AGR1118: Moving Forward to Sustainable Development of Saskatchewan Pulse Industry - [ong-¢erm Wesearch /ollaboration .etween Agriculture and Agri-Food Canada (AAFC) and Saskatchewan Pulse Growers (SPG)

Benefits of crop rotation on crop yield have been widely recognized in Western Canada, but how various crop rotations may affect soil health, environmental footprints, and long-term sustainability has not been documented. In this project, four-year crop rotations with 14 treatments were assessed at Swift Current, Saskatchewan, and at Brooks, Alberta, with each system tested for three cycles. Also, pea-canola intensified rotation systems with various cereals were grown at Indian Head, Saskatchewan, with six rotation patterns. All rotation sequences are replicated four times. Results showed that across three cycles of the experimentation, field pea (P) and lentil (L) as previous crops or intensified field pea (P-P-P-W) and lentil (L-L-L-W) rotations with wheat (W) had highest soil water in the 60-90 cm layer. Field pea and lentil previous crops and intensified rotations (P-P-P-W and L-L-L-W) had the highest total nitrogen at 30-60 cm and 60-90 cm soil depths, and wheat previous crops and wheat-based rotations (W-W-W-W, P-W-W-W, C-W-W-W) had the lowest. Grain yield of wheat preceded by field pea and lentil increased by 26% and 18%, respectively, compared with wheat preceded by wheat. Field pea (P-W-P-W and P-P-P-W) and lentil (L-W-L-W and L-L-L-W) intensified rotations had a significantly greater yield over continuous wheat or rotations that included one pulse crop in wheat-based systems (P-W-W-W and C-W-W-W). A lentil-wheat alternate year rotation system has been in place since in 1979 at Swift Current. The data from 25-yrs (1979-2005) show that this lentil-wheat rotation system had the lowest carbon footprint at a value of -540 kg CO_2 eq ha^{-1} annually. This is due to a lower rate of N fertilizer being applied to the wheat crops grown after the lentil, which fixes N from the atmosphere. In the dry ecoregions, soil dehydrogenase activity is a main indicator of overall soil microbial activity. Soil dehydrogenase activity during phase four of the four-yr rotation systems revealed that soil microbial activities were significantly improved in rotations with two pulses every four years (P-W-P-W, L-W-L-W and C-W-C-W) compared to continuous wheat or rotations with one pulse every four years. The inclusion of pulses into rotations promoted higher soil microbial activity. Arbuscular mycorrhizal (AM) and non-AM fungal root colonization was significantly higher in the rotations including two or more pulses (> 65% root length colonization) and lowest in rotations where wheat was grown for at least two consecutive years (<40% root length colonization). Continuous wheat rotation had a significantly higher abundance of *Verrucomicrobia* colonizing wheat roots compared to all other treatments. The rotations with three consecutive pulses (P-P-P, L-L-L and C-C-C) generally had an increased relative abundance of *Microbacterium*, *Arthrobacter*, *Massilia*, *Friedmanniella*, *Blastococcus*, and *Blastocatella*. However, the consequences of this shift of bacterial communities are not known. A significant drop in fungal richness and diversity was observed in rotation with increased intensification of pulses. The continuous wheat rotation and rotations with only one pulse every four years (P-W-W-W and C-W-W-W) had the highest fungal richness and diversity, and the lowest levels were observed in the rotations with three consecutive pulses (P-P-P-W, L-L-L-W and C-C-C-W). At the phyla level, the rotations with three consecutive pulses were characterized by having a higher abundance of *Ascomycota* and lower abundance of *Basidiomycota*, *Zygomycota*, and *Chytridiomycota* in the soil compared to continuous wheat and rotations with only one pulse every four years.