

PERFORMANCE OF DIFFERENT BELL PEPPER (*Capsicum annuum* L.) GENOTYPES IN RESPONSE TO SYNTHETIC HORMONES

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ABSTRACT

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A field study was carried out at the Horticulture Research Centre Farm, Bangladesh Agricultural Research Institute, Jopdebpur, Gazipur during October 1998 to April 1999 to determine the performance of different bell pepper (*Capsicum annuum* L.) genotypes in response to synthetic hormones. Ten genotypes viz, CP0039, CP0041, CP0043, CP0044, CP0045, CP0053, CP0054, CP0055, CP0061 and CP0068 and two synthetic hormones Milstim and Litosen along with control (fresh water) were used as treatments in this study. It was found that, due to hormonal treatments significant variation exists among the genotypes in respect of morphological characters, physiological parameters, fruit yield and seeds per fruit. Genotype CP0039 produced the highest leaves (63.64), branches (7.36), plant height (24.23 cm), fruit (19) per plant and seed (150) per fruit. Highest fruit yield (18.69 t ha⁻¹) was obtained from CP0045. Fruit weight was maximum (18.58 g) in CP0061. Seeds extracted from CP0041 fruits had highest (92%) germination. On the contrary, the lowest seed germination (22%) was recorded in CP0045. Genotype CP0039 plants treated Milstim and Litosen produced 20 and 18 fruits per plant resulting 20.37 t ha⁻¹ and 19.93 t ha⁻¹ yield, respectively. Lowest fruit bearing (4-fruits/ plant) and yield (4.14 t ha⁻¹) were recorded in control plants of CP0068. So both Milstim and Litosen treated plants performed better than control plants regarding fruit bearing and yield.

Key words: Genotypes, synthetic hormone, fruit yield

INTRODUCTION

Bell pepper (*Capsicum annuum* L.) is a solanaceous vegetable crop. It is the second most important vegetable after tomato (AVRDC, 1989) in the world. Tropical South America, especially Brazil is thought to be the original home of pepper (Shoemaker and Teskey, 1955). It is now widely cultivated in America, South America, Europe and some countries of Asia-Pacific. Bell pepper sometimes, known as sweet pepper or green pepper having mild flavor with pungency. Bell pepper green or red may be eaten as cooked or raw, sliced in salads. It is also used for pickling in brine, baking and stuffing. Nutritive value of bell pepper is high as it contains 1.29 mg protein, 11 mg calcium, 870 I.U. vitamin A, 17.5 mg ascorbic acid, 0.6 mg thiamin, 0.03 mg riboflavin and 0.55 mg niacin per 100 g edible of fruit (Joshi and Singe, 1975). Bell pepper is a vegetable in Bangladesh and its production statistics are not available. A small-scale cultivation is found in peri-urban areas primarily for the supply to some city markets in Bangladesh. Its production has some constraints which include flower dropping, poor fruit set, and susceptibility to virus diseases. Some chemicals are generally used to improve fruit set and yield of bell pepper. Two chemicals namely Milstim and Litosen improve fruit set and thereby yield in bell pepper including other vegetables as claimed by the different hormone producing company. Since poor fruit set is a problem in bell pepper cultivation, the present investigation was undertaken to study the performance of different bell pepper genotypes in response to synthetic hormones.

MATERIALS AND METHODS

The experiment was conducted at the Horticulture Research Centre Farm, Bangladesh Agriculture Research Institute, Jopdebpur, Gazipur during October 1998 to April 1999.Ten-genotypes viz., CP0039(G1), CP0041(G2), CP0043(G3), CP0044(G4), CP0045(G5), CP0053(G6), CP0054(G7), CP0055(G8), CP0061(G9) and CP0068(G10) and two synthetic hormones Milstim (M) and Litosen (L) along with control (water) were used as treatments in this study. Milstim and Litosen were used sprayed on the above ten genotypes of bell pepper at the rate of 0.50 ml and 1.00ml litre⁻¹ water, respectively as these two doses were recommended by manufacturer. Control plots were sprayed with water. Thus there were 30 treatment combinations. The experiment was laid out in the Randomized Complete Block Design (RCBD) with three replications. The experimental field was first divided into three blocks. Each block was further divided into 30 unit plots i.e equal to the number of treatment combinations. The size of each unit plot was 1.35 m X 1 m. The blocks and plots were spaced at 0.5 m and 0.35m, respectively. Thirty treatments were randomly assigned to 30 plots of each block. Thirty five-day-old healthy seedlings were transplanted in the experimental plots on 03, December 1998. Planting was done maintaining the spacing of 45 cm x 45 cm. Fertilizer and manure viz., well decomposed cow dung, Urea, TSP and MP were applied @ 5 t, 180 kg, 200kg and 100kg ha⁻¹, respectively (Annonymous,1991). The entire quantity of cowdung was applied during the land preparation and was mixed well with the soil. Half of the required quantity of urea, the total quantity of TSP and half of the MP were applied at the final land preparation. The rest quantity of urea and MP were applied as side dressing in two equal installments after 30

and 60 days of planting. Milstim and Litosen were applied three times on the plants. Milstim was sprayed @ 0.50 ml liter⁻¹ at each time. Litosen was sprayed @ 1.00 ml litre⁻¹ at each application. Applications of these chemicals were done during flower initiation, full blossoming and fruit setting stages. Plants in control plots were sprayed with clean water. All cultural and pest control measures were done as and when needed. The data were taken from randomly selected 4 plants from each plots of 9 plants on the following characters: plant height, number of leaves plant⁻¹, number of branches plant⁻¹, days to 50% flowering, days to harvest/maturity, fruit plant⁻¹ individual fruit weight, fruit length (cm), fruit diameter (cm), yield plant⁻¹, yield (t ha⁻¹), seeds fruit⁻¹, weight of 1000 seed (g) and germination (%). The recorded data were statistically analyzed to find out the variation resulting from the experimental treatments by F test. Treatment means were compared by Duncan's Multiple Range Test (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

The Performances of different bell pepper genotype in response to synthetic hormones are presented as mean values with statistical notation in the Table 1. Results of the experiment showed that, plant height (12.09 cm) and leaves number /plant (43.57) were lowest in CP0068 while those were highest(63.54) in CP0039 (Table 1), Which is in good agreement with that of Abdul *et al.* (1998) who reported increased plant height and leaf with GA₃ (at 50, 100 and 150 ppm) on bell pepper. But the number of branches was minimum (4.71) in CP0053 and that was maximum (7.36) in CP0039, Deka and Shadque (1996) obtained the highest branches, leaves, fruit set and yield of bell pepper with Cycocel at 500, 1000 or 1500 ppm. All these data indicated that CP0039 had vigorous growth and development. However, the variation in these morphological characters among the ten different genotypes is likely due to their difference in their genetic make up. Days to 50% flowering showed significant variation. CP0041 required 22 days (lowest) and CP0055 took 42 days to 50% flowering. Time to first harvest was earliest (52 days) in CP0041 while that was delayed (68 days) in CP0055. Variation in the days to first harvest among the genotype was statistically significant. Fruit bearing was the lowest (4 fruits plant⁻¹) in CP0068 while that was the highest (19 fruits plant⁻¹) in CP0039, which was similar to the findings of Rajmani *et al* (1990) and Bisaria and Parkash (1978) who found increased percentage of fruit set with 2, 4-D (2-5 ppm) and tricontanol (1.25-5 ppm) in capsicum cultivar Co-1 and with chorflurenol on bell pepper, respectively. The variation of fruits per plant among the genotypes was statistically significant which in other words demonstrates genetic difference in fruit bearing among the genotypes. The individual fruit weight was the lowest (14.18 g) in CP0054 and highest (18.58 g) in CP0061 which is almost similar to the findings of Hansi-Pekerti (1980), reported that the fruit weight was increased by application of same kind of hormone. The variation of individual fruit weight among the genotypes was statistically significant which is due to their genetic variability. The maximum fruit length (6.02 cm) in CP0054 while that was minimum (3.02 cm) in CP0053, which is also similar to that of Hansi-Pekerti (1980) and Djumaijah *et al* (1986) who reported increased fruit length with different growth regulators on chilly and bell pepper, respectively. The variation of fruit length among the genotype was statistically significant. The variation in fruit diameter among the different genotypes was statistically significant. The maximum diameter of fruit (4.43 cm) was found in CP0068 while that was minimum (1.98 cm) in CP0045. Fruit yield per plant was the highest (280.34g) in CP0045 and that was the lowest (65.49g) in CP0068, which was also in good agreement with the findings of Rajmani *et al* (1990) and Lyngdon and Sanyal (1992) who reported the highest fruit yield plant⁻¹ with 75 ppm NAA treatment on bell pepper. The fruit bearing character varied with the genotypes significantly. Fruit yield per hectare showed significant effect due to genotype. The highest fruit yield (18.69 t ha⁻¹) was found in CP0045 followed by CP0039 (18.03 t ha⁻¹) and CP0043 (16.76 t ha⁻¹) while the lowest yield (4.37 t ha⁻¹) was obtained from CP0068. This findings were in good agreement with those of Pandita *et al* (1980), Singh *et al* (1994), Patil and Ballal (1980), Abdul *et al* (1998) and Cachita-Cosma *et al* (1980) with different synthetic growth regulators on bell pepper. The maximum seeds (150) per fruit was achieved from CP0039 while that was minimum (62) in CP0044. The variation in number of seeds per fruits among the genotypes was statistically significant. The maximum seeds weight was 5.82g per plant in CP0044 while that was minimum (4.36g) in CP0045. The variation was statistically significant. Percent germination was minimum in CP0045 (22%) and maximum in CP0041 (92%). The variation of percent germination among the genotypes was statistically significant, which is due to the difference in their genetic make up.

Table 1. Performance of different bell pepper genotypes in response to synthetic hormone.

Genotypes	CP0039	CP0041	CP0043	CP0044	CP0045	CP0053	CP0054	CP0055	CP0061	CP0068
Plant height	24.23a	18.96d	18.02d	22.96ab	22.19b	14.24e	20.00b	14.68e	20.44c	12.09f
No of branches plant-1	7.36a	6.98a	6.92a	6.35a	6.30a	4.71b	7.21b	4.96b	6.44a	4.81b
No. of leaves plant-1	63.54a	58.13b	59.23b	54.55b	57.07b	45.97c	56.87b	48.19c	63.35a	43.57c
Days to 50% flowering	30e	22f	30e	34cd	35cd	36bc	38b	42a	33d	38b
Days to first harvest	58c	52d	58c	60c	63b	65a	54d	68a	54d	66a
No. of fruits plant ⁻¹	19 a	14 b	15 ab	12 c	19 a	10 c	7 c	8 d	10 c	4 e
Individual fruit wt. (g)	15.19c	16.52b	16.67b	15.23c	14.86cd	14.66cd	14.18d	15.14c	18.58a	15.18 c
Fruit length (cm)	4.98b	4.06d	4.40c	4.17d	4.27cd	3.02e	6.02a	3.07e	5.15b	3.16 e
Fruit diameter (cm)	2.32f	3.40c	2.91e	2.00g	1.98g	4.05b	2.37f	3.21d	3.56c	4.43 a
Fruit yield plant-1	270.52a	229.23b	251.43ab	175.58c	280.34a	155.32c	91.46e	114.32d	173.31c	65.49 e
Seeds fruit-1	150a	81f	123c	62g	133b	79f	110d	81f	128c	95 e
Fruit yield t ha ⁻¹	18.03 a	15.30 b	16.76 ab	11.50 c	18.69 a	10.10 c	5.10 e	8.10 d	12.30 c	4.37 e
1000 seeds wt. (g)	5.17b	5.66c	4.47e	5.82a	4.36 e	5.10c	5.77a	4.87cd	5.16b	4.83 d
Germination (%)	35 g	92 a	45 f	31 h	22 i	63c	72 b	51 e	34 g	60 d

Treatment means having common letter(s) are not significantly different from each other at the P≥0.01 level measured by DMRT

The interaction effect of different genotypes and hormone on the number of leaves, days to 50% flowering, days to first harvest, fruit length, fruit diameter, 1000 seeds weight and percentage of germination was found to be statistically significant whereas, plant height, number of branches, Number of fruit per plant, individual fruit weight, fruit yield per plant and seeds per fruit showed non-significant effect (Table 2, 3 & 4). Highest number of leaves (72.20) was found from G₁x M combination (CP0039 with Milstim) followed by G₃ x M (CP0043 with Milstim) combination (68.35) and least (39.37) from G10 x 0 (CP0068 with control) combination (Table 2). The days to 50% flowering showed that CP0041 plants treated with Litosen flowered earliest (22 days) among the genotypes compared to other treatments. Both hormones promoted the harvesting a few day in CP0055, CP0061 and CP0068 but delayed harvest in other genotypes. The highest number of fruits (20 fruit/plant) was in CP0039 with Milstim, while that was lowest (4 fruits/ plant) in CP0068 of control plots. The highest fruit length (6.23 cm) was in CP0054 plants with Litosen. The maximum fruit diameter (4.67 cm) was in treatment combination of genotype CP0068 with Litosen and the minimum (1.24 cm) from CP0044 of control plants. Fruit yield per plant showed statistically insignificant effect due to the interaction effect of genotype and hormones (Table 3). Variation in seeds per fruit was not affected significantly. Influence of different hormone application in respect of weight of 1000 seeds was highly significant (Table 4). Maximum (6.58 g) weight of 1000 seeds was obtained from CP0044 of control plots whereas minimum weight (4.01 g) was in CP0043 with Litosen hormone. The interaction of genotype and hormone indicated that variation in germination percentage was reduced significantly (Table 4). The maximum percentage (95%) was in CP0041 of control plots, whereas 20 % in CP0045 with Litosen and 21% in Milstim. There two hormone might have partial perthenocarpic effect on fruit set with sterile seeds. The interaction of genotype and hormone on fruit yield per hectare remained unaffected significantly (Table 4). But numerically the maximum yield was 20.37 t ha⁻¹ in CP0039 with Milstim while that was minimum (4.14 t ha⁻¹) in CP0068 of control plant. Hormone treated plants exhibited the trend of higher yield compared to control plants but difference was insignificant. Different higher doses of these two hormones will presumably produce higher yield for which further investigation will be required.

It was found that CP0039, CP0041, CP0043 and CP0045 may be used for increase fruit bearing and yield of bell pepper.

Table 2. Interaction Effect (genotype x hormone) on leaves, branches and Plant height of bell pepper

Treatment combination (genotype x hormone)	Plant height (cm)	Number of branches/plant	Number of leaves/plant
G ₁ x 0	22.70	5.33	51.69 h-k
G ₁ x M	24.94	7.78	72.20 a
G ₁ x L	25.03	8.99	66.75 bc
G ₂ x 0	17.32	5.51	45.70 i-l
G ₂ x M	19.12	7.84	66.35 a-d
G ₂ x L	20.43	7.60	62.34 b-e
G ₃ x 0	17.36	5.02	52.13 f-j
G ₃ x M	18.31	7.67	68.35 ab
G ₃ x L	18.38	8.08	57.20 d-g
G ₄ x 0	22.71	5.40	48.39 h-l
G ₄ x M	23.44	6.75	61.20 b-e
G ₄ x L	22.71	6.90	54.06 e-i
G ₅ x 0	22.18	5.04	45.37 i-l
G ₅ x M	22.89	7.08	60.83 b-f
G ₅ x L	22.51	6.79	65.00 a-d
G ₆ x 0	14.15	4.31	48.10 j-l
G ₆ x M	14.78	4.97	48.22 h-l
G ₆ x L	13.77	4.87	46.20 i-l
G ₇ x 0	21.34	5.84	51.55 g-k
G ₇ x M	22.65	8.02	58.32 c-g
G ₇ x L	21.99	8.11	60.75 b-g
G ₈ x 0	14.62	4.60	42.50 k-l
G ₈ x M	15.59	5.11	48.78 h-k
G ₈ x L	13.80	5.18	53.30 e-i
G ₉ x 0	18.36	5.63	59.21 b-g
G ₉ x M	21.24	7.18	65.61 a-d
G ₉ x L	21.71	6.52	65.23 a-d
G ₁₀ x 0	11.49	4.03	39.37 l
G ₁₀ x M	12.46	5.00	45.97 i-l
G ₁₀ x L	12.31	5.40	46.37 i-l
Level of significance	NS	NS	**

Treatment means having common letter (s) are not significantly different from each other at the P \geq 0.01 level measured by DMRT.

Table 3. Interaction Effect (genotype x hormone) on leaves, branches and Plant height of bell pepper

Treatment combination (genotype x hormone)	Days to 50% flowering	Days to first harvest	No. of fruit plant ⁻¹	Individual fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit yield per plant (g)
G ₁ x 0	29 klm	53 mno	19	15.05	4.33 efghij	1.75 p	206.99
G ₁ x M	32 ijk	60 hij	20	15.34	5.63 ab	2.92 ij	305.36
G ₁ x L	27 m	61 ghij	18	15.16	4.98 cd	2.29 lmn	299.20
G ₂ x 0	21 n	48 p	14	16.31	3.44 klmn	3.17 hi	222.79
G ₂ x M	23 n	53 mno	19	16.52	4.72 cdefg	3.64 ef	236.45
G ₂ x L	22 n	54 lmno	14	16.74	4.02 hijk	3.39 fgh	228.45
G ₃ x 0	29 lm	52 no	14	16.17	3.75 jklm	1.98 nof	236.79
G ₃ x M	30 jkl	60 hij	15	17.14	4.85 cdef	3.62 efg	267.38
G ₃ x L	31 jkl	62 efghi	15	16.72	4.61 defgh	3.13 hij	250.11
G ₄ x 0	34 fghi	54 lmno	11	14.91	3.43 klmn	1.24 q	165.33
G ₄ x M	34 fghi	64 defghi	14	14.57	4.90 cde	2.82 jk	189.53
G ₄ x L	34 ghij	62 efghi	11	16.21	4.18 ghij	1.95 op	171.68
G ₅ x 0	35 fghi	60 ijk	14	14.72	4.73 cdef	1.75 p	269.76
G ₅ x M	36 efg	66 bcdef	20	14.60	3.83 ijk	2.22 mno	286.52
G ₅ x L	33 hij	64 defgh	19	15.26	4.25 fghi	1.97 nop	284.73
G ₆ x 0	35 fghi	62 ghi	9	14.71	2.37 o	3.89 de	149.86
G ₆ x M	36 defgh	69 abc	10	14.60	3.43 klm	4.21 bc	159.99
G ₆ x L	38 cdef	66 abcde	10	14.67	3.25 lmn	4.07 cd	156.12
G ₇ x 0	39 bcde	50 op	6	14.15	5.71 ab	2.13 mno	87.40
G ₇ x M	39 bcde	55 lmn	7	13.84	6.13 a	2.43 lm	93.39
G ₇ x L	37 cdefg	56 klm	6	14.56	6.23 a	2.54 kl	93.60
G ₈ x 0	43 a	69 ab	6	14.64	2.50 o	2.93 ij	108.12
G ₈ x M	42 ab	67 abcd	9	15.59	3.35 lmn	3.30 gh	120.11
G ₈ x L	40 abc	66 abcde	8	15.20	3.36 lmn	3.39 fgh	114.73
G ₉ x 0	34 fghi	58 jkl	10	18.67	4.43 defg	3.25 hi	155.40
G ₉ x M	33 hij	52 no	10	18.84	5.73 ab	3.68 ef	182.40
G ₉ x L	32 ijk	52 nop	11	18.23	5.30 ab	3.75 e	182.14
G ₁₀ x 0	40 abc	70 a	4	15.08	2.82 no	4.12 cd	62.05
G ₁₀ x M	40 bcd	65 cdefg	4	15.30	3.18 mn	4.57 ab	69.52
G ₁₀ x L	35 fgh	64 defgh	4	15.16	3.48 efg	4.67 a	64.90
Level of significance	*	**	NS	NS	**	**	NS

Treatment means having common letter (s) are not significantly different from each other at the P≥0.01 level measured by DMRT.

Table 4. Interaction Effect (genotype x hormone) on seeds per fruit, seed weight and percentage germination of bell pepper.

Treatment combination (genotype x hormone)	Seeds per fruit	1000 seeds weight (g)	Percentage of germination	Fruit yield t ha ⁻¹
G ₁ x 0	157.19	6.02 bc	41 j	14.20
G ₁ x M	150.61	5.16 efg	34 kl	20.37
G ₁ x L	143.60	4.32 jkl	31 lm	19.93
G ₂ x 0	83.66	6.30 ab	95 a	14.50
G ₂ x M	81.67	5.59 cde	91 b	17.20
G ₂ x L	77.67	5.10 efg	88 b	16.52
G ₃ x 0	127.67	5.14 efg	51 h	16.10
G ₃ x M	122.00	4.18 kl	44 ij	18.10
G ₃ x L	119.67	4.07 kl	41 j	17.50
G ₄ x 0	65.33	6.58 a	36 k	12.10
G ₄ x M	61.00	6.00 bc	32 lm	14.20
G ₄ x L	59.33	4.86 fghi	27 no	13.50
G ₅ x 0	135.00	4.85 ghi	25 o	17.90
G ₅ x M	133.33	4.18 kl	21 p	19.50
G ₅ x L	131.00	4.03 l	20 p	19.30
G ₆ x 0	83.67	5.35 def	65 f	11.30
G ₆ x M	78.33	5.13 efg	62 g	12.40
G ₆ x L	75.33	4.83 ghi	61 g	12.20
G ₇ x 0	114.67	6.32 ab	75 c	6.20
G ₇ x M	111.33	5.54 de	72 d	7.00
G ₇ x L	104.67	5.13 fg	69 de	6.90
G ₈ x 0	89.00	5.23 defg	54 h	8.10
G ₈ x M	79.00	4.81 ghi	51 h	9.30
G ₈ x L	76.33	4.54 hijk	47 i	9.10
G ₉ x 0	128.67	5.68 cd	41 j	11.30
G ₉ x M	129.67	5.02 fgh	32 klm	12.50
G ₉ x L	124.67	4.78 ghij	29 mn	12.40
G ₁₀ x 0	99.00	5.18 efg	67 ef	4.14
G ₁₀ x M	94.67	4.83 ghi	60 g	4.90
G ₁₀ x L	91.67	4.47 ijk	52 h	4.80
Level of significance	NS	**	**	NS

Treatment means having common letter (s) are not significantly different from each other at the P≥0.01 level measured by DMRT

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