

**This study was conducted to evaluate the effect of apical dominance and fertilizer application on the yield and quality of Pectomech, a variant of tomato**

Ampomah Yeboah Edward¹; Ansong Wisdom²; Annor-Yeboah Samuel³; Berko Jacqueline Agyapomaa⁴; Harpreet Kaur⁵

Department of theoretical and Applied, University of Science of Science and Technology, Ghana^{1,2,3,4}

Research scholar at Guru Arjan Dev Institute of Development Studies Amritsar⁵

ABSTRACT

Undoubtedly Ghanaians consume high amounts of tomatoes, thus the need to find sustainable ways of cultivating this vegetable to meet these high demands. This study was conducted to evaluate the effect of apical dominance and fertilizer application on the yield and quality of Pectomech, a variant of tomato. A field experiment was conducted in the Department of Theoretical and Applied Biology Experimental Gardens (KNUST). The experiment was carried out with a completely randomized block design with three replications for each of the four treatments. Only one variant of tomato was subjected fertilizer application, apical dominance, a combination of the two and a control.

From results obtained from inducing apical dominance by pruning; the tomato plant doesn't show strong apical dominance, thus shows more branching and bushy growth. The main aim of pruning is to maximize fruit yield. Also, careful pruning balances shoot growth and fruit production. The mean heights taken from all replications of each treatments was the major source of data used in this study. The average initial heights for both treated and control plants after 28 days of transplanting ranged from 43.6cm to 45.3cm.

The mean heights for control tomato plants remained fairly stable (46.6cm) even at the third week of data collection. Tomato plants subjected to fertilizer application only attained a mean height of 48.3cm during this same time period.

The difference in height between apical dominance plants (51.3cm) and apical dominance plus fertilizer application plants (51cm) during the third week was not appreciable with a narrow margin of 0.3cm favoring plants subjected to apical dominance only.

Generally, plants treated with only fertilizer yielded but not as compared to plants subjected to both apical dominance plus fertilizer application. Furthermore, plants treated with only apical dominance equally gave good yields.

Keywords: *Tomato, KNUST, fertilizer, dominance, Apical.*

***Corresponding Author**

Ansong Wisdom

*Department of theoretical and Applied, University of
Science of Science and Technology, Ghana*



© Copy Right, IJMPR, 2020. All Rights Reserved

INTRODUCTION

Vegetables are commonly grown all around the world mainly because they are an integral part of our diet. Different countries have varieties of vegetables that grow and develop successfully with good productivity. China is the largest producer of vegetables in the world currently. The local trade in agricultural products allows consumers to purchase vegetables grown in faraway countries [1]. Vegetables can be eaten raw or cooked; they play a key role in human nutrition, being mostly low in fats and carbohydrates, but high in vitamins, minerals and dietary fiber [2]. Tomato is no exception of a common kind of vegetable grown around the world with its varieties being different locally across the world.

Apical dominance is control over the outgrowth of lateral buds by the apical portions of the shoot [3]. This phenomenon has been observed in many species of plants, it has been observed in bryophytes and pteridophytes. It has also been observed in trees that, growth in the terminal bud is more active than the lateral bud denoting an influence of Apical Dominance.

According to de Zeeuw [4], floral development may be enhanced by taking out young leaves. Also [5] in their work showed that floral development may be enhanced by the removal of young developing leaves. The removal of young axillary shoot has also been found to promote floral development, a prerequisite for fruit. Many pruning techniques such as coppicing and pollarding make use of Apical Dominance to curb direct plant growth and achieve a plant's desire size,

shape and productivity level. The theory of apical dominance is exploited for hedge building, espalier development and artistic topiary artistic sculptures [6].

MATERIALS AND METHODS:

THE STUDY AREA

The experiment was conducted in the Department of Theoretical and Applied Biology Experimental Gardens (KNUST), between January, 2020 and April, 2020. KNUST is located in the Kumasi metropolis of the Ashanti Region. The metropolitan area lies at latitude 6.6745°N and longitude 1.5716°W, with an approximate area of 254km². It shares boundaries with Sekyere district on the north, Atwima Nwabiagya district to the west, Ejisu- Juabeng district to the east and Atwima Kwanwoma Bosumtwi district to the south [7]. The area is subjected to marked wet and dry season with bimodal rainfall pattern. The two rainfall peaks make two growing seasons possible.

There is a heavy rainfall in May-July, which is interrupted by a dry period of about two weeks in August; this is followed by another period of heavy rainfall from September to October. The dry season lasts between 120 to 130 days. The temperature of the area ranges between 24-40°C [8].

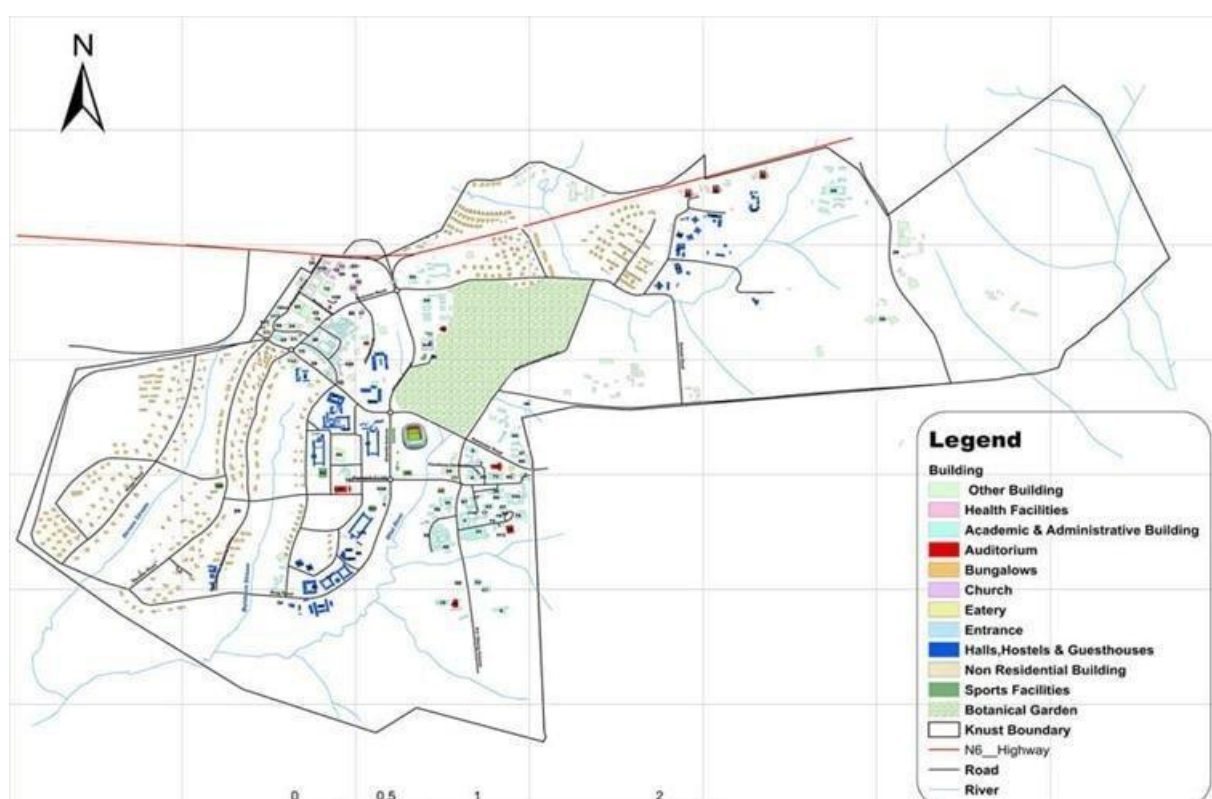


Fig 2.1 Map of study area

SITE PREPARATION

1. Nursing of seeds and raising of seedlings

Pectomech variety of Tomato (*Lycopersicon esculentum*) seeds were used for the experiment. The seeds were obtained from Agric Seeds Limited, Kumasi. The nursery started on January 18, 2020. A raised bed measuring 7.2m by 1.1m was prepared, it was first ploughed using a hoe. Holes were made on the bed using a wooden meter stick measuring about 1.8 meters. The seeds were then placed in the holes.

They were then covered lightly with soil and watered. Klopax 24 SC (an insecticide) was mixed with water and used to water the whole bed to get rid of harmful insects. To prevent direct scorching by the sun and excessive rainfall, the whole bed was covered with palm fronds. Afterwards, the mixture of Klopax and water was re-watered on the bed to also get rid of harmful insects that may be in the palm fronds. The seeds were watered daily for the subsequent days.

On the fifth day, the palm fronds were removed because the germinating seedlings were old and strong enough to withstand the scorching sun. The daily watering of the seedlings continued until transplanting.

2. Preparation of plot

An experimental area of size 34m x 16m was prepared and divided into 24 beds. Each bed measured 5m x 1.4m, with a space of 20cm at both edges of each bed and a space of 50 cm was allowed between the rows and columns and an alley of 1m between the various beds. The layout of the experimental plot is shown in figure 2.

FIELD(Area) = 17m X 8m

Dimension of Each Bed Was 5m X 1.4m

Height Per Bed from ground = 20cm

Distance between Beds = 50 cm

Distance B/n seedlings: Breadth = 50cm Length = 50cm And 30 seedlings per bed

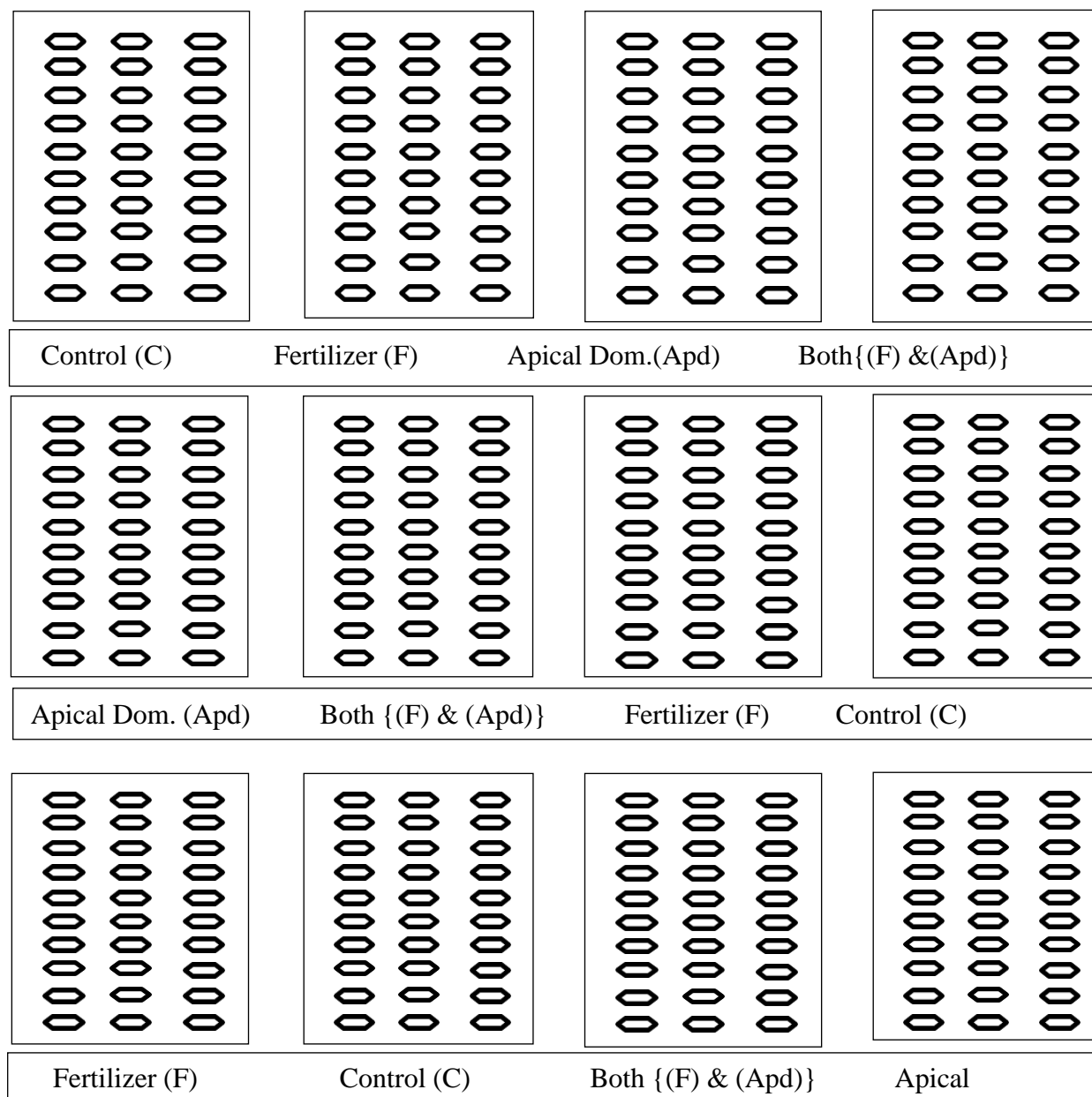


Fig 2:2layout of the experimental plot

Soil characteristics

The plot consists of sandy loam soil which is well drained with optimum water holding capacity and an average moisture content of 10.16%.The soil moisture content was determined by taking the difference between weight of the

moist soil and the dried soil. The dried soil was obtained by subjecting the soil to a temperature of about 75°C for 24 hours using the earth thermometer. The soil was slightly acidic with a PH of 6.54. The available nitrogen, phosphorus, potassium, calcium and magnesium content were 11mg/kg, 12.39 mg/kg, 19.5mg/kg, 18 mg/kg and 60 mg/kg respectively. The laboratory analysis was conducted in the Department of Crop and Soil Sciences Laboratory-KNUST from February 10, 2020 to February 26, 2020.

Transplanting of seedlings

The seedlings were transplanted onto the plots after 28 days of nursing. The average height of the seedlings were 15 to 20 centimeters at the time of transplanting. Each bed had 10 rows and three columns, a total of thirty seedlings on a bed. Transplanting was carried out in the evening to help prevent too much water loss and wilting in the newly transplanted seedlings. The seedlings were watered with a watering can.

Treatments carried out on plants

The experiment had three treatments and a control. The selection of the plots for the treatments was in a completely randomized manner (Fig 2). The treatments were: fertilizer application, apical dominance, both fertilizer and apical dominance and the control. There were three replicates each for Control and Apical Dominance whiles fertilizer treatment and Apical Dominance plus fertilizer treatment had nine replicates.

Care of seedlings after transplant

The seedlings were watered when necessary. Weeding and soil loosen up were two cultural practices that were carried out. The insecticide Klopax 24 SC was sprayed when required. Various sticks were used to stake the plant after 28 days of transplanting. Fungicide (benzyl benzoate) was applied whenever needed.

Fertilizer applications

There were three NPK 15:15:15 fertilizer treatments: 5ml, 10ml and 15ml of the fertilizer (each having three replicates) was applied on the plants in a ring format leaving a distance of 10cm around the tomato plants. The beds were watered after the treatments. In all 270 tomato plants were treated with fertilizer with thirty from each of the beds. Fertilizer application was done when necessary.

1. Removal of lateral shoots (Apical dominance)

Apical dominance was carried out 28 days after transplanting and continued at 7 day- intervals. Ninety tomato plants (*Pectomech* variety) were pruned (vegetative removal of lateral shoots), pruning was carried out using secateurs.

2. Fertilizer application plus removal of lateral shoots

There were three NPK 15:15:15 fertilizer application plus apical dominance treatments with each having three replicates. 270 tomato plants (*Pectomech* variety) were pruned (vegetative removal of lateral shoots) and in addition subjected to fertilizer application. Pruning was carried out with secateurs.

On nine separate beds: 5ml, 10ml and 15ml of NPK 15:15:15 fertilizer was also applied in a ring form leaving a distance of 10cm around the tomato plants. Pruning continued at 7 day- intervals and fertilizer application was carried out whenever needed.

3. Control

Ninety tomato plants (*Pectomech* variety) were allowed to grow normally without any fertilizer application or removal of lateral shoots. These served as control for the treatments.

4. Measurements

Data were collected on both the treated and control tomato plants (*Pectomech* variety) at the commencement of planting via to the third week of maturity. The data collected included the following:

- The progressive heights of tomato plants
- The number of lateral buds removed

RESULTS:

Germination of tomato seeds in the nursery started five days after sowing and transplanted when the seedlings were 28 days old.

Vegetative Pruning (Removal of lateral shoots)-

The number of lateral shoots removed from the tomato plants for Apical Dominance only and Apical Dominance plus Fertilizer application are shown in Tables 3.1 and 3.2.

Table 3.1. Number of lateral buds removed from the tomato plants for a period of three weeks for Apical dominance (AD)

Replicate	Number of lateral buds removed in		
	WEEK 1	WEEK 2	WEEK 3
1	189	92	68
2	142	71	49
3	121	58	32
Mean	151	74	50

Removal of lateral buds from tomato plants subjected to Apical Dominance only was done for three weeks. A total of 189 buds were removed during the first week, 92 buds in the second week and 68 buds were removed in the third week for the first replicate. For replicate two, 142 buds were removed during Week one, 71 buds in the second week and 49 buds were removed in Week 3. For the third replicate, 121 buds were removed in the first week, 58 buds in the second weekend 32 buds were removed in the third week. The mean heights of tomato plants for Week 1, Week 2 and Week 3 were 151, 74 and 50 respectively.

Table 3.2. Number of lateral buds removed for a period of three weeks- apical dominance and fertilizer (AD & FERT)

Replicate	Number of lateral buds removed in		
	WEEK 1	WEEK 2	WEEK 3
1	164	101	85
2	172	115	78
3	156	118	70
Mean	164	111	78

Removal of lateral buds removed from tomato plants subjected to Apical Dominance and Apical Dominance plus Fertilizer application was done for three weeks. A total of 164 buds were removed during the first week, 101 buds were removed in the second week and 85 buds were removed in the third week for the first replicate. For replicate two, 172 buds were removed during Week1, 115 buds in Week two and 78 buds were removed at the last week. For the third replicate, 156 buds were removed in Week one, 118 buds during the second week and 78 buds were removed in the third week. The mean heights of tomato plants for Week 1, Week 2 and Week 3 were 164,111 and 78 respectively.

Height of tomato plants-

The heights of both treated and the control plants were measured for a period of three weeks. The results are shown in Table 3.3

From Week 0 to Week 3, the control plants had heights ranging from 45cm to 50cm. Plants treated with Fertilizer application only had heights from 43cm to 51 cm from the initial week to the third week. Those subjected to Apical Dominance only had heights from 44 cm to 54cm from Week 0 to Week 3. Tomato plants treated with both Apical Dominance and Apical Dominance plus Fertilizer Application recorded heights from 45 cm to 51cm from Week 0 to the last week of measurement.

Table 3.3. Height of treated and non- treated tomato plants (cm) for three weeks.

Replicate	Height (cm) of tomato plants in															
	WEEK 0				WEEK 1				WEEK 2				WEEK 3			
	CON	FERT	AD	AD+ FERT	CON	FERT	AD	AD+ FERT	CON	FERT	AD	AD+ FERT	CON	FERT	AD	AD+ FERT
1	45	47	45	45	45	49	48	46	45	51	52	48	45	51	54	51
2	47	45	44	45	50	46	45	46	50	48	48	47	50	48	49	49
3	43	43	44	46	45	45	46	48	45	46	49	50	45	46	51	53
Mean	45	45	43.6	45.3	46.6	46.6	46	46.6	46.6	48.3	50	48.3	46.6	48.3	51	51

Height of tomato plants-

The average heights of both treated and control tomato plants were measured for a period of three weeks to know the difference in heights between the treated and control plants. The results are shown in Table 3.4.

Table 3.4. Mean heights of tomato plants for three weeks

TREAT&CON	WEEK 0	WEEK 1	WEEK 2	WEEK 3
CON	45	46.6	46.6	46.6
FERT	45	46.6	48.3	48.3
AD	43.6	46.3	49.6	51.3
AD& FERT	45.3	46.6	48.3	51

The mean heights of both treated and control tomato plants were measured for three progressive weeks. The mean height for control plants ranged from 45 cm in Week 0 to 46.6 cm at the Week3. Tomato plants treated with Fertilizer Application had a mean height of 45cm in Week 0 to 48.3cm in Week 3. Those subjected to Apical Dominance only had a mean height from 43.6cm to 51.3cm from the initial week to the third week.

Lastly, it was recorded that plants treated with both Apical Dominance and Apical Dominance plus Fertilizer Application had an average height ranging from 45cm to 51 cm from Week 0 to Week 3.

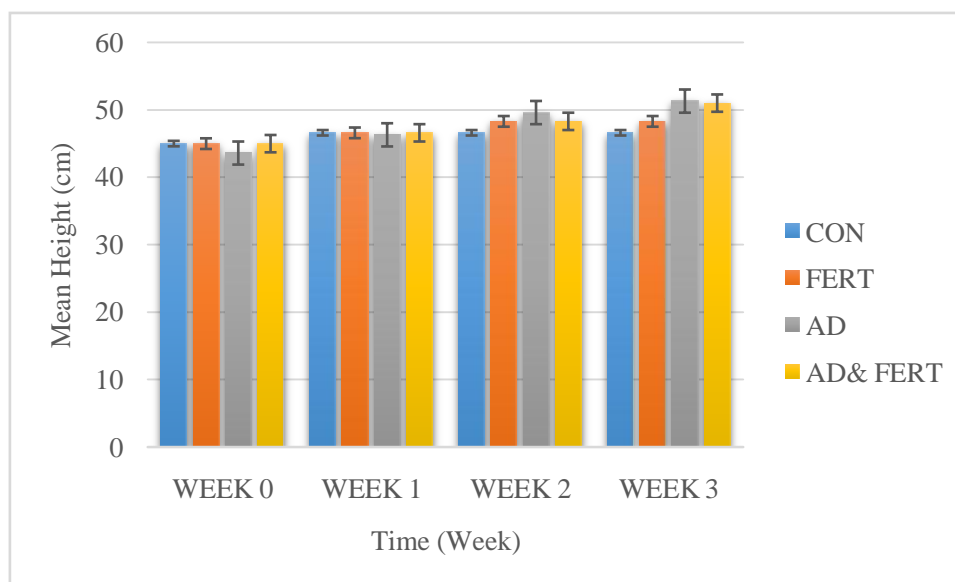


Fig 4.1 Height of Tomato Plants

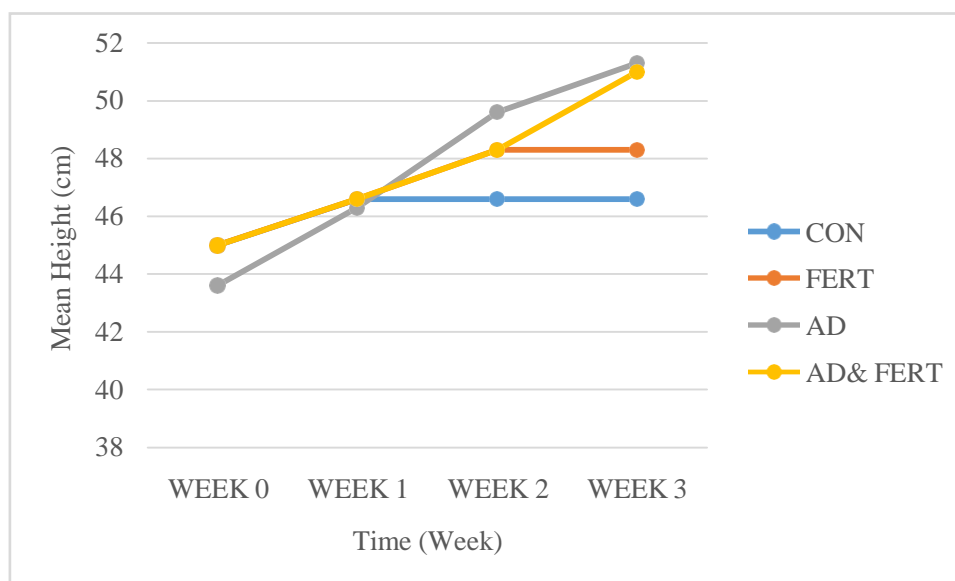


Fig 4.2 Height of Tomato Plants

DISCUSSION:

Effects of vegetative pruning on tomato plants-

In general, there was a significant decrease in the number of lateral buds pruned for both apical dominances only and fertilizer application plus apical dominance tomato plants from the first week through to the third week. (Tables 1.1 and 1.2). The main aim when pruning is to maximize fruit yield. Unpruned plants tend to produce large numbers of small fruits that may be difficult to reach when harvesting by hand. Over pruned plants on the other hand tend to produce light crops of large, flavorless fruit that does not store well. Careful pruning balances shoot growth and fruit production [9]. This results build on existing evidence that, when the main central stem of a plant is dominant over the lateral branches, the growth and development of the lateral buds/branches are suppressed by the terminal buds [3].

Studies proves that this suppression in the growth and development of lateral buds is as a result of endogenous auxins (indole acetic acid) produced at the terminal bud of the plant.

Effects of vegetative pruning on the height of tomato plants (Pectomech)-

This mean range in heights of the tomatoes corresponds with the data provided by researches (www.gardenguides.com) for average height of tomato plants 21-30 days after transplanting. There was no difference in the mean heights between the control tomato plants and those subjected to fertilizer application only from the initial period (Week 0) through to Week 1 of data collection (Fig 4.1) This implies that, tomato plants (*Pectomech*) subjected to treatment whether fertilizer application only, apical dominance and fertilizer application plus apical dominance generally grow taller than those left to grow naturally. Also among the treated tomatoes, it was observed that those subjected to fertilizer application only had the least mean height at the end of the 3 weeks. This confirms the finding that fertilizer generally improves yield as compared to the control that had no fertilizer. Tomato plants subjected to apical dominance only had the highest mean height supporting the existing theory that apical dominance offers a plant the tendency to grow beyond its normal height [10]. Since both pruning and fertilizer application generally improves yield, it was expected that of the tomato plants subjected to apical dominance plus fertilizer application to reach higher heights and this expectation was met because increases within the weeks was significant.

CONCLUSION:

This research aimed to identify the effects of apical dominance and fertilizer application on the yield and quality of tomato (*Pectomech*). Apical dominance and fertilizer application influenced the growth and development of tomato plants and this impact was felt among the treated tomato plants though some obvious differences were observed. From the results of this study it can be concluded that;

- A plantation of tomato fruit is better when treated than left to grow naturally, since treated plants showed signs of implied good yields by the increase in heights of their tomato plants as compared to the controls.
- Plants treated with only fertilizer will yield but not as compared to plants subjected to both apical dominance plus fertilizer application. Also plants treated with only apical dominance will equally give good yield.

Therefore, cultivation of Pectomech variant in Ghana should never be without treatment. Since farmers are already used to applying fertilizer to plants; they should assimilate the practice of apical dominance in addition, since it is a good way of ensuring the growth of tomatoes for good yields.

REFERENCES

1. Halder, P., & Pati, S. (2011). A need for paradigm shift to improve supply chain management of fruits & vegetables in India. *Asian Journal of Agriculture and Rural Development*, 1(393-2016-23908), 1-20.
2. Oniang'o, R. K., Mutuku, J. M., & Malaba, S. J. (2003). Contemporary African food habits and their nutritional and health implications. *Asia Pacific journal of clinical nutrition*, 12(3).
3. Cline, M. G. (1991). The botanical review on Apical Dominance. Wiley online library 57(4):318- 358. Accessed at <https://www.wileyonlinelibrary.com> on 19/03/20.
4. De Zeeuw, D. (1954). Floral development and removal of young leaves. *Asian journal of promotion of floral development* 2:38-47.
5. Leopold, A. C., & Lam, S. L. (1960). A leaf factor influencing tomato earliness. In *Proceedings. American Society for Horticultural Science* (Vol. 76, pp. 543-7).
6. Adams, C. R., Bamford, K. M., & Early, M. P. (2011). *Principles of horticulture*. Routledge.
7. Gyabeng, B. A., Andam, B. (2017). KNUST map locator. Wiley online library 1:1-7. Accessed at <https://www.wileyonlinelibrary.com> on 16/05/2020.
8. Aryee, J. N. A., Amekudzi, L. K., Quansah, E., Klutse, N. A. B., Atiah, W. A., & Yorke, C. (2018). Development of high spatial resolution rainfall data for Ghana. *International Journal of Climatology*, 38(3), 1201-1215.
9. Linda, B. G. (2006). Careful pruning balances shoot growth and fruit production in plants. *American journal of agriculture* 2:109-116.
10. Booker, J., Ottoline, L.A. (2003). The growth habit of Apical Dominance treated plants. Wiley online library 45(6):31-43. Accessed at <https://www.wileyonlinelibrary.com> on 20/03/2020.