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CANOLA SEEDING TIME AS A STRATEGY TO STABILIZE GRAIN YIELD IN SUBTROPICAL BRAZIL

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ABSTRACT

The objective of this research was to study the behavior of commercial canola hybrids sown on different dates, in order to determine the most appropriate seeding time. Treatments included seeding time as a main plot and canola hybrid as a sub-plot. Hybrids were Hyola 61 and Hyola 432 in the years 2007 and 2008, and Hyola 61 and Hyola 433 in the years 2009 and 2010. In each year canola was sown in nine dates. Considering two year average for Hyola 432, the best planting period was from May 27th – June 3rd, although it was not different from April 15th – 23rd. The highest grain yield for Hyola 433 in two year average was obtained when canola was seeded from April 15th – 23rd until early June. The best time for planting Hyola 61, considering a four year average, was April 15th – 23rd although it was not different from March 23rd – 30th and May 27th – June 3rd. Taking all together, the best sowing dates for the three tested hybrids ranged from late March to late May, although grain yield was highly influenced by year (mainly due to frost damage) and hybrid effects.

Keywords: Seeding time, canola hybrids, stability, subtropical Brazil

INTRODUCTION

The production of canola (*Brassica napus* L.) in southern Brazil has been claiming as an alternative winter crop, providing opportunities for the production of vegetable oils and protein during this time of year, where currently oats (*Avena sativa*, L.), wheat (*Triticum aestivum* L.) and barley (*Hordeum vulgare* L.) have commercial importance. Specifically in the State of Paraná, canola is an attractive and competitive crop alternative, especially in the south region where heavy frosts occur, which prevents the production of corn during the winter season (DE ALMEIDA & TOMM, 2008). The use of different seeding dates on winter cereals, within the recommended period, is a strategy to achieve greater stability in grain yield, mainly due to large climatic variability that occurs between years in subtropical areas in Brazil (DE ALMEIDA et al., 2013). The objective of this research was to study the behavior of commercial canola hybrids sown on different dates, in order to determine the most appropriate seeding time for maximum grain yield potential in the subtropical part of Brazil.

METHODS

Canola field trials were established at Guarapuava 1100 m above sea level in the State of Paraná, Brazil with different planting dates (Table 1). The soils used were Hapludox (FONTOURA & BAYER, 2010). The experimental design was a split-plot design with four blocks. Treatments included seeding time as a main plot and canola hybrid as a sub-plot. Hybrids were Hyola 61 and Hyola 432 in the years 2007 and 2008. During the years 2009 and 2010 the hybrids Hyola 61 and Hyola 433 were used. Grain yield was corrected on the basis of 10% moisture.

Table 1. Canola seeding dates at the FAPA, Guarapuava, Paraná, Brazil, Winter 2007, 2008, 2009 and 2010.

Seeding time	2007	2008	2009	2010
1º	15/02	15/02	22/01	21/01
2º	8/03	7/03	12/02	11/02
3º	29/03	28/03	4/03	4/03
4º	19/04	23/04	23/03	30/03
5º	10/05	8/05	16/04	15/04
6º	31/05	3/06	6/05	10/05
7º	21/06	23/06	27/05	28/05
8º	12/07	11/07	17/06	17/06
9º	02/08	30/07	8/07	9/07

RESULTS AND DISCUSSION

Table 2 lists the analysis of variance for canola grain yield and its interactions with hybrids, seeding time and year during 2007-2008 and 2009-2010 growing seasons. For the experiments conducted in the years 2007 and 2008 there were significant interaction between year and hybrid and between year and seeding time for the variable grain yield.

Table 2. Analysis of variance for canola grain yield and its interactions with hybrids, seeding time and year during 2007-2008 and 2009-2010 growing seasons in the field experiments conducted in Guarapuava, Paraná, Brazil.

Source of variation	Grain yield 2007-2008	Grain yield 2009-2010
	F Test	F Test
Year	142.2**	0.6$^{n.s.}$
Block	1.4$^{n.s.}$	1.4$^{n.s.}$
Year*block	1.8$^{n.s.}$	3.7*
Seeding time	10.0**	109.8**
Hybrid	0.6$^{n.s.}$	22.0**
Seeding time*hybrid	4.6**	6.2**
Year*seeding time	25.6**	60.5**
Year*hybrid	27.3**	0.0$^{n.s.}$
Year*seeding time*hybrid	3.0**	4.1**

* Indicates significance at the 0.05 probability level; ** Indicates significance at the 0.01 probability level; n.s.= not significant.

For these reasons each hybrid was studied separately in each year. On the other hand, for the 2009 and 2010 years there was no interaction between year and hybrid and consequently a two year average was analyzed. The eighth and ninth season in 2010 was lost due to occurrence of late frosts in early maturity stage.

Planting Hyola 61 from early March until early June resulted in superior grain yield in 2007 (Table 3). In the year 2008, due to different frost events, alternate seeding times resulted in superior grain yield for the Hyola 61 hybrid. Similarly, the best planting period for Hyola 432 in 2007 was from early March until early June. The frosts events in 2008 also resulted superior grain yield in alternate seeding time for the Hyola 432 hybrid.

The highest grain yield for Hyola 61 was obtained when canola was seeded in January 21st - 22nd and April 16th – 15th, considering 2009 and 2010 years (Table 4). The best grain yield results for Hyola 433 was when seeds were planted in end January and from April 15th until the end of May.

Table 3. Canola grain yield, in different seeding dates at the FAPA, Guarapuava, Paraná, Brazil, Winter 2007 and 2008.

Seeding time	Grain yield 2007 (kg ha^{-1})	Grain yield 2008 (kg ha^{-1})	Grain yield average (kg ha^{-1})
		Hyola 61	
1ª – 15/02	1552 bc	992 a	1272 ab
2ª – 8 and 7/03	2627 a	249 b	1438 abc
3ª – 29 and 28/03	2169 ab	673 a	1421 a
4ª – 19 and 23/04	2112 ab	230 b	1171 abcd
5ª – 10 and 8/05	1791 abc	215 b	1003 cd
6ª – 31/05 and 3/06	1921 abc	625 a	1273 abc
7ª – 21 and 23/06	1141 cd	628 a	884 bcd
8ª – 12 and 11/07	488 e	1023 a	756 d
9ª – 2/08 and 30/07	678 de	999 a	838 cd
F test	20.7**	15.2**	6.0**
Experiment C.V.	11.3	15.4	12.9
Overall mean	A 1609	B 626	1117
		Hyola 432	
1ª – 15/02	960 bc	551 de	756 c
2ª – 8 and 7/03	2425 a	295 e	1360 bc
3ª – 29 and 28/03	1344 abc	735 cd	1039 bc
4ª – 19 and 23/04	1639 ab	1537 a	1588 ab
5ª – 10 and 8/05	1533 ab	632 cd	1083 bc
6ª – 31/05 and 3/06	2132 ab	1460 ab	1796 a
7ª – 21 and 23/06	1085 bc	1636 a	1360 ab
8ª – 12 and 11/07	562 c	928 cd	745 c
9ª – 2/08 and 30/07	508 c	958 bc	733 c
F test	7.9**	26.5**	9.7**
Experiment C.V.	18.4	10.2	15.6
Overall mean	A 1354	A 970	1162

† Values followed by the same letter are not significantly different (Tukey´s t-test: α<0.05); *p<0.05; ** p<0.01; ‡ n.s.= not significant.

Table 4 shows canola grain yield for Hyola 432 and Hyola 433 (two year average) and Hyola 61 (four year average) in different seeding dates. Considering two year average for Hyola 432, the best planting period was from May 27 – June 3rd, although it was not different from April 15th – 23rd. The highest grain yield for Hyola 433 in two year average was obtained when canola was seeded from April 15th – 23rd until early June. The best time for planting Hyola 61, considering a four year average, was April 15th – 23rd although it was not different from March 23rd – 30th and May 27th – June 3rd.

Table 4. Canola grain yield, in different seeding dates at the FAPA, Guarapuava, Paraná, Brazil, Winter 2009 and 2010.

Seeding time	Hyola 61	Hyola 433	Two year average
		Grain yield (kg ha^{-1})	
1ª – 22 and 21/01	1664 a	1866 a	1765 a
2ª – 12 and 11/02	830 c	1045 b	937 d
3ª – 4/03	310 d	372 c	341 e
4ª – 23 and 30/03	861 c	794 b	827 d
5ª – 16 and 15/04	1768 a	1624 a	1696 ab
6ª – 6 and 10/05	1099 bc	1547 a	1323 c
7ª – 27 and 28/05	1237 b	1748 a	1492 bc
F test	53.2**	59.4**	134.2**
Experiment C.V.	17.7	15.9	8.7
Overall mean	B 1110	A 1285	1197

† Values followed by the same letter are not significantly different (Tukey´s t-test: α<0.05); *p<0.05; ** p<0.01; ‡ n.s.= not significant.

Table 5. Canola grain yield, in different seeding dates from 2007 to 2010 growing seasons at the FAPA, Guarapuava, Paraná, Brazil, Winter.

Seeding time	Hyola 432 Two year average	Hyola 433 Two year average	Hyola 61 Four year average
		Grain yield (kg ha^{-1})	
1ª – From 11/02 to 15/02	756 c	1045 b	1051 bc
2ª – From 4/03 to 8/03	1360 bc	372 c	874 d
3ª – From 23/03 to 30/03	1039 bc	794 b	1141 abc
4ª – From 15/04 to 23/04	1588 ab	1624 a	1469 a
5ª – From 6/05 to 10/05	1083 bc	1547 a	1051 c
6ª – From 27/05 to 3/06	1796 a	1747 a	1255 ab
F test	7.5**	86.6**	19.8**
Experiment C.V.	16.8	7.9	10.7
Overall mean	1270	1188	1140

† Values followed by the same letter are not significantly different (Tukey´s t-test: α<0.05); *p<0.05; ** p<0.01; ‡ n.s.= not significant.

CONCLUSIONS

Although grain yield is highly influenced by year (mainly due to frost damage) and hybrid effects, it can be stated that the best sowing dates for the three tested hybrids ranged from late March to late May. However it should be considered that the total cycle of canola should not delay the next crop sowing. Nevertheless, this study should continue with new hybrids, mainly due to a significant interaction between year and seeding time.

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