Evaluating the competitive ability of semi-leafless field pea cultivars

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Abstract

Field pea (*Pisum sativum* L.) is an important grain legume in Western Canada. Growers can, however, be reluctant to include pulse crops in their rotation because they are poor competitors with weeds. Developing more competitive field pea cultivars is important to ameliorate weed competition. The identification of competitive cultivars and the traits conferring competitive ability should lead to the development of more competitive field pea cultivars. The objective of this research was to evaluate the ability of semi-leafless field pea cultivars to suppress and withstand weed competition and to identify traits that may confer competitive ability in field pea. Field experiments were conducted in 2012 at Floral, Saskatchewan and St. Albert, Alberta. Fourteen semi-leafless field pea cultivars with divergent pedigree, vine length, seed size, and market classes were seeded at a target density of 75 plants m^{-2} under weedy and weed-free conditions. Imidazolinone-tolerant wheat (c.v. CDC Imagine) and canola (c.v. 45H73) were planted as pseudo weeds at a target density of 20 plants m^{-2} in the weedy plots. Variables measured were leaf area index, plant height, pea biomass, weed biomass, pea yield, and weed seed production. Data were subjected to ANOVA using the mixed model procedure in SAS. There was no cultivar by treatment interaction for pea yield at Floral, so cultivars did not differ under treatments. CDC Dakota produced the greatest pea yield and Reward produced the poorest pea yield. CDC Dakota was among the best for pea biomass production at both sites, compared to CDC Leroy, which was among the worst at both sites. CDC Dakota was also among the best for the low weed seed production at Floral. CDC Mozart, CDC Patrick, and Cutlass were among the best at Floral for ability to withstand competition at Floral. While, CDC Dakota, CDC Meadow, and CDC Patrick were among the best for their ability to compete at Floral. At both sites, no correlations were strong enough to show which traits are conferring competitiveness in semi-leafless field pea cultivars.

Introduction

Field pea *(Pisum sativum L.)* is an important pulse crop to the Saskatchewan economy and in farmers' crop rotations, with 2010 production estimated at approximately 1.9 million tonnes and an export value totalling $870 million. In 2011, production was estimated at approximately 1.3 million tonnes. Approximately 2.6 million acres were seeded to field peas in 2010 and approximately 1.5 million acres seeded to field peas in 2011 (Saskatchewan Ministry of Agriculture, 2011). Canada plays an important role as the world's largest producer and exporter of field peas. Saskatchewan production accounts for 65% of Canada's field pea crop, while production in Alberta and Manitoba make up the other 35% (Saskatchewan Pulse Growers, 2009). Field pea has a benefit over many other crops in that it has the ability to fix its own nitrogen. This rotational benefit makes a useful crop in almost any crop rotation.

Field peas are vulnerable to many pests including weeds. Weed competition can be detrimental to field pea yields as weeds compete vigorously with the crop. Growers face a major challenge in field pea production due to the poor competitive ability of the crop. Canadian farmers spend more than $500 million each year on herbicides to control weeds in their crops (Croplife Canada, 2003). Late flushes of weeds not controlled by herbicides in wheat, barley, and canola combine to total $120 million in crop losses (O'Donovan et al., 2005). Pulse crops are the most susceptible crops to weed interference as typical yield losses of 20% to 40% are common (Wall et al., 1991). Yield losses as high as 80% can be observed (Boreboom and Young 1995). This lack of a competitive ability leads to reluctance from growers to include pulse crops in their crop rotation. Including competitive crop cultivars in crop rotations is an essential part of integrated weed management (Dew, 1972).

Developing more competitive field pea cultivars will result in an expansion of acres seeded to field pea. Often, there is a variation in competitive ability between crop cultivars (Tepe et al., 2005; Willenborg et al., 2005; Watson et al., 2006). Field pea may be an exception to this as breeding has mainly focused on improving lodging and disease resistance, as a result competitive ability may have been forgotten about in favor of improving the aforementioned agronomic traits. An example of this is semi-leafless field pea cultivars, which farmers prefer to grow in conventional agriculture and plant breeders have reacted by releasing cultivars that are almost leafless and show little variation in plant height (vine length) (Willenborg, 2011). Leaf area (Cote et al., 1992) and plant height (Wall et al., 1991; Harker et al., 2008) are key components of a competitive crop. McDonald (2003) and Wall and Townley-Smith (1996) have shown that tall field pea cultivars will yield higher than short and medium height under weed competition. Harker et al., (2008) have shown that unsprayed forage cultivars (leafy) of field pea can yield as much or more than semi-leafless cultivars that have received a herbicide application. Similar research has also found that leafy cultivars were more competitive with wild mustard (*Sinapsis arvensis*) than semi-leafless cultivars (Wall et al., 1991).

As a consequence of breeding to improve agronomic traits, we may have reached a point where competitive ability has been bred out of field peas or the variation for traits that confer competitive ability between cultivars is insignificant (Willenborg, 2011). Therefore, it is important to recognize if differences in competitive ability exist between field pea cultivars and if so, which traits are driving these competitive differences, whether above- or below-ground or a combination of both.

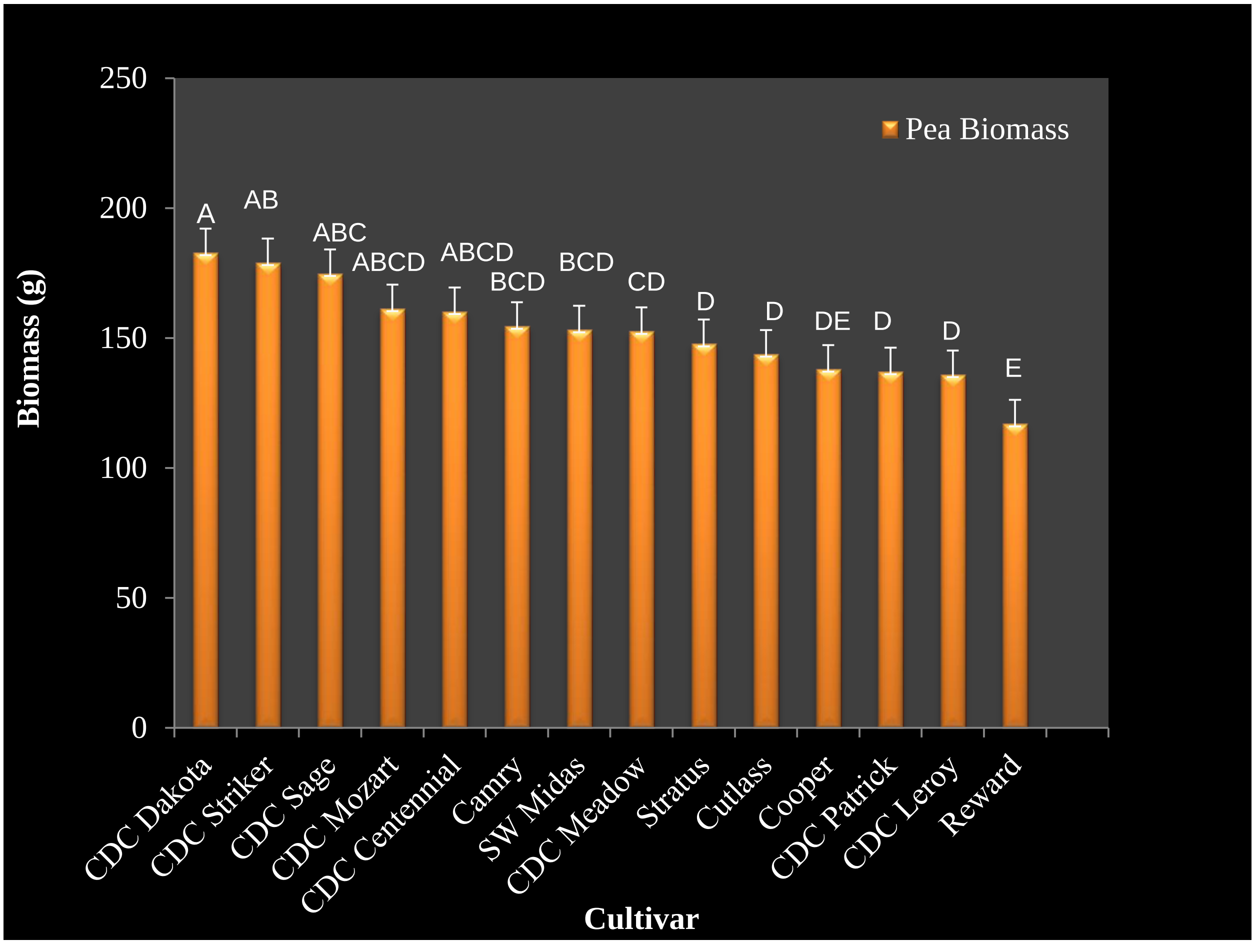

Figure 1. Pea biomass, Floral, SK.

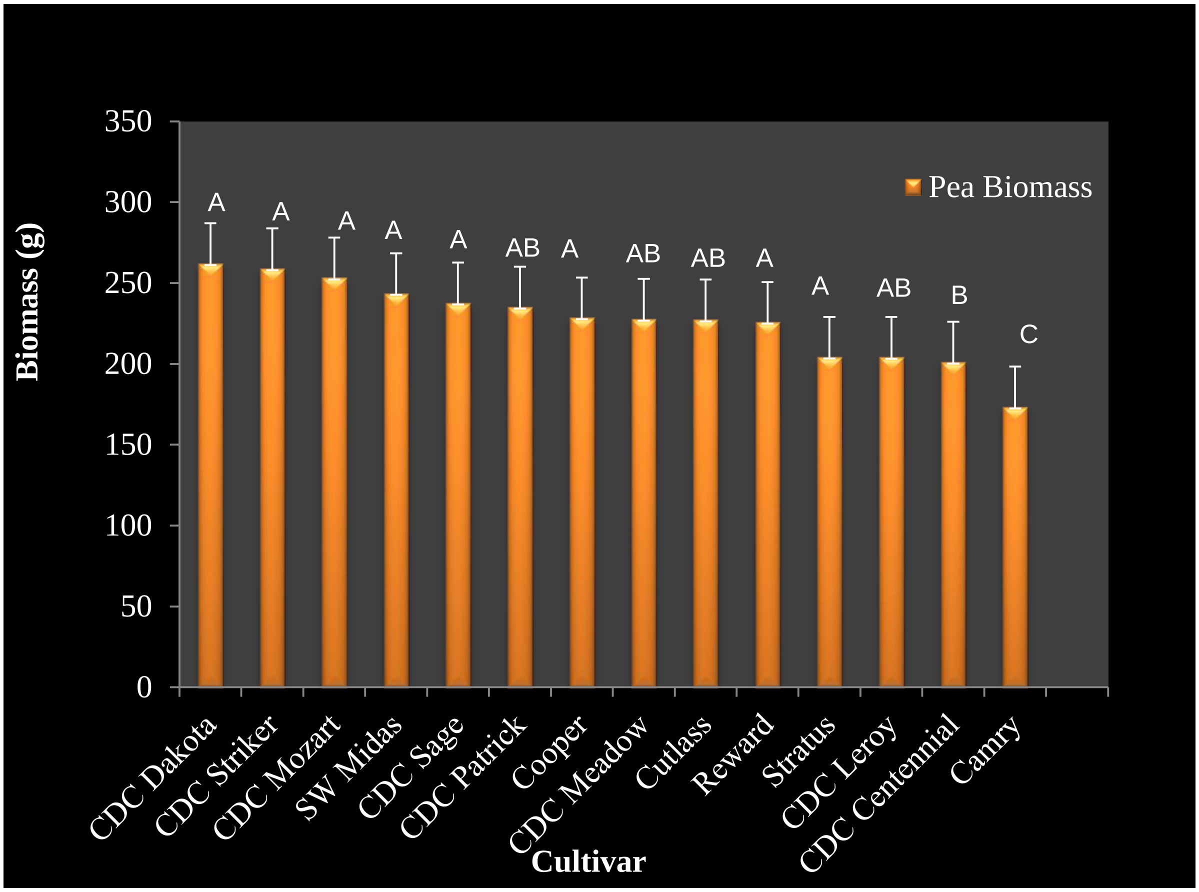

Figure 2. Pea biomass, St. Alberta, AB.

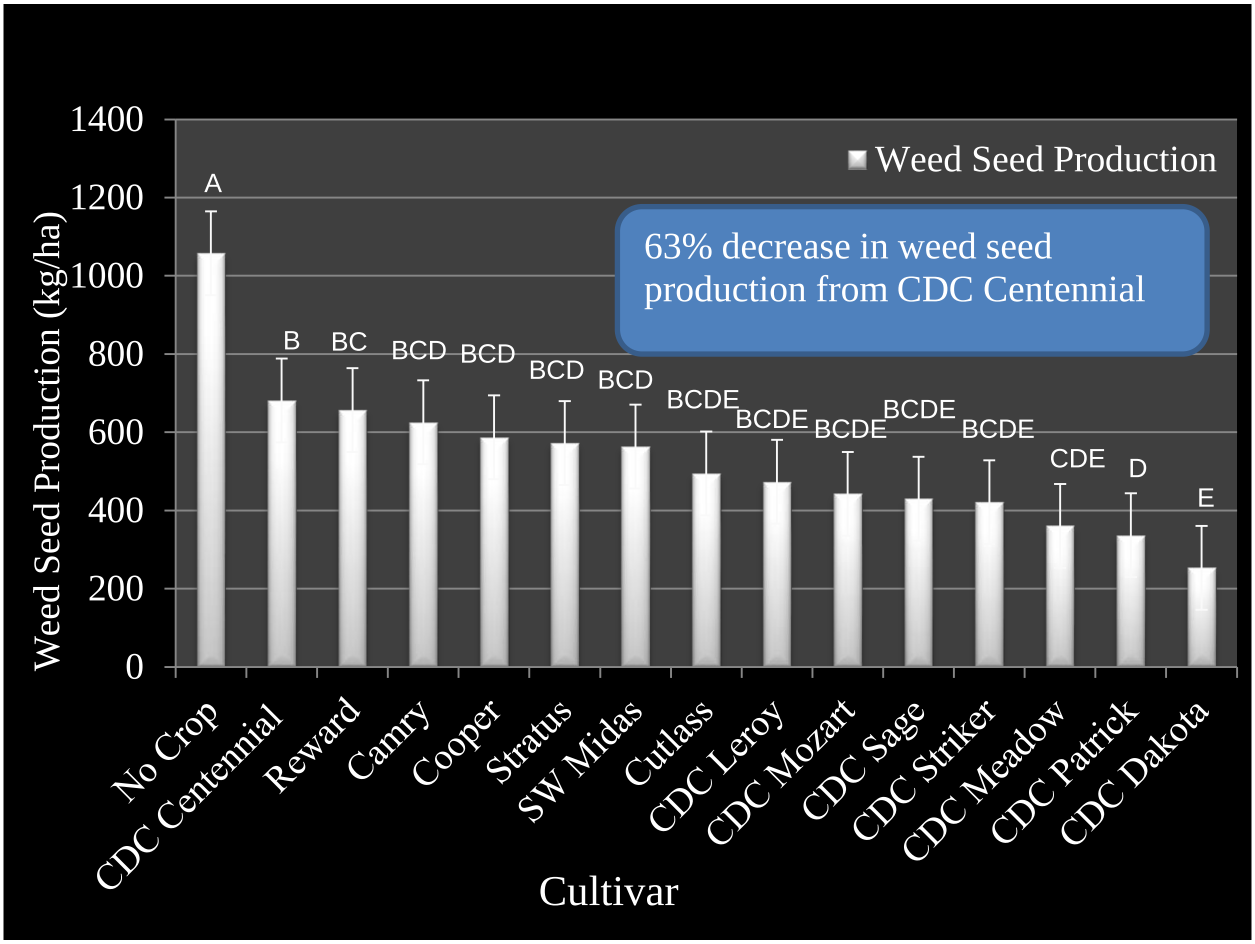

Figure 3. Weed seed production, Floral, SK.

Table 1. Correlations Floral, SK.

	Leaf area index	**Pea height**	**Pea biomass**	**Weed biomass**	**Pea yield**	**Weed seed production**	**Days to full canopy closure**
Leaf area index	1.000.00						
Pea height	**0.30534**	1.000.00					
Pea biomass	**0.33667**	0.13841	1.000.00				
Weed biomass	-0.07089	-0.08241	**-0.48949**	1.000.00			
Pea yield	**0.40991**	**0.25751**	**0.43762**	**-0**.23039	1.000.00		
Weed seed production	0.03644	-0.22019	**-0.37318**	**0.60347**	**-0.32277**	1.000.00	
Days to full canopy closure	0.01223	0.14794	0.12313	-0.11973	**0.29398**	-0.16848	1.000.00

Table 2. Correlations St. Albert, AB.

	Leaf area index	**Pea height**	**Pea biomass**	**Weed biomass**
Leaf area index	1.0000			
Pea height	0.07350	1.0000		
Pea biomass	0.00492	**0.19262**	1.0000	
Weed biomass	-0.12203	0.06689	-0.08881	1.0000

Table 3. Ability of semi-leafless field pea cultivars to Withstand Competition and Ability to Compete, Floral, SK.

Ability to Withstand Competition (100-%yield loss)			Ability to Compete (100-%dockage)		
Rank	Variety	AWC	Rank	Variety	AC
1	CDC Mozart	99	1	CDC Dakota	95
2	CDC Patrick	95	2	CDC Meadow	91
3	Cutlass	93	3	CDC Patrick	91
4	CDC Sage	87	4	CDC Striker	90
5	CDC Striker	86	5	CDC Mozart	89
6	CDC Centennial	83	6	Cutlass	89
7	CDC Dakota	83	7	CDC Sage	88
8	CDC Leroy	83	8	CDC Leroy	87
9	SW Midas	83	9	Cooper	87
10	Camry	79	10	Stratus	86
11	Cooper	78	11	SW Midas	86
12	CDC Meadow	76	12	CDC Centennial	86
13	Stratus	75	13	Camry	83
14	Reward	62	14	Reward	80