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EFFECT OF PRUNING, DEFOLIATION AND NITROGEN FERTILIZATION ON GROWTH, FRUIT SET AND QUALITY OF ABDEL-RAZIK ANNONA CULTIVAR.

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Abstract: This investigation was carried out during two successive seasons of 2003 and 2004 on Abdel-Razik cultivar Annona. The trees were 11 years old grown in a private orchard at Badr Center, Behera Governorate. The study aimed to show the effect of some pruning levels, defoliation and nitrogen fertilization on growth, fruit set and quality. Results revealed that, N fertilization combined with pruning regimes gave the greatest values. Such treatments led to increase the lateral shoots number and number of leaves per shoot. The effective treatment was heading back by removing 20 cm. from shoot top plus N fertilization. All pruning treatments including defoliation either with or without N fertilization advanced flowering date while flowering period was not affected. The investigation showed that pruning regimes and pruning combined with N fertilization treatment increased number of flower per shoot, fruit set percentage and yield. The effective treatment, in this respect, was heading back by removing 10 cm. of shoot top + N fertilization. Such treatment had the highest value of fruit weight. No significant differences between different treatments and control concerning the fruit height, diameter and H/D, ratios were found. Treatments with N fertilization decreased the presence of TSS while total acidity was increased, this led to decrease in TSS/acid ratio. N fertilization increased leaf content of N and P while leaf content of K was not affected. Results revealed that, N fertilization supported with pruning improved growth, fruit set and fruit quality.

Key words: Annona, Pruning, Defoliation, N fertilization, Fruit set, Fruit quality, Thinning**.**

Abreviations: HB= Heading back, LS= Lateral shoots, Def.= Defoliation, TO = Thinning out.

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Introduction

The flowering in custard apple (*Annona atemoya*, Hort) African pride cv. was strongly associated with vegetative flushing and most flowers being produced on the basal nodes of newly emerging vegetative laterals (Geroge and Nissen, 1986a). In *Annona atemoya*, there were positive linear relations of tree yield to tree girth, but was not with cross-sectional area, Canopy volumes and number of laterals, while fruit weight was negatively related to fruit number per tree. On a limb basis, mean fruit size and pulp: seed ratio was weakly related to the leaf area per fruit (George and Nissen, 1986b).

Defoliation of *Annona muricata* either manually or chemically increased the number of flowers and annual fruit production (Cruz and Cedeno, 1989). Different pruning techniques used in cherimoya cultivation for increasing production. Several of these techniques allow trees to be kept permanently under 3m in height. Cherimoya trees seemed to remain productive at a reduced size, producing yield similar to those of conventional large trees but with bigger fruit (Farre *et al*., 2000). Shoot tipping in cherimoya at 10 buds and its combination with bark girding obtained the best results, with an increase of 22% in yield and 25% in fruit weight, respectively. Shoot tipping also significantly decreased shoot length according to the date it was done (Bruno and Evelyn 2001).

Pruning is necessary for cherimoya (*A. cherimoya*) trees and it must be done after leaf defoliation. Fertilization with ammonium nitrate or ammonium sulfate after pruning, increased number of new lateral shoots, number of flowers and yield. Nitrogen fertilization overcomes the negative effect of pruning in Annona trees (Kahn *et al*., 2001).In coffee trees; the advantages of pruning (mainly to improve light distribution and ventilation within the crown and to encourage new growth) are briefly outlined. Selective pruning consisting of the removal of all broken and diseased branches, gave significantly higher annual yields (Figueroa, 1991). Heading back treatment in fig trees led to significant increment in the number of buds developing to vegetative growth, length of new shoot and average number of leaves arised on those shoots in relation to thinning treatment. TSS and juice acidity were not significantly affected by pruning regime (Stino and El–Fakharani 1995). Heading back weakens apical dominance lead to the release of many buds from dormancy and the development of vigorous shoots in apple and pear trees (Forshey *et al*., 1992).Five levels of pruning were studied on litchi trees. All treatments increased number of fruits per panicle, fruit weight, yield per plant, TSS, total sugars and ascorbic acid content (Sonali *et al*.,

2001). The best growth of Annona trees was obtained with high N application rate. Flowering was advanced by 10-15 days while low N levels delayed flowering date. Number of flowers increased by increasing N levels and fruit set percentage was enhanced (Sadnh and Ghosh, 1976). Nitrogen fertilization significantly increased total number of flowers, percentage of fruits set, total yield and acidity while TSS was decreased in Annona fruits (Said A. Galila and El-Massry, 1991).

Shoot growth rate and number of leaves were highest in sugar apple *(Annona squamosa*.L.*)* when high levels of N,P,K were applied the flowering was earliest. Production of greatest number of flowers, higher fruit set, fruit retention and yield were also obtained with the highest N.P.K. rate (Ashutosh *et al*. 1995). Nitrogen fertilization was most beneficial in custard apple (*Annona squamosa*) and necessary for good production and vegetative growth (Zang and Xu, 2002).

Materials and Methods

This investigation was carried out on 11-year-old Annona trees Abdel-Razik cv. grown in a private orchard at Badr center, Behera Governorate during two consecutive seasons i.e 2003 and 2004.

The trees planted in sand soil, irrigated with drip system and subjected to the normal horticultural practices.

For this study, thirty-six uniform trees were chosen. Hand defoliation was conducted on the chosen trees except control and trees received N fertilization without pruning regimes on mid. January in each studied season. Then, ammonium nitrate (33.5%) was added twice in (1^{st} Feb. and 1^{st} Apr.) at rate of 100 kg./ fedd divided to daily applications(Fertigation) at each date during both studied seasons. Twelve completely randomized treatments each of 3 replicates were conducted as follows:

1. Control (untreated) trees.
2. N Fertilization only.
3. Defoliation + N Fertilization.
4. H.B. by removing 5 cm. from shoot top + N Fertilization.
5. H.B. by removing 10 cm. from shoot top + N Fertilization.
6. H.B. by removing 20 cm. from shoot top + N Fertilization.
7. Thinning out (removing 1/3 numbers of shoot/tree) + N Fertilization.
8. Defoliation.
9. H.B. by removing 5 cm from shoot top.
10. Removing 10 cm from shoot top.
11. H.B. by removing 20 cm from shoot top.

12. Thinning out (removing 1/3 numbers of shoot/tree).

The following measurements were taken:

1. Number of lateral shoots and leaves number per shoot.

2. Flowering times.

3. Average number of flowers, then fruit set percentage was estimated and yield components (number of fruits/tree and kg/tree).

4. Some physical properties of fruit i.e. fruit weigh-fruit height-diameter and H/D, ratio.

5. Some chemical properties of fruit i.e. total soluble solids percentage (TSS%) using hand rafractometer, total acidity (g/100g) using titration NaOH at 0.1N and phenolphethalene as an indicator and expressed as citric acid along, with TSS/acid., ratio.

6. Leaf content of N, P and K.

Chosen trees under study were left to open pollination. The complete randomized design was followed throughout the whole study. The data was subjected to analysis of variance (ANOVA). The new L.S.D test was used for comprising the means (*Snedecor* and *Cochran* 1977).

Results and Discussion

1- Average number of laterals and leaves per shoot :

Data in Table (1) show the effect of some pruning levels and N fertilization on number of laterals shoot and number of leaves per shoot. Generally, no new laterals emerged on shoots of control trees. Meanwhile, pruning regimes enhanced growth of lateral shoots and leaves number per shoot. Defoliation (Def.) and removing 5 cm. from shoot top regimes gave 1.3 & 1.0 and 1.3 & 1.3 lateral shoot (LS) with average leaves number of 47.6 & 47.8 and 47.9 & 48.0 leaves/shoot. The highest values concerning average number of lateral shoot 4.5 and 4.8 and number of leaves/shoot 53.0 and 52.6 were obtained from HB by removing 20 cm. from shoot top treatment while removing 10 cm. and thinning out treatments gave intermediate values 3.4 and 2.4 and 2.0 and 1.3 LS, respectively. Such treatment had 51.5 & 50.4 and 48.3 & 48.0 leaves/shoot in the first and second seasons, respectively.

Nitrogen Fertilization had additive effect in this respect. Such treatment gave 1.0 and 1.0 lateral shoot and 48.0 and 47.7 leaves per shoot, in addition, N fertilization combined with pruning regimes significantly increased average number of LS and leaves per shoot compared to control. The most effective treatment was HB by removing 20 cm. plus N fertilization which produced 7.3 and 5.2 lateral shoots (LS) and highest number of leaves per shoot 60.3 and 59.2 followed by removing 10 cm. plus N fertilization had 5.1 and 5.0 lateral shoots with 56.0 and 54.9 leaves/shoot.

Defoliation and HB by removing 5 cm. plus N fertilization treatment arranged between the above mentioned values, this is clear in both studied seasons, respectively.

These results were in agreement with the finding of Kahn *et al.* (2001) on *Annona cherimoya* who revealed that, N-fertilization after leaf defoliation and pruning increased number of lateral shoots. Moreover, Zang and XU (2002) on *Annona squamosa* (sugar apple) found that, N fertilization after pruning practice was necessary for good production and growth. Also, Cruz and Cedeno (1989) noticed that, defoliation handly or chemically in Annona gave significantly greater number of lateral shoots as compared to the control. Moreover, Forshey *et al.*, (1992) stated that, heading back weakens apical dominance and this lead to the release of many buds from dormancy and the development of vigrous shoots in apple and pear trees. In addition, Stino and El-Fakharani (1995) mentioned that, the heading back treatment in fig tree led to significant increment in the number of buds developing to vegetative growth and average number of leaves arise on shoots in relation to thinning treatments.

2- Effect of some pruning levels and N-fertilization on Flowering:

As shown in Table (2), flowering commencement in pruned trees at different levels either with N fertilization or without N fertilization at early May (from 6th to 12th) and (from 7th to 13th May) as compared with control which beginning to emergence their flower buds at late May (23rd) and (28th), revealed that, pruning with and/or without N fertilization advanced date of flowering compared to control, this is clear in the first and second season. In addition, flowering in treated trees ceased at late Aug. (from 23rd to 30th) and (from 23rd to 31st) while in control (untreated) trees, flowering end during Sep. (11th) and (16th). In this respect, and from the above mentioned results, days from flowering commencement and ceased (flowering period) in treated trees required from (110 to 114 days) as compared to control (112 days) showed insignificant differences between control and pruning regimes with or without N fertilization treatments during first and second seasons.

The obtained results accordance with the finding of Sadnh and Ghosh (1976) who revealed that, flowering of Annona was advanced by 10-15 days with high level of N fertilization. In addition, Said,A.Galila and El.Masry (1991) and Ashutosh *et al.* (1995), found that, N fertilization significantly advanced flowering date and produced greatest number of flowers per shoot.

Moreover, Kahn (2001) mentioned that, Fertilization with ammonium nitrate or ammonium

sulphate after pruning, increased number of new lateral shoots and number of flowers in *Annona cherimoy* trees.

3- Number of flowers per shoot, fruit set and yield :

As shown in Table (3), number of flowers increased in all treated trees compared to untreated ones. In this respect, all pruning level treatments including defoliation plus N fertilization gave the best results in increasing number of flower per shoot from 39.3 to 51.1 and from 40.1 to 52.7 in the first and second seasons, respectively. While pruning regimes without N fertilization gave 36.0 to 43.5 and from 35.6 to 44.0 flowers. In addition, N fertilization treatment increased values of average number of flower buds per shoot (38.2) and (37.5) as compared to control trees (33.4 and 34.8) flowers in the first and second season, respectively. Data reveled that, HB by removing 10 cm. from shoot top plus N-fertilization gave the best effect concerning average number of flowers emerged on shoot (51.1 and 52.7) in both studied seasons, respectively.

Concerning percentage of fruit set and yield per tree, data in Table 3 showed that, untreated (control) trees gave only 2.1 and 2.0% fruit set, resulted in low yield either as number of fruits per tree (8.1 and 7.4) or as weight (2.360 and 2.208 kg./tree) in both studied seasons. This percentage increased to 5.0 and 4.6% with N-fertilization treatment which produced 12.5 and 10.5 fruits per tree and weighted 3.776 and 3.195 kg./tree. In addition, pruning regimes including defoliation (Def.) increased percentage of fruit set from (5.4 to 10.1%) and from (5.1 to 10.0%) with average number of fruits per tree ranged between 13.0 & 27.0 and between 12.4 & 24.5 fruits/tree which weighted from 3.903 to 9.763 and from 3.737 to 8.771 kg./tree. Moreover, when N-fertilization combined with pruning levels, it supported results in this respect, which fruit set increased from 8.3 to 14.6 and from 7.5 to 14.8% produced highest number of fruits per tree ranged between 14.9 & 40.1 and between 13.1 & 141.3 with best results of fruit weight ranged between 5.402 to 15.077 and between 4.704 to 15.755 kg./tree in the first and second season, respectively.

It is obvious to notice that, treatment of HB by removing 10 cm. plus N-fertilization gave the highest values of fruit set percentage; 14.6 and 14.8%; and yield either as number of fruit per tree; 40.1 and 41.3; or as weight; 15.077 and 15.755 kg./tree. It is clear that. N-fertilization supported pruning regimes for improving fruit set and yield in Abdel-Razik Annona cultivar.

The obtained results in agreement with the finding of Kahn *et al.* (2001) who revealed that, N-fertilization after pruning, increased number of lateral shoots and

number of flowers per shoot in chermoya. Also, Figueroa (1991) on coffee and George and Nissen (1986b) on Annona, mentioned that, there were linear relations of tree yield to girth, butt cross-sectional area, canopy values and number of lateral shoots.

In addition, Croz and Cedeno (1989) noticed that, manual defoliation gave highest production in *Annona muricata*. Also, Farre *et al*., (2000) found that, *Annona cherimoya* trees seemed to remain productive at reduce size, producing yield similar to those of conventional large trees but with bigger fruits. Moreover, Bruno and Evelyn (2001) mentioned that, shoot tipping in cherimoya increased yield by 22% as compared to control. Concerning the effect of N fertilization,. Said,A. Galila and El-Masry (1991); Ashotosh, *et al.,* (1995) and Zang and XU (2002) found that, N-fertilization increased number of flowers, fruit set percentage and yield in Annona.

4- Physical properties of fruit :

The effect of pruning levels alone and combined with N-fertilization on fruit weight, fruit height (H), fruit diameter (D) and H/D, ratio were shown in Table (4). Data revealed that, N-fertilization increased fruit weight from 291.4 to 302.1 g. and from 298.5 to 309.3 g. while pruning practices either as HB by removing 5, 10, 20 cm. and thinning out gave higher values of fruit weight ranged between 316.2 and 368.4 g. and between 312.7 and 360.2 g. Meanwhile, hand defoliation (Def.) gave only fruit weighted from 300.3 to 301.4 g. Application of ammonium nitrate to pruned trees increased fruit weight from 318.1 to 389.2 g. and from 307.6 to 388.3 g. which the highest values in this respect were obtained from pruning regime of HB by removing 20 cm. plus N-fertilization treatment, in the studied seasons.

Concerning fruit height and diameter and H/D, ratio, the obtained data showed that, insignificant differences were found between different pruning levels treatments with or without N-fertilization and control during the two studied seasons, respectively.

These results coinciding the finding of Georg and Nissen (1986a&b) who mentioned that, fruit weight of atemoya negatively related to fruit number per tree. Moreover, Farre (2000) found that, reduced Annona tree size gave bigger fruit. In addition, Bruno and Evelyn (2001) noticed that, shoot tipping in Annona cherimoya increased fruit weight by 25% as compared to control. On litchi, Sonali *et al*. (2001) found that, different tested levels of pruning increased fruit weight. Also, Kahn *et al.* (2001) revealed that, N-fertilization after defoliation increased fruit weight. Sadnh and Ghosh, (1976),. Said, A Galila and El-Masry (1991) Ashotosh *et al.*, (1993) and Zang and XU (2000)

mentioned that N fertilization advancing flowering date, increased fruit set and weight.

5- Chemical properties of fruits :

As for the effect of pruning levels and N fertilization, Data in Table (5) clearly showed that, total soluble solids (TSS) values were significantly higher in fruits of untreated control trees and pruning regimes without N fertilization which ranged between 20.53 to 20.68 and between 20.49 to 20.62 compared to N-fertilized trees with or without pruning regimes which gave lower values ranged between 19.13 to 19.85 and between 19.44 to 19.86 in the first and second season, respectively.

Acidity values also showed insignificant increments with fruit of pruned and non pruned trees received N application which arranged between (0.22) to (0.23) in the first and second season respectively.

Thus, TSS/acid, ratio significantly increased in fruit of control and pruning regimes from 93.17 to 94.00 and from 93.12 to 93.64 compared to N-fertilized trees which gave lower TSS/acid ratio arranged between 76.52 to 82,38 and between 79.44 to 82.50 in the first and second seasons , respectively.

These results agree the finding of Stino and El-Fakharani (1995) who found that, TSS and Juice acidity of syconium not affected significantly by the pruning regime. In addition, Said, A. Galila and El-Masry (1991) mentioned that, N fertilization significantly increased acidity while T.S.S was decreased in Annona. On the other hand, Sonali, *et al.*, (2001) revealed that with 5 levels of pruning in litchi trees, all treatments increased number of fruit per panicle, fruit weight, yield, TSS and total sugars and ascorbic acid content.

6- Leaf content of N,P and K :

Effect of some pruning levels and N-fertilization on leaf content of N,P and K presented in Table (6), the obtained results revealed that, pruned and non pruned trees received N Fertilization gave insignificant increments of N and P content as compared to control and pruned trees without N-fertilization. Moreover, leaf content of K not affected significantly between all tested treatments and untreated (control) tree in both investigated seasons. In this respect, Said, A. Galila and El-Masry (1991) on Annona, found that, N fertilization resulted in gradual and significant increased in leaf content of N and P, whereas, it failed to exert any considerable effect on leaf K content.

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تأثير التقليم واسقاط الأوراق والتسميد النيتروجينى على النمو والعقد وجودة الثمار فى صنف القشطة عبد الرازق

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معهد بحوث البساتين – الجيزة

أجريت هذه الدراسة على أشجار القشطة صنف عبد الرازق بعمر 11 سنة – نامية فى مزرعة خاصة بمركز بدر محافظة البحيرة خلال موسمى 2003، 2004 بهدف دراسة تأثير مستويات التقليم والتسميد النيتروجينى على النمو والعقد وجودة الثمار.

أوضحت النتائج أن التسميد النيتروجينى مع معاملات التقليم أعطت أعلى النتائج حيث أدت إلى زيادة عدد الشماريخ الجانبية وعدد الأوراق على الفرع خاصة المعاملة بإزالة 20 سم من قمة الفرع مع التسميد النيتروجينى. كما أدت جميع المعاملات سواء تقليم أو تقليم مع التسميد النيتروجينى إلى تبكير التزهير مقارنة بالأشجار الغير معاملة (الكنترول) فى حين لم تتأثر فترة التزهير بالمعاملات المختلفة.

وأوضحت الدراسة أن معاملات التقليم متضمنة اسقاط الأوراق أو التقليم مع التسميد النيتروجينى أدت إلى زيادة عدد الأزهار ونسبة عقد الثمار مما أدى إلى زيادة المحصول وكانت المعاملة بإزالة 10 سم من طرف الفرع مع التسميد النيتروجينى هى الأكثر فاعلية فى هذا الصدد. حيث أدت هذه المعاملة أيضا إلى زيادة متوسط وزن الثمرة. ولم تكن هناك فروق معنوية بين المعاملات المختلفة بخصوص ارتفاع وقطر الثمرة ونسبة الارتفاع الى القطر للثمرة. علاوة على ذلك أدت المعاملة بالتسميد الأزوتى إلى نقص فى نسبة المواد الصلبة الذائبة الكلية فى حين زادت الحموضة مما أدى إلى نقص نسبة المواد الصلبة الذائبة الكلية/ الحموضة فى الثمار الناتجة عن معاملات الكنترول والتقليم بدون تسميد أزوتى. كما أدى التسميد الأزوتى إلى زيادة غير معنوية فى محتوى الأوراق من النيتروجين والفوسفور فى حين لم يتأثر محتوى الأوراق من البوتاسيوم.

وأوضحت النتائج أن التسميد النيتروجينى يزيد من تأثير التقليم فى تحسين النمو والعقد وجودة الثمار.