

Effect of Transplanting Date on Growth and Yield of Sweet Pepper (*Capsicum annuum* L.) Under Open and Net House Environment at Rampur, Chitwan, Nepal

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Abstract

Sweet pepper, though a highly remunerative vegetable, environmental variability and inappropriate transplanting date have resulted low yield in Terai. Hence, to identify the suitable transplanting date under open and net house environment, a field research was conducted at Agriculture and Forestry University, Rampur, Nepal, from October 2018 to May 2019. A split-plot design was used with two factors and three replications. Main-factor comprised of growing environments (open field and net house) and sub-factor was transplanting dates (October 15, November 4, November 24 and December 14). The plant height (94.38 cm), leaf area (91.24 cm²), plant spread (55.22 cm) as well as fruit quality parameters like fruit length (8.72 cm), fruit girth (7.32 cm), fruit weight (63.07 g) and pericarp thickness (6.85 mm) were significantly higher under net house while these parameters were significantly lower in open field. Significantly greater marketable yield was observed under net house (20.08 t/ha) than open field (16.29 t/ha). The plant growth and yield parameters were significantly the best with early transplanting date (October 15) and the least with December 14. Interactive effect revealed that October 15 inside the net house performed the best in terms of yield (33.31 t/ha) and marketable yield (33.17 t/ha), while the poorest performance was recorded on December 14 under open field with a yield of 3.96 t/ha and marketable yield of 3.48 t/ha. Therefore, transplanting inside the net house as early as October 15 helps to maximize sweet pepper yield with better size marketable fruits.

Keywords: Bell pepper, High-value vegetable, Marketable fruits, Protected cultivation

Introduction:

Sweet pepper (*Capsicum annuum* L. var. *grossum* Sendt.; 2n=2x=24) belongs to the family Solanaceae under the genus *Capsicum*. Brazil is thought to be the original home of peppers. The species *annuum* includes eleven groups (Farris, 1988) which can be divided into two sub group Sweet and Hot Peppers. They differ in size, shape and colour of the fruits, capsaicin content and usage. The sweet pepper is relatively non-pungent and has thick flesh (Wein et al., 1989). Bell pepper is green, yellow or red and may be used as cooked or raw

as well as in salad and valued for its high vitamin C content. It has attained the status of a high value and highly remunerative crop in Nepal during recent years (Bhattarai & Poudel, 2014). In Nepal, the sweet pepper growing area is 1192 ha with a production of 12372 tons and productivity of 10 tons per ha (MoALC, 2017). Major Sweet pepper producing districts of Nepal are Kavrepalanchok, Chitwan, Lalitpur, Dhading etc. Kavrepalanchok has the highest area (160 ha), production (2560 ton) as well as productivity (16 ton/ha) (MoALC, 2017).

Sweet pepper is a cool-season tropical crop. It is highly sensitive to temperature stress. High temperature decreases pollen viability and leads to abortion (Turner & Wien, 1994). High night temperature (24°C) promoted flower drop in sweet pepper (Rylski & Halevy, 1974). Yields are high when the daily air temperature ranges between 18-32°C and fruits do not set above 32°C (Aloni et al., 1999). At temperatures below 10°C, fruit size decreases and are malformed (Shaked et al., 2004). It is difficult to realize higher yields of good quality sweet pepper under open field environment (Prasad & Chakravorty, 2015). Field grown peppers are more likely to develop abiotic disorders like sunscald and cracks (Ilić et al., 2012). In the open field, insect pests are becoming more aggressive in recent years due to climate change resulting in heavy pesticides (Krol, Arsenault, & Mattina, 2000).

However, on the other hand, experiments reveal that sweet pepper can successfully be cultivated under protected conditions (Singh et al., 2010). Protected cultivation doubles yields of crops by as much as 4 to 10 times as compared to the crops grown under open field conditions and reduces dependency on chemicals, longer growing season, and high-quality yield (Wiltshire, 2007). Singh and Sirohi (2008) reported protected cultivation of vegetables also offers off-season cultivation of many vegetables, fetching good returns to the farmers when the crop fails under open field cultivation. Reduction of UV, higher PAR, and diffused light inside the net house increases the radiation use efficiency and it has a positive effect on timing, yields, and quality (Kong et al., 2013).

With the introduction of net house technology in tropical areas, the growers can extend the harvesting of winter crops towards the summer months (Chatterjee & Mahanta, 2013). On the other hand, the reduction in yield attributes of capsicum with very early or delayed transplanting is mainly the result of exposure to high or low temperature and rainfall patterns with a great impact on the duration of crop production (Hamma et al., 2012).

Hence, the adjustment of transplanting date and farming under net house can be the best alternative adaptation measure to mitigate the adverse effect of climate change on vegetable production and thereby minimize pesticide use and increased production potential and higher quality of produce. The present study was conducted to evaluate how different transplanting dates affect both open field and net house cultivated capsicum at Chitwan.

The study had the following objectives:

Objectives:

- To compare the effect of open field and net house environment on growth, yield and quality of sweet pepper.
- To determine the optimum date of transplanting sweet pepper in Chitwan condition.
- To assess the interactive effect of the growing environment under different date of transplanting to obtain a higher yield and production quality of sweet pepper.

Materials and Methods:

Location of the site

This field experiment was carried out at Agriculture and Forestry University, Rampur, Chitwan District of Nepal from October 2018 to May 2019.

Description of the variety and net house

The variety of sweet pepper taken for the experiment was 'Wonder Bell'. This is a hybrid variety produced by Takii Seeds, Japan and marketed by National Seed Company, Nepal. The pest exclusion net (net house) used for the research was of 16 m × 6 m. The centre height of PEN was 5 m and the side height was 3 m. The aluminium net was used as roofing material and the side pest exclusion net (insect net) was of mesh size 40. It had a single entrance of a chain system. The shading factor of the roof was fifty percent.

Experimental design and layout

The experiment was framed in split-plot Design (SPD) with eight treatments and three replications. The treatments were designed as main-factor and sub-factor. Main-factor included two growing environments, i.e. i) Net house and ii) Open field, whereas the sub-factor included four transplanting dates, i.e. i) October 15, ii) November 4, iii) November 24 and iv) December 14. The entire experimental field (both inside net house and open field), was divided into three blocks (i.e. equal to the number of replications). Net house and Open field were taken as main plots, and inside main plots, subplots equal to subplot treatments were made. Randomization of treatments was done independently in each of the main plots and sub plots, i.e. transplanting dates were allocated randomly inside the net house and in the open field within the replications or blocks. The

individual plot size was 5.4 m² with 3 m length and 1.8 m breadth. The row to row distance was 60 cm, and the plant to plant distance was 45 cm. There were 5 rows in each plot and 4 plants in each row. There were 20 plants in each plot while inner 6 plants were selected for data collection as sample plants.

Treatment details

Table 1. Details of the treatments used in the experiment at Rampur, Chitwan, 2018/19

S.N.	Factors	Symbols
Main-factor: Growing environment		
1.	Pest Exclusion Net (PEN) cultivation	G1
2.	Open-field	G2
Sub-factor: Dates of transplanting		
1.	October 15	D1
2.	November 4	D2
3.	November 24	D3
4.	December 14	D4

Details of field operations

Seeds were sown in plastic trays using coco-peat as growing media and were kept inside the poly house. Well decomposed farmyard manure (FYM) was applied @ 30 t/ha in all the plots. Chemical fertilizer was applied at the rate of 120: 50: 50 kg NPK/ha (Krishi Diary, 2019). Thirty-day-old healthy seedlings with 4-6 leaves were lifted and transplanted at the evening hours of the day in each of the four transplanting dates both in and outside the net house. Side dressing with urea and slight hoeing around the plant was done at 30 and 60 DAT. All the leaves and suckers below the strong natural branching were pruned starting from 30 to 45 DAT.

Observations, measurement and analysis

In the experiment, the morphological/growth characters like plant height, number of leaves per plant, leaf area and plant spread similarly yield contributing characters like fruit length, fruit girth, fruit weight, pericarp thickness, fruit number per plant, fruit yield per plant, fruit yield per ha and marketable fruit per ha from six tagged plants were recorded at every thirty days interval starting from 30 days after transplanting. Computer software viz., Microsoft Excel and RSTAT software package (R version 3.5.3) were used for the analysis of different parameters.

Results:

Effect of growing environment and date of transplanting on growth parameters

There was a significant effect of growing environment and date of transplanting on plant height, the number of leaves per plant, leaf area and plant spread at final harvest (Table 2). At the final harvest, net house-grown plants were significantly taller (94.38 cm) than grown in the open field (49.63 cm). Planting on October 15 had significantly the tallest plant (80.17 cm) followed by November 4, which was statistically at par with November 24, while significantly, the shortest plant (61.01 cm) was observed on December 14. At 30 and 60 DAT, there were significantly higher leaves inside the net house than sweet pepper cultivated in the open field. At the final harvest, sweet pepper transplanted on October 15 had the highest number of leaves while December 14 had the lowest number of leaves. Significantly higher leaf area (91.24 cm²) was observed inside the net house while significantly lower leaf area

Table 2. Effect of growing environment and date of transplanting on growth parameters of sweet pepper (*Capsicum annum* L.) at Rampur, Chitwan, 2018/2019

Treatments	Growth parameters			
	Plant height (cm)	Number of leaves per plant	Leaf area (cm ²)	Plant spread (cm)
Growing environment (Main factor)				
Net house	94.38a	84.45	91.24a	55.22a
Open field	49.63b	77.20	54.80b	40.21b
SEm (±)	0.661	4.305	7.559	0.922
LSD0.05	1.422***	9.254NS	16.249*	1.982***
CV (%)	1.1%	6.5%	12.7%	2.4%

Treatments	Growth parameters			
	Plant height (cm)	Number of leaves per plant	Leaf area (cm ²)	Plant spread (cm)
Date of transplanting (Sub factor)				
October 15	80.17a	111.40a	103.14a	50.40ab
November 4	74.26b	94.88b	74.23b	52.25a
November 24	72.58b	70.16c	60.15c	48.66b
December 14	61.01c	46.86d	54.57c	39.56c
SEm (±)	1.382	2.694	8.678	1.835
LSD0.05	2.129***	4.151***	13.370***	2.828***
CV (%)	2.4%	4.1%	14.6%	4.7%

Means with same letter in column are not significantly different at $p = 0.05$ by DMRT. *Significant at 5% ($P < 0.05$). **Significant at 1% ($P < 0.01$) and NS: not significantly different at 5% ($P > 0.05$). SEM = Standard error of mean, LSD = Least significant difference, CV = Coefficient of variance and DAT = Days after transplanting

(54.80 cm²) in open field conditions. Sweet pepper transplanted on October 15 produced significantly the largest leaf area, followed by November 4, while December 14 produced significantly the smallest leaf area, which was statistically at par with November 24. There was a significantly greater plant spread (55.22 cm) inside the net house than the open field (40.21 cm). The highest plant spread was observed from November 4 transplanting date. Similarly, significantly the least plant spread was observed on December 14.

Fruit quality parameters

There was a significant effect of growing environment and date of planting on fruit length, fruit girth, fruit weight and pericarp thickness (Table 3). Fruits from the sweet pepper transplanted in the net house were

significantly longer (8.72 cm) as compared to open field fruit length (6.78 cm). Sweet pepper fruits from the net house had significantly greater fruit girth (7.32 cm) than open field fruit girth (6.46 cm). Sweet pepper transplanted on October 15 had the largest fruit length (8.56 cm), which was at par with November 4 (8.33 cm) while the least fruit length (6.74 cm) was observed on December 14. Fruits from sweet pepper transplanted in the net house were significantly greater in fruit weight (63.07 g) as compared to fruit weight (52.01 g) in an open field. Sweet pepper transplanted on October 15 produced highly significant and the largest fruit weight (63.63 g) followed by November 4 (60.63 g), which was at par with November 24 (60.39 g), while the least fruit weight (45.50 g) was obtained from December 14 transplanting date. Sweet pepper transplanted in net

Table 3. Effect of growing environment and date of transplanting on fruit quality parameters of sweet pepper (*Capsicum annum L.*) at Rampur, Chitwan, 2018/2019

Treatments	Fruit quality parameters			
	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	Pericarp thickness (mm)
Growing environment (Main factor)				
Net house	8.72a	7.32a	63.07a	6.85a
Open field	6.78b	6.46b	52.01b	4.60b
SEm (±)	0.313	0.216	0.928	0.029
LSD0.05	0.674**	0.465*	1.996**	0.062***
CV (%)	5%	3.8%	2%	0.6%

Treatments	Fruit quality parameters			
	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	Pericarp thickness (mm)
Date of transplanting (Sub factor)				
October 15	8.56a	7.75a	63.64a	6.52a
November 4	8.33a	7.04b	60.63b	5.92b
November 24	7.38b	6.56c	60.39b	5.42c
December 14	6.74c	6.22d	45.50c	5.04d
SEm (\pm)	0.222	0.155	0.969	0.083
LSD0.05	0.343***	0.239***	1.493***	0.127***
CV (%)	3.5%	2.8%	2.1%	1.8%

Means with same letter in column are not significantly different at $p = 0.05$ by DMRT. *Significant at 5% ($P < 0.05$). **Significant at 1% ($P < 0.01$) and NS: not significantly different at 5% ($P > 0.05$). SEM = Standard error of mean, LSD = Least significant difference, CV = Coefficient of variance and DAT = Days after transplanting

house produced significantly thicker pericarp (6.85 mm) as compared to pericarp thickness (4.60 mm) from an open field. Significantly the thickest pericarp (6.52 mm) was observed in sweet pepper transplanted on October 15, while the thinnest pericarp (5.04 mm) was obtained from December 14.

Yield and yield attributing characters

Effect of growing environment on fruit number per plant, fruit yield per plant and fruit yield per ha was non-significant, while both growing environment and date of planting significantly affected marketable yield per ha (Table 4). Significantly the highest number of fruits per plant (13.80) was obtained from October 15

transplanting date, while the least number of fruits (3.46) was observed on December 14 transplanting date. Net house recorded 20.20 t/ha fruit yield while open field produced 18.43 t/ha. However, these yields per hectare were statistically similar. Sweet pepper transplanted on October 15 produced significantly the highest fruit yield (32.23 t/ha) while significantly the least yield (6.04 t/ha) was obtained from December 14. Sweet pepper transplanted in net house produced significantly higher marketable fruit yield (20.08 t/ha) as compared to sweet pepper cultivated in an open field (16.29 t/ha). October 15 transplanting date recorded significantly the highest marketable fruit yield (29.89 t/ha), while December 14 produced significantly the least marketable fruit yield (5.75 t/ha).

Table 4. Effect of growing environment and date of transplanting on yield parameters of sweet pepper (*Capsicum annuum* L.) at Rampur, Chitwan, 2018/2019

Treatments	Yield parameters			
	Fruit number per plant	Fruit yield (g/plant)	Fruit yield (t/ha)	Marketable yield (t/ha)
Growing environment (Main factor)				
Net house	8.35	545.63	20.20	20.08a
Open field	9.01	497.73	18.43	16.29b
SEm (\pm)	0.726	26.32	0.975	0.903
LSD0.05	1.561NS	56.59NS	2.095NS	1.941*
CV (%)	10.2%	6.2%	6.2%	6.1%

Treatments	Yield parameters			
	Fruit number per plant	Fruit yield (g/plant)	Fruit yield (t/ha)	Marketable yield (t/ha)
Date of transplanting (Sub factor)				
October 15	13.80a	870.46a	32.23a	29.89a
November 4	10.66b	642.40b	23.79b	22.77b
November 24	6.80c	410.73c	15.21c	14.33c
December 14	3.46d	163.13d	6.04d	5.75d
SEm (\pm)	0.331	22.87	0.847	0.841
LSD0.05	0.510***	35.239***	1.305***	1.296***
CV (%)	4.7%	5.4%	5.4%	5.7%

Means with same letter in column are not significantly different at $p = 0.05$ by DMRT. *Significant at 5% ($P < 0.05$). **Significant at 1% ($P < 0.01$) and NS: not significantly different at 5% ($P > 0.05$). SEM = Standard error of mean, LSD = Least significant difference, CV = Coefficient of variance and DAT = Days after transplanting

Interaction effect of growing environment and date of planting on yield parameters

Interaction effect of growing environment and date of transplanting on the number of fruits per plant was highly significant (Table 5). Sweet pepper transplanted in open field on October 15 produced significantly the highest number of fruits per plant (14.86) followed by sweet pepper transplanted in net house on the same date, while significantly the least number of fruits was observed in sweet pepper transplanted in an open field on December 14. The interaction effect of growing environment and date of transplanting on fruit yield per ha was significantly different. Sweet pepper transplanted

in the net house on October 15 recorded significantly the highest fruit yield (33.31 t/ha) followed by sweet pepper transplanted in an open field on the same date (31.16 t/ha) while significantly the least yield per hectare (3.96 t/ha) was obtained from sweet pepper transplanted in the open field on December 14. Interaction effect of growing environment and date of transplanting on marketable fruit yield per hectare was highly significant. Sweet pepper transplanted in the net house on October 15 recorded significantly the highest marketable fruit yield (33.17 t/ha) followed by open field on the same date (26.61 t/ha), while the least marketable fruit yield (3.48 t/ha) was obtained from sweet pepper transplanted in the open field on December 14.

Table 5. Interaction effect of growing environment and date of transplanting on yield parameters of sweet pepper (*Capsicum annum L.*) at Rampur, Chitwan, 2018/2019

Treatments	Yield parameters			
	Fruit number per plant	Fruit yield (g/plant)	Fruit yield (t/ha)	Marketable yield (t/ha)
Net house \times October 15	12.73b	899.40a	33.31a	33.17a
Net house \times November 4	10.20d	659.73c	24.43c	24.28c
Net house \times November 24	6.33f	404.20d	14.97d	13.84e
Net house \times December 14	4.13g	219.20e	8.11e	8.02f
Open field \times October 15	14.86a	841.53b	31.16b	26.61b
Open field \times November 4	11.13c	625.06c	23.15c	21.26d
Open field \times November 24	7.26e	417.26d	15.45d	13.83e
Open field \times December 14	2.80h	107.06f	3.96f	3.48g

Treatments	Yield parameters			
	Fruit number per plant	Fruit yield (g/plant)	Fruit yield (t/ha)	Marketable yield (t/ha)
SEm (\pm)	0.424	26.20	0.970	0.917
LSD0.05	0.740***	45.755*	1.694*	1.601**

Means with same letter in column are not significantly different at $p = 0.05$ by DMRT. *Significant at 5% ($P < 0.05$). **Significant at 1% ($P < 0.01$) and NS: not significantly different at 5% ($P > 0.05$). SEM = Standard error of mean, LSD = Least significant difference, CV = Coefficient of variance and DAT = Days after transplanting

Discussion:

Effect of growing environment and date of transplanting on growth parameters

Plant height

Plants grown under the net house were taller compared to those grown under the open situation. An increase in plant height of capsicum under the net house was due to low light intensity (Prabhu et al., 2009). Higher radiation decreased the elongation growth of plants (Wyżgolik et al., 2008). Different transplanting dates showed a significant effect on the performance of Sweet pepper and early transplanting (November 15) resulted in maximum plant height (44.60 cm) compared to later transplanting dates of November 30 and December 15 (Koner et al., 2015). The observed differences in height at the different transplanting times could be attributed to the effects of varying environmental conditions such as rainfall, temperature, daylight and relative humidity at the different transplanting periods.

Number of leaves per plant

The growing environment significantly affected the number of leaves per plant. The number of leaves per plant was higher for the capsicum cultivated in the net house over the open field (Rao et al., 2013). Maximum number of leaves under net house due to low light intensity and better environmental conditions was also reported by Prabhu et al. (2010). Similar results by Jakhar, Singh and Kumawat (2017). A significant effect in the number of leaves per plant was observed in the transplanting date. This is in agreement with Islam et al. (2010). Koner et al. (2015) also observed a significant effect of transplanting dates on leaf area. Harrington and Minges (1997) reported seeding on appropriate date with favorably warm soil temperatures encourages vigorous seedling growth.

Leaf area

Cultivation of sweet pepper under net house showed significant effect and recorded the maximum leaf area as compared to open field condition. These results are in line with the findings of Chatterjee et al. (2018). Leaf area in sweet pepper was found to increase with increased level of shade (Diaz-Perez, 2010). Shaded plants of sweet pepper showed higher relative water content, higher stomatal resistance to transpiration, reduced leaf temperature and higher chlorophyll content. While open field condition showed the highest rate of transpiration (Vethamoni & Natarajan, 2008). Plants grown in the shade tend to have a larger leaf area because cells expand more under low light intensities in order to receive light for photosynthesis (Tinyane et al., 2013).

There was a significant difference in leaf area due to the transplanting date. This agrees with the results of Koner et al. (2015), who found that among the transplanting dates, November 30 transplanting recorded the maximum leaf area. The warmer soil and air temperature during early transplanting date provides sufficient time for vegetative growth thereby increasing leaf area while later transplanted crop have to face cold winters during early stage of the growth (Bakker & van Uffelen, 1988).

Plant spread

Plant spread was significantly higher in capsicum grown in the net house than the open field. Higher radiation under open fields decreased the elongation growth of plants. Sweet pepper grown in higher light intensity had lower stem elongation than shade grown plants. It is well known that light delays elongation growth (Rajapakse, 2004). Early transplanting provided enough time and warmer temperature for growth and development of crops and consistently produced a healthy stand leading to advanced vegetative growth stage (Bevacqua & Vanleeuwen, 2003).

Effect of growing environment and date of transplanting on fruit parameters

Fruit length and fruit girth

Bell pepper showed significantly greater fruit length and girth under the net house as compared to open field. The higher length of fruits under protected structure might be due to the translocation of more photosynthates from source to sink and favourable microclimate. Net house microclimate would have influenced auxin availability to the developing ovary (Priya et al., 2002). A significant variation in length and girth of fruit was observed due to the transplanting date. At temperatures below 10°C fruit size decreases due to inefficient pollination and fertilization (Shaked et al., 2004), which causes a reduction in fruit length (Aloni et al., 1999) and possible fruit malformation (Rylski & Aloni, 1994).

Fruit weight

Fruit weight was significantly greater in sweet pepper grown in the net house compared to the open field. Chatterjee et al. (2018) also reported higher fruit weight inside the net house as compared to open field conditions. Priya et al. (2002) reported similar results in paprika. They reported that the lower fruit weight under open conditions might be due to reduced fruit size and high transpiration leading to water deficit in the plant system. The fruit weight of sweet pepper was significantly influenced by the transplanting date. Favorable transplanting date had emerged as highly efficient in production and translocation of assimilates to the developing sink and accelerated the formation of larger sized fruits which is supported with the findings of Islam et al. (2010).

Pericarp thickness

Pericarp thickness was significantly greater in sweet pepper grown in the net house as compared to open field. These results are in line with the findings of Ilic et al. (2017), who reported that pericarp fruit thickness was higher in the plants from net house compared to open field cultivated sweet pepper. In addition, there was a significant difference in pericarp thickness due to different transplanting dates. In earlier transplanting, higher number of leaves and leaf area provided greater source to sink ratio and increased the pericarp thickness. This is in line with the findings of Islam et al. (2010). Thanopoulos et al. (2015) also reported fruit size, fresh weight, and volume were higher in the autumn due to increased fruit length and pericarp thickness.

Effect of growing environment and date of transplanting on yield parameters

Number of fruits per plant

The number of fruits was non-significant due to different growing environments. However, a relatively higher number of fruits (9.01) was observed in the open field than the net house (8.35). Shukla et al. (2019) observed similar results, who reported this might be attributed to the increased number of secondary branches per plant under open field conditions. The number of fruits per plant was significantly different among the transplanting date. Decrease in fruit set due to delayed transplanting may be attributed to reduced concentrations of reducing sugars in flower buds and flowers resulting in failure of pollination and abscission of flowers induced by high-temperature conditions (Erickson & Markhart, 2001).

Fruit yield per hectare

Fruit yield per hectare was statistically non-significant over two different growing environments. However, a greater fruit yield value was obtained under net house than open field. The plants grown at 35 percent shade net house were able to trap the available 65 percent of light and utilized efficiently for photosynthesis. Whereas, under open field condition, the photosynthetic yield was found increasing up to a level (light saturation point) and thereafter reduction was noticed. The higher temperature prevailed under open conditions might also have caused dehydration in cells (Vethamoni & Natarajan, 2008). Date of transplanting significantly affected fruit yield per hectare. These results can be supported from the findings of Islam et al. (2010). This may be related to the availability of favourable growing environment for proper synchronization of flowering and ensuring its transformation to fruit for optimum fruit production (Nahardani et al., 2013).

Marketable fruit yield per hectare

A significantly higher marketable fruit yield of sweet pepper was observed under the net house as compared to open field conditions. Increased fruit size resulted in increase in marketable fruit yield, in addition, marketable yield was also strongly influenced by a reduced number of cull fruit (Ilic et al., 2017). There was a significant difference in marketable yield due to different transplanting dates. Turner and Wien (1994) reported that at higher temperature change in physiological activities occur in the plant system like decrease in sugar content and lower enzymatic

activities leading to abnormal development of pollen, flower abscission, reduced fruit set and yield with fruit abnormalities like sunscald, fruit cracks, blossom end rot, watery tissue and small sized immature fruits.

Conclusion:

All the growth parameters as well as fruit parameters were significantly better under net-house as compared to open field. Effect of growing environments on yield per plant and per hectare did not significantly differ, however, significantly greater marketable fruit yield was observed under net-house. Sweet pepper transplanted on October 15 had significantly greatest values of growth, fruit and yield parameters while decreasing trend was observed on later planting dates with poorest performance of December 14 transplanting date. Interactive effect reveal that sweet pepper transplanted in net-house on October 15 performed the best in terms of yield and marketable yield followed by open field on the same date while the poorest performance by December 14 planted sweet pepper on open field. Therefore, transplanting as early as October 15 inside the net house helps to maximize sweet pepper yield with better size marketable fruits.

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Declaration of conflict of interest and ethical approval:

The authors agree that they don't have any conflicting interests in the published materials. Ganesh Lamsal is involved in designing the experiment, field research, data collection, data analysis and writing the manuscript. Arjun Kumar Shrestha, Kalyani Mishra Tripathi and Hom Nath Giri participated in designing the experiment, data analysis and writing the manuscript. All the authors have gone through the document before submitting to the journal of Nepalese Horticulture. The current article does not include any human participants or animals by the authors and has taken prior approval if applicable.

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