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Influence of Stage and Intensity of Reproductive Organs Pruning on Quality of Pepper (*Capsicum annuum* L.) At Humbo, Southern Ethiopia

Ashenafi Woldeselassie[1*], and Tekalign Tsegaw[2]
1.Department of Horticulture, College of Agricultural Sciences, Wolaita Sodo University, Ethiopia
*E-mail : ashehel@yahoo.com
2.Department of Plant Sciences, College of Agricultural Sciences, Haramaya University, Ethiopia
E-mail : tekaligntsegaw@yahoo.com

ABSTRACT
Field experiment was conducted on farmer's field from 2009 to 2010 at Humbo, Southern Ethiopia, to assess the effects of stage and intensity of reproductive organs pruning on quality of pepper. Four levels of pruning (control, one-reproductive organ, two-reproductive organs and three-reproductive organs) and three stages of pruning (bud, anthesis and fruit set), were arranged in factorial combination in Randomized Complete Block Design with three replications. Pepper cultivar called 'Marekofana' was used. The interaction effect of three- reproductive organs pruned treatment with fruit set stage gave the highest fruit length (14.64 cm), pericarp thickness (3.65 mm) and fruit diameter (2.98 cm) and the least values were obtained from the control. The interaction effect of three- reproductive organs pruned treatment with anthesis stage gave the highest fruit volume (33.98 cm^3) and the least values were obtained from the control.
Key words: Stage, intensity, reproductive organ, pruning, pepper

INTRODUCTION

Pepper (*Capsicum annuum* L.) is an economically and traditionally important crop in Ethiopia. It is a major spice and vegetable crop produced by the majority of farmers in .Pepper is warm season crop which is annual in temperate regions, but can produce continuous growth in tropical areas. The continuous growth of the plant in tropics increase the number of fruit per plants and which increases the potential for competition between fruits and the consequent reduction in fruit size (Van Ravestijin and molhoek, 1978). Pruning of some of the flowers or fruits from crops like tomato and pepper results in assimilate re-distribution to the remaining fruits and increase their size. However, the extent of re-distribution of assimilates to the remaining fruits appears to depend mainly on the sink-strength of fruit which varies with age of fruit and on the transport path way (Kinet and Peet, 1997).

Therefore, studies on a non chemical method of reproductive organs pruning had significantly importance as the pepper cultivar 'Marekofana' is widely grown in the different parts of the country as fresh market and dried pods. Ethiopians have strong attachments to dark red pepper, which has high value principally for its high pungency. The fine powdered pungent product is an indispensable flavoring and coloring ingredient in the common traditional sauce 'wot' where as the green pod is consumed as vegetable with other food items. There is a general belief among Ethiopians that a person who frequently consumes hot pepper has resistance to various diseases'. Besides, it has significant economic importance in the country, vital role as a means of income generation to the farmers and immense potential in the country for expansion and for export markets. Hence, there is no recommendation when and at what intensity reproductive organs pruning should be effected to regulate fruit size and ultimately to influence fruit yield. Therefore, assessing the effect of stage and intensity of reproductive organs pruning on quality of pepper is the objective of the study presented in this paper.

MATERIALS AND METHODS

Description of the Study Site

The study was conducted on farmer field at Humbo woreda of Wolaita Zone in 2009/2010 'belg' growing season. Humbo is located in the Southern Nation Nationalities and Peoples Regional State. It is located at 6°40'46"N latitude and 37°46'56"E longitude at an altitude of 1450 m.a.s.l and the area has bimodal rainfall distribution with mean annual rainfall of 500 mm. Seventy percent of the woreda has hot to warm climate with mean minimum and maximum air temperature of 24°C and 32°C, respectively. The soil is Nitisol, reddish brown in color and classified as sandy loam in texture (Gebre, 2007).

Planting material

Pepper (*Capsicum annuum* L.) cultivar 'Mareko Fana' was used for the study. As Peppers show a lot of variability, two main branches were retained per plant and the other ones were pruned just above its first leaf. In this way, plants with two main branches were formed.

Treatments and experimental design

The experiment was laid in a Randomized Complete Block Design (RCBD) in a 4x3 factorial arrangement with three replications. There were a total of twelve treatment combinations; four pruning intensities and three stages of pruning. The gross area of each plot was 10.5 m^2, with 3 m length and 3.5 m width. The spacing between plots and adjacent replication were 1 m and 1.5 m, respectively. There was a total of 634.5 m^2 area for experimental site.

Pruning intensities: Treatment 1: no reproductive organs pruned (control), Treatment 2: the first reproductive organ pruned, Treatment 3: the first two reproductive organs pruned and Treatment 4: the first three reproductive organs pruned

Stage of pruning: At bud stage, at anthesis of the first flower and at fruit set (when the first fruit was attained 2 mm in diameter).

Cultural Practices

Land preparation for nursery bed and main field were done in 2009 and 2010, respectively, using oxen and human labor. Seedlings of pepper were sown on November 1, 2009 on well prepared seed beds of 1 m width and 5 m length at spacing of 15 cm between rows. After sowing, the beds were covered with hay mulch until emergence. In the nursery 10 kg P_2O_5 ha^{-1} in the form of DAP (46% P_2O_5 and 18% N) at sowing and 10 kg N ha^{-1} in the form of urea (46% N) was applied after thinning. Well established seedlings (standard seedlings) at 3 to 4 leaves stage, were transplanted in January 29, 2010 to experimental field on ridges in five rows per plot at spacing of 70 x30 cm with 10 seedlings per row to obtain 50 plants per plot. The recommended fertilizer, 100 kg DAP ha^{-1} was applied once at transplanting and 100 kg urea ha^{-1} was applied 50% at transplanting and the remaining 50% at the onset of flowering. The fertilizers applied during transplanting were applied in a band form on the ridges and incorporated in the soil to facilitate nutrient up take by the plants. The crop was cultivated under supplementary irrigation conditions. No major disease and pest incidences were encountered, but weeding and other necessary cultural practices were employed uniformly to all treatments during all the stages of crop growth.

Data Collected

Data were collected on Fruit length, Fruit diameter, Fruit volume and Pericarp thickness

Data Analysis

The data were subjected to analysis of variance using SAS statistical software (SAS Version 6.12, 1997). Means were compared using the Least Significant Difference (LSD) test at 5% or 1% probability levels.

RESULTS AND DISCUSSION

Fruit length

Fruit length of pepper was highly significantly ($P<0.05$) affected by the interaction effects of stage and intensity of fruit pruning (Table 1). The combination of three-reproductive organs pruned at fruit set stage produced fruit with the largest fruit length (14.64cm) and the smallest (9.44cm) was obtained from the control. Similarly, Ali and Kelly (1992) states that even if assimilate availability is not limited the presence of older fruit can suppress the growth of the younger fruit by producing growth inhibiting substances.

Fruit diameter

Fruit diameter of pepper was highly significantly ($P<0.01$) affected by the interaction effects of stage and intensity of fruit pruning (Table 1). The combination of three-reproductive organs pruned at fruit set stage produced fruits with the largest fruit diameter (2.98cm) and the smallest (1.9cm) was from the control treatment. This could be because plants have more access to growth factors and undergo efficient photosynthesis at lower density and due to the reduced fruit number and probably the increased individual leaf area, as reported by (Amroszczy and Cebula, 2003). In line with this, Cebula and Kalisz (2001) stated that increased leaf area to fruit number ratio, hence more assimilate partitioning to the fruits under sever pruning. Similarly, Ali and Kelly (1992) found that the inhibitory effect of old fruit on fresh weight, length, diameter and pericarp thickness of younger ones was significant only from flower bud inception through weeks two and four after fruit set.

Fruit volume

Fruit volume of pepper was significantly ($P < 0.05$) affected by the interaction effects of stage and intensity of fruit pruning (Table 1). All the pruning treatments tended towards higher fruit volume than the control, the highest fruit volume (33.98 cm^3) was found in the combination of three fruit pruned at anthesis stage and the lowest (9.96 cm^3) was from the control treatment. Fruit volume was not significantly correlated with number of seed per fruit. Such result may have appeared because reducing the number of fruit allows the plant to distribute assimilates to a lesser number of fruit which will attain a bigger size. Therefore, potential fruit size may be determined by factors regulating the cell number and seed number rather than the seed number per pod. As parthenocarpic fruit still can grow to appreciable size, seed number may not be a suitable measure of sink size, which is defined as physical constraint of sink strength (Ho, 1992).

Pericarp thickness of fruit

Pericarp thickness of pepper fruit was significantly ($P<0.05$) affected by the interaction effects of stage and intensity of fruit pruning (Table 1). Three-reproductive organs pruned treatment at fruit set stage produced fruit with the thickest pericarp (3.65 mm) and the thinnest (2.44 mm) was from the control treatment. Such result was appeared because reducing the number of fruit allows the plant to distribute assimilates to a lesser number of fruit which will attain the thickest pericarp. It was positively and strongly correlated (r=0.666**) with fruit volume. This was similar to the observation of Steven *et al*., (1977) where large fruits had thicker pericarp than small fruits. Similarly, Ali and Kelly (1992) observed similar results in sweet pepper where older fruits inhibited the increase in pericarp thickness of young fruits, and removal of the older fruits significantly increased the pericarp thickness of the young fruits.

Table1. The interaction effect of stage and intensity of reproductive organs pruning on fruit length, fruit diameter, fruit volume and pericarp thickness of pepper fruit

Treatment		Fruit length (cm)	Fruit diameter (cm)	Fruit volume (cm^3)	Pericarp thickness (mm)
Stage of Pruning	Level of pruning				
Bud	Control	9.44j	1.96h-j	10.59g-i	2.44i
	One- RO	11.71e-i	2.36d-f	18.20d	2.58g-i
	Two- RO	12.34c-i	2.47c-f	19.50d	2.69e-i
	Three- RO	12.33d-i	2.49b-f	27.69bc	2.96c-f
Anthesis	Control	9.61j	1.97g-j	10.53hi	2.62f-i
	One- RO	11.27i	2.22f-i	15.29d-h	2.73c-h
	Two- RO	11.53f-i	2.34ef	15.61d-f	2.70d-i
	Three- RO	13.14b-d	2.75a-c	33.98a	3.10bc
Fruit set	Control	9.82j	1.90j	9.96i	2.49hi
	One- RO	11.34hi	1.94ij	11.91f-i	2.90c-g
	Two- RO	11.36g-i	1.94ij	12.06e-i	2.94c-f
	Three- RO	14.64a	2.98a	26.17c	3.65a
F-test		*	**	*	*
CV (%)		6.12	8.01	16.34	6.25

* and ** refers to significant at 5% and significant at 1% significance level, respectively. Interaction means followed by the same letter are not significantly different at the prescribed level of significance.

RO = Reproductive Organs

Table 2. The ANOVA output of quality parameters' in respect to mean sum of square and coefficient of variation

	Source of variation					
Variables	Replication	Stage (S)	Intensity (I)	SXI	Error	CV (%)
DF	2	2	3	6	22	
PT	0.050^{ns}	0.327^{**}	0.827^{**}	0.080^{*}	0.031	6.25
FV	3.925^{ns}	60.903^{**}	595.376^{**}	20.722^{*}	8.304	16.34
FD	0.035^{ns}	0.071^{ns}	1.008^{**}	0.161^{**}	0.033	8.01
FL	0.152853^{ns}	0.551786^{ns}	21.24377^{**}	1.562727^{*}	0.499632	6.12

** and * refer to mean square values significant at 1% and 5% probability level, respectively

ns = Non-significant at 5% probability level

DF: Degree of freedom

PT: pericarp thickness

FV: Fruit volume

FL: Fruit Length

CV: Coefficient of variation

Conclusion

Regardless of the physical quality parameters of pepper pruning three- reproductive organs at fruit set and anthesis stage gave the better quality.

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