International Journal of Farm Sciences **1(2)** :56-62, 2011

Effect of age of transplants on growth and yield of capsicum

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ABSTRACT

The present study was conducted at Vegetable Research Farm of Department of Vegetable Science, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh during summer season of 2008. The experiment was laid in a randomized block design with three replications. There were ten treatments comprising of transplants starting from 15 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 mid hill regions of Himachal Pradesh.

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

INTRODUCTION

Capsicum 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 hills of Himachal Pradesh 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 Himachal Pradesh, there is about 2, 277 ha area under capsicum with a production and productivity of 33,534 MT and 14.72 MT/ha, respectively (Anon 2006a).

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 factors, which affect growth and yield; but generally, this factor is ignored by the farmers. The optimum seedling age depends on the soil, environmental factors (temperature,

moisture), location and cultural practices. Several investigations have been conducted to see the effect of transplant age on crop performance. Bell pepper (*Capsicum annuum* L) generally had increased fruit set and early yields when transplant age was increased from 33 to 77 days (McCraw and Greig 1986, Weston 1988). Therefore, the effect of 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 greenhouse and in the field. Generally, 4-6 weeks old transplants are recommended for transplanting in mid hill regions of Himachal Pradesh (Anon 2006b) but this is a very big range. Exact age of transplant would therefore be helpful in understanding the relationship between the physiological state of the transplant, its survival in the field and its growth responses under various cultural systems and environments. In order to reduce the wide gap (4-6 weeks) in the age of seedlings, the present investigations entitled, "Effect of age of transplants on growth and yield of capsicum" was conducted to ascertain the optimum age of transplants for maximization of fruit yield.

MATERIAL AND METHODS

The experiment was conducted at Vegetable Research Farm of Department of Vegetable Science, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, HP during summer season of 2008. The research farm is located at an elevation of 1260 m above mean sea level. The geographical location of the site is between latitude $30^0 52'$ North and longitude $77^0 11'$ East and it falls under mid hill agro-climatic zone of Himachal Pradesh. Counted numbers of seeds were sown in pot trays on 20 February 2008. All the precautions in raising healthy seedlings were taken and seedlings of required age were transplanted. There were ten treatments comprising of transplants starting from 15 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 2.40 x 2.25 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 transplants/seedlings of capsicum at 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

Maximum seedling length (8.04 cm) was recorded in T_{10} (45 days old) which was statistically at par with T_9 (42 days old) ie 7.76 cm while minimum length (2.56 cm) was observed in T_1 (18 days old). The length of seedlings at transplanting increased with increase in seedling age. More length of seedlings in case of older transplants may be attributed to higher biomass especially the well developed and established root system which resulted into more uptake of water and nutrients from the soil leading to better cellular elongation. Similar trends have also been reported by Lee Jiwon et al (2001).

Maximum number (4.66) of true leaves at transplanting was observed in T_{10} (45 days old) which was at par with treatments T_9 (42 days old), T_8 (39 days old), T_7 (36 days old) and T_6 (33 days old) On the other hand, minimum number of true leaves at transplanting (3.80) was found in T_1 (18 days old) which was also at par with T_2 (21 days old). Here also, the number of true leaves increased with increase in 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 (1991) also reported similar results by transplanting the older seedlings of tomato.

A perusal of the data revealed a significant effect of age of transplants on survival of seedlings after transplanting. Maximum survival ie 100 per cent was observed in T_2, T_3 (24 days old), T_4 (27 days old) and so on except in T_1 (18 days old) which was at the tail end (96.71%). More survival may be attributed to well established root system in older seedlings which was capable of causing enhanced water absorption and translocation along with nutrients from the rhizosphere. The present findings are in line with those of Safina-Naz et al (2006).

Maximum number of fruits per plant (8.09) was obtained in T_7 (36 days old) which was found to be at par with T_6 (33 days old) having 7.01 fruits per plant while minimum number of fruits per plant (5.33) 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, 5.80, 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 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 reported by Salik et al (2000) in tomato. Contrary to this, Adelana (1983) reported maximum number of fruits from younger transplants while Renuka and Perera (2002) found more fruits from older transplants.

Maximum fruit yield per plot observed in T_7 ie 7.58 kg was statistically at par with T_6 and minimum fruit yield (5.31 kg/ plot) was observed in T_1, 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 high fruit yield. Interestingly, the size of the fruits was not affected by of number of fruits. This may be because of higher or enhanced biomass, accumulation of resources 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 views have been reported by workers like Salik et al (2000) in tomato who also obtained maximum yield by using middle aged transplants. However, Safina-Naz et al (2005) obtained maximum yield by using younger transplants while Montano-Mata and Nunez (2003) used older transplants for maximum possible yield.

Maximum fruit shape index (1.272) was recorded in T_9 which was closely followed by $T_{10,}$ $T_{4,}$ T_1, T_8 and T_5 having fruit shape indices of 1.252, 1.196, 1.195, 1.149 and 1.116, respectively, whereas, minimum fruit shape index (1.070) was recorded in T_3. In the present case, the fruit shape index did not show any significant difference in both the crops, probably, because the fruit shape index is a genetically controlled character and 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 (4.21^0B) was recorded in T_6, which was closely followed by T_8, T_{10} and T_2 having total soluble solids of 4.15, 4.09 and 4.04 ^{0}B, respectively. On the other hand, lowest TSS (3.75^0B) was recorded in T_9, which was at the tail end. Non-significant effect of age of transplants as in case of present investigations shows that 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 transplants.

Age of transplant was found to be ineffective for pericarp thickness. However, 33 days old seedlings (T_6) produced maximum value (4.35 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.

A perusal of the data reveal that the effect of age of transplants on harvest duration was significant. Maximum harvest duration was observed 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 ie 75 days each. In the present findings, maximum harvest duration was observed with middle aged transplants while minimum harvest duration was observed in comparatively younger transplants. It appears that the younger transplants might not have accumulated sufficient quantities 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 (2000) in tomato who also observed prolonged harvest duration and yield by using middle aged transplants.

The data reveal that in capsicum, maximum plant height (86.80 cm) was recorded in treatment T_8 (39 days old) which was at par with T_7 (86.23 cm) and T_6 (85.33 cm). Plants of treatment number T_{10}, however, produced minimum plant height ie 70.07 cm. The possible reason for more plant height in the middle aged transplants seems to be that the younger seedlings stored less food needed for vegetative extension, whereas, older shoots had become mature enough which limited vegetative extension due to formation of secondary substances and thickening of wall of tissues. Another possible cause for more plant height in middle aged transplants may be that in younger seedlings there was less stored food 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

Table 2. Effect of age of transplants on horticultural traits in capsicum

Treatment code	Age of transplant (days)	Length of seedling at transplanting (cm)	Number of true leaves at transplanting	Survival of seedlings after transplanting (%)	Number of fruits/plant	Fruit yield/ plot (kg)	Fruit shape Index	Total soluble solids (°B)	Pericarp thickness (mm)	Harvest duration (days)	Plant height (cm)
T_1	18	2.56	3.80	96.71 (9.83)*	5.33	5.31	1.195	3.97	4.06	75.00	80.17
T_2	21	3.77	3.93	100 (10.00)	5.50	5.57	1.093	4.04	4.11	75.00	81.60
T_3	24	4.33	4.30	100 (10.00	5.80	5.62	1.070	4.01	4.15	78.33	82.17
T_4	27	5.05	4.33	100 (10.00)	6.13	6.15	1.196	4.03	4.17	80.00	82.47
T_5	30	5.73	4.38	100 (10.00)	6.73	6.73	1.116	4.01	4.22	81.67	83.30
T_6	33	6.33	4.52	100 (10.00)	7.01	6.80	1.107	4.21	4.35	85.00	85.33
T_7	36	6.36	4.55	100 (10.00)	8.09	7.58	1.102	3.87	4.28	85.00	86.23
T_8	39	7.32	4.62	100 (10.00)	6.73	6.72	1.149	4.15	4.24	85.00	86.80
T_9	42	7.76	4.63	100 (10.00)	6.20	6.37	1.272	3.75	4.14	83.33	79.60
T_{10}	45	8.04	4.66	100 (10.00)	5.83	5.78	1.252	4.09	4.10	81.67	70.07
	$CD_{0.05}$	0.62	0.14	0.08	1.30	0.80	NS	NS	NS	3.17	2.14

* Figures in parentheses represent square root transformed values

NS: Non significant

middle aged seedlings had already attained.The present findings are similar to those of Salik et al (2000) who also reported more plant height in middle aged transplants.

It is thus concluded that 33 to 36 days old transplants having length greater than 6.00 cm with more than 4 leaves were found best regarding yield and yield contributing characters.

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Received : 23.2.2011 *Accepted : 18.3.2011*