K-STATE
Research and Extension

Soy-Protein: An Environment-Friendly Seed Lubricant For Pneumatic Row Crop Planters

Introduction

Seed lubricants have been used for many years to keep seeds from clumping together during planting. The most common seed lubricant has been a combination of graphite and talc, but this product can be abrasive to the insecticide coatings on seeds. This can result in a dust that is harmful to pollinators and people. Recent research indicates that soy protein is an effective, economical, and environmentally friendly seed lubricant. This fact sheet provides information to help producers make wise choices about seed lubricants.

What are seed lubricants?

Pneumatic meters on row crop planters have been shown to have more accurate seed singulation compared to traditional metering systems. Seed singulation can be enhanced using seed lubricants to improve seed flowability by reducing friction between the seeds and components inside the metering unit. Flowability is the ability of the seeds to slide seamlessly inside the seed metering system, while singulation is how the metering system delivers individual seeds accurately from the metering unit to the ground.

During planting, pneumatic planters take in large volumes of air. Under humid conditions, the neonicotinoid insecticide coatings can readily absorb water vapor from the air coming into the metering system. As they absorb moisture, the seeds start to clump together, leading to problems in singulation and flowability. Therefore, most planter manufacturers recommend the use of seed lubricants, and it has been a standard practice for growers during planting. Currently, commercially available seed lubricants use graphite, talc, or a combination of both in varying proportions.

Graphite is a naturally occurring mineral with very low hardness and a distinctive greasy feel, which makes it an excellent dry lubricant. Talc is known as the softest mineral and drying agent because of its ability to absorb moisture. When talc and graphite are combined, they can be an excellent anti-bridging material and seed lubricant, providing the optimum seed drying capabilities and lubrication between the seeds and mechanical components.

Seed lubricants are typically added at several levels as the hopper is filled with neonicotinoid treated seeds (Figure 1). This allows the seed lubricants to evenly adhere to all seeds, providing the necessary lubrication during the metering process.

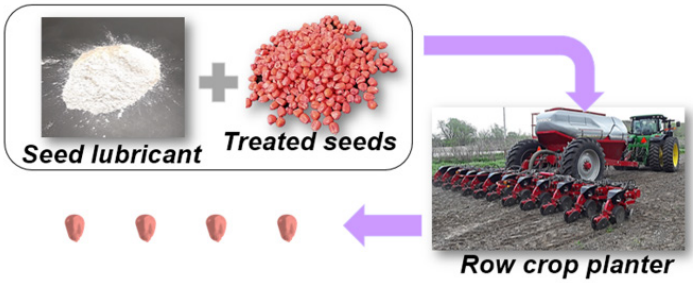

Figure 1. The addition of seed lubricant to seeds in row crop planters to enhance seed flowability and singulation during planting.

What are neonicotinoids?

Bayer CropScience introduced neonicotinoid insecticide in the 1990s, and it has since become the world's most widely used group of insecticide. Neonicotinoids are systemic insecticides, which means that plants absorb it usually through the roots and transport the chemical to the rest of the plant parts. This action helps protect the plant from a wide range of pests, from boring to root-feeding pests. Usually, neonicotinoid insecticide is applied as a seed treatment but it can also be used in the form of granules, sprays, or a mix to combine with irrigation water.

Between 2003 and 2011, a rapid increase in neonicotinoid use accounted for more than 40% and 90% of hectares of soybeans and corn, respectively, treated with this insecticide. The increased use of systemic insecticide has been associated with the contamination of air and the surrounding environment. Studies (Xue et al., 2015, Bonmantin et al, 2015 and Krupke et al, 2012) have reported that seed lubricant abrades seed coatings, which are then expelled into the air during planting. Exposure to these toxic seed treatment compounds containing neonicotinoids are harmful to bees and pose a potential health hazard for people.

Effects from neonicotinoid exposure

Although talc and graphite have been effective in improving seed flowability and singulation, residual talc taken from metering units and dust samples behind the planter during planting (Figure 2) contains significant concentration of seed treatment compounds that far exceed the level known to be lethal to pollinators. The pest management regulatory agency (PMRA) in Canada reported deaths of bees were likely due to contaminated dust based on detection of residual insecticide on dead bees. In fact, the agency already prohibited the use of talc and graphite as a seed lubricant for pneumatic planters when planting seeds treated with neonicotinoid insecticides (Health Canada, 2015).

Similarly, the presence of neonicotinoids in food and water raises concerns about their potential health hazards for humans. The ability of these insecticides to interfere with brain and nerve structure could possibly impair the development of the human nervous system (Cimino et al, 2017 and EFSA, 2014). Although further study is needed to support the results, pervasive use of these toxic seed treatment compounds is certainly causing adverse effects to non-target organisms. Thus, the need to identify control measures to reduce neonicotinoid exposure to pollinators and humans is extremely important.

Figure 2. Dust behind a pneumatic planter during planting which may contain residual seed lubricant and seed treatment coatings.

Alternative seed lubricant

At present, the PRMA recommends the use of an alternative seed lubricant called the Fluency Agent. Bayer Crop Science introduced this seed lubricant as an alternative to talc and graphite. This seed lubricant is made up of polyethylene-wax-based powder developed to reduce the dispersal of contaminated dust into the atmosphere during planting. However, preliminary reports by the Corn Dust Research Consortium (CRDC) showed no difference between fluency agent and talc/graphite in reducing dust and active ingredient emission during planting (CDRC, 2017). Moreover, the consortium also showed in their final report that there is little evidence of reduction in insecticide leaving the planter compared to talc and graphite. The report suggests the abrasiveness of these seed lubricants is scraping away the seed coatings, which can be due to the irregular particle shape of talc and fluency agent as revealed by the result of particle analysis (Figure 3). This property of seed lubricants creates a sliding action between particles, making them abrasive (Badua et al, 2018). One recommendation to minimize contaminated dust released during planting includes using a less abrasive seed lubricant (CDRC, 2017).

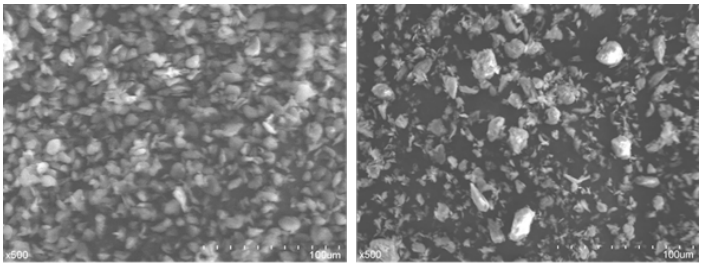

Figure 3. Particle shape of commercially available seed lubricants (magnified at 500X)

What is soy-protein?

Recently, an environmentally friendly material has been developed as a potential alternative seed lubricant. Soy-protein isolate is one of the byproducts after dehulling and defatting soybeans. It contains phospholipids, which are associated with lecithin, (Samoto et al., 2007) a substance that can be used as an emulsifier, stabilizer, and lubricant. Its biodegradability, abundant supply, renewable source, and low cost means soy protein can be used extensively in many industrial applications. Moreover, soy-protein is an ideal source of amino acids acting as a biostimulant for the plant, leading to better seed germination and biological activity (Popko et al., 2018). As a seed lubricant, soy-protein contains more than 99% hydrolyzed isolated soy protein powder with less than 1% soy lecithin added to the particle surface. The particle shape of the powder is spheroid (Figure 4) with the average particle size ranging from 90 to 100 microns.

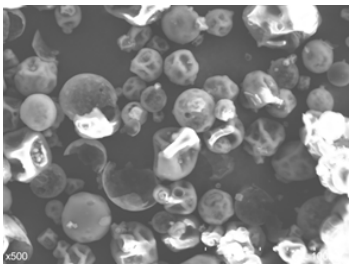

Figure 4. Particle shape of soy-protein (magnified at 500X)

Laboratory experiments

A study was conducted at the Biological and Agricultural Engineering Department at Kansas State University aimed to quantify seed flowability of corn and soybean seeds and economic viability of soy protein as an alternative to commercially available seed lubricants (Talc and Fluency

Agent). Corn and soybean hybrid varieties from Ohlde and Pioneer were used in the study. Results highlighted the potential of soy-protein seed lubricant to provide the desired seed flowability similar to other commercially available seed lubricants.

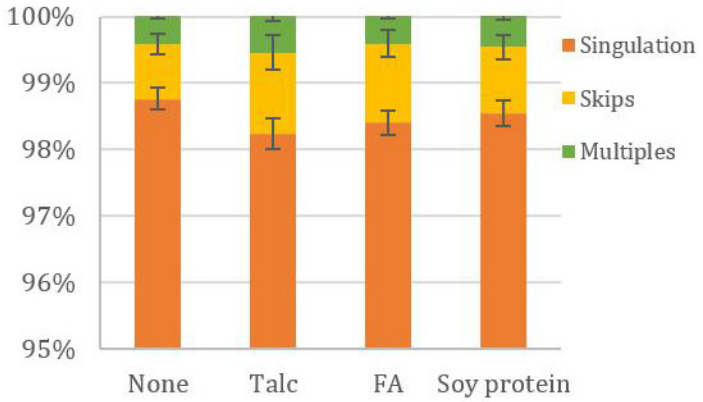

Figure 5. Corn % singulation, % skips and % multiples for each seed lubricant.

The study reported no significant differences on singulation, skips, and multiples across seed lubricants when metering corn, (Figure 5) while fluency agent and soy-protein resulted in comparable singulation and the lowest skips and multiples for soybeans (Figure 6).

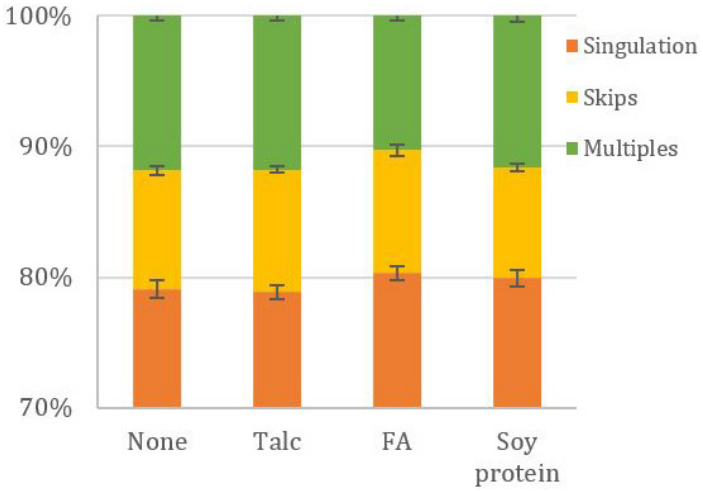

Figure 6. Soybean % singulation, % skips and % multiples for each seed lubricant.

The ability of soy-protein to provide comparable flowability can be due to its lecithin content. Spheroidal particles of soy protein also act as a roller bearing between seeds, potentially reducing abrasiveness of the material and minimizing dust containing seed coatings released during planting. Further laboratory tests were performed to quantify the amount of dust generated when seeds are mixed with talc and soy-protein. Results revealed that without seed coating, a small amount of dust was generated but applying a seed coating reduced production of dust. However, mixing talc significantly increased the dust produced compared to soy-protein. These results are consistent with published reports (Bonmantin et al, 2015 and Krupke et al, 2012) suggesting talc enhances the production of contaminated dust.

Table 1. Laboratory test results on dust produced when mixing seed lubricants to treated seeds.

Sample ID	Dust Amt per 100g (g)	Dust/ 100,000 Seed (g)	seeds/lb	Mean dust per 100kg (g)
No seed coating	0.00150	0.34	1982.1	1.50
Treated seed only	0.00006	0.014	1963.6	0.06
Treated seed + Talc	0.03683	8.34	2002.6	36.83
Treated seed + Soy Dry Lubricant	0.00296	0.64	2109.8	2.96

Usage cost

Simple cost analysis showed that talc had the lowest cost of usage per acre followed by soy-protein and fluency agent. Soy protein is 63% less expensive as compared to Fluency Agent. Although slightly expensive by 44% compared to talc, the use of an environmentally friendly material for seed lubricant protects pollinators and the environment.

Table 2. Cost analysis of using the seed lubricants for corn and soybean

	Per Container		Seeding Rate, (seeds/acre)		Cost of Lubricant ($/acre)	
Seed Lubricant	Weight (lb)	Cost ($)	Corn	Soybean	Corn	Soybean
Talc	8.0	20.0	36,000	140,000	0.28	0.63
Fluency agent	4.4	108.5	36,000	140,000	1.36	3.01
Soy protein	11.0	49.5	36,000	140,000	0.51	1.13

Benefits

- Soy protein is biodegradable, providing greater value in environmental stewardship.
- Soy-protein is renewable and abundant in supply.
- Soy protein is an ideal source of amino acids for better seed germination and biological activity.
- Soy protein lubricant can potentially reduce abrasiveness and reduce release of neonicotinoids in the environment, saving bees and enhancing natural pollination.
- Soy protein provide comparable flowability and singulation to commercially available seed lubricants.
- Low cost of usage per acre of soy protein seed lubricant increasing profitability for producers.

Summary

The use of seed lubricants has been a standard practice for corn and soybean growers to improve seed flow and singulation during planting. However, currently available commercial seed lubricants have been reported to increase

dust production, which emits significant amounts of insecticides in the air and threatening pollinators. Soy-protein derived from dehulling soybeans was developed as an alternative seed lubricant. Tests showed comparable singulation and flowability compared to talc and fluency agent. Further tests reported significant reduction in dust generated compared to talc.

In 2018, LowMuTech introduced Dust soy-protein seed lubricant in the market. More details can be found on their website https://lowmutech.com/product/dust/. For more information on other commercially available seed lubricants please visit the websites provided below.

More detailed information on commercially available seed lubricants

https://www.cropscience.bayer.us/seedgrowth/fluency-agent-advanced

https://jdparts.deere.com/partsmkt/document/english/pmac/6032_fb_TalcLubr.htm

https://agvsinc.com/products/precision-planting/seed-lubricants/graphite-powder/

https://www.slipplate.com/product/seed-slik-talc

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