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FRUIT BLEMISHES CAUSED BY ABIOTIC FACTORS IN KINNOW MANDARIN (*Citrus reticulata* Blanco)

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Abstract

Kinnow mandarin (*Citrus reticulata* Blanco) is the major tree fruit export commodity of Pakistan. Unfortunately this commodity can be exported only to a few markets owing to its poor cosmetic look resulting from fruit blemishes caused by various abiotic and biotic factors. Due to these blemishes, the price of Pakistani Kinnow is too low compared with other mandarin exporters of the world in these markets. In the present research, we explored the extent of fruit blemishes caused by abiotic factors at different farm levels (small, medium and large) and different tree canopy locations of Kinnow mandarin. The study was conducted in fifteen Kinnow orchards in the major Kinnow production areas (Bhalwal and Kot Momin) of Pakistan. Sixteen trees were selected in each orchard and fruits were harvested from three canopy locations of individual trees to determine the blemishes caused by different abiotic factors. The identified blemishes were mostly caused by wind, nutritional imbalance, sun burn, peel splitting and physical injuries. The damage was maximum in the small farms (58.69%) and top location of the canopy (54.50%) followed by medium farms (51.73%) and bottom location of the canopy (52.15%) and the damage was minimum in the large farms (47.69%) and central location of the canopy (51.46%). The detailed account of fruit blemishes caused by abiotic factors in Kinnow mandarin is described in this paper.

INTRODUCTION

Citrus is the key fresh tree fruit product of Pakistan which remains at top in terms of area, production and export. In the year 2005, Pakistan produced 1.7 million tonnes of citrus from 185 thousand hectares of land while it exported 189.29 thousand tonnes of value US\$ 38965 (Anonymous, 2006). Fruit blemishes are becoming very important issue in consumer's prospect in making decision of acceptance or rejection of a fresh produce both in domestic and the international markets. Morphologically the blemish is collapsed hypodermis tissue related to shrunk or destroyed oil glands (Safran, 1975), resulting in lowering fruit quality and ultimately low export prices. Due to the same reason, Pakistan is earning far low citrus export price (US\$ 205.8 per tonne) compared with US\$ 600 per tonne, earned by many other fresh citrus exporting countries of the world (Spain, Mexico, etc.). This situation causes high losses in citrus trade and is increasing by the passage of time.

Many factors (biotic as well as abiotic) are involved in causing these blemishes in Kinnow and among the abiotic factors; Freeman (1976) reported that wind scarring is a major

blemish of citrus fruit. These blemishes occur almost exclusively within 12 weeks of petal fall and the rate of increase of blemish severity differed according to the degree of exposure to wind. Agusti (1999) observed the influence of environment on the development of fruit blemishes in well established citrus grooves and inferred that the sun burn is one of the major causes of fruit blemishes in citrus; however, its effect has been related to fruit position on the tree (Arpaia et al., 1991). Chapman (1958) and Grierson (1965) worked on effect of different levels of nutrition on the fruit blemishes in citrus and Ben-Yahoshua (1969) showed that the flavedo was the major tissue that lost water in case of some physiological injury to the fruit.

Following the studied of these researchers, the present study was conducted to determine the extent and nature of fruit blemishes in Kinnow mandarin caused by different abiotic factors in the agro-environmental conditions of Pakistan.

MATERIALS AND METHOD

The experiments were conducted in the main citrus production areas of the country i.e. Bhalwal and Kotmomin. Fifteen citrus orchards were selected for the study; five each of small, medium and large sized orchards randomly in different areas of the vicinity. The fruit was harvested randomly from sixteen trees selected at random from each orchard and twenty fruits were harvested from three locations of the tree canopy i.e. top, centre and bottom. The nature of blemishes was identified by relating them to the different casual agents, based up on past experience and expert advice. A performa was developed to record the data and the data was analyzed using the Completely Randomized Design (CRD) with factorial arrangement. The data of each parameter was subjected to statistical analysis and Least Significant Difference (LSD) test was applied to determine the level of significance. In this way the study was conducted to reveal the contribution of abiotic factors in causing fruit blemishes in Kinnow mandarin in different levels of farming and at different locations of the tree canopy.

RESULTS AND DISCUSSION

The data regarding the fruit blemishes caused by abiotic factors was collected and analyzed according to the Completely Randomized Design (CRD) under two factors factorial. The analysis of variance indicated highly significant results for orchard size, significant results for canopy location and non significant results for the interaction of the orchard size and the canopy location (Table 1).

The results obtained in case of fruit blemishes caused by abiotic factors were found highly significant in orchard size and the mean values of fruit blemishes (Table 2) showed that the small sized orchards were affected the most by the abiotic factors, and had significantly higher fruit blemishes (58.69%) compared with medium (51.73%) and small sized orchards (47.69%). The graphical representation of results is given in the Figure 1.

The obvious reason for significance of abiotic factors in small orchards was the exposure of more number of plants to the light and the other environmental factors which enhance the development of the peel splitting and the fruit blemishes (Agusti et al., 2001). In the medium and the large sized farms, the number of exposed trees to the factors causing fruit blemishes were lesser, thus the peel blemishes were not significant. The results of the experiment coincide with those of Schneider (1968) and Spiegel (1996).

The results obtained in case of fruit blemishes caused by abiotic factors were found significant in canopy location and the mean values of fruit blemishes (Table 3) showed that the top portion of the canopy was affected most by the abiotic factors, and had significantly higher fruit blemishes (54.50%) compared with bottom (52.15%) and the centre (51.46%) portions of the canopy. The graphically representation of results is given in the Figure 2.

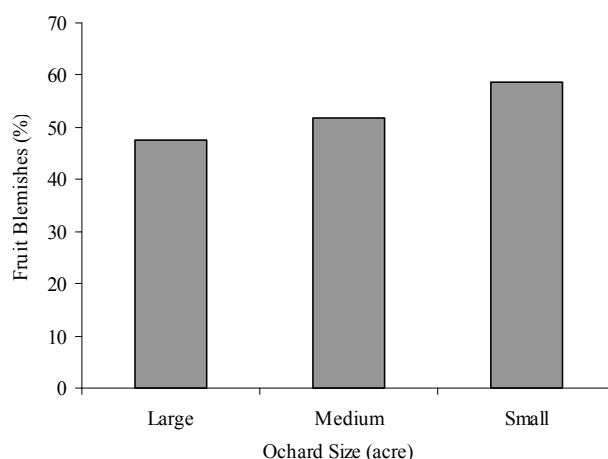


Figure 1: Mean values of orchard size for on tree data of fruit blemish (%) in Kinnow mandarin caused by abiotic factors

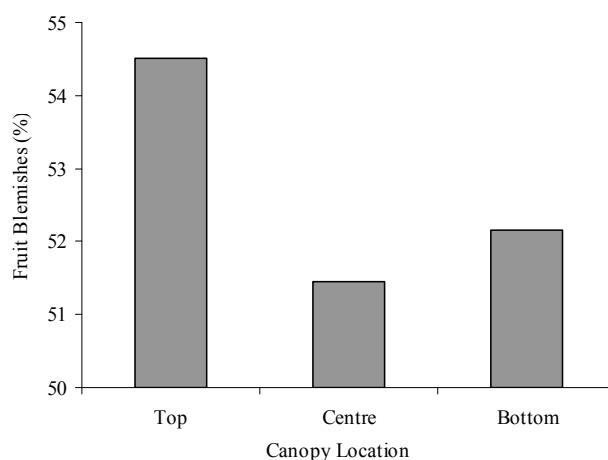


Figure 2: Mean values of canopy location for on tree data of fruit blemish (%) in Kinnow mandarin caused by abiotic factors

The reason for significant impact of abiotic factors on canopy location is the exposure of top canopy to the wind, relative humidity and other climatic factors (Zaragoza & Alonso, 1975), which ultimately caused the scarring and blemishes on peel of the fruit of top portion of the canopy (Freeman, 1976). In the centre and the bottom canopy, the exposure to the climatic factors was lesser, thus the intensity of blemishes was not significant in the centre and bottom locations of the canopy.

CONCLUSION

The results of fruit blemishes caused by abiotic factors in different orchard sizes and canopy locations suggest that large sized plots of citrus grooves and the central portion of the tree canopy are least affected and the reason is that these two are least exposed to the abiotic factor causing fruit blemishes in Kinnow mandarin, which affects minimum the larger sized plots and the central portion of the canopy while the effect is maximum in smaller sized grooves and on the top most portion of the canopy. So, establishing larger sized plots of citrus grooves, maintaining wind

breaks around the citrus grooves, proper pruning of the tree to maintain the tree structure and circulation of air and light through the tree canopy, taking care of nutritional requirements of the plants and proper handling of fruits at harvest can significantly reduce the fruit blemishes caused by abiotic factors in Kinnow mandarin.

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Table 1: Analysis of variance for on tree data of fruit blemish (%) in Kinnow mandarin caused by abiotic factors

S. O. V	df	S.S	M.S	F. Value
Orchard Size (S)	2	743.01	371.51	44.92**
Canopy Location (L)	2	61.07	30.53	3.69*
S × L	4	36.19	9.05	1.09 ^{NS}
Error	27	223.33	8.27	
Total	35	1063.60		

** = Highly Significant ($P \leq 0.01$), * = Significant ($P \leq 0.05$), ^{NS} = Non Significant ($P > 0.05$)

Table 2: Mean values of orchard size for on tree data of fruit blemish (%) in Kinnow mandarin caused by abiotic factors

Original order		Ranked order	
T ₁	47.69 c	T ₃	58.69 a
T ₂	51.73 b	T ₂	51.73 b
T ₃	58.69 a	T ₁	47.69 c

Any two means not sharing a letter differ significantly at 5% level of probability

Table 3: Mean values of canopy location for on tree data of fruit blemish (%) in Kinnow mandarin caused by abiotic factors

Original order		Ranked order	
T ₁	54.50 a	T ₁	54.50 a
T ₂	51.46 b	T ₃	52.15 ab
T ₃	52.15 ab	T ₂	51.46 b

Any two means not sharing a letter differ significantly at 5% level of probability