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Effect of seedling age at transplants on growth, yield and seed production of sweet pepper in Bangladesh

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ABSTRACT

Recently, sweet pepper (Capsicum spp.) has been a commercially important crop in Bangladesh. The cultivation procedure is highly sensitive to different environments. In the case of quality production, appropriate seedling age is a prerequisite for higher yield. The experiment was carried out at the Regional Horticulture Research Station, Bangladesh Agricultural Research Institute, Shibpur, Narsingdi, Bangladesh during the Rabi season of 2017-2018. Six treatments were used i.e.,. 14 days, 21 days, 28 days, 35 days, 42 days and 48 days at the age of transplanting seedlings. The experiment was conducted in a randomized complete block design with three replications. The number of seeds per fruit and thousand seeds weights resulted better at 21 days, 28 days and 35 days the age of transplanting seedlings. Considering marketable fruit number (13.55), yield per plant (1.69 kg) and yield (26.80 t ha^{-1}) was found at 28 days' age of transplant seedling, which was followed by 35 days' age of transplant seedling. The lowest yield per plant (0.49 kg) and yield (7.76 t ha^{-1}) were recorded at 48 days age of transplant seedling, respectively. From the result of this experiment, it may be recommended that 28 days' age of seedling at transplant growth, yield and seed production showed better performance than other ages of seedlings at transplants of BARI Mistimorich-1.

Key Words: *Capsicum, Transplanting, Growth, Production and Yield.*

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I. Introduction

Sweet pepper or capsicum is an essential and valuable commercial vegetable crop grown worldwide, especially in Mexico and South America. It is the world's second most important vegetable after tomato, rich in Vitamin A and C. Sweet pepper (*Capsicum annum* var.) belongs to the family Solanaceae under the genus Capsicum. It's also popular as bell peppers or green pepper (Brhan et al., 2018;

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Srikanth, 2019). It is used in fast food shops, can be eaten cooked or raw, and is preferred in salad and components like soups, pizza, or rice (Kelley and Boyan, 2009). The transplanting age of seedlings is a prerequisite to crop growth and yield parameters. In the Seedling period, the plant root system was not well developed. Then plant numerous spine-like hairy roots produced afterward. These excessive hair roots uptake water from soil pores. When a baby seedling was transplanted, root hair has been damaged. The effect of transplanting age relies on the type of vegetable grown, the variation of the environment, and the predictable financial returns (Akinrotimi, 2018). Transplant age is the most important in rice cultivation. Also, different types of transplant age studies showed, such as tobacco, cotton, and brassica, as well as different forest species (Gupta, 1994; Abou-Zeid, 1995; Akinrotimi, 2018).

Different types of literature and also research conducted on vegetables of transplanted age (Lorenze, 1988; Naz, 2006; Essilfie, 2017). The proper age of seedlings affects edaphic and environmental culture practices. Also, a research report found that chili pepper growth and yield are markedly influenced by different ages of transplants and transplanting dates (Osei, 2013). Sweet pepper generally had increased fruit set and early yield when the transplant age was increased from 33 to 77 days (McCraw and Greig, 2006; Akinrotimi, 2018). Saxena and Singh (2019) result stated that 33 to 36 days old transplants were best regarding the growth and yield of capsicum. The performance of any crop culture depends on different environmental factors, types of cultivars, cultural practices, etc. The Optimum age of transplants is one of the important factors. Among the factors which affect the growth and yield of the crop (Shukla, 2011). The age of seedling transplants understanding the physiological state of seedling survivability, growth, and yield. There is a lack of research articles on the effect of transplanting seedling age. For those prospects, the present experiment was conducted to ascertain the optimum age of transplants to maximize fruit yield and seed production in the Narsingdi district of Bangladesh.

II. Materials and Methods

The experiment was carried out at the Regional Horticulture Research Station, BARI, Shibpur, Narsingdi, during the Rabi season of 2018 to 2019. Out of 30 AEZ in Bangladesh, the shibpur upazila belongs to AEZ-28 (Madhupur Tract) at Narsingdi region (23°55′22″ N and 90°43′03″ E) of Bangladesh. The land type was sandy loam and the soil pH of 6.8 (Ahmed et al., 2018). Different ages of transplant seedlings were started from 14 days old seedlings with a gap of seven days. Six treatments were T_1 =14 days, T_2 =21 days, T_3 =28 days, T_4 = 35 days, T_5 = 42 days, and T_6 = 48 days at the age of transplanting seedlings. From 2018 to 2019, seeds were sown in seedbeds on 15 October 2018. The days of fifty percent seed germination was considered zero-day and successive day were counted for deciding seedling age. The experiment was conducted in a randomized block design with three replications. The variety BARI Mistimorich-1 was transplanted as per treatment.

The unit plot size was 3.0 × 1.0 m and plant spacing was 60 × 50 cm. There were ten plants in unit plots. Cowdung, Urea, TSP, MoP, Gypsum, and Zinc Sulfate at 10 t, 250 kg, 350 kg, 250 kg, 110 kg, and 12 kg ha^{-1}, respectively, were applied. Half of the quantity of Cowdung was applied during the final land preparation. During the pit preparation, the remaining Cowdung, the entire amount of TSP, Gypsum, Zinc Sulphate, and one-third of the Urea and MoP were applied. After transplanting in the primary field, the remaining urea and MoP were applied in two equal portions at 25 and 50 days later. Weeding, irrigation, and other cross-cultural tasks were carried out as required. From December to March, when the crop reached the vegetative and fruiting stages, the nighttime temperature inside the polythene and nylon net-covered tunnel was 5-9^{0}C higher than in the open field and other treatments. Weeding, irrigation, insecticide and fungicide application were all used to raise healthy seedlings. Five mature plants were harvested randomly after maturation to note the factors contributing to growth and yield. Statistical Tools for Agricultural Research (STAR) program 2.0.1 version was used to analyze variance on mean data (STAR, 2014).

III. Results and Discussion

Effect of Plant height at different Stages of plant growth

A significant variation was responded to plant height a different stage of plant growth (Table 01). Among the treatment, the tallest plant height at 30 days of transplanting was found at 25.89 cm at 21

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days aged transplants (T_1), whereas the shortest was recorded at 15.66 cm at 48 days aged transplants (T_1). In the case of 50% flowering at plant height, the highest was obtained in 52.44 cm at 28 days aged transplants (T_2), but the lowest was found in 39.66 cm at 48 days aged transplants (T_6) which was followed by 42 days aged transplants (T_5). Also, maximum plant height at first harvest was recorded at 58.33 cm at 28 days aged transplants which were followed by 35 days aged transplants (T_4). The lowest plant height at first harvest was found at 45.22 cm at 48 days aged transplants (T_6). On the other hand, the tallest plant height at final harvesting was recorded at 65.55 cm at 28 days aged transplants (T_3), but the smallest was recorded at 48.44 cm at 21 days aged transplants (T_2). When seedlings were transplanted, their length grew longer as they grew older. The higher biomass in older transplants, particularly the established and well-developed root system, which allowed for greater uptake of water and nutrients from the soil and improved cellular elongation, may also be responsible for the increased plant height (Lee Jiwon et al., 2001).

Effect of Plant growth characteristics

The significant difference was also shown in plant growth characteristics such as stem girth, shoot length, root length, and shoot/root ratio (Table 02). The highest stem girth at the plant was observed in 1.53 cm at 28 days aged transplants (T_3) which were statistically similar to 1.54 cm at 14 days aged transplant seedling (T_1). The stem girth produced the least girth of 1.07 cm at 48 days aged transplants (T_6), statistically similar to 35 days and 42 days aged transplants. The highest shoot length and root length were recorded in 66.55 cm and 19.22 cm at 21 days aged transplants, respectively which were statistically similar to 14 days aged transplants. The lowest shoot length was observed in 51.66 at 48 days aged transplants and root length was recorded in 12.55 at 48 days aged transplants. The highest shoot and root length ratio was recorded in 4.12 at 48 days aged transplants, statistically similar to 35 days aged transplant seedlings. But the lowest ratio was found in 3.03 at 14 days aged transplants which were followed by 28 days aged transplants. This result was found by Osei (2013) and Daudu et al. (2020).

Table 01. Effect of different ages of seedlings at transplants on plant height at different stages of plant growth.

Treatment Age of seedlings at transplants	plant height at 30 days after transplanting (cm)	plant height at 50% flowering (cm)	plant height at first harvesting (cm)	plant height at final harvesting (cm)
T_1 (14 days)	25.89	45.33	52.89	55.55
T_2 (21 days)	23.11	41.89	47.89	48.44
T_3 (28 days)	20.66	52.44	58.33	65.55
T_4 (35 days)	19.44	44.33	55.00	57.22
T_5 (42 days)	18.55	42.66	50.89	52.55
T_6 (48 days)	15.66	39.66	45.22	52.66
LSD	3.50	4.58	6.05	7.60
CV%	6.01	3.64	4.12	4.87

Table 02. Effect of different ages of seedlings at transplants on plant growth characteristics

Treatment Age of seedlings at transplants	Stem grith (cm)	Shoot length (cm)	Root length (cm)	Shoot and Root length ratio
T_1 (14 days)	1.54	56.55	18.66	3.03
T_2 (21 days)	1.26	66.55	19.22	3.50
T_3 (28 days)	1.53	53.78	16.89	3.19
T_4 (35 days)	1.13	58.55	14.89	3.97
T_5 (42 days)	1.17	56.55	14.66	3.87
T_6 (48 days)	1.07	51.66	12.55	4.12
LSD	0.33	7.45	3.68	0.92
CV%	9.09	4.59	8.04	9.03

The youngest and oldest seedling vegetative growth was found to be low, whereas middle-aged seedling stem and shoot and root growth was well developed because favorable climate conditions remained in the growing period. The older transplants produced the shortest shoot and root length other than the youngest-aged seedling. As a result, shoot and root ratio were higher found in older

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aged transplants seedling. This might be due to the shortest vegetative period of older aged transplants. It could be affected by experimental site temperature and the more significant time to field established for the youngest to oldest seedlings.

Effect of fruit characteristics

In Table 03, The highest individual fruit weight was recorded at 131.60 g at 28 days aged transplants (T_3) which was followed by 113.43 g at 35 aged transplants seedling (T_4), whereas the lowest average individual fruit weight was found in 67.87 g at 48 days aged transplants (T_6) which were statistically similar to 80.19 g at 14 days aged transplants (T_1). The longest fruit length was recorded at 8.95 cm at 35 days aged transplants (T_4) which was statistically similar to 8.94 cm at 42 days aged transplants (T_5), but the shortest fruit length was found at 6.26 cm at 14 days aged transplants (T_1). On the other hand, the highest fruit breadth was observed in 6.98 cm at 42 days aged transplants (T_5) which was statistically similar to 6.97 cm at 28 days aged transplants (T_3), whereas the lowest was recorded in 6.23 cm at 14 days aged transplants (T_1). The maximum number of seeds per fruit was recorded in 80.04 at 28 days aged transplants (T_3) which were followed by 63.31 at 35 days aged transplants (T_4), whereas the lowest was observed in 40.09 at 14 days aged transplants (T_1). The heaviest average thousand seeds weight was recorded at 8.17 g at 28 days aged transplants (T_3) which were statistically similar to 8.07 g at 21 days aged transplants (T_2) and the thinnest weight was recorded at 6.60 g at 42 days aged transplants (T_5).

The middle-aged seedlings were found in a heavier and higher number of fruits and had the longest fruit size because their vegetative growth was better than other aged seedlings. The oldest seedling may have damaged its feeding root and came to flower earlier than the transplanted seedling. In comparison to younger or older transplants, middle-aged transplants produced more fruits per plant, according to Shukla and Rajender (2011). Tomatoes produced the most fruits per plant by middle-aged transplants, according to Salik et al. (2000).

Table 03. Effect of different ages of seedling at transplants on fruit characteristics.

Treatment	Average individual fruit weight (g)	Fruit length (cm)	Fruit breadth (cm)	Number of seeds per fruit
T_1 (14 days)	80.19	6.26	6.23	40.09
T_2 (21 days)	101.30	7.68	6.52	56.87
T_3 (28 days)	131.60	8.22	6.97	80.04
T_4 (35 days)	113.43	8.95	6.57	63.31
T_5 (42 days)	85.57	8.94	6.98	52.16
T_2 (48 days)	67.87	7.75	6.35	56.90
LSD	15.32	1.35	0.72	11.42
CV%	5.59	5.98	3.85	6.91

Effect of yield contributing characteristics

A significant variation was observed in yield-contributing characteristics (Table 04). The highest marketable fruits per plant were recorded in 13.55 at 28 days aged transplants (T_3) which was followed by 35 days aged transplants (T_3), whereas the lowest fruits per plant were found in 7.22 at 48 days aged transplants (T_6) which was followed by 9.17 at 42 days aged transplants. The highest yield per plant, yield per plot, and yield ton per hectare were recorded in 1.69 kg/plant, 16.92 kg/plot, and 26.80 ton per hectare, respectively, at 28 days aged transplants (T_3) which was followed by 1.32 kg per plant, 13.16 kg per plot and 20.88 ton per hectare respectively at 35 days old transplants seedling (T_4). The lowest yield per plant, yield per plot and yield ton per hectare were recorded at 0.49 kg/plant, 4.88 kg/plot and 7.76 ton per hectare, respectively, at 48 days aged transplants (T_6) which was followed by 0.79 kg per plant, 7.85 kg per plot and 12.47 ton per hectare respectively at 42 days aged transplants seedling (T_5).

The earliest-aged transplant seedling yield was low but gradually increased yield middle-aged transplants. On the other hand, the oldest aged transplant seedling dramatically reduced yield per plant per plot and hectare. This might be due to delay flowering, fruiting, and harvesting period. Sweet pepper requires durable initial growth to support earliness and abundant fruit set. This result was shown by Naz et al. (2006) and Osei (2013).

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Table 04. Effect of different age of seedlings at transplants on yield contributing characteristics

Age of seedlings at transplants	Marketable no. of fruits per plant	Yield per plant (kg)	Yield per plot (kg)	Yield (t/ha)	Thousand seed weight (g)
T_1 (14 days)	10.29	0.82	8.26	13.01	7.47
T_2 (21 days)	10.65	1.01	10.07	15.98	8.07
T_3 (28 days)	13.55	1.69	16.92	26.80	8.17
T_4 (35 days)	11.77	1.32	13.16	20.88	6.97
T_5 (42 days)	9.17	0.79	7.85	12.47	6.60
T_6 (48 days)	7.22	0.49	4.88	7.76	7.23
LSD	2.21	0.22	2.23	3.55	1.05
CV%	7.54	7.79	7.74	7.76	4.98

IV. Conclusion

In aspect of yield per plant, yield per plot and yield ton per ha which were the maximum, was obtained in 28 days aged transplanting seedling which was followed by 35 days aged transplants. In case of no. of seeds per fruit and thousand seeds, weight was statistically better resulted at 28 days and 35 days the age of transplant seedling. The lowest yield was recorded at 48 days of age of seedlings at transplants. It may be recommended that 28 days age of seedlings at transplants was found best regarding growth, yield, and seed production of other ages of seedlings at transplants of BARI Mistimorich-1 for the areas under AEZ 28 of Bangladesh.

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