ABSTRACT

'EFFECT OF PRUNING LEVELS AND TIME OF PRUNING ON GROWTH, YIELD AND QUALITY PARAMETERS OF CUSTARD APPLE (*Annona squamosa* L.) UNDER NORTH MAHARASHTRA CONDITIONS'

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The present investigation, 'Effect of pruning levels and time of pruning on growth, yield and quality parameters of custard apple (*Annona squamosa* L.) under North Maharashtra conditions' was carried out at Horticulture Farm, College of Agriculture, Dhule during the year 2012-2013. The plants were spaced at 5 x 5 m. The experiment were designed as five dates of pruning at 15 days intervals and five different levels of pruning treatments replicated three times in Split Plot Design with two plants per treatment unit. The pruning was done on main shoot and also

subsequent secondary and tertiary shoots on whole plant with different intensities of tip pruning, 30 cm, 60 cm, 90 cm and control pruning levels from top to end, at different time i.e. from 16th December, 1st January, 16th January, 1st February and 16th February.

All the above treatments were compared in respect of growth characters, fruit yield, fruit quality, grading of fruits and incidence of mealy bugs. The results obtained are expressed here as below:

Maximum length of shoots (18.48 cm) at monthly interval was recorded in treatment D_1P_4-pruning of 16th December with 90 cm pruning intensity which was at par with the treatment D_2P_4- i.e. pruning on 1st January with 90 cm pruning level (17.46 cm). The maximum number of internodes at monthly interval were recorded in treatment D_1P_3-i.e. pruning on 16th December with 60 cm pruning intensity (17.50) which was statistically at par with the treatment D_2P_3 i.e. pruning on 1th January with 60 cm pruning (17.26). The early flowering i.e. minimum number of days required for flowering (93.67) was registered in treatment D_1P_5-i.e. pruning on 16th December with control pruning. The maximum number of flowers per shoot (8.43) was noticed in treatment D_4P_2 i.e. pruning on 1st February with 30 cm pruning level which was statistically at par with the treatment D_5P_2-i.e. pruning on 16th February with 30 cm pruning (8.42).

The highest percentage of fruit set (71.17%) was registered in treatment D_4P_2-i.e. pruning of 1st February with 30 cm on pruning level. The treatments D_4P_2 i.e. pruning on 1st February with 30 cm pruning level and D_5P_2 i.e. pruning on 16th February with 30 cm pruning level were statistically at par with each other. The size of fruits increases with increasing severity of pruning, the highest polar diameter of fruit (7.90 cm) was registered in treatment D_4P_3-i.e. pruning on 1st February with 60 cm of pruning level, and the highest equatorial diameter of fruit (8.45 cm) was registered in treatment D_4P_4 -i.e. pruning on 1st February with 90 cm pruning level.

The average number of fruits per plant was significantly influenced by the time and intensity of pruning. The maximum number of fruits per tree (106.65) was noticed in treatment D_4P_2 -i.e. pruning on 1st February with 30 cm pruning level. The maximum weight of fruit (342.17g) was found in treatment D_4P_4-i.e. pruning on 1st February with 90 cm pruning level. The maximum yield per plant (26.33 kg) was noted in treatment D_4P_2-i.e. pruning on 1st February with 30 cm pruning level.

The results showed significant treatment differences in respect of time of pruning and intensities of pruning and interactions showed non-significant results in total soluble solids. The maximum pulp percentage was observed in treatment D_4P_2-i.e. pruning on 1st February with 30 cm pruning level (60.43 %). The seed percentage and seed: pulp ratio decreased due to pruning over control pruning. Also the acidity was not much deteriorated due to pruning. Thus pruning at proper time and intensity was beneficial to improve fruit quality in terms of fruit pulp, TSS percentage etc.

The maximum A grade (7.23 kg) and C Grade (10.57 kg) fruit were registered in treatments D_4P_2 i.e. pruning on 1st February with 30 cm pruning level However, maximum B grade fruits was registered in treatment D_5P_2-i.e. pruning on 16th February with 30 cm pruning level (9.60 kg).

Lowest incidence of mealy bug (1.57 %) confined to treatment D_4P_2-i.e. pruning of 1st February with 30 cm pruning level. However, the highest incidence of mealy bug (4.94 %) was registered in treatment D_3P_4-i.e. pruning in 16th January with 90 cm pruning level.

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1. INTRODUCTION

Custard apple (*Annona squamosa* L.) is tropical fruit crop; hence it is very popular fruit in dry land areas of Maharashtra. Annona is fruit that belong to the family Annonaceae which consist of approximately 800 arboreal species of the tropical region, with fruit is berry and buffy. Among annonaceous fruits, custard apple botanically knows as *Annona squamosa* L, is most important dry land fruit of India. It is popular by virtue of its spontaneous spread in forest, west lands, rocky slope and other uncultivated places. It is generally class as a semi-wild fruit. Custard apple is hardy and known to thrive under diverse conditions of soil and climate. Custard apple has gained commercial significance and exclusive orchards are emerging in Andhra Pradesh and Maharashtra.

Custard apple (*Annona squamosa*) belongs to family Annonaceae and genus annona and is very popular and commercial importance in India.

Annona squamosa is a small, semi-deciduous much branched shrub or small tree having 3 to 8 meters tall and very similar to sour sop (*Annona muricata)* with a broad, open crown or irregularly spreading branches and a short trunk, not buttressed at base. The fruit of *Annona squamosa* has delicious whitish pulp and is popular in tropical markets.

Custard apple (*Annona squamosa* L.) is one of the finest fruit gifted to India by tropical America and West Indies. It is also known as sharifa, sitaphal, sugar apple, sweetsop, sitaphalam etc. Andhra Pradesh is the major custard apple growing state followed by Maharashtra, Tamil Nadu, Orissa, Assam, Uttar Pradesh, Bihar and Rajasthan. Besides India, it is grown in China, Philippines and Cuba and has a commercial importance in Egypt and Central Africa.

Custard apple is now grown in Brazil, Australia, Myanmar, Chili, Egypt, Mexico, Israel, Philippines, Spain, South Africa, West Indies, India and Sri Lanka.

In India, the custard apples are very popular in Deccan plateu and are grown commercially on smaller scale in Andhra Pradesh, Bihar, Madhya Pradesh, Maharashtra, Uttar Pradesh, Tamil Nadu, Assam, Karnataka and Orissa. Maharashtra and Andhra Pradesh are the leading states in Annona cultivation and annual production.

In Maharashtra, it is widely grown in Pune especially in Purandar Tahsil, Ahmednagar, Aurangabad, Usmanabad, and Solapur district etc. In 2011, the area covered under this crop was 40230 ha and the production was 65273MT in Maharashtra (Anon, 2011).

Custard apple is one of the most delicious and highly perishable fruit. It has its delightful taste, flavour, moderate price in markets and a high nutritional status. Overall the importance of fruits in domestic and export market as fresh fruits and processed products.

The custard apple is rich source of carbohydrates, protein, fibre, minerals like calcium, phosphorus, iron and vitamin C. They are considered good energy source with the value of 104 kcal. *Annona squamosa* fruit contains carbohydrates 23.5 g, protein 1.6 g, mineral 0.9 g, fibre 3.1 g, calcium 17 mg, phosphorus 47 mg, iron 1.5 mg and vitamin (37 mg). These values are based on 100 fruit pulp (Bal and Singh, 2008).

Besides high nutritive value, it has also high medicinal value. Root is drastic purgative; leaves are used for unhealthy ulcer and for store grains pests. Seed extracts and seed oil have insecticidal properties.

The period of availability of the custard apple fruits commences in August and continues up to December, the peak period of availability being October and November. Custard apple is a naturally cross pollinated crop. It is protrandrous in nature. The custard apple has a versatile adaptability to a wide range of soil and

climatic conditions. It is hardy and drought tolerant. It can also tolerate adverse weather conditions, such as humidity, heavy and scanty rainfall and desiccating winds; but at the cost of growth and yield.

Custard apple is mostly consumed as dessert fruits. They can be preserved as jam, jelly and are also used in ice-cream and other milk products. The edible portion of fruit is creamy, granular with an excellent blend of sweetness and acidity. The immature fruits, seeds, leaves and roots are known for their medicinal use in Ayurveda (Parekh and Sharma, 1993). The seed cake contains nitrogen, thus can be used as manure.

Annona species bears flowers on both old and current season growth and very rarely on older wood. The flowering period of custard apple is very long commencing from March-April, continuing up to July-August. The peak flowering is observed in April and May. No fruit set is occurs during the entire spring and summer and it commences only in the rainy season. The setting of fruits early in the season is important because immature fruits instead of developing become inedible in winter season.

Annona is small deciduous ever green tree which grow to an average 6-8m. Therefore, it requires little pruning. It is essential to develop a good crown to get better yield over a long period of time without pruning the plant become bushy and lowers its bearing efficiency. Hence timely removal misplaced limbs is necessary to build a strong framework. Selective and mild pruning of dead wood and very old branches should be carried out to avoid congestion and encourage well spaced branching. Yellowing of leaves starts as the harvesting season of fruits ends. The leaves begin to drop with onset of winter and fresh growth occurs in spring.

Flowering occurs singly or rarely in small cluster mostly on current season growth and occasionally on old wood.

The increase in length and diameter of subsequent new shoots produced after pruning is directly proportional to the severity of pruning. Average fruit size and weight are also increased in pruned trees as compared to those in un-pruned ones (Gham, 2011). Although total fruit yield is slightly decreased, the quality of good size harvested fruit is increased with pruning. Hence, for obtaining improved growth and better quality fruit a light pruning to break apical dominance (i.e. removal of unwanted growth) and a general thinning of diseased and broken branches, are reported to be essential to make the ber orchard a remunerative one (Verma and Chand, 2008).

Considering the need, time and future thrust, it is very necessary to standardize time of pruning and intensity of pruning in custard apple under prevailing climatic condition of North Maharashtra. Hence, the present investigation on 'Effect of pruning levels and time of pruning on growth, yield and quality parameters of custard apple (*Annona squanmosa* L.) under North Maharashtra conditions' was undertaken at Horticulture Farm, College of Agriculture, Dhule during the year 2012-13 with following objectives-

1. To study the effect of pruning intensity on growth, yield and quality parameters in custard apple.
2. To standardize the optimum time of pruning in custard apple.
3. To find out the interactive effect between pruning intensity and time of pruning on growth, yield and quality parameters in custard apple.

2. REVIEW OF LITERATURE

Pruning comprises of the renewal of certain plant parts so as to influence the physiological functions in promoting more crops with better quality. It essentially diverts sap flow from one part to the other. It also helps in better distribution of the fruiting wood and maintains the tree in a manageable form. The pruning techniques are related to the application of physiological principles. The growth control often depends on the interaction between environmental and genetic factors.

The different modes of pruning that are practiced in different fruit crops or trees are based on the same general principle of concentrating the vigour in to certain parts of the plant by the cutting away of other portions, either of the stem, branches, roots or the leaves. The objective may be to have more yield or better quality of fruits, straight clean stem twisted or bent stems, wide spreading branches or an abundance of young shoots and foliage as in tea cultivation.

In all fruit crops, the intensity of pruning differs according to their growth, flowering and fruiting habits. However, the specific pruning intensity in custard apple crops, has not yet been reported.

In the fruit crops like guava, fig, ber, grape, apple, pear, peach, plum, cherry, apricot and phalsa the practice of pruning is adopted in order to regulate the crop over a number of years. In custard apple, specific pruning intensity has been reported. It can also influence the pruning practice, with respect to intensity and time. Very scanty literature is available on time of pruning and intensities of pruning in custard apple. Therefore, in order to illustrate these aspects, the available literature is reviewed hereunder.

1. Effect of time of pruning on growth, yield and quality parameters

George and Nissen (1980) reported that, the pruning and defoliation practices on juvenile custard apple trees cv. African Pride, clonally propagated from

cuttings. Moderate summer and spring dormant pruning (the traditional pruning time) resulted in severe yield reduction. This was related with reduction in lateral numbers and floral buds initiated. The trees receiving no pruning or defoliation treatments (control), although high yielding, were structurally unsound and exhibited severe limb breakage. In comparison, the trees which received the mid-summer defoliation treatment were structurally sound and exhibited the best shape.

Singh and Sandhu (1984) reported that pruning carried out during mid-May to mid-June in ber cv. Umran resulted in higher yields and better quality fruits than earlier (15-30 April) or later (29 June-14 July) pruning.

George and Nissen (1987) showed that, in custard apple the responses associated with a reduction in a number of flowers with defoliation and increases after summer pruning. The main effect of summer pruning was to increase the number of sub-petiolar buds which emerged on the new wood. There was no significant effect of treatments on the number of buds emerging from one year old wood.

Guimond *et al.* (1998) stated that the time of pruning, length of the shoots after pruning, and location of the pruning cut can influenced subsequent flower bud formation and vegetative growth in sweet cherry.

Mohan Swaroop *et al.* (2001) stated that, mango trees pruned after harvesting in November-December 1997 and January–February 1998 produced more shoots and one month earlier (march) during the same year and maximum number (373.6%) of shoots emerged after November pruning and minimum number (227.4%) of shoots emerged in January.

Norbetro and Chalfun (2001) reported that, pruned plants during second fortnight of May resulted in larger number average fruits in fig. Bound and Summer (2001) reported that higher T.S.S. in winter pruned than in spring pruned Fuji apple.

Dhaliwal and Kaur (2003) reported that the interaction effects of dates and pruning intensities showed maximum age (days) of flowering shoot with 30 cm on 10th April which is at par 0 cm and 20th April and 0 cm and 30th April. Minimum age of flowering shoot was observed with 10 cm and 30th April and hastening of flower production about a fortnight with the severity of pruning in ber.

Soler and Cuevas (2004) reported that in custard apple pruning trees severely in January, followed by tipping newly emerged shoot together either at 1st or 15th June. Both dates were highly successful because all tipped shoots produce a second bloom in July.

Leonardo Lombardini (2006) stated that, time of pruning have positive effect observed on yield and quality of fruit after pruning in Pecan trees. Basu *et al.* (2007) reported that time of pruning had significant effect on fruit set, yield and physiochemical characters in fruits obtained from plants pruned in April.

Salunkhe *et al.* (2008) reported that time of pruning had significant effect on number of bunch per vine, bunch weight, yield and TSS in Thompson Seedless grapes. Robertson and Olesen (2008) stated that, mango trees pruned on nine occasions from February to April 2005, the greater flowering in the earliest pruned treatments probably occurred because the mature flush was more likely to initiate growth during florally inductive conditions.

Lang *et al.* (2010) reported that when conditions were favorable for walnut, the growth of tree and head pruning at dormancy resulted in the greatest amount of trunk growth and shoot extension. Gham (2011) reported that custard apple pruning in 1st week of April with 25 per cent pruning intensity enhance plant growth, yield and quality of fruit.

Choudhari (2012) reported that, custard apple pruning after the 75 days of previous harvest with 25 per cent pruning intensity enhance yield and quality of

custard apple fruits. Dhaliwal *et al.* (2013) observed that the length of shoot, shoot girth, number of leaves and number of buds in citrus were improved significantly in plants with intermediate pruning and excellent vigor.

2. Effect of pruning intensity on growth parameters

Sundarajan and Muthuswamy (1964) reported enhanced growth due to light pruning in guava. Nijjar (1969) stated that, heavy pruning in phalsa weather in young tree or old tress generally resulted in profuse vegetative growth and tress of bearing age heavy pruning results in a reduction in fruitfulness.

Bhonsle (1972) reported that the growth parameters such as rate of growth of shoot, total length of shoot, number of leaves per shoot and leaf size increased with the severity of pruning in grapes. The percent sprouting of buds was also increased with more severe pruning.

Bajpai *et al.* (1973) observed that, the length of shoots and number of leaves per shoot was found maximum in severely pruned tress in guava and minimum in un-pruned tress and no significant difference between 60 and 30 cm pruning treatments.

Bajwa and Sarowa (1977) also found increased length and girth of subsequent new branches and the increase was directly proportional to the severity of pruning in ber. Zhelev (1977) studied that due to pruning, the apple leaves on remaining shoots were larger in size and richer in chlorophyll content.

Gondkar (1978) recorded observations in respect of length, diameter, number of leaves and number of fruits borne per shoot in fig. It was observed that, in ground level pruning the shoot length was significant.

Singh *et al.* (1978), Lal and Prasad (1979) and Sharma *et al.* (1980) reported that, the best growth of ber trees due to moderate pruning as compared to light and severe pruning.

George and Nissen (1980) observed that in custard apple summer and spring pruning resulted in reduction in lateral numbers and floral buds initiated.

Lal and Prasad (1980b) reported maximum flower production, fruit set and their retention together with improved fruit size in ber trees pruned moderately by leaving 90 cm long shoots.

Ghunake (1981) observed that the plant growth of guava as revealed by height, spread, sprouting of shoots, weight of pruned material and leaf area, although increased with severity of pruning.

George and Nissen (1987) observed that in custard apple the main effect of summer pruning was to sub-petiolar buds which emerged on the new wood.

Patil (1987) observed that growth of cv. Umran ber trees in terms of weight of pruned material, number of new shoots sprouted, mean shoot length, number of leaves produced per shoot was significantly influenced by the various pruning treatment. The increase in growth rate was progressively more with increase in pruning intensity and with advance in period after pruning.

Bruno *et al.* (2001) noted that the bark girdling and shoot tipping in cherimoya at 10 buds identified a higher percentage of fruit set, while the control was the lowest final fruit

Dias and Matsumoto (2003) evaluated the effect of pruning branches of different diameters on vegetative growth, flowering and fruiting of *Annona squamosa* was in semi arid region in Bahia, Brazil, during June to November 2000 with following treatments viz. thick branches (11-14 mm diameter); medium branches (7-10 mm) and thin branches (3-6 mm) . They observed that growth and flower vigour were greater on thick branches, but different branch diameters did not affect fruit quality.

Nilma Oliveira *et al.* (2004) was conducted to evaluate the influence of pruning with different branches lengths on vegetative and reproductive growth of custard apple and showed that smaller branches pruning lengths reduced emission of flowers and increased characteristics of branches and fruits growth.

Olesen and Muldoon (2009) reported that in custard apple summer tip pruning prevented new vegetative growth in the canopy of tree and fruit size decreased relative to the control tree.

Shahein *et al*. (2010) reported that in annona, most effective treatment was heading back by removing 20cm plus nitrogen fertilization which produced 7.3 and 5.2 lateral shoots and higher number of leaves per shoots 60.3 and 59.2.

Lang *et al*. (2010) reported that, in walnut head pruning (removed at least half the previous year shoot) trees had significantly greater shoot growth after pruning than Tip pruning trees in Chandler and Lara (removed only one quarter of the previous year shoot growth).

Gham (2011) reported that maximum number of shoots per branch in light pruning in custard apple (*Annona squamosa* L.) cv. Balanagar. Choudhari (2012) studied that lowest number of shoots per branch in no pruning in custard apple (*Annona squamosa* L.) cv. Balanagar. Dhaliwal *et al.* (2013) reported that number of leaves and buds per shoot were also recorded significantly higher in pruned plants as compared to un-pruned plants in citrus.

3. Effect of pruning on flowering

Lal and Prasad (1980b) reported that pruned ber trees flowered earlier by 3-6 days as compared to un-pruned one and maximum flower number per branch-let were produced by medium pruning whereas the minimum flower number per branch-let were produced under control.

Dhaliwal and Sandhu (1982) reported that the number of flowers per shoot decreased with pruning severity in ber. The juvenility is more at the base of a tree or branch and gets gradually reduced in acropetal manner towards the distal end in custard apple (Leopold and Kriedmann 1982).

Rajput and Pattanayak (1985) observed in ber delay in differentiation of floral primordial due to pruning in case of young trees, which had then not flowered. The delay in appearance was more or less proportional to the degree of pruning.

George and Nissen (1987) observed that trunk cincturing at monthly internals from bud break to mid January had no significant effect on flowering of 6year old custard apple trees.

Patil (1987) demonstrated that the number of days required for appearance of first flower increased with increase in severity of ber pruning. Least period was required in control treatment for this process. This ultimately resulted in significant differences in period required for 50 per cent flowering and fruit setting process.

Guimond *et al.* (1998) stated that all pruning treatments (i.e.15, 20, 25, or 30cm from the shoot base) significantly increased the number of flower buds per shoot in sweet cherry.

Mohan Swaroop *et al.* (2001) reported that 'on' year mango trees should be pruned in July, August and December for increasing panicle on a shoot and hermaphrodite flower in panicle, to control malformation and to increase fruit yield and quality. Kahn *et al.* (2001) reveled that in cherimoya N- fertilization after pruning increased number of lateral shoots and number of flower pre shoot.

Dias and Sila (2004) observed that, the effect of pruning of different branch lengths on the vegetative and reproductive growth of custard apple (*Annona reticulata*) was investigated from 21 February to 1st July 2003. Pruning using short branches reduced flower fall and improved branching and fruit growth.

Soler and Cuevas (2004) reported that, the custard apple trees were encouraged to flower out of season by pruning them back severely in January, followed by tipping the newly emerged shoots together with the removal of apical on either 1st or 15th June. Both dates were highly successful because all tipped shoots produced a second bloom in July.

Robertson and Olesen (2008) stated that in mango there was a linear decline in flowering from the earliest to the latest pruning date and this was reflected in subsequent yield and there was a linear relationship between flowering and yield.

Shahein *et al*. (2010) reported that in annona all pruning level treatments including defoliation plus nitrogen fertilization gave the best result in increasing number of flower per shoot from 39.3 to 51.1 and from 40.1 to 52.7in first and second season.

Gham (2011) reported the highest per cent flowered shoots were registered in control pruning. The significant highest number of flowers was registered in light pruning of shoots. Days required for flowering were lowest under no pruning condition in custard apple.

Choudhari (2012) studied that the maximum numbers flowers were registered in pruning after the 75 days previous harvest with 25 per cent pruning. The minimum numbers of days required for flowering in pruning after the 45 days previous harvest in custard apple.

4. Effect of pruning on yield and yield contributing characters

Hayes (1943) observed that, heavily pruned guava trees produced bigger fruits but the number of fruits per tree and yield per acre was half of that of the lightly pruned trees.

Sundarajan and Muthuswamy (1964), Bajpai *et al.* (1973) and Jauhari and Singh (1973) reported higher yield in guava due to light pruning.

Awasthi and Mishra (1969) studied that initial fruit set was maximum in medium pruning followed by heavy pruning but at final set light pruning proved to be best as compared with control and others treatments in ber.

Nijjar (1969) observed that the bushes pruned to 90 or 120 cm above ground level gave the best yield in phalsa. Bhonsle (1972) studied that; productivity of the grapevine was increased with the lighter pruning treatments. Maximum fruit bud differentiation was observed on the spurs in the 4^{th} to 7^{th} bud region in least severe treatment.

Bajpai *et al.* (1973) found in guava that cv. Allahabad Safeda gave higher fruit retention and yield with 30 cm (light) pruning; severely pruned trees produced few fruits.

Gupta and Singh (1977) reported that, highest yield per tree was obtained under control treatment and lowest under medium level of pruning followed by heavy pruning and no significant differences in yields due to different pruning treatments in ber.

Singh *et al.* (1978) reported maximum average yield of ber under 75 cm pruning (medium pruning) while the yields were minimum in control treatment.

Lal and Prasad (1980c) and Sharma *et al.* (1980) reported highest yield from ber trees pruned to 120 cm length (light pruning). George and Nissen (1980) observed that summer and spring dormant pruning resulted in severe yield reduction in custard apple. Ghunake (1981) observed that, light pruning of Sardar guava gave more total yield per tree and per hectare over severe and medium pruning treatments.

Lal (1983) reported that in guava cv. Lucknow-49 the treatment combination of 2 x 2 m spacing with un-pruned (control) gave maximum yield per ha during rainy season, whereas, treatment combination of 2 x 2 m spacing with one leaf pair pruning gave maximum yield per hector in winter season.

Patil (1987) found highest yield from un-pruned trees, which was comparable with that obtained in medium pruned trees (heading back of 50 % distal growth) in ber cv. Umran. Bruno *et al.* (2001) mentioned that, shoot tipping in cherimoya increased yield by 22% as compared to control.

Shahein *et al.* (2010) observed that the pruning regimes and pruning combines with nitrogen fertilization treatment increased number of flower per shoot, fruit set percentage and yield in custard apple and reported that in annona treatment of heading back by removing 10 cm plus nitrogen fertilization gave the highest value of fruit set percentage 14.6 and 14.8% and yield either as number of fruit per tree or as weight. Gham (2011) reported that, the significant highest number of fruits per plant, average weight of fruit and yield per tree of custard apple were recorded in light pruning.

5. Effect of pruning on quality contributing characters

Singh and Sharma (1961) observed that, heavy pruning leads to delayed maturity but it increased the fruit size and juice content of phalsa. Sundarajan and Muthuswamy (1964) reported that, size and weight of guava fruits increased due to severe pruning.

Nijjar (1969) reported that due to pruning colour, quality and size of individual fruit are favorably influenced in phalsa. Bhonsle (1972) reported that in grape increased T.S.S. with lighter pruning and reduced acidity. Bajpai *et al.* (1973) reported that un-pruned trees produced the smallest fruits with lowest T.S.S. and sugar levels in guava.

Sharma *et al.* (1976) registered no effect of pruning on berry quality of Kishmish Chorni variety of grape. Singh *et al.* (1978) reported higher percentages of T.S.S. and sugars in Karaka ber cultivar due to minimum pruning. Lal and Prasad

(1980c) reported that better weight, length volume and pulp: stone ratio in fruits of lightly pruned ber trees.

Bruno *et al.* (2001) reported that in custard apple shoot tipping at 10 buds produced a significantly greater fruit weight than the control. Bound and Summer (2001) reported that in fuji apple TSS was higher in winter pruned treatments than spring pruned.

Sonali *et al*. (2001) revealed that with 5 levels of pruning in litchi trees, all treatment increased number of fruit per panicle, fruit weight, yield, T.S.S. and total sugars and ascorbic acid content.

Soler and Cuevas (2004) reported that in custard apple number of seeds per fruit and the seed index increased in fruit produced under defoliation treatments in (2005 and 2006) both season.

Basu *et al*. (2007) reported that total soluble solid were found to be highest in guava plants pruned in April 2003 and total sugar content was highest in June pruned plants and reducing sugar content was higher in April pruned plants 2003.

Bal and Singh (2008) reported that the number of seeds per fruit was recorded minimum in control at 10cm pruning with paclobutrazol 1000 ppm at 20 cm pruning in guava. Olesen and Muldoon (2009) observed that summer tip pruning decreased fruit size relative to the control trees by carbon 23% in custard apple.

Masalkar and Joshi (2009) quoted that maximum average no. of fruits (80.80) registered in the treatment of pruning 20 cm without thinning in pomegranate cv. Bhagava.

Shahein *et al*. (2010) reported that effect of pruning levels alone and combined with N- fertilization in custard apple increased fruit weight from 291.4 to 302.1g and while pruning practices by removing 5, 10, 20 cm and thinning out gave higher value of fruit weight.

Gham (2011) the significant lowest acidity (0.19) found in light pruning of custard apple trees. Choudhari (2012) reported significantly maximum T.S.S. percentage (19.81 %) in severe pruning.

6. Grading of fruits according to class

Gazette of India, Part-2, Section-3, Sub Section-1 published by Government of India, Ministry of Agriculture (Department of Agriculture and Co-operation) Dated (9^{th} aug.2007) published that grading of custard apple (*Annona squamosa*) fruits according to size is determined by the weight of the fruit. Size classes A, B, C for fruit weight 301 gm and above, 201-300 gm, 150-200 gm, respectively.

7. Incidence of mealy bug (%)

In India, Singh and Ghosh (1970) studied the seasonal activity of *M. hirsutus* in Mesta under natural conditions, however, the activity of the mealy bug was observed from the month of March. The peak infestation was usually noted from the first week of September to the last week of October.

Ghose (1972) reported that *M. hirsutus* was active during winter also, without hibernation but was most active during March-October on Roselle around West Bengal.

Mani (1989) reported that *M. hirsutus* (Green) was the major pest of *Annona squamosa* L. in Maharashtra. Shreedharan *et al.* (1989) reported that the pest, *P. citri*. was severe in summer season (March-July) and no incidence in winter season (October-November) in mandarins orange (*Citrus reticulata*). The studies on associated with weather factors revealed that the population of mealy bug was positively correlated with the temperature and negatively with relative humidity, while it had no clear correlation with total rainfall.

During the survey of the pests of grape wine gardens at Arvi Pimpalgaon of Pune district (Maharashtra) in 1991-1992, it was observed that, the mealy bug

population was maximum from middle of February to May and middle of September to middle of November. The pest was found to be inactive from middle of November to middle of February (Anonymous, 1992).

The studies were undertaken on the population dynamics of pest of pomegranate and custard apple at Rahuri from 1991-94. The incidence of mealy bugs was the highest during Ambe bahar. The maximum build up of pest was recorded in the month of May; while the least incidence was noticed during the month of December on pomegranate indicating a significant and positive correlation with maximum temperature, minimum temperature and significant negative correlation with morning relative humidity. In custard apple orchard, the mealy bug population was more pronounced during October- November at the time of maturity of fruits indicating non- significant negative correlation coefficient with all meteorological parameters. Another study on pest s of custard apple carried out at Solapur (Maharashtra) in 1994 revealed that the infestation of mealy bugs was severe and recorded its peak (85.10% infestation of fruits /plant) in the first fortnight of December and there existed a negative correlation of mealy bug infestation with minimum and maximum temperature, relative humidity and rainfall (Anon. 1995).

Field studies were carried out during 1995-96 in Andhra Pradesh, India to investigate fluctuation in *M. hirsutus* populations in grapes and *Annona reticulata* L. The highest population was found on grapes during the first half of July (vegetative phase) and during the second half of March (reproductive phase) and on *Annona reticulata* in June (Murthy and Babu, 1996).

Koli (2003) was opinion that, grape mealy bug was active during September to march in Rahuri (Maharashtra). The number of egg sacs, nymphs and adults/bud varied from 0.82-1.83, 8.83 to 61.58 and 2.16 to 17.08, respectively from September to March. The egg sacs, nymphs and adults of mealy bugs on grapes showed highly significant positive correlation with maximum and minimum temperature and highly

significant negative correlation with morning and evening relative humidity and non-significant negative correlation with rainfall.

3. MATERIAL AND METHODS

The present research programme 'Effect of pruning levels and time of pruning on growth, yield and quality parameters of custard apple (*Annona squamosa* L.) under North Maharashtra conditions' was carried out at Research farm, Horticulture section, College of Agriculture, Dhule during the year 2012-2013.

Present research programme was laid out in Split Plot Design consisting five levels of pruning with different intensity and time of pruning at 15 days intervals with three replications from 16th December to 16th February 2012-2013. The six year old age of Custard apple and two plants per treatments were used for research programme.

Material

The experiment was conducted on 6 year old trees of custard apple cv. Balanagar spaced at 5 x 5 m. Healthy trees of uniform growth and vigour was selected for the experiment. The soil of experimental plot was light to medium and good drainage. It has well leveled topography.

A) Experimental details

The experiment was started two month after harvesting of previous year fruits. The experiment was conducted in Split Plot Design with three replications during the month of December-February at an interval of 15 days with different pruning intensities and the following treatments were given to unit of two plants per replication.

B) Experimental details

1) Number of replication – Three

2) Experimental design – Split Plot Design (SPD)

3) Number of treatment combinations – 25

C) Treatments details -

I) Main Treatments- Time of pruning's

D_1- Pruning on 16th December

D_2- Pruning on 1st January

D_3- Pruning on 16th January

D_4- Pruning on 1st February

D_5- Pruning on 16th February

II) Sub Treatments- Pruning levels

P_1- Tip pruning

P_2- Pruning at 30 cm

P_3- Pruning at 60cm

P_4- Pruning at 90 cm

P_5- No pruning (control)

III) Treatment application

The pruning was commenced from 16th December 2012 after harvesting of previous year fruits, and continued at 1st January, 2013, 16th January, 2013, 1st February, 2013, 16th February, 2013 respectively.

The pruning was done on main shoot and also subsequent secondary and tertiary shoots on whole plant with different levels of Tip pruning, 30 cm, 60cm, 90 cm and No pruning (control) from top end.

D) Statistical data

The statistical analysis was performed as per Panse and Sukhatme (1985).

Observations

The observations in respect of vegetative growth, flowering and yield contributing characters and fruit quality were recorded as follows.

A) Growth Parameters

To observe the effect pruning time and pruning intensities on vegetative growth, the following observations were recorded.

1. Average length of shoot at monthly interval (cm)

The length of new shoots in each tree was recorded from tagged branch of each shoots emerged. The observation was recorded from the date of pruning till the date of visible appearance of first new shoot were counted and recorded.

2. Average number of internodes at monthly intervals

The number of internodes at monthly interval were recorded from tagged branches of each tree, from the date of pruning to the appearance of first new shoot were counted and recorded.

3. Average days required for the initiation flower

The date of visible appearance of first flower on each of the tree was recorded. The average number of days from the date of pruning till the date of appearance of first flower were counted and recorded as the period required for appearance of first flower.

4. Number of flowers per shoot

From onset of flowering, the total number of flowers per branch were counted on each tree from tagged branches, including the flowers dropped under each tree were regularly collected and counted.

B) Yield and yield contributing characters

1. Fruit set (%)

The percentage fruit set was calculated by dividing total number of flower by total number of fruit multiplied by 100.

2. Average number of fruits

As and when the fruits were matured, they were harvested and counted at each harvesting from each observational plant. The total numbers of all harvested fruits were counted to get total number of fruits harvested per tree during the season.

3. Size of fruit at polar and equatorial diameter (cm)

The size of fruits both polar and equatorial diameter was measured with the help of Vernier Caliper.

4. Average weight of fruit (g)

The average fruit weight was calculated by dividing the total weight of fruits per plant (yield) by the total number of fruits per plant.

5. Fruit yield (kg/tree)

The total weight of fruits harvested was taken at each harvesting from each observational plant. Sum up all the harvested fruits from each harvesting to get total weight of fruits harvested during the season.

C) Quality contributing characters

Selected fruits from each treatment per tree were taken during peak harvesting period to record the following quality characters.

1. Total Soluble Solids (^{o}B)

Homogenous pulp sample was used for recording TSS percentage. Percentage of total soluble solids (TSS) was recorded by automatic hand Refractometer (Erma Tokyo A 032) by taking a drop of pulp on prism of the Hand Refractometer and the readings were recorded.

2. Acidity (%)

The acidity of the pulp was determined from well homogenized pulp with 20 ml water and titrated against 0.1 N NaOH, using phenolphthalein as an indicator as per the method advocated by A.O.A.C. (1985) and Ranganna, S. (1986) and expressed as percentage of gluconic acid.

3. Pulp (%)

The pulp was extracted from fruit by separating the outer cover and seeds present. The weight of pulp was taken separately from each fruit. The percentage pulp was calculated by dividing actual weight of pulp by total weight of fruit multiplied by 100.

3. Seed (%)

The seeds were separated from the fruits, by separating pulp and outer cover of fruit. The seed percentage was calculated by dividing total weight of seeds by total weight of fruit multiplied by 100.

4. Seed : pulp ratio

The seed: pulp ratio was calculated by dividing total weight of pulp of fruit by total weight of seeds of fruit.

D) Incidence of mealy bug (%)

The incidence of mealy bugs was recorded by dividing total no. of individual of mealy bug actually present on fruit by total unit area of fruit multiplied by 100.

E) Grading of fruits according to classes

The grading of fruits was recorded according to the size for different classes (Anon, 2007) viz., A grade (300 g and above), B grade (above 200 g) and C grade (150-200 g and below).

4. EXPERIMENTAL RESULTS

The present investigation entitled 'Effect of pruning levels and time of pruning on growth, yield and quality parameters of custard apple (*Annona squamosa* L.) under North Maharashtra conditions' was carried out at Farm of Horticulture Section, Department of Horticulture, College of Agriculture, Dhule under M.P.K.V., Rahuri during the year 2012-13. The results obtained are broadly grouped into five major heads; (1) Growth (2) Yield (3) Quality (4) Grading (5) Incidence of mealy bugs. The data for quantitative and qualitative characters was subjected to statistical analysis by using Split Plot Design (SPD). The results obtained on these aspects are presented here under with appropriate headings-

4.1 Growth and flowering parameters

The data pertaining to average length of shoots at monthly interval, average number of internodes, average days required for initiation flower and average number of flowers per shoot are presented in Table 1 and Table 2.

4.1.1 Average Length of shoot at monthly interval (cm)

In case of average number of shoots, highest length of shoots at monthly interval was observed in pruning of trees on 16th December (10.58 cm) followed by pruning on 1st January while it was noticed minimum in pruning on 16th February(6.84 cm). The treatments D_1-pruning on 16th December and D_2-pruning on 1st January as well as D_3-pruning on 16th January and D_4-pruning on 1st February were at par with each other, respectively.

Maximum length of shoots at monthly interval was noticed at 90 cm pruning level (13.94 cm) which was significantly superior over rest of the treatments and minimum length of shoots at monthly interval was registered in control pruning (4.11cm).

The interaction effect due to the time of pruning interval and different intensities of pruning showed significant results among different combinations. Maximum length of shoots (18.48 cm) was recorded in treatment D_1P_4-pruning of

16th December with 90 cm pruning intensity which was at par with the treatment D_2P_4- i.e. pruning on 1st January with 90 cm pruning level (17.46 cm). The minimum length of shoots at monthly interval (3.58 cm) was noticed in the treatment D_4P_5 i.e. pruning on 1st February with control pruning.

4.1.2 Average number of internodes at monthly interval

Maximum number of internodes at monthly interval were observed in pruning of trees on 16th December (13.60) over rest of the treatments, while it was noted minimum in pruning on 16th February (11.08). The treatments D_3-pruning on 16th January, D_4-pruning on 1st February and D_5-pruning on 16th February were at par with each other.

Significantly maximum number of internodes at monthly interval was noticed in 60 cm pruning level of shoots (14.36) and minimum number of internodes was registered in control pruning (7.77). The treatments P_2-pruning at 30 cm and P_4-pruning at 90 cm were at par with each other.

Among the interaction effect due to time of pruning and intensity of pruning, maximum number of internodes at monthly interval (17.50) were recorded in treatment D_1P_3-pruning of trees on 16th December with 60 cm pruning intensity which was statistically at par with the treatment D_2P_3 i.e. pruning on 1th January with 60 cm pruning (17.26) and the minimum number of internodes at monthly interval was noticed in the treatment D_5P_5 i.e. pruning on 16th February with control pruning (6.65).

4.1.3 Average days required for initiation of flower

From the data presented in Table 1, the significant differences were observed for days taken to flowering as influenced by different pruning treatments. Significantly minimum number of days required for initiation of flowering was noticed in pruning on 16th December (95.10) while it was observed maximum in pruning on 16th February (102.08). The treatments D_2-pruning on 1st January and

D_3-pruning on 16th January as well as D_4-pruning on 1st February and D_5-pruning on 16th February were at par with each other, respectively.

Significantly minimum number of days for flowering was recorded due to the control pruning of shoots (95.97) over rest of the treatments. Whereas, maximum days were required for flowering in 90 cm pruning level of shoots (101.53) followed by 60 cm of pruning level (99.73) and tip pruning level (98.18).

The interaction effect due to the time of pruning and intensity of pruning was found non-significant result. The early flowering i.e. minimum number of days required for flowering (93.67) were registered in treatment D_1P_5-i.e. pruning of 16th December with control pruning and late flowering i.e. maximum number of days for flowering (105.67) were observed in the treatment D_5P_4 i.e. pruning of 16th February and with 90 cm of pruning level.

4.1.4 Number of flowers per shoot

The average number of flowers per shoot as influenced by different pruning treatment showed significant differences among the different treatments and its interaction. The maximum number of flowers per shoot (4.63) was noticed in pruning on 1st February followed by pruning on 16th February (4.33) and pruning on 16th January (4.27). The treatments D_3-pruning on 16th January, D_4-pruning on 1st February and D_5-pruning on 16th February were at par with each other. The minimum number of flowers per shoot (3.41) was recorded in pruning of trees on 16th December.

Significantly highest numbers of flowers per shoot were registered due to the 30 cm of pruning level of shoots (6.94). The minimum number of flowers per shoot (2.32) was recorded in 90 cm of pruning level. Maximum number of flowers per shoot (8.43) was noticed in treatment D_4P_2 i.e. pruning on 1st February with 30 cm pruning level which was statistically at par with the treatment D_5P_2 i.e. pruning on 16th February with 30 cm pruning (8.42). However, it was noticed minimum in treatment D_2P_4- i.e. pruning on 1st January with 90 cm pruning intensity (2.11).

Table 1 Effect of pruning time (D) and pruning levels (P) on growth and flowering parameters

Treatments details	Av. length of shoot at monthly interval (cm)	Av. number of internodes at monthly interval	Av. Days required for initiation of flower	Number of flowers per shoot
MAIN PLOT				
D_1-Pruning on 16thDecember	10.58	13.60	95.10	3.41
D_2- Pruning on 1st January	10.15	12.55	97.00	3.44
D_3- Pruning on 16th January	8.27	11.54	97.80	4.27
D_4- Pruning on 1st February	8.30	11.35	101.02	4.63
D_5-Pruning on 16th February	6.84	11.08	102.08	4.33
S. E. ±	0.35	0.20	0.43	0.22
C. D. at 5%	1.14	0.66	1.41	0.73
SUB PLOT				
P_1-Tip pruning	6.42	11.21	98.18	3.66
P_2-Pruning at 30 cm	9.17	13.26	97.58	6.94
P_3-Pruning at 60 cm	10.50	14.36	99.73	4.13
P_4-Pruning at 90 cm	13.94	13.53	101.53	2.32
P_5-No Pruning (Control)	4.11	7.77	95.97	3.02
S. E. ±	0.35	0.18	0.33	0.16
C. D. at 5%	1.02	0.52	0.95	0.47

Table 2 Interaction effect of pruning time and pruning levels (D x P) on growth and flowering contributing parameters

Treatments details	P_1 Tip Pruning	P_2 Pruning at 30 cm	P_3 Pruning at 60 cm	P_4 Pruning at 90 cm	P5 No pruning	S. E. ±	C. D. at 5%
1. Av. length of shoot at monthly interval (cm)							
D_1- Pruning on 16th December	6.90	9.67	13.06	18.48	4.79	0.80	2.28
D_2- Pruning on 1st January	5.97	10.20	12.54	17.46	4.55		
D_3- Pruning on 16th January	5.39	8.50	8.03	15.42	3.99		
D_4- Pruning on 1st February	8.36	11.35	10.05	8.15	3.58		
D_5- Pruning on 16th February	5.46	6.09	8.83	10.18	3.64		
2. Av. number of internodes at monthly interval							
D_1- Pruning on 16th December	10.62	14.84	17.50	16.00	9.06	0.40	1.16
D_2- Pruning on 1st January	9.55	12.68	17.26	15.18	8.10		
D_3- Pruning on 16th January	14.09	12.92	10.70	12.44	7.57		
D_4- Pruning on 1st February	13.89	12.68	12.32	10.43	7.47		
D_5- Pruning on 16th February	7.91	13.21	14.01	13.60	6.65		
3. Av. days required for initiation of flower							
D_1- Pruning on 16th December	95.33	94.17	96.00	96.33	93.67	0.74	NS
D_2- Pruning on 1st January	96.33	96.42	98.25	99.17	94.83		
D_3- Pruning on 16th January	96.58	97.17	98.25	101.83	95.17		
D_4- Pruning on 1st February	100.75	99.33	103.17	104.67	97.17		
D_5- Pruning on 16th February	101.92	100.83	103.00	105.67	99.00		
4. Av. number of flowers per shoot							
D_1- Pruning on 16th December	3.17	5.40	3.66	2.17	2.64	0.37	1.06
D_2- Pruning on 1st January	3.37	5.39	3.09	2.11	3.22		
D_3- Pruning on 16th January	4.31	7.05	4.83	2.14	3.03		
D_4- Pruning on 1st February	3.97	8.43	4.50	2.93	3.33		
D_5- Pruning on 16th February	3.50	8.42	4.55	2.27	2.91		

4.2 Yield and yield contributing characters

The data in respect of fruit set percentage, average number of fruits per plant, size of fruit, average weight of fruits, yield per plant and are presented in Table-3 and 4 (a & b).

4.2.1 Fruit set (%)

Maximum fruit set (60.98%) were noted in pruning of trees on 1st February which was at par with the pruning of trees on 16th February. While, minimum fruit set was observed in pruning of trees on 16th December (51.11%).

Significant results were obtained due to the different intensities of pruning. Significantly maximum fruit set were registered in 30 cm pruning level (66.44%) followed by 60 cm pruning level of trees (64.99 %). The lowest per cent fruit set was observed in 90 cm pruning level (43.65 %).

The interaction effect due to time interval of pruning and different intensities of pruning showed significant results among different combinations. The highest percentage of fruit set (71.17%) was registered in treatment D_4P_2 i.e. pruning on 1st February with 30 cm pruning level. The treatments D_4P_2 i.e. pruning on 1st February with 30 cm pruning level and D_5P_2 i.e. pruning on 16th February with 30 cm pruning level were statistically at par with each other. Minimum fruit set was observed in the treatment D_2P_4 i.e. pruning of 1st January with 90 cm of pruning level (36.50 %).

4.2.2 Size of fruit (Polar and Equatorial diameter)

4.2.2 (A) Polar diameter (cm)

Maximum polar diameter of fruit (6.98 cm) were noted in pruning of tree of 1st February which was statistically at par with pruning of trees on 16th January (6.88 cm) while, it was noticed minimum in pruning of trees of 16th December (6.38 cm).

Significant results were obtained due to the different intensities of pruning for polar diameter. The highest polar diameter of fruit was registered in 90 cm of pruning level (7.59 cm) followed by pruning on 60 cm level (7.14 cm). The lowest polar diameter of fruit was observed in no pruning (5.77 cm).

The effect of interaction due to time of interval of pruning and different intensities of pruning showed significant results among different combinations. The maximum polar diameter of fruit (7.90 cm) was registered in treatment D_4P_3- i.e. pruning of 1st February with 60 cm of pruning level. The treatments D_4P_4-i.e. pruning on 1th February with 90 cm pruning, D_3P_4 -i.e. pruning on 16th January with 90 cm pruning, D_5P_4-i.e. pruning on 16th February with 90 cm pruning and D_2P_4 -i.e. pruning on 1st January with 90 cm pruning were statistically at par with each other. Minimum polar diameter (5.45 cm) was observed in treatment D_2P_5- i.e. pruning on 1st January with no pruning.

4.2.2 (B) Equatorial diameter (cm)

Significantly maximum equatorial diameter of fruit (7.79 cm) were noted in pruning of trees on 1st February, while, it was recorded minimum (7.20 cm) in pruning of trees of 16th December. The treatments D_5-i.e. pruning on 16th February, D_3-i.e. pruning on 1st January and D_4-i.e. pruning on 1st February were statistically at par with each other.

Significant results were obtained due to the different intensities of pruning for equatorial diameter. The highest equatorial diameter of fruit was registered in 90 cm of pruning level (8.28 cm) followed by pruning at 60 cm (7.93 cm). The lowest equatorial diameter of fruit was observed in no pruning (6.48 cm).

The effect of interaction due to time interval of pruning and different intensities of pruning showed non-significant results among different combinations. The highest equatorial diameter of fruit (8.45 cm) was registered in treatment D_4P_4-i.e. pruning of 1st February with 90 cm of pruning level followed by D_5P_4-i.e. pruning on 16th February with 90 cm of pruning level (8.34 cm) and

minimum equatorial diameter was recorded in treatment D_1P_5 i.e. pruning of 16th December with control pruning (6.10 cm).

4.2.3 Average number of fruits/plant

Significant results were obtained due to the time of pruning. Highest number of fruits per plant were recorded in pruning of trees on 1st February (75.23) which was statistically at par with pruning on 16th February (72.75) while, the lowest number of fruits per plant (55.01) were recorded in pruning of tree on 16th December.

Significantly highest numbers of fruits per plant were registered due to the 30 cm pruning level of shoots (86.26) followed by control pruning (80.69). Minimum numbers of fruits were recorded due to pruning on 90 cm level of shoots (28.66).

Significantly maximum number of fruits per tree (106.65) was noticed in treatment D_4P_2-i.e. pruning on 1st February with 30 of pruning level. The minimum number of fruits per tree (22.61) was recorded in treatment D_2P_4 -i.e. pruning on 1st January with 90 cm pruning level. The treatments D_5P_2, D_4P_5, D_5P_5, D_4P_1 and D_5P_1 were statistically at par with each other.

4.2.4 Average weight of fruits (g)

The time of pruning revealed that maximum average weight of fruits was recorded in pruning on 1st February (251.73g) followed by pruning on 16th February (244.47g). The minimum weight of fruit was noticed in pruning on 16th December (213.40g). The treatments D_5-pruning on 16th February (244.47g) and D_3-pruning on 16th January (241.07g) were statistically at par with each other.

Significantly highest weight of fruits (299.30g) was noted in 90 cm pruning level followed by 60 cm pruning level (260.29g). The minimum weight of fruits was recorded in control pruning (172.44g).

Significant results were obtained as effect of interaction due to time of pruning and different pruning intensities among different treatment combinations. Significantly maximum weight of fruit (342.17g) was found in the treatment D_4P_4- i.e. pruning on 1st February with 90 cm pruning level and minimum in D_2P_5 -i.e. pruning on 1st January and with no pruning (154.72g). The treatments D_3P_4, D_2P_4, and D_4P_3, were statistically at par with each other.

4.2.5 Yield/plant (kg/plant)

The results obtained from yield data indicate productivity of the crop. The time of pruning leads to significant results in yield character. This is quantitative measure to assess productivity of crop. Among the time of pruning, significantly highest yield per plant was registered in pruning on 1st February (18.37 kg) followed by pruning on 16th February (17.36 kg). The lowest yield was recorded in pruning on 16th December (11.65 kg).

Significantly maximum yield per plant (20.74 kg) was found in 30 cm pruning level followed by tip pruning (16.01 kg), while the minimum yield per plant (9.96 kg) was noted in 90 cm pruning level.

The interaction effect due to time of pruning and pruning intensities showed significant results among the different treatment combinations. The maximum yield per plant (26.33 kg) was noted in treatment D_4P_2 -i.e. pruning on 1st February with 30 cm pruning level. While, minimum yield per plant (8.24 kg) was observed in treatment D_1P_4-i.e. pruning on 16th December and with 90 cm pruning level. The treatments D_3P_2, D_4P_1, and D_5P_1 were statistically at par with each other.

Table 3 Effect of pruning time (D) and pruning levels (P) on yield and yield contributing parameters

Treatments details	Fruit set (%)	Diameter of fruit (cm)		Av. number of fruits per plant	Av. weight of fruits (g)	Yield (kg/plant)
		Polar	Equatorial			
MAIN PLOT						
D_1- Pruning on 16th December	51.11	6.38	7.20	55.01	213.40	11.65
D_3-Pruning on 1st January	55.21	6.49	7.35	53.56	223.25	12.12
D_3-Pruning on 16th January	57.93	6.88	7.29	59.78	241.07	14.00
D_4-Pruning on 1st February	60.98	6.98	7.79	75.23	251.73	18.37
D_5-Pruning on 16th February	60.41	6.68	7.38	72.75	244.47	17.36
S. E. ±	0.42	0.04	0.03	0.80	2.98	0.20
C. D. at 5%	1.37	0.16	0.11	2.63	9.73	0.68
SUB PLOT						
P_1-Tip pruning	58.57	6.30	6.95	74.25	211.27	16.01
P_2-Pruning at 30 cm	66.44	6.62	7.37	86.26	230.62	20.74
P_3-Pruning at 60 cm	64.99	7.14	7.93	46.47	260.29	12.35
P_4-Pruning at 90 cm	43.65	7.59	8.28	28.66	299.30	9.96
P_5-No Pruning Control)	51.98	5.77	6.48	80.69	172.44	14.44
S. E. ±	0.31	0.08	0.09	1.28	3.18	0.26
C. D. at 5%	0.90	0.22	0.26	3.68	9.11	0.75

Table 4 (a) Interaction effect of pruning time and pruning levels (D x P) on yield and yield contributing characters

1. Fruit set %							
Treatments details	P_1 Tip Pruning	P_2 Pruning at 30 cm	P_3 Pruning at 60 cm	P_4 Pruning at 90 cm	P_5 No pruning	S. E. ±	C. D. at 5%
D_1-Pruning on 16th December	49.65	56.51	62.59	38.68	48.11	0.70	2.01
D_2-Pruning on 1st January	58.35	67.33	64.47	36.50	49.38		
D_3-Pruning on 16th January	61.07	67.90	64.46	43.92	52.30		
D_4-Pruning on 1st February	62.36	71.17	67.13	48.81	55.41		
D_5-Pruning on 16th February	61.43	69.28	66.27	50.35	54.71		
2. Size of fruits a) Polar diameter (cm)							
D_1-Pruning on 16th December	6.00	6.44	6.49	7.33	5.66	0.16	0.48
D_2-Pruning on 1st January	6.26	6.58	6.60	7.54	5.45		
D_3-Pruning on 16th January	6.48	6.61	7.36	7.65	6.30		
D_4-Pruning on 1st February	6.57	6.68	7.90	7.84	5.93		
D_5-Pruning on 16th February	6.17	6.77	7.34	7.61	5.49		
3. Size of fruits b) Equatorial diameter (cm)							
D_1-Pruning on 16th December	6.82	7.17	7.73	8.15	6.10	0.18	NS
D_2-Pruning on 1st January	6.68	7.29	7.90	8.27	6.59		
D_3-Pruning on 16th January	6.76	7.24	7.92	8.19	6.37		
D_4-Pruning on 1st February	7.52	7.98	8.07	8.45	6.95		
D_5-Pruning on 16th February	6.99	7.20	8.05	8.34	6.32		

Table 4 (b) Interaction effect of pruning time and pruning levels (D x P) on yield and yield contributing characters

4. Average number of fruits per plant							
Treatments details	P_1 Tip Pruning	P_2 Pruning at 30 cm	P_3 Pruning at 60 cm	P_4 Pruning at 90 cm	P_5 No pruning	S. E. ±	C. D. at 5%
D_1-Pruning on 16th December	61.46	70.81	46.95	23.08	72.75	2.87	8.22
D_2-Pruning on 1st January	60.30	73.09	39.50	22.61	72.31		
D_3-Pruning on 16th January	69.48	84.36	42.31	30.41	72.33		
D_4-Pruning on 1st February	90.46	106.65	52.29	33.32	93.42		
D_5-Pruning on 16th February	89.53	96.38	51.31	33.88	92.65		
5. Average weight of fruits (g)							
D_1-Pruning on 16th December	218.03	197.70	237.73	251.87	161.67	7.12	20.37
D_2-Pruning on 1st January	197.97	223.57	250.60	289.38	154.72		
D_3-Pruning on 16th January	206.33	266.40	264.43	295.00	173.17		
D_4-Pruning on 1st February	221.47	227.63	275.72	342.17	191.68		
D_5-Pruning on 16th February	212.57	237.82	272.97	318.07	180.95		
6. Yield (kg/plant)							
D_1-Pruning on 16th December	12.54	15.87	10.26	8.24	11.34	0.59	1.69
D_2-Pruning on 1st January	12.74	16.89	10.23	8.77	11.95		
D_3-Pruning on 16th January	15.26	20.38	11.51	9.44	13.40		
D_4-Pruning on 1st February	20.31	26.33	15.08	11.97	18.17		
D_5-Pruning on 16th February	19.23	24.21	14.66	11.39	17.33		

4.3 Quality contributing characters

The data in respect of T.S.S. (%), acidity (%), pulp (%), seed (%) and seed: pulp ratios are presented in Table-5 and Table 6 (a & b).

4.3.1 Total soluble solids (^{o}B)

The results showed significant treatment differences in respect of time of pruning and intensities of pruning and interactions showed non-significant results. Among time of pruning, pruning on 1st February showed higher per cent of total soluble solids (20.52 ^{0}B) as most superior treatment followed by pruning on 16th February. Whereas, pruning on 16th December recorded minimum per cent of total soluble solids (19.23 ^{0}B).

Significantly maximum percentage of total soluble solids was recorded in 60 cm pruning level (21.13 ^{0}B) followed by 30 cm pruning level (20.76 ^{0}B). The minimum percentage of total soluble solids was noted in 90 cm pruning level (18.22 ^{0}B).

Interaction effect due to time of pruning and intensities of pruning was found statistically non-significant results. Treatment D_4P_3 i.e. pruning on 1st February with 60 cm pruning level was found maximum percentage of total soluble solids (21.83 ^{0}B). Minimum total soluble solids (17.63 ^{0}B) were noticed in treatment D_2P_4-i.e. pruning on 1st January with 90 cm pruning level.

4.3.2 Acidity (%)

Non-significant results were obtained due to the time of pruning and different pruning intensities. The lowest acidity was noticed in pruning on 1st February (0.19 %). Maximum acidity was found in pruning on 16th January (0.22 %). Lowest acidity was found in 30 cm pruning level of shoots (0.19 %) followed by 60 cm pruning level (0.20 %) and highest acidity was recorded in 90 cm pruning level of shoots.

The effect of interaction due to time and intensity of pruning revealed non-significant differences among different treatment combinations.

The lowest acidity (0.16 %) was registered in treatment D_4P_2-i.e. pruning on 1st February with 30 cm pruning level and the highest acidity content was observed in treatment D_3P_4 i.e. pruning on 16th January with 90 cm pruning (0.24 %).

4.3.3 Pulp (%)

This is the most important quality parameter in respect of pulp industry. The data pertaining to pulp percentage was revealed significant results due to the time of pruning. Significantly maximum pulp percentage was recorded in pruning of trees on 1st February (53.27 %) followed by pruning on 16th February (51.59) while, it was noticed minimum in pruning of trees on 16th December (49.95%).

Significantly highest percent of pulp (55.72%) was found due to 30 cm pruning level followed by 60 cm pruning level (52.30 %). The minimum pulp percentage was recorded due to 90 cm pruning level of shoots (47.91 %).

The interaction effect due to the time of pruning and intensity of pruning revealed significant results. The maximum pulp percentage was observed in treatment D_4P_2-i.e. pruning on 1st February with 30 cm pruning level (60.43 %) while, minimum pulp per cent were registered in treatment D_2P_4-i.e. pruning on 1th January with 90 cm of pruning level (47.59 %).

4.3.4 Seed (%)

The data obtained regarding seed percent was found non-significant and minimum seed percentage was found in pruning on 1st February (10.31 %) followed by pruning on 16th January (11.13 %). The maximum seed percentage was observed in the pruning on 1st January (12.04 %).

Among the intensity of pruning, non-significant results were obtained. Minimum percentage of seed was recorded in 30 cm pruning level (10.65 %)

while; maximum percentage of seed (11.86 %) was recorded in 90 cm pruning level.

The interaction effect due to time of pruning and intensity of pruning among different treatments combinations were found non-significant results. Minimum percentage of seed was registered in the treatment D_4P_5 -i.e. pruning on 1st February with control pruning (9.70 %). Maximum percentage of seed was noticed in treatment D_2P_5-i.e. pruning on 1st January with no pruning (13.14 %).

4.3.5 Seed: pulp ratio

Non-significant results were obtained due to the time of pruning. The lowest seed: pulp ratio (0.20) was noted in pruning on 1st February followed by pruning on 16th February (0.22) and pruning on 16th January (0.22). The highest seed: pulp (0.24) was registered in pruning on 1st January.

Non-significantly lowest seed: pulp ratio due to the intensity of pruning was recorded in 30 cm pruning level (0.21) followed by 60 cm of pruning level (0.22). Whereas, the maximum seed: pulp ratio was noted in control pruning (0.24).

The interaction effect due to the time of pruning and intensity of pruning showed non-significant results. The lowest seed: pulp ratio (0.19) confined to the treatment D_4P_2-i.e. pruning on 1st February with 30 cm of pruning level. The highest seed: pulp ratio (0.26) was registered in treatment D_2P_5-i.e. pruning in 1st January with control pruning.

Table 5 Effect of pruning time (D) and pruning levels (P) on quality contributing parameters

Treatments details	T.S.S. (^{o}B)	Acidity (%)	Pulp (%)	Seed (%)	Seed: Pulp Ratio
MAIN PLOT					
D_1-Pruning on 16th December	19.29	0.21	49.95	11.38	0.23
D_2-Pruning on 1st January	19.23	0.21	50.77	12.04	0.24
D_3-Pruning on 16th January	19.68	0.22	50.52	11.13	0.22
D_4-Pruning on 1st February	20.52	0.19	53.27	10.31	0.20
D_5-Pruning on 16th February	19.80	0.20	51.59	11.26	0.22
S. E. ±	0.18	0.007	0.21	0.44	0.01
C. D. at 5%	0.58	NS	0.70	NS	NS
SUB PLOT					
P_1-Tip pruning	19.75	0.22	51.13	11.16	0.23
P_2-Pruning at 30 cm	20.76	0.19	55.72	10.65	0.21
P_3-Pruning at 60 cm	21.13	0.20	52.30	10.88	0.22
P_4-Pruning at 90 cm	18.22	0.22	47.91	11.86	0.23
P_5-No Pruning (Control)	18.66	0.21	49.04	11.56	0.24
S. E. ±	0.16	0.006	0.23	0.30	0.006
C. D. at 5%	0.46	NS	0.66	NS	NS

Table 6 (a) Interaction effect of pruning time and pruning levels (D x P) on quality contributing characters

Treatments details	P_1 Tip Pruning	P_2 Pruning at 30 cm	P_3 Pruning at 60 cm	P_4 Pruning at 90 cm	P_5 No pruning	S. E. ±	C. D. at 5%
1. Total soluble solids (^oB)							
D_1-Pruning on 16th December	19.72	20.53	20.50	17.83	17.90	0.36	NS
D_2-Pruning on 1st January	19.43	20.03	20.22	17.63	18.85		
D_3-Pruning on 16th January	19.40	20.30	21.39	18.25	19.05		
D_4-Pruning on 1st February	20.76	21.70	21.83	18.82	19.46		
D_5-Pruning on 16th February	19.44	21.25	21.70	18.57	18.05		
2. Acidity (%)							
D_1-Pruning on 16th December	0.22	0.20	0.20	0.23	0.21	0.015	NS
D_2-Pruning on 1st January	0.22	0.20	0.22	0.19	0.20		
D_3-Pruning on 16th January	0.24	0.21	0.20	0.24	0.21		
D_4-Pruning on 1st February	0.20	0.16	0.20	0.21	0.20		
D_5-Pruning on 16th February	0.21	0.19	0.20	0.21	0.21		
3. Pulp (%)							
D_1-Pruning on 16th December	50.91	52.25	50.44	47.68	48.47	0.51	1.48
D_2-Pruning on 1st January	50.76	55.40	51.81	47.59	48.32		
D_3-Pruning on 16th January	50.28	53.79	52.32	47.62	48.59		
D_4-Pruning on 1st February	52.42	60.43	54.41	48.75	50.36		
D_5-Pruning on 16th February	51.30	56.43	52.52	47.92	49.47		

Table 6 (b) Interaction effect of pruning time and pruning levels (D x P) on quality contributing characters

4. Seed (%)							
Treatments details	P_1 Tip Pruning	P_2 Pruning at 30 cm	P_3 Pruning at 60 cm	P_4 Pruning at 90 cm	P_5 No pruning	S. E. ±	C. D. at 5%
D_1-Pruning on 16th December	11.45	10.76	11.03	12.10	11.55	0.68	NS
D_2-Pruning on 1st January	12.02	10.92	11.41	12.71	13.14		
D_3-Pruning on 16th January	11.42	10.44	10.91	11.74	11.13		
D_4-Pruning on 1st February	10.68	10.66	10.13	10.38	9.70		
D_5-Pruning on 16th February	10.21	10.46	10.91	12.40	12.30		
5. Seed: Pulp ratio							
D_1-Pruning on 16th December	0.23	0.23	0.22	0.25	0.24	0.014	NS
D_2-Pruning on 1st January	0.24	0.23	0.23	0.25	0.26		
D_3-Pruning on 16th January	0.24	0.20	0.21	0.23	0.24		
D_4-Pruning on 1st February	0.20	0.19	0.21	0.20	0.19		
D_5-Pruning on 16th February	0.22	0.20	0.22	0.21	0.20		

4.4 Incidence of mealy bug (%) and Grading of fruits according to class (kg)

The data in respect of incidence of mealy bug and grading of fruits are presented in Table-7 and 8.

4.4.1 Incidence of mealy bugs (%)

Significantly lowest incidence of mealy bug (2.41 %) was noted in pruning on 1st February. The highest incidence of mealy bug (3.82 %) was registered in pruning time on 16th December.

Significantly lowest incidence of mealy bug (2.68 %) was observed in pruning level of 30 cm followed by 60 cm pruning level (2.97%). The highest incidence of mealy bug (3.68 %) was registered in 90 cm pruning level.

The interaction effect due to the time of pruning and intensity of pruning showed non-significant result. Lowest incidence of mealy bug (1.57 %) confined to treatment D_4P_2 -i.e. pruning of 1st February with 30 cm pruning level. However, the highest incidence of mealy bug (4.94 %) was registered in treatment D_3P_4-i.e. pruning on 16th January with 90 cm pruning level.

4.4.2 Grading of fruits

Significantly maximum A grade fruits (5.84 kg) noted in pruning of trees on 1st February and minimum were recorded in pruning of tree on 16th December (3.06 kg). Maximum B grade fruits (6.73 kg) were noticed in pruning of trees on 1st February which was at par with pruning of trees on 16th February (6.56 kg) and minimum B grade fruits were found in pruning of trees on 1st January (4.39 kg). Whereas, maximum C grade fruits were noted in pruning of trees on 16th February (6.39 kg) which was at par with pruning of trees on 1th February (6.20 kg) and minimum C grade fruits were registered in pruning of tree on 16th December (4.13 kg).

The significant results were obtained due to the different intensities of pruning's, for A, B and C grade fruits. Significantly maximum A grade fruits were

recorded in 30 cm pruning level (5.19 kg). Minimum A grade fruits were found in control pruning (2.94 kg). Significantly maximum B grade fruits were noted in 30 cm pruning level (7.67 kg) followed by tip pruning (5.87 kg) and minimum B grade fruits were registered in 90 cm pruning level (3.98 kg). Significantly maximum C grade of fruits (8.14 kg) were noted in 30 cm pruning level. While, minimum C grade of fruits observed in 90 cm pruning level (2.03 kg).

` The effect of interaction due to time of interval of pruning and different intensities of pruning showed significant results for A grade, B grade and C grade fruits.

The maximum A grade fruits were registered in treatment D_4P_2-i.e. pruning on 1st February with 30 cm pruning level (7.23 kg) which was statistically at par with treatment D_4P_3-i.e. pruning on 1st February with 60 cm pruning level (6.48 kg). Whereas, minimum A grade fruits was registered in treatment D_2P_5-i.e. pruning on 1st January with control pruning (2.50 kg).

The maximum B grade fruit were registered in treatment D_5P_2-i.e. pruning on 16th February with 30 cm pruning level of shoots (9.60 kg) which was statistically at par with the treatment D_4P_2-i.e. pruning on 1st February with 30 cm pruning level (9.55 kg). However, minimum B grade fruits (2.90 kg) were noticed in treatment D_2P_4 -i.e. pruning on 1st January with 90 cm pruning level.

The maximum C grade fruit was registered in treatment D_4P_2-i.e. pruning on 1st February with 30 cm pruning level (10.57 kg) which was statistically at par with the treatment D_5P_2-i.e. pruning on 16th February with 30 cm pruning level (10.42 kg). Minimum C grade fruits were registered in treatment D_3P_4-i.e. pruning on 16st January with 90 cm pruning level (1.73 kg).

Table 7 Effect of pruning time (D) and pruning levels (P) on incidence of mealy bug and grading of fruits

Treatments details	Incidence of mealy bug (%)	Weight of A Grade fruits (kg)	Weight of B Grade fruits (kg)	Weight of C Grade fruits (kg)
MAIN PLOT				
D_1-Pruning on 16thDecember	3.82	3.06	4.84	4.13
D_2- Pruning on 1st January	3.64	3.22	4.39	4.48
D_3- Pruning on 16th January	3.11	3.91	4.79	5.40
D_4- Pruning on 1st February	2.41	5.84	6.73	6.20
D_5-Pruning on 16th February	2.87	4.47	6.56	6.39
S. E. ±	0.08	0.15	0.18	0.14
C. D. at 5%	0.28	0.50	0.59	0.47
SUB PLOT				
P_1-Tip pruning	3.28	3.97	5.87	6.54
P_2-Pruning at 30 cm	2.68	5.19	7.67	8.14
P_3-Pruning at 60 cm	2.97	4.45	4.57	3.50
P_4-Pruning at 90 cm	3.68	4.25	3.98	2.03
P_5-No Pruning (Control)	3.24	2.94	5.23	6.40
S. E. ±	0.17	0.14	0.18	0.18
C. D. at 5%	0.51	0.41	0.51	0.52

Table 8 Interaction effect of pruning time and pruning levels (D x P) on incidence of mealy bug and grading of fruits

1. Incidence of mealy bug (%)							
Treatments details	P_1 Tip Pruning	P_2 Pruning at 30 cm	P_3 Pruning at 60 cm	P_4 Pruning at 90 cm	P5 No pruning	S. E. ±	C. D. at 5%
D_1- Pruning on 16th December	3.63	3.76	3.36	4.29	4.07	0.40	NS
D_2- Pruning on 1st January	3.87	3.28	2.97	4.42	3.68		
D_3- Pruning on 16th January	3.29	2.54	2.61	4.94	3.17		
D_4- Pruning on 1st February	2.44	1.57	2.82	2.79	2.42		
D_5- Pruning on 16th February	3.16	2.25	3.12	2.94	2.88		
2. Grading of fruits (kg) a) A Grade fruits							
D_1- Pruning on 16th December	2.41	4.02	3.13	3.02	2.70	0.32	0.92
D_2- Pruning on 1st January	2.63	4.03	3.37	3.57	2.50		
D_3- Pruning on 16th January	4.25	5.52	3.99	3.53	2.27		
D_4- Pruning on 1st February	5.67	7.23	6.48	6.09	3.73		
D_5- Pruning on 16th February	4.91	5.15	5.27	5.03	3.50		
3. Grading of fruits (kg) a) B Grade fruits							
D_1- Pruning on 16th December	5.69	5.58	4.23	4.03	4.67	0.40	1.16
D_2- Pruning on 1st January	4.97	6.69	3.58	2.90	3.80		
D_3- Pruning on 16th January	5.30	6.91	3.97	3.87	3.90		
D_4- Pruning on 1st February	6.98	9.55	5.44	4.53	7.17		
D_5- Pruning on 16th February	6.40	9.60	5.65	4.55	6.60		
4. Grading of fruits (kg) a) C Grade fruits							
D_1- Pruning on 16th December	5.05	5.93	3.55	1.77	4.37	0.41	1.18
D_2- Pruning on 1st January	5.30	6.02	3.50	2.53	5.07		
D_3- Pruning on 16th January	6.33	7.78	3.30	1.73	7.83		
D_4- Pruning on 1st February	8.32	10.57	3.30	1.83	7.00		
D_5- Pruning on 16th February	7.69	10.42	3.83	2.28	7.73		

5. DISCUSSION

The present investigation entitled 'Effect of pruning levels and time of pruning on growth, yield and quality parameters of custard apple (*Annona squamosa* L.) under North Maharashtra conditions' was carried out with different time and pruning intensities.

The data regarding the growth, yield, quality, grading and incidence of mealy bug's are presented in preceding chapters. The results obtained are discussed here under with appropriate subheadings.

5.1 Growth parameters

The results obtained regarding different growth parameters viz., average length of shoots at monthly interval, average number of internodes at monthly interval, average days required for initiation flower and average number of flowers per shoot as influenced by different treatments of time and intensities of pruning differed significantly.

5.1.1 Length of shoot at monthly interval

The results indicated that the effect of time and intensity of pruning was beneficial in increasing growth of plant. The average length of shoot at monthly interval was found maximum during early days of pruning and delayed with further extent of days of pruning. The maximum length of shoots was observed in pruning of trees on 16th December (10.58 cm) followed by pruning on 1st January (10.15 cm). The trees under control pruning showed minimum length of shoot, but increased in severity of pruning. The maximum average length of shoots at monthly interval was observed in 90 cm pruning level (13.94 cm) followed by 60 cm pruning level (10.50 cm).

Among the interaction effects due to the time of pruning and intensity of pruning, significantly maximum length of shoots at monthly interval (18.48 cm) was recorded in treatment D_1P_4- i.e., pruning of 16th December with 90 cm pruning intensity followed by D_2P_4 (17.46 cm). These results are in accordance with those reported by Awasthi and Misra (1969) who studied the length of shoot increased with increase in severity of pruning in ber. Bhonsle (1972) reported similar results where total number of shoots per vine increased with decrease in severity of pruning in lighter pruning of grape.

Forshey *et al*., (1992) stated that heading back weakness apical dominance and this leads to the release of many buds from dormancy and the development vigourous shoot in apple and pear trees.

Shahein *et al.* (2010) revealed that the most effective treatment was heading back by removing 20 cm plus nitrogen fertilization which produced 73 and 5.2 lateral shoots and highest number of leaves per shoot 60.3 and 59.2 in custard apple.

Gham (2011) reported that new shoots per branch in custard apple was found maximum during early 60 days of pruning after previous harvest with 75 per cent pruning intensity (265.00) and was minimum due to late pruning (120 days) with no pruning (110.00).

5.1.2 Number of internodes at monthly interval

The average number of internodes at monthly interval was found maximum during early days of pruning and delayed with further extent of days of pruning. Significantly maximum number of internodes at monthly interval were observed in pruning of trees on 16th December (13.60) over rest of the treatments, while it was observed minimum (11.08) in pruning on 16th February. Significantly maximum number of internodes at monthly interval was noticed in 60 cm pruning level of shoots (14.36).

Maximum number of internodes at monthly interval (17.50) were recorded in treatment D_1P_3-pruning of trees on 16th December with 60 cm pruning intensity which was statistically at par with the treatment D_2P_3 i.e. pruning on 1th January with 60 cm pruning (17.26).

These result were in agreement with the finding of Awasthi and Misra (1969) that, the number of internodes increased with increase in severity of pruning in ber.

Arvindakshan (1963) who reported similar results that increased number of internodes were due to heavy pruning and total number of shoots increased due to lighter pruning in guava. Shahein *et al.* (2010) revealed that all pruning level treatments including defoliation plus nitrogen fertilization gave the best results in increasing number of flower shoot from 39.3 to 51.1 and from 40.1 to 52.7 in the first and second season in custard apple, respectively.

5.1.3 Days required for initiation of flower

As pruning delayed with intensity of pruning increases, the appearance of first flower on a shoot was significantly delayed. All the pruning treatments took significantly longer period than the control for this process. Significantly minimum number of days required for initiation of flowering was noticed in pruning on 16th December (95.10) followed by pruning on 1st January (97.00). As the result showed significantly minimum number of days for flowering was recorded due to the control pruning of shoots (95.97) and flowering was much delayed in 90 cm pruning level of shoots (101.53).

The early flowering i.e. minimum number of days required for flowering (93.67) were registered in treatment D_1P_5-i.e. pruning on 16th December with no pruning and late flowering i.e. maximum number of days required for flowering (105.67) were observed in the treatment D_5P_4 - i.e. pruning on 16th February and with 90 cm of pruning level.

Lal and Prasad (1980a) reported almost similar findings that, the un-pruned trees (control) produced flowering earlier by 3-5 days in Pewandi ber cultivar and 4-6 days in Karaka ber cultivar than their pruned ones.

Leopold and Kriedmann, (1982) reported in custard apple, the most fruitful and differentiated buds are located on distal portion of the branches. The flowers are produced on the distal portion of the canopy which is also observed in case of some fruits like pomegranate and custard apple. A removal of such parts by pruning would also remove these buds which are quick to cane out. It is also thought that, there exists juvenility gradient in tree. The juvenility is more at the base of a tree or branch and gets gradually reduced in acropetal manner towards the distal end. Thus, it is hard to believe to have more fruitful buds located on lower portion of branches, at the time of pruning. They are likely to be differentiated after pruning. This would need more time for visible appearance of flowers on a pruned tree. This also emphasized that, since the wood located at apex, pruning away from the terminal portion of a branch would lower down the total flower production.

The inverse correlation between the period required for flowering and the pruning intensity was observed. Pawar (1993) reported that pruning studies in pomegranate, that the appearance of first flower was delayed as intensity of pruning was increased. Ghum (2011) reported similar results regarding days required for flowering after pruning in custard apple.

5.1.4 Number of flowers per shoot

In any bearing fruit tree pruning removes the fruiting wood; it would normally reduce total flowers with increased severity of pruning which is substantiated by improved crop quality. The fruitfulness of a pruned tree is indicated by time taken for fruit bud differentiation and number of flowers produced. Highest number of

flowers per shoot was observed in pruning on 1st February (4.63) and least number of flowers per shoot was observed in pruning on16th December (3.41).

The observations of present investigation i.e. average number of flowers per shoot showed maximum due to 30 cm pruning level of shoots (6.94) followed by 60 cm pruning level (4.13) and 90 cm pruning level (2.32). The number of flowers per shoot proportionally decreased with increased severity of pruning.

Maximum number of flowers per shoot (8.43) was noticed in treatment D_4P_2 i.e. pruning of 1st February with 30 cm pruning level which was statistically at par with the treatment D_5P_2 i.e. pruning of 16th February with 30 cm pruning (18.42). However, it was minimum in treatment D_2P_4 (2.11) i.e. pruning on 1st January with 90 cm of pruning intensity.

Similar observations that, pruning reduces the number of flowers per tree have also been reported by Stamper and Gliha (1969) in peach and Dhaliwal and Sandhu (1982) in ber.

Guimond *et al.* (1998) reported that, in young high density sweet cherry plantings, summer pruning may be useful for increasing flower bud formation on current season shoots. The time of pruning, length of shoots after pruning and location of pruning cut can influence subsequent flower bud formation and vegetative re-growth. The obtained results in agreement with the finding of Khan *et al.,* (2001) who revealed that, nitrogen fertilization after pruning increased number of lateral shoots and number of flowers per shoot in cherimoya.

The above results were in agreement with the finding of Shahein *et al.,* (2010) who revealed that the most effective treatment was heading back by removing 20 cm plus nitrogen fertilization which produced 73 and 5.2 lateral shoots and highest number of leaves per shoot 60.3 and 59.2 in custard apple. Gham (2011) reported that, average number of flowers per branch in custard apple was maximum due to

early pruning (60 days) with 75 per cent pruning and minimum in pruning after 120 days of previous season harvesting with no pruning.

5.2 Yield contributing parameters

5.2.1 Fruit set

Maximum fruit set was observed in pruning on 1st February (60.98 %) which was at par with the pruning of trees on 16th February and minimum on 16th December (51.11 %) as shown in Table-3. The fruit set was observed maximum (66.44 %) in 30 cm pruning level. The lowest fruit set (43.65 %) were recorded in 90 cm pruning level.

The interaction effect due to time of interval of pruning and different intensities of pruning showed significant results among different combinations. The highest percentage of fruit set (71.17%) was registered in treatment D_4P_2-i.e. pruning on 1st February with 30 cm pruning level and minimum fruit set was observed in the treatment D_2P_4 -i.e. pruning on 1st January with 90 cm pruning level (36.50 %).

The obtained results in agreement with the finding of Bhonsle (1972) who revealed that, percentage of flower shoots increased with the lighter pruning, maximum being at the 5th to 7th bud region in least severe treatment of pruning in grape. The above results were in agreement with the finding of Shahein *et al.,* (2010) who revealed that the treatment of heading back by removing 10 cm plus nitrogen fertilization gave the highest values of fruit set percentage, 14.6 and 14.8 % in custard apple.

5.2.2 Size of fruit (Polar and Equatorial diameter)

The maximum size as polar diameter (6.98 cm) and equatorial diameter (7.79 cm) of fruits recorded in pruning on 1st February and minimum polar (6.38 cm) and equatorial diameter (7.20 cm) of fruit recorded in pruning on 16th December. The

data in present investigation showed maximum size of polar (7.59 cm) and equatorial diameter (8.28 cm) was observed in 90 cm pruning level and minimum polar (5.77 cm) and equatorial diameter (6.48 cm) of fruit noted in no pruning.

The data in present investigation due to interaction of pruning time and pruning level, the highest polar diameter of fruit (7.90 cm) was registered in treatment D_4P_3 - i.e. pruning on 1st February with 60 cm pruning level. Treatment D_3P_4 - i.e. pruning on 16th January with 90 cm pruning and treatment D_4P_4- i.e. pruning on 1th February with 90 cm pruning were statistically at par with each other. Also, the highest equatorial diameter of fruit (8.45 cm) was registered in treatment D_4P_4 -i.e. pruning on 1st February with 90 cm pruning.

Similar results were observed by Pawar (1993) that pruning induces strong vigorous and juvenile growth which is evident in vegetative parts in pomegranate. This indicates that in pruned trees longer period is required for physiological maturity of the organs. Gondkar (1978) observed that, in case of severely pruned figs in spite of low crop load and better fruit size the maturity was delayed.

5.2.3 Average number of fruits per tree

The light pruning was found beneficial in increasing the number of fruits per tree. The maximum average number of fruits obtained in pruning on 1st February (75.23) and minimum average number of fruits obtained in pruning on 1st January (53.56). Maximum average number of fruits obtained due to 30 cm pruning level (86.26) and the minimum numbers of fruits were recorded due to 90 cm pruning level (28.66). Significantly maximum number of fruits per tree (106.65) was noticed in treatment D_4P_2 -i.e. pruning on 1st February with 30 pruning level. However, the minimum number of fruits per tree (23.08) was recorded in treatment D_1P_4 -i.e. pruning on 16th December with 90 cm pruning level.

Similar results were observed by Nijjar (1972) that pruning in trees, attributed to renewal of potential fruit buds and retention of more juvenile wood as explained earlier. Although pruning encourage substantial new growth, the total growth of unpruned trees was greater than that observed in pruned trees, suggesting that pruning is a dwarfing process. Therefore, one has to strike a proper balance between vegetative growth and productivity, if pruning is to be practiced. The surplus availability of other factors such as irrigation, fertilizer nutrients etc., concomitant with pruning might help in maintaining the proper C: N ratio in the left over parts of the pruned trees.

Anon (2010 b) reported that, the maximum average number of fruits (83.10) in treatment at pruning 20 cm without thinning in pomegranate cv. Bhagava. Ghum (2011) reported highest number of fruits due to 25 per cent pruning and minimum number of fruits were recorded due to 75 per cent pruning in custard apple.

5.2.4 Average weight of fruit

The weight of fruit is an important quality character for marketing of fruits. The present investigation results indicate that average weight of fruits increased with increased intensity of pruning. In respect of time of pruning, maximum average weight of fruits (251.73 g) was found in pruning on 1st February and minimum average weight of fruits (213.40 g) was found in pruning on 16th December. The maximum weight of fruits was recorded in 90 cm pruning level (299.30 g) and minimum average weight was found due to control pruning (172.44 g). Significant results were obtained as effect of interaction due to time of pruning and different pruning intensities among different treatment combinations. The maximum weight of fruit (342.17g) was found in the treatment D_4P_4 -i.e. pruning on 1st February with

90 cm pruning level and minimum in D_2P_5 i.e. pruning on 1st January and with control pruning (154.72g).

Awasthi and Misra (1969) reported that, all the pruning intensities were effective in increasing weight of fruit as compared to that in control in ber. Bound and Summer (2001) reported that, crop load was reduced with increasing severity of pruning in Red Fuji apple. Mean fruit weight and diameter were correlated with crop load, the lower crop load greater the increase in both fruit weight and diameter.

Similar results were recorded by Patil (1987) that in medium pruning treatment the average weight were highest in ber. David *et al.* (2005) also found similar results that a comparison of cluster thinning times from bloom to near version showed increase in cluster and juice PH become greater as time of cluster thinning delayed in grape.

Trevor and Steven (2009) revealed that, summer tip pruning prevented new vegetative growth in the canopy, fruit size decreased relative to control trees by 23% in custard apple. The reason for this decrease was probably related to increase carbon limitation to growth given that down water soluble and non-structural carbohydrate concentrations were lower in tip pruned trees.

Anon (2010 a) resulted the similar results that, average weight of fruit (90.13) found maximum in September pruning and was at par with October pruning i.e. 82.53 and August pruning (80.98 %) in fig.

Gham (2011) revealed that maximum weight of was due to pruning after 75 days of previous season harvesting with control pruning and minimum average weight of fruits was due to pruning after 120 days of previous season harvesting with 50 per cent pruning followed by 50 per cent pruning in custard apple.

5.2.5 Yield

The different time and intensities of pruning treatments revealed in this experiment showed remarkable effect on yield. The highest yield (18.37 kg) was obtained in pruning time on 1st February while, lowest yield was obtained in pruning on 16th December (11.65 kg). Also the highest yield obtained (20.74 kg) due to 30 cm pruning level while the minimum yield was recorded in 90 cm pruning (9.96 kg).

The interaction effect due to time of pruning and pruning intensities showed significant results among the different treatment combinations. The maximum yield per plant (26.33 kg) was noted in treatment D_4P_2 -i.e. pruning on 1st February with 30 cm pruning level. While, minimum yield per plant (8.24 kg) was observed in treatment D_1P_4-i.e. pruning on 16th December and with 90 cm pruning level). The treatments D_3P_2, D_4P_1, and D_5P_1 were statistically at par with each other.

Gupta and Singh (1977) reported the highest yield of unpruned trees as compared to the obtained in pruned ones in ber. Minimal pruning in grape vines also resulted in higher yields than from conventionally pruned ones Tomer and Brar, (1982).

The similar results were observed by Patil (1987) that the highest yield per trees was obtained under control treatments and the lowest under severe pruning treatments in ber. Goncalves *et al.* (2006) reported that, there were yield differences between the pruning times; the March and April pruned plants presented higher yieldsin fig. Gill and Bal (2006) concluded that, Umran ber trees pruned on 9th May retaining 6 buds yielded maximum fruits of superior quality. Joshi (2007) stated similar results as in case of ber, pruning between April-May resulted in higher yields.

Thakur *et al.* (2008) gave the results on the same aspect, light pruning + 10 ppm GA_3 proved to be the best in terms of fruit yield and quality of custard apple.

Dalastra *et al.* (2009) found similar results that, there were differences among pruning times; July and August pruned plants presented higher yields, from December to February with production pick in January in fig. Masalkar and Joshi (2009) reported the maximum fruit yield (19.76) kg/trees) in treatment 20 cm pruning with thinning and were at par with all other treatments in pomegranate.

Anon (2010a) recorded, similar results to some that, maximum yield was recorded by September pruning (37.72 kg/trees) and was at par with October pruning (35.58 kg/tree) in Fig. Anonymous (2010 b) also found similar results as in case of pomegranate cv. Bhagwa that maximum fruit yield (21.82 kg/ha) was observed in treatment of 20 cm pruning with thinning. Ghum (2011) reported similar results in respect of yield in custard apple. Highest yield in custard apple due to pruning after 75 days of previous season harvesting with 25 per cent pruning however minimum yield pruning after 60 days of previous season harvesting with due to 75 per cent pruning.

5.3 Quality parameters

5.3.1 TSS and acidity

The studies carried in respect of chemical attributes *viz.,* TSS, pulp percentage revealed that, the pruning treatment showed significant differences in fruit quality. Pruning on 1st February showed higher per cent of total soluble solids (20.52 %) as most superior treatment. whereas, pruning on 16th December recorded minimum per cent of total soluble solids (19.23 %). Significantly maximum percentage of total soluble solids was recorded in 60 cm pruning level (21.13 %) followed by 30 cm pruning level (20.76%). The minimum percentage of total soluble solids was noted in 90 cm pruning level (18.22 %)

The non-significant results were obtained due to the time of pruning and different pruning intensities. The lowest percent acidity was noticed in 1st February

pruning (0.19 %). Maximum acidity was found in pruning on 16th January (0.22 %). Lowest acidity was found in 30 cm pruning level of shoots (0.19 %) followed by 60 cm pruning level (0.20 %) and highest acidity was recorded in 90 cm pruning level of shoots.

The lowest acidity (0.16 %) was registered in treatment D_4P_2 -i.e. pruning on 1st February with 30 cm pruning level while highest acidity content was observed in treatment D_3P_4 i.e. pruning on16th January and with 90 cm pruning (0.24 %).

The fruit pulp under server pruning of 60 cm, 90 cm pruned level of trees had substantially higher TSS. Gupta and Singh (1977) found no significant difference in respect of TSS and acidity of ber fruit pulp due to different pruning treatments. More or less similar results in guava were reported by Ghunake (1981).

Patil (1987) reported similar results that, the increased pruning intensities had higher T.S.S. in ber fruit pulp. Gonclaves *et al.* (2006) reported similar results that different pruning times and conduction systems did not affect the quality of fig fruit and contents of soluble solids, pH, total sugars, glucose, sugars and starch.

Ireneusz (2010) reported similar results that time of pruning had no influence on the chemical composition as total sugars in plum.

5.3.2 Pulp

The data pertaining to pulp percentage was revealed significant results due to the time of pruning. Significantly maximum pulp percent recorded in pruning of trees on 1st February (53.27 %) followed by pruning on 16th February (51.59). while, it was minimum in pruning of trees on 16th December (49.95%).

The highest percent of pulp (55.72%) was found due to 30 cm pruning level followed by 60 cm pruning level (52.30 %). The minimum pulp percent was

recorded due to 90 cm pruning level of trees (47.91 %) increased with increase severity of pruning but showed maximum pulp percentage than control pruning.

The interaction effect due to the time of pruning and intensity of pruning revealed significant results. The maximum pulp percent was observed in treatment D_4P_2 i.e. pruning of 1st February with 30 cm pruning level (60.43 %), while, minimum pulp per cent were registered in treatment D_2P_4 i.e. pruning of 1th January with 90 cm of pruning level (47.59 %).

Similar results were reported by Pawar (1993) that 0 to 60 cm pruning was quite effective for increasing juice percentage in pomegranate.

Ghum (2011) revealed that, maximum pulp (%) was recorded by pruning after 75 days of previous harvesting with 50 per cent intensity (63.95) and was minimum due to early pruning (45 days) with light pruning (25 %) i.e. (40.53) in custard apple.

5.3.3 Seed and Seed: pulp ratio

Non-significant results were obtained due to the time of pruning and pruning intensities. Minimum seed percentage was found in pruning of 1st February (10.31 %) followed by pruning on 16th January (11.13 %). The maximum seed percentage was observed in pruning on 1st January (12.04 %). The minimum seed percentage was observed in 30 cm pruning level (10.65 %) and maximum in 90 cm pruning level (11.86 %).

The interaction effect due to time of pruning and intensity of pruning among different treatments combinations were found non-significant results. Minimum percentage of seed was registered in the treatment D_4P_5 -i.e. pruning on 1st February with no pruning (9.70 %). Maximum percentage of seed was noticed in treatment D_2P_5-i.e. pruning on 1st January with no pruning (13.14 %).

In case of seed: pulp ratio, non-significant results were obtained due to the time of pruning, lowest seed: pulp ratio (0.20) was noted in pruning on 1st February and the highest seed: pulp (0.24) was registered in pruning on 1st January. The non-significantly lowest seed: pulp ratio due to the intensity of pruning was recorded in 30 cm pruning level (0.21). Whereas, the maximum seed: pulp ratio was noted in control pruning (0.24). However, lowest seed: pulp ratio (0.19) confined to the treatment D_4P_2-i.e. pruning on 1st February with 30 cm of pruning level. The highest seed: pulp ratio (0.26) was registered in treatment D_2P_5-i.e. pruning on 1st January with no pruning.

This helps to improve fruit quality which is most dominating parameter in commercial marketing of fruits. Such evidences that, pruning enhances fruit quality have also been observed in other fruit crops like grapes by Bajpai *et al.* (1973), Gondkar (1978), Awasthi and Misra (1969).

Zhelev (1977) reported that, pruning the apple, leaves on the remaining shoots were larger in size and richer in chlorophyll. Almost similar effect might be expected in pruned ber trees (Patil, 1987). The large and chlorophyll rich leaves of pruned trees, might have synthesized more of photosynthate i.e. carbohydrates and there by fruit size, its weight and pulp etc., might have increased.

5.4 Incidence of mealy bug

In respect of time of pruning, significantly lowest incidence of mealy bug (2.41 %) was noted in pruning on 1st February. The highest incidence of mealy bug (3.82 %) was registered in pruning time on 16th December.

Significantly lowest incidence of mealy bug (2.68 %) in respect of level of pruning was noted in 30 cm pruning level followed by 60 cm pruning level (2.97%). The highest incidence of mealy bug (3.68 %) was registered on 90 cm pruning level. The interaction effect due to the time of pruning and intensity of pruning showed

lowest incidence of mealy bug confined to treatment D_4P_2-i.e. pruning of 1st February with 30 cm pruning level (1.57 %). However, the highest incidence of mealy bug (4.94 %) was registered in treatment D_3P_4-i.e. pruning on 16th January with 90 cm pruning level.

In India, Singh and Ghosh (1970) studied under natural conditions, the seasonal activity of *M. hirsutus* on Mesta, the activity of the mealy bug was observed from the month of March. The peak infestation was usually noted from the first week of September to the last week of October.

Shreedharan *et al.* (1989) reported that, the pest, *P. citri* was severe in summer season (March-July) and no incidence in winter season (October-November) in Mandarin orange (*Citrus reticulatae Blanco.*). The studies on associated with weather factors revealed that, the population of mealy bug was positively correlated with the temperature and negatively with relative humidity, while it had no clear correlation with total rainfall.

Anon (1991) studied on population dynamics of mealy bugs on pomegranate (*Punica granatum* L.) and custard apple conducted at Rahuri during 1991-1992 indicated that, the peak mealy bug population in pomegranate orchard was recorded in April (31.50 %) and May (21.16 %) and low incidence from October (0.0 %) to December (1.0 %) while, in custard apple orchard, the infestation of mealy bugs was much evident in October (2.50 %) and November (5.80 %).

During the survey of the pests of grape vine gardens at Arvi Pimpalgaon of Pune district (Maharashtra) in 1991-1992, it was observed that, the mealy bug population was more from middle of February to May and middle of September to middle of November. The pest was found to be inactive from middle of November to middle of February (Anon, 1992).

The studies were undertaken on the population dynamics of pest of pomegranate and custard apple at Rahuri from 1991-94. The incidence of mealy bugs was the highest during *Ambia bahar*. The maximum build up of pest was recorded in the month of May; while the least incidence was noticed during the month of December on pomegranate indicating a significant and positive correlation with maximum temperature, minimum temperature and significant negative correlation with morning relative humidity.

In custard apple orchard, the mealy bug population was more pronounced during October-November at the time of maturity of fruits indicating non- significant negative correlation coefficient with all meteorological parameters. Another study on pests of custard apple carried out at Solapur (Maharashtra) in 1994 revealed that the infestation of mealy bugs was severe and recorded its peak (85.10% infestation of fruits /plant) in the first fortnight of December and there existed a negative correlation of mealy bug infestation with minimum and maximum temperature, relative humidity and rainfall Anonymous, (1995)

Field studies were carried out during 1995-96 in Andhra Pradesh, India to investigate fluctuation in *M.hirsutus* populations in grapes and *Annona reticulata L.* The highest population was found on grapes during the first half of July (vegetative phase) and during the second half of March (reproductive phase) and on *Annona reticulata* (Murthy and Babu, 1996).

5.5 Grading of fruits according to class

The maximum A grade fruits (5.84 kg) and B grade fruits (6.73 kg) were noted in pruning of trees on 1st February and maximum C grade fruits were noted in pruning of trees on 16th February (6.39 kg).

Significantly maximum A grade fruits (5.19 kg), B grade fruits (7.67 kg) and C grade fruit (8.14 kg) were recorded in 30 cm pruning level. However, minimum A

grade fruits were found in control pruning (2.94 kg) and minimum B grade (3.98 kg) and C grade fruits (2.03 kg) were observed in 90 cm pruning level.

The effect of interaction due to time of interval of pruning and different intensities of pruning showed significant results for A grade, B grade and C grade fruits.

The maximum A grade fruits were registered in treatment D_4P_2-i.e. pruning on 1st February with 30 cm pruning level (7.23 kg) which was statistically at par with treatment D_4P_3-i.e. pruning on 1st February with 60 cm pruning level (6.48 kg). Whereas, minimum A grade fruits was registered in treatment D_2P_5-i.e. pruning on 1st January with no pruning (2.50 kg).

The maximum B grade fruit were registered in treatment D_5P_2-i.e. pruning on 16th February with 30 cm pruning level of shoots (9.60 kg) which was statistically at par with the treatment D_4P_2-i.e. pruning on 1st February with 30 cm pruning level (9.55 kg). However, minimum B grade fruits (2.90 kg) were noticed in treatment D_2P_4 -i.e. pruning on 1st January with 90 cm pruning level.

The maximum C grade fruit was registered in treatment D_4P_2-i.e. pruning on 1st February with 30 cm pruning level (10.57 kg) which was statistically at par with the treatment D_5P_2-i.e. pruning on 16th February with 30 cm pruning level (10.42 kg). Minimum C grade fruits were registered in treatment D_3P_4-i.e. pruning on 16st January with 90 cm pruning level (1.73kg).

6. SUMMERY AND CONCLUSIONS

There is vast scope for cultivation of annonaceous fruits. The custard apple has a versatile adaptability, hardy nature and low maintenance cost. Custard apple fruits have commercial importance in Maharashtra and the area under cultivation of these crops increasing rapidly. Custard apple is mainly grown in Pune, Ahmednagar, Solapur districts. The proper pruning technique with knowledge of intensity and proper time of pruning operation affect the yield positively with good quality fruits.

The present investigation 'Effect of pruning levels and time of pruning on growth, yield and quality parameters of custard apple (*Annona Squamosa* L.) under North Maharashtra conditions' was carried out at Horticulture Farm, College of Agriculture Dhule, during the year 2012-2013. The plants were spaced at 5 x 5 m. The Experiment was designed in five different time intervals with five pruning treatments replicated three times in Split Plot Design with two plants per treatment. The pruning was done on main shoot and also subsequent secondary and tertiary shoots on whole plant with different intensities of tip, 30cm, 60cm, 90cm and control, from top to end, at different time i.e. from 16th December, 1st January, 16th January, 1st February and 16th February.

All the above treatments were compared in respect of growth, flowering characters, fruit yield, fruit quality, grading of fruits and incidence of mealy bugs. The results obtained are summarized here as below.

6.1 Growth parameters

The effect of time and intensity of pruning in respect of growth parameters like the average length of shoot at monthly interval, average number of internodes at monthly interval, days required for initiation of flower, number of flower per shoot was significantly influenced by the time and pruning intensity.

The highest length of shoots at monthly interval was recorded in treatment D_1P_4-i.e. pruning on 16th December with 90 cm pruning intensity (18.48 cm) which was at par with the treatment D_2P_4- i.e. pruning on 1st January with 90 cm pruning level (17.46 cm). The highest number of internodes at monthly interval was recorded in treatment D_1P_3-i.e. pruning on 16th December with 60 cm pruning intensity (17.50) which was statistically at par with the treatment D_2P_3 i.e. pruning on 1th January with 30 cm pruning (17.26). The days required for flowering increased with increasing severity of pruning. Minimum number of days required for flowering (93.67) was found in treatment D_1P_5-i.e. pruning on 16th December with control pruning. The highest number of flowers per shoot (8.43) was noticed in treatment D_4P_2 i.e. pruning on 1st February with 30 cm pruning level.

6.2 Yield and yield contributing characters

The highest percentage of fruit set (71.17%) was found in treatment D_4P_2-i.e. pruning on 1st February with 30 cm pruning level and size of fruit (polar and equatorial diameter) increase with increase severity of pruning, The highest polar diameter of fruit (7.90 cm) was found in treatment D_4P_3 -i.e. pruning on 1st February with 60 cm pruning level and highest equatorial diameter of fruit (8.45 cm) was found in treatment D_4P_4-i.e. pruning on 1st February with 90 cm pruning level. The average number of fruits per plant was significantly influenced by the time and intensity of pruning. The average numbers of fruits per plant were highest due to treatment D_4P_2-i.e. pruning of 1st February with 30 of pruning level.

The average weight of fruits was found maximum in the treatment D_4P_4-i.e. pruning on 1st February with 90 cm pruning level (342.17 gm). The maximum yield per plant was recorded due to treatment D_4P_2 i.e. pruning of 1st February with 30 cm pruning level (26.33 kg). This showed the positive impact of the pruning over control pruning.

6.3 Quality parameters

The pulp percentage was significantly influenced by the time and intensity of pruning and TSS percentage was found non-significant results. Maximum percentage of total soluble solids (21.83 ^{0}B) was observed in treatment D_4P_3 i.e. pruning on 1st February with 60 cm pruning level. The maximum pulp percentage was observed in treatment D_4P_2-i.e. pruning of 1st February with 30 cm pruning level (60.43 %) over control pruning.

The seed percentage and seed: pulp ratio decreased due to pruning over control pruning with considering the pulp percentage. Minimum percentage of seed was registered in the treatment D_4P_5-i.e. pruning on 1st February with control pruning (9.70 %) and lowest seed: pulp ratio (0.19) confined to the treatment D_4P_2 -i.e. pruning of 1st February with 30 cm of pruning level. The acidity was not much deteriorated due to pruning. Lowest acidity was found in 30 cm of pruning level of shoots (0.19 %) followed by 60 cm pruning level (0.20 %) and highest acidity was recorded in 90 cm of pruning level of shoots. Thus pruning at proper time and intensity was beneficial to improve fruit quality.

6.3 Grading of fruits according to class

The maximum A grade (7.23 kg) and C Grade (10.57 kg) fruit were registered in treatments D_4P_2 i.e. pruning on 1st February with 30 cm pruning level However, maximum B grade fruits was registered in treatment D_5P_2-i.e. pruning on 16th February with 30 cm pruning level (9.60 kg).

6.3 Incidence of mealy bug (%)

Lowest incidence of mealy bug (1.57 %) confined to treatment D_4P_2-i.e. pruning on 1st February with 30 cm pruning level. However, the highest incidence of mealy bug (4.94 %) was registered in treatment D_3P_4 i.e. pruning on 16th January with 90 cm pruning level.

The present investigation concluded by considering all aspects, that the time of pruning and intensity of pruning influenced significantly and pruning can be followed in custard apple to improve the growth characters, yield characters, quality characters and grading and to reduce incidence of mealy bug.

Considering the need, time and future thrust, it is necessary to standardize time of pruning and intensity of pruning in custard apple and it is concluded that light to medium pruning of primary and secondary branches i.e. 30 cm pruning level on 1st February was found best which improves the growth, yield and quality characters. The second best treatment i. e. pruning on 16th February with 60 cm pruning level is also observed beneficial treatment in custard apple.

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8. VITA

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of

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in

FRUIT SCIENCE

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