Flowering Responses of North American Strawberry Cultivars

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STRAWBERRY CULTIVAR CLASSIFICATION

- US strawberry cultivars are classified based on flowering responses into 3 groups: June-bearing, ever-bearing and day-neutral (Table 1).

Table 1. Strawberry cultivar classification based on flowering response

June-bearing (short-day)	Typically showing an obligate response, these plants require a photoperiod shorter than a specific threshold (called 'critical photoperiod') to initiate flowers. (Darrow and Waldo, 1934; Heide, 2013)
Ever-bearing	Generally known to have facultative long-day flowering response, accelerating flowering response when photoperiods are longer (Darrow and Waldo, 1934; Heide, 2013)
Day- neutral	Known to flower at the same time irrespective of the photoperiod (Durner et al., 1984; Heide, 2013)

Issues in current classification of cultivars

- Current classification is based on less reliable methods of genetic background or /and open field responses.
- There is not a standardized methodology for testing photoperiod effect on flowering in strawberry for accurate cultivar classification.
- Previous research done by Bradford et al. (2010) and Serçe and Hancock (2005) showed that conventional classification of strawberries could have some errors.

SIGNIFICANCE OF PHOTOPERIOD RESEARCH IN STRAWBERRY TOWARDS DEVELOPING GREENHOUSE PRODUCTION PRACTICES

Time-to-flower is critical and must be optimized in fruiting crop production under controlled environment. Therefore, finding exact responses to photoperiod in order to trigger flowering is necessary in developing technologies towards off-season greenhouse strawberry production.

Our research objective

To determine photoperiodic response of economically important American strawberry cultivars by identifying day-neutral, facultative vs. obligate responses of cultivars conventionally classified as short-day (SD), ever-bearing (EB), and day-neutral (DN) cultivars using the proper methodology developed in floriculture research.

APPROACH

Eight cultivars were selected from the list of major cultivars planted in US during 2010-2014 and a standard methodology of testing photoperiodic responses widely used in floriculture was applied.

Photoperiodic treatments (Fig 1,2)

Experiment 1: SD cultivars

Selected cultivars
Chandler
F-127
Radiance
Shuksan

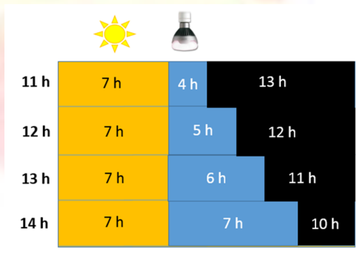

Fig. 1. Photoperiodic treatments is SD cultivars

Experiment 2: DN/EB cultivars

Selected cultivars
Albion
Monterey
Portola
San Andreas

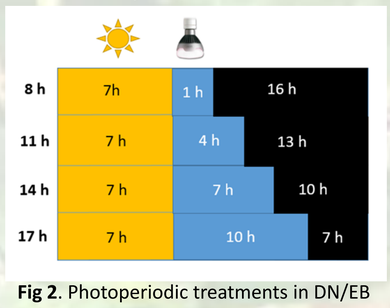

Fig 2. Photoperiodic treatments in DN/EB cultivars

Cultivars	Air temp. in GH (°C)	Air temp. in GC (°C)	Air temp. (24 h) (°C)
Shuksan / Chandler	21.2 ± 0.9	14.8 ± 0.4	17.1 ± 1.1
Radiance / F-127	24.9 ± 1.5	14.1 ± 0.5	17.3 ± 0.9

Cultivars	Air temp. in GH (°C)	Air temp. in GC (°C)	Air temp. (24 h) (°C)
DN/EB cultivars	21.3 ± 1.0	15.0 ± 0.4	17.3 ± 0.4

* Mother plants and rooting runners where subjected to pre-treatment conditions (Short-day cultivars to 8 h photoperiod / Day-neutral and ever-bearing cultivars to 8 h and 16 h photoperiod).

APPROACH

Environmental conditions

Target average daily temperature: 17 °C

Target light intensity in photoperiodic lighting (Fig.3): 2 µmol m^{-2} s^{-1} (400-800 nm)

Lamp source: LEDs containing balanced R:FR light (Phillips, The Netherlands)

Fig. 3. 'Albion' plants under photoperiodic lighting.

Data collection:

Microscopic observation of apical meristems and classification of the meristems into 12 developmental stages (From 0-11) (Fig.4)

- **SD cultivars:** Shoot apical meristem (SAM) dissections week 8.
- **EV/DN cultivars:** SAM dissection week 7, 8 and 10.

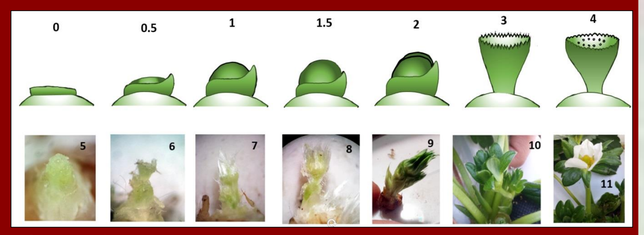

Fig. 4. Indices representing strawberry shoot apical meristem stages (indices: 0-11) used in the present experiments.

RESULTS

Experiment 1: Short-day cultivars

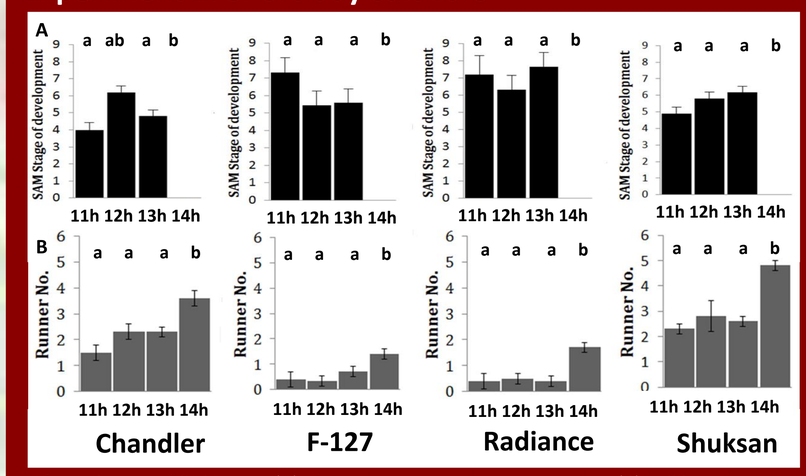

Fig. 5. Results of SAM stage (A) of development and runner number (B) in SD cultivars

- Critical photoperiod for initiating flower development in 'Chandler', 'Radiance', 'F-127', and 'Shuksan' were between 13 h and 14 h photoperiod (Fig.5).
- Short-day cultivars receiving 14 h photoperiod developed more runners than plants receiving 11 h -13 h photoperiod (Fig 5).

Experiment 2: ever-bearing and day-neutral cultivars

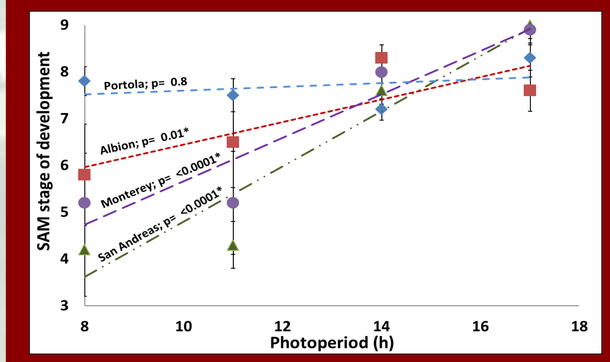

Fig. 6. Correlation of SAM stage and photoperiod in DN/EV cultivars

- 'Albion' showed a relatively weak facultative long-day response.
- 'San Andreas' and 'Monterey' were found to have a relatively strong facultative long-day response (Fig.6).
- 'Portola' showed a consistent day-neutral response in our experiment (Fig.6).
- No difference was found between pre-treatments after treatments in DN/EB cultivars.

CONCLUSIONS

- Short-day cultivars 'Chandler', 'Radiance', F-127' and 'Shuksan' have a critical photoperiod between 13 h and 14 h photoperiod at an average daily temperature of 17 °C.
- 'Albion', 'Monterey' and 'San Andreas' showed a facultative long-day response and Portola' showed a day-neutral response at an average daily temperature of 17 °C.
- Further experiments must be conducted to confirm cultivar-specific responses and identify possible interactions in photoperiod response with varied temperatures.

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