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EFFECT OF APICAL REMOVAL OF BRANCHES AND BRANCHES NUMBER ON GROWTH AND YIELD OF TWO (*Capsicum annuum* L.) CULTIVARS

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ABSTRACT

This study was aimed to evaluate the effects of some pruning systems on the growth of two (*Capsicum annuum* L.) cultivars. The experiment was designed as Factorial Randomized Complete Block Design (RCBD) each treatment replicated 3 times each with 8 treatments (experimental unit) representing 2 cultivars (California wonder and Biotek), two number of branches (leaving 2 and 4 branches on the main stem) and 2 treatments of apical removal; control (without apical removal) and apical removal of main branches. The highest value of plant height was recorded from California wonder cultivar when pruned on four branches without apical removal and the highest number of sub branches as well as number of fruits, yield.plant^{-1}, yield.plot^{-1} and yield.ha^{-1} (40.77, 40.27, 0.89kg, 5.39kg and 47.95ton respectively) were observed from Biotek cultivar, pruned on two branches with apical removal of branches.

KEY WORDS*: Two (Capsicum annuum L.)*Cultivars, number of branches, apical removal.

1. INTRODUCTION

Bell pepper (*Capsicum annuum* L.) was originated in the Mexico, Central Ameria regions, it is one of the most widely used foods in the world, and Bell pepper is a member of Solanaceae family (Wien, 1997). The best climates of pepper are with temperatures in the growing season at the range of 25 to 30°C at the day and 18 to 20° C at the night (Hebbar *et al.*, 2011). The genus Capsicum contains about 30 species (Grubben and Mohamed, 2004). Peppers are usually classified as sweet or hot, these two types include many cultivars which vary by fruit shape, flavor, pungency, color, and culinary use. Pickling, grinding, roasting, drying, and freezing can influence flavor (Matloub *et al.*, 1989 and ISU, 2009).

Apical dominance refers to encourage of lateral bud growth by removal of the apical bud (Pessarakli and Dris, 2003). Proper pruning practices may lead to the production increase yield, early harvest, easy harvesting of fruits and relatively large sized fruit with better quality, in addition of appropriateness in intercultural practicability without fruits or plants damage (Tinni *et al.*, 2014). Jovicich *et al.* (1999) resulted that the shoot pruning of sweet pepper on four branches caused increasing of marketable fruits (number and weight).m^{-2}, extra large fruit yield.m^{-2}, number and dry weight of leaves, branch diameter but total plant dry weight were higher on four and two branches than in single ones.. Seo *et al.* (2006) studied the effects of pinching methods (main stem and first node of main branch) on branching, growth and fruiting of green pepper seedlings. They reported that lateral braches lengths were longer in topping main stem and increasing of fresh and dry weight of above ground parts. Chauhan *et al.* (2009) studied the effect of apical pinching on the seedlings growth of bell pepper, and found that had significant effect on plant height, number of branches.plant^{-1}, days to first picking of green fruits, days of harvest duration of green fruits, and green fruit yield.ha^{-1}. Seifi *et al.* (2012) investigated the effects of shoot pruning (without pruning and with three main branches) on yield characteristics and growth of sweet pepper, they observed that shoot pruning had significant effects on yield.plant^{-1}, yield.m^{-2}, fruit weight, number of fruits.plant^{-1} and plant weight. Alsadon *et al.* (2013) found that pepper plants when pruned on one branch caused significant increase in early yield, fruit size and internal fruit quality with a decrease in total fruit yield ton.ha^{-1}, however plants pruned to four

branches produced the highest yield.ha^{-1}. Ahirwar and Hedau (2015) studied the effect of shoot pruning (zero, two, three and four branches) on yield and quality of a winter (*Capsicum annuum* L.), the results showed that marketable yield (number and weight).m^2 total marketable yield.plant^{-1}, extra large fruit yields, number seeds.fruit^{-1}, peal thickness(mm) of fruit and yield.plant^{-1} increased linearly in plants with four branches treatment than in those with control, two and three branches, but branch length and number of nodes.branche^{-1} were greater in single branch than in four branches plant.

More production techniques are required to improve pepper quality and yield. The purpose of this present study is to evaluate the influence of number of branches and their apical removal (it is a new technique applied on vegetable crops) on growth and yield of two pepper cultivars under field conditions of Kurdistan Region.

2. MATERIALS AND METHODES

This experiment was carried out during April 6th to September 6th 2016 at Grdarasha open field, College of Agriculture, Salahaddin University. The experiments arranged to study the effects of some pruning systems on two pepper (*Capsicum annuum* L.) cultivars (California wonder and Biotek). Some chemical and physical properties of the soil taken from different locations of the field at 0-30cm depth depending on (Estefan *et al.*, 2013), the results of the analysis are shown in the table (1). The metrological data during the experimental period are shown in table (2).

Table(1): Some physical and chemical properties of the soil used in the study*.

Properties	Field Soil
pH	7.65
Electro Conductivity (EC)	2.36 dS.m^{-1}
Organic mater	1.134%
Total potassium (K_2O)	0.440%
Total iron (Fe)	0.016%
Clay	34.710%
Silt	52.355%
Sand	12.935%
Soil texture	Silty Clay Loam

*Laboratory of Collage of Agriculture / Soil and Water Department.

Table (2): The metrological data during the study periods*:

Month	Average air temperature °C		Average air Humidity %	
	Minimum	Maximum	Minimum	Maximum
April	13.33	26.47	26.29	71.04
May	18.83	33.23	15.37	46.94
June	25.76	39.12	10.36	28.77
July	27.54	43.42	8.14	24.14
August	26.95	43.37	7.90	25.09
September	22.12	36.96	12.94	36.52

*Agriculture research center Erbil, Ministry of agriculture of Kurdistan region.

2.1 Seed Sowing And Cultivation:

Seeds of two studied sweet pepper cultivars (California wonder and Biotek) were sown in polystyrene seedling trays (5×3×4cm). The trays were filled with peat moss (pH: 6 and organic matter 90%). After 5-6 weeks from seed sowing all plants had developed two to four branches.

2.2 Field Preparation And Transplanting:

The land was divided manually to plots (150×75 cm), the irrigation system was drip irrigation which prepared before transplanting of the seedlings. The seedlings were planted in the rows, 50 cm between the rows and 40 cm between the plants. Eight weeks old seedlings, when they

reached 5-6 leaves with healthy and uniform sized were transplanted (Fawzy *et al.*, 2012). The seedlings were transplanted to the experimental plots on April 6th in the afternoon, each plot contain 6 plants and watered immediately after transplanting. The recommended organic fertilizer is cow manures at the rate of $40m^2.ha^{-1}$ added before transplanting. The chemical fertilizer was added at the rates of $240kg.ha^{-1}$ of superphosphate after two weeks from transplanting, $360kg.ha^{-1}$ of sulphate ammonium in the beginning of flowering and $360kg.don^{-1}$ of sulphate ammonium during flowering.

2.3 Description Of The Experiments:

This experiment was designed as Factorial Randomized Complete Block Design (RCBD), each treatment was replicated 3 times included 8 treatments (experimental unit) representing 2 cultivars (California wonder and Biotek), two number of branches (leaving 2 and 4 branches on the main stem) and 2 treatments of apical removal; control (without apical removal) and apical removal of main branches. The results were analyzed statistically and the means compared by Duncan's Multiple Range test at 5% probability level (Al-Rawi and Khalaf-Allah, 1980). The statistical analysis was carried out by using SPSS (Statistical Package for Social Sciences) program (Casanova *et al.*, 2004).

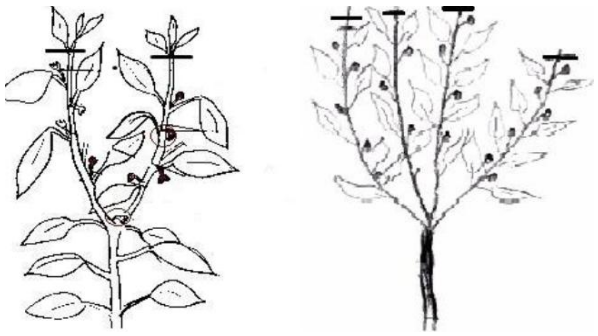

Fig.(1): Two and four branches and apical removal of branches.

2.4 Experimental Parameters

2.4.1 Vegetative growth measurements

1- Plant height (cm): Plant height was measured from the contact point (crown) of the stem with soil to the apical point of the main shoot (Mohammad-Amin, 2008).

2- Stem Diameter (mm): Plant stem diameter was measured using vernier calipers at the height of 5cm from the soil surface. The stem diameter was expressed in Millimetres (mm) (Sabli, 2012).

3- Number of Sub Branches.plant^{-1}: Number of sub branches was counted from plants, when they can be seen by the naked eye (Mohammad-Amin, 2008).

4- Number of Leaves.plant^{-1}: Number of visible leaves was counted (Mohammad-Amin, 2008).

5- Leaf Area (cm^2): Ten leaves per replicate were collected and their area was measured by using digital planimeter (PLACOM, KP90, No.H 15858, JAPAN) and the average leaf area was calculated (Ghoreishi *et al.*, 2012).

6- Shoot Fresh Weight.plant^{-1} (g): Fresh weight of shoot system was measured by sensitive balance as soon as possible after harvesting (Shekhany, 2014).

7- Shoot Dry Weight.plant^{-1}(g): Shoot system was oven dried to constant weight at 70°C for 72h and the weight was measured by sensitive balance (Mohammad-Amin, 2008).

2.4.2 Qualitative and Quantitative of yield:

1- Number of Flowers.plant^{-1}: Number of flowers was counted weekly when the first flower was observed of six selected plants in each plot, the number of flowers.plant^{-1} was measured as follows (Mohammad-Amin, 2008):

$$\text{Number of flowers.plant}^{-1} = \frac{\text{Number of flower.plot}^{-1}}{\text{Number of plants.plot}^{-1}} \quad \ldots\ldots$$

2- Number of Fruits.plant^{-1}: The number of harvested fruits were counted for the same selected plants in each plot, thereafter the number of fruits.plant^{-1} was measured as follows (Kabir, 2014):

$$\text{Number of fruits.plant}^{-1} = \frac{\text{Number of fruits.plot}^{-1}}{\text{Numberof plants.plot}^{-1}} \quad \ldots\ldots$$

3- Fruit Length (mm): Fruit length was measured by

digital Venier from the neck of the fruit to the bottom of five marketable fruits from each plot (Mitra, 2007).

4- Fruit Diameter (mm): Diameter of fruit was measured at the middle portion of the same five marketable fruits from each plot with a digital Vernier (Mitra, 2007).

5- Flesh Thickness (mm): The same five samples of fruits per plot were sliced at their equator; the pericarp thickness was measured using a digital Vernier (Beyer, 2012).

6- Fresh Weight of Individual Fruit (g): Fresh weight of individual fruit calculated by following law (Beyer, 2012):

$$\text{Fresh weight of individual fruit (g)} = \frac{\text{Total fresh weight of fruits.plot}^{-1}}{\text{Number of fruits.plot}^{-1}} \ldots\ldots$$

7- Dry Weight of Individual Fruit (g): The harvested fruits were oven dried to a constant weight at 70°C then taken dry weight of individual fruits calculated as follows (Beyer, 2012):

$$\text{Dry weight of individual fruit (g)} = \frac{\text{Total dry weight of fruits.plot}^{-1}}{\text{Number of fruits.plot}^{-1}} \ldots\ldots$$

8- Yield.plant^{-1} (kg): The fresh weight of fruits.plant^{-1} was calculated by weighting the harvested fruits as follows:

$$\text{Fresh weight of fruits.plant}^{-1}\text{(kg)} = \frac{\text{Total feresh weight of fruits.plot}^{-1}}{\text{Number of plants.plot}^{-1}}$$

9- Yield.plot^{-1} (kg): Fruit yield.plot^{-1} was measured from weighted marketable fruits during the period from first to final harvest for all plants in each experimental unit (Mitra, 2007).

10- Yield.ha^{-1} (ton): Yield.ha^{-1} was calculated by the following formula (Aman and Rab, 2013):

$$\text{Fruit yield.ha}^{-1}\text{(ton)} = \frac{\text{Fruit yield.plot}^{-1}\text{(kg)} \times 10000}{\text{Plot area (m}^2) \times 1000} \ldots\ldots$$

3. RESULTS AND DISCUSSION:

3.1 Vegetative Growth Parameters:

3.1.1 Response of Cultivars:

Figure (2. a and b) shows significant responses of cultivars on plant height, number of sub branches, number of leaves, and shoot fresh weight. The best result of plant height was recorded from California wonder cultivar. While the best results of number of sub branches and number of leaves were obtained from Biotek cultivar. These results may be due to the genetic variability between these two cultivars (Karanatsidis and Berova, 2009).

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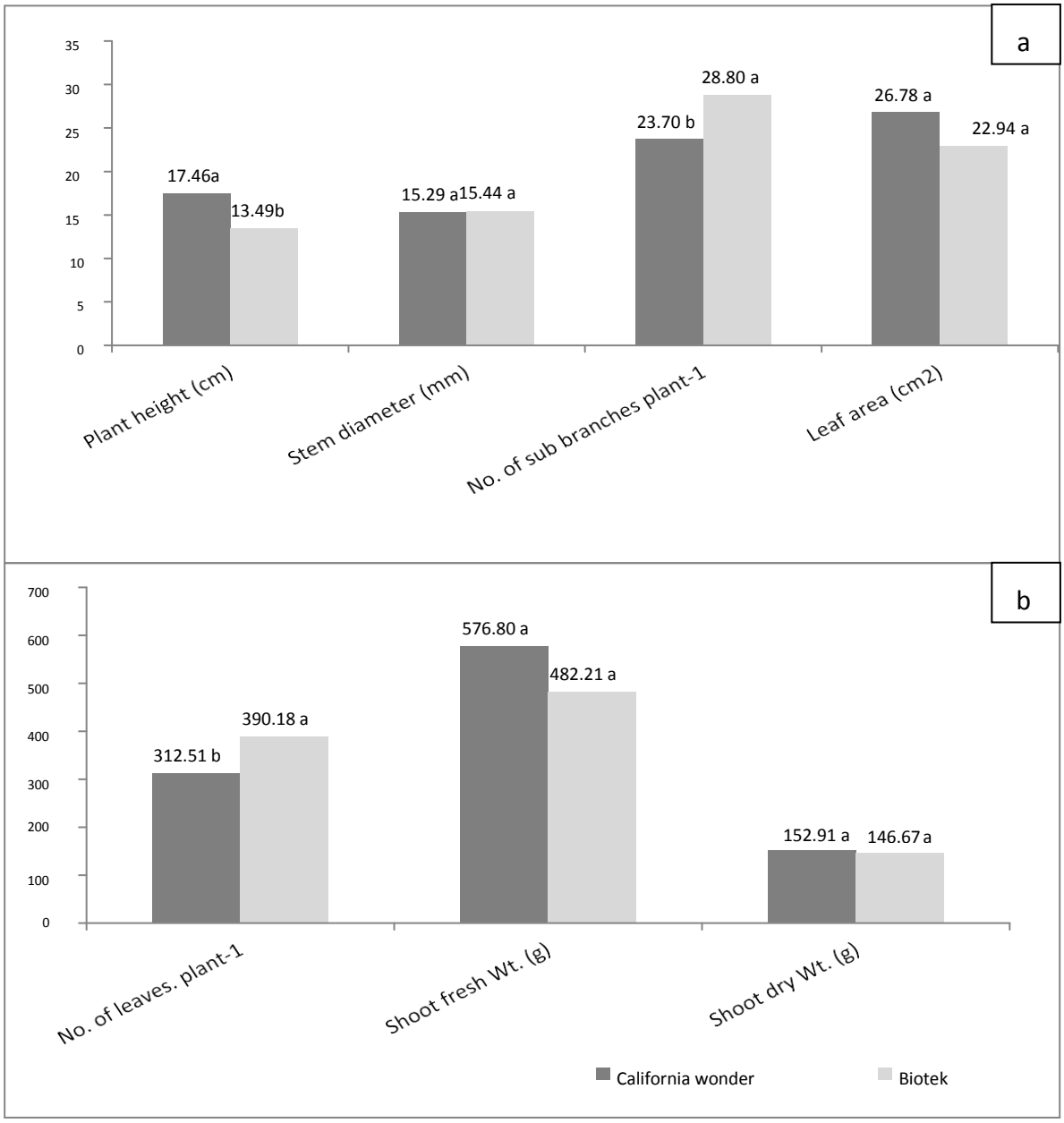

Fig. (2. a and b): Response of *Capsicum annuum* L. cultivars on vegetative growth parameters.
*****(columns with the same letter are not significantly different from each other according to Duncan's Multiple Range test at 0.05 level).

3.1.2 Effect of Number of Branches:

Figure (3. a and b) observes that there are no significant effect of number of branches on vegetative parameters except number of sub branches. The highest value of number of sub branches (34.55) was obtained from pruning on two branches. This result is agreement with (Jovicich *et al*. 1999) and might be due to the fact that competition between plants for available water, nutrients and light is less in less branch system than in much branches system (Alsadon *et al.*, 2013).

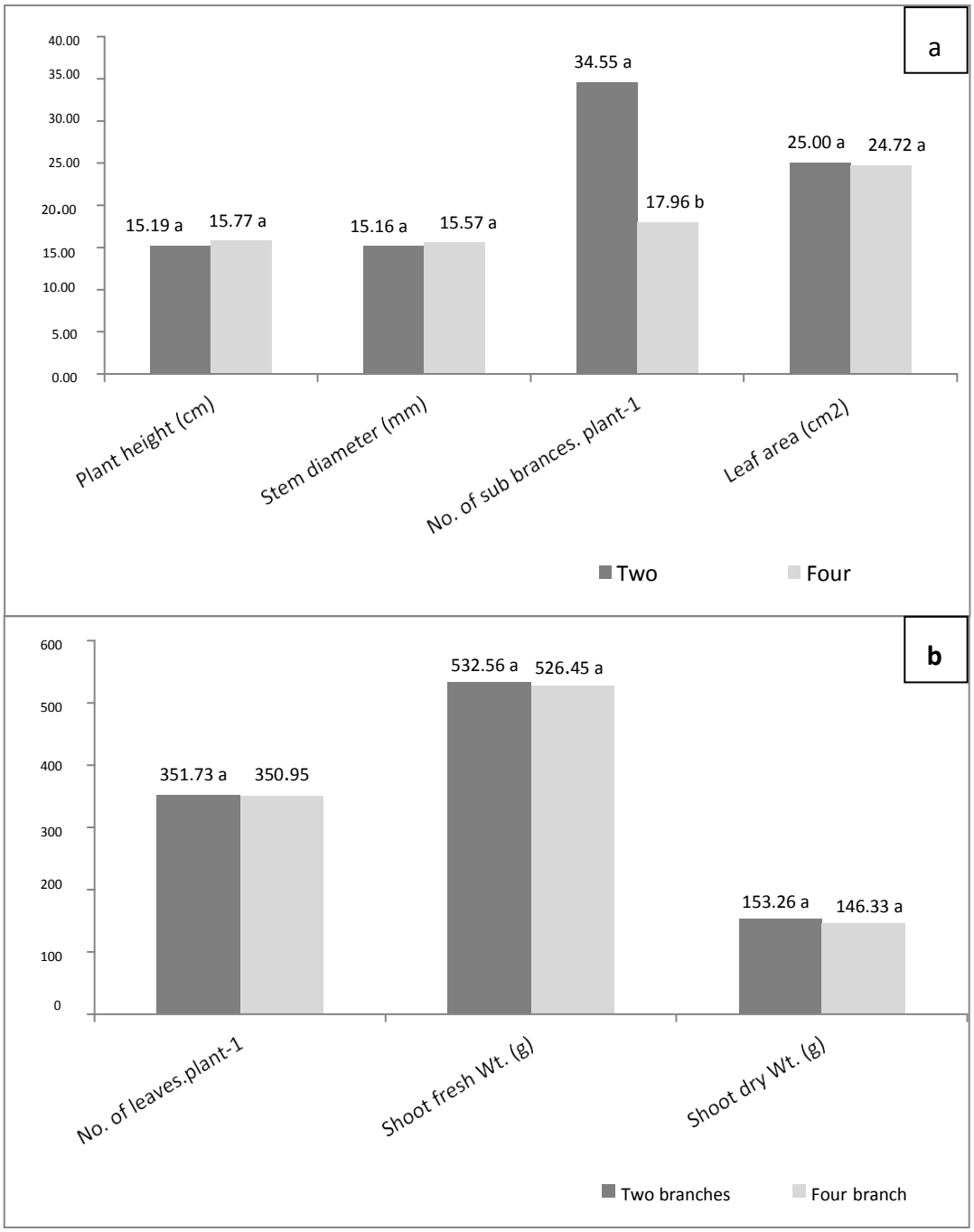

Fig. (3. a and b): Effects of number of branches on vegetative growth parameters of *Capsicum annuum* L.

*****(columns with the same letter are not significantly different from each other according to Duncan's Multiple Range test at 0.05 level).

3.1.3 Effect of Apical Removal of Branches:

Figure (4. a and b) shows no significant effect of apical removal of branches on all studied vegetative growth parameters.

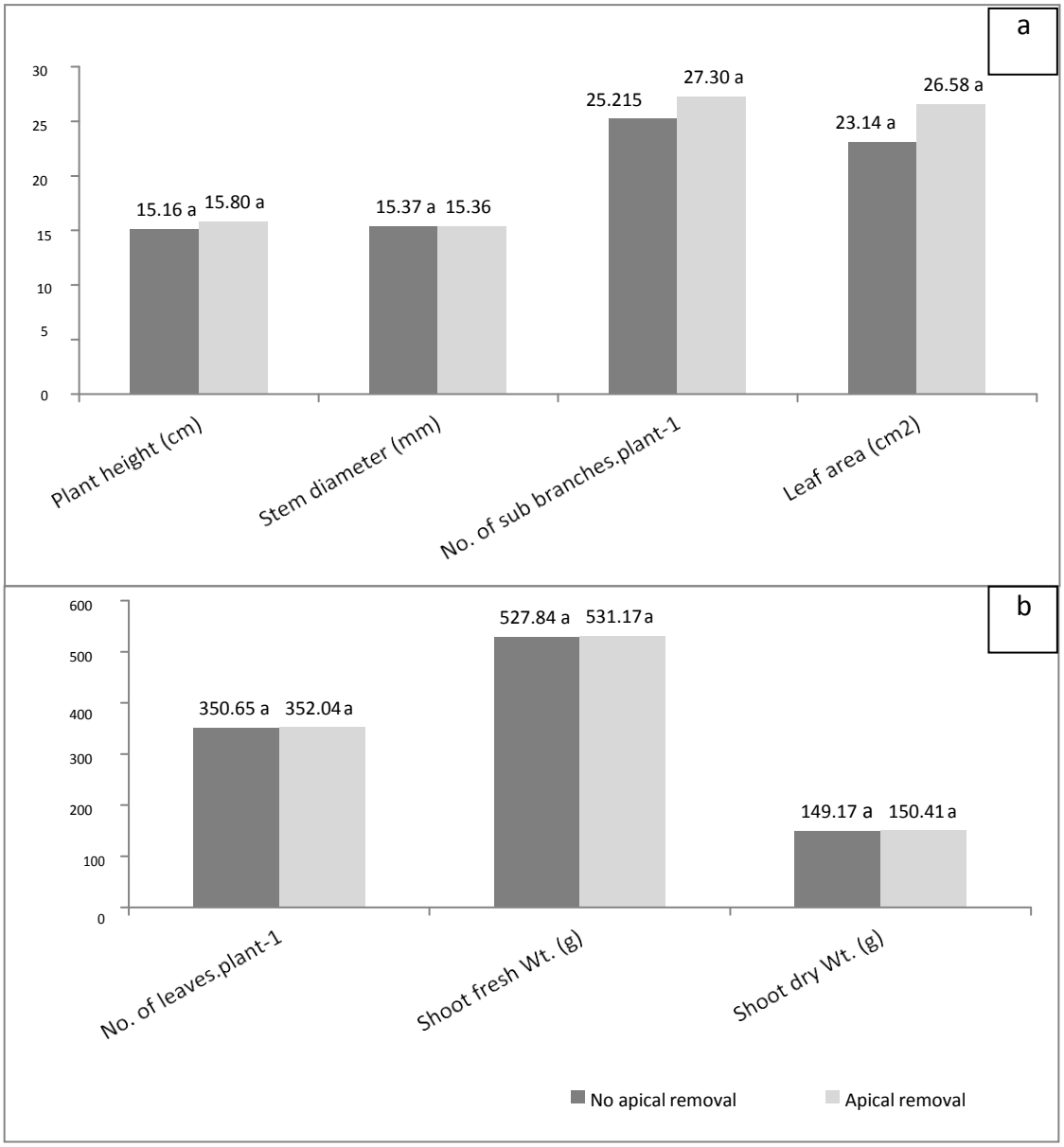

Fig. (4. a and b): Effect of apical removal of branches on vegetative growth parameters of *Capsicum annuum* L.

*(columns with the same letter are not significantly different from each other according to Duncan's Multiple Range test at 0.05 level).

3.1.4 Response of Cultivars and Number of Branches:

Data in table (3) shows that there are significant effect of cultivars and the number of branches interaction on plant height and number of sub branches. The highest value height was recorded from California wonder cultivar when pruned on four branches. However, the maximum value of number of sub branches was obtained from Biotek cultivar and pruned on two branches. These results are in

harmony with the finding of Alam *et al.* (2016) on tomato plants, and this may be due to that the removal of some branches leads to supply nutrients in the remaining branches.

Table (3): Response of cultivars and number of branches introduction on vegetative growth parameters of *Capsicum annuum* L.

Cultivars	Number of branches	ant height (cm)	em Diameter (mm)	No. of sub branches .plant^{-1}	No. of leaves .plant^{-1}	Leaf area (cm^2)	Shoot Fresh Wt. (g)	Shoot Dry Wt. (g)
California wonder	Two branches	16.27 ab	15.14 a	30.26 b	318.05 a	27.04 a	584.58 a	**153.60 a**
	Four branches	18.66 a	15.45 a	17.15 c	306.97 a	26.53 a	569.02 a	**152.22 a**
Biotek	Two branches	14.10 bc	15.19 a	38.84 a	385.41 a	22.96 a	480.55 a	**152.91 a**
	Four branches	**12.88 c**	**15.69 a**	**18.77 c**	**394.94 a**	**22.91 a**	**483.88 a**	**140.44 a**

*****Values within each column followed with the same letters are not significantly different from each other according to Duncan's Multiple Range test at the0.05 level.

3.1.5 Response of Cultivars and Apical Removal of Branches:

Table (4) shows the interaction effects of cultivars and apical removal on vegetative growth parameters, these results showed significant differences among the treatments on plant height and leaf area only. The highest values of plant height and leaf area were recorded from the interaction of California wonder cultivar and apical removal of branches treatment. Our results agreed with those which were obtained by (Abdulla, 2012) on tomato plants. The apical removal of branches encouraged the plants to give more sub branches and thus the largest number of leaves the effectual sites of photosynthesis which reflected positively on the leaf area (Aljebory, 2006).

Table (4): Response of cultivars and apical removal introduction of branches on vegetative growth parameters of *Capsicum annuum* L.

Cultivars	Apical removal of branches	Plant height (cm)	Stem Diameter (mm)	No. of sub branches. plant^{-1}	No. of leaves. plant^{-1}	Leaf area (cm^2)	Shoot Fresh Wt. (g)	Shoot Dry Wt. (g)
California Wonder	No apical removal	17.05 a	15.47 a	22.56 a	308.55 a	23.22 b	587.08 a	**158.33 a**
	Apical removal	17.88 a	15.11 a	24.84 a	316.47 a	30.35 a	566.52 a	**147.49 a**
Biotek	No apical removal	13.27 b	15.26 a	27.86 a	392.75 a	23.05 b	468.61 a	**140.02 a**
	Apical removal	**13.72 b**	**15.61 a**	**29.75 a**	**387.61 a**	**22.82 b**	**495.82 a**	**153.33 a**

*****Values within each column followed with the same letters are not significantly different from each other according to Duncan's Multiple Range test at the0.05 level.

3.1.6 Interaction Effects Number of Branches and Apical Removal of Branches:

Data represented in table (5) clearly shows that the interaction of number of branches and apical removal had no significant effects on all vegetative parameters except number of sub branches. The maximum number of sub branches.plant^{-1} was recorded from pruning on two branching and apical removal treatment. This result can be attributed to the physiological role of

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apical dominance, when the apical bud is removed the apical dominance of auxin is removed thereby removing the inhibitory effect on cytokinin, which thus initiates lateral buds into branches (Adinde *et al.*, 2016).

3.1.7 Response of Cultivars to Number of Branches and Apical Removal of Branches:

Table (6) notice that the comparison among the values of growth parameters which were affected by the interaction of cultivars, number of branches and apical removal of branches. The highest value of plant height was recorded from California wonder cultivar when pruned on four branches without apical removal.

Table (5): Interaction effects of number of branches and apical removal of branches on vegetative growth parameters of Capsicum annuum *L.*

Number of branches	Apical removal of branches	Plant height (cm)	Stem Diameter (mm)	No. of sub branches . plant^{-1}	No. of leaves.plant^{-1}	Leaf area (cm^2)	Shoot Fresh Wt. (g)	Shoot Dry Wt. (g)
Two Branches	No apical removal	14.22 a	14.72 a	32.15 a	343.30 a	21.64 a	508.58 a	**149.91 A**
	Apical removal	16.16 a	15.61 a	36.02 a	360.16 a	28.36 a	559.72 a	**158.88 a**
Four Branches	No apical removal	16.10 a	16.02 a	20.26 b	358.00 a	24.63 a	541.60 a	**148.65 a**
	Apical removal	**15.44 a**	**15.12 a**	**18.57 a**	**343.91 a**	**24.81 a**	**502.63 a**	**141.94 a**

***** Values within each column followed with the same latter are not significantly different from each other according to Duncan's Multiple Range test at the 0.05 level.

Table (6): Response of cultivars, number of branches and apical removal of branches interaction on vegetative growth parameters of Capsicum annuum *L.*

Cultivars	Number of branches	Apical removal of branches	Plant height (cm)	Stem diameter (mm)	No. of sub branches. plant^{-1}	No.of leavs. plant^{-1}	Leaf area (cm^2)	Shoot Fresh Wt. (g)	Shoot Dry Wt. (g)
	2	No apical removal	15.22 ab	14.98 a	29.25 b	315.77 a	24.23 abc	567.50 a	**156.11 a**
		Apical removal	17.33 ab	15.30 a	31.27 ab	320.33 a	29.85 ab	601.66 a	**151.10 a**
	4	No apical removal	18.88 a	15.96 a	15.88 c	301.33 a	22.21 bc	606.66 a	**160.55 a**
		Apical removal	18.44 a	14.93 a	18.41 c	312.61 a	30.85 a	531.38 a	**143.88 a**
	2	No apical removal	13.22 b	14.46 a	36.91 ab	370.83 a	19.05 c	443.33 a	**139.16 a**
		Apical removal	14.99 ab	15.92 a	40.77 a	400.00 a	26.87 abc	517.77 a	**166.66 a**
	4	No apical removal	13.33 b	16.07 a	18.80 c	414.66 a	27.05 abc	493.88 a	**140.88 a**
		Apical removal	**12.44 b**	**15.31 a**	**18.73 c**	**375.22 a**	**18.77 c**	**473.88 a**	**139.99 a**

***** Values within each column followed with the same latter are not significantly different from each other according to Duncan's Multiple Range test at the 0.05 level.

However, the highest number of sub branches was obtained from Biotek cultivar, pruning on two branches and apical removal treatment. The highest value of leaf area was observed from California wonder cultivar, pruning on four branches and apical removal treatment. This might be due to that the

process of apical removal is increasing available nutrients for auxiliary buds that allow to growth and development of sub branches, moreover this process may affects on distribution of plant hormones like auxin, gibberellins and cytokines, whenever to become available to growth auxiliary bud instead of terminal bud that causes increasing number of leaves (Hopkins and Huner, 2004 and Hassan *et al.*, 2014).

3.2 Qualitative and Quantitative of yield parameters:

3.2 .1 Response of Cultivars:

Figure (5. a and b) observes significant response of cultivars on number of fruits, fruit diameter, fresh and dry weights of individual fruit. The highest value of number of fruit was recorded from Biotek cultivar. However the best results of fruit diameter, fresh and dry weights of individual fruit were recorded from California wonder cultivar. These results may be due to the ability of the two studied cultivars for exploiting the environmental factors because of their genetic variations (Awole *et al.*, 2011).

3.2.2 Effect of Number of branches:

The result in figure (6. a and b) shows no significant effects of number of branches on all reproductive parameter.

3.2.3 Effect Apical Removal of Branches:

Figure (7 a and b) shows significant effects apical removal of branches on number of fruits, fruit length, yield.plant^{-1}, yield.plot^{-1} and yield.ha^{-1}**.**The highest values of number of fruit.plant^{-1}, fruit length, yield.plant^{-1}, yield.plot^{-1} and yield.ha^{-1} were obtained from the plant with apical removal of branches. These results are in accordance with the findings of (Adinde *et al.* 2016), it could be attributed to the removal of auxin (Indole Acetic Acid) at the apical bud which possibly reduced apical dominance of auxin. When the apical bud is removed, the cytokinins are able to promote the growth of lateral buds into branches. More branches will possibly initiate more flower buds and possibly more yield (Campbell *et al.*, 2008).

3.2.4 Response of Cultivars and Number of branches:

It is obvious from table (7) that the cultivars and number of branches caused significant effects on number of fruits.plant^{-1}, fruit diameter, flesh thickness, fresh and dry weights of individual fruit. The best value of number of fruits (30.88) was recorded from Biotek cultivar and pruning on four branches. The highest values of fruit diameter and fruit flesh thickness were obtained from California wonder and pruning on four branches. The maximum values of fresh and dry weights of individual fruit were recorded from California wonder cultivar and pruning on two branches. These results agree with the results of

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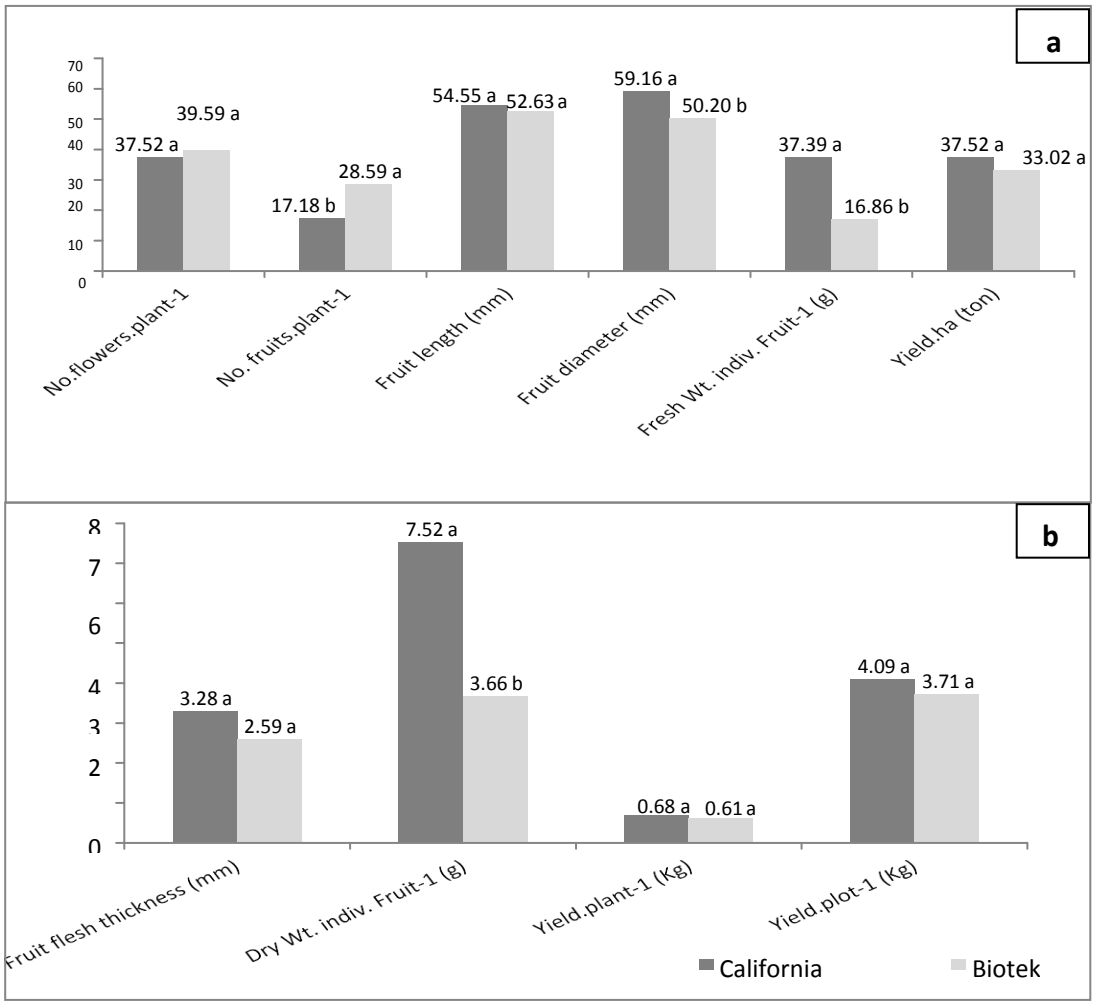

Fig. (5. a and b): Response *Capsicum annuum* L. cultivars on yield parameters.
*****(columns with the same letter are not significantly different from each other according to Duncan's Multiple Range test at 0.05 level).

(Dasgan and Abak, 2003 and Alsadon *et al.*, 2013). Cytokinins have been implicated in the release of axillary buds from apical dominance, they participate in the regulation of many plant processes, including cell division, morphogenesis of shoots and roots, chloroplast maturation, cell enlargement, and senescence. Both cytokinin and auxin regulate the plant cell cycle and are needed for cell division (Taiz and Zeiger, 2002).

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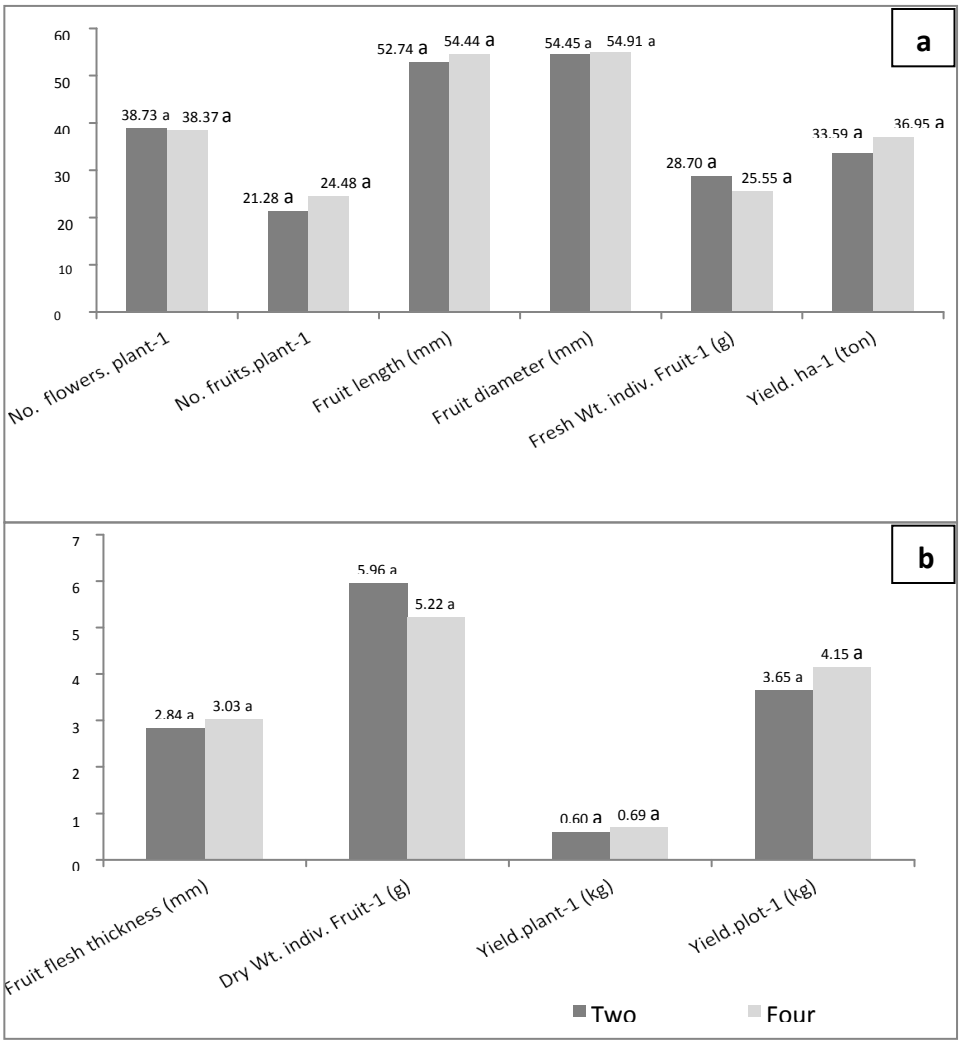

Fig. (6. a and b): Effect of number of branches on yield parameters of *Capsicum annuum* L.
*****(columns with the same letter are not significantly different from each other according to Duncan's Multiple Range test at 0.05 level).

3.2.5 Response of Cultivars and Apical Removals of Branches:

Result in the table (8) indicated that interaction of cultivars and apical removals of branches have significant effects on all reproductive parameters. The highest values of number of flowers.plant^{-1}, number of fruits.plant^{-1}, fruit length, yield.plant^{-1}, yield.plot^{-1} and yield.ha^{-1} were recorded from Biotek cultivar and apical removal of branches treatment. The best fruit diameter, fruit flesh thickness, fresh and dry weight of individual fruit was obtained from California wonder and no apical removal treatment. Results may be due to influence of apical removal process on vegetative growth, which have increased the number of branches, number of leaves and leaf area which reflected positively on increasing fruit and thus increasing yield per plant which leads naturally to increasing total production (Aljebory, 2006).

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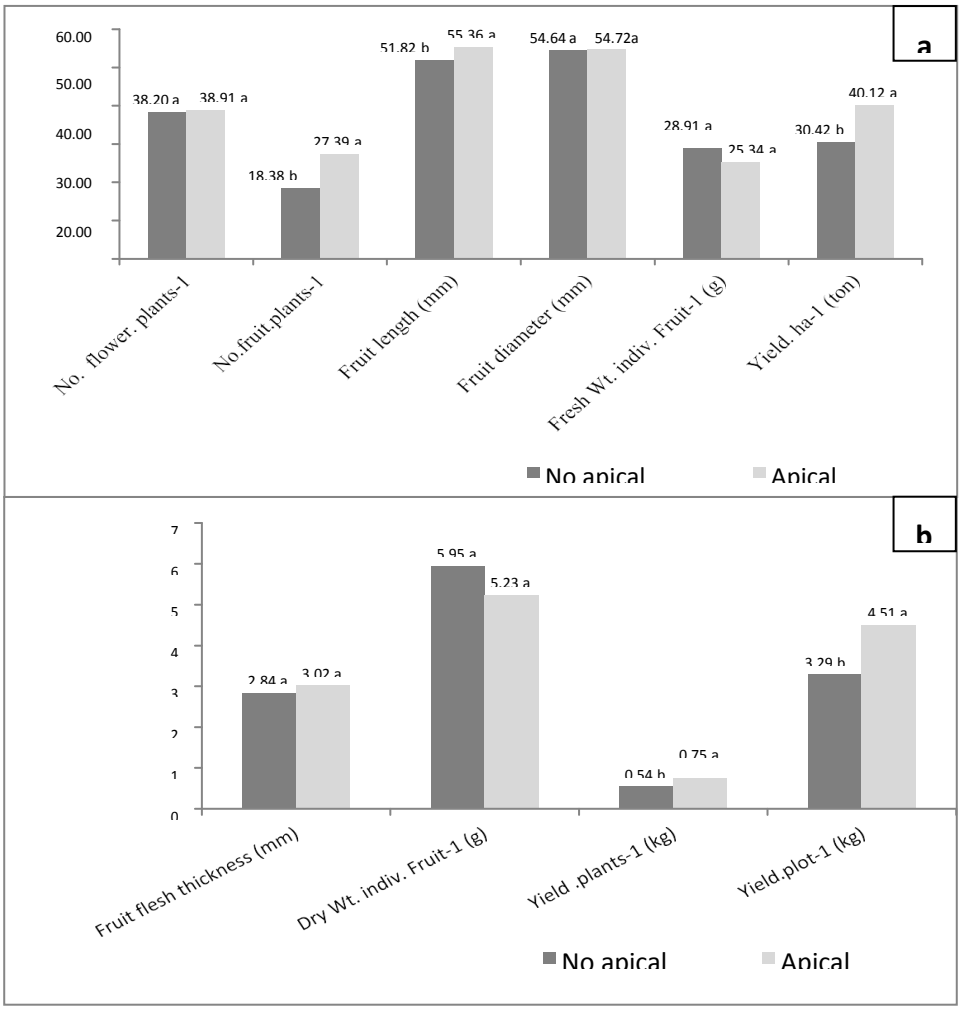

Fig. (7. a and b): Effect of apical removal of branches on yield parameters of Capsicum annuum *L.*
*****(columns with the same letter are not significantly different from each other according to Duncan's Multiple Range test at 0.05 level).

Table (7): Response of cultivars and number of branches interaction on yield parameters of *Capsicum annuum* L.

Cultivars	Number of branches	No. of flower. Plant^{-1}	No. fruit. plants^{-1}	Fruit length (mm)	Fruit diameter (mm)	Fruit flesh thickness (mm)	Fresh Wt.Individual fruit(g)	Dry Wt. ndividual fruit(g)	Yield. plant^{-1} (kg)	Yield. plot^{-1} (kg)	Yield .ha^{-1} (ton)
California wonder	Two branches	37.69 a	16.27 b	52.20 a	58.66 a	3.12 a	39.21 a	7.56 a	0.63 a	3.82 a	**36.15 a**
	Four branches	37.35 a	18.09 ab	56.90 a	59.65 a	3.43 a	35.58 a	7.49 a	0.72 a	4.37 a	**38.89 a**
Biotek	Two branches	39.77 a	26.30 ab	53.29 a	50.24 b	2.55 b	18.18 b	4.37 ab	0.57 a	3.48 a	**31.03 a**
	Four branches	39.40 a	30.88 a	51.98 a	50.16 b	2.63 b	15.53 b	2.94 b	0.65 a	3.93 a	35.01 a

*****Values within each column followed with the same latter are not significantly different from each other according to Duncan's Multiple Range test at the 0.05 level.

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Table (8): Response of cultivars and apical removal of branches interaction on reproductive parameters of *Capsicum annuum* L.

Cultivars	Apical removal of branches	No. of flower. plant^{-1}	No. of fruits. plant^{-1}	Fruit length (mm)	Fruit dia-meter (mm)	Fruit flesh thick-ness (mm)	Fresh Wt. Individ-ual fruit (g)	Dry Wt. Individ-ual fruit (g)	Yield plant^{1} (kg)	Yield .plot^{1} (kg)	Yield .ha^{-1} (ton)
California wonder	No apical removal	38.25 ab	17.60 b	54.39 a	59.67 a	3.31 a	39.82 a	8.04 a	0.67 ab	4.07 ab	**38.42 a**
	Apical removal	36.79 b	16.76 b	54.71 a	58.65 a	3.24 ab	34.97 a	7.01 ab	0.68 ab	4.12 ab	**36.63 a**
Biotek	No apical removal	38.15 ab	19.16 b	49.25 b	49.62 b	2.37 c	18.00 b	3.87 b	0.41 b	2.52 b	**22.43 b**
	Apical removal	**41.02 a**	**38.02 a**	**56.02 a**	**50.79 b**	**2.81 bc**	**15.71 b**	**3.44 b**	**0.81 a**	**4.90 a**	**43.61 a**

*****Values within each column followed with the same latter are not significantly different from each other according to Duncan's Multiple Range test at the 0.05 level.

3.2.6 Interaction Effect of number of branches and Apical Removal of Branches:

Table (9) shows that the interaction of number of branches and apical removal of branches led to significant effects on number of fruits, yield.plant^{-1}, yield.plot^{-1} and yield.ha^{-1}. The highest values of number of fruits, yield.plant^{-1}, yield.plot^{-1}, yield.ha^{-1} (28.94, 0.81kg, 4.87kg and 43.31ton respectively) were recorded from pruning on two branches and apical removal of branches treatment. This may because of better vegetative growth and more number of fruits per plant caused increasing of total yield, another reason for getting the maximum yield may due to balanced nutrients supply and sufficient space for vegetative growth, which ensured healthy plants (Chauhan *et al.*, 2009).

Table (9): Interaction effect of number of branches and apical removal of branches on yield parameters of *Capsicum annuum* L.

Number of branches	Apical removal of branches	No. of flower .Plant 1	No. of fruit. plant^{-1}	Fruit length (mm)	Fruit dia-meter (mm)	Fruit flesh thick-ness (mm)	Fresh Wt. Indivi-dual fruit (g)	Dry Wt. Indivi-dual fruit (g)	Yield plant^{1} (kg)	Yield plot^{1} (kg)	Yield .ha^{-1} (ton)
Two branches	No apical removal	37.83 a	13.53 b	50.76 a	55.76 a	2.80 a	34.08 a	8.05 a	0.42 b	2.55 b	**25.25 b**
	Apical removal	39.87 a	28.94 a	55.25 a	54.53 a	2.95 a	27.19 a	4.99 a	0.81 a	4.87 a	**43.31 a**
Four branches	No apical removal	38.46 a	21.85 ab	52.58 a	53.84 a	2.88 a	27.62 a	4.97 a	0.63 ab	3.83 ab	**34.12 ab**
	Apical removal	37.95 a	25.84 ab	55.47 a	54.90 a	3.09 a	23.48 a	5.46 a	0.69 ab	4.15 ab	**36.93 ab**

*****Values within each column followed with the same latter are not significantly different from each other according to Duncan's Multiple Range test at the 0.05 level.

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3.2.6 Response of Cultivars to Number of branches and Apical Removal of Branches:

It is obvious from Table (10) that the cultivars, number of branches and apical removal of branches interactions caused significant effects on all reproductive

parameters. The highest values of number of flowers, number of fruits, yield.plant^{-1}, yield.plot^{-1} and yield.ha^{-1} (42.11, 40.27, 0.89kg, 5.39kg and 47.95ton respectively) were recorded from Biotek cultivar, pruning on two branches and apical removal of branches interaction. However, the highest fruit length and fruit diameter was recorded from California wonder cultivar, pruning on four branches and no apical removal treatment. The best value of fruit flesh thickness was recorded from the interaction of California wonder cultivar, pruning on four branches and apical removal of branches treatment. Highest fresh and dry weights of individual fruit were obtained from California wonder

Table (10): Response of cultivars, number of branches and apical removal of branches interaction on yield parameters of Capsicum annuum *L.*

cultivars	Number of branches	Apical removal of branches	No. of flowers. plant^{-1}	No. fruit. plants^{-1}	Fruit leng-th (mm)	Fruit dia-meter (mm)	Flesh thick-ness (mm)	Fresh Wt. Indivi-dual fruit(g)	Dry Wt. Indivi-dual fruit (g)	Yield plant^{1} (kg)	Yied plot-^{1} (kg)	Yield .ha^{1} (ton)
California wander	Two branches	No apical removal	37.75 ab	14.944 cd	50.59 abc	58.92 a	3.23 abc	41.13 a	8.94 a	0.54 ab	3.29 ab	**33.64 ab**
	Two branches	Apical removal	37.63 ab	17.60 cd	53.81 abc	58.41 a	3.02 abc	37.30 a	6.18 ab	0.72 a	4.35 a	**38.66 a**
	Four branches	No apical removal	38.75 ab	20.27 cd	58.20 a	60.42 a	3.40 ab	38.51 a	7.14 ab	0.81 a	4.86 a	**43.19 a**
	Four branches	Apical removal	35.95 b	15.91 cd	55.61 abc	58.89 a	3.45 a	32.64 ab	7.84 ab	0.64 a	3.89 ab	**34.59 a**
Biotek	Two branches	No apical removal	37.44 ab	12.33 d	49.89 bc	49.82 b	2.22 d	19.27 bc	4.94 ab	0.25 b	1.58 b	**14.11 b**
	Two branches	Apical removal	42.11 a	40.27 a	56.70 ab	50.66 b	2.89 abcd	17.09 c	3.80 ab	0.89 a	5.39 a	**47.95 a**
	Four branches	No apical removal	38.86 ab	25.99 bc	48.62 c	49.41 b	2.52 cd	16.74 c	2.80 b	0.57 ab	3.46 ab	**30.75 ab**
	Four branches	Apical removal	**39.94 ab**	**35.77 ab**	**55.34 abc**	**50.92 b**	**2.73 bcd**	**14.33 c**	**3.09 ab**	**0.73 a**	**4.41 a**	**39.27 a**

*****Values within each column followed with the same latter are not significantly different from each other according to Duncan's Multiple Range test at the 0.05 level.

cultivar, pruning on two branches and no apical removal of branches interaction. These return to significant response of cultivars on number of sub branches, which leads to increasing reproductive parameters. Generally, pruning enhances fruit size and earliness for growing vigorously plants which agree with (Mbonihakuye *et al.*, 2013). Removal of apical and lateral vegetative growth hence reducing sink number, thereby making more assimilates available for fruit set (Mnzava, 1984).

4. CONCLUSIONS AND RECOMMENDATIONS

1- Response of California wonder to apical removal of branches positively affected on vegetative growth characteristics, while, the Biotek cultivar response to apical removals of their branches gave the best reproductive parameters. Generally, the Interaction between

prunings on two branches with apical removal positively increased most reproductive parameters.
2- Finally, the three studied factors combination showed that California wonder when pruned on four branches with apical removal was more effective on vegetative growth parameters, and what is drew attention in pepper crop is that best reproductive parameters were resulted in Biotek cultivar with two branches their apex were removed.
Building on previous results, the following is recommended:
1- Combination of pruning on two branches with apical removal is recommended to obtain higher yield for pepper.
2- Further studies on other vegetable crops are required for increasing their yield.

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کاریگەری لابردنی لوتکە زاڵ بوون و ژمارەی لق لە سەرگەشە و بەرهەمی دوو چە شنی بیبەر(**Capsicum annuum L.**)

پوختە

دارشتنی ئەم لێکۆلینەوە بەمەبەستی تاقیکردنەوەی کاریگەری هەندێك لە سیستمی هە لْپاچین لە سەر دوو چە شنی **(Capsicum annuum L.).** تۆێژینەوەکە دارشترا بەبەکار هێنانی دیزاینی فا کتۆریەل **(RCBD)**بە سێ دووبارە هەر یەکەیان هەشت یەکەی تۆێژینەوەی تێدایە، کەبریتیە لە دوو چە شن **(California wonder**وە**Biotek** ، دوو جۆر هە لْپاچین **(**لە سەر دوو لق و لە سەر چوار لق**)** و لابردنی لوتکەی زاڵ هی لقەکانی لەگەڵ کۆنترۆل **(**لا نە بردنی لوتکەی زاڵ**)** تاقیکراوە**.** باشترین ئە نجامی بەرزی رووەك بەدی کرا لە چە شنی **California wonder** کە هە لْپاچرابوو لە سەر چوار لق بە بێ لابردنی لوتکەی زاڵ ، بەرزترین ئەنجامی ماناداری ژمارەی لقی دووەمی و هەروەها ژمارەی بەر، بەرهەمی یەك رووەك، بەرهەمی یەکەی تاقیکردنەوەی و تاقیکردنەوەی بەرهەمی هێکتارێك **(40.77**، **40.27** ، **0.89**کلگم،**5.39** کلگم و **47.95** تون یەك بە دوای یەکدا**)** بەدەست هێنرا لەلایەن چە شنی **Biotek** کە هە لْپاچرابوو لە سەر دوو لقی لوتکە لێکراوە**.**