THE IMBIBITION AND EMERGENCE RESPONSES OF POLYMER-COATED FUZZY COTTONSEED

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Abstract

With increased concerns surrounding the acid delinting process, alternatives have been investigated that utilize polymers as a means to increase flowability of cotton seed without delinting. However, the use of polymers as a means of improving handling of planting seed can only be practical if the coating does not significantly slow or inhibit germination and emergence. In this study, Paymaster 2200RR and Paymaster 2326RR were utilized. All treatments had 0.75 oz/cwt. of Apron TL, 3 oz/cwt. of Captan 4000, and 6 oz/cwt. of Vitavax-PCNB applied for control of fungal growth. The controls consisted of the raw fuzzy seed and acid delinted seed treated with the fungicide mixture and no polymer coatings. To evaluate the effects of various polymers and polymer rates, a starch polymer (EasiFlo) and Opadry Ag were each applied at 4 and 8% of seed weight by Tom Wedegaertner at Cotton Incorporated in Raleigh, North Carolina. The treatments were tested for cool germination %, warm germination %, Emergence Rate Index (64^0F /18^0C and 86^0F/ 30^0C), and Establishment Index (64^0F /18^0C and 86^0F/ 30^0C). In general, the polymer coating treatments did not reduce the cool or warm germination percentages with the exception that the Paymaster 2200RR cool germination percentage was reduced with starch polymer coating (4 and 8%). The emergence rate index and establishment index (%) was reduced in the cool emergence tests by the 4 and 8 % rates of the starch polymer with the exception that ERI and EI were not reduced by the 4% starch polymer coating on the PM2326RR variety. In general, the ERI and EI values were reduced in the warm emergence tests by only the 8% starch polymer rate. The Opadry Ag polymer coatings had no effect on the warm or cool germination percentages and no effect on the warm or cool ERI and EI values.

Introduction

Historically, fuzzy cottonseed was used for planting purposes, but due to handling difficulties, delinting became common. As concerns surrounding the use of acid delinting have increased, alternatives that allow planting of non-delinted seed in modern equipment have become a focus of research. The polymer coating of fuzzy cottonseed for planting purposes may circumvent possible problems associated with anhydrous HCl and dilute H_2SO_4 acid delinting. Currently acid delinting has several negative aspects including worker safety concerns, possible equipment damage, environmental issues, and occasional damage to the seed from the acid or improper neutralization.

Recently, Weldon Liard (USDA-ARS) and Cotton Incorporated patented a starch coating technology (EasiFlo Cottonseed) that improved the flowability of cottonseed without the use of acid delinting. This technology is currently used for livestock feed, but may have applications to the planting seed industry as well.

However, the use of polymers as a means of improving handling of planting seed can only be practical if the coating does not significantly slow or inhibit germination and emergence. Previous studies have demonstrated that some coatings may either retard or increase imbibition, which may have a positive or negative effect on germination, establishment, and emergence depending on water potential status and temperature. A.G. Taylor (1997) coated snap beans with a polymer that slowed imbibition to reduce chilling injury. A slight improvement in germination was noted under a chilled germination test. In a 1989 review by J.M. Scott, particulate coatings (including lime) were noted for enhancing imbibition and germination of pasture seeds. However, it was stated that these results were demonstrated over a small range of limiting moisture tensions. Thus, each coating and filler should be tested under a wide array of temperature and water potential combinations.

The purpose of our study was to determine the effects of various polymers and polymer rates on 1) germination percentages under cool and warm temperatures and 2) emergence and establishment at cool and warm temperatures.

Materials and Methods

In our study, widely planted cotton cultivars Paymaster 2200RR and Paymaster 2326RR were utilized. All treatments had 0.75 oz/cwt. of Apron TL, 3 oz/cwt. of Captan 4000, and 6 oz/cwt. of Vitavax-PCNB applied to control microbial growth. The controls consisted of the raw fuzzy seed and acid delinted seed treated with the fungicide mixture and no polymer coatings. To evaluate the effects of various polymers and polymer rates, a starch polymer (EasiFlo) and Opadry Ag were each applied at 4 and 8% of seed weight to fuzzy cottonseed. The polymer treatments were applied by Tom Wedegaertner at Cotton Incorporated in Raleigh, North Carolina The treated seed were tested for cool germination, warm germination, Emergence Rate Index (64^0F /18^0C and 86^0F/ 30^0C), and Establishment Index (64^0F /18^0C and 86^0F/ 30^0C).

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:601-603 (2000)
National Cotton Council, Memphis TN

The cool and warm germination percentages were obtained by placing fifty seed per repetition (four repetitions per treatment) on germination towels dampened with distilled water. One set was placed in a chamber set at 64^0F /18^0C for seven days. The other set was placed in a chamber set at 86^0F/ 30^0C for seven days. Those seeds with a visible radicle were counted as germinated for the cool germination percentage. The seedlings with radicles that were one and a half inches or greater were counted for the warm germination percentage.

The cool establishment index (%) and emergence rate index were calculated on seed tested in a chamber set at 64^0F (18^0C). The warm establishment index (%) and emergence rate index were calculated on seed tested in a chamber set at 86^0F (30^0C). 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 the desired temperature) and covered with approximately one inch dry sand. Each day emerged seedlings were counted through twenty-one days (cool) and fourteen days (warm). The number of seedlings that emerged were expressed as a percentage of the total number of seed planted and used to calculate the emergence rate index and the establishment index.

Results and Discussion

In general, the polymer coating treatments did not reduce the cool or warm germination percentages with the exception that the Paymaster 2200RR cool germination percentage was reduced with starch polymer coating at 4 and 8% (Figure 1 and Figure 2). The emergence rate index and establishment index (%) were reduced in the cool emergence tests by the 4 and 8 % rates of the starch polymer with the exception that ERI and EI were not reduced by the 4% starch polymer coating on the PM2326RR variety (Figure 3 and Figure 4). Overall, the ERI and EI values were reduced in the warm emergence tests by only the 8% starch polymer rate (Figure 5 and Figure 6). The Opadry Ag polymer coatings had no effect on the warm or cool germination percentages and no effect on the warm or cool ERI and EI values (Fig. 1, 2, 3, 4, 5, 6).

From these results, it appears that the Opadry Ag polymer had the least impact on reducing seed germination and emergence. Within the starch coating, the 4% rate performed better than the 8% coating.

It should be noted that these results are for non-stress moisture conditions and that research is currently under way to investigate responses to a variety of water potential and temperature combinations.

Acknowledgments

The authors would like to express appreciation to Cotton Incorporated and the ARCS Foundation (Lubbock Chapter) for financial support of this project.

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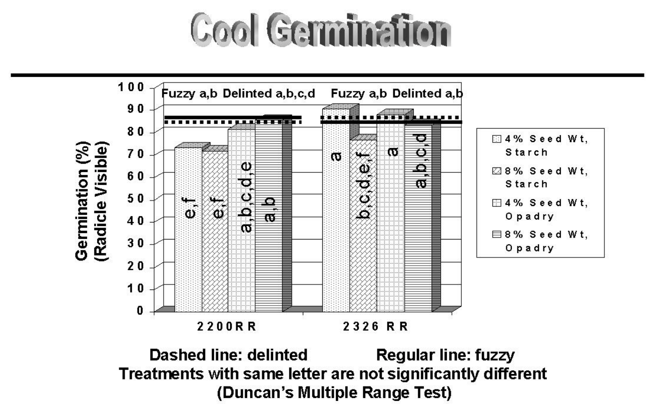

Figure 1. Cool germination % as affected by the starch and Opadry Ag polymers at 4 and 8% of seed weight in comparison to the acid delinted and raw fuzzy controls.

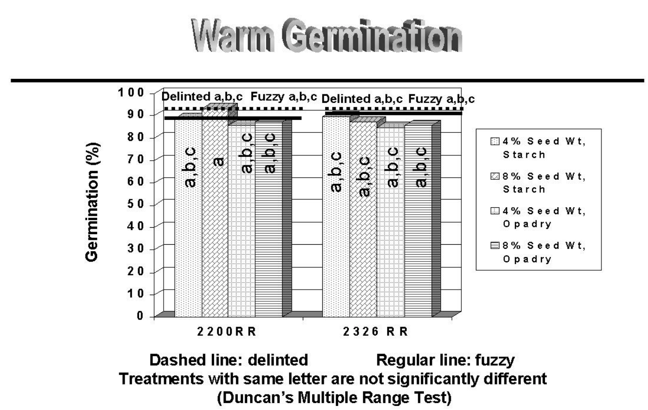

Figure 2. Warm germination % as affected by the starch and Opadry Ag polymers at 4 and 8% of seed weight in comparison to the acid delinted and raw fuzzy controls.

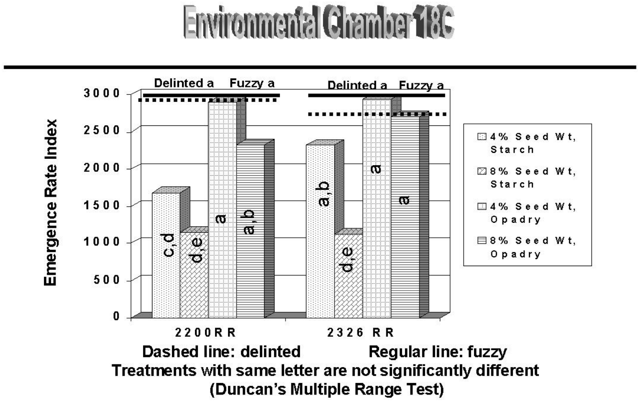

Figure 3. Emergence Rate Index (18^{0}C) as affected by the starch and Opadry Ag polymers at 4 and 8% of seed weight in comparison to the acid delinted and raw fuzzy controls.

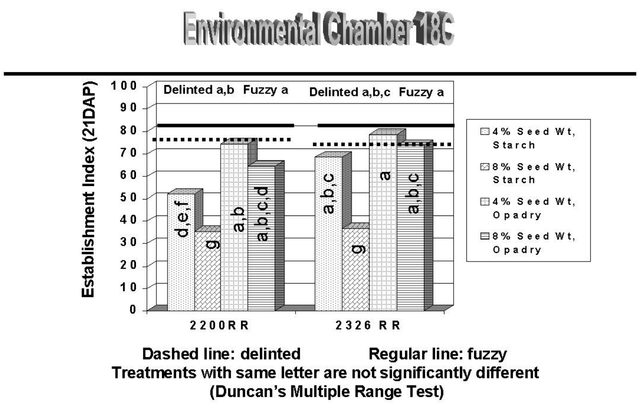

Figure 4. Establishment Index (18^{0}C) at 21 days after planting as affected by the starch and Opadry Ag polymers at 4 and 8% of seed weight in comparison to the acid delinted and raw fuzzy controls.

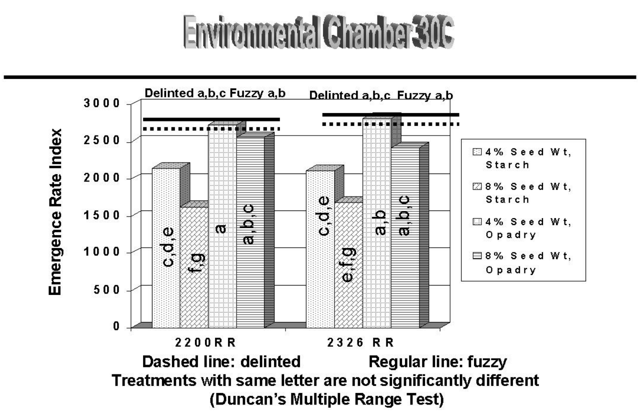

Figure 5. Emergence Rate Index (30^{0}C) as affected by the starch and Opadry Ag polymers at 4 and 8% of seed weight in comparison to the acid delinted and raw fuzzy controls.

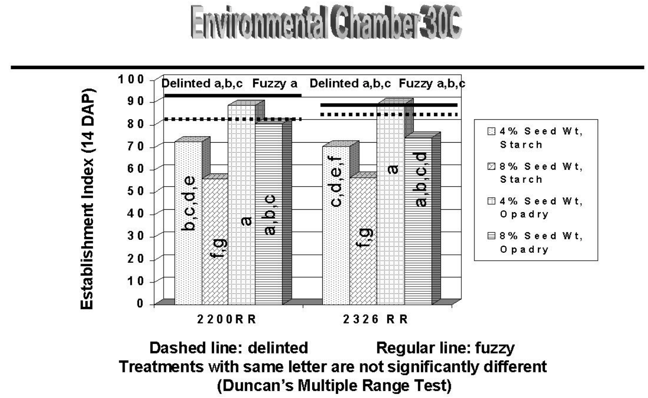

Figure 6. Establishment Index (30^{0}C) at 14 days after planting as affected by the starch and Opadry Ag polymers at 4 and 8% of seed weight in comparison to the acid delinted and raw fuzzy controls.