

Evaluation of Winter Pruning to Synchronize the Flowering of Sensation Mango Trees

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ABSTRACT

Removal of the apical buds or developing panicles on terminal shoots just prior to or during the flowering period to effect synchronous flowering was evaluated. Pruning, whether performed on July 3, July 17 or July 31, was effective in synchronizing flowering, the greatest degree of flowering uniformity occurring following pruning on July 31. Pruning generally delayed the onset of flowering from mid-July to mid- to late August. There was marked reduction in the number of fruit retained by the pruned trees, which gave rise to reduced yields despite increases in the average weight of the fruit harvested. Differences in monetary return were largely offset as a result of the increased size, and therefore value, of the fruit harvested from the pruned as opposed to the unpruned trees. The negative effect of pruning on fruit retention, yield, and average fruit weight was least when pruning was performed on July 31. Pruning in late July might be recommended after taking the additional benefit of synchronized flowering into account.

UITTREKSEL

Verwydering van die apikale groeipunte of ontwikkelende vrugstiele op die terminale lote net voor of gedurende die blomstadium om gesinchroniseerde blom te veroorsaak is ondersoek. Snoeiing, ongeag of dit uitgevoer is op 3 Julie, 17 Julie en 31 Julie, was effektief in die sinchronisering van blom. Die hoogste graad van uniformiteit van blomtyd het voorgekom na snoeiing op 31 Julie. Snoeiing het in die algemeen die aanvang van blom vertraag vanaf mid-Julie tot mid- tot laat Augustus. Daar was 'n merkbare vermindering in die aantal vrugte wat behou is deur die gesnoeide bome, wat aanleiding gegee het tot 'n vermindering in opbrengs ten spyte van die verhoogde gemiddelde vrugmassa. Verskille in die inkomste gelewer deur gesnoeide en ongesnoeide bome is egter uigekanseleer deur die verhoogde waarde van die groter vrugte. Die effek van snoeiing op die aanhou van vrugte, opbrengs en gemiddelde vrugmassa was die minste met snoeiing wat op 31 Julie uitgevoer is. Snoeiing gedurende laat Julie kan moontlik aanbeveel word nadat die addisionele voordeel van gesinchroniseerde blom in ag geneem word.

INTRODUCTION

When the developing panicles and/or still quiescent apical buds on terminal shoots are removed just prior to or during the period of flowering by pruning, the trees respond by flowering four to six weeks afterwards from axillary buds at the distal end of the terminal shoots. The intensity of bloom is increased due to floral development of more than one bud per terminal shoot.

In Sensation, flowering between trees and even between individual branches within a tree, is often conspicuously uneven. Consequently, the time of fruit set, the stage of fruit growth and development at a point in time, and the stage of maturity at harvest all show pronounced variation. As a result, problems are encountered in orchard management as well as marketing of the fruit. Growers find difficulty in adhering to cultural and other management practices whose execution is based on a particular phenological stage. Problems relating to marketing include the choice of a suitable temperature or temperature regime for sea export, in view of the strong dependence between the adequacy of the storage temperature and the stage of maturity at harvest. Moreover, foreign and local agents have difficulty in marketing fruit showing pronounced variability in ability to ripen.

It was previously reported by the author (Oosthuysen, 1991a) that in Sensation, synchrony of flowering, unifor-

mity in the time of fruit set, and uniformity in the stage of maturity at harvest, can be achieved by pruning to remove developing panicles and still quiescent apical buds terminal shoots during the normal flowering period. Pruning in this manner was also reported to effectively delay the general harvest date, determined on the basis of the commencement of pulp colouration. The pruned trees retained less fruit than the unpruned trees, but due to the greater size attained by the fruit on the pruned trees, a difference in yield between the pruned and unpruned trees was unapparent. Differences in fruit retention, and average fruit mass and yield at harvest, were unapparent with respect to the actual time of pruning. Due to the existence of positive relationship between fruit size and price per kilogram received on European markets, the return realized by the pruned trees was greater than that realized by the unpruned trees.

The experiment performed in 1991 was re-performed on the same trees in 1992 for the purpose of affirming the results previously obtained. Evaluation of the effect of removing the panicles and/or apical buds by heading the terminal shoots 5 cm beyond the point of panicle or apical bud attachment was omitted in 1992 (the effect was found to be unfavourable in 1991). Thus, all panicles or apical buds were removed by cutting at the point of their attachment. The results of the "repeat" experiment are presented in this paper.

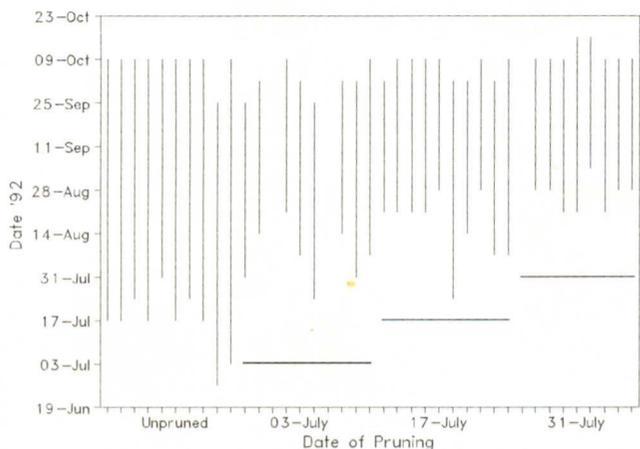


Fig. 1 Period of flowering of each tree. Absent vertical lines indicate trees that did not flower.

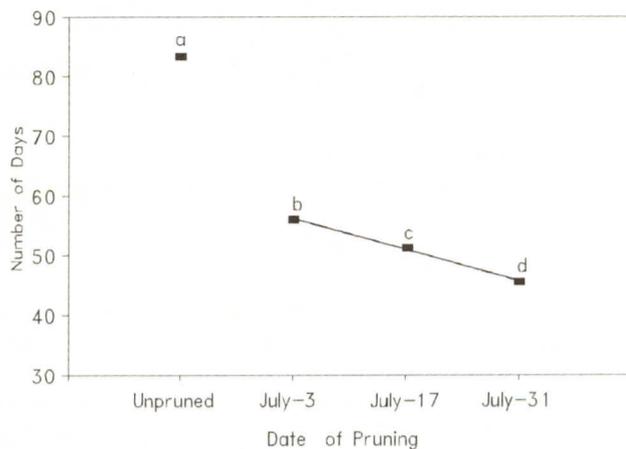


Fig. 2 Average flowering duration of the unpruned trees and the trees pruned on each date. Mean separation by LSD, 0.05 level.

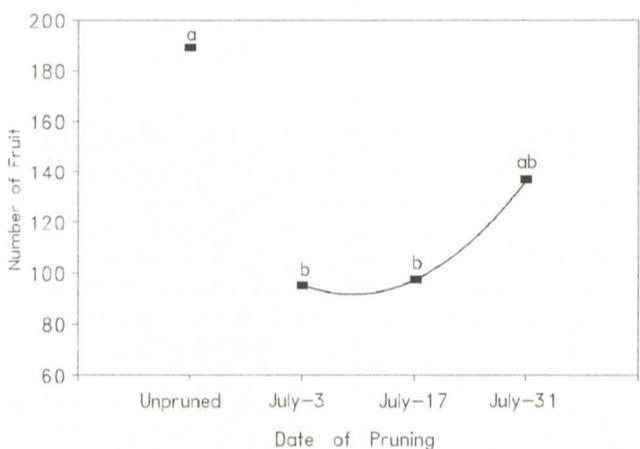


Fig. 3 Average number of fruit retained by the unpruned trees and the trees pruned on each date. Mean separation by LSD, 0.05 level.

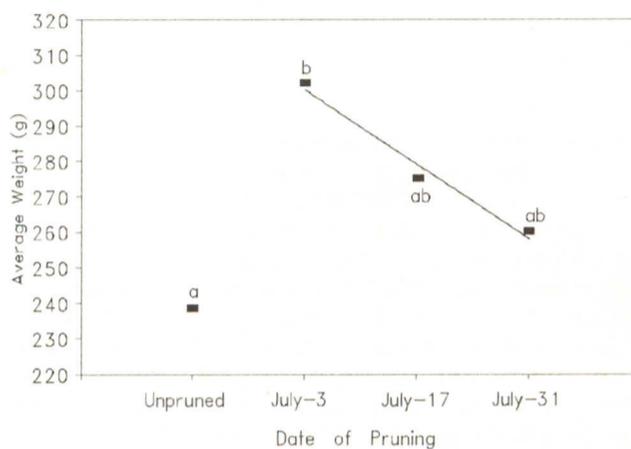


Fig. 4 Average individual fruit weight for the unpruned trees and the trees pruned on each date. Mean separation by LSD, 0.05 level.

MATERIALS AND METHODS

The stages of panicle development identified by the author (Oosthuysen, 1991b) are referred to in the present study. The Sensation trees (11-year-old and generally in their "off" year) were pruned on three dates: (1) approximately two weeks before the commencement panicle emergence (July 3), (2) when the panicles were generally beginning to emerge ("bud-swell" to "pre-shoot") (July 17), and (3) when panicle elongation was generally occurring ("in shoot") (July 31). Panicles or apical buds were removed by pruning at the point of their attachment.

During the entire period of flowering, the trees were sprayed with Nustar® (5 ml/100l H₂O) every 14 days to control panicle diseases.

Single trees served as plots in a completely randomized design. Ten trees were pruned on each date, and 10 trees were left to serve as controls. The data were subjected to analysis of variance, adopting "least significant difference" (0.05 level) as a significance test.

To quantify time and duration of flowering, the date when the most advanced panicles were at "pre-shoot," and the date when the last panicles were at "bare panicle," were recorded for each tree.

The fruit on the trees of a common "treatment" were picked when colouration of the pulp had generally been initiated. At harvest, the fruit were individually weighed. Fruit number, average fruit weight, and total fruit weight per tree were subjected to analysis of variance. The average prices received for Sensation fruit of the various counts, after deduction for packing and shipping costs, were obtained from Hans Merensky Exporting Company. A price was accordingly designated to each fruit, and return per tree likewise subjected to analysis of variance.

RESULTS

Period and Duration of Flowering

The time and duration of flowering of each tree is shown in Fig. 1. The duration of flowering was greatest for the unpruned trees, which were each in flower for 83 days (11.9 weeks) on average (Fig. 2). In the case of the pruned trees, flowering duration became progressively shorter the later the date of pruning. The tree pruned first were each in flower for 56 days on average, whereas the trees pruned last were each in flower for 46 days on average. Visually, panicle development "within trees" was highly uniform in the case of the pruned trees.

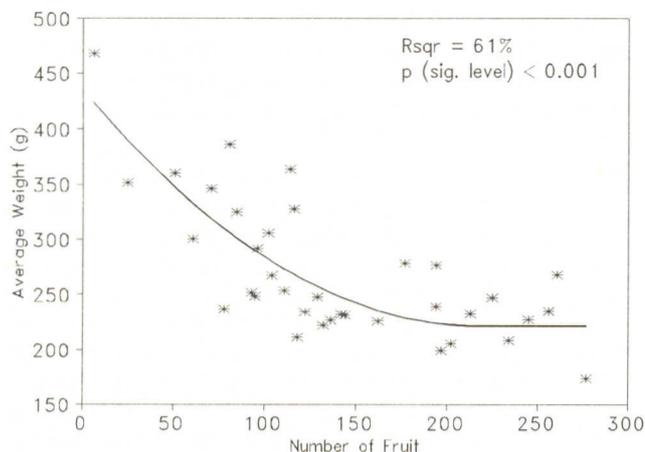


Fig. 5 Relationship between fruit number and average fruit weight per tree.

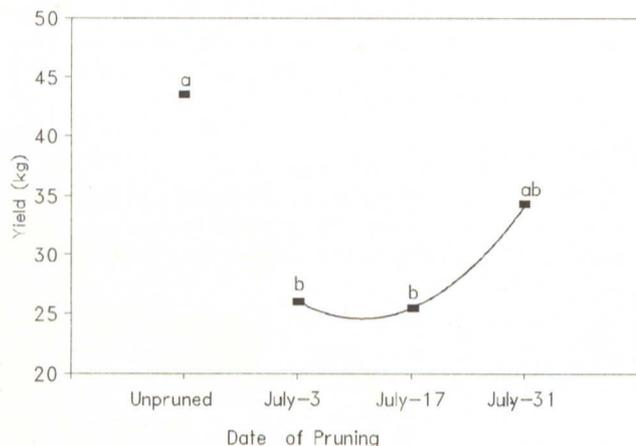


Fig. 6 Average yield of the control trees and the trees pruned on each date. Mean separation by LSD, 0.05 level.

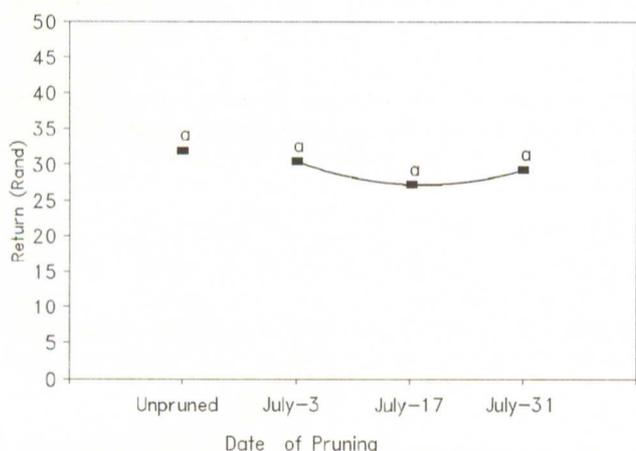


Fig. 7 Average return of the unpruned trees and the trees pruned on each date. Mean separation by LSD, 0.05 level.

Collectively, the unpruned trees were in flower for 105 days, whereas the trees pruned last on July 31 were in flower for only 56 days. The latter result signifies a high degree of flowering uniformity between the trees pruned on July 31, in view of it taking approximately 50 days for a mango panicle to develop from the stage of "pre-shoot" to that of "bare panicle" (Oosthuysen, 1991b). The 10 trees

pruned on July 3 or July 17 were each in flower for 77 days, i.e., both groups of trees were in flower for the same period of time. This indicates a lesser degree of "between tree" uniformity in flowering for the trees pruned on July 3 or July 17. It was interesting to observe that, irrespective of "treatment" and thus the time at which flowering was initiated, flowering generally ended during the second week of October.

Fruit retention

The pruned trees retained less fruit than the unpruned trees (Fig. 3). On average, the reduction was 49 and 48% for the trees pruned on July 3 and July 17 respectively, whereas the reduction was only 27% for the trees pruned on July 31.

Average fruit weight at harvest

The reductions in the number of fruit retained per tree due to pruning, each corresponded an increases in average fruit weight (Fig. 4). On average, the fruit on the trees pruned on July 3 were 27% larger than the fruit on the unpruned trees. Average increases in fruit size of 15 and 9% were associated with the trees pruned on July 17 and July 31, respectively.

A negative relationship was found to exist between the number and average weight of the fruit harvested from each tree (Fig. 5). A curvilinear equation best described this relationship, indicating a strong dependence between fruit number and size over the lower ranges in fruit number, whereas a weak or non-existent dependence over the higher ranges. Nevertheless, it would appear that the increase in average fruit weight encountered in response to pruning was a direct result of the reduction in fruit retention caused by pruning.

Yield

In considering the total weight of fruit harvested per tree, it is evident that the increases in fruit size associated with pruning on the various dates were not compensated for by the associated reductions in fruit retention (Fig. 6). On average, pruning on July 3 and July 17 gave rise to respective yield reductions of 40 and 41% relative to the unpruned trees. The reduction for the trees pruned on July 31 was 21%.

Return

In considering return per tree based on prices received for Sensation mangos in the various size classes during the 1992 export season, the reductions in fruit number associated with pruning were largely compensated for as a result of the elevated value of the fruit harvested from the pruned trees (Fig. 7). Average returns were only 5, 15 and 8% less for the trees pruned on July 3, July 17 and July 31, respectively, than the average return for the unpruned trees.

DISCUSSION AND CONCLUSION

The results reported here largely corresponded with those reported for the previous season. The negative effect of pruning on fruit retention was greater during the second season, however. The enhanced reduction may relate to the fact that the trees were in their off-year.

In mango, developing mango panicles are seen as being a drain on reserves and currently produced assimilates (Wolstenholme and Cutting, 1991). Removal of the apical buds or developing panicles at the point of their attachment on the terminal shoots prior to or during

period of flowering, effects an enhanced intensity of flowering due to the greater number of panicles that subsequently develop per terminal shoot. An increased gain of flowering on reserves and currently produced assimilates would be expected to be greater following pruning. Furthermore, it would be anticipated that the developing panicles removed when pruning would add to the decrement in growth substances. The pruned trees were often observed to set vast numbers of fruit initially. Excessive fruit drop soon followed, however. According to Chacko (1984), the immediate and most direct reason for the heavy drop of mango fruitlets is the competition between them for a limited supply of assimilates. In light of the above, it might be concluded that the reduction in fruit retention associated with pruning was due to a reduced availability of assimilates to the young fruit during their early stages of development.

Poor fruit retention has been attributed to the negative effect of low temperatures on pollination and fertilization (De Wet and Robbertse, 1986; Robbertse, *et al.*, 1988), as well as the negative effect of low temperatures during panicle development on the number of hermaphrodite as opposed to male flowers formed per panicle (Mullins, 1987). Pruning, as performed in the present study, generally deferred the onset of flowering from mid-July to mid- or late August when conditions were warmer. A positive effect on fruit set and retention might thus have been expected.

In the opinion of the author, the results concerning fruit retention reflect a trade-off between temperatures during flowering and the initial stages of fruit development, and the availability of substances required for fruit growth. This apparent increase in number of fruit retained when pruning was performed on July 31 as opposed to July 3 and 7, supports this perception.

A reduction in return of 8% is indicated following pruning on July 31 when panicle elongation was generally occurring. However, this reduction does not take into account the monetary benefit associated with uniform flowering, synchrony in the time of fruit set, and uniformity in the stage of maturity at harvest. It might reasonably be assumed that this benefit would more than compensate for the reduction in return of 8%. In view of the results presented here, as well as those presented at the previously (Oosthuyse, 1991a), pruning of Sensation mango trees in late July might be recommended.

Panicle removal by chemical means can be employed as an alternative to hand pruning. A double spray of Chemox[®] (dinoseb acetate) at 300 ppm (product) was recently found to be effective in deblossoming Sensation mango trees. Application made when the first panicles to emerge were fully developed (100% anthesis), followed by a repeat application three weeks later, was successful in causing panicle die-back and uniform flowering from axillary buds adjacent to the points of panicle attachment. Phytotoxicity to the leaves was not caused.

In view of the probable withdrawal of Chemox[®] for commercial use, future trials will incorporate other prospective chemical deblossoming agents. Ethrel[®] sprayed on trees at concentrations of greater than 1200 ppm (a.i.) may prove to be effective.

Gibberellin (GA₃) applied as a spray before the flowering period was reported to be effective in delaying and synchronizing flowering of Keitt mango (Nunez-Elisea and Davenport, 1991). In an experiment recently performed by the author, spray application of GA₃ at 200 ppm approximately three weeks before flowering, markedly delayed budbreak and gave rise to shoot as opposed to panicle development. Failure to obtain the desired response may have been related to the time or dose of the application. This option is to receive further investigation.

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