AGRONOMSKI GLASNIK 1/2010.
ISSN 0002-1954

Original scientific paper
Izvorni znanstveni članak

EFFECT OF SOWING DATE ON THE GROWTH AND YIELD OF SWEET PEPPER (*CAPSICUM ANNUUM* L.)

DJELOVANJE DATUMA SIJANJA NA RAST I PRINOS SLATKE PAPRIKE (*CAPSICUM ARUNUM* L)

M. Islam, S. Saha, H. Akand, A. Rahim

ABSTRACT

An experiment was carried out at the Horticultural farm of the Bangladesh Agricultural Research Institute, Joydebpur, Gazipur, during September 2006 to April 2007 to investigate growth and yield of sweet pepper as influenced by sowing date. There were seven levels of sowing date viz. September 1, September 15, October 1, October 15, October 30, November 15 and November 30. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Data were recorded on various parameters and statistically analyzed. The results of the experiment demonstrated that the majority of growth parameters and yield components were significantly increased at the earlier sowing (October 1). The highest yield (19.36 t/ha) of fruit was recorded from the earlier sowing (October 1) with the spacing (50×30 cm) which also gave the highest benefit cost ratio (4.58). Considering the yield of fruits per hectare, cost of production and net return, the treatment combinations of October 1 sowing appeared to be recommendable for the cultivation of sweet pepper.

Key words: sowing date, yield, growth, sweet pepper

SAŽETAK

Na poljoprivrednoj farmi Zavoda za istraživanja u poljoprivredi Bangladeša u Joydepuru, Gazipur, obavljen je pokus od rujna 2006. do travnja 2007. da se istraži rast i prinos slatke paprike pod utjecajem datuma sijanja. Sijanje je obavljeno na sedam datuma, tj. 1. rujna, 15. rujna, 1. listopada, 15. listopada, 30. listopada, 15. studenog i 30. studenog. Pokus je postavljen u slučajnom

potpunom bloku s tri ponavljanja. Podaci su bilježeni za različite parametre i statistički analizirani. Rezultati pokusa su pokazali da je većina parametara rasta i prinosa značajno porasla s ranijim sijanjem (1. listopada). Najveći prinos (19,36 t/ha) plodova zabilježen je za raniju sjetvu (1. listopada) uz razmak od 50x30cm, što je također dalo najviši/najbolji omjer koristi i troškova (4,58). Uzevši u obzir prinos plodova po hektaru, troškove proizvodnje i neto povrat sijanje 1. listopada može se preporučiti za uzgoj slatke paprike.

Ključne riječi: datum sijanja, prinos, rast, slatka paprika

INTRODUCTION

Sweet pepper (*Capsicum annuum* var. *grossum* L.) belongs to the family Solanaceae under the genus *Capsicum*. Sweet pepper, chilli and the Capsicum are native to Tropical South America. Especially Brazil is thought to be the original home of peppers (Shoemaker and Teskey, 1955). The genus *Capsicum* contains about 20 species. Now five domesticated species are only recognized: *Capsicum annuum*, *C. frutescens*, *C. chinense*, *C. baccatum* and *C. pubescens*. All cultivated species of Capsicum have 2n = 24 chromosomes (Greenleaf, 1986). Within *C. annuum*, a tremendous range in size, shape and mature colour of fruits has been selected that now forms the basis for the types used in commerce throughout the world (Andrews, 1984; Greenleaf, 1986). The species *annuum* includes eleven groups (Farris, 1988) which can be divided into two sub group Sweet and Hot peppers. The sweet pepper is relatively non-pungent with thick flesh and it is the world's second most important vegetables after tomato (Anonymous, 1989). Sweet pepper is used either green or red, and may be eaten as cooked or raw, as well as in salad. It is also used for pickling in brine, baking and stuffing. The leaves are also consumed as salad, soup or eaten with rice (Lovelook, 1973). It was also discovered to be a good source of medicinal preparation for black vomit, tonic for gout and paralysis (Knott and Deanon, 1967). Capsicum has a little energy value. But the nutritive value of sweet pepper is high as it contains 1.29 mg protein, 11 mg calcium, 870 I.U vitamins-A, 175 mg ascorbic acid, 0.06 mg thiamine, 0.03 mg riboflavin and 0.55 mg niacin per 100g edible fruit (Joshi and Singh, 1975). The vitamin C content was found as high as 321 mg. Meanwhile, Sweet pepper is a minor vegetable in Bangladesh and its production statistics is not available (Hasanuzzaman, 1999). A small-scale cultivation is found in peri-urban areas

primarily for the supply to some city markets in Bangladesh. The crop has got high export potentiality. Considering its high nutritive value and export potentiality, it is imperative to take attempts for its successful cultivation in the country. Successful cultivation of any crop depends in several factors. Sowing date is one of the important aspects for production system of different crops. Optimum sowing or planting time ensures proper growth and development of plant resulting maximum yield of crop and economic use of land. The present study was carried out to clarify the optimum sowing/planting time for Sweet pepper in Bangladesh.

MATERIALS AND METHODS

The experiment was conducted at the Horticultural farm of the Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur, during the *Kharif* and *Rabi* season (September 2006 to April 2007). The experimental area is situated at 24.00^0N latitude and 90.25^0E longitude at an elevation of 8.4 meters from the sea level (Anonymous, 1995). The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. There were in total 21 unit plots, each plot of 3×1m were made and raised by 10 cm which was separated by 0.50 m space. The blocks were also separated by 0.50 m space. The treatments included 7 sowing times and 3 replications. There were 21 treatment combinations. The seeds were sown in seven dates at 15 days interval viz. T_1= sowing on 1 September, 2006; T_2 = sowing on 15 September, 2006; T_3 = sowing on 1 October, 2006; T_4 = sowing on 15 October, 2006; T_5 = sowing on 30 October, 2006; T_6 = sowing on 15 November, 2006 and T_7 = sowing on 30 November, 2006. *Capsicum annuum* var*. grossum* cv. California Wonder, 10 g seeds were needed for sowing. Seeds were soaked in water for 12 hour prior to sowing. Half of the quantity of cowdung was applied during final land preparation. The remaining half of Cowdung, the entire quantity of TSP, ZnO, Gypsum and one third each of urea and MP were applied during pit preparation. The rest of Urea and MP were applied in two equal splits, 25 and 50 days after transplanting in the main field (Table 1). Thirty days old seedlings were transplanted on experimental plots at each planting time with 2 cm depth providing 50×30 cm spacing. After planting the seedlings, the following intercultural operations were accomplished for their better growth and

Table 1. Doses of application of manure and fertilizers for of sweet pepper

Elemental form	Fertilizer form
Cowdung	10 t/ha
N-100 kg/ha	Urea-217 kg/ha
P_2O_5-150 kg/ha	TSP – 333 kg/ha
K_2O-120 kg/ha	MP- 200 kg/ha
S-20 kg/ha	Gypsum – 111 kg/ha
Zn-4 kg/ha	ZnO – 5 kg/ha

development. The crop was irrigated when needed depending on the moisture status of the soil and requirement of plants. Plots with transplanted seedlings were regularly observed to find out any damage or dead seedlings for its replacement and weeding was done as per requirement and also plant protective measures were done against insect and disease. Data were collected from five plants were randomly selected from each plot for data collection on growth and yield characteristics. These were plant height (cm), number of branches per plant, number of leaves per plant, stem girth (mm), fruit length (cm), fruit breadth (cm), days 50% to flowering, days to 1st harvest, number of fruits per plant, individual fruit weight (g), yield per plant (g) and yield per plot (kg). The recorded data for different characters were analyzed statistically using 'MSTAT-C' program to find out the significance of variation among the treatments. The analysis of variance (ANOVA) was performed by F-test, while the significance of difference between the pairs of treatment means were evaluated by the Duncan's Multiple Range Test (DMRT) test at 5% and 1% level of probability (Gomez and Gomez 1984).

RESULTS AND DISCUSSION

All the characters showed significant influence on all the growth and yield component for sowing time (Table 2 and 3). The effect of sowing date on plant height of sweet pepper was significant (Figure 1). It indicated that the plant heights gradually increased when recorded at different growth stages. Plants which were sown in September 1 to October 15 attained the maximum height.

Table 2. Analysis of variance (ANOVA) for plant height in Sweet pepper as influenced by sowing date

Source of variation	Degree of freedom	Mean squares of plant height (cm)				
		45 DAS	60 DAS	75 DAS	90 DAS	At final harvest
Replication	2	0.049	0.021	0.016	0.210	1.325
Sowing date	6	41.074**	131.606**	106.956**	96.274**	110.639**
Error	40	0.117	0.212	1.190	3.442	8.919

DAS = Days after sowing, **Significance at 1% level of probability

Table 3. Analysis of variance (ANOVA) for different growth and yield component characters of Sweet pepper as influenced by sowing date

Source of variation	Degree of freedom	Mean squares										
		No. of Branches /plant	No of Leaves /plant	Stem girth (mm)	Days to 50% flowering	Number of fruits /plant	Days to 1st harvest	Fruit length (cm)	Fruit breadth (cm)	Individual fruit weight (g)	Yield per plant (g)	Yield per plot (kg)
Replication	2	0.002	8.883	0.011	1.175	0.039	0.968	0.002	0.064	0.571	20918.92	3.048
Sowing date	6	1.405 **	5891.63 **	5.024 **	372.08 **	26.822 **	1237.91 **	1.856 **	1.080 **	151.583 **	32944.97 **	7.519 **
Error	40	0.136	131.814	0.119	7.731	0.157	11.535	0.043	0.057	8.271	73.896	0.013

*Significance at 1% level of probability

Figure 1. Effect of sowing date on plant height of sweet pepper at different stages of plant growth.

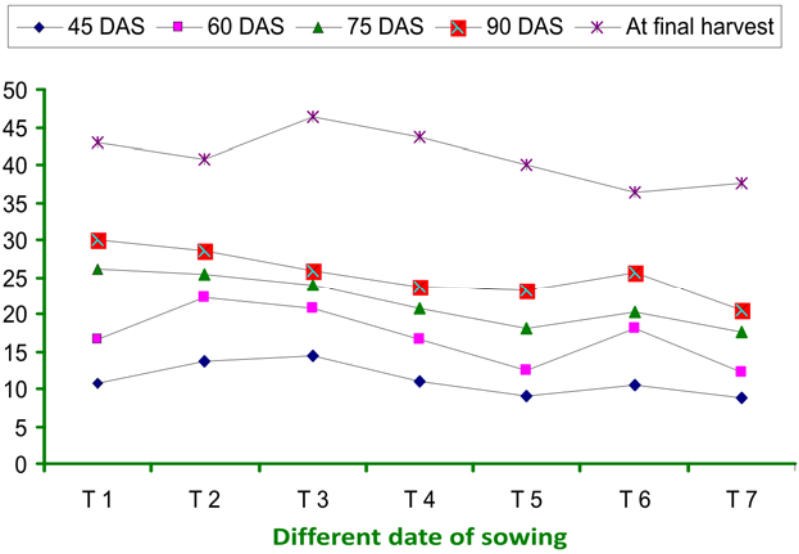
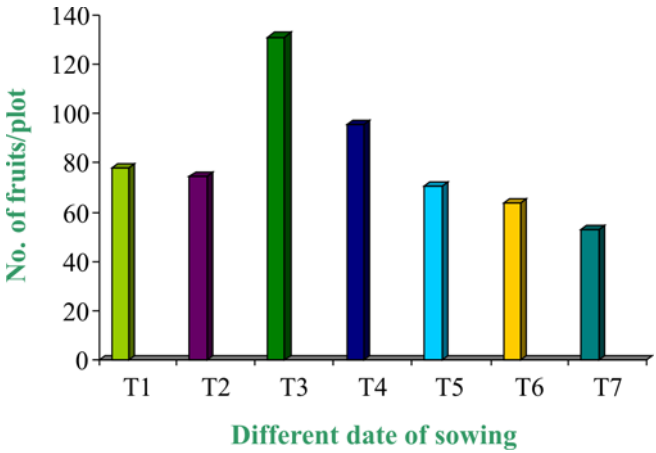


Figure 2. The effect of sowing date on number of fruits per plot of Sweet pepper



The tallest plant (46.32 cm) was obtained from October 1 sowing at final harvest which was statistically similar to those of October 15 (43.07 cm) and September 1 (42.92 cm) sowing respectively. Plants those were sown after October 1 attained the minimum plant height (Table 4). The minimum plant height (36.32 cm) at final harvesting stage was obtained from the November 15 sowing which was statistical similar to those of October 30 and November 30 sowing. The maximum average number of branches (5.20) was recorded in plants from the September 1 and October 1 sowings which were statistically similar to those of September 15, October 15 and October 30 sowings.

Table 4. Effect of sowing date on plant height of sweet pepper at different stages of plant growth

	Plant height (cm)				
Sowing date	45 DAS	60 DAS	75 DAS	90 DAS	At final harvest
September 01 (T_1)	10.91de	15.40h	27.10	31.15	43.90
September 15 (T_2)	14.16b	22.59a	26.30	29.59	42.66
October 01 (T_3)	15.12a	21.21bc	24.56	27.08	47.92
October 15 (T_4)	11.24d	17.15ef	21.64	24.30	45.10
October 30 (T_5)	10.86de	13.35i	20.34	23.75	41.92
November 15 (T_6)	11.32d	19.68d	22.48	26.35	37.62
November 30 (T_7)	9.01gh	13.26i	19.07	21.08	41.84
Level of Sig.	**	**	NS	NS	NS
CV (%)	3.07	2.72	5.02	7.33	7.27

**Significant at 1% level of probability, ^{NS} Non significant
In a column, means followed by common letters are not significantly different from each other at 1% level of probability by DMRT

Minimum number of branches (4.30) per plant was found at November 30 sowing which was statistically similar to those of November 15 and September 15 sowing (Table 5). A significant variation in number of leaves per plant was observed in case of sowing date (Table 5. October 1 sowing produced the maximum number of leaves per plant (243.82) while it was the lowest (169.41) in November 30 sowing which was statistically similar to those of October 30 to

Table 5. Effect of sowing date on different growth and yield component characters of Sweet pepper

Treatment (Sowing date)	No. of branches /plant	No. of leaves /plant	Stem girth (mm)	Days to 50% flowering	No. of fruits /plant	Days to 1st harvest	Fruit length (cm)	Fruit breadth (cm)	Individual fruit weight (g)	Yield per plant (g)	Yield per plot (kg)
September 01 (T_1)	5.20a	174.15d	15.30a	104.78b	5.13c	129.56e	6.54a	5.32c	41.32cd	218.95d	3.29d
September 15 (T_2)	4.78ab	193.89bc	14.28b	97.89c	4.99c	125.89e	5.99b	5.49bc	49.25a	246.03c	3.65c
October 01 (T_3)	5.20a	243.82a	14.49b	105.00b	8.69a	156.78a	5.78b	6.12a	37.57d	326.91a	4.90a
October 15 (T_4)	5.15a	198.43b	13.84c	107.00b	6.41b	152.22b	5.44c	6.20a	44.74bc	287.64b	4.25b
October 30 (T_5)	4.98a	176.09d	13.74c	108.44b	4.66cd	148.11b	5.25c	6.13a	48.14ab	225.20d	3.36d
November 15 (T_6)	4.32b	180.91cd	13.01d	115.22a	4.17d	143.67c	5.47c	5.79b	43.11c	185.31e	2.73e
November 30 (T_7)	4.30b	169.41d	13.48c	116.56a	3.48e	135.00d	5.38c	5.67b	41.28cd	146.64f	2.15f
Level of significance	**	**	**	**	**	**	**	**	**	**	**

** Significant at 1% level of probability measured by DMRT

November 30 and September 1 sowing. Stem girth of sweet pepper varied significantly due to different sowing date (Table 5). It was found that the earlier sowing (September 1) produced plant with maximum (15.30 mm) stem girth which was statistically different from the other treatments whereas the minimum stem girth (13.01 mm) was recorded from November 15 sowing. Days to 50% flowering was found significantly effective by sowing date (Table 5). Late sowing required significantly more time as compared to early sowing. The plants of November 30 sowing took the highest period (116.56 days) for 50% flowering which was statistically similar (115.22 days) to that of November 15 sowing and the shortest period (97.89 days) took by the plant of September 15 sowing which was statistically different from other treatments. This might be late sown plant required more time for receiving favorable cool temperature which may induce flowering. The significant variation was found for days to 1st harvest (Table 5). It was observed that October 1 sowing required more time (156.78 days) as compared to other sowings. The shortest period (125.89 days) was taken took by the plant of September 15 sowing which was statistically similar (129.56 days) to September 1 sowing. Among the yield contributing characters, number of fruits per plant is one of the important characters. The number of fruits per plant showed significant difference among the plant due to sowing date (Table 5). The highest average number of fruits (8.69) per plant was found from the plants of October 1 sowing. The minimum number of fruits (3.48) per plant being noticed in plants of November 30 sowing and differed significantly from that of other sowing dates. Significant effect of sowing date was found on the number of fruits per plot (Figure 2). The highest number (130.71) of fruits per plot was obtained in October 1 sowing and differed significantly with the rest of sowing dates. The lowest number (52.77) of fruits per plot was obtained from the November 30 sowing. The highest number of fruits per plot at October 1 sowing might be due to favorable weather conditions prevailed during this time. A significant variation in length of fruit was observed due to both sowing date and plant spacing. The earlier sowing (September 1) produced the longest fruits (6.54 cm). Later sowing (October 30) produced the shortest fruits (5.25 cm) which was closely followed by October 15, November 15 and November 30 sowings (Table 5). Fruit breadth was significantly influenced by sowing date (Table 5). The widest fruit breadth (6.20 cm) was found at the October 15 sowing which was statistically similar to that of October 1 (6.12 cm) and October 30 (6.13 cm) sowing. The

lowest fruit breadth (5.32 cm) was found in September 1 sowing which was statistically similar (5.49 cm) to September 15 sowing. Individual fruit weight of sweet pepper was significantly influenced by sowing date. The heaviest fruit (49.25 g) was obtained at September 15 sowing, which was statistically similar (48.14 g) to October 30 sowing (Table 5). The lowest fruit (37.57 g) weight was produced from the October 1 sowing, which was statistically similar to September 1 and November 30 sowings (41.31g) and (41.28 g) respectively. Sowing date imposed significant difference in respect of yield per plant (Table 5). October 1 grown plant showed the maximum yield (326.91g) per plant, which was significantly higher than all other treatments. October 15 grown plants produced intermediate yield (287.64 g) per plant and the lowest yield (146.64 g) was recorded from November 30 sowing plants. The difference in yield per plant among the sowing date can be explained that the October 1 sowing plants received favorable environment for growth and thus produced the highest number of fruit per plant which led to the highest yield per plant. The effect of sowing date was found to be significant at 1% level of probability regarding yield per plot (Table 3). October 1 grown plants produced significantly higher yield (4.90 kg/plot). The lowest yield (2.15 kg/plot) was obtained from later sowings (November 30), which was dissimilar from the all sowing dates (Table 5). Bevacqua and Vanleeuwen (2003) reported that Chile pepper (*Capsicum annuum* L.) yields were highly variable and were strongly influenced by disease and weather. They stated that the planting date had a significant effect on crop performance. The best stand establishment and highest yield were associated with the earliest planting date, 13 March. Russo (1995) reported that the sequential planting from early May in South Central USA is a viable method of increasing the marketable yield of bell peppers.

CONCLUSION

It was evident from the results that significant increase in the growth parameter and yield per plant were obtained with the earlier sowing (October 1). The highest yield per plant (326.91 g) was obtained from the earlier sowing (October 1) while the later sowing (November 30) produced the minimum yield (146.64 g) per plant and in the same trend it was found that the earlier sowing (October 1) produced the maximum yield (16.33 t/ha) whereas later sowing (November 30) recorded the minimum yield (7.19 t/ha).

REFERENCES

1. Andrews, J. 1984. Peppers, The Domesticates Capsicums. University of Texas Press, Austin. p. 321.
2. Anonymous. 1989. Tomato and Pepper Production in the Tropics. Asian Vegetable Research and Development Center, Taiwan. p585.
3. Anonymous. 1995. Agro-climatological data. Agromet Division, Bangladesh Meteorological Department, Joydebpur, Gazipure. pp.35-65.
4. Bevacqua, R. F.' Vanleeuwen, D. M. 2003. Planting date effects on stand establishment and yield of chile pepper. *American Society for HorticulturalScience*.**38**: 357-360.
   Gomez, K. A. and Gomez, A A. 1984. Statistical Procedure for Agricultural Research (2nd edition). Int. Rice Res. Inst. A Willey Int. Sci. Pub. pp.28-192.
5. Greenleaf, W. H. 1986. Pepper breeding. In: Bassett, M.J. (ed.) Breeding Vegetable Crops. Avi Publishing, Westport, Connecticut, pp. 67-134.
6. Farris, N. P. 1988. Perfect Peppers, Horticulture. U.S.A. Horticultural Limited Partnership. Pp. 60-62.
7. Hasanuzzaman, S. M. 1999. Effect of hormone on yield of Bell Pepper (*Capsicum annuum*). MS Thesis, Department of Horticulture. Bangladesh Agricultural University, Mymensingh.
8. Joshi, M. C. and Singh, D. P. 1975. Chemical Composition in bell pepper. *Indian Hort*. **20**: 19-21.
9. Lovelook, Y. 1973. Various herbs spices and condiments. **In**: The vegetable Book. St Martin Press, New York. p.34.
10. Knott, J. E., Deanon, J. R. 1967. Eggplant, tomato and pepper. Vegetable Production in Southeast Asia, Laguna, Philippones: University of Philippines Press. pp. 99-109.
11. Russo V. M. 1996. Planting date, fertilizer rate, and harvest timing affect yield of Jalapeno and Banana peppers. *American Society for Horticultural Science*, **31**(7):1097-1118.
12. Shoemaker, J. S., Tesky, B. J. E. 1955. Practical Horticulture. John Willy and Sons, Inc. New York. p. 371.
13. Verroens, P., Verlinden, B.E., Sauviller, C., Lammertyn, J., De Ketelaere, B., Nicolaï. B.M.2006. Time series analysis of *capsicum annuum* fruit production cultivated in greenhouse. ISHS Acta Horticulturae 718: III International Symposium on Models for Plant Growth, Environmental Control and Farm Management in Protected Cultivation. (http://www.actahort.org/members/showpdf?booknrarnr=718_10)

Author's addreses – adresa autora:
Monirul Islam[1],
Satyaranjan Saha[2],
Md. Hasanuzzaman Akand[1]
Md. Abdur Rahim[3]

Received – Primljeno:
31.01.2010.

[1] Department of Horticulture,
Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh
[2] Horticulture Division, Bangladesh Agricultural Research Institutre, Gazipuir, Bangladesh
[3] Department of Genetics and Plant Breeding, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh