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A NEW METHOD FOR MEASURING RELATIVE MATURITY DIFFERENCES

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Abstract

Many different cotton maturity rating methods have been used by breeders and agronomists since cotton maturity ratings have been taken. Most of these methods incorporate a visual rating method, due to the numerous plots that need to be rated. Delta and Pine Land Company's Technical Services department has developed a rating scale that estimates the number of additional heat units (DD 60's) required to open all the harvestable first position bolls. This estimation is made by counting the nodes or branches between the node of the upper most first position open or cracked boll (NUCB) and the node of the upper most harvestable boll (NUHB). The numerical difference between the NUHB and the NUCB is multiplied by 50 to estimate the number of additional heat units required to open all first position, harvestable bolls. Relative maturity ratings can be determined among varieties in field trials when this method is used. This new method has been very helpful in developing the relative maturity rating for new germplasm releases. Knowing a cotton variety's relative maturity is key in the introduction process a new variety. This new method also offers the opportunity to more objectively quantify a variety's relative maturity.

Introduction

Various subjective and objective rating scales have been used to assess the maturity of new germplasm releases. For example, when rating small plot entries a subjective rating based on percent open bolls and general senescence observations can be used. Many cotton breeders develop their own maturity rating scales, i.e. 1=late and 9=early (Calhoun and Riney, 2002). Determining maturity differences can also be made by calculating the proportion of open bolls to total bolls among varieties. This is a less subjective rating method, however it can be labor intensive and time consuming. Delta and Pine Land Company has developed a plant mapping method of rating relative maturity differences by determining the number of nodes between the node of the upper most cracked boll (NUCB) and the node of the upper most harvestable boll (NUHB). The calculated difference between the NUHB and NUCB will give the number of nodes that contain harvestable fruit. The node difference is multiplied by 50 to approximate the number of additional heat units (DD 60's) required to open all FP1 bolls between the NUCB and NUHB (Kerby et al. 1987).

Materials and Methods

Determining Relative Maturity Differences in Variety Trials

Determining relative maturity differences can be achieved by plant mapping individual plants, harvested from the field. Plant mapping should be conducted on 10 consecutive, undamaged plants with a first position cracked boll. This was repeated on each plot or treatment within the trial. These measurements should be taken when the crop is 30 to 70% open boll. Plants should be collected from areas that are most representative of the entire field. To accurately determine the difference in NUCB and NUHB, plants must have a newly cracked/open boll at the first position (FP1) on the fruiting branch. There should also be green, unopened FP1 bolls at first sympodial nodes above the cracked boll. The upper most harvestable FP1 boll is defined as a full size boll (approaching the size of large, unopened bolls lower in the plant), beginning to harden with seed not yet mature (at 30% open) or hard when squeezed, difficult to cut with a sharp knife, and seed nearing maturity (at 70% open). NUCB and NUHB are determined by counting nodes above the cotyledonary nodes. The cotyledonary nodes are counted as zero, then each subsequent node above are counted 1, 2, 3 … etc. Nodes are counted sequentially until recording the NUCB and the NUHB. Usually, the NUHB will be higher than the NUCB. If plant mapping is taken when the crop is nearly or fully open, the NUCB and NUHB could be on the same node number, and differences in maturity between varieties become negligible. Maturity mapping should take place prior to the time the earliest variety reaches 85% open boll. An average value for NUCB and NUHB should be developed from a minimum of 10 plants.

Once the average NUCB and NUHB are obtained for each entry in a variety trial, the difference between NUHB and NUCB can be calculated. The node difference is multiplied by 50 to approximate the number of additional heat units (DD 60's) required to open all FP1 bolls between the NUCB and NUHB (Kerby et al. 1987). It is assumed that each node was developed with the accumulation of 50 DD 60's during the later part of the growing season. Table 1 illustrates a typical data sheet from a variety trial rated in 2003. The varieties are sorted in descending order based on additional DD60's required to open all FP1 bolls between NUCB and NUHB. Recorded NUCB and NUHB values from common entries among field trials can be entered in a spreadsheet for analyzing. The spreadsheet can contain plant mappings from multiple years and multiple locations.

Results and Discussion

Table 2 shows the relative maturity differences, using balanced data, among 5 varieties based on DD 60's to 100% open. The average difference between the most full season variety (DP 555 BG/RR) and the earliest variety (DP 444 BG/RR), in this example, was 127 heat units (HU) or DD 60's. Based on this new method of rating relative maturities, DP 555 BG/RR would require 127 additional heat units to reach 100% open boll than DP 444 BG/RR. If theses two varieties were grown in an environment where an average of 10 heat units were received each day, one could estimate that DP 555 BG/RR requires 12.7 days longer (calculated as DD 60's difference / ave. HU received per day during the boll opening period) to reach 100% open boll than DP 444 BG/RR.

Our experience has shown that if the maturity ratings are taken too early, i.e. the later maturing varieties are not at least 30% open, then the data will tend to over estimate the maturity difference between the early and later maturing varieties. Conversely, if the maturity ratings are taken when the earliest variety has more than 85% open boll, the maturity ratings tend to underestimate the actual, larger maturity differences between early and later maturing varieties. The most optimum time to take the maturity ratings was when the earlier maturing varieties were at about 70% open and the later maturing varieties were past 30% open.

Least square means analysis has shown to be useful to determine maturity differences among unbalanced data sets. Table 3 shows least square means from combined (2001-2003) data and 2003, 2002, and 2001 data individually. The relative maturity rankings stay the same as the balanced data set, except for 2001 when the data set was highly unbalanced relative to DP 451 B/RR.

Conclusions

This new method for has proven to be a relatively quick, qualitative tool for determining relative maturity differences among cotton varieties. The data developed from this method can be used to rate relative maturities among varieties as well as determining the additional heat units required to open all harvestable FP1 bolls above the cracked boll.

References

Calhoun, D.S., and J.B. Riney. 2002. Non-replicated testing in the real world. Proc. Beltwide Cotton Conf. Atlanta, GA, Jan 8-12, 2002. Nat'l Cotton Council, Memphis, TN.

Kerby, T.A., M. Keeley, and S.H. Johnson. 1987. Growth and development of Acala cotton. Univ. of Calif. DANR Bull. 1921.

Table 1. Typical datasheet from field trial in 2003.

County	State	Map Date	Variety	Mean NUCB	Mean NUHB	Mean DD 60's to 100% Open
Lawrence	AL	9/16/2003	DP 555 BG/RR	14.2	20.4	310
Lawrence	AL	9/16/2003	DP 449 BG/RR	14.3	18.9	233
Lawrence	AL	9/16/2003	DP 451B/RR	13.3	17.3	200
Lawrence	AL	9/16/2003	SG 215 BG/RR	13.2	16.2	150
Lawrence	AL	9/16/2003	DP 444 BG/RR	13.7	16.5	137

Table 2. Relative Maturity Chart sorted in Descending DD 60 values from 44 trials where all entries were present. Sixteen trials from 2002 and 28 trials from 2003.

Variety	n	Mean NUCB	Mean NUHB	Mean DD 60's to 100% Open
DP 555 BG/RR	44	12.8	18.6	288 a
DP 449 BG/RR	44	12.0	16.8	238 b
DP 451 B/RR	44	12.1	16.2	205 bc
SG 215 BG/RR	44	11.7	15.5	191cd
DP 444 BG/RR	44	12.1	15.4	161 d
				LSD = 42.7

Table 3. Least Square Means analysis on DD 60's to 100% Open data from 2001-2003, for these 5 varieties.

	All Available Data		2003 Data Only		2002 Data Only		2001 Data Only	
Variety	**n**	**LSM DD 60's**	**n**	**LSM DD 60's**	**n**	**LSM DD 60's**	**n**	**LSM DD 60's**
DP 555 BG/RR	194	267	94	273	84	267	16	226
DP 449 BG/RR	169	218	99	216	61	225	9	184
DP 451 B/RR	254	197	61	212	71	190	123	193
SG 215 BG/RR	246	168	77	175	79	154	91	175
DP 444 BG/RR	131	139	85	137	35	134	11	172