

## Brassica oilseeds – underpinning diversity and productivity in global cropping systems

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Brassica oilseeds are generally grown in cereal-dominated cropping systems where the rotational benefits in weed and disease control form a significant part of the value to the farming business and a major driver for adoption. The wide adaptation of brassicas to most soils on which cereals are grown means the benefits are widespread. In a global review, the yield benefit to the following wheat crops compared to wheat after wheat consistently averaged  $0.80 \pm 0.17$  t/ha with a further 0.14 t/ha benefit persisting to a second cereal crop. In Australia, the profitability of the canola provided incentive to apply lime to acid soils, increased the responsiveness of subsequent disease-free wheat crops to applied nitrogen, and facilitated the adoption of earlier-sown, stubble-retained, no-till farming systems – a synergy of agronomic practice that increased both the profitability and sustainability of the entire farming system. As herbicide resistance in weeds emerged in intensive, no-till systems the availability of herbicide-tolerant canola varieties has added further flexibility to weed management programs.

In mixed crop-livestock farming systems, the use of Brassica oilseeds (predominately canola) as a dual-purpose graze-grain crop is relatively new. In Australia, dual-purpose canola is sown early, grazed by sheep for 4-8 weeks in autumn and winter and if carefully managed, recovers to provide high seed yields in good seasons, or can be grazed out or cut for hay in dry seasons. This improves flexibility, profitability and reduces risk in variable climates, with 200,000 ha of canola grazed annually in Australia and farm level profitability increasing by around \$100/farm ha/yr. Significant areas of canola are also grazed by cattle on the US Great Plains.

Brassica oilseed intercrops and cover crops provide further diversification opportunities in farming systems globally. The intercrop benefits of Brassica-legume mixtures are being increasingly recognised. Brassicas scavenge soil N effectively, increasing N fixation by the legume. They provide a trellis to support the legumes to reduce lodging and improve harvestability and can reduce the epidemics of legume fungal disease. Brassica species (rape, mustard, radish, turnip) have been grown as vegetative cover crops grown between cash crops for soil protection or improvement with roles complementing legume and grass species in reducing N leaching (deep roots, high N uptake), suppressing weeds and disease (biofumigant properties) and in soil structural improvement (tillage radish). More recently, short-season winter-hardy forms of a range of minor Brassicaceae oilseed crops, such as Carinata (*Brassica carinata*), Camelina (*Camelina sativa*) and Pennycress (*Thlaspi arvense*) are being deployed as oilseed cover crops between the corn/soy summer crops in North America, providing a sustainable intensification option to generate low carbon intensity renewable fuel feedstocks that do not compete against food crop production.

The significant system level benefits of Brassica oilseeds are at risk of being undermined in some global production systems by intensification of production in close rotations (1 year in 2). The strategic use of legumes in intensive cereal-Brassica systems is being encouraged and is proving effective to maintain and build on the production and environmental benefits of more diverse production systems.