# Evaluation of Planting Date Effects on Crop Growth and Yield for Upland and Pima Cotton, 1996

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## *Abstract*

*Three field studies were conducted in 1996 at the Maricopa (1,175 ft. elevation), Marana (1,974 ft. elevation), and Safford (3,000 ft. elevation) Agricultural Centers to evaluate the effects of three planting dates on yield and crop development for Upland and Pima varieties. Planting dates ranged from 19 March to 16 May and also 437-1199 HU/Jan 1 86/55° F thresholds). Crop monitoring revealed increased vegetative growth tendencies with later plantings. General trends also showed decreasing lint yield with the later plantings for all varieties at each location.*

## Introduction

There are numerous factors that contribute to the realization of a successful cotton crop. Two major management decisions, variety selection and planting date management can have a profound effect on the development and final outcome of the crop. Selection of a specific variety will have a large impact on the way in which planting date should be managed. Similarly, the time frame in which a crop can be planted due to weather and/or other circumstances should have a large impact on the selection of a suitable variety.

Earlier research in Arizona has demonstrated that delayed plantings often result in higher vegetative growth tendencies at the expense of yield and optimum planting date windows have been developed for different variety maturity groups (Figure 1) based upon heat units accumulated from January 1 (Silvertooth et al., 1989; Silvertooth et al., 1990; Silvertooth et al., 1991; Silvertooth et al., 1992; and Silvertooth et al., 1993; Silvertooth et al., 1994; Unruh et al., 1995). Planting date management not only has a large effect on crop growth, development, and yield but also impacts insect pest management (Brown et al. 1992, 1993, 1994, and 1995). Reduced season management, of which early planting plays a major role, has become increasingly important in recent years. The ability to get a crop in early, carry it through the primary fruiting cycle in a timely and efficient manner, followed by early termination has become increasingly important with increased late-season insect pressures in Arizona. This approach to earliness management has also been important in terms of avoiding inclement weather conditions commonly associated with the summer monsoon season, which creates higher humidities (higher dew point levels) and higher night temperatures, resulting in accelerated rates of fruit loss and abortion. Another method used for insect pest management is delayed planting. Delayed plantings have been utilized by many producers in some parts of Arizona to aid in the management of pink bollworm (Pectinophora gossypiella (Saunders)) populations. The delayed plantings are intended to encourage suicidal emergence of overwintering pink bollworm populations, theoretically lowering early season infestation levels.

The objective of this study was to further validate and refine planting date windows and recommendations and continue to investigate the effects of planting date management on the growth, development, and yield of both Upland (Gossypium hirsutum L.) and Pima (Gossypium barbadense L.) varieties.

## Methods and Materials

Studies were conducted in 1996 at the Maricopa (1,175 ft., Casa Grande sandy loam soil), Marana (1,974 ft., Pima clay loam soil), and Safford (3,000 ft., Grabe clay loam soil) Agricultural Centers. The experimental design was a split-plot within a randomized complete block design. The mainplots were planting dates with subplots being

varieties. Each subplot consisted of 8, 40 inch rows that extended the full length of the irrigation run (approximately 600 ft.). Planting dates were constructed so as to have three representative points along the recommended planting date range (Figure 1). Table 1 summarizes planting dates and respective heat units accumulated since 1 January (HU/1Jan., 86/55°F thresholds). Varieties selected for this study (Table 2) ranged in maturity from a short season, determinate varieties (STV 132 and DPL 20) to full season, indeterminate varieties (DPL 5816, DPL 90, and Pima S-7). A range of medium maturity varieties were also utilized (DPL 5415, STV 474, HS 46, and SG 501). All plots were planted into moisture across all varieties and planting dates at Marana and Safford. At Maricopa, plots were dry planted and watered-up. All inputs such as fertilizer, water, and pest controls were managed on an as-needed basis.

A complete set of plant measurements were collected from each site on 14 day intervals. Measurements taken included: plant height, number of mainstem nodes, first fruiting branch, total number of aborted sites (positions 1 & 2), number of nodes above the top (1st position) fresh bloom, canopy closure, and number of blooms per unit area. Climatic conditions were also monitored using an Arizona Meteorological network (AZMET) site located on each of the stations.

Irrigation termination dates are listed in Table 1. Yields were determined by harvesting the entire center 4 rows from each plot to obtain seedcotton yield estimates. Turn-out values for each PD and variety combination were used to calculate lint yields.

## Results

Lint yield results for all PD and variety combinations are presented in Tables 3, 4, and 5 for Maricopa, Marana, and Safford, respectively. Fruit retention (FR) and plant vigor estimates (height to node ratios, HNR) patterns are shown in 2 through 7 for all PD, variety, and location combination. The FR and HNR figures are sorted by location with a given variety and the three dates of planting presented on a given figure for comparison.

Vegetative growth tendencies as noted by height to node ratios (HNR),that have proven to be consistently associated with later plantings, were observed at all three locations in this study. This trend is well illustrated in these studies (Figures 3, 5, and 7) and it is generally true with all varieties, but it is most pronounced with the more indeterminate varieties. The increased vegetative growth tendencies, as shown with HNRs, tended to become evident in the range of approximately 1200-2000 heat units accumulated after planting (HUAP). This is the period from approximately first bloom to peak bloom which is a critical time for fruit development and retention. The increase in height to node ratios indicate that the plant is placing more carbohydrate energy into vegetative growth than into fruit development and retention, thus decreasing its yield potential.

Early fruit retention levels revealed distinct decreases at Maricopa and to some extent at Marana, apparently due to inclement weather conditions and a lygus infestations (Figure 3). Due to the loss in fruit load, a corresponding increase was commonly observed in the HNRs for that given treatment. The 1996 growing season was characterized as an extremely hot season with a relatively early monsoon season, which affected the State at the beginning of July. It is interesting to note the drop in FR, particularly at Maricopa associated with each of the varieties planted on the first PD. These FR patterns are not entirely related to the increasing temperatures (day and night) and dewpoint levels, which diminish the plants ability to cool itself, but these weather conditions did exacerbate the declining FR in the PD 1 plots due in part to the fact that these plots were progressing toward peak bloom at the first of July and were quite vulnerable to the heat stresses. It is also important to point out that we were struggling to control Lygus infestations at Maricopa and Marana for a significant portion of the season, which also served to reduce FR levels to some extent.

Date of planting was a significant effect ($P<0.05$) at all locations. Lint yield differences were found to be significant among varieties and planting dates ($P<0.05$) as shown in Tables 3, 4, and 5.

DPL 5415, which is a very common variety in Arizona, demonstrated a classic response for a long-medium to long season variety. A significant reduction in yield was observed from PD1 to PD3 at both Maricopa and Marana.

However, the first and second dates of planting for DPL 5415 were not significantly different at these two locations where it was planted. One important conclusion from this information supports the recommendation that DPL 5415 should not be planted extremely early if soil temperatures are cool (< 65 °F) and/or the forecast is providing a cool period after planting. Therefore, in western and central Arizona a variety such as DPL 5415, which is not known for having a strong, vigorous seedling, should be planted when soil temperatures (8:00 A.M.) are more favorable (60 °F or more for several consecutive days) with a good five-day forecast. Therefore, for most years, a prime window for planting varieties of this type would extend through the first half of April, or a HU/Jan. 1 window of approximately 600 to 900 HU/Jan. 1.

In general, the more determinate varieties yielded higher for PD3 at each location than the longer maturity (more indeterminate) varieties, which is also a consistent trend with earlier work in this region.

## Summary

The delayed plantings generally demonstrated higher vegetative growth tendencies which is consistent with earlier research (Silvertooth et al., 1989; Silvertooth et al., 1990; Silvertooth et al., 1991; Silvertooth et al., 1992; and Silvertooth et al., 1993; Silvertooth et al., 1994; Unruh et al., 1995). A lint yield decrease was commonly seen for all varieties from PD2 to PD3. This study served to demonstrate the importance of selecting a variety that is best suited to planting conditions. Highest yielding potentials are usually realized with an early, optimum (includes optimum soil temperatures) planting date and a medium to full season type variety. In a delayed planting situation, a higher yield potential can often be realized from a more determinate, shorter season variety.

## Acknowledgements

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Table 1. Planting dates and associated heat units accumulated from January 1 for each location, 1996.

| Location | Planting Dates | Heat Units/Jan. 1 (86/55°F Thresholds) | Irrigation Termination Dates |
|---|---|---|---|
| Maricopa | | | |
| | 19 March | 494 | 17 August |
| | 11 April | 667 | 15 September |
| | 8 May | 1199 | 15 September |
| Marana | | | |
| | 2 April | 569 | 27 August |
| | 25 April | 957 | 9 September |
| | 16 May | 1388 | 9 September |
| Safford | | | |
| | 1 April | 437 | 9 September |
| | 25 April | 737 | 9 September |
| | 16 May | 1098 | 22 September |

Table 2. Varieties planted at each location, 1996.

| Location | Varieties |
|---|---|
| Maricopa | |
| | Stoneville 474 |
| | Deltapine 5415 |
| | Deltapine 5816 |
| Marana | |
| | Deltapine 5415 |
| | Deltapine 20 |
| | Pima S-7 |
| Safford | |
| | Deltapine 90 |
| | HyPerformer HS46 |
| | Suregrow 501 |
| | Stoneville 132 |

Table 3. Lint yields summarized by variety for each date of planting, Maricopa, 1996.

| | Lint Yield (lbs. lint/acre) |
|---|---|
| **DPL 5415** | |
| PD1 | 1182 a* |
| PD2 | 1206 a |
| PD3 | 785 b |
| LSD (α=0.05) | 181 |
| OSL | 0.0021 |
| C.V. (%) | 9.87 |
| **DPL 5816** | |
| PD1 | 1090 a* |
| PD2 | 998 a |
| PD3 | 606 b |
| LSD (α=0.05) | 166 |
| OSL | 0.0009 |
| C.V. (%) | 10.71 |
| **Stoneville 474** | |
| PD1 | 1148 a* |
| PD2 | 1158 a |
| PD3 | 901 b |
| LSD (α=0.05) | 217 |
| OSL | 0.0456 |
| C.V. (%) | 11.72 |

* Means followed by the same letter, within a variety grouping, are not significantly different (P<0.05) according to pairwise comparisons using a Fisher's LSD.

Table 4. Lint yields summarized by variety for each date of planting, Marana, 1996.

| | Lint Yield (lbs. lint/acre) |
|---|---|
| **DPL 5415** | |
| PD1 | 1254 a* |
| PD2 | 1217 a |
| PD3 | 868 b |
| LSD (α=0.05) | 99 |
| OSL | 0.0001 |
| C.V. (%) | 5.15 |
| **DPL 20** | |
| PD1 | 1176 a* |
| PD2 | 1152 a |
| PD3 | 1034 b |
| LSD (α=0.05) | 82 |
| OSL | 0.0108 |
| C.V. (%) | 4.2 |
| **Pima S-7** | |
| PD1 | 892 a* |
| PD2 | 817 a |
| PD3 | 491 b |
| LSD (α=0.05) | 102 |
| OSL | 0.0002 |
| C.V. (%) | 8.06 |

* Means followed by the same letter, within a variety grouping, are not significantly different (P<0.05) according to pairwise comparisons using a Fisher's LSD.

Table 5. Lint yields summarized by variety for each date of planting, Safford, 1996.

| | Lint Yield (lbs. lint/acre) |
|---|---|
| **DPL 90** | |
| PD1 | 1003 a* |
| PD2 | 923 a |
| PD3 | 731 a |
| LSD ($\alpha$=0.05) | NS |
| OSL | 0.2025 |
| C.V. (%) | 21.76 |
| **HyPerformer HS46** | |
| PD1 | 829 a* |
| PD2 | 832 a |
| PD3 | 896 a |
| LSD ($\alpha$=0.05) | NS |
| OSL | 0.1865 |
| C.V. (%) | 5.94 |
| **Sure Grow 501** | |
| PD1 | 746 ab* |
| PD2 | 825 a |
| PD3 | 657 b |
| LSD ($\alpha$=0.05) | 106 |
| OSL | 0.0234 |
| C.V. (%) | 8.27 |
| **Stoneville 132** | |
| PD1 | 535 b* |
| PD2 | 777 a |
| PD3 | 563 b |
| LSD ($\alpha$=0.05) | 181 |
| OSL | 0.0324 |
| C.V.(%) | 16.71 |

* Means followed by the same letter, within a variety grouping, are not significantly different (P<0.05) according to pairwise comparisons using a Fisher's LSD.

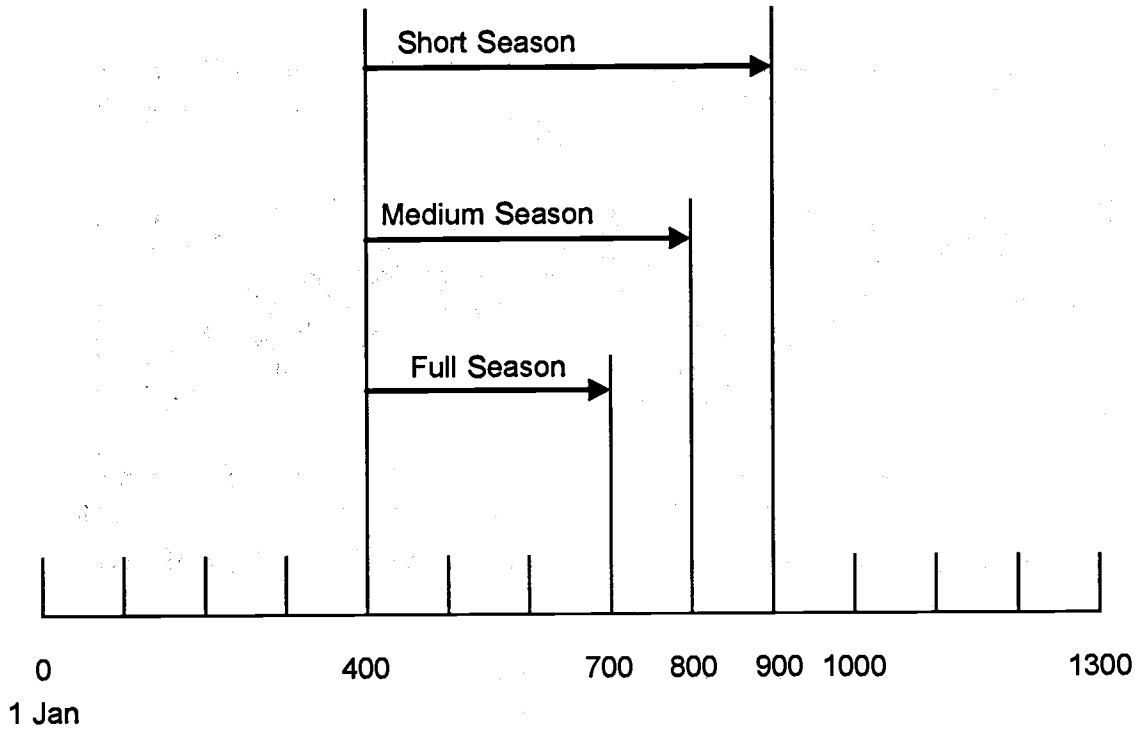


Figure 1. General recommended planting date windows for different maturity type varieties grown in Arizona (J.C. Silvertooth, Univ. of Arizona).

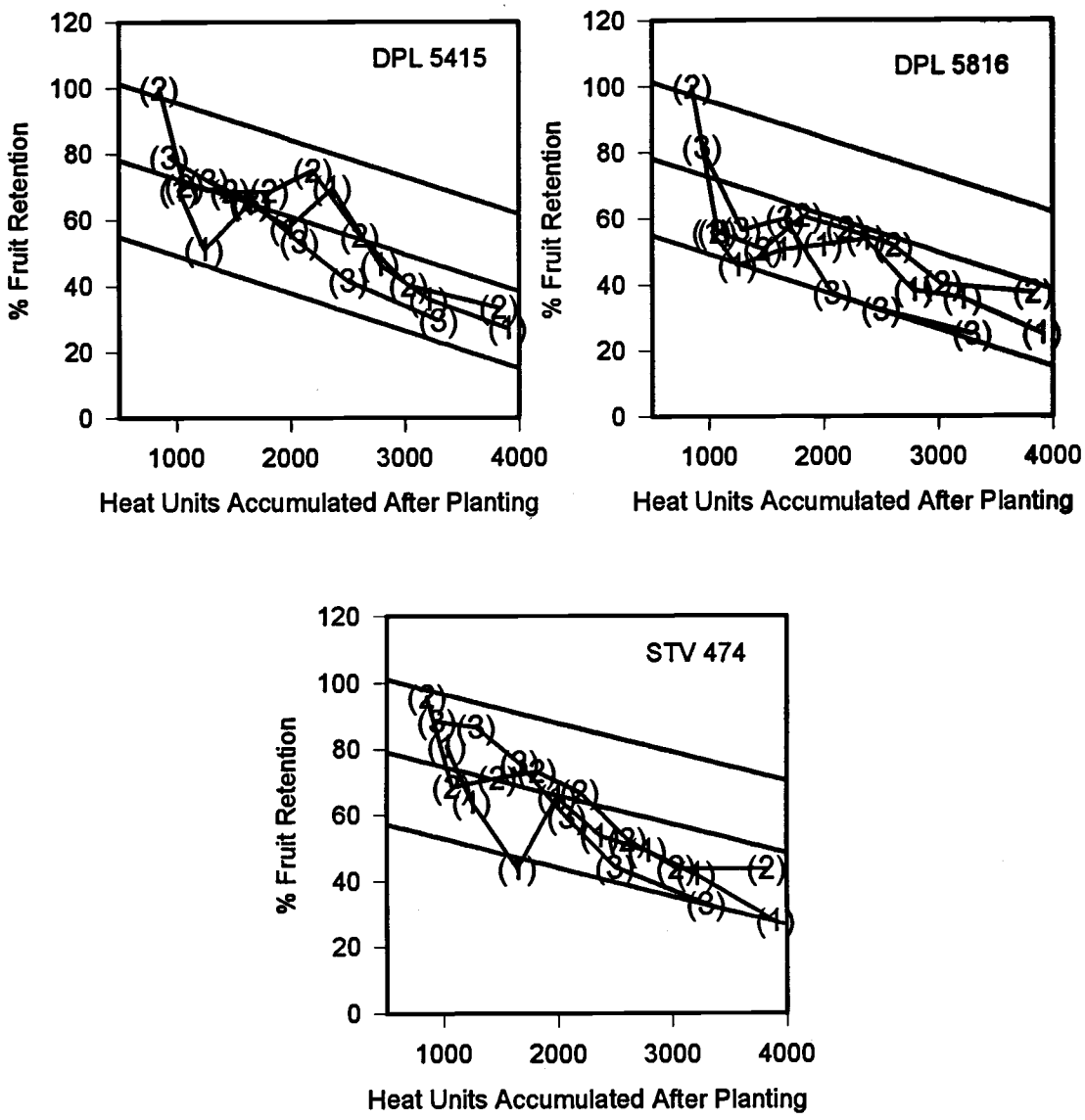


Fig. 2. Fruit retention data summary results for planting date by variety study, MAC, 1996.

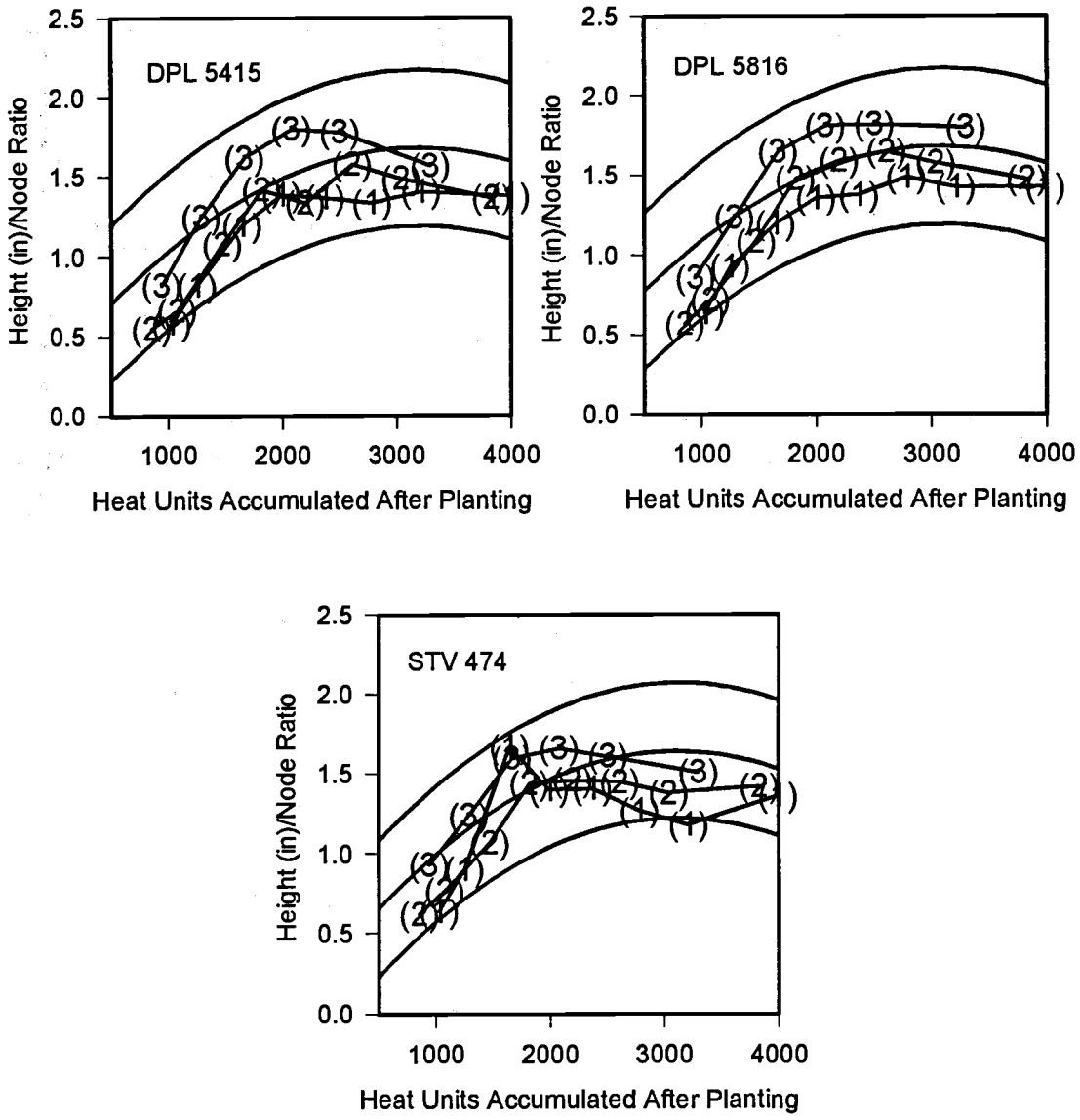


Fig. 3. Height to node ratio data summary results for planting date by variety study, MAC, 1996.

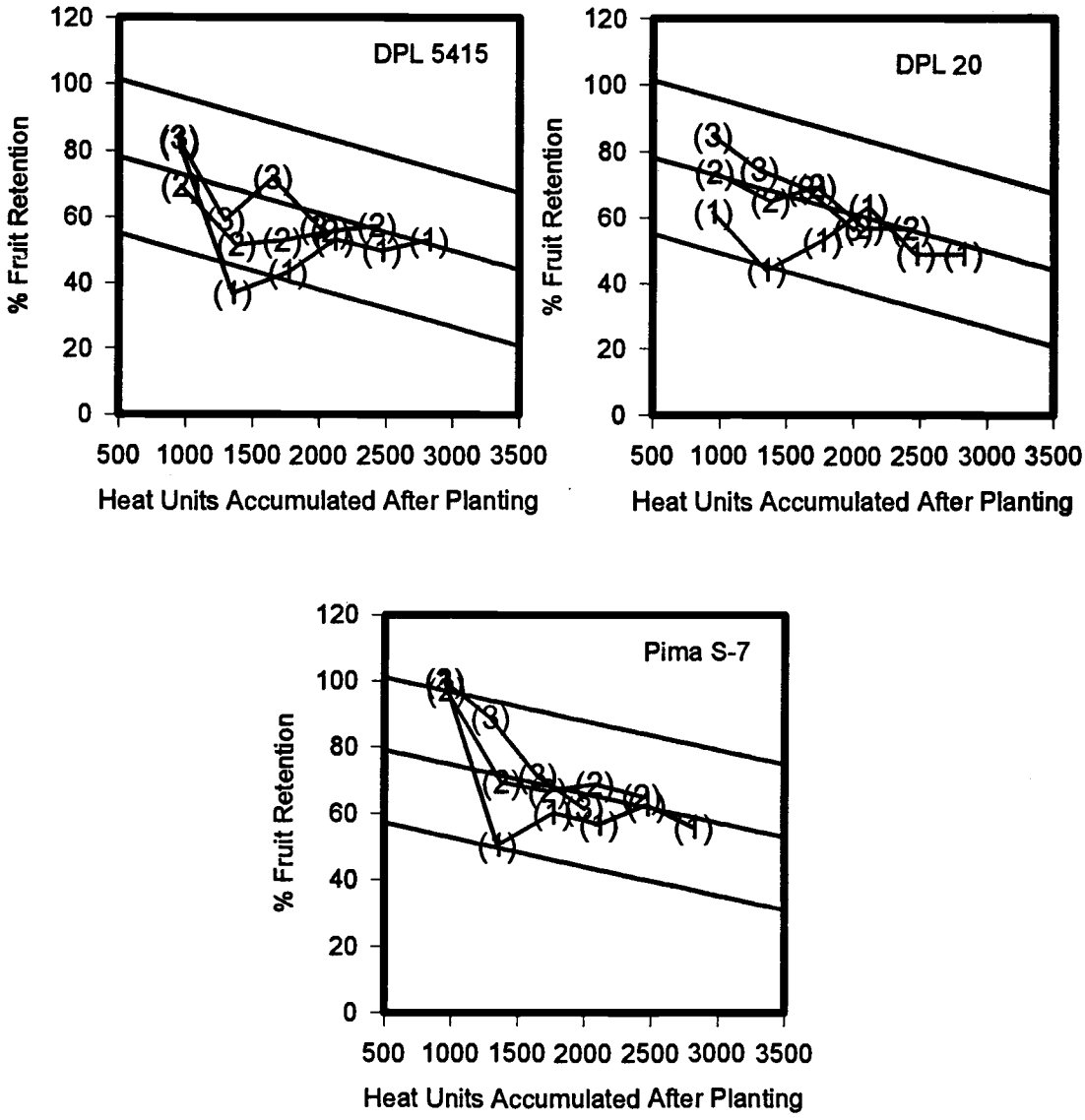


Fig. 4. Fruit retention data summary results for planting date by variety study, Marana, 1996.

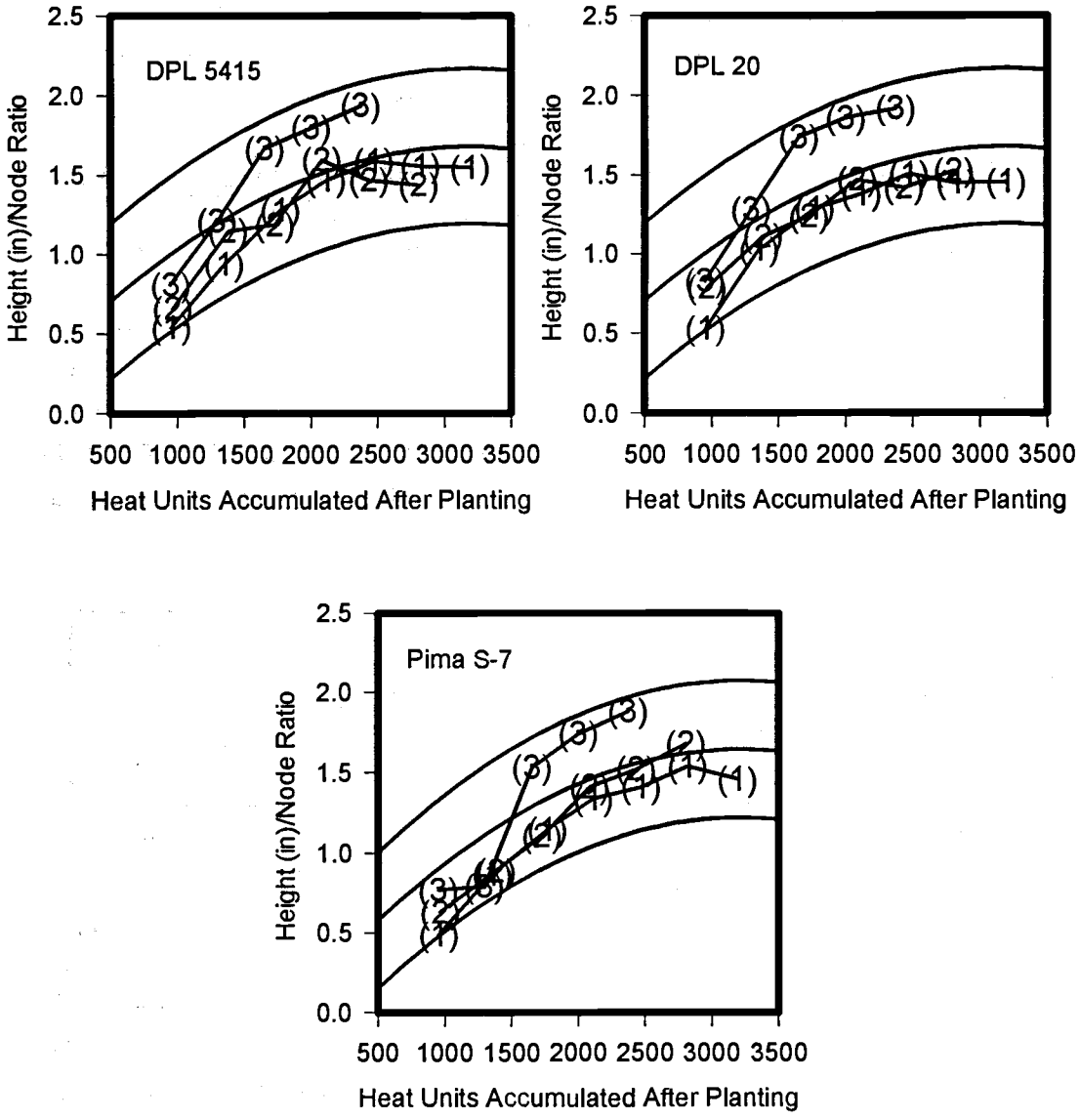


Fig. 5. Height to node ratio data summary results for planting date by variety study, Marana, 1996.

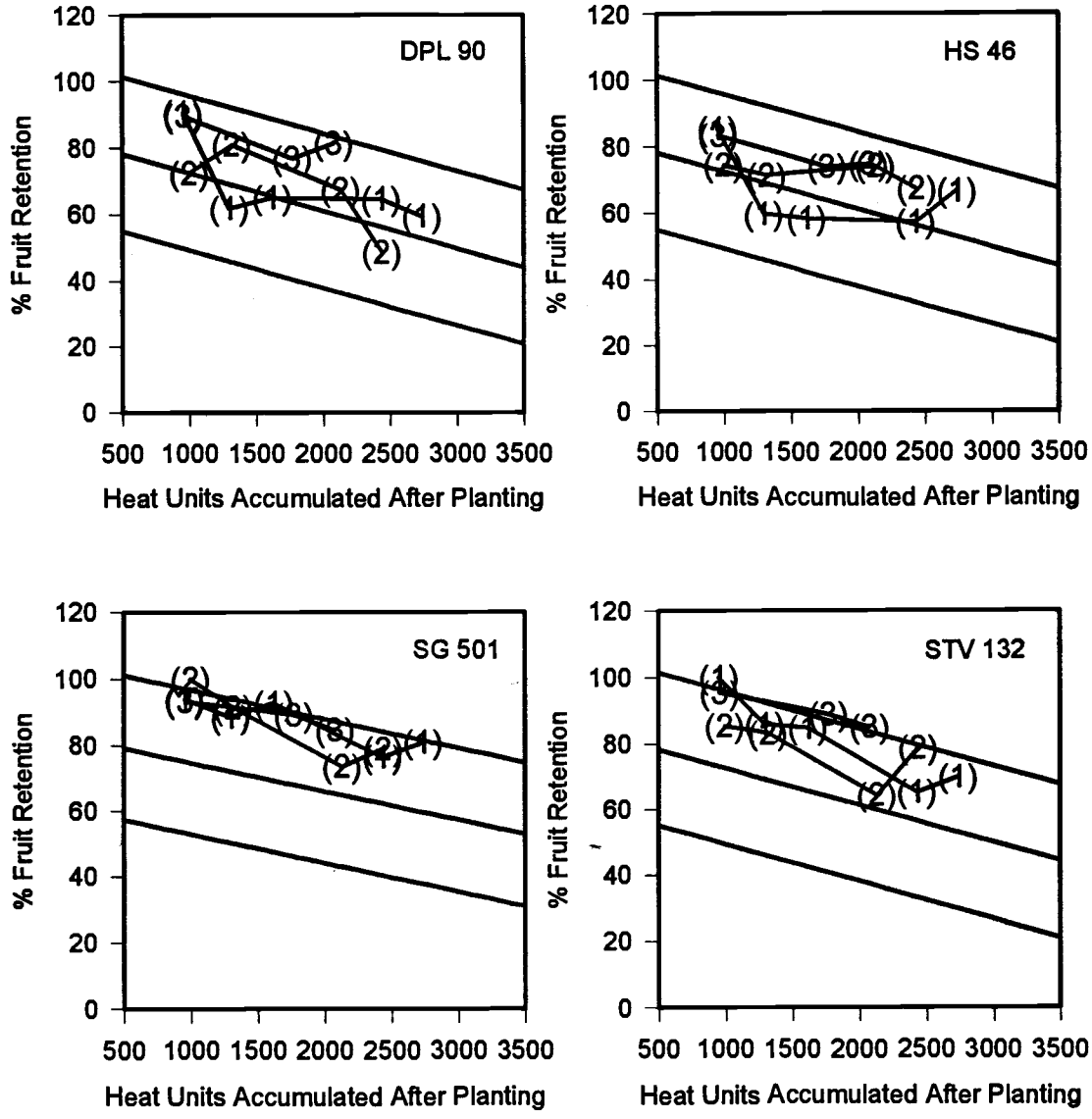


Fig. 6. Fruit retention data summary results for planting date by variety study, Safford, 1996.

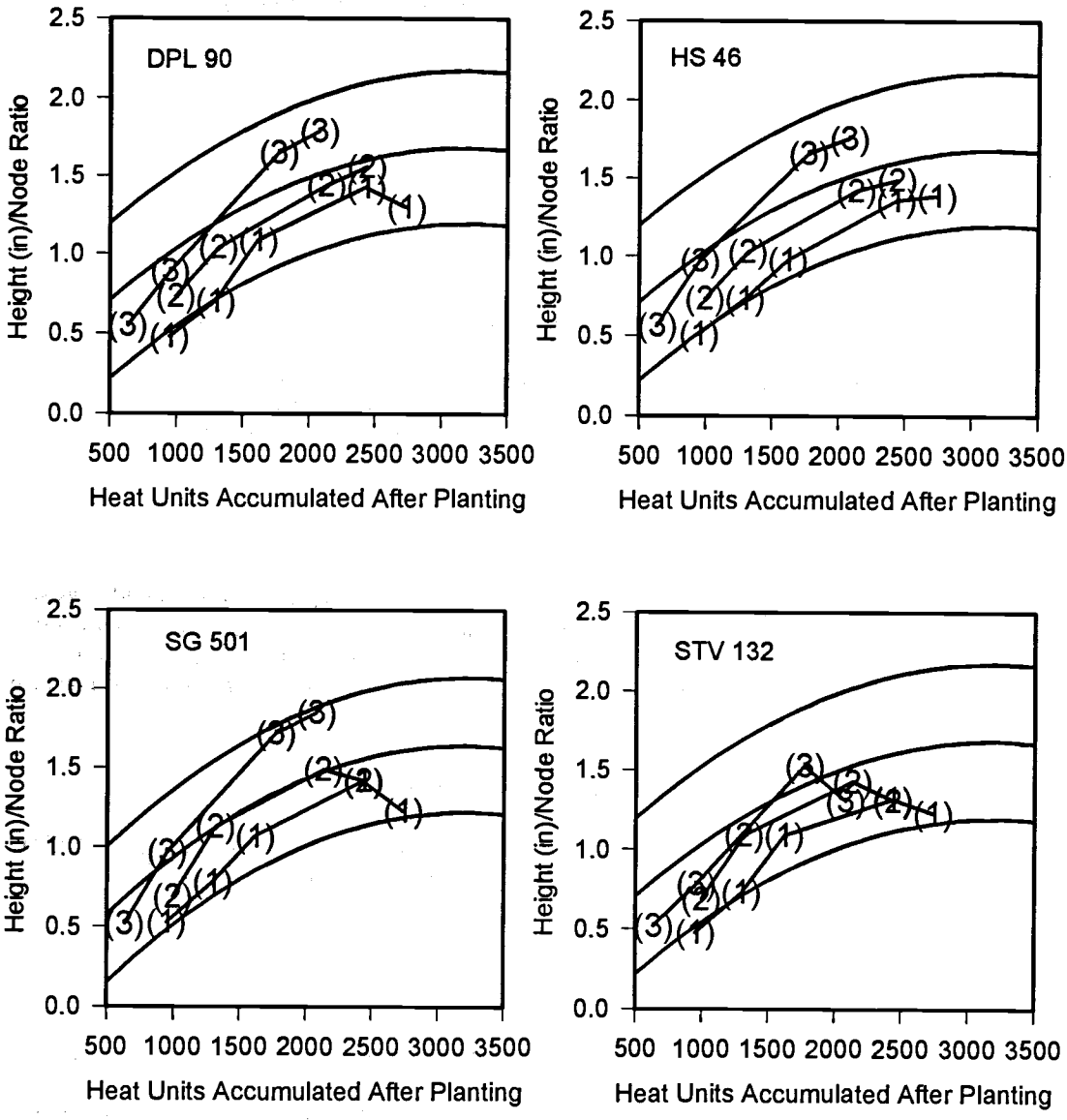


Fig. 7. Height to node ratio data summary results for planting date by variety study, Safford, 1996.