Flat Pulses in a Flat Land – What's on the Horizon?

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Introduction

One of the long-term goals of research and development efforts for pulse crops in the flat land of Saskatchewan is to achieve an economically sustainable cropping system in which annual pulse crops occupy 20-25% of the cropping base. This goal will never be achieved with a single pulse crop because individual pulse crop markets are too small. Market structure for pulses is diverse. Customers demand specific sizes, colours, shapes and quality. At the same time, Saskatchewan has a wide range of agricultural ecosystems that determine where specific pulse crops have optimum adaptation. So in the long run, we are really trying to develop a crop economy in which a choice of at least 2 annual pulse crops can be profitably grown on any farm in Saskatchewan. Some regions may be able to sustain 3 or 4 pulse crops. Within each crop, access to varieties in a wide range of market classes will be necessary to optimize market opportunities. This vision of the future implies that research efforts for pulses will need continuous focus on genetic improvement for specific regions and market classes, on development of specific agronomic systems to maximize quality and yield, and on development of systems of identity preservation that can meet the needs of all markets around the world.

Of the five major world pulse crops that can be successfully grown in Saskatchewan, seeds of lentil, dry bean and faba bean tend to have a flat shape in comparison to pea and chickpea. The following discussion focuses on some of the genetic improvement research and development that should have some impact on these crops in the next 3 to 5 years. One of the themes of this discussion will be the issue of seed shape.

Lentil

Plant breeding efforts for all crops usually incorporate various objectives that involve yield, quality and disease resistance. In the context of pulses, we can also include the objective of improved adaptation. Lentil was originally developed as a crop in winter cropping systems in Mediterranean climates. This makes the northern temperate climate exotic relative to the original zone of adaptation. Most of the original genotypes grown in Saskatchewan originated from northern temperate Eurasia, so we have not fully exploited the genetic variation of most of the world's lentils. One of the recent trends in local lentil breeding is development of red lentil varieties that can be grown further north to take advantage of higher yield potential. This will make the crop more competitive in global markets in comparison to Turkish and Australian export origins.

We are entering a phase of major improvements in red lentil varieties in terms of disease resistance, quality and yield. The variety Crimson has been the dominant red lentil export product from Canada until now. It is acceptable in most of the mainstream markets for split red lentils. The variety CDC Robin is a specific market class intended for specific markets in South Asia. Crimson will soon be replaced by varieties like CDC Blaze that have better resistance to ascochyta and reduced lodging. A second round of significant genetic improvement is about to occur with the release in 2004 of breeding lines like 1254S-1 that have improved lodging, greater height, resistance to both ascochyta and anthracnose, and most importantly, seed shape that is more plump. Around the globe, splitting mills show preference for red lentils with rounder shape, similar to those available from Turkey. Seed shape is one of the key features that determine the efficiency and final quality of decorticated whole and split red lentils. We know from breeding experience that seed shape can be genetically controlled, probably by just a few genes. We have systematically introduced genotypes with improved seed shape into the breeding program, taking care not to reduce yield potential or reduce disease resistance. The red lentil breeding program has been designed to rigorously select for seed shape. Through the Saskatchewan Pulse Growers variety release program, large amounts of seed of 1254S-1 should be available to Select seed growers in 2004.

Dry bean

The dry bean crop is developing steadily in Saskatchewan. Dryland production should increase in 2003 as potential growers experiment with the crop. Relative to other pulse crops, 2002 was a successful production year. Late season rain is very beneficial for seed filling and maximizing yield potential. CDC Pintium appears to be commercially successful, mostly due to its extremely early maturity relative to other varieties and this maturity range is now the baseline for the breeding program for all market classes.

As part of a Pulse Canada to Mexico in April 2002, we were able to explore perceptions of visual quality of beans with various importers. The pinto bean market in Mexico places value on seed types that are plump, just like the red lentil market. Samples of CDC Pintium were well received because of it has a relatively plump shape. The second important feature for importers of pinto bean is seed coat colour. Buyers prefer pinto beans with light background colour and especially prefer those varieties that maintain light background colour. We have identified adapted breeding lines that show greatly improved colour retention. In the next few years, we will see major improvements in the colour retention for pinto bean varieties that also combine the early maturity and plump seed type of CDC Pintium. If the current NAFTA agreement schedules for bean imports are not altered, free trade in beans by 2008 could have some impact on crop development in Saskatchewan if the varieties with improved quality and agronomic characters are available by then. Several exporting companies are already making plans to take advantage of expanded production from Saskatchewan sources. We are also deliberately breeding for specific markets in Latin America that are distinct from the standpoint of seed coat colour and shape, including flor de mayo and bayo beans for Mexico and bola roja beans for Colombia.

Faba bean

Seeds of faba bean are remarkably diverse in size, shape and colour. Individual seed weight can range from 150 mg to more than 2000 mg. Seed shape ranges from completely round to flat. Seed coat colour can be various shades of black, green, gray, red, purple, white and brown. The crop has never really taken off in Saskatchewan, except for small pockets of production in west-central irrigation districts and in east central regions where precipitation tends to be higher compared to the rest of Saskatchewan.

One of the reasons the crop has had only limited success is that most of the varieties grown in Canada were not suitable for the main Middle Eastern markets like Egypt where faba bean is consumed as a staple food. Consumers there demand specific seed size, shape and colour. Colour retention is also an issue. A prairie wide faba bean breeding effort was started in late 2002 with the objective of developing specific types for potential markets, including Egypt. Another reason for limited success was that the large seed size of the traditional faba bean varieties made them uneconomic in comparison to field pea from the standpoint of seeding cost. The original development goal for this crop in Canada was to use it to supply protein for animal feed. A potential market for faba bean does exist in the domestic and export animal feed market. Faba bean has 28-30% protein compared to about 23% for field pea. The higher protein level may make the crop more suitable for producing protein fractionation products The goal of this stream in the new breeding project is development of small-seeded low tannin types that can be used flexibly in cropping systems as forage or feed in short season, high rainfall regions such as the eastern border of Saskatchewan. Compared to field pea, the crop has improved protein, improved nitrogen fixation, and improved resistance to lodging. For this market to develop its potential, seed size will have to be reduced to about the same range as field pea while maintaining yield potential. Ideally, seeds should be round to help make them indistinguishable in blends with feed peas.

Summary

Improving quality for specific markets is obviously one of the current themes in genetic improvement of pulses. Canadian exporters are becoming more conscious of quality issues as competition develops in global markets. Most pulses are used directly by consumers in either whole or decorticated and split form. At this time, relatively few pulses enter the fractionation or ingredient sectors of agricultural processing, with the exception of the inclusion of pea and faba bean in animal feeds. From the standpoint of genetic improvement, seed shape and appearance represents the main basis for establishing the final value of pulses. In this context, the issue of seed shape is a large factor that influences preference for specific varieties. Many of the seed shape issues are common across many of the pulse crop species and market classes. The examples described here show that in general, we need to develop varieties that are plumper and rounder. We expect to expand research that will improve our fundamental understanding of the biochemical and genetic factors that influence seed shape. We are confident that in many cases, we will see that some of the not-so-flat pulses have significant economic impact in Saskatchewan. Continued diversification of markets will be an important factor in achieving the goal of 20-25% pulse crops in annual cropping systems.