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Effect of Apical Pinching on the Performance of *Asontem* Okra

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Abstract: Apical pinching redirects movement of auxin from the apical part of a plant to lower areas, stimulating the development of lateral branches which increases the potential podding points on a plant thereby increasing the number of fruits produced per plant. This study was aimed at determining the effects of apical pinching on the growth characteristics and yield of *Asontem* okra variety. The experimental work was carried out on Ghana Rubber and Estates Limited (GREL) out-grower farm at Agona Nkwanta in the Western Region of Ghana between January and May 2016. A randomised complete block design (RCBD) consisting of 5 treatments with 3 replications each was used. The treatments included: no pinching (control treatment, T1) and pinching 2 weeks (T2), 3 weeks (T3), 4 weeks (T4) and 5 weeks (T5) after seedling emergence. Data collected were subjected to Analysis of Variance (ANOVA) at a significance level of 5%. Results obtained generally revealed that pinching had significant effect on plant height, stem girth and number of internodes but had no significant effect on vegetative growth, number of pods per plant and weight of pods per plant. Unpinched *Asontem* okra plants (T1) produced the tallest plants due to the presence of auxin in the apical part. *Asontem* okra plants pinched 3 (T3) and 4 (T4) weeks after emergence produced the biggest leaves, increasing their photosynthetic characteristics. Pinching 2 to 3 weeks after emergence also produced the thickest plants, while pinching on the third week, followed by pinching on the fourth week, after emergence produced the highest number of internodes. Both treatments T3 and T4 produced the highest number of pods of 14 each, while T4 produced the heaviest pods per plant followed by T3.

Key words: Apical pinching · *Asontem* okra · Growth characteristics · Yield

INTRODUCTION

Okra (*Abelmoschus esculentus*) is an important annual vegetable crop grown in tropical and subtropical areas of the world and consumed worldwide [1, 2]. It is a multipurpose crop because it can be used in various forms to prepare various meals and in various medicinal applications. Its fresh leaves, buds, flowers, pods, stems and seeds are all edible [3, 4, 5]. Immature fruits of okra are consumed as vegetables in salads, soups and stews and it is also used in stews and sauces to provide mucilaginous consistency [6]. It is rich in nutritional elements such as calcium, potassium and magnesium in addition to vitamins such as Riboflavin, Thiamin, Vitamin C and Vitamin A [7, 8]. The mucilage found in okra is used as a plasma replacement or blood volume expander. It also binds cholesterol and bile acid carrying toxins from the liver [4, 9]. Okra seeds have good potential as a source of oil. Its oil concentrations could be up to 40% and contains up to 47.4% linoleic acid, a polyunsaturated fatty acid essential for human nutrition [10, 11, 12].

Asontem okra is an early maturing and one of the highest yielding varieties of okra originating from Ghana. It has also been found to have significantly high yield of comparatively thicker mucilage [13, 14]. Even though this variety is known to be susceptible to insect pests and diseases, with good pest and disease management coupled with other yield enhancement techniques, it has the potential to improve the livelihood of its farmers [14, 15, 16].

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Apical pinching also known as topping is one of the techniques employed to enhance crop growth and yield. It involves the removal of the apical bud of a stem to encourage the development of lateral shoots or side branches. It redirects auxin from the apical part of a plant to lower areas which stimulate the development of side branches [17, 18]. This increases the potential podding points on the plant thereby increasing the number of fruits produced per plant [19, 20, 21]. Pinching just above the first set of basil leaves (*Ocimum basilicum*) encouraged the development of more nodes under the leaves which produced more side branches [22]. Sajjan *et al*. [23] and Venkatareddy *et al*. [24] observed that apical bud pinching of okra resulted in significantly higher processed seed yield, about twice the yield of unpinched okra plants. Akumani [25] also observed that pinching okra plants at 4 weeks gave a higher yield than pinching at 6 weeks. The main aim of this study, therefore, was to determine the influence of apical pinching on the growth characteristics and yield of *Asontem* okra.

MATERIALS AND METHODS

Experimental Site: The experiment was carried out on a Ghana Rubber and Estates Limited (GREL) out-grower farm at Agona Nkwanta in the Western Region of Ghana, located around latitude 4° 51' N and longitude 02° 15' W. The area lies within the Rain Forest Zone of Ghana and experiences almost all year rainfall regimes. The average annual rainfall is about 1600 mm. The experiment was conducted between January and May 2016. The soil is classified as Forest Oxysols [26]. The soil at the experimental site was sandy loam in texture with the characteristics as shown in Table 1.

Table 1: Physio-chemical properties of soil of study site

Soil properties	0-15cm	15-30cm
Sand (%)	90.2	88.2
Silt (%)	3.9	5.9
Clay (%)	5.9	5.9
Organic Carbon (%)	0.9	0.6
Organic Matter (%)	1.55	1.03
Total Nitrogen (%)	0.14	0.13
K (cmol /100g)	0.49	0.23
Na (cmol /100g)	0.95	0.87
Ca (cmol /100g)	5.6	5.8
Mg (cmol /100g)	1.4	2.4
Available P (mg/kg or ppm)	155.56	139.47
pH	5.3	4.92

Experimental Design and Layout: A Randomized Complete Block Design (RCBD) comprising of 5 treatments with 3 replications each was used. The treatments were namely no pinching (T1), pinching two weeks after emergence (T2), pinching three weeks after emergence (T3), pinching four weeks after emergence (T4) and pinching five weeks after emergence (T5). Each plot measured 2.4 m × 1.8 m, with 1.2 m and 1 m buffer zone between the blocks and the plots respectively. Inter and intra row spacing between the plants were 60 cm × 45 cm respectively and each plot had 25 plants [14].

Sowing and Cultural Practices: *Asontem* okra seeds were obtained from the Crops Research Institute of the Council for Scientific and Industrial Research (CRI-CSIR), Anyinase. Sowing was done using a custom made depth control dibbler at a rate of 2 seeds per hill to a depth of 2.5 cm and thinned to 1 plant per hole 10 days after emergence. Thinned-out seedlings were used as transplants to fill in seeds that failed to germinate.

Regular watering and weed control by hoeing were done. During the growing season, NPK (15-15-15) was applied to the plants at a rate of 7 g per plant [27]. An organic insecticide 'Nemazal', (neem seed oil) with active ingredient azadirachtin, was used to control insect pests while Topcop, a sulphur-based organic multipurpose disease control chemical was used to control fungal diseases. The rate of the Nemazal application was 4 ml/litre at 7 days' intervals. Topcop was applied at an initial application rate of 6.5 ml/litre when the plants were 4 weeks old and increased to 10 ml/litre at flowering and fruiting stages at 10 days' intervals.

Data Collection and Analysis: Data were collected on plant height, leaf length and width, stem girth, number of internodes, weight and number of pods harvested per plant. Three plants were randomly selected for the measurement of growth parameters such as plant height, leaf length and width, stem girth and number of internodes starting one week to ten weeks after seedling emergence. Plant height was measured using tape measure. Leaves at the middle part of the plants were randomly chosen and their widths and lengths were measured using a tape measure in centimetres. Stem girth was measured using inextensible thread round the stem at 5 cm above the ground. The length of the thread that was used round the stem was then measured using the tape measure. The number of internodes was recorded by counting the internodes on the stems of the okra plants. The number of okra pods harvested per plant was

determined by counting and averaging the number of pods harvested from 3 plants on each plot for the 3 replicates and weighed to determine the weight of pods per plant. Fruits from 3 plants on each plot were sampled and the average values in kilograms were recorded. Data on the weight and number of pods harvested per plant were collected weekly from the seventh to the tenth weeks. All data collected were subjected to analysis of variance (ANOVA) using the IBM® SPSS® Statistics 21 at a significance level of 5%.

RESULTS AND DISCUSSION

Effect of Pinching on Plant Height: Pinching affects the growth of plants in height as auxins (plant hormone responsible for elongation growth) are redirected to other buds to enhance lateral growth and thus reduced plant height [28]. Results obtained from this study are displayed in Fig. 1. Significant difference in *Asontem* okra plant height was observed from the third week till the tenth week after emergence. The difference was observed from the third week after emergence because the first pinching treatment was applied on the second week after emergence. *Asontem* okra plants under the control treatment (T1 - no pinching) grew tallest, followed by plants pinched at the second week after emergence (T2), then pinching at the fourth week after emergence (T4) and the least recorded height with respect to the treatment were pinching on the third (T3) and fifth (T5) weeks after emergence.

Effect of Pinching on Vegetative Development: Apical pinching generally leads to increase in vegetative development (growing of more and bigger leaves) [23]. This provides wider surface area for greater photosynthetic activities which in turn increase other growth characteristics and yield [28, 29]. Results on this are shown in Figures 2 and 3. It is evident that T3 produced the longest leaves followed by T4 and T1. T2 produced the shortest *Asontem* okra leaves. Also, T4 and T3 produced the broadest leaves followed by T1, T2 and T5. However, at the end of the tenth week, these effects were not statistically significant.

Effect of Pinching on Stem Girth: Effect of pinching on the stem girth of *Asontem* okra is illustrated in Fig. 4. The results indicate that the stem girth of unpinched *Asontem* okra plants was significantly lower than the other treatments. However, there were no significant difference among the other treatments. At the end of 10 weeks, T2 and T3 had produced the thickest stems of *Asontem* okra plants followed by T4 and T5. The control treatment, T1 produced the thinnest *Asontem* okra plants.

Effect of Pinching on the Number of Internodes: The nodes contain the buds that can easily produce lateral buds. Development of more internode buds was significantly encouraged by the removal of the apical bud only from the sixth to the tenth weeks after emergence. This led to the development of relatively more stems. From Fig. 5, it could be seen that *Asontem* okra plants under T3 had the highest average number of internodes (11.07) followed by those under T4 (10.77). Treatments T2 and T5 had average numbers of internodes of 10 and 9.9 respectively while *Asontem* okra plants under T1 produced the least number of internodes (9.4).

Effect of Pinching on Number of Pods per Plant: Fig. 6 shows the number of pods produced per *Asontem* okra plant under the various pinching treatments. There was no significant effect of apical pinching on the number of pods produced by the okra plants. Pinching at weeks 3 (T3) and 4 (T4) after emergence produced 14 pods each which is the highest number of okra pods produced per plant. This was followed by *Asontem* okra plants pinched at the 2 weeks after emergence (T2) which produced 12.33 pods per plant while no pinching (T1) and pinching at the 5 weeks after emergence (T5) produced an average of 12 pods per plant each which is the lowest number of pods produced per plant. These results are in agreement with the findings of Marie *et al*. [19], Sajjan *et al*. [23] and Vasudevan *et al*. [30].

Effect of Pinching on Weight of Pods per Plant: Fig. 7 present results on the effect of the different pinching treatments on the weight of pods harvested per *Asontem* okra plant. Generally, apical pinching had no significant effect on the weight of pods produced per plant which is contrary to that observed by Marie *et al*. [19]. Marie *et al*. [19] observed that okra pinched at a height of 25 cm above the soil surface yielded significantly more pods per plant. It could be seen that *Asontem* okra plants pinched four weeks after emergence (T4) produced the heaviest pods per plant (2.75 kg) which implies the highest yield per unit area. It was followed by T3 (2.52 kg), T5 (2.38 kg) and T1 (2.24 kg) with T2 producing the lowest yield of 2.23 kg. This confirms the finding of Akumani [25] that pinching okra plants at 4 weeks gave a higher yield than pinching at 6 weeks.

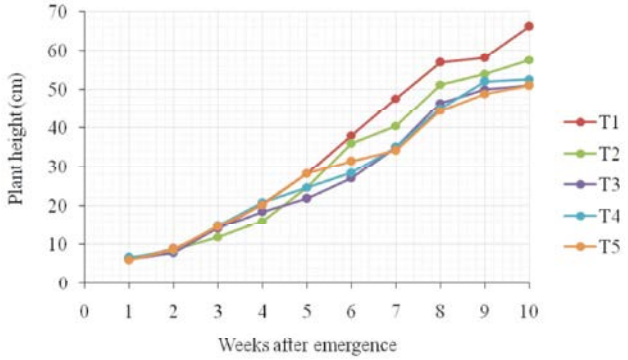

Fig. 1: Effect of pinching on plant height

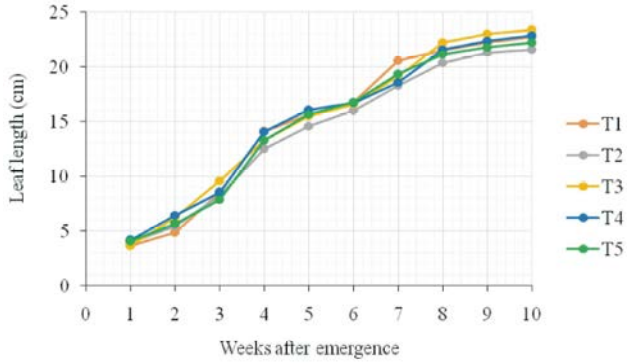

Fig. 2: Effects of pinching on leaf length

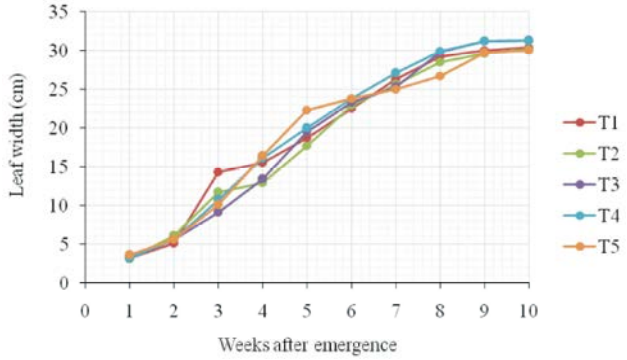

Fig. 3: Effect of pinching on leaf length

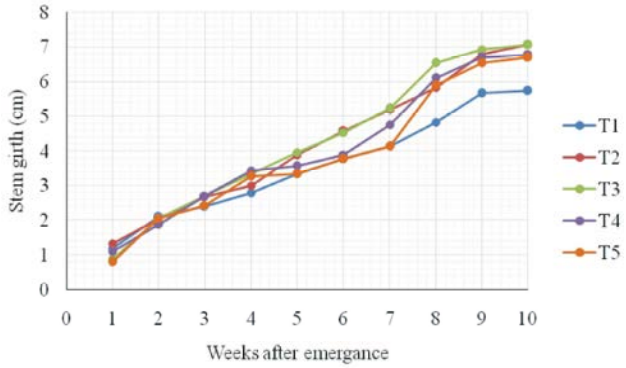

Fig. 4: Effect of pinching on stem girth

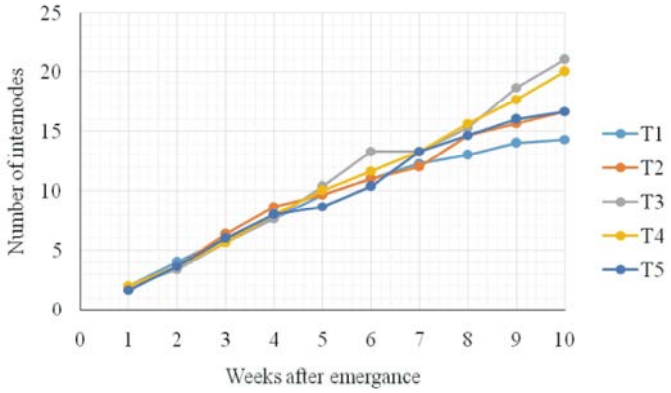

Fig. 5: Effect of pinching on number of internodes

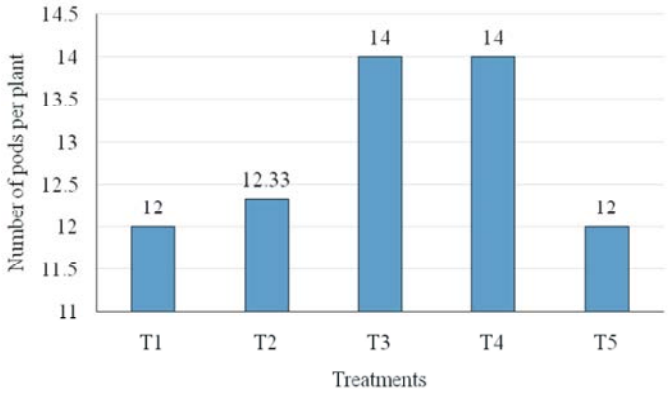

Fig. 6: Effect of pinching on number of pods per plant

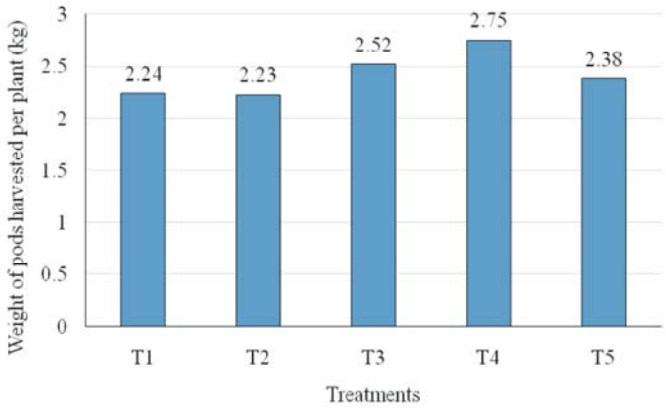

Fig. 7: Effect of pinching on the weight of pods harvested per plant

CONCLUSION

Apical pinching effect on growth and yield parameters of *Asontem* okra plants was explored. Results obtained generally revealed that pinching significantly affected plant height, stem girth and number of internodes. Leaf length and width, number of pods per plant and weight of pods per plant were not significantly affected by apical pinching of *Asontem* okra. Unpinched *Asontem* okra plants (T1) produced the tallest plants because the presence of auxin enhanced "elongational" growth. However, *Asontem* okra plants pinched 3 (T3) and 4 (T4) weeks after emergence produced the biggest leaves, increasing their photosynthetic activities. Pinching 2 to 3 weeks after emergence also produced the thickest plants while pinching on the third week, followed

by pinching on the fourth week, after emergence produced the highest number of internodes. Both treatments T3 and T4 produced the highest number of pods of 14 each while T4 produced the heaviest pods per plant. This indicates, taking into account previous research, that pinching 3 to 4 weeks after *Asontem* okra seedling emergence is reliable to produce bigger leaves and higher yield in terms of number and weight of pods which are two of its most economic parts.

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