RELATIVE MATURITY OF NEXGEN VARIETIES

Ken E. Legé
Americot, Inc.
Lubbock, Texas

Abstract

Relative maturity is an important variety characteristic that is commonly requested by producers, and is used to make planting decisions with regard to overall farm management. The characteristic is also used by seed companies to make better-informed decisions as to geographic fit and proper placement of new products. Since cotton is a perennial, indeterminate plant type, determining relative maturity can be difficult. Several methods, including percent first pick, percent open boll, and nodes above white flower have been used to characterize variety maturity, but none of those methods can be practically used effectively over a wide geography and numerous trial sites. A method using nodes above cracked boll was reported in 2004 as a means to determine relative maturity over geographies and numerous trial sites. This study utilized this method to describe relative maturity of the NexGen commercial line up and compared to relevant commercial competitors. With only a few exceptions, Americot and other seed companies have described relative maturity in a reasonably accurate manner. These data also suggested that 100 to 120 replicates (e.g., 25 to 30 locations of a 4-replicate trial, or any combination thereof) of nodes above cracked boll data would be required to properly classify new varieties into the classifications currently used by seed companies.

Introduction

Relative maturity is one of the most commonly requested variety characteristics by producers, who use the descriptor to manage planting and harvest activities, as well as mitigate risk to weather events throughout the season. Seed companies routinely collect data on candidate varieties to attempt to accurately describe the relative maturity to ensure proper placement and positioning of the new variety. Since cotton is an indeterminate perennial, quantifying relative maturity can be difficult.

Several methods have been used to determine relative maturity among varieties. Percent first pick (numerous sources in the literature; e.g., Richmond and Ray, 1966) is a very accurate method that involves two harvests with a spindle picker. A first harvest operation prior to 100% open boll is made, followed by a final harvest once 100% open boll is reached, and percent first pick is calculated by dividing the first harvest amount by the total of first and final harvest amounts, then converted to a percentage. However, this method is limited to the geographies and production systems that use a spindle picker, rather than a stripper, which removes all bolls from the plant, preventing a second harvest. Also, injury from a first picking operation could potentially cause wounding that could elevate ethylene production in the remaining bolls. The elevated ethylene levels could potentially hasten dehiscence of the remaining bolls,

Calculating percent open bolls (numerous sources in the literature; e.g., Legé et al. 1997) is an effective and accurate method by which the total harvestable bolls and the total open bolls are counted from a measured representative area of a plot. Total harvestable bolls, which includes open bolls and green bolls that would be anticipated to fully mature and dehisce, are divided into the number of open bolls from that same area, then converted to a percentage. The primary disadvantage of this method is that data collection requires a large amount of time, making it somewhat impractical to use across a wide geography unless an organization has the personnel to dedicate to that task.

Nodes above white flower has been used to quantify varietal differences in relative maturity (Bourland et al., 2001). Periodically during the bloom period, the number of nodes between the highest first-position white flower and the terminal mainstem node are recorded for a number of plants per plot. Ideally, these data are collected near first bloom, then at approximately two-week periods thereafter. This method accurately reflects the timing of first flower for a variety, as well as the rate of maturity as cutout is reached. However, while the method of collecting data is relatively fast, the need to collect data over a period of time makes it difficult to use over numerous locations, and an organization would need a rather large staff to collect over multiple geographies.

The nodes above cracked boll method (Speed et al., 2004) involves counting the number of nodes between the highest, first-position dehisced boll and the highest, first-position harvestable boll from a number of plants per plot.

The concept was originally developed to time harvest aids, but has more recently been used to quantify relative maturity among varieties. The advantages include: 1) relatively fast data collection, 2) one-time data collection, 3) data are inherently standardized or normalized among locations, and 4) since data exist suggesting that 50 heat units, or degree-day, base 60°F, are required to develop one node (Kerby et al., 1997), and therefore to dehisce the bolls associated with the first-position bolls, the nodes above cracked boll data can be expressed in an estimated number of days difference in maturity between or among varieties using local long-term weather data.

The objectives of this study were to 1) quantify relative maturity for the NexGen commercial varieties, 2) compare relative maturity of NexGen varieties to that of relevant commercial competitor varieties, and 3) determine the number of locations or replicates needed to accurately classify relative maturity as 'early', 'early-mid', 'medium or mid', 'mid-full', or 'full' for varieties.

Materials and Methods

Nodes above cracked boll data were collected from numerous university official variety trials, county Extension on-farm variety trials, Americot replicated breeding trials, and consultant on-farm variety trials from Texas to South Carolina in 2013. From trials with four replicates, five plants per plot were collected, totaling twenty plants per variety per location. From trials with three replicates, seven plants per plot were collected, totaling twenty-one plants per variety per location. Data were collected from a very small amount of non-replicated trials; nodes above cracked boll were collected from five plants each from four random areas of the large strips of each variety at such locations. Data from all locations were collected when the earliest variety was no more than 70% open, and the latest variety was no less than 30% open (Speed et al., 2004).

Two balanced datasets were created each for the Mid-South/southeast region and for the high and rolling plains region. Analysis of variance was conducted on each dataset for nodes above cracked boll (NACB), as well as the difference in heat units, or degree-day, base 60°F (DD60s), and the estimated difference in the number of days in maturity, using average weather data during the boll opening period. Fifty DD60s per node were assumed from Kerby et al., 1997 to convert the NACB difference among varieties to the DD60 difference among varieties.

Long-term (30-year average) DD60 data (www.weather.com) were averaged across representative locations across the cotton belt. For 'northern areas' of the Mid-South/southeast region, long-term DD60 data were averaged for September 1 to 30 (assumed to be the primary boll-opening period for this region) from these locations: Jackson, TN, Keiser, AR, Rocky Mount, NC, and Portageville, MO. The average DD60s for these northern area locations of the Mid-South/southeast was 12.1 per day. For 'southern areas' of the Mid-South/southeast region, long-term DD60 data were averaged for September 1 to 30 (assumed to be the primary boll-opening period for this region) from these locations: Alexandria, LA, Headland, AL, Stoneville, MS, and Tifton, GA. The average DD60s for these southern area locations of the Mid-South/southeast was 16.4 per day. For the high and rolling plains region, long-term DD60 data were used from Lubbock, TX, for the period of September 16 to October 15 (assumed to be the primary boll-opening period for this region). The average DD60 during this period in Lubbock, TX, was 6.4 DD60s per day.

For each table within, the difference in DD60s relative to the earliest variety is presented. This was calculated by multiplying the difference in NACB between each variety and the earliest variety in the comparison by 50 DD60s (Kerby et al., 1997). Also in each table within, the difference in the estimated number of days relative to the earliest variety in each dataset is presented. This was calculated by dividing the DD60 difference (described above) by the assumed average DD60s per day for the assumed primary boll-opening period for the appropriate region (6.4 DD60s per day for high and rolling plains; 12.1 DD60s per day for 'northern areas' of the Mid-South/southeast region; 16.4 DD60s per day for the 'southern areas' of the Mid-South/southeast region).

Results and Discussion

Mid-South/Southeast Region

Four varieties were compared across twelve locations in the Mid-South/southeast region in 2013. NG 1511 B2RF was significantly earlier than NG 5315 B2RF and ST 6448GLB2, but only numerically earlier than PHY 499 WRF (Table 1). For northern areas of the Mid-South/southeast region, this equated to NG 1511 B2RF's being five and seven days earlier than NG 5315 B2RF and ST 6448GLB2, respectively. In southern areas of the Mid-South/southeast region, those same differences were four and six days, respectively. The respective seed companies classified NG 1511 B2RF as ‘medium’, PHY 499 WRF as ‘mid’, and NG 5315 B2RF and ST 6448GLB2 as ‘full’ maturity; these data support those classifications.

Table 1. Relative maturity of four varieties from twelve Mid-South/southeast locations in 2013.

Variety	Nodes Above Cracked Boll	DD60s later than DP 1321 B2RF	Estimated days later than NG 1511 B2RF: Northern areas	Estimated days later than NG 1511 B2RF: Southern areas	Seed company classification
NG 1511 B2RF	5.61 a	-	-	-	Medium
PHY 499 WRF	5.89 ab	14.0	1.2	0.9	Mid
NG 5315 B2RF	6.85 bc	62.0	5.1	3.8	Full
ST 6448GLB2	7.40 c	89.5	7.4	5.5	Full
Prob>F	0.0108				
LSD	1.17	58.5	4.8	3.6	

Among eleven varieties compared across the Mid-South/southeast region in 2013, PHY 339 WRF was the earliest maturing, which was significantly earlier than NG 1511 B2RF, DP 1137 B2RF, and MON12R242B2R2 (Table 2). AM 1550 B2RF, PHY 499 WRF, DP 1321 B2RF, MON12R224B2R2, ST 4946GLB2, and FM 1944GLB2 were not significantly different in maturity from the other varieties in the comparison. In the northern areas of the region, PHY 339 WRF was about 12 days earlier than MON12R242B2R2, the latest variety in the comparison; in southern areas of the region, the difference between those two varieties were about 9 days. These data support seed company classifications of most of these eleven varieties except for one: PHY 499 WRF is classified as a ‘mid’, but these data suggest it is an ‘early-mid’.

Table 2. Relative maturity of eleven varieties from four Mid-South/southeast locations in 2013.

Variety	Nodes Above Cracked Boll	DD60s later than PHY 339 WRF	Estimated days later than PHY 339 WRF: Northern areas	Estimated days later than PHY 339 WRF: Southern areas	Seed company classification
PHY 339 WRF	3.08 a	-	-	-	Early
DP 0912 B2RF	3.41 ab	16.5	1.4	1.0	Early
AM 1550 B2RF	4.20 abc	56.0	4.6	3.4	Early-Mid
PHY 499 WRF	4.26 abc	59.0	4.9	3.6	Mid
DP 1321 B2RF	4.41 abc	66.5	5.5	4.1	Early-Mid
MON12R224B2R2	4.79 abc	85.5	7.1	5.2	n/a
ST 4946GLB2	4.84 abc	88.0	7.3	5.4	Early-Mid
FM 1944GLB2	5.09 abc	100.5	8.3	6.1	Mid
NG 1511 B2RF	5.25 bc	108.5	9.0	6.6	Medium
DP 1137 B2RF	5.80 bc	136.0	11.2	8.3	Mid
MON12R242B2R2	6.06 c	149.0	12.3	9.1	n/a
Prob>F	0.0646				
LSD	2.03	101.3	8.4	6.2	

High and Rolling Plains Region

Seven NexGen varieties were compared across the high plains region in five locations in 2013. NG 3348 B2RF, NG 3306 B2RF, and NG 2051 B2RF were significantly earlier than NG 4012 B2RF and NG 1511 B2RF (Table 3). The earliest variety in the comparison, NG 3348 B2RF, was approximately 15 days earlier than NG 1511 B2RF, assuming long-term weather conditions at Lubbock, TX. These data supported seed company maturity classifications for all varieties except NG 2051 B2RF; that variety is currently classified as an 'early' maturity, but these data suggest it is an 'early-mid'.

Table 3. Relative maturity of seven varieties from five high plains locations in 2013.

Variety	Nodes Above Cracked Boll	DD60s later than NG 3348 B2RF	Estimated days later than NG 3348 B2RF	Seed company classification
NG 3348 B2RF	2.68 a	-	-	Early-Mid
NG 3306 B2RF	2.96 a	14.0	2.2	Early-Mid
NG 2051 B2RF	3.07 a	19.5	3.0	Early
NG 4111 RF	3.72 ab	52.0	8.1	Medium
NG 4010 B2RF	3.99 ab	65.5	10.2	Medium
NG 4012 B2RF	4.48 b	90.0	14.1	Medium
NG 1511 B2RF	4.62 b	97.0	15.2	Medium
Prob>F	0.0241			
LSD	1.32	66.0	10.3	

Seven varieties were compared across the high and rolling plains region in 2013 for relative maturity. DP 1321 B2RF was significantly earlier than FM 1944GLB2, DP 1044 B2RF, and DP 1219 B2RF, and NG 1511 B2RF and PHY 499 WRF were significantly earlier than DP 1219 B2RF (Table 4). DP 1219 B2RF, the latest-maturing variety in the comparison was approximately 17 days later than DP 1321 B2RF, the earliest variety in the comparison. Seed company maturity classifications were supported by these data for six of the varieties; however, DP 1219 B2RF is classified as an 'early' variety, but these data strongly suggest it is a 'mid-full' or even a 'full' season variety.

Table 4. Relative maturity of seven varieties from fifteen high and rolling plains locations in 2013.

Variety	Nodes Above Cracked Boll	DD60s later than DP 1321 B2RF	Estimated days later than DP 1321 B2RF	Seed company classification
DP 1321 B2RF	2.91 a	-	-	Early-Mid
NG 1511 B2RF	3.22 ab	15.5	2.4	Medium
PHY 499 WRF	3.70 ab	39.5	6.2	Mid
FM 2484B2F	4.07 abc	58.0	9.1	Medium
FM 1944GLB2	4.33 bc	71.0	11.1	Medium
DP 1044 B2RF	4.33 bc	71.0	11.1	Mid-Full
DP 1219 B2RF	5.06 c	107.5	16.8	Early
Prob>F	0.0045			
LSD	1.16	58.0	9.1	

From the data presented in tables 1 through 4, seed company classification differences typically spanned a difference of 30 to 40 DD60s; e.g., early-mid maturing varieties tended to be within 30 to 40 DD60s from one another. This suggests that a 'reasonable' difference to target to enable seed companies to accurately classify varieties as 'early', 'early-mid', 'mid', 'mid-full', or 'full'. Figure 1 shows the relationship between the least square differences from six analyses run in this study (two analyses were not presented to avoid duplicity) and the approximate number of replicates to detect the DD60 difference. In order to detect a 30 to 40 DD60 difference, these data suggest 100 to 120 replicates of NACB data are needed. This would equate to 30 locations of 4-replicate trials, or any combination thereof. However, since this is an extremely small dataset, caution should be taken when interpreting the data shown in Figure 1.

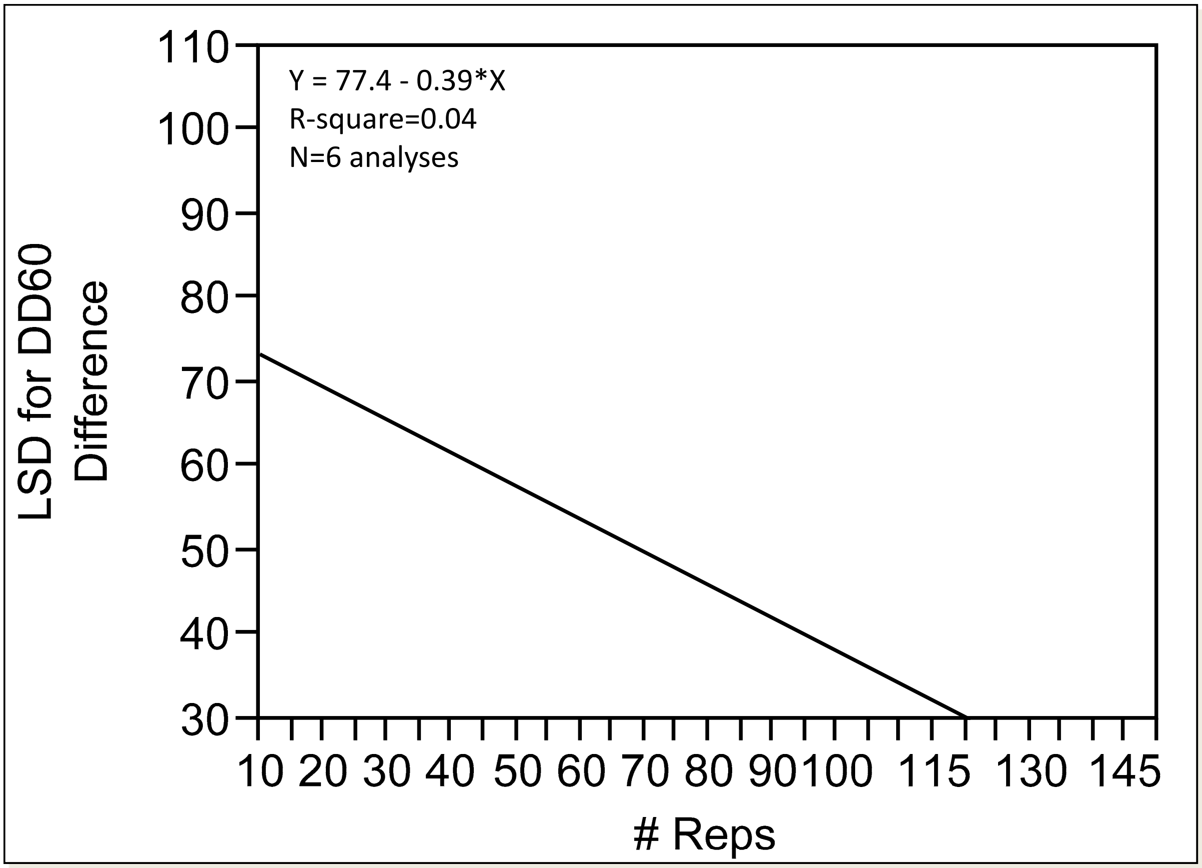

Figure 1. Relationship between least significant difference of six analyses run in this study and the number of replicates needed to detect that difference of degree-days, base 60^{o}F (DD60).

Summary

Nodes above cracked boll method enabled the detection of varietal differences that, in general, were consistent with the current classifications provided by the various seed companies. However, NG 2051 B2RF, DP 1219 B2RF, and possibly PHY 499 WRF may differ from their published maturity classifications. For seed companies to accurately assign new varieties a maturity classification, 100 to 120 replicates of NACB data should be collected.

References

Bourland, Freddie M., N. Ray Bensen, Earl D. Vories, N. Phillip Tugwell, and Diana M. Danforth. 2001. Measuring maturity of cotton using nodes above white flower. Journal of Cotton Science 5:1-8.

Kerby, T.A., R.E. Plant, and R.D. Horrocks. 1997. Height-to-node ratio as an index of early season cotton growth. J. Prod. Agr. 10:80-83.

Legé, K.E., M.E. Roof, and O.L. May. 1997. Evaluation of Finish as a harvest-aid material in the southeastern coastal plains. Proceedings of the Beltwide Cotton Conferences, p. 1363.

Richman, T.R. and L.L. Ray. 1966. Product-quantity measures of earliness of crop maturity in cotton. Crop Sci. 6:235-239.

Speed, Tom, David W. Albers, Ken E. Legé, Kevin Howard, and Tom A. Kerby. 2004. A new method for measuring relative maturity differences. Proceedings of the Beltwide Cotton Conferences, pp. 1103-1105.