Factors affecting sheepnose incidence in grapefruit

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Summary
Sheepnosed grapefruit are large and pear shaped with a pronounced neck at the stem end and often have thick and puffy rinds. The causes of sheepnose incidence are not fully understood. This article is a summary of a few known factors to be involved in sheepnose incidence in grapefruit. Sheepnosed fruit are more prevalent in inland, arid areas with high temperatures and low relative humidity, warm days and cool nights, i.e. where large variations in daily maximum and minimum temperatures occur. Sheepnose incidence is less in coastal growing areas or under humid subtropical or tropical conditions. Conditions that promote rapid fruit growth normally increase sheepnose incidence. Sheepnose incidence can be worse in lighter cropping years with larger fruit than in heavier cropping years with smaller fruit. Relatively high rates of nitrogen fertilizer application can lead to increased tree vigour and to more sheepnosed fruit. No clear differences in sheepnose incidence occur among fruit from different canopy positions. Cultivar and rootstock do not seem to influence the percentage sheepnose incidence. Irrigation should be carefully controlled to prevent any stress and to ensure optimal fruit set. Late harvest in an on-year should be avoided in sheepnose-prone orchards or in orchards with a history of alternate bearing.

Introduction
Sheepnosed grapefruit are large and pyriform (pear shaped) with a pronounced neck at the stem end and often have thick and puffy rinds (Figure 1). Sheepnose is a major cull factor in the packhouse because affected fruit fail to meet export standards. The amount of fruit affected in South Africa varies from year to year and with location. The causes of sheepnose incidence are not fully understood. There is also no effective method to predict the severity of sheepnose incidence early in the season. The height/width ratio (H/W ratio) is a good indicator of fruit shape, but is not a good indicator of the amount of sheepnosed fruit, because even sheepnosed fruit tend to be wider on the horizontal axis than the vertical axis (H/W ratio <1) (Syvertsen et al., 2005). This article is a summary of a few known factors associated with sheepnose incidence in grapefruit.

Factors affecting sheepnose incidence:
Year to year variations in sheepnose incidence have been reported, probably due to differences in climate and location, crop load or fruit size.

Climate and location
Location and climate have a strong influence on fruit shape, most likely because they have an impact on tree water status and fruit growth. Grapefruit grown in areas with relatively higher humidity and lower mean daily maximum temperatures between April and October (Northern Hemisphere (NH) (October to April in SH) have less sheepnosed fruit (Patial, 2001). Sheepnosed fruit are more prevalent in inland, arid areas with high temperatures and low relative humidity (Cohen et al., 1972; Reuter, 1973), warm days and cool nights, therefore where large variations in daily maximum and minimum temperatures occur (Wutschier, 1976). Sheepnose incidence is less in coastal growing areas (Soost et al., 1963) or under humid subtropical or tropical conditions (Gibson, 1975). Fruit from late blooms or off-blooms, which grow during relatively warm late spring, tend to be more sheepnosed (Sauls, 1996; Wutschier, 1976). The dry weather and higher than normal temperatures during bloom and early fruit development most likely predispose the fruit to sheepnose development (Sauls, 1996). Similarly, elevated early season temperatures from before full bloom (February) until June (NH) (August until December in SH) created by covering trees with clear plastic, led to higher fruit growth rates, lower yields, larger fruit, and an increased percentage of sheepnosed fruit (Syvertsen et al., 2004; 2005). On the contrary, covering trees with 50% shade cloth from February to June (NH) (August to December in SH) reduced temperatures and reduced the percentage of sheepnosed fruit (Syvertsen et al., 2004).
Tree vigour and fruit size
Conditions that promote rapid fruit growth normally increase sheepnose incidence. Large fruit and fruit from young, vigorous trees are more likely to be sheepnosed (Soost et al., 1965; Sauls, 1996) as well as fruit grown under conditions that promote tree vigour. The percentage sheepnosed fruit is greater among larger fruit than among smaller fruit and peel thickness is greater in sheepnosed fruit compared to normal fruit as shown in Figure 1 (Patil, 2001). Sheepnose incidence is normally associated with thick rinds, a lower juice content and puffiness of the fruit (Patil, 2001). The excessive fruit growth that leads to sheepnose incidence can begin as early as in the flowering stage (Syvertsen et al., 2004).

Crop load
Sheepnose incidence can be worse in lighter cropping years than in heavier cropping years (Gibson, 1975; Syvertsen et al., 2005). In general, the percentage sheepnosed fruit is positively correlated with fruit weight and negatively correlated with yield. A major reduction (5 to 11%) in crop load by manual thinning in July (NH) (January in SH) increased the sheepnose percentage of the remaining fruit (Syvertsen et al., 2005). Therefore, a poor fruit set may give similar results. Grapefruit trees normally have relatively high carbohydrate reserves at the time of flower bud initiation after a light crop when a heavy crop is expected and sheepnose incidence on fruit from this heavy crop is normally much lower. Therefore, carbohydrate reserves in the tree at the time of flower bud initiation may play a role in sheepnose incidence.

Nutrition
Fertilizer effects on sheepnose incidence seem to be due to a secondary effect on both tree vigour and fruit growth rate. Relatively high rates of nitrogen (N) fertilizer application can lead to increased tree vigour and to more sheepnosed fruit (Gilfillan and Stevenson, 1976; Syvertsen et al., 2004), especially in orchards with a history of alternate bearing, after a heavy crop load when a light crop load is expected.

Irrigation and soil factors
Withholding all irrigation (October to March (NH) (April to September in SH)) decreased fruit size and the percentage of sheepnosed fruit (Syvertsen et al., 2005). Regulated deficit irrigation after the fruit set is known to be low may be an option in sheepnose-prone orchards to reduce fruit size and possibly sheepnose incidence. On the other hand, irrigation should be optimal during the fruit set period to avoid a poor set of large fruit. Trees under microjet irrigation produced a higher percentage of sheepnosed fruit than trees flood irrigated (Patil, 2001) and sheepnose incidence was more severe on trees grown in sandy soils compared to silt loam (Gibson, 1975). Therefore sheepnose incidence is influenced by tree water status.

Canopy position
No differences in sheepnose incidence between north and south canopy positions were observed by Syvertsen et al. (2004). However, Syvertsen et al. (2005) reported that fruit picked from the south side of the tree were larger and more sheepnosed than from the north and fruit from the west had more sheepnose incidence than from the east of the tree. Canopy position may not only affect temperature and/or light levels, but may have a secondary effect on sheepnose incidence due to an effect on fruit size.

Cultivar and rootstock
Cultivar does not seem to influence the percentage sheepnose
incidence as no differences in sheepnose incidence were observed among the four grapefruit cultivars, Marsh, Ruby Red, Ray Ruby, and Flame (Syvertsen et al., 2004). No significant effects of rootstock on sheepnose incidence were observed (Syvertsen et al., 2004). However, Carizzo produced lower yields and a greater percentage of sheepnosed fruit than Swingle rootstock (Patil, 2001; Syvertsen et al., 2005), and Volkamer lemon produce higher yields with less sheepnosed fruit than Sour orange rootstock (Syvertsen et al., 2005). Rootstock may have a secondary effect on sheepnose incidence by affecting fruit set, yield or fruit size.

Conclusion

Normally, conditions that promote vigorous tree growth and fruit growth promote sheepnose incidence. Therefore, overly vigorous growth, excessive water and fertilization and/or lowered fruit set exacerbate sheepnose incidence. Any cultural practices that discourage fruit growth may decrease sheepnose incidence, particularly when the crop load is low. Although not much can be done to high temperatures and low humidity during bloom and early fruit development, or to late blooms, irrigation should be optimally to prevent any stress during this time and to ensure optimal fruit set. Sheepnose incidence can be related to relatively small crop loads and/or large fruit size regardless of cultivar and rootstock. Lower yields due to poor fruit set, thinning or increased average fruit size can increase sheepnose incidence. Reducing nitrogen application rates and irrigation as soon as fruit set is known to be low can be done to reduce sheepnose incidence. Extending the harvest season with Gibberellic acid (GA3) sprays or late harvest (later than the optimal picking period) should be avoided in sheepnose-prone orchards or orchards with a history of alternate bearing, especially when the trees bears an on-crop, as this may result in more sheepnosed fruit in the following season. Late harvest depletes carbohydrate reserves in the period between harvest and flowering and may exacerbate sheepnose incidence the following season.

Literature cited