THE GERMINATION AND EMERGENCE RESPONSES OF POLYMER-COATED FUZZY COTTONSEED

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Abstract

Currently cottonseed (*Gossypium hirsutum, L.)* must be delinted to be used in modern planting equipment. The two most common methods are wet acid delinting using sulfuric acid and gas delinting using hydrogen chloride. There are several possible problems associated with acid delinting including damage to seed quality by improper procedures during the acid delinting process, damage to the seed by ammonia during the neutralization process, worker safety concerns, and disposal issues. If coating does not negatively effect germination and emergence of the seed, then polymer coating of fuzzy cottonseed to improve the flowability may be one way to avoid the potential problems associated with acid delinting.

In this study the effects on germination and emergence of coating fuzzy cottonseed with the EasiFlo polymer were studied. Four cultivars (PM2326RR, PM2200RR, DP2379, and DP2156) were utilized. Each cultivar was coated with EasiFlo polymer at 0, 1.5, 3, and 4.5% of seed weight to study the effects of rate on germination and emergence. After the coating was applied, each treatment had a fungicide mixture applied. To determine the effect on seed germination, 4 replications of 50 seed per treatment per test were rolled on moist germination towels. The treatments were then subjected to the Cool Germination test and Warm Germination test. The Cool Warm Vigor Index was calculated by numerically adding the results from the four day warm germination percentage and the seven day Cool Germination test. To determine establishment (rate and total) 3 replications of 50 seed per treatment were placed on wet sand and covered with an inch of dry sand in plastic containers. The containers were placed in a warm chamber and the emerged seedlings were counted daily. The Establishment Index (EI) at day 13 was expressed as a percentage of planted seed that emerged. The Emergence Rate Index was also calculated from these data (rate and total emergence).

Under the conditions of this study, variety differences existed for the Warm Germination (10 day), Cool Germination, Emergence Rate Index and Establishment Index values. However, for the Cool Warm Vigor Index, a variety by polymer interaction was noted, suggesting that CWVI did not respond in the same manner for each variety across the different EasiFlo polymer rates. No pattern was obvious to explain the differences in the CWVI across polymer rates for the varieties. With the exception of the Cool Warm Vigor Index test, the Easiflow polymer itself did not significantly effect germination (Warm and Cool tests) and emergence (ERI and EI-13 days). Our data suggest that the use of EasiFlo polymer to treat fuzzy cottonseed for planting should not negatively effect seed germination and emergence.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:623-625 (1999)
National Cotton Council, Memphis TN

Introduction

Delinting of cottonseed can be accomplished by several methods. Mechanical delinting, wet acid delinting using sulfuric acid in a dilute form, and gas delinting with hydrogen chloride are the most common methods.

Delinting of cottonseed using wet acid and hydrogen chloride improves handling. Fuzzy seed has long fibers (linters) that tend to clump together and resist flowing smoothly. Acid delinting is necessary to handle cottonseed using modern equipment to treat and plant. Seed treaters and planters are designed to handle seeds that act as single units that are easily manipulated by using gravity.

Although delinting has several positive effects, there are also negative aspects associated with delinting. Gas delinting is a viable option only in areas of low humidity. Sulfuric acid and hydrogen chloride pose potential hazardous handling problems to workers and are becoming increasingly expensive to dispose of. Seed that is acid delinted must be properly neutralized or the pH levels on the seed coat can decrease drastically. An acidic seed coat may allow microbes to infect the seed and may be responsible for a decrease in germination that accompanies the drop in pH levels (Brannen and Backman, 1994). Damage may be caused by ammonia during the neutralization process, causing a decline in the quality of seed.

Devay et. al. (1995) reported that machine delinted cottonseed with a polymer film coating has potential for use as planting seed. They noted that while the Acala Maxxa seed coated with Colorcon polymer (Opatint Red) had a 12 to 24 hour delay in emergence, the lint yield was not decreased. Their study demonstrated that at the Dos Palos location reduced stand counts in the polymer treated seed did not cause a reduction in yield. At another location, there were no significant differences in emergence, percent seedling survival, seedling growth, or yield between the coated and uncoated seed (Devay et. Al., 1995).

A benefit of coating fuzzy seed is that since acid is not involved, neutralization is also no longer necessary. Some cultivars are particularly sensitive to acidity. Brannen and

Backman (1994) reported that in a 1993 survey that the seed surface pH averaged 2.6. They investigated the difference in emergence of acid-delinted seed with a pH of 2.0 and a pH of 5.0 (further neutralized) and discovered that the seed with a pH of 5.0 produced significantly higher stands and significantly less soreshin symptoms in field soil and pasteurized soil (Brannen and Backman, 1994). They suggested that there might be a possible connection between seed surface pH and *R. solani* infection. Brannen and Backman also noted that in a dissertation by Cabrera that author suspected that acid residue may have a negative impact on seed quality during storage (Cabrera, 1983). Although Brannen and Backman suggested that since their results were not based upon storage it could not account for their results (Brannen and Backman, 1994). In any case, if improper neutralization impacts the performance of the seed by harming quality during storage and/or encouraging microbial infection of the seedlings, coating of fuzzy cottonseed could be one way of avoiding acid residue and the resulting negative impact upon production.

Materials and Methods

In our study, four widely planted cotton cultivars (PM2326RR, PM2200RR, DP2379, and DP2156) were utilized. All treatments had a .75 oz/cwt application of Apron TL, 3 oz/cwt of Captan 4000, and 6 oz/cwt of Vitavax-PCNB. The controls (0% coating) consisted of the fuzzy cottonseed treated with the fungicide mixture. To evaluate the effects of varying rates and application methods the EasiFlo coating was applied at 1.5, 3, and 4.5% of seed weight with the fungicide mixture applied after the seed was dry. The treatments were tested for the Cool Warm Vigor Index, 10 day Warm Germination, Cool Germination, warm chamber stand establishment (EI 13), and warm chamber Emergence Rate Index.

The Cool Warm Vigor Index was obtained by placing 50 seed per replication on dampened germination towels. One set of four replications per treatment was placed in a chamber set at 64^0F (18^0C) for seven days. The other set was placed in a chamber alternating at 68^0F/ 20^0C (16 hours) and 86^0F/ 30^0C (8 hours) and counted at days four and ten. The seedlings that were one and a half inches or greater on day four (Warm Germination) and day seven (Cool Germination) were added together to determine the Cool Warm Vigor Index. The percentage of seedlings one and a half inches or greater on day 10 in the warm chamber was used to calculate the 10 day Warm Germination. The percentage of seedlings one and a half inches or greater on day seven in the cool chamber was used to calculate the Cool Germination.

The Establishment Index (%) and Emergence Rate Index were calculated in a warm growth chamber set at 86^0F (30^0C). Three replications of fifty seed from each treatment were placed in 8.25 in. x 13.5 in. x 3.5 in. containers on saturated sand (equilibrated to 86^0F) and covered with approximately 1 inch dry sand. Emerged seedlings were counted daily through 13 days. The number of surviving seedlings at day 13 was expressed as a percentage of the total number of seed planted for the Establishment Index. The Emergence Rate Index (ERI) is a measure of rate and total emergence.

Results and Discussion

For the Cool Warm Vigor Index (Figure 1) a variety by polymer interaction was noted. This suggested that the CWVI did not respond consistently for each variety across the EasiFlo polymer rates. No discernable pattern was observed across the different varieties to help explain these differences.

Results for the ten day Warm Germination Test (Figure 2) showed no significant differences were noted due to EasiFlo coating application rates. Varieties showed significant differences. 2326RR (93%) had the highest Warm Germination percentage after 10 days. 2326RR was significantly different from the varieties 2200RR (89%) , DP2370 (85%), and DP2156 (85%).

The seven day Cool Germination Test (Figure 3) indicated no differences in germination due to polymer coatings. Each variety was significantly different from all other varieties under cool conditions with 2326RR exhibiting the highest with 76% germination. 2326RR was followed by 2200RR (71%), DP2156 (58%), and DP2379 (49%).

In the warm growth chamber, no differences were noted due to EasiFlo polymer rates in either the 13 day Establishment Index (Figure 4) or the Emergence Rate Index (Figure 5). Variety differences were observed in the total number of seedlings emerged on day 13 (Figure 4). The highest Establishment Index percentage (EI) was noted from the 2326RR variety. 2200RR was not significantly different from any of the other varieties (85%). DP2379 (80%) and DP2156 (80%) were significantly lower than the 2326RR variety. For the Emergence Rate Index (Figure 5) varietal differences were noted. The variety 2326RR (2336 units) and 2200RR (2297 units) had a faster emergence and greater total emergence than the DP2379 (1941 units) and DP2156 (2024 units) varieties.

These data suggest that under the conditions of this study that variety differences existed for the Warm Germination Test, Cool Germination Test, Emergence Rate Index, and Establishment Index values. However, with the exception of the Cool Warm Vigor Index, the EasiFlo polymer coating had no effect on the germination (Warm and Cool tests) or the emergence (rate and total) of the treated seed. Therefore, the use of EasiFlo polymer to treat and plant fuzzy cottonseed should not negatively effect the seed germination and emergence.

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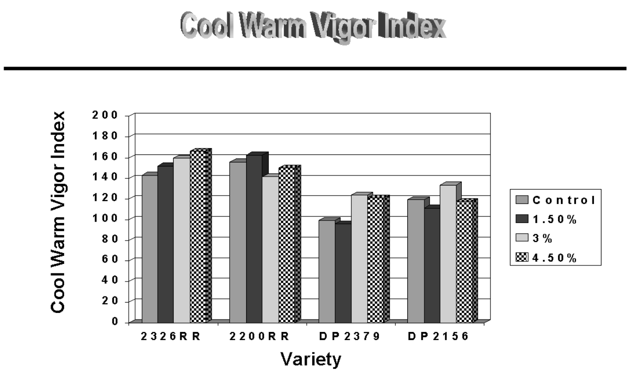

Figure 1. The effect of polymer rate (O% or control, 1.5%, 3%, and 5% by seed weight left to right grouped for each variety) and variety on the Cool Warm Vigor Index. A significant interaction between polymer rate and variety existed, although no pattern was observed to help explain this effect.

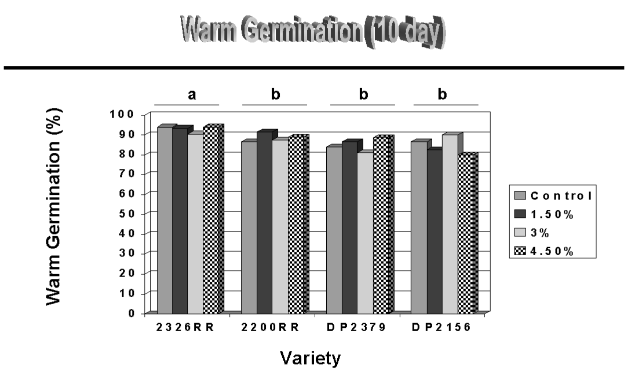

Figure 2. The effect of polymer rate (O% or control, 1.5%, 3%, and 5% by seed weight left to right grouped for each variety) and variety on the Warm Germination percentage after 10 days. No significant differences existed among the rates of EasiFlo coating. Varieties with different letters are significantly different according Duncan's multiple range test.

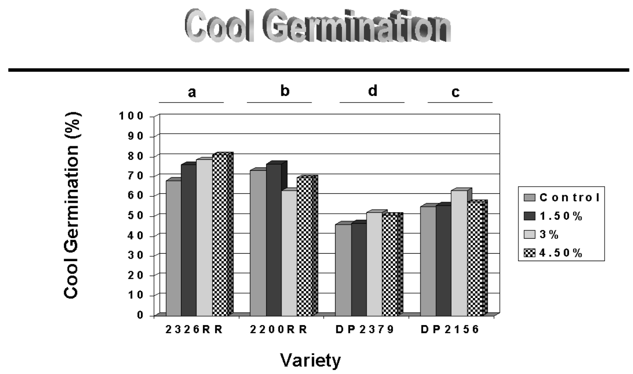

Figure 3. The effect of polymer rate (O% or control, 1.5%, 3%, and 5% by seed weight left to right grouped for each variety) and variety on the Cool Germination percentage after 7 days. No significant differences existed among the rates of EasiFlo coating. Varieties with different letters are significantly different according Duncan's multiple range test.

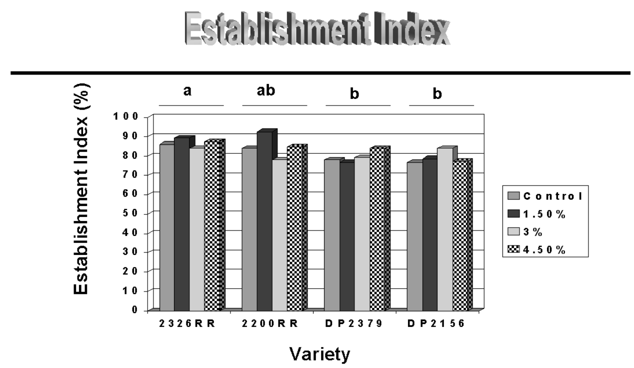

Figure 4. The effect of polymer rate (O% or control, 1.5%, 3%, and 5% by seed weight left to right grouped for each variety) and variety on the Establishment Index percentage after 13 days. No significant differences existed among the rates of EasiFlo coating. Varieties with different letters are significantly different according Duncan's multiple range test.

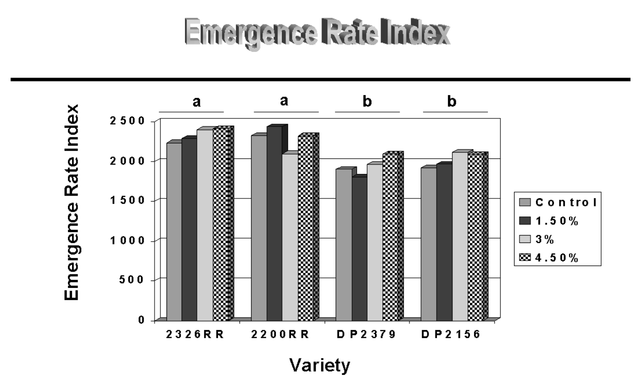

Figure 5. The effect of polymer rate (O% or control, 1.5%, 3%, and 5% by seed weight left to right grouped for each variety) and variety on the Emergence Rate Index after 13 days. No significant differences existed among the rates of EasiFlo coating. Varieties with different letters are significantly different according Duncan's multiple range test.