Tackling pests and climate change

Global rapeseed production today stands at some 70M tonnes, with the crop enjoying a price premium above other oil crops. However, pest and disease control and climate change are some of the challenges facing producers

Serena Lim

The yellow fields of rapeseed across Europe and major global producer Canada are an iconic sight but could genetically modified red rapeseed, smelling of lavender, be seen in the future?

This was a tongue in cheek comment made by Samantha Cook of the UK's Rothamsted Research at the 15th International Rapeseed Congress (IRC) in Berlin held on 17-19 June.

Cook, who is a behavioural ecologist, was talking about how pollen beetles – one of the major pests attacking rapeseed – were attracted to yellow and fluorescent green and blue colours. If canola was modified to be red, it would attract less pests.

Lavender was also the most repellent smell for pollen beetles. In a trial, canola plants sprayed with its scent attracted far less pests than canola is a control field, although that would be an expensive solution to the pest problem.

Pest and disease control is one of the major issues facing rapeseed producers today, the congress – which attracted 850 delegates from 43 countries, was told.

"Today, oilseed rape/canola is one of the major sources of edible oil in the world," said Wolfgang Friedt, president of the congress organiser, International Consultative Group of Research on Rapeseed (GCIRC). "The total rapeseed acreage amounts to nearly 34M ha, from which almost 70M tonnes of rapeseed are produced every year." (*see Figure 1, p24*)

However, rapeseed cultivation was confronted with major challenges worldwide including control of diseases and pests; adverse climate conditions such as dryness and heat; and new breeding techniques which faced political opposition in Europe.

Hubertus Paetow, president of the German Agriculture Society, said Germany's total rapeseed acreage of 880,000ha had reached a historic low and average yields had fallen in the last five years.

"The reasons are complex. A major factor has been density of cultivation, which has encouraged pests and diseases such as clubroot. The EU's ban of neonicotinoid weedkillers has reduced options to combat insects".

There was resistance to alternative pyrethroid insecticides and stricter crop protection regulations were likely to come into force in the rest of world.

"New active ingredients must be developed but there are fears that the efforts required to develop new chemicals may become too burdensome for developers."

Pest and disease

Andreas von Tiedemann of Germany's University of Göttingen told the congress that pests and diseases were the key constraint on the productivity of rapeseed.

"We have seen declining yield trends in Europe and Australia since 1995 in spite of continuous genetic improvements (*see Figure 2, p24*). This is partly explained by the diverse prevalence of pests and diseases in the four global cropping regions for rapeseed."

Chemical control was a key factor in control but compromised in Europe by the neonicotinoid ban and developing resistance to insecticides.

The university conducted a global survey of pests and diseases in the EU, Australia, Canada, China and India and identified 16 diseases and 31 insect

Rapeseed/canola: producers and neonicotinoids

Canola and rapeseed belong to the cabbage or mustard family. Canola was registered in 1979 in Canada and refers to a variety of rapeseed bred through traditional plant cross-breeding to remove glucosinolates and erucic acids, considered inedible or toxic in high levels. Canola has less than 30 micromoles of glucosinolates and less than 2% erucic acid.

The leading global producers of rapeseed/canola and their approximate production are: Canada (21M tonnes); the EU (19M tonnes); China (13M tonnes) and India (6.6M tonnes), Australia (3.4M tonnes) and the Ukraine (*see Figure 1, p24*)

In 2013, the EU severely restricted three kinds of neonicotinioid pesticides (clothianidin, thametoxam and imidacloprid) on bee-attractive crops including maize, oilseed rape and sunflower, to protect honeybees. The ban was widened to all outdoor use in May 2018.

pests, plus slugs and nematodes, affecting rapeseed.

"This is quite a remarkable list for a relatively young crop."

Five diseases and nine pests were identified in the seedling stage; 12 diseases and 16 pests were identified in the stem elongation to flowering stage; and three diseases and four pests were identified in the mature stage.

In Europe, the most affected region in terms of pests, 16 insects were identified including the cabbage stem flea beetle, pollen beetle, cabbage seed weevil, cabbage stem weevil, rapeseed stem weevil and brassica pod midge. Major diseases included clubroot, sclerotinia, blackleg, verticillium and light leaf spot.

Chemical control and crop rotation were the main tools used to combat pest and disease. With fungal diseases, there were 16 active chemical ingredients available today, and pathogens were bound to the field, making crop rotation more effective.

"However, we are in a critical situation in terms of insect control."

Insecticide resistance was growing, particularly in flea beetles, pollen beetles and aphids.

Crop rotation was also a blunt sword against migrating insects, depending on their life cycle and mobility.

Flea and pollen beetles, the rape stem weevil, brassica pod midge and aphids were not field-bound and could move across more than 10km, to a neighbouring farm or in natural habitats.

"The only way to manage migrating insects is to think on a landscape level."

Crop rotation needed to be synchronised on regional scale, defined by natural boundaries such as forests and mountains, with break years, he said.

Cook described how 5% of the UK rapeseed crop was lost when the EU neonicotinioid ban came into force in 2013, and how there had been a 12% reduction in UK oilseed rape since.

She advocated an integrated pest management (IPM) approach.

This included setting an action threshold when an acceptable level of pest and disease was exceeded, and monitoring plants. Prevention methods included using crop rotation, pest resistant cultivars, pheromone repellents and intercropping.

Control methods included biological control such as planting crops to attract pests away from rapeseed, the use of natural enemies such as spiders, and the use of pesticides, when necessary.

Climate challenges

John Kierkegaard from Australia's Commonwealth and Scientific and Industrial Research Organisation (CSIRO), described the agronomic challenges in adapting canola into the world's cropping systems.

Rapeseed was a valuable break crop when planted with wheat. It broke soil-borne wheat pathogens and helped control weeds, with wheat seeing a 0.8 tonne/ha yield advantage as a result, he said.

Kierkegaard said Australia grew canola on 2.5M ha of land, with a yield of 1.4 tonnes/ha. It produced some 3.4M tonnes of rapeseed, exporting 80% of its crop as the number two global rapeseed exporter.

He said canola was first grown in medium rainfall areas with less heat.

However, Australian farmers were planting canola in dryer areas more dominated by cereal production, with less than 325mm of rain, as a break crop for cereals.

"You have to rethink agronomy when you move to dryer areas," he said.

In the last five years, Australia had moved to earlier sowing systems because of climate drivers. Autumn sowing rains in May were declining. Frosts in August were more variable and unpredictable. And spring weather when canola flowered was getting hotter.

Kierkegaard said earlier sown crops could cover the ground, reduce evaporation and had deeper roots to access moisture. Experiments were carried out between 2014-2019 and, overall, risks were reduced moving to earlier sowing.

Early sowing was carried out at the start of April, compared with the old system of late April/early May, and had resulted in a yield increase of around 1 tonne/ha, with about half of leading farms in Australia already moving in this direction.

Kierkegaard said strategic tilling was also used in parts of Western Australia.

"Australia is the biggest adopter of no till farming" but faced multiple issues including a water repellent topsoil, herbicide resistant weeds, compact soil and an acid subsurface leading to poor canola establishment.

"Once the soil is disturbed, it can support much better crops," Kierkegaard said.

In Australia's wetter areas with rainfall above 550mm and long seasons, famers used European winter canola to provide several months of grazing for sheep and cattle on the farm.

Early sowing increased the number of grazing days, with good grazing management taking animals off the yield at the right time to prevent yield loss.

"Grazed canola is one of most profitable things farmers can do in Australia."

Moving to other parts of the world, Australia's phenology suited the growing of rapeseed in the lower latitudes of South America very well, Kierkegaard said.

In Brazil, rapeseed was grown on 348,710ha of land but a potential 10.8M ha was available for cultivation.

Areas in Brazil suitable to grow canola had 1,000-2,000mm of rainfall.

"The agronomic challenges in Brazil are the opposite to Australia, with high rainfall and more disease; frost at higher altitudes; and nitrogen loss due to high rainfall.

Brazil grew soyabean and maize in the summer months. In the cool season, a second maize crop could be grown but it was more sensitive to frost than canola.

In that context, fitting in canola in a short growing window, with a short cycle and blackleg resistance, had potential.

Production costs

Yelto Zimmer of Argi Benchmark compared rapeseed with other oil crops, saying that rapeseed traded at a premium of about US$50/tonne over other oils.

The application of nitrogen fertiliser was a key economic cost in rapeseed production, and was also a relevant factor in terms of greenhouse gas emissions, he said.

Australians applied about 50kg/ha of nitrogen, compared with 230kg/ha among German, Danish, French and UK farmers.

Other major production costs included seeds, other fertilisers and crop care chemicals. This totalled around US$600/ha in the EU, US$200-250 in Australia, with Canada and Ukraine in between the two.

Canola protein

Curtis Rempel, vice president, crop production and innovation, at the Canola Council of Canada, talked about increasing the value of canola meal, describing how a canola seed comprised 43% oil, 22% protein and 30% of substances with no ▶

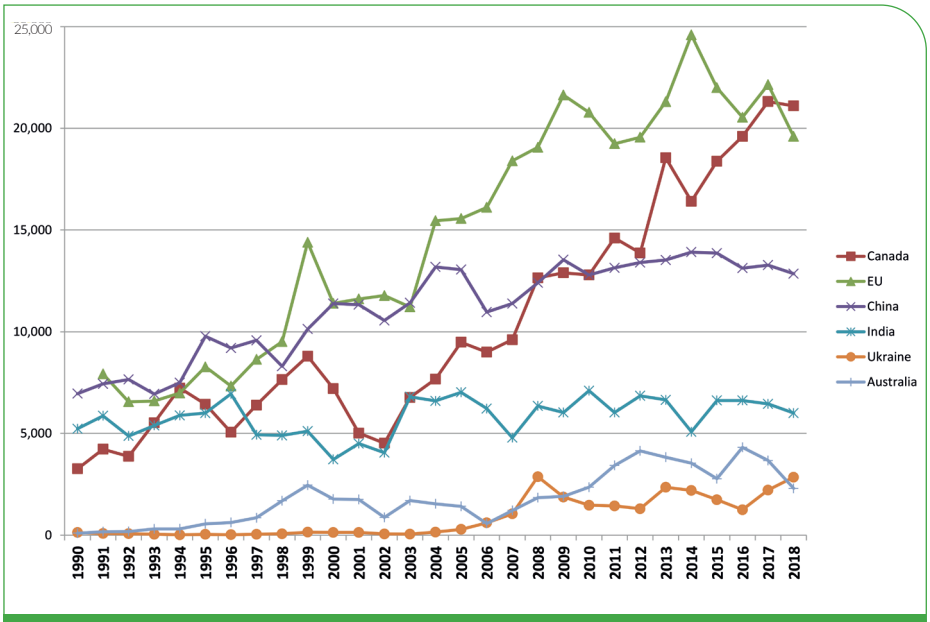

Figure 1: International canola/rapeseed production ('000 tonnes)

Source: Canola Council of Canada

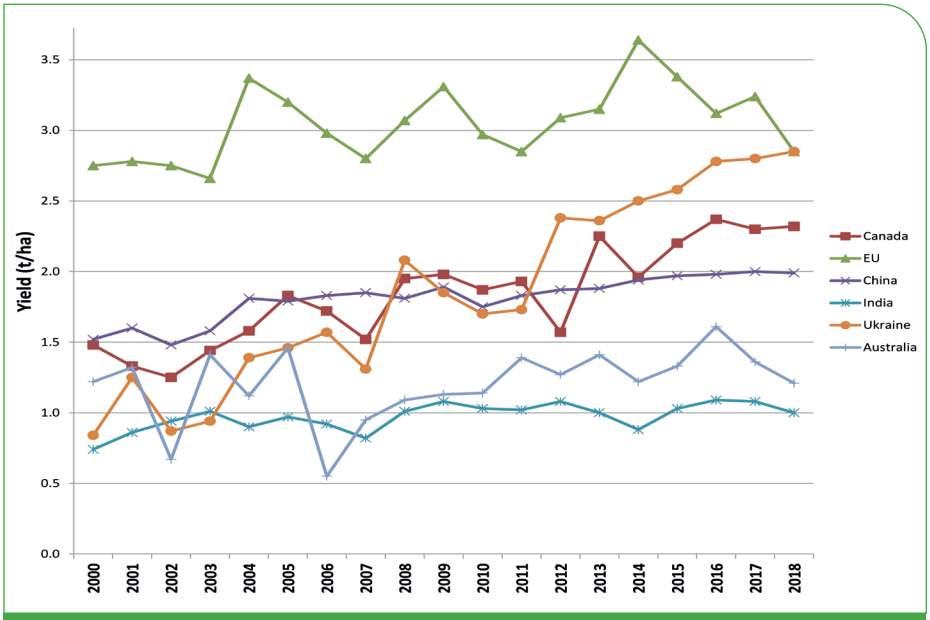

Figure 2: International canola/rapeseed yield (tonnes/hectare)

Source: Canola Council of Canada

▶ value (*see Figure 3, previous page*).

To increase the value of canola, a breeder had to increase its protein content and quality; decrease anti-nutritional compounds such as myrosinase, phytate and glucosinolates; and maintain or increase its oil content.

Literature and discussion with breeders indicated that it was possible to boost oil content to 48-50% seed oil and 27% seed protein without a yield drag, but an increase in nitrogen fertiliser was needed to achieve this.

In terms of protein content, canola meal competed with soyabean meal, selling for about 60% of soya's price and with 75% of the protein content of soyabean meal.

Rempel said the animal feed protein market was growing at 3.3% CAGR. World poultry demand was increasing, requiring higher protein in feed, and the 2.5M tonnes aquaculture market was valued at US$3bn, with fish meal supply declining.

Front-end dehulling could be used to mitigate seasonal and location variability in canola protein content. Using this in combination with a high protein seed could open access to previously unobtainable markets, such as aquaculture.

Dehulled, high protein canola meal could achieve higher protein and lower levels of difficult-to-digest acid detergent fibre (ADF) than soyabean meal, he said (*see Figure 4, previous page*).

New product streams such as the use of canola proteins in food and biodegradable biocomposites for food packaging use could also add to canola's value.

"New commercial product streams translate to $US1,500-$12,000 tonne of product value versus US$340-$500/tonne from current conventional processing." ●

The 16th International Rapeseed Congress will be held in Sydney, Australia on 24-27 September 2023

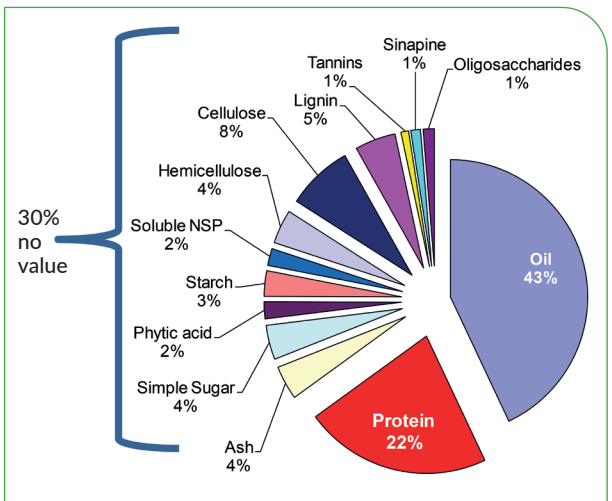

Figure 3: What's in a canola seed?

Source: Canola Council of Canada

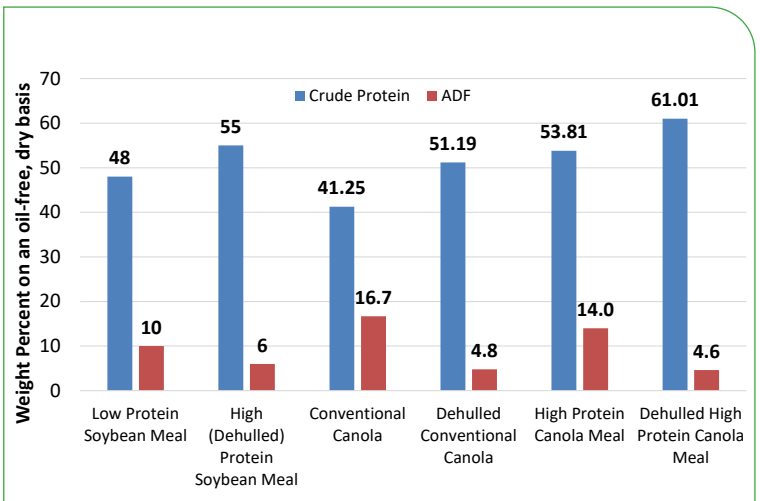

Figure 4: Canola meal versus soyabean meal

Source: Canola Council of Canada