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Quality changes in 12% moisture content canola stored in silo bags under Canadian Prairie conditions

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ABSTRACT

A study was conducted for two storage years (2011–12 and 2013–14) to determine the changes in grain quality while storing 12% moisture content (m.c., wet basis) canola seeds in silo bags under Canadian Prairie conditions. Canola seeds were stored in three silo bags (67 tonnes per bag) and unloaded at three different times (one bag at a time) which represent 20 weeks of storage (unloaded in late winter), 28 weeks of storage (unloaded in spring) and 40 weeks of storage (unloaded after summer storage). Canola seed quality parameters (germination, free fatty acid value (FAV), and moisture content), and intergranular composition (CO_2 and O_2 levels) at different locations in silo bags were analysed every two weeks. Temperature of canola seeds at various locations in the silo bag was recorded every 30 min. The germination of canola seeds at most parts of the silo bags stayed above a safe level up to late winter (20 weeks of storage). At the top layer of the silo bags, germination of canola seeds decreased to below 30% during summer storage (after 40 weeks of storage). Moisture content of canola seeds increased at the top layer in both storage years. The FAV values remained at safe levels until 20 weeks of storage, and increased more than two times the initial values after summer storage. The commercial grades after first, second and third unloading (after 20, 28 and 40 weeks of storage) were Grade 1, Grade 2 and Feed Grade, respectively, in year 1. Whereas for year 2, these were Grade 1, Grade 1 and Grade 2 after first, second and third unloading, respectively. The grain quality analysis and commercial grading results indicated that ambient temperature had a major role in quality of canola during storage.

1. Introduction

Canola is one of the major oilseeds grown around the world and Canada is the world's largest producer of canola (CCC, 2013). In Canada, canola is harvested in late August or early September, and most of the times harvest moisture content of canola is higher than the recommended storage moisture content(10% m.c.). Farmers dry the canola seeds to safe storage moisture using near ambient air or heated air drying system and then store it in steel bins on the farm for few weeks or as long as 12 months. Silo bag or harvest bag storage system is the newly developed temporary on-field storage technique and is used by Canadian Prairie farmers to store cereal grains and oilseeds. Since the silo bag storage is an on-field storage technique, farmers do not have the access to dryer to reduce the moisture content of the canola in the field. Farmers will sell and deliver canola throughout the year, so the accessibility of silo bags throughout the year is important.

Storage moisture content is one of the major factors playing a role in quality changes of canola during storage and determining safe storage time. Mills and Sinha (1980) compared the safe storage time of different moisture content rapeseeds stored in the laboratory at different temperatures with rapeseed stored in non-aerated farm bins for 5 months and they concluded that rapeseed with 8.5% or less moisture could be stored for 5 months in non-aerated bins without any spoilage. Below 10% m.c. mould activity is low at Canadian storage conditions but some mould species can grow at higher canola temperatures (30–40 °C), even when the moisture content of canola is less than 8% (Sathya et al., 2009). Burrell et al. (1980) reported that, rapeseeds with 10.6% m.c. stored at 25 °C clumped together after 11 days of storage, and visible moulds were

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noticed after 21 days of storage. Deterioration of wheat at five moisture contents (15, 16 17, 18 and 18%, wet basis) stored at different temperature regimes was studied by Karunakaran et al. (2001), and they found that there were no changes in germination of 15 and 16% moisture content wheat stored at 25 °C for 70 days. But in high moisture (17, 18 and 19%) wheat, germination decreased with the increase in storage time. Ochandio et al. (2010) stored dry canola seeds (6% moisture, wet basis) in silo bags without any quality deterioration for 12 months in Argentina, but Rodriguez et al. (2004) reported significant change in FAV of high moisture sunflower seeds (16.4%, wet basis) in 160 days of storage in silo bags. Safe storage guidelines for wheat, rye and canola (Nithya et al., 2011; Sathya et al., 2008, 2009) also recommended shorter storage times for high moisture products. Similar studies have not been conducted under Canadian conditions, so, it is necessary to determine the safe storage guidelines in silo bags of canola loaded directly (at any moisture content) into the silo bag without any prior drying. The objectives of this study were to determine the changes in grade and quality of 12% m.c. canola after storing for 20–24 weeks (unloaded in winter), 28–32 weeks (unloaded in spring) and 40 weeks (unloaded in summer).

2. Materials and methods

2.1. Materials

For the first year study (2011–12), canola seeds (Grade: Canada No.1) with 12.1% moisture content were received from Richardson Pioneer grain elevator, Dauphin, Manitoba on September 29, 2011, and loaded into three bags. Each bag was loaded with approximately 67 tonnes of canola seeds using grain bag loader, and lengths of all three bags were 21 m each. Bags used for this study were 2.74 m diameter and 238 μm thickness, and had 10% stretching capacity while loading (Manufacturer: IpesaSilo, Ciudadela, Argentina). For the second year experiment (2013–14), 12.4% m.c. canola seeds were received from the same grain elevator on October 11, 2013. To prevent the damage to silo bags from the mice and other rodents, agricultural lime (calcium carbonate) was spread on the ground before silo bags were loaded with canola seeds (Fig. 1). To check the effect of location along the length of bag (head, centre and tail portions) on canola quality parameters, seed samples were collected at three different locations along the length of each bag: 4.6 m from the tail (referred to as T), centre (referred to as C), and 4.6 m from the head of the bag (referred to as H) (Fig. 2). Seed sampling ports were created by placing PVC nipples with bulkhead fittings into the bags. These nipples were closed at the end with caps; and the cuts made for inserting these fittings were

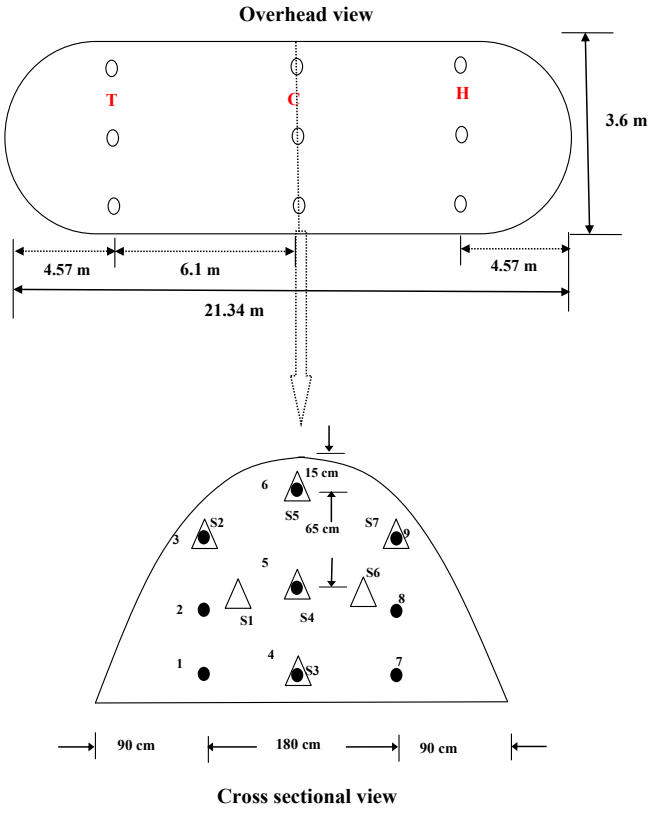

Fig. 2. Plan and cross sectional view of bags with sampling locations (△S – seed sampling locations;●- temperature measurement locations and CO_2 collection locations).

Fig. 1. Application of agricultural lime on the ground during loading of silo bags.