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Using the Floral Status of Strawberry Plants, as Determined by Stereomicroscopy and Scanning Electron Microscopy, to Survey the Phenology of Commercial Crops

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Abstract. **Field surveys were conducted on cultivated strawberries (*Fragaria ×ananassa* Duch.) to determine the time of flower initiation and its relation to maximum and minimum temperatures and daylength. Stereomicroscopy and scanning electron microscopy (SEM) were compared. Flower initiation in 'Torrey' strawberry was more dependent on minimum temperature than on daylength or maximum temperature. Flower initiation in the day-neutral 'Aptos' occurred regardless of daylength or temperature during sampling. For the study of flower initiation and inflorescence development, SEM gave more detail than stereomicroscopy.**

The transition from vegetative growth to flowering is one of the most important periods of ontogenesis. It requires the structural and physiological preparation of the entire plant and occurs at a definite time of the year and under definite conditions (Aksennova et al., 1980). Scanning electron microscopy (SEM) is a well established technique which has allowed a considerable advancement in studies on floral morphogenesis. The development of flowers of a number of tropical and subtropical fruit and nut species (Moncur, 1988) has been documented using this technique. The use of SEM to study flower development in strawberry has not been reported.

Studies in controlled environments have shown that flowering in strawberry in daylength responsive lines can be induced either by short days (Guttridge, 1969; Ito and Saito, 1962) or low temperature (Guttridge, 1985; Heide, 1977), with a strong interaction between daylength and temperature (Durner et al., 1984; Went, 1957). Flower induction in day-neutral types can be modified by temperature (Durner et al., 1984; Himelrick, 1985). Flower initiation and/or flower development of strawberry in the field has been studied using a microscopic dissecting technique (Durner and Poling, 1985; Jahn and Dana, 1970).

Two surveys in the commercial growing area around Sydney, Australia, were conducted to study the correlation between daylength and temperature, and flower initiation of short-day and day-neutral types. Stereomicroscopy and SEM were used and compared to study flower initiation and development. This study aimed to obtain information on the time of flower initiation in field grown plants of both strawberry types.

Materials and Methods

Greenhouse studies. Plants were grown from fresh runners of the short-day cultivar Torrey. On 24 July 1990, runners were transplanted into pots (15 cm depth and 14 cm width) containing a potting mix consisting of 1 peat : 1 coarse sand : 1 loamy sand soil (by volume). A complete fertilizer was also mixed with the soil. Plants were grown for 1 month under natural light at 21/16 °C (day/night temperature, 12 h each) at the Darlington greenhouse, Univ. of Sydney. During this time plants were watered twice daily and fertilized with liquid fertilizer. At the end of August, plants were divided into six groups and grown at six different day/night temperatures (15/10, 18/13, 21/16, 24/19, 27/22, and 30/25 °C) under natural photoperiods. Six uniform plants were sampled periodically between the end of September and the middle of November 1990. This was to ensure that apices at stages from vegetative to floral initiation to floral development were sampled.

Field studies. Farmers in New South Wales, Australia, usually plant cold stored runners from January to the end of February. Short-day 'Torrey' was planted in February 1988 at Tahmoor, Australia, ≈107 km southwest of Sydney (34.13S, 150.54E, 168 m above sea level). Ten crowns each of 1-year-old and newly planted cold-stored runners were sampled at 2-week intervals for 1 year starting in February. The day-neutral 'Aptos' and the short-day 'Pajaro' were planted in March 1989 at Kellyville ≈30 km northwest of Sydney (33.43S, 150.57E, 60 m above sea level). Ten crowns each of both cultivars were sampled at 2-week intervals from summer to the end of fall. The samples were dissected under a Wild Heerbrugg M5 stereomicroscope at a magnification of 6 to 50× and the percentages of floral apices of first- and second-year plants were recorded. The climatic data at the Tahmoor site was obtained from the Bureau of Meteorology. A portable weather station (Environdata Mark 3) was set up at the Kellyville site and maximum and minimum temperatures were recorded daily during the sampling period. Daylengths include civil twilight, and were obtained from the Sydney Observatory.

Examination of flowering. Apices were examined under a Wild Heerbrugg M5 stereomicroscope (6 to 50× magnification). For SEM, apices were fixed in 1% glutaraldehyde in 0.1 M phosphate buffer, pH 6.8, by adding fixative during dissection and then exposing to fixative for 2 h, during which time they were continuously rotated. The apices were then washed with three changes of 0.1 M phosphate buffer pH 6.8. Postfixation was with 1% osmium tetroxide in phosphate buffer pH 6.8 for 1 h. After washing in three changes of distilled water and dehydration using a graded ethanol series (30% to 100%), apices were critical-point-dried through carbon dioxide and stored in a desiccator for 2 d before being mounted on aluminium SEM stubs. The stubs were

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