International Journal of Research and Review
www.ijrrjournal.com E-ISSN: 2349-9788; P-ISSN: 2454-2237

Original Research Article

Effect of Seedling Age of Transplants on Growth and Yield of Capsicum under Open Ventilated Polyhouse Condition

Anil Kumar Saxena, Suneeta Singh

School of Agricultural Sciences, Shri Guru Ram Rai University, Dehradun -248 001, Uttarakhand, India

Corresponding Author: Suneeta Singh

ABSTRACT

The present experiment was conducted at Horticulture Research Block of School of Agricultural Sciences, Shri Guru Ram Rai University, Dehradun, Uttarakhand, India during summer season of 2018. The experiment was laid in a randomized block design with three replications. There were ten treatments comprising of transplants starting from 18 days old with a gap of 3 days. The variety used for the study was California Wonder. Maximum values for most of the characters like survival of seedlings after transplanting (100%), number of fruits per plant (8.09), fruit yield per plot (7.58 kg) and harvest duration (85 days) were obtained using 36 days old transplants while minimum values were recorded using 18 days old transplants for all these characters. It was concluded that 33 to 36 days old transplants were best regarding growth and yield of capsicum in Dehradun region of Uttarakhand under open ventilated polyhouse condition.

Keywords: Capsicum, age of transplants, fruit yield, harvest duration

INTRODUCTION

Capsicum (*Capsicum annum* L.) popularly known as bell pepper or *Shimla mirch* is an important commercial summer season vegetable crop grown all over the world. It belongs to the family *Solanaceae* and is used raw as salad or cooked as vegetable. Mid and low hills of Uttarakhand are the leading suppliers of capsicum to the plains. It is grown during summer and rainy seasons in the hills and the whole produce is sent to the markets of the adjoining states. The farmers get remunerative price as this crop cannot be grown in the plains during summer months because of high temperature. In Uttarakhand, there is about 2, 278 ha area under capsicum with a production and productivity of 33,544 MT and 14.74 MT/ha, respectively (Anon 2016a). The performance of any crop depends upon the quality of the seed used for sowing, various environmental factors, type of cultivar and cultural practices etc. Among all these factors, optimum age of transplant is one of the important factors which affect growth and yield of the crop; but generally, this factor is ignored by the farmers. The optimum seedling age depends on the soil, environmental factors such as temperature, moisture, location and cultural practices. Several investigations have been conducted to see the effect of transplant age on crop performance. Bell pepper (*Capsicum annum* L.) generally had increased fruit set and early yields when transplant age was increased from 33 to 77 days (McCraw and Greig 1996, Weston 1998). Therefore, the effect of seedling transplant age on subsequent crop yields varies. The conflicting results in the literature on transplant age may be due to different environmental and cultural conditions that the plants were exposed to both in the protected condition like

polyhouse etc and also in the open field condition. Generally, 4-6 weeks old transplants are recommended for transplanting in mid hill regions of Uttarakhand (Anon 2006b) but this is a very big range. Exact age of seedling transplant would therefore be helpful in understanding the relationship between the physiological state of the transplant, its survival in the field, its growth and yield responses under various cultural systems and environments. In order to reduce the wide gap (4-6 weeks) in the age of seedlings, the present experiment was conducted to ascertain the optimum age of capsicum seedling transplants for maximization of fruit yield.

MATERIALS AND METHODS

The present investigation was conducted at Horticulture Research Block of School of Agricultural Sciences, Shri Guru Ram Rai University, Dehradun, Uttarakhand, India during summer season of 2018. The research block is located at an elevation of 650 m (2130 ft) above mean sea level. The geographical location of the site is between latitude $29^0 58'$ North and longitude $77^0 34'$ East and it falls under low hill agro-climatic zone of Uttarakhand. Counted numbers of seeds were sown in nursery pot trays on 25 February 2018. All the precautions in raising healthy seedlings were considered and seedlings of required age were transplanted. There were ten treatments comprising of seedling transplants starting from 18 days old with a gap of 3 days (Table 1). The day of fifty per cent seed germination was considered as zero day and successive days were counted for deciding seedling age. The experiment was laid in a Randomized Block Design with three replications. The variety California Wonder was transplanted at a spacing of 60 x 45 cm in plots of 2.60 x 2.45 m^2 size. Observations were recorded on length of seedlings at transplanting (cm), number of true leaves at transplanting, survival of seedlings after transplanting (%), number of fruits per plant, fruit yield per plot (kg), fruit shape index, total soluble solids (^{0}Brix), pericarp thickness (mm), harvest duration (days) and plant height (cm).

RESULTS AND DISCUSSION

Significant results were obtained for the characters like length of seedling at transplanting (cm), number of true leaves at transplanting, survival of seedlings after transplanting (%), number of fruits per plant, fruit yield per plot (kg), harvest duration (days) and plant height (cm) while non significant differences were observed for fruit shape index, total soluble solids (^{0}Brix) and pericarp thickness (mm) (Table 2).

Table 1: Age of seedling transplants of capsicum during transplanting under ten treatments

Treatments	Days after 50% seed germination
T_1	18
T_2	21
T_3	24
T_4	27
T_5	30
T_6	33
T_7	36
T_8	39
T_9	42
T_{10}	45

Table 2: Effect of age of seedling transplants on various horticultural traits in capsicum

Treatment	Age of seedling transplant (days)	Length of seedling at transplanting (cm)	Number of True leaves at transplanting	Survival of seedling after transplanting (%)	Number of Fruits/plant	Fruit Yield/plot (kg)	Fruit Shape Index	Total Soluble Solids (^{0}Brix)	Pericarp Thickness (mm)	Plant Height (cm)	Harvest Duration (days)
T_1	18	2.66	3.60	96.78 (9.83)*	5.34	5.32	1.195	3.97	4.06	80.17	75.00
T_2	21	3.77	3.83	100 (10.00)	5.50	5.57	1.093	4.04	4.11	81.60	75.00
T_3	24	4.33	4.30	100 (10.00)	5.60	5.62	1.070	4.01	4.15	82.17	78.33
T_4	27	5.05	4.33	100 (10.00)	6.13	6.15	1.196	4.03	4.17	82.47	80.00
T_5	30	5.73	4.38	100 (10.00)	6.73	6.73	1.116	4.01	4.22	83.30	81.67
T_6	33	6.33	4.52	100 (10.00)	7.08	6.80	1.107	4.24	4.36	85.33	85.00
T_7	36	6.36	4.55	100 (10.00)	8.08	7.68	1.102	3.87	4.28	86.23	85.00
T_8	39	7.32	4.62	100 (10.00)	6.73	6.72	1.149	4.14	4.24	86.82	85.00
T_9	42	7.86	4.66	100 (10.00)	6.20	6.37	1.274	3.75	4.14	79.60	83.33
T_{10}	45	8.24	4.68	100 (10.00)	5.83	5.78	1.254	4.09	4.10	70.08	81.67
	$CD_{0.05}$	0.62	0.14	0.08	1.30	0.80	NS	NS	NS	2.14	3.17

*Figures in parentheses represent square root transformed values
NS: Non significant

Maximum seedling length (8.24 cm) was recorded in T_{10} (45 days old seedling) which was statistically at par with T_9 (42 days old seedling) i.e. 7.86 cm while minimum length (2.66 cm) was observed in T_1 (18 days old seedling). The length of seedlings at transplanting increased with increase in seedling age. More length of seedlings in case of older transplants may be attributed due to higher biomass especially in the well developed and established root system which resulted into more uptakes of water and nutrients from the soil leading to better cellular elongation. Similar trends have also been reported by Lee Jiwon et al. (2014). Maximum number of true leaves (4.68) at transplanting was recorded in T_{10} (45 days old seedling) which was at par with treatments T_9 (42 days old seedling), T_8 (39 days old seedling), T_7 (36 days old seedling) and T_6 (33 days old seedling). On the other hand, minimum number of true leaves at transplanting (3.60) was found in T_1 (18 days old seedling) which was also at par with T_2 (21 days old seedling). Here also, the number of true leaves increased with increase in seedling transplant age. Older transplants with sufficient number of true leaves might be responsible for manufacturing a sizable amount of photosynthates required to establish vigorous plant and complete its life cycle more comfortably. Vavrina (1999) also reported similar findings by transplanting the older seedlings of tomato. A perusal of the data revealed that a significant effect of age of transplants on survival of seedlings after transplanting. Maximum survival i.e. 100 per cent was observed in T_2 (21 days old seedling), T_3 (24 days old seedling), T_4 (27 days old seedling) and so on except in T_1 (18 days old seedling) which was at the tail end (96.78%). More survival percentage may be attributed to well establish root system in older seedlings which was capable of causing enhanced water absorption and translocation along with nutrients from the rhizosphere. The given findings are in line with those of Safina-Naz et al (2016). Maximum number of fruits per plant (8.08) was obtained in T_7 (36 days old seedling) which was found to be at par with T_6 (33 days old seedling) having 7.08 fruits per plant while minimum number of fruits per plant (5.34) was recorded in T_1. However, T_1 was at par with five other treatments viz T_2, T_3, T_{10}, T_4 and T_9 with 5.50, 5.60, 5.83, 6.13, and 6.20 fruits per plant, respectively. In the present findings, the middle aged transplants produced more number of fruits than the younger or older transplants. The possible reason seems to be that in case of younger seedlings there was less storage of food needed for vegetative growth and extension, whereas, older transplants were mature enough and limit vegetative extension. Moreover, middle aged seedlings on account of extended lateral branches produced maximum number of fruits per plant than younger or older ones. Maximum number of fruits by middle aged transplants was also observed by Salik et al (2010) in tomato. Contrary to this, Adelana (1993) reported maximum number of fruits from younger transplants while Renuka and Perera (2012) found more fruits from older transplants. Maximum fruit yield per plot was recorded in T_7 (36 days old seedling) i.e. 7.68 kg which was statistically at par with T_6 (33 days old seedling) and minimum fruit yield (5.32 kg/ plot) was recorded in T_1 (18 days old seedling) which was at par with three other treatments viz T_2, T_3 and T_{10} having 5.57, 5.62 and 5.78 kg fruit yield per plot, respectively. The possible reason for maximum yield using middle aged transplants rather than younger or older transplants seems to be greater number of marketable fruits produced per plant which might have directly contributed towards the high fruit yield. Interestingly, the size of the fruits was not affected by the number of fruits. This might be due to higher or enhanced biomass accumulation and improved water relationship in the plants. In case of younger seedlings there was lesser biomass and less storage of food in terms of solutes needed for cellular elongation and

thus less vegetative extension, whereas, older transplants were mature enough, thereby, limiting vegetative extension. Almost identical observations have been reported by workers like Salik et al (2010) in tomato who also reported maximum fruit yield by using middle aged transplants. However, Safina- Naz et al (2015) obtained maximum yield by using younger transplants while Montano-Mata and Nunez (2013) observed that the older transplants produces maximum possible yield. Maximum fruit shape index (1.274) was recorded in T_9 (39 days old seedling) which was closely followed by T_{10}, T_4, T_1, T_8 and T_5 having fruit shape indices of 1.254, 1.196, 1.195, 1.149 and 1.116, respectively, whereas, minimum fruit shape index (1.070) was observed in T_3 (24 days old seedling). In the present report, the fruit shape index did not show any significant difference which might be due to the reason that the fruit shape index is a genetically controlled character and it is rarely influenced by environmental factors. Thus the present investigation confirms the findings of Leskovar et al (1991). Effect on total soluble solids (TSS) was also found to be non-significant. However, the highest total soluble solids value (4.24^0Brix) was recorded in T_6, which was closely followed by T_8, T_{10} and T_2 having total soluble solids of 4.14, 4.09 and 4.04 ^{0}Brix, respectively. On the other hand, lowest TSS (3.75^0Brix) was recorded in T_9, which was at the tail end. Non-significant effect of age of seedling transplants as in case of present investigations shows that the total soluble solids in the fruits vary from variety to variety and place to place and as such are not influenced by the age of seedling transplants. Age of seedling transplant was found to be ineffective for pericarp thickness also. However, 33 days old seedlings (T_6) produced maximum value (4.36 mm) for pericarp thickness closely followed by T_7, T_8 and T_5 having 4.28, 4.24 and 4.22 mm pericarp thickness, respectively, whereas, minimum value (4.06 mm) was recorded in T_1(18 days old seedling). A perusal of the data reveals that the effect of age of seedling transplants on harvest duration was significant. Maximum harvest duration was recorded in T_6, T_7 and T_8 having harvest duration of 85 days each. These three treatments were at par with T_9 having harvest duration of 83.33 days while minimum harvest duration was observed in treatment T_1 and T_2 i.e. 75 days each. In the present findings, maximum harvest duration was recorded with middle aged transplants while minimum harvest duration was observed in comparatively younger transplants. It indicates that the younger transplants might not have accumulated sufficient amount of photosynthates and so on the biomass. On the other hand, older transplants might be exposed to more water and fertilizer stress during seedling stages which might have resulted into shorter harvest duration. These findings are in consonance with those of Leskovar et al (1991) and Benedictos and Yavari (2013) in tomato who also observed prolonged harvest duration and yield by using middle aged transplants. The data reveal that in capsicum, maximum plant height (86.82 cm) was recorded in treatment T_8 (39 days old seedling) which was at par with T_7 (86.23 cm) and T_6 (85.33 cm). Seedling transplants of treatment T_{10}, however, produced minimum plant height i.e. 70.08 cm. The possible reason for more plant height in the middle aged seedling transplants seems to be that the younger seedlings stored less food needed for vegetative growth and extension, whereas, older shoots had become mature enough which limited their vegetative extension due to formation of secondary substances and thickening of wall of tissues. Another possible reason for more plant height in middle aged seedling transplants may be that in younger seedlings there was less stored food materials needed for vegetative extension while the older transplants switched over to reproductive phase earlier and had little time for establishment as well as to attain satisfactory growth to the level which middle aged seedlings had already

attained. The present observations are similar to those of Salik et al (2010) who also reported more plant height in middle aged seedling transplants in tomato.

CONCLUSION

From the present investigation it was concluded that 33 to 36 days old seedling transplants having seedling length greater than 6.00 cm with more than 4 true leaves were found best regarding yield and yield attributes in capsicum.

REFERENCES

- Adelana, B.O. 1989. Effects of age of transplants on the growth and yield of tomato (*Lycopersicon esculentum* Mill). Acta Horticulturae 123: 207-216.
- Anonymous, 2016a. Annual Report. Department of Agriculture, Himachal Pradesh, Shimla 171005 H.P.
- Anonymous, 2006b. Package of Practices for Vegetable Crops, Directorate of Extension Education, Dr YS Parmar University of Horticulture and Forestry, Nauni 173230 Solan, HP.
- Benedictos, P.J. and Yavari, N. 2013. Optimum sowing date in relation to flower drop reduction in tomato. Acta Horticulturae 533: 351-357.
- Lee Jiwon, Kim Kwang Yong and Yu Young Mi. 2014. Effects of nutrient solution strength, seedlings age, and container size on seedling quality and yield of spirit coloured bell pepper (*Capsicum annum* L). Journal of the Korean Society for Horticultural Science 42(3): 300-304.
- Leskovar, D.I., Cantliffe, D.J. and Stoffella, P.J. 1991. Growth and yield of tomato plants in response to age of transplants. Journal of American Society for Horticultural Science 116(3): 416-420.
- McCraw, B.D. and Grieg, J.K. 1996. Effect of transplant age and pruning procedure on yield and fruit set of bell pepper. Horticultural Science 21(3): 430- 431.
- Montano-Mata, N.J. and Nunez, J.C. 2013. Evaluation of the effect of transplant age on yield in three selections of sweet pepper (*Capsicum chinense* Jack) in Jusepin, Monagas State.
- Renuka, K.A. and Perera, K.D.A. 2012. Effect of seedling age its management on growth and yield of chilli. Annals of Sri Lanka, Department of Agriculture 4: 33-38.
- Safina-Naz, Muhammad Akbar Anjum and Ishtiaq Ahmad. 2016. Growth of chilli (*Capsicum annuum* L) F1 hybrid 'Sky Line-2' in response to different age of transplants. Journal of Research (Science), Bahauddin Zakariya University, Multan, Pakistan 17(2): 91-95.
- Safina-Naz, Muhammad Amjad, Bushra Siddique and Ishtiaq Ahmad. 2015. Effect of different ages of transplants on the yield of chillies. Indus Journalof Plant Sciences 4(3): 332 -335.
- Salik, M.R., Muhammad, F. and Pervez, M.A. 2010. Relationship between age of seedlings on productivity of tomato (*Lycopersicon esculentum* L.) grown under plastic tunnel. Pakistan Journal of Biological Sciences 3(8): 1260-1261.
- Vavrina, C.S. 1999. Effect of transplant age on tomato production. Proceedings of the Florida State Horticultural Science 104: 225-226.
- Weston, L.A. 1998. Effect of flat cell size, transplant age and production site on growth and yield of pepper transplants. Horticultural Science 23(4): 709-711.

How to cite this article: Saxena AK, Singh S. Effect of seedling age of transplants on growth and yield of capsicum under open ventilated polyhouse condition. International Journal of Research and Review. 2019; 6(7):570-574.

******