

Article

## Effect of shape pruning from the time of planting under high planting density on fruit yield of mango cultivar (Haden)

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**Abstract:** The yield of mango is dependent on cultivar and the number of plants per unit area. Traditional spacing results in low returns during the early years of crop growth before the full canopy stage. Farmers have started adopting high density planting techniques and resort to thinning of trees once branches start torching. Yet there is potential for implementing some pruning techniques that will allow the high density stands to be maintained throughout the life span of the crop. Whip and tongue grafts of mango cultivar Haden were planted at a density of 5 m x 4 m (500 tree/ha). Box pruning, spherical pruning and the central leader (no pruning) methods were effected from the third year of transplanting. Similar rise and fall occurred in the annual yields of all the treatments because of irregular bearing. Cumulative yield for nine years showed no significant difference in yield among the treatments. There was no yield advantage in pruning and shape pruning mango trees spaced at 5 m x 4 m for 10 years from planting.

**Keywords:** Mango, pruning technique, high planting density

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### 1. Introduction

Mango is an important tropical fruit in Zimbabwe. It is more prevalent in the drier parts of Zimbabwe. Fibrous cultivars are readily available in Zimbabwe and production of improved varieties is still low. In 2015 the area under mango production in Zimbabwe was 3 862 ha with an annual production of 140 680 mt and a productivity of 36 427 t/ha (AMA, 2015). Production of improved varieties is growing slowly to meet the demand on the growing and already strong local market. Many small holder farmers are also considering international markets. Therefore there is need to increase productivity and quality of our mangoes in Zimbabwe.

Mango trees generally become commercially productive in three to four years after planting (Davenport, 2006). Low productivity is enforced during the early stages of the tree. For high productivity and high early returns per unit area high density orchards appears to be the only answer (Menzel and Le Lagadec 2017); (Gaikward et al., 2017); (Ram et al., 1996). As trees grow the yield continues increase as canopies enlarge until shading by adjacent trees force the growth upward and out of reach of harvesters. The trees become very difficult to manage (Ram et al., 1996).

The mango trees are adapted to growing in full sun conditions (Menzel and Le Lagadec, 2017). It is a point bearer, flower production and fruit production will only occur on the stem exterior. Lower branches supporting previous year's productive stems die back due to shading by higher branches. Shading by higher branches leads to reduction of light incidence on leaves, consequently great or part of the canopy contributes little or nothing to the production of carbohydrates necessary for growth leading to yield reduction (Sousa et al., 2012). Therefore productivity in trees depends on the capture of light by the canopy and the translocation of photosynthates to the developing crop. There is usually a strong relationship between fruit size and the number of leaves supporting an individual fruit (Urban and Lechaudel, 2005).

Poor canopy management is one of the major limiting factors in mango production (Rathore, 2009); (Tewodros et al., 2019). Farmers avoid pruning their trees since they

consider it loss of vital vegetative parts (Yeshitela et al., 2003). Some farmers have resorted to thinning the trees once branches start torching (Cassidy, 1987). There is potential for implementing some pruning and thinning techniques which allow the high density stands to be maintained throughout the life span of the crop (Oothuyse, 2005).

Pruning maintains tree height, canopy spread, lower bearing canopy and density (Crane, 1996). This is required for effective spraying and harvesting resulting in better fruit quality and quantity (Singh et al., 2010); (Asrey et al., 2013) and (Uddin et al., 2014). Pruning is effective in diverting organic substances minerals, nutrients and water to productive branches. Consequently, the mango trees have earlier and uniform flushing; faster flush maturation, better response to flower induction, better fruit set and higher yield.

Oliveira et al., (2017) reported that different types of pruning have an effect on mango yield. The way that the plants are trained is also important, which may accentuate or not apical dominance and consequently, height growth as planting density increases (Sousa et al., 2012).

Tree size control practices that are effective and practical to small holder farmers who cannot afford to invest in mechanized pruning equipment have to be developed.

This has necessitated the need to assess the effect of different pruning techniques on the fruit yield and size of the mango cultivar Haden. Haden was selected for this investigation because it is one of the fruits favoured by the processing companies because it is one of the locally available cultivars with a high recovery %.

## **2. Materials and Methods**

An investigation on the effect of different pruning techniques was carried out at Chiredzi Research Station. The pruning techniques were applied on three years old mango trees spaced at 5 m x 4 m. The design was a randomised complete block design having three treatments and three replicates.

Each experimental unit consisted of three trees the trees were pruned moderately to maintain the tree height of the pruned trees at 2.5 m. Treatments were effected from the 3<sup>rd</sup> year of planting and after every four seasons (7<sup>th</sup> and 11<sup>th</sup>) in a randomised complete design with three treatments, replicated three times. The treatments were box pruning (pruning to box shape), round pruning and central leader method (no pruning) which acted as the control. Pruning operations were done in February soon after the last harvest. Records taken were weight of marketable fruits, weight of non marketable fruits, number of marketable fruits and number of non marketable fruits, plant height, canopy height and canopy diameter.

## **3. Results**

There were no significant differences between pruned and trees not pruned from the 4<sup>th</sup> year to the 7<sup>th</sup> year and 9<sup>th</sup> year to the 11<sup>th</sup> year of the mango trees. Pruning significantly affected fruit yield in the 10<sup>th</sup> year (fig1). The yield of the trees not pruned was significantly higher than the yield of box pruned and round pruned trees.

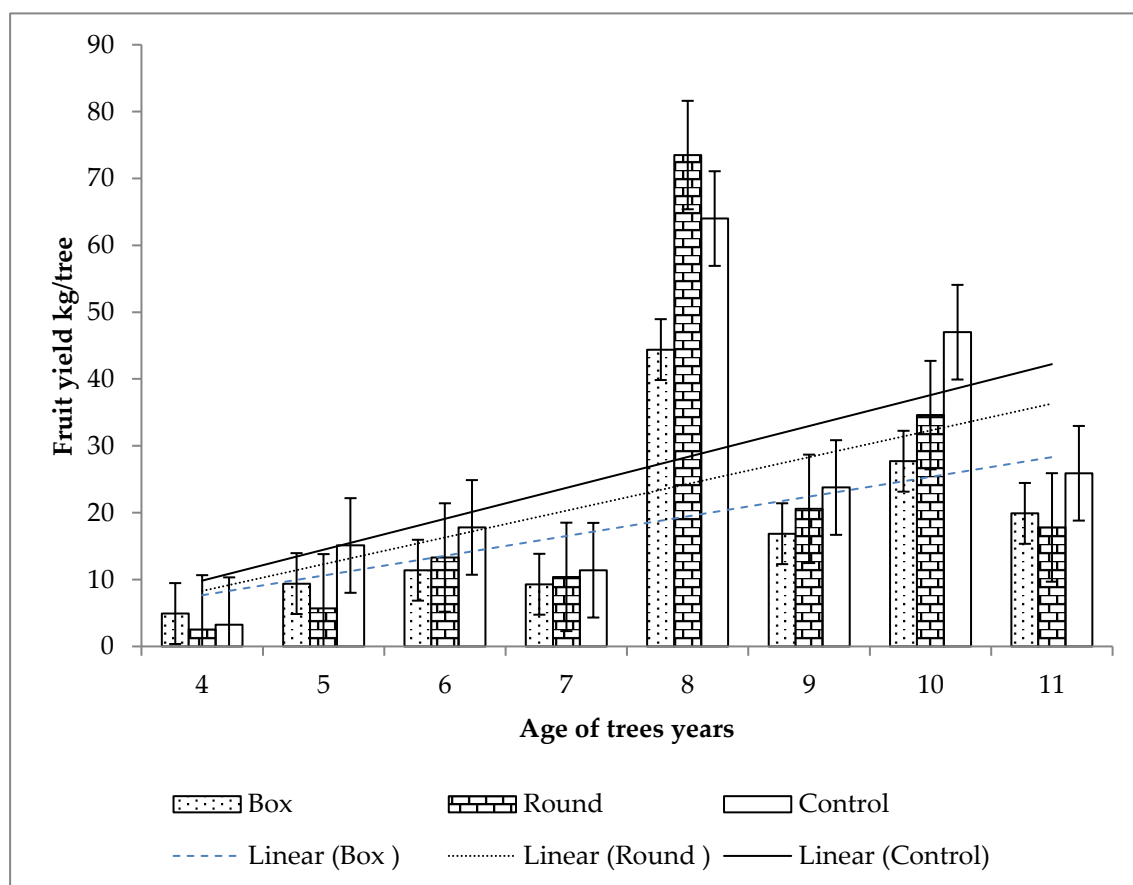


Fig 1. Annual fruit yield of Haden mango cultivar under different pruning techniques under high planting density

Pruned trees registered a sharp increase in yield in the second year after pruning (8<sup>th</sup> year) although there was no significant difference in yield for pruned trees and trees not pruned in the second season (8<sup>th</sup> year) and third season (9<sup>th</sup> year) after pruning. The severely pruned (box pruned) trees showed lesser yield per tree. Pruning trees did not affect the growth of the trees. This was shown by the expected continuous increase in yield per tree as the trees grow. The continuous yield increase was observed on box pruned, round pruned and trees not pruned.

**Table 1. Canopy diameter, canopy height, plant height and stem girth for 11 years old mango trees cultivar Haden under high planting density**

Treatment	Canopy diameter (m)	Canopy height (m)	Plant height (m)	Stem girth (cm)
Box	3.311 a	1.49 a	3.2 a	18.54 a
Round	3.750 a	1.48 a	3.08 a	19.71 a
Control	5.261 b	3.72 b	5.328 b	22.12 b
Mean	4.107	2.23	3.870	20.12
P value	0.002	0.003	0.001	0.024
Lsd	0.598	0.866	0.671	2.176
Cv%	2%	11%	4.9%	5.0%

There were significant differences in growth parameters (canopy diameter, canopy height, plant height and stem girths) between pruned trees and trees not pruned. No

significant differences were observed between box pruning and round pruning on the growth parameters.

#### 4. Discussion

During the first 9 years there were no significant differences in yield for pruned trees and trees not pruned. Asrey et al., (2013) recorded similar results in cultivar Sensation where he observed that postharvest pruning is effective in maintaining tree size without there being an adverse effect on yield.

The yield of the tree not pruned was significantly higher than the yield of box pruned and round pruned trees in the 10<sup>th</sup> year is due to the retention of more number of past season shoots opposed to the removal of many such shoots in the pruning treatments Gopu et al., (2014); Singh et al., (2009) and Ghavale et al., (2016) recorded similar results, where severely pruned trees showed lesser yield and number of fruits per tree.

The growth pattern shows that mango has an irregular cropping habit across different years. There were periods of irregular and alternate bearing in the orchard. Fitchet et al., (2016) supports this idea that there can be period of alternate bearing and irregular bearing in the same orchard. The yield of the trees not pruned varied considerably across seasons in the same pattern as the pruned trees. This was also reported by many (Spreer et al., 2009). Asrey et al., (2013) suggests that under high density planting there is a progressive decline in mango yield after 14-15 years due to overcrowding of canopies. According to Menzel et al., (2017) this kind of experiment should run for at least 20 years.

#### 5. Conclusions

Shape pruning mango tree spaced at 5 m x 4 m does not significantly reduce yield when the orchard is less than 10 years. Tree height can be maintained at 2.5 m without significantly affecting yield during the early years of the orchard. Operation like spraying and harvesting can be carried out effectively.

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#### References

- AMA. (2015) Zimbabwe Agricultural Sector Statistical Report (2000-2015). Volume 4.
- Asrey, R., Patel, V.B., Barman, K and Pal, R. k. (2013) Pruning affects fruit yield and postharvest quality in mango (*Mangifera indica*) cv. Amrapali. *Fruits* 68, 367-381.
- Cassidy, M. (1987) Tropical and subtropical fruit production in Zimbabwe. Horticulture Promotion Council. Harare. Zimbabwe.
- Crane, J. H., (1996) Tree size control for selected tropical fruit crops I Proceedings of the International Conference on Tropical Fruits, 23-26 July 1996, Kuala Lumpur, Malaysia.
- Davenport, T.L (2006) Pruning strategies to maximize tropical mango production from the time of planting to restoration of old orchards. *Hortscience* 41(3) 544-548.
- Fitchett, J. Grab, S.W. and Thompson, D.L. (2016) Temperature and tree age interact to increase mango yield in the lowveld, South Africa. *South Afr. Geogr.J.*98, 105-117.
- Gaikward, S. P., Chalak, S. U and Kamble, A. B. (2017) Effect of spacing on the growth, yield and Quality of mango. *Krishi Vigyan*, 5 (2):50 - 53.
- Ghavale, S. I., Pujari, K. H and Tatil, S. R. S (2016) Studies on the Effect of Pruning on flowering behavior of mango cultivar Alphonso. *International Journal of Tropical Agriculture* 34(4)16
- Gopu, B. Balamohan, T. N. and Jeyakumar, P. (2014) Studies on pruning mango (*mangifera indica. L*) cv Alphonso under ultra high density planting. *J. Applied Horticulture* 16 (1): 50-53
- Menzel, C M and Le Lagadec M. D. (2017) Can productivity of mango orchards be increased by using high density plantings? *Scientia Horticulturae* 218: 225-263.
- Oliveira, G. P., Siqueira D. L., Salomao, L. C. C., Cecon, P. R., and Machado, D. L. M. (2017) Paclobutrazol and branch tip pruning on the flowering induction and quality of mango tree fruits. *Pesquisa Agropecuaria Tropical*. 47 (1) 7-14.
- Oothuyse, S. A. (2005) Greatly enhanced ease in growing mangoes on small trees. *Mango*. 8:52 1-51.
- Ram, S., Singh C.P., Kumar S and Pujari K. (1996) Achieving high productivity in mango through high density orcharding and control of alternate bearing in Proceedings of the International conference on tropical fruits. Kuala Lumpur. Malaysia. 23-26 July 1996 Volume III pp 139-150.

- Rathore, D.S. (2009) Conceptualization of tree canopy management for higher productivity in subtropical fruits. In Management of canopy architecture for higher productivity in subtropical fruits, CISH, Lucknow, India. p.5-7.
- Singh, S.K., Singh S.K. Sharma R.R. and Srivastav, M., (2009) Effect of pruning on morphological parameters and microclimate under high density planting of mango (*Mangifera Indica* L.) Indian. J. Agric. Sci. 79, 632-635.
- Singh, S.K., Singh, S.K., and Sharma R. R., (2010) Effect of pruning on the biochemical status of shoot buds in three mango (*mangifera indica* L.) cultivars planted at high density. J. Hortic. Sci. Biotechnol. 85, 483-490.
- Sousa, A. A.F.de, Cavalcanti, M. I. I. G., Vasconcelos, L. F. L., Souza, H.U.de, Ribeiro, V. Q., Silvia, J. A.L. da, (2012) Tommy Atkins' mango trees subjected to high density planting in sub humid tropical climate in northeastern Brazil. Pesq. Agropec. Bras. 47, 36-43.
- Spreer, W., Ongprasert, S., Hegele, M., Wunsche, J. N., Muller, J. (2009) Yield and fruit development in mango (*Mangifera indica* L cv Chok Anan) under different irrigation regimes. Agric. Water Manage. 96, 574-584.
- Tewodros, B. N, Fredah, K. R. W, Wassu, M. A, Willis, O. O and Githri, S. M. (2019) Mango (*Mangifera indica* L) production practices and constraints in major production regions of Ethiopia. African Journal of Agricultural Research. Volume 14 (14) pp 185-196.
- Uddin, M. S, Hossain, M. F. Islam, M. S. Hossain, M. M. and Uddin M. S. (2014) Effect of postharvest pruning on the control of tree size and yield of mango. Bull. Inst. Tropical. Agriculture., Kyushu University 37: 41-46.
- Urban, L., and Lechaudel, M., (2005) Effect of leaf fruit ratio on leaf nitrogen content and net photosynthesis in girdled branches of *Mangifera Indica* L trees 19, 564-671.
- Yeshitela, T, Robbertse, P.J and Stassen P.J. C. (2003) The impact of panicle and shoot pruning on inflorescence and yield related development in some mango cultivars. Applied Horticulture 5 (2) 69-75.