

## Designing resource efficient, resilient cropping systems

Martin H. Entz

Jarislowsky Chair in Natural Systems Agriculture for Climate Solutions

Department of Plant Science

University of Manitoba

Cropping systems use both natural and human-made resources. The efficiency with which these resources are used dictates a system's profitability, and its resilience to abiotic (drought, heat, excess water, salinity, soil compaction) and biotic (eg., pest attack) stresses. The presentation begins by distinguishing between natural and "store-bought" resources. I begin with the efficiency of the big-ticket items like N fertilizer. What are options to reduce N fertilizer use in the hopes of increasing fertilizer efficiency? Spoiler alert – it involves more intensive use of legumes, smart manure management and even livestock integration. Today's spot spraying technology can increase herbicide use efficiency, but let's not forget the competitive ability of crops like oats, winter cereals, annual forages and others. I will review our early work on "Pesticide-Free Production", where the economics of herbicide use was improved by strategically skipping applications on certain crops. I will then shift to the "free" resources like sunshine/photosynthesis, rain/snow, wind and prevailing temperature. What can be done to increase their efficiency and does it pay? Examples of systems that make better use of these free resources include winter crops; mixed and strip intercropping; agroforestry and vegetative barriers; and site-specific crop planting (called pixel farming). I will draw on our recent work from the Ian N. Morrison Research Farm where a 4-year no-till rotation that included 1) fall rye grain with cover crop; 2) corn/soybean grain intercrop; 3) pea/canola grain intercrop; and 4) a mixed species cover crop had the same profitability as a wheat-canola-soybean rotation when grown under severe drought but used half as much N fertilizer (see Curtis et al. 2024. Cropping system typologies perform differently under climate stress in Manitoba, Canada: multi-criteria assessment. *Canadian Journal of Plant Science* available on google scholar). I will end with some thoughts on "planning" vs "design". Thinking of ourselves as designers instead of planners "improves our understanding" and provides a stronger foundation for the creation of more resilient and resource efficient cropping systems.