Factors Affecting Budbreak in Honey Mesquite in West Texas

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Abstract

Budbreak in honey mesquite in west Texas rarely occurs prior to the last spring frost. We monitored many trees from 1970 to 1980 attempting to better correlate mesquite mortality from herbicides to growth stage. In doing so, we found clues to the probable conditions triggering budbreak. Budbreak was closely correlated to daily minimum winter temperatures but totally unrelated to winter maximum, mean, or soil temperatures. Our data showed that the higher the number of consecutive days with minimums below -1°C during January 15 to February 14, the earlier spring budbreak would occur. Once chilling requirements were met, date of budburst then became a function of relatively warmer daily minimum temperatures from February 15 to March 15. Being able to predict budbreak (from equations developed herein) as early as February 15 and/or March 15 should give ranchers and herbicide applicators 4 to 6 weeks lead time in planning mesquite control programs.

West Texas notoriously has spring "cold spells" sufficiently severe to freeze foliage and the young fruit of trees that have leafed out and blossomed from late winter or early spring warm periods. Particularly vulnerable are exotic fruit trees, such as peach *(Prunus persica)* and apricot *(Prunus armeniaca)*. Honey mesquite *(Prosopis glandulosa* var. *glandulosa)*, the major endemic woody plant in the area, seemingly oblivious to even prolonged warm weather in February and early March, usually waits until danger of freezing weather is past, then it leafs out. Some believe that once honey mesquite breaks bud, the danger no longer exists for a late spring frost.

From 1970 to 1973, we monitored many honey mesquite trees attempting to better correlate their response to herbicides. In doing so, we found clues to the probable conditions triggering budbreak (Goen 1975).

For more than 50 years, observers have reported that trees and shrubs of cold climates kept continuously warm during the winter start growth much later in the spring than those subjected to a period of chilling (Coville 1920). Chandler et al. (1937) also noticed that warm winters delayed budbreak of most deciduous trees, and trees or shrubs growing in shade had their chilling requirement satisfied better than those growing in the sun. Further, budbreak started on shaded parts of the same tree earlier than on those parts exposed to the sun all day. McGee (1976) also noticed this effect of shade on budbreak of young oak trees (*Quercus* sp.). Others have noted that floral emergence was not always advanced by high temperatures, but the reverse was often the case. In fact, Ashby (1962) noted that unchilled basswood plants (*Tilia* sp.) did not break buds until late summer.

If winter conditions trigger physiological processes in mesquite that predispose it to budbreak, then it should be possible to predict approximate date of budbreak by monitoring locally collected weather data. Information on timing of budbreak as early as mid-February or mid-March would be of value to many agriculturalists, especially ranchers and herbicide applicators, as it would give them 4 to 6-weeks lead time in planning mesquite control programs.

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Methods and Procedures

Trees monitored during 1970-73 in this study were about 5 km south of Grassland, Texas, in Lynn County on the Post-Montgomery Estate Ranch. The ranch is transitional from the southern short grass plains of the Llano Estacado to the Red rolling plains of Texas. The topography is level to undulating with rock outcroppings and it has swales, depressions, and draws draining to the rolling plains below the caprock escarpment.

Twenty-five trees were tagged for observation on seven sites. Bottom and upland sites as well as northern, southern, and easterly exposures were selected for contrast. Also, sites studied included sandy, loamy, and clayey soils. This study was initiated to explore variations in phenological development of honey mesquite as influenced by various environmental situations. Soil temperature was measured weekly with mercury filled glass laboratory thermometers inserted into the soil at 15-cm intervals to a depth of 60 cm. Air temperatures were obtained from local weather bureau records. Supplemental measurements in the Lubbock area during 1975-76 (Fick 1978) and 1978, 1979, and 1980 provided similar information relative to mesquite budbreak.

We assumed that the triggering mechanism for budbreak would necessarily precede the visual evidence; therefore, we attempted to correlate soil temperature, maximum, minimum, and mean air temperatures for various periods with budbreak. Budbreak was quantified by counting the number of days from January 1 to visual evidence of leaf emergence.

Results and Discussion

Budbreak in honey mesquite never occurred during this study prior to March 1. Whereas many other tree species such as Chinese elm *(Ulmus pumila)* and fruit trees experienced budbreak during "warm spells" prior to this date.

Table 1. Days to mesquite budbreak as influenced by patterns of daily minimum air temperatures from January 15 to March 15 from 1970 to 1980.

Year	Y^1	$X_1{}^2$	$X_2{}^3$
1970	106	7	21
1971	99	15	13
1972	77	22	22
1973	122	4	20
1975	125	6	13
1976	105	8	23
1978	95	16	14
1979	106	8	21
1980	106	9	18

[1]Number of days from January 1 until mesquite budbreak.
[2]Number of consecutive days between January 15 and February 14 with daily minimum temperatures less than -1°C.
[3]Number of days from February 15 to March 15 with daily minimum temperatures -1°C or greater.

According to Glerum (1973) as cited in Rehfeldt (1979) winter dormancy of most north temperate trees cannot be broken until chilling requirements have been satisfied. Levitt (1972) indicated that cold hardiness generally is a response to minimum temperatures. Also, from their literature search, Campbell and Sugano (1975) reported that all conifers tested have definite chilling requirements for bud release. Our first attempt to find a reason why mesquite usually remains dormant long after ornamental trees have leafed out was simply to correlate the length of time required for dormancy release to weather bureau temperature records. Maximum and mean air temperatures during this period were unrelated to bud burst as correlation coefficients (r) were only 0.29 and 0.22, respectively. Also, soil temperature was not well correlated with bud emergence (r=0.21). However, the correlation of budbreak with minimum air temperature was 0.95. Consequently, our efforts to predict budbreak from environmental data have stressed winter and early spring minimum air temperature records.

The earliest west Texas mesquite budburst in recent history occurred on March 17, 1972, and the latest occurred on May 2, 1973, and May 5, 1975, a full 6-weeks later than budbreak in 1972. The winter of 1972 was relatively mild with many warm days, however, the period from mid-January to mid-February had 22 consecutive days with minimum temperatures below -1° C. No other year in the past 15 had such a long string of low minimum temperatures. Characteristically minimums below -1° C occur for one to several days then they warm to -1° C or higher for one to several days. In 1973 and 1975 from January 15 to February 15, no more than 4 to 6 consecutive days of minimums below -1° C occurred and budbreak was much delayed. Erez et al. (1979) found that frequent high temperature influxes following short periods of chilling resulted in prolonged dormancy of peach. They emphasized that the length of the chilling period and the frequency of high temperature occurrences were highly important.

Campbell and Sugano (1975) found that budburst in Douglas-fir *(Pseudotsuga menziesii)* depended on chilling, photoperiod, and flushing temperature. One study showed that days to seedling budbreak could be shortened considerably either by reducing chilling temperatures from 7.2 to 4.4° C or by lengthening the chilling period from 11 to 44 days. They noted that once chilling requirements were met, date of budburst became a function of spring temperature. Our data also suggest that if sufficient chilling has occurred to induce budburst, the actual date of of budburst can be influenced by the spring temperature regimes. For example, in 1972 with chilling requirements amply met with 22 consecutive "chilling days" prior to February 15, this period was followed by 13 consecutive days of minimums with -1° C or above, and budbreak occurred on March 17 (Table 1). However, 19 such "warm days" in 1973 failed to result in budbreak before May because chilling requirements were not met during January and February.

To be useful, prediction criteria should be readily available and simply applied. In our study with 9 years of data, we were able to show that 85% of the variation in date of mesquite budbreak was accounted for by the number of uninterrupted cold days from January 15 through February 14. Daily minimums are easily obtained from local newspapers, radio, or from backyard thermometers. Thus, on February 15 with this one value—maximum number of consecutive days with minimums less than -1° C—one can use the equations $Y=128.3-2.25X_1$ and obtain a good estimate of budbreak (Y=number of days from January 1 to expected budbreak and X_1maximum consecutive days with minimum temperatues less than -1° C).

To increase prediction accuracy, also include the number of days from February 15 to March 15 with minimum daily temperatures

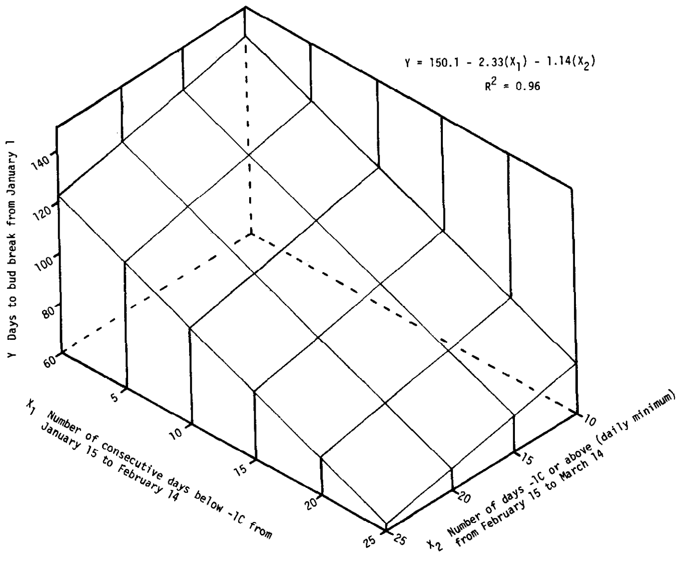

Fig. 1. *Influence of length of chilling treatment prior to February 15, and temperature regimes from February 15 to March 14 on date of mesquite budbreak.*

of -1° C or above (Fig. 1). The prediction equation then becomes $Y=150.1-2.33X_1-1.14X_2$. In tis case, X_2number of days with minimum temperatures -1° C or higher from February 15 to March 15. These two variables apparently account for 96% of the variation in date of mesquite budbreak (R=0.96). Thus, our data shows that a long period of consistently low daily minimum temperatures during the winter provides mesquite chilling requirements allowing for early budbreak. Once the chilling requirement is met relatively warm minimum daily temperatures can hasten budbreak

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