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The Innovative Oilseed: sustainably feeding and fuelling a growing world

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Agriculture faces many daunting challenges over the coming decades. However, these also signal great opportunities for agribusiness, research and innovation. The imperative of growing sufficient nutritious food for 10 billion people must be achieved within the boundaries of environmental stewardship and greenhouse gas emissions. Agricultural production accounts for about 8-9% of total GHG. However, the global food system including land use changes, transport and waste accounts for 25% of GHG emissions. Therefore, agriculture must find ways to reduce these net emissions even while the population increases, and available arable land remains static. How can rapeseed (and its close relatives) help to address this problem?

A major innovation involving rapeseed happened in the late 1990s: the introduction of herbicide-tolerant Canola. This development allowed no-till agriculture on millions of hectares of land in Canada. This has resulted in net-zero emissions in Saskatchewan's crop sector by 2016 due to retention of soil carbon. Continued progress with these innovative oilseeds now includes pod-shatter resistance, production of renewable biofuels, biosynthesis of healthy long chain omega-3 oils and the use of *Brassica* cover crops to conserve soil carbon and permit double-cropping.

Pod-shatter resistance has proven to be a highly valuable trait to growers. While it protects against yield loss under a variety of conditions, it also provides a degree of flexibility to the grower at harvest with cutting/swathing and timing. In the EU, estimates of the value of avoiding pod-shatter are between €30-150 per hectare on grower net profits.

Policies around climate change and fossil fuels have encouraged the use of *Brassicaceae* oilseeds as feedstocks for renewable biofuels. This has mainly involved an increasing utilisation of rapeseed oil as feedstock in the expanding biodiesel, renewable diesel, and sustainable aviation fuel (SAF) markets. However, rapeseed/canola production is now responding to this opportunity by expanding into new winter cropping zones, such as in the US. Additionally, previously underutilised *Brassicaceae* oilseeds such as *Brassica carinata*, *Thlaspi arvense* and *Camelina sativa* are being developed and deployed as valuable, low carbon intensity cover crops. This development enables fuel oil feedstocks to be produced by intensifying existing cropping systems rather than by competing with food crops and opens up the ability to produce diversified *Brassica* oilseed products for new food and industrial use in these specialised crop platforms.

One of the most innovative developments involves the metabolic engineering of lipid biosynthetic pathways to produce a terrestrial source of long-chain omega-3 fatty acid oils such as DHA and EPA. This provides a near inexhaustible source of these healthy oils, relieving the relentless environmental pressure on wild-caught fish, which has been the traditional source of these important dietary lipids.

Innovation using *Brassica* oilseeds is providing a playbook for how food and agriculture can adapt to and mitigate the threat of climate change and resolve other environmental challenges. For farmers across the globe, *Brassica* oilseeds will continue to be crops of choice with enhanced returns and exemplary environmental credentials.