). The reduction in leaf size under pesticide stress was indicative not only of retarded growth but also of reduction in surface area thereby accommodating lesser number of stomata, similar results were found by Sharma *et al.* (1980). In comparison with control plants, density of trichome increased significantly at the higher concentration; such observation was in conformity with those of Ali (1998) and Palaniswamy *et al.* (1995). Vessel element length decreased significantly and consistently at the higher concentration of pesticides T_4 = 0.08%, which is due to development of short vessels under pesticide stress. Similar results have been reported in *Polyganum glabrum* (Khan *et al.*, 1989) and *Magnifera indica* (Ghouse *et al.,* 1984). Width of vessel elements also decreased significantly similar results were found in chenopodium album (Ghouse *et al.*, 1985). On the basis of the data collected on morpho-anatomical parameters, it may be concluded that growth and development of cultivar Red Delicious at low level of Fenarimol was not much affected. But it has been observed that at the higher concentration of Fenarimol it becomes sensitive to pesticide exposure.

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