Inflorescence Development and Fruit Set in *Ilex cornuta* Lindl. et Paxt. cv. Burfordii as Influenced by Temperature and Photoperiod

R. D. Wright

*Virginia Polytechnic Institute and State University, Blacksburg, VA 24061*

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Abstract. Inflorescence development and fruit set of 'Burford' holly was rapid at a day/night temperature of 26°C/22°C and progressively slower at 22°C/18°C and 18°C/14°C. The number of flowers to set fruit, however, was increased at lower temperatures for both long photoperiod (LD = 9 hours + 3 hours dark interruption) and short photoperiod (SD = 9 hours). At 22°C/18°C, SD increased fruit set over LD. No significant temperature-photoperiod interaction was observed. A greater number of vegetative shoots developed as temperature increased and mean shoot length was correlated with the number of flowers to set fruit.

Flowers of 'Burford' holly develop in the spring from floral buds which formed the previous fall. Fruits are commonly parthenocarpic (2) which probably accounts for the heavy fruit set often observed with this cultivar. There is a high potential to produce heavily fruited 'Burford' holly plants in a container as a nursery-florist crop. Before this can be accomplished, however, information is needed on the environmental conditions necessary for anthesis and fruit set. The purpose of this study was to determine the effects of temp and photoperiod on inflorescence development and fruit set of Burford holly.

Materials and Methods

Rooted cuttings of 'Burford' holly plants with developed flower primordia were used. Plants were potted in plastic containers with a growing medium of 2/no. 16 mesh gravel: 1 Jiffy-Mix (v/v). Fertilization was accomplished by daily watering with a modified Hoagland's solution (8).

The Southeastern Plant Environment Laboratories (Phytotron) (4) at Raleigh, N.C. was used for this study. The growth chambers provided a light intensity of about 480 hectolux, 67% of which was from "cool white" fluorescent lamps and 33% from incandescent lights (4). This light level provided a photon flux density of photosynthetically active radiation of about 700 μE m⁻² sec⁻¹ and about 13 wm⁻² of far-red radiation. The plants were grown under 2 photoperiods; a short photoperiod (SD) of 9 hr high intensity light and a long photoperiod (LD) consisting of 9 hr high intensity light plus 3 hr of incandescent light interrupting the dark period (1). Under each photoperiod, plants were grown at 3 day/night temp schedules: 26°C/22°C, 22°C/18°C, 18°C/14°C. Each of the 6 treatments (2 photoperiods x 3 temp) was replicated 9 times with 2 plants per replication. Values used for statistical analysis in Fig. 2, 4 were averages for the 2 plants of each replication. Because environmental factors in the Phytotron are controlled within narrow limits, replications of the physical environment may be unnecessary and statistically reliable treatment responses can be obtained with minor plant replication (9).

Results

Inflorescence development proceeded at all temp treatments but at different rates (Fig. 1). At 26°C/22°C, anthesis, fruit set and full fruit expansion occurred within 4—5 weeks. Temp of 22°C/18°C and 18°C/14°C required 6—7 and 9—10 weeks respectively for anthesis and fruit expansion to occur. The no. of flowers to reach anthesis was not affected by either temp or photoperiod (data not shown) but the no. of flowers to set fruit was affected (Fig. 2 and 3). Compared to 26°C/22°C, 2.2 times more flowers set fruit at 22°C/18°C and 3.8 times more at 18°C/14°C. Fruit set was higher at SD compared to LD at 22°C/18°C but to a lesser extent at other temp (Fig. 2).

Vegetative shoot growth was highest at 26°C/22°C compared to 22°C/18°C and 18°C/14°C (Fig. 4. Shoot development was also greater under LD than SD and most noticeably at 22°C/18°C. An inverse correlation between vegetative growth and fruit set was significant (Fig. 5).

Discussion

Flower primordia of 'Burford' holly develop at the base of cataphyls that surround an intact shoot meristem. Following vernalization, further development of the flower primordia and shoot meristem is influenced by photoperiod and temp. Vegetative shoot growth and anthesis were accelerated at 26°C/22°C, and full fruit expansion occurred within 4—5 weeks. Temp of 22°C/18°C and 18°C/14°C required 6—7 and 9—10 weeks respectively for anthesis and fruit expansion to occur. The no. of flowers to reach anthesis was not affected by either temp or photoperiod (data not shown) but the no. of flowers to set fruit was affected (Fig. 2 and 3). Compared to 26°C/22°C, 2.2 times more flowers set fruit at 22°C/18°C and 3.8 times more at 18°C/14°C. Fruit set was higher at SD compared to LD at 22°C/18°C but to a lesser extent at other temp (Fig. 2).

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Fig. 2. Effects of temp and photoperiod on fruit set of ‘Burford’ holly. However, fruit set was lowest at this temp. Fruit set was highest at the lowest temp but shoot growth was depressed.

Various studies have demonstrated competition for nutrients among plant organs. If reproductive processes are prevented (6, 8), the remaining vegetative organs of the plants grow faster. Furthermore, factors that stimulate shoot growth may retard flower and fruit development (5). The exact relationship between fruit set and vegetative growth of ‘Burford’ holly in this study is unclear. While it is true plants supporting new shoot growth at 26°/22°C developed few fruit, it does not account for the low fruit development on individual plants on which no vegetative shoots grew. The plant in Fig. 3, 26°/22°C, SD,

Fig. 3. Effects of temp and photoperiod on fruit set of ‘Burford’ holly.


Fig. 4. Effect of temp and photoperiod on new shoot growth of ‘Burford’ holly.

Fig. 5. Relationship between mean shoot length and fruit set of ‘Burford’ holly at different temp and photoperiods. Correlation coefficients were significant at 0.1% level. Regression lines for 18°/14° and 26°/22°C are each based upon both LD and SD values since the regression lines for each photoperiod were not significantly different.
exemplifies this point. No vegetative shoot grew on this plant, however, fruit number was low compared to plants at lower temp. However on 3 plants grown at 180/140 under SD, vegetative shoots developed with few fruit developing. These points seem to indicate that temp and photoperiod may have both a direct and indirect effect on fruit set. Similar effects of temp and photoperiod on fruit set have been demonstrated with other plants (3, 8, 10, 11).

Plants transferred at experiment termination from the lower growth chamber temp to a greenhouse maintained at 30°/25°C developed vegetative shoots. These shoots did not increase the no. of fruit already present on these plants. Shoot development, therefore, seemed to be a significant factor influencing fruit set only when plants were grown at temp which promoted shoot development at the time of anthesis.

In another unpublished study, vegetative growth of 'Burford' holly plants with no flower buds was also greatest at 26°/22°C under LD photoperiod compared to 22°/18°C while no growth occurred at 18°/14°C. This shows that temp and photoperiod can also have a direct effect on vegetative growth of 'Burford' holly since no developing flower or fruit were present. The extent to which vegetative growth and fruit set are interrelated and may be indirectly affected by temp and photoperiod deserves further investigation. These results do indicate though that heavy fruit set on 'Burford' holly can be expected if plants are maintained at 18°/14°C until anthesis is completed and fruit begin to expand.

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Inheritance of Interlocular Cavitation in a Six-parent Diallel Cross in Snap Beans (Phaseolus vulgaris L.) 1

Hyo G. Park and David W. Davis2
Department of Horticultural Science, University of Minnesota, St. Paul, MN 55108

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Abstract. The inheritance of interlocular cavitation (IC), characterized by rupture of the soft, parenchymatous endocarp tissue between the seed locules in developing snap bean pods, was studied using 6 parental cultivars, all 30 possible F1 progenies grown in the greenhouse, and the 30 F2 families grown at various planting dates at 2 field locations.

IC appeared to be a highly heritable character conditioned by a predominantly additive polygenic system with partial dominance for resistance. Reciprocal effects were negligible. Neither epistasis nor transgressive segregation was detected. Order of susceptibility among genotypes was maintained over the wide range of environments. Genotype x environment interaction was significant, but was relatively small compared to total genetic variability.

Association between greenhouse-grown F1 and field-grown F2 plants was high for degree of IC, suggesting that F1 performance might be informative in choosing superior crosses. Breeding progress appears to be feasible in a program designed to utilize the large amount of additive genetic variance.

Interlocular cavitation (IC) is a physiological and morphological disorder occurring in the succulent parenchymatous tissues which comprise the bulk of edible mass within the pod of snap beans (10). Although the bean breeder has been interested in this trait, little definitive research has been conducted on the problem until recently. Lee and Read described the anatomical development (10) and the influence of environment on IC (8, 9). This disorder can greatly degrade product quality by increasing the % of malformed pods and the frequency of damage during harvest and subsequent handling, and by causing tissue separation and/or softening after processing. IC should not be confused with pod senescence. Although both phenomena sometimes appear to be similar, they occur at different sites in the pod tissue (Fig. 1) (10).

Lee et al. suggested that IC may be reduced by cultivar choice (11) and by proper cultural practices, such as use of irrigation control (8). However, it also would seem desirable to overcome the problem through plant breeding, if possible. The main objectives of our study were to determine whether IC is heritable and, if so, to study breeding behavior, environmental effect, and the stability of expression.