Interaction of Temperature and Light Intensity On Flowering of *Capsicum frutescens* var *grossum* cv. 'California Wonder'[1]

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Abstract. Pepper seedlings, cv. 'California Wonder', were exposed for 25 days to a 17 hr photoperiod at a light intensity of 800 to 1600 ft-c and a night temperature of 12 or 18°C. The treatments were initiated when the third, fourth, of fifth true leaf was 1 cm long.

More flowers were produced, as a result of increased branching, on plants exposed to the low temperature (12°) or low light intensity (800 ft-c). The response to the temperature and light treatments was greater if the treatment was initiated when the third true leaf was 1 cm long. The low temperature increased the number of days to first anthesis and decreased the number of nodes to the first flower, while light intensity had no influence on either the time of flowering or number of nodes to the first flower.

Introduction

Peppers are an important vegetable crop, however, very little literature is available on the physiology of flowering of this crop as in tomatoes.

Tomato seedlings exposed to 12–13°C night temperatures for 2 to 3 weeks immediately after cotyledon expansion produced more flowers at the first truss and at a lower node (1, 3, 12, 13). Similarly, Tiessen (11) reported that pepper plants, cv. 'Calwonder', exposed to cold treatments similar to that used for tomatoes (1, 12, 13) in that plants grown for 3 weeks at a night temperature of 12–13° produced more flowers than those grown at night temperatures of 19–22°. Dorland and Went (6) observed that pepper plants produced their first flower at the 9th to 11th node, and subsequently stem growth terminated in a flower bud. They believed that stage of plant development rather than age determined response to temperature.

This investigation was initiated to determine at what physiological stage pepper seedlings are most sensitive to different temperature and light treatments and if this influences flowering.

Materials and Methods

During the summer and fall of 1965 three factorial experiments were conducted in which pepper plants, cv. 'California Wonder', were exposed to 2 light intensities and 2 temperatures at 3 stages of leaf development.

Temperature and light treatments in experiments 1 and 3 were commenced when the 3rd, 4th or 5th true leaf was 1 cm long. Treatments in experiment 2 commenced when the 1st, 2nd or 3rd true leaf was 1 cm long.

Two pepper seeds were sown 1 cm deep in 14 cm peat pots containing a sterilized soil mixture and the pots were placed in a growth chamber at a light intensity of 1600 ft-c for 17 hr daily, at a dark period temperature of 18–20°C. Plants received a nutrient solution containing 0.5 g of 10-52-17 commercial fertilizer per liter every 10 days. After emergence the seedlings were thinned to 1 plant per pot. Plants were then grown at 2 temperatures (12 and 18°±2°) and 2 light intensities (1600 and 800 ft-c) containing 28 fluorescent and 10 incandescent lights in 2 growth chambers. Light intensities were adjusted by the distance plants were grown from the source of light.

When the seedling attained the desired developmental stages, flats were selected at random and exposed to the various treatments for 25 days. After 25 days exposure the plants treated at the 1st, 2nd, 3rd and 4th leaf stages were returned to the pretreatment conditions until all of the plants at the 5th leaf stage had received the 25 day exposure; then all plants were placed outdoors or in the greenhouse. Plants in experiments 1 and 2 were transplanted outdoors 60 cm apart in rows 90 cm apart using a starter solution. A preplanting application of 540 kg of 8-16-8 fertilizer per acre was made. The plants received about 3 cm water every 10 days from precipitation or irrigation. There were 3 replications of 8 plants each.

Experiment 3 was carried out in the greenhouse. There were 3 replicates of 5 plants each, grown in 12-inch clay pots. Additional plants were grown under the various treatments for anatomical studies. Nutrients were supplied as mentioned previously. The minimum night temperature in the greenhouse was 18°C, but the day temperature varied with fluctuating weather conditions.

Five plant apices for anatomical studies were harvested from pepper seedlings receiving the different treatments 4 days before light and temperature treatments commenced and every 4 days thereafter, until the first flower buds were evident. These apices were preserved in 1:1 Karpachenko's number 1 and 2 solutions and processed as described by Sass (9).

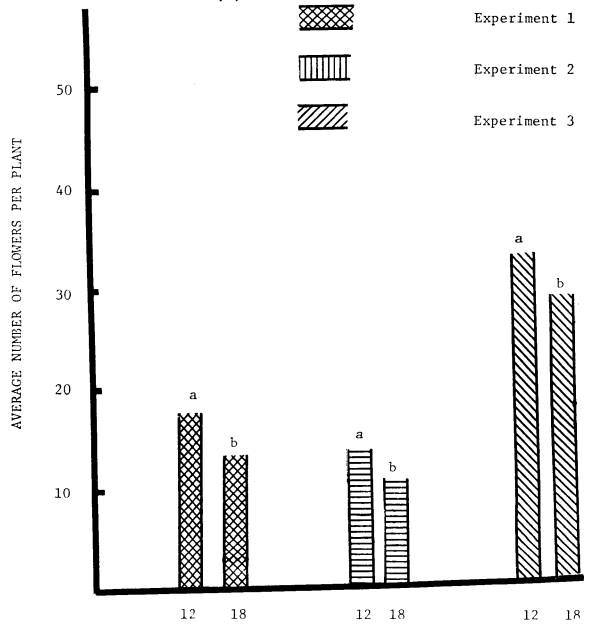

Fig. 1. The influence of temperature on flowering of pepper plants. Means followed by different letters are significantly different at the 5% level.

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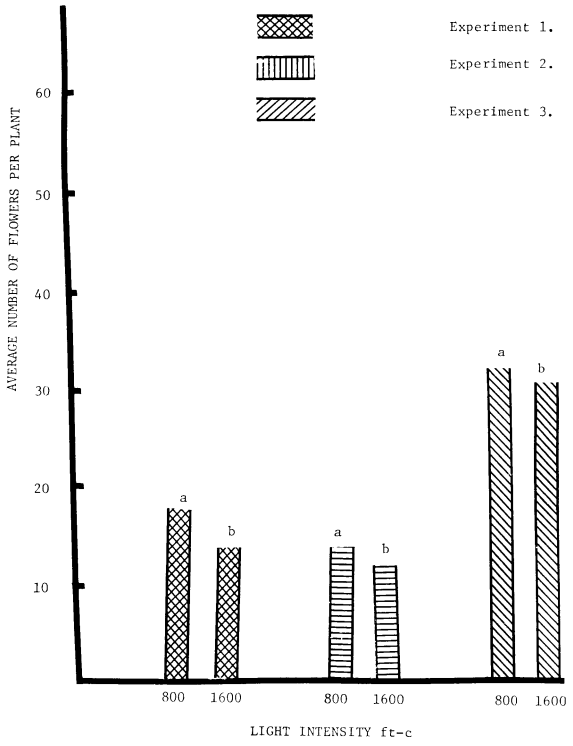

Fig. 2. The influence of light intensity on flowering of pepper plants. Means followed by different letters are significantly different at the 5% level.

In each experiment, control plants remained constantly at pretreatment conditions of 18°C night temperature and light intensity of 1600 ft-c. Records were taken 90 days after transplanting.

Fig. 3. The apex of a pepper plant grown at 18°C night temperature and 1600 ft-c of light when its third true leaf was 1 cm long.

Plant height, as measured from the first node, and the number of nodes preceding the first bud formation were recorded at time of transplanting. Records were also taken of the flowering date and the number of flowers occurring per plant.

Results and Discussion

More flowers occurred on plants grown at the night temperature of 12° than at 18°C (Fig. 1). Similar results were obtained by some of our previous investigations (10, 11).

In tomatoes, cold treatment of seedlings promotes an increase in flower number due to an increase in the size of the inflorescence (1, 2, 12, 13). Peppers are morphologically different from tomatoes, in that the flowers are produced singly in the axil of the branch. A change in branching habit of pepper plants generally induces a corresponding change in flower number. Plants exposed to low temperature branched more profusely and so produced more flowers than those grown at a higher temperature.

The 2 light intensities had different effects on the flowering of pepper plants. Plants grown at 800 ft-c of light produced more flowers than those grown at 1600 ft-c (Fig. 2).

Plants whose 3rd leaf was 1 cm long had a dome shaped apex which indicated only vegetative growth (Fig. 3). When the 4th leaf reached 1 cm in length a flat apex appeared approximately 16–20 days after cotyledon expansion which indicated the beginning of the reproduction phase (Fig. 4).

The effects of the different temperature and light regimes initiated at different physiological stages of

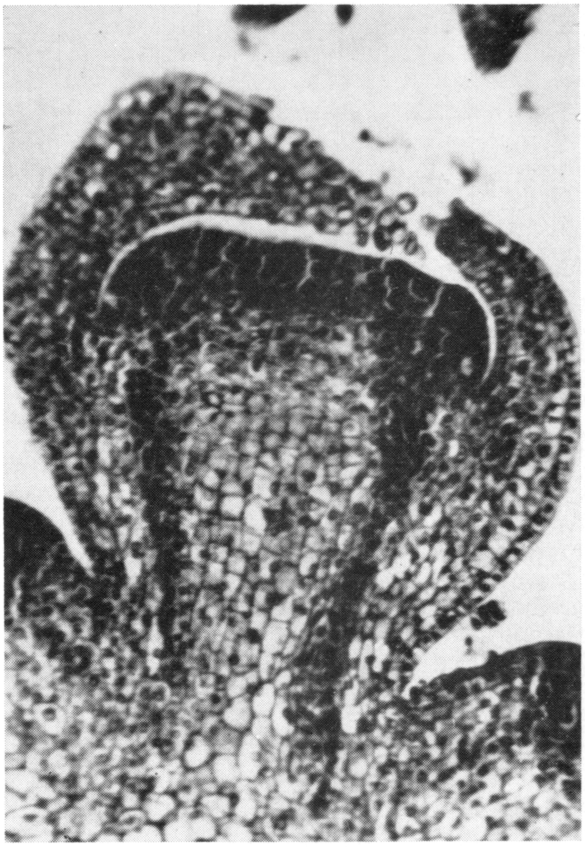

Fig. 4. The apex of a pepper plant grown at 18°C night temperature and 1600 ft-c of light when its fourth true leaf was 1 cm long.

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plant development indicate that the plants appear to be most sensitive to the treatments when their 3rd leaf is 1 cm long, which was about 4 days before the appearance of the flat apical meristem or 12–14 days after cotyledon expansion.

The effectiveness of the cold treatment was usually dependent on the stage of plant development. In tomatoes, cold treatments are most successful when initiated 7 or 8 days after cotyledon expansion (1, 4, 12, 13). Cochran (5) observed the first sign of flower differentiation in peppers when the fourth leaf appeared. The morphological studies in this investigation support this observation, since reproduction growth in the pepper plant apex was observed when the fourth leaf was 1 cm long or 4 days after the 3rd leaf was 1 cm long.

Stage of plant development had no effect on the number of days to flowering of peppers. There was, however, an effect of temperature and light intensity on the number of days to flowering (Table 1). A combination of the higher night temperature and higher light intensity induced earlier flowering (Table 1). Plants grown at 12°C

Table 1. Influence of light intensity and temperature on days to flowering of pepper plants.[x]

Light intensity (ft-C)	Temperature (°C)	
	18°	12°
1600 ft-c	62 days a	74 days c[y]
800 ft-c	67 days b	75 days c

[x]Average of experiments 1 and 2. No difference for stage of plant development.
[y]Means followed by different letters are significantly different at 5% level.

flowered later than those grown at 18°. A further delay in flowering was observed when the light intensity was reduced from 1600 to 800 ft-c, however, these plants produced a larger number of flowers. Although large differences were observed in the flowering dates, (62–75 days) there was very little difference in first harvest date since all treatments were harvested less than 3 days apart.

The low temperature reduced significantly the number of nodes before the appearance of the first flower. A similar response was not evident for light intensity (Table 2). No differences were evident in the average number of nodes preceding the flower. The low temperature (12°C) induced a significant reduction in plant height, but light intensity had no influence on height (Table 2).

The response of peppers and tomatoes to low temperatures is similar in that the low temperature reduced the number of nodes to the first flower in both crops (1, 12).

Thus, if peppers are exposed to temperatures of 12–13°C commencing at the 3rd true leaf stage for 3 weeks, higher early yields may result. This early yield is associated with a more heavily branched plant with fewer nodes preceding the first axil where the flowers are borne.

Table 2. Influence of light intensity, temperature, and stage of plant development on plant height and number of nodes to first flower of peppers.[x]

Light intensity (ft-c)	Leaf no.	Temperature (°C)			
		18°		12°	
		Height (cm)	Node no.	Height (cm)	Node[y] no.
1600	1	16.5ac	9a	10.0ac	8ab[z]
	2	16.5ac	9a	12.0b	9ac
	3	16.5ac	9a	11.0ab	7b
	4	16.5ac	9a	9.0c	5d
	5	16.5ac	9a	12.5b	10c
800	1	18.0ab	9a	10.0ac	7b
	2	15.0c	9a	11.0ab	8b
	3	13.0d	9a	10.0ac	8b
	4	16.4ac	9a	12.0b	7b
	5	20.0e	9a	12.0b	9ac

[x]Average of experiments 1 and 2.
[y]Node no. preceding first flower bud.
[z]Means within each temperature followed by different letters are significantly different at 5% level.

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