ETHEPHON DEFOLIATION OF *PLUMERIA RUBRA* FOR WINTER FLOWERING

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ABSTRACT

A popular lei flower, the plumeria (*Plumeria rubra*) is dormant during the winter tourist season in Hawaii and is unavailable for its use as a greeting to visitors. Foliar sprays of ethephon cause defoliation and result in the inability of the plant to perceive short photoperiods. Plumeria trees were treated at different times in fall 2003 and fall 2004 with 800 ppm a.i. ethephon, and shoot tips were tagged to follow inflorescence development. Results from the 2004-2005 period are reported. Trees treated 10/23/04 averaged 78.4 days to flower with a range of 44 to 126 days. The average fell on 1/9/05 with 50% of tagged shoots producing their first flower by 1/5/05. Trees treated 11/30/04 averaged 81 days to flower with a range of 48 to 113 days. The average bloom date for this treatment was 2/18/05, with 50% of the tagged shoots producing their first flowers by 2/24/05. Tagged shoots on untreated plants were timed from the 10/23/04 date of first treatment and averaged 123.7 days to flower with a range of 53 to 167 days. The average date for flowering was 2/23/05, but the 50% flowering date was 3/3/05. Despite the poor data in 2003-2004, fall ethephon treatments were responsible for some earlier flowering of plumeria. These results are useful for commercial growers of plumeria and the winter tourism trade in Hawaii.

INTRODUCTION

A plumeria lei is a traditional greeting among both residents and tourists in Hawaii. As a lei flower, plumeria is much underestimated in terms of its value in the floriculture industry because many flowers are gathered from backyards and roadside plantings and thus are not counted in the annual census conducted by the USDA/Hawaii Agricultural Statistics Service, which has reported on average 13 commercial producers during the past 5 years. In 2004, 13 producers reported farm gate sales of $513,000 from some 16 million blooms (HASS, 2005). The “image value” of plumeria flowers to Hawaii’s tourist industry is probably many times that amount.

During winter, plumeria flower production nearly ceases at a time when visitor counts are high. Other flowers are imported to meet the needs for lei flowers with prestrung dendrobium orchids from Thailand being among the most prominent. Plumeria growers have tried different strategies in an effort to produce flowers for the winter market, ranging from hand defoliation to planting many acres so that a least a few flowers can be gathered, or choosing warm parts of the state in which to grow plumeria trees.

Inflorescences are largely produced in the spring and may continue to bear flowers for six months, although the last flowers are small and infrequent. Murashige (1966) reported that leaf retention and abscission were controlled by daylength. Lawton

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and Akpan (1968) reached the same conclusion and added that stem growth and leaf production continued under long days. Sheehan and Murashige (1962) reported that plants treated with long days or gibberellic acid continued to produce leaves and did not go dormant until natural short days were imposed. Criley (1995) reported that ethephon applications to plumeria prior to September caused little defoliation and the inflorescence stalk developed on July and August treatments as a nub with no flowers. Later treatments resulted in earlier flowering. These results suggested that inflorescences were initiated during the long days of summer and that development ceased under the influence of shortening day lengths in the fall. Since winter night temperatures at sea level in Hawaii seldom drop much below 16 C, growth can resume with elongation of the terminal inflorescence given periods of warmth.

MATERIALS AND METHODS

In fall 2003, an experiment was initiated on a block of 'Celadine' plumeria trees at the University of Hawaii Waimanalo Research Farm to determine if enhanced temperatures could speed the development of inflorescences following treatment with ethephon. The ethephon concentration used was 800 ppm, a concentration previously shown effective in defoliation studies (Stevens and Criley, 1985). Ethephon was applied on 9/30/03 and 10/24/03 with good defoliation occurring within two weeks. At three weeks after treatment, two-thirds of the inflorescences were covered with plastic bags to raise the temperature surrounding the terminal, a treatment suggested by Canadian grape growers (Eddy, 2003). Half of these bags were removed after 4 weeks and the remainder after 8 weeks. One-third of ethephon treated terminals were not covered, and a set of trees that were not sprayed were included as controls. For each treatment, 15 inflorescences were tagged for a total of 147 branches (September) and 137 branches (October); some branch tips were lost to rot. The date of first open flower on an inflorescence was recorded.

In fall of 2004, 800 ppm ethephon sprays were applied to foliage of a plumeria cultivar identified only as 'Graveyard Yellow" (its original source was a graveyard) on 10/23/04 and 11/30/04. Fifty terminals were tagged on nine trees at each spray date and their date of first open flower was recorded. An unsprayed set of nine trees served as controls with 50 tagged terminals. Some terminals were accidentally broken off the 11/30/04 trees, leaving 45 tagged terminals.

RESULTS

Heavy rains during fall and winter 2003-2004 caused the plastic bags covering the terminals to fill with water. Cool, overcast weather negated much of the influence of the treatments, and little or no difference was noted between the two bagged treatments and controls. Even the few flowers that opened during the rainy weather were deformed as a result of *Botrytis* infection. A few September-treated terminals did flower in late December and early January, but on average, approximately 146 days were required following defoliation for first bloom (about 2/24/04) for the September treatment and 129 days for the October treatment (about 3/1/04), with controls performing about the same as

the treated terminals (2/20/04). In general, the results were disappointing and details are not presented.

The 2004-2005 experiment met with better weather. Fifty percent of the October-treated terminals produced their first flowers by January 5, 2005, while fifty percent of the November treatment had come into bloom by February 14, 2005 (Table 1). Untreated controls reached fifty percent bloom by March 3, 2005 (Table 1). The earliest October-treated terminals flowered before Christmas, approximately 50 days after treatment and fully 40% had presented their first flowers by the end of the year. Because terminal development was uneven, flowering was not concentrated, but ethephon-treated plumeria generally required fewer days to reach 100% first bloom (Figure 1).

DISCUSSION

The 2003-2004 results showed the dependence of plumeria on warm, sunny weather to continue the development of previously-initiated inflorescences. Treatment with ethephon to defoliate plumeria for early flowering would be most successful on the drier, sunnier leeward sides of the islands. The bagging treatment proved to be more work than it was worth, and since the bags filled with water from the rainy weather, their effect in raising temperatures was not recorded. The bags had to be secured tightly or they would blow off in the wind.

This research demonstrated that plumeria trees with well-developed inflorescence structures can be forced into flower in time to meet the needs of the lei flower industry during a season when the availability of plumeria flowers is normally low. My hypothesis is that with ethephon-induced defoliation, leaves are not present to sense photoperiod and send the terminal into a dormant state. Under suitable conditions of warmth, active growth resumes and the terminal inflorescence elongates and produces flowers.

Ethephon has received a registration for defoliating and defruiting a number of ornamentals, including plumeria. Alternative defoliation materials have not been evaluated for plumeria.

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Table 1. Flowering dates (first open flower) for 10% percentiles of 'Graveyard Yellow'plumeria defoliated with ethephon on October 23, 2004 (N=50) or November 30, 2004 (N = 45) or untreated (N=50).

Percent in bloom	Treated Oct. 23, 2004	Treated Nov. 30, 2004	Untreated
10	12/18/04	1/21/05	1/18/05
20	12/22/04	2/6/05	2/10/05
30	12/28/04	2/9/05	2/24/05
40	12/30/04	2/10/05	3/1/05
50	1/5/05	2/12/05	3/3/05
60	1/15/05	2/18/05	3/4/05
70	1/20/05	2/26/05	3/5/05
80	1/28/05	3/4/05	3/8/05
90	2/5/05	3/12/05	3/16/05
100	2/26/05	3/20/05	4/8/05

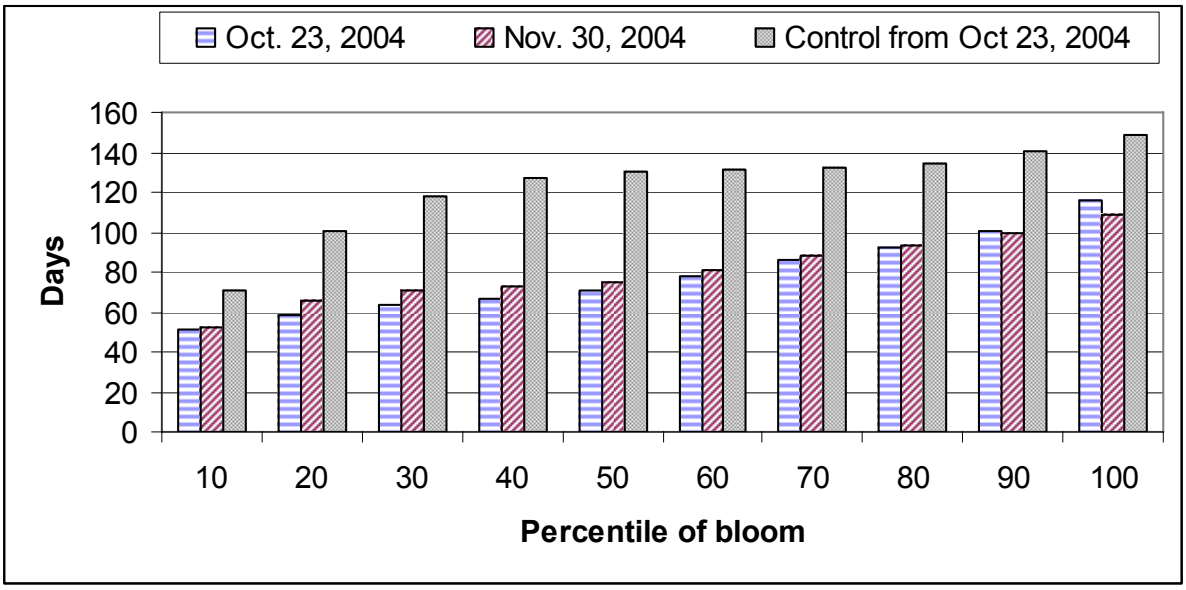

Figure 1. Average days from treatment to first open flower for each ten percent increment of flowering for ethephon-treated 'Graveyard Yellow' plumeria. Days to flower for untreated controls were determined from October 23, 2004.