➔DOI : 10.15740/HAS/AJBS/10.1/1-5
e ISSN-0976-8343 | ■ Visit us : *www.researchjournal.co.in*
ASIAN JOURNAL OF BIO SCIENCE
Volume **10** | Issue 1 | April, 2015 | 1-5

RESEARCH **P**APER

Effect of shoot pruning on yield and quality attribute of a winter capsicum (*Capsicum annum* L.) crops in hills protected condition

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Article Info : Received : 05.05.2014; Revised : 01.02.2015; Accepted : 15.02.2015

In greenhouse crops, fruit yield and quality can be increased by managing shoot pruning. An experiment was conducted to study the growth and flowering performance of one varieties of capsicum (*Capsicum annum* L.) at experimental farm Division of Vegetable, Vivekananda Research Institute of Hill Agriculture, Almora. Was studied for effects on fruit yield, fruit quality and plant growth of greenhouse grown sweet pepper (*Capsicum annum* L. cv. ROBUSTA) during winter 2012-2013 in Uttrakhand Hill. Fruit set was inhibited due to the high temperatures. Marketable yield (number and weight) per m^2 increased linearly was greater on plants with four stems than in those with Control, Double Leader system, Triple Leader system, Fourth Leader system. Total marketable yield and extra large fruit yields per plant were greatest in the Fourth Leader system. Plants Red fruits were harvested 79 and 105 days after transplanting. The stem length and the number of nodes per stem increased linearly with the decrease in plant spacing. Stem length and number of nodes per stem were greater in single-stem than in four-stem plants. Number seeds and peal thickness of fruits and total yield were higher in four and two than in single-stem plants. Total stem weight in fourth-stem plants increased linearly with Results indicated pruned to four stems increased marketable and extra large fruit yield in a short harvest period of a winter poly house sweet pepper crop in Uttrakhand hills. Results showed that capsicum (*Capsicum annum* L.) yield and quality can be effectively manipulated by plant population and stem pruning, while fruit pruning had only a limited effect.

Key words : Capsicum, *Capsicum annum* L., Protected cultivation, Fruit quality, Stem pruning, Fruit yield

How to cite this paper : Ahirwar, Chandan Singh and Hedau, N.K. (2015). Effect of shoot pruning on yield and quality attribute of a winter capsicum (*Capsicum annum* L.) crops in hills protected condition. *Asian J. Bio. Sci.*, **10** (1) : 1-5.

INTRODUCTION

The vegetable greenhouse production profits are greatly dependent on high yield and quality per unit area. Plant spatial arrangement is a crop management practice that has been used to increase yield per unit area in greenhouse sweet pepper. Wide within-row plant spacing's increase per plant yield but decreases production per unit area in greenhouse (Araujo *et al.*, 1974). Peppers. Higher plant densities reduced fruit weight from early yield (Cebula, 1995 and 2003). Fruit weight, which is associated with fruit size, is of great importance because it determines prices for coloured sweet pepper. In commercial greenhouse pepper crops fruit development is controlled by restricting the branching pattern to 2, 3 or 4 main stems (Lorenzo and Castilla, 1995 and Jovicich *et al.*, 2003 and 2004). The reasons for pruning sweet

pepper under greenhouse conditions are to train plant growth to facilitate light penetration throughout the leaf canopy for more efficient interception of light (Verheij *et al.*, 1971).

Greenhouse sweet pepper is a relatively new crop in Uttrakhand hills with potential to expand production in the future. Poly house environmental conditions, seasonality, as well as the type of greenhouse structure used for growing may result in particular recommendations regarding crop management practices as plant density and pruning levels, that are different from studies reported from other countries (Rylski and Spigelman, 1982). The present study was conducted to determine the effects of plant population density and number of stems per plant on sweet pepper red fruit yield and quality, and plant growth in a summer greenhouse crop at Hills.

RESEARCH METHODOLOGY

The experiment was conducted during winter 2012-13 in a double layer polyethylene single type greenhouse of 11 × 25 × 4 m (width × length × height) (Poly house Systems, In constructed.). The present investigation was conducted in the experimental Farm, Hawalbagh, Vivekananda Research Institute of Hill Agriculture, Almora (29°36' N, 79°40' E and 1250 m above msl) during winter. Experimental layout was a complete Randomized Block Design with three replicates. The poly house had a roof wing ventilation system, lateral curtains, and electric fans for ventilation. Sweet pepper (*Capsicum annum* L.) seedlings were grown on order to encourage initial vegetative growth, first (crown flower) and second order flowers were pulled from the plants in all treatments. Lateral shoots and flowers just above the cotyledonary node were also removed. Lateral branch shoots were pruned to form a plant structure of 2, 3 or 4 main branches. When pruning a main branch, only the flower on the branch node and its adjacent leaf were left. Lateral plastic twines and wood stakes were used to support the plants. Plants were irrigated with a complete nutrient solution with nutrient concentrations levels developed for poly house grown. Nutrient levels for different Capsicum plant developing stages were adapted as follows: from transplant to second order flowers N-P-K concentration in the irrigation the end of the experiment. Each plant was irrigated with pressure compensated emitters with a flow discharge. Length (maximum distance without considering the peduncle), and pericarp thickness (as an average of measures at the middle of the fruit length) fruits were graded by diameter into small, medium, large, and extra-large size. After the last harvest two plants from each replication were used for analyzing plant growth were measured. Plant stem determined, analysis of variance was performed on fruit yield and plant growth variables. When no interaction between training and pruning method by in-row plant spacing was found mean from main effects were analyzed if they were significant mean values for pruning stem were separated was analyzed for its polynomial (linear and quadratic) effects by regression analysis.

Statistical analysis:

The data were analyzed statistically (Panse and Sukhatme, 1989); Chandel (1978) and Karl (1978).

RESEARCH FINDINGS AND ANALYSIS

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Effect of shoot pruning :

Results obtained in 2012-2013 showed a high number of marketable fruits, marketable yield and total yield, when plants were pruned to fourth leader system. Conversely, plants pruned to control leader system had the highest unmarketable yield, mainly because of the higher number of fruits observed. The results are in agreement (Jovicich *et al.*, 1999) with the yield was found to increase with an increase in stem number.

Marketable fruit yield :

Total number of fruits per plant :

The data pertaining to number of fruits harvested per plant as influenced by growing conditions, training and pruning levels are presented in Table 1. Significantly higher among the pruning level of control (110.69) number of fruits per plant was noticed under naturally ventilated poly house Among the double leaders system levels, the significantly higher (76.33), number of fruits per plant was recorded under triple leaders system is lower (55.68, fruits/plant) was recorded (Backer, 1989).

Total yield per plant (kg) :

Yield per plant (kg) the data pertaining to yield per plant (kg) as influenced by growing conditions, training

and pruning levels are fourth leader system presented in Table 1 and depicted in Fig. 1. significantly higher (6.58 kg/plant) fruit yield per plant was obtained under naturally ventilated poly house. The lower fruit yield is (4.23 kg/plant) was obtained under the double leader system. The double leader system and fourth leader system were at par with each other. With regards to the pruning levels is control, the higher (10.68 kg/plant) fruit yield per plant was obtained under pruning level is control (Ayas *et al.*, 1981 and Stofella and Bryan, 1988).

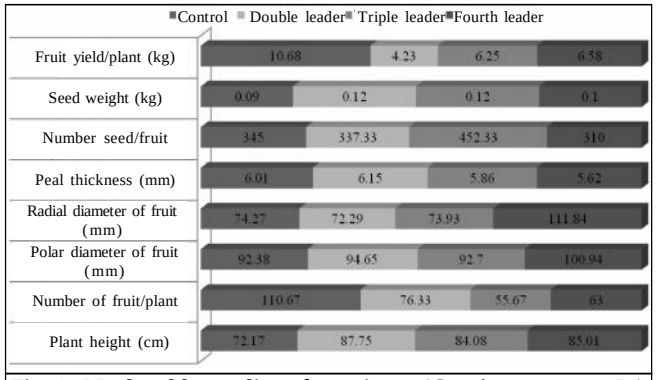

Fig. 1 : Marketable quality of capsicum (*Capsicum annum* L.) production under influence of plant density and shoots pruning method

Polar diameter of fruit (mm) :

The data pertaining to polar diameter of fruit (mm.) of fruits harvested per plant as influenced by growing conditions, Training and pruning levels are presented in Table 1. Significantly higher among the pruning level of fourth leader system (100.94) of polar diameter of fruit (mm). Then fruits per plant was noticed under naturally ventilated poly house, among the double leaders system levels, the significantly higher (94.65), polar diameter of fruit per plant was recorded under triple leaders system is lower (92.7), fruits/plant) was recorded.

Radial diameter of fruit (mm) :

The data pertaining to radial diameter of fruit (mm) of fruits harvested per plant as influenced by growing conditions, Training and pruning levels are presented in Table 1. Significantly higher among the pruning level of fourth leader system (111.84) of radial diameter (mm) of fruit (mm). Fruits per plant was noticed under naturally ventilated poly house, among the triple leaders system levels, the significantly higher (73.93), radial diameter (mm) of fruit per plant was recorded under double leaders system in lower (72.29), fruits/plant.

Peal thickness (mm) :

The data pertaining to peal thickness (mm) of fruits harvested per plant as influenced by growing conditions, training and pruning levels are presented in Table 1. Significantly higher among the pruning level of double leader system (6.15) of peal thickness (mm). Fruits per plant was noticed under naturally ventilated poly house, among the triple leaders system levels, the significantly higher (5.86), peal thickness (mm) of fruit per plant was recorded under fourth leaders system is lower (5.62), fruits/plant).

Number seed/fruit :

The data pertaining to number seed/fruit of fruits harvested per plant as influenced by growing conditions, training and pruning levels are presented in Table 1. Significantly higher among the pruning level of triple leader system (452.33) of number seed/fruit. Then fruits per plant was noticed under naturally ventilated poly house, among the double leaders system levels, the significantly higher (337.33), number

Table 1 : Effect of pruning levels and growing conditions on number of fruits per plant, fruit yield per plant (kg), of capsicum

Treatments	Plant height (cm)	Number of fruit/plant	Polar diameter of fruit (mm)	Radial diameter of fruit (mm)	Peal thickness (mm)	Number seed/fruit	Seed weight/ (kg.) fruit	Fruit yield/plant (kg)
Control	72.17	110.67	92.38	74.27	6.01	345	0.09	10.68
Double leader	87.75	76.33	94.65	72.29	6.15	337.33	0.12	4.23
Triple leader	84.08	55.67	92.7	73.93	5.86	452.33	0.12	6.25
Fourth leader	85.01	63	100.94	111.84	5.62	310	0.1	6.58
Total mean	82.25	76.42	95.17	83.09	5.91	361.17	0.1	6.94
F test	S	S	S	S	S	S	S	S
CV	6.05	13.97	4	8.38	93.62	9.67	18.94	47.31
CD	9.94	21.32	7.6	13.92	11.05	69.76	0.04	6.56

seed/fruit of fruit per plant was recorded under fourth leaders system is lower (310), fruits/plant.

Seed weight/(kg) fruit :

The data pertaining to seed weight /(kg) fruit of fruits harvested per plant as influenced by growing conditions, training and pruning levels are presented in Table 1. Significantly higher among the pruning level of both double or triple leader system (0.12 g) of seed weight / (kg) fruit of fruit per plant was recorded under fourth leaders system is lower (0.1g), fruits/plant). Tiwari *et al.*, 2013 and Ramana Rao *et al.*,2013 also worked on the related topic.

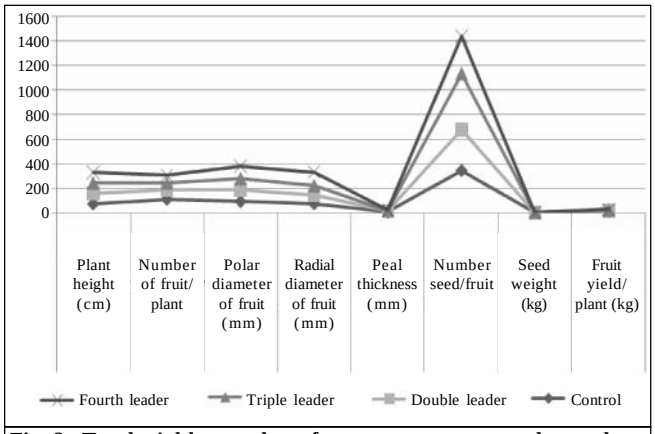

Fig. 2 :Total yield per plant for sweet pepper at three plant

Conclusion :

The capsicum (*Capsicum annum* L.) has given a tremendous response to different growing conditions, pruning levels. For economic point of view the closer spacing (45 × 30 cm) and pruning level were found better for capsicum as far as quality and higher marketable yield concerned pruning level. Fourth leader system was found better. In case of different growing environments the naturally ventilated poly house recorded highest total marketable yield with more number of excellent quality export grade fruits. For common farmers the growing of capsicum under poly house condition with closer spacing fourth leader system would be more profitable in winter season at Uttrakhand Hills.

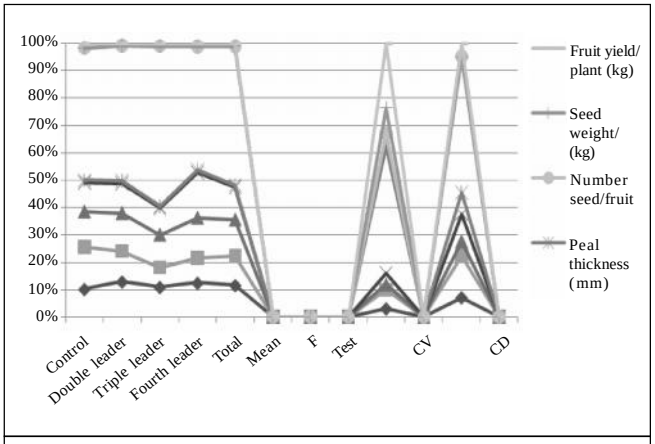

Fig. 3 :Linear effects of total fruit weight per plant for two, three and four leader system plants at the three plant densities

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