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Impact of a polyethylene liner on the storage of winter canola seed in unaerated steel bins

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Winter canola has potential as a rotational crop for small cereal grains throughout the southern United States. However, canola is typically harvested just before wheat and is not yet considered a primary crop in the south. This combined with already tight storage capacity has led producers and facility managers to look for ways to press older, low-quality storage bins into service. One idea has been the use of grain bag material as a liner for older bins that lack functional aeration systems. This project compared the storage quality of canola in lined and unlined steel grain bins without aeration. There was not a significant difference in storage quality between the lined and unlined bins. Canola seed at 5.4% moisture content was stored without loss in grade for eleven months. Lining the entire bin with grain bag material does not appear to be justified, however, there may be merit in lining the bottom of older grain storage bins to prevent moisture intrusion.

1. Introduction

Canola is a member of the mustard (*Brassicaceae*) family. Canola (*Brassica napus*) was originally developed in Canada through traditional breeding of the rapeseed plant. Production of vegetable oil is the main use of the seed, with the leftover meal used as a protein supplement for livestock (Boyles et al., 2012). According to the Foreign Agricultural Service (2016), canola (including edible rapeseed) is the second largest global oilseed crop after soybeans, with production of 70.2 million metric tons in 2015/16. North Dakota dominates production in the U.S. with 87% of the canola crop in 2015. But canola acreage has also been growing in the southern United States. For example, Oklahoma has been the number two producer of canola in the U.S. since 2009 (USDA, 2015). Winter varieties of canola have performed well as a rotational crop for wheat in the southern Great Plains. They provide a significant increase in wheat yields following canola and herbicide tolerant varieties help combat problematic weeds such as Italian ryegrass and feral rye (Bushong et al., 2012). The southeastern United States faces similar challenges with weeds due to wheat monocropping and could also benefit from canola rotation. (Bishnoi et al., 2007; Kumar et al., 2007).

Canola has potential throughout the southern United States as a rotational crop for small grains. However, there is limited information available concerning the long-term storage of winter canola seed in the southern U.S. Most research concerning the storage of canola seed has been performed in cooler climates and with spring varieties that are harvested in early fall. Winter varieties are harvested in late spring and grain bin temperatures increase quickly during the summer in this region, especially without aeration. Canola is not a primary crop in the southern U.S. and is harvested just a few weeks before wheat. This has led producers and grain facility managers to look for alternative storage options for canola so that their primary storage capacity is ready for wheat harvest. Grain bags are a possible alternative, but space considerations and the specialized loading and unloading equipment they require can be a deterrent. Many facilities have older, leaky bins that lack functional aeration systems. While these bins are not ideally suited for canola storage, producers and managers have looked for ways to press these bins into temporary storage for canola seed. Placing grain storage bags inside existing grain storage structures has been considered by facility managers in the southern Great Plains. The goal of this project was to determine if there is a difference in storage quality for winter canola seed placed in unaerated steel bins with and without the use of a polyethylene grain bag liner.

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2. Materials and methods

2.1. Experimental methods

Testing was completed at Oklahoma State University's Stored Product and Research Education Center (SPREC) in Stillwater, OK. Six steel, 170 bushel bins were utilized during testing. The bins were arranged in an east-west orientation and numbered from 1 to 6 starting from the west. Three of the bins (2, 4, and 6) received the treatment of a 9.3 mil thick polyethylene liner made from grain bag material provided by Delta Grain Bag Systems, Inc. (Monette, AR). The liner was closed with a heat sealer and duct tape. A silage bag vent (Ag-Bag, St. Nazianz, WI) was installed at the top of each liner to allow for periodic sample collection. Prior to loading, the base of all the bins were recoated with elastomeric roof paint and a single 60 mm vent cap was added to the top of each bin to prevent condensation in the head space. A layer of grain bag material was placed in the bottom of the unlined bins and extended up the sidewall approximately 200 mm.

2.2. Canola seed

Canola seed (DeKalb DKW 44-10) was purchased directly from a farmer in Covington, OK and delivered to SPREC during harvest. The seed was graded by Enid Grain Inspection (Enid, OK) at delivery. The initial seed grade was U.S. No. 1 with 5.4% moisture content, 38.4% oil content, and 2.03% dockage. Excessive rain delayed the loading of canola into the 170bu bins for 2 1/2 weeks. It was stored in two 500bu bins at SPREC until it could be transferred.

2.3. Data collection

A single StorMax temperature cable was located in the center of each bin (OPIsystems Inc., Calgary, Canada), which allowed temperature readings to be collected at six elevations. Temperatures were collected two to three times per week for twelve months. Seed samples were collected on a monthly basis near the center of the bins with a five-foot-long grain trier. Samples were tested for grade, free fatty acid (FFA), and germination. FFA testing was completed by North Dakota State University by titration (AOCS Ca 5a-40). Germination tests were performed by adding 5 ml of distilled water to a 90 mm petri dish containing a filter paper disk. Fifty seeds were added and counts of germinated seeds were made after three days and five days. Additional water was added at day three as needed. A visual inspection of the stored canola was conducted during unloading.

2.4. Statistical analysis

Differences in temperature and FFA between lined and unlined bins were evaluated by analysis of variance using SAS software version 9.3 (SAS Institute Inc., Cary, NC, USA). The MIXED procedure was used to evaluate FFA and germination rates, with days in storage as a repeated measure. All measures of significance were evaluated for $\alpha = 0.05$.

3. Results

3.1. Temperature

Bin temperatures began to drop immediately after being placed in storage. There was not a significant difference in mean temperature between the lined and unlined bins ($p = 0.9921$), and the bin temperatures appeared to track the ambient daily maximum air temperature from Oklahoma Mesonet data (Brock et al., 1995; McPherson et al., 2007) throughout the storage period (Fig. 1).

3.2. Free fatty acid

The free fatty acid content of the canola seed samples rose throughout the storage period, but stayed below 0.4% for all six bins (Fig. 2). There was no significant difference in the FFA between the lined and unlined bins ($p = 0.8057$).

3.3. Germinations

Germination testing was completed on a monthly basis. Mean germination rates remained above 80% for both lined and unlined bins. There was a significant difference in the mean germination rate ($p = 0.0359$), with a higher germination rate in the unlined bins (Fig. 3).

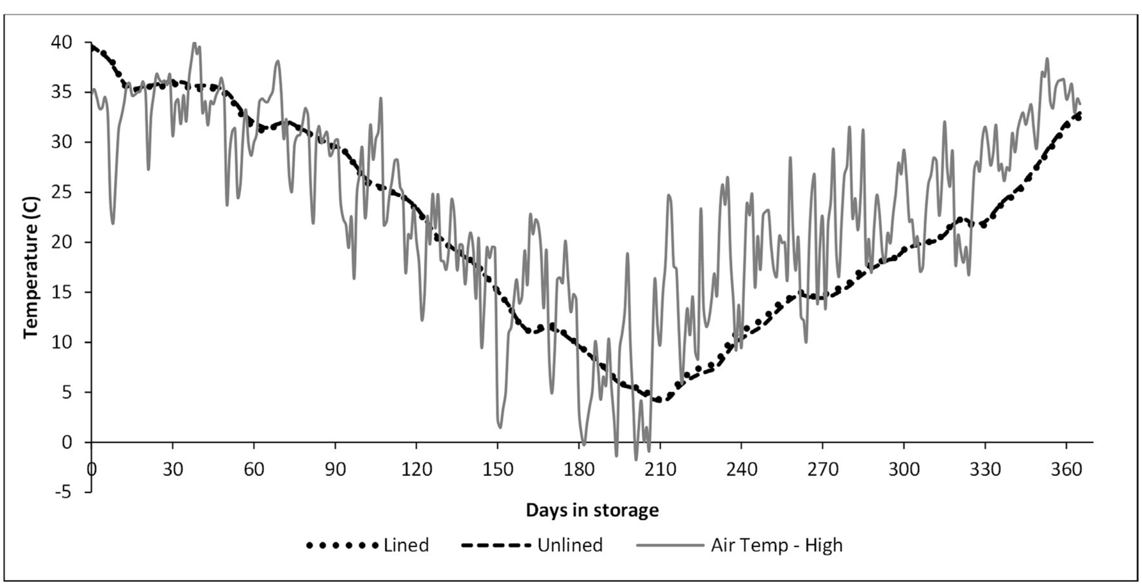

Fig. 1. Comparison of ambient and average bin temperatures in lined and unlined bins.