Polymer coating effects on seed quality ratings of cotton

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ABSTRACT

Modern planting equipment requires cottonseed to flow in a single seed manner to function properly. Linters and small amounts of long fibers that are not removed by the ginning process resist this single seed flowing action by causing the seed to clump together. Therefore, cottonseed is delinted by using an acid delinting procedure prior to planting. This acid delinting process is very effective and inexpensive, yet concerns associated with the process include potential seed damage, worker safety, waste disposal, and deterioration of equipment exposed to acid. The use of an alternative method of preparing cottonseed for planting could address some of these concerns associated with acid delinting. The objective of this study was to evaluate several mechanical delinting times and polymer starch coatings with subsequent density separation fractions on several measures of seed quality (Cool Germination Test – CGT, Warm Germination Test – WGT, and Cool Warm Vigor Index – CWVI). The data from the seed quality tests suggested that a 10 minute delinting time was generally equal to or superior to 20 and 60 minute delinting times. Therefore, based upon the data collected, the 10 minute delinting time was selected to evaluate the effects of starch levels and density fractions on the seed quality parameters. Test results collected from the different starch levels indicated that the starch treated seed exhibited significantly increased germination and vigor percentages in the CGT, WGT, and CWVI tests. Data also showed that starch-coated seed can be separated into fractions of different seed qualities - presumably of differing densities. Generally the light fraction performed significantly lower than the medium and heavy fractions for the three seed quality tests.

Introduction

For modern planting equipment to function properly, cottonseed must flow in a single seed manner. Linters and small amounts of long fibers not removed in the ginning process cause the seed to clump together preventing this single seed flowing action. Therefore, seed intended for commercial sale is delinted prior to planting by using one of two acid delinting procedures: hydrochloric acid (gas) and sulfuric acid (liquid). Even though acid delinting is a very effective and inexpensive method of preparing cottonseed for planting, it is also associated with a few concerns or disadvantages. These concerns include: potential seed damage, worker safety, waste disposal, and deterioration of equipment exposed to acid. As commercial gins strive to increase their capacity by more aggressive ginning, they potentially cause more damage to the seed coat. This increased damage to the seed coat allows the acid delinting process to cause more damage to the seed. The use of an alternative method of preparing cottonseed for planting could address some of these concerns associated with the acid delinting process. Methods tried in the past include: Flame burners (this method is associated with high heat which causes damage to the seed) and mechanical delinting (previously an abrasive process that generated a lot of heat which could cause mechanical and heat damage to the seed). More recently polymer/starch coatings have come to the attention of the seed industry with the *Easiflo* method of coating cottonseed for cattle feed. Therefore, one objective of this study was to evaluate various mechanical delinting times, using a new proprietary mechanical delinting process (no heat) developed by Tom Wedegaertner from Cotton Incorporated, on several measures of seed quality (Cool Germination Test-CGT, Warm Germination Test-WGT and Cool Warm Vigor Index-CWVI). In addition, the effect of starch-coating of the mechanical delinted seed was evaluated using the same seed quality tests after performing a density separation on the coated seed. Since polymer coating of cottonseed is not a process developed for planting purposes, a few questions need to be answered: 1) Does the polymer coated cottonseed provide adequate flowability to be used in modern planting equipment; 2) Do polymer seed coatings affect the rate and the total germination/emergence under a range of temperature and moisture conditions; 3) Does mechanical delinting time have any effect on seed quality rating; 4) Is it possible to gravity separate partially delinted (mechanical) starch coated cottonseed; and 5) Does polymer coatings have any effect on disease incidence?

Experimental procedure

A sample of fuzzy cottonseed was exposed to a proprietary mechanical delinting process developed by Tom Wedegaertner from Cotton Incorporated for various time periods (10, 20, and 60 minutes). The seed samples were then treated with starch (10 min – 0 and 3%; 20 min – 0 and 2%; and 60 min – 0 and 1%), resulting in six treatments to be evaluated. Bulk samples of each of the six treatments were run through a Fractionating Aspirator developed by Carter Day, resulting in a light, medium and heavy fraction. In addition, a non-separated fraction (composite) was evaluated as a control. Adjustments to the aspirator were such that the light fraction consisted of 15% (± 5%) of the total sample. The remaining portion of the sample was divided between the medium and heavy fractions.

The samples from each treatment were evaluated in the laboratory by subjecting seed from each treatment to the CGT, WGT and CWVI. In the CGT and the WGT, four replications of 50 seeds each for the treatments were planted on standard germination towels, rolled, and placed in a germination chamber. For the CGT the temperature was set at a constant 18 °C and germination counts was taken seven days after planting. Only seedlings with a healthy hypocotyl/radicle length of 3.8 cm or greater were counted. The WGT temperature was set at an alternating 20 °C for 16 hours and 30 °C for 8 hours in a 24-hour period. The WGT germination counts were taken after 4 days after which the towels were re-rolled and placed back in the chamber to be re-counted after 10 days. The same criteria of healthy hypocotyl/radicles with a length of 3.8 cm or greater was used in the WGT. The CWVI is calculated by the numerical addition of the CGT 7 DAP and the WGT 4 DAP. This is a measure of the seedling vigor.

Results and Conclusion

The first parameter to be evaluated was the effect delinting time had on the seed quality as measured by the CWVI. In general, within a starch level the CWVI for the 10 minute delinting time was not significantly different from the 20 and 60 minute delinting times or was higher than the 20 and 60 minute delinting times (Table 1). The only exception was that the 20 minute delinting time with no starch had a higher CWVI than the 10 minute delinting time with no starch. The CWVI for the 10 minute delinting time within each of the seed density fractions was not significantly different, or was higher, than the values for the 20 and 60 minute delinting times (Table 2). The data were not consistent enough to conclude that the longer delinting times were detrimental to the seed quality. However, since the 10 minute delinting time removed an adequate amount of the lint to facilitate polymer coating, this delinting time was selected to evaluate the effects starch levels and density fractions had on the seed quality parameters.

Next to be investigated was the effect that the polymer starch coating might have on the seed quality parameters. If this method of preparing seed for planting is to be adopted, it must not significantly reduce the performance of the seed/seedling. The cool germination percentage for the starch coated seed (80%) was significantly higher than the cool germination percentage for the non-coated seed (62%) (Table 3). Further, the starch coated seed had a significantly higher warm germination percentage when counted 4 days after planting (81%) than did the non-coated seed (69%) and elevated CWVI values (161) when compared to the treatment without starch (130). This data suggests that starch coating of cottonseed had no detrimental effect on seed/seedling performance and, in fact, may have had a positive effect.

Because cotton is an indeterminate plant, a wide range in seed maturity may exist from the bottom to the top of the plant. When cotton is stripper harvested, this diversity in maturity, and, hence, seed quality, exists in the seed lot. Generally, the low-density cottonseed is separated from the remainder of the seed by using a gravity separator during the seed conditioning process. Again, if this method of preparing seed for planting is to replace the acid delinting method, the low-density starch coated seed must by able to be separated from the higher density seed. In this study, starch coated seed were fractionated into light, medium, and heavy categories using an air stream. The light fraction had a significantly reduced cool germination percentage (56%) when compared to the control (73%), medium (76%), and heavy (78%) fractions (Table 4). No differences were noted among the control, medium, and heavy fractions. Further, the medium and heavy fraction seed performed significantly higher on the WGT 4 DAP (81 and 83%, respectively) than both the control (73%), and light (64%) fractions. The light fraction performed significantly lower than the control. The light fraction seed also showed a reduced CWVI value (120) compared to the control (146), medium (156), and heavy (161) fractions. The control had a reduced CWVI value compared to the medium and heavy fractions. These data would strongly suggest that, at the very least, that low-density starch coated seed could be separated from the medium and high-density fractions.

Summary

The seed quality data suggested that the 10 minute delinting time was generally equal to or superior to the 20 and 60 minute delinting times. Test results also indicated that starch treated seed had increased germination and vigor ratings when compared using the CGT, WGT, and CWVI tests. Data showed that low density starch-coated seed can be separated from medium and high density fractions. In general, the light fraction performed significantly lower than the medium and heavy fractions for the three seed quality tests.

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Table 1. *The effect of delinting times (10, 20, and 60 minutes) and starch levels (without and with) on the cool warm vigor Index (CWVI) of cottonseed.*

	Delinting Time (minutes)		
Starch Level	10	20	60
Without	130 b**	140 a	129 b
With*	161 a**	142 c	153 b

* Starch coating levels were 3%, 2%, and 1% by seed weight for the 10, 20, and 60 minute delinting times, respectively.

** Means within a row followed by the same letter are not significantly different at the 5% level of probability.

Table 2. *The effect of delinting times (10, 20, and 60 minutes) and seed density fractions (control (composite), light, medium and heavy) on the cool warm vigor index (CWVI) of cotton seed.*

	Delinting Time (minutes)		
Seed Density Fraction	10	20	60
Control	146 a*	149 a	144 a
Light	120 a*	113 ab	108 b
Medium	156 a*	138 b	150 a
Heavy	161 a*	166 a	163 a

* Means within a row followed by the same letter are not significantly different at the 5% level of probability.

Table 3. The effect of starch levels (without=0% and with=3% by seed weight) on the cool germination test (CGT), warm germination test 4 days after planting (WGT-4), and the cool warm vigor index (CWVI) of cottonseed mechanically delinted for 10 minutes.

Starch level	Seed quality test		
	CGT	WGT-4	CWVI
Without	62 a*	69 a*	130 a*
With	80 b	81 b	161 b

* Means within a column followed by the same letter are not significantly different at the 5% level of probability.

Table 4. The effect of various seed density fractions (control (composite), light, medium, and heavy) on the cool germination test (CGT), warm germination test four days after planting (WGT-4), and the cool warm vigor index (CWVI) of cottonseed mechanically delinted for 10 minutes.

Seed density fraction	Seed quality test		
	CGT	WGT-4	CWVI
Control	73 a*	73 b*	146 b*
Light	56 b	64 c	120 c
Medium	76 a	81 a	156 a
Heavy	78 a	83 a	161 a

* Means within a column followed by the same letter are not significantly different at the 5% level of probability.