Summary

This research project addresses the importance of developing bio-based lubricants, focusing on soybean oil as a next-generation bio-lubricant and its benefits for North Dakota soybean farmers. With increasing global concerns about the environmental impact and depletion of mineral oil, there is a growing need for alternative lubricants. Vegetable oils, including soybean oil, have gained popularity as potential base oils. This study aimed to develop high-performance lubricants by modifying high oleic soybean oil to enhance surface protection. The research involved conducting tests on regular soybean oil (RSOY), high oleic soybean oil (HOSOY), and modified high oleic soybean oil (BHOSOY). BHOSOY was produced by introducing isopropyl groups onto the double bonds of unsaturated fatty acids. The research revealed that BHOSOY exhibited improved oxidative stability (resistance to oxidation), lower pour point (temperature of solidification), and lower cloud point (temperature of cloudiness or haze appearance) compared to HOSOY and RSOY. In friction and wear tests, BHOSOY demonstrated a higher coefficient of friction due to its increased viscosity but showed more stable friction behavior in all conditions. Moreover, BHOSOY exhibited 10.6% greater wear resistance than HOSOY, indicating less material loss or damage under similar friction and wear conditions. Scanning Electron Microscopy based analysis showed that BHOSOY had no cracks or metal flakes in the flat samples tested at room temperature, while the other oil samples did. At high temperatures, BHOSOY exhibited significantly lower amounts of metal flakes compared to the other oils. The wear observed in the flat samples resulted from rubbing or abrasion between contacting surfaces. In the ball samples, adhesion wear occurred, with iron transferring from the flat samples to the ball samples, as confirmed by Energy Dispersive X-Ray Spectrometry and mapping analysis. BHOSOY demonstrated the lowest wear width for both ball and flat samples. The research holds significant potential benefits for North Dakota soybean farmers and the industry. By tapping into the market for soybean-based lubricants, farmers can increase profitability and stimulate economic growth. The utilization of soybean oil for lubricant production can create new opportunities, potentially leading to a surge in soybean market prices. Additionally, this research aligns with the growing demand for eco-friendly products and contributes to sustainable agricultural practices. In conclusion, this research project highlights the potential of soybean oil as a bio-based lubricant, offering improved performance, environmental compatibility, and economic benefits for North Dakota soybean farmers and the industry while contributing to sustainable agricultural practices.