Can canola be produced in tropical areas?

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abstract

Canola (OSR) production in Brazil is based on spring types of *Brassica napus* L. and reached 45,900 ha in 2010. Canola, a temperate environment crop has been developed at latitudes between 35º to 55º. However, no information is available concerning the possibility to grow canola in tropical areas. The objective of this work was to evaluate the viability of producing canola in tropical areas aiming at providing insights about the latitude and altitude limits of adaptation of the available hybrids. The average yield of eight genotypes at Chapadão do Céu, GO (Latitude 18º 29' 59" S, altitude 815 m) was 1,949 kg.ha^{-1}. The lowest latitude at which promising performance was achieved is located in Northeastern Brazil, at Areia, PB (Latitude 6º57'48" South, altitude 618 m) were the hybrids yielded up to 2,268 kg.ha^{-1}. The effect of higher altitude on environmental conditions can compensate for the lower latitudes to an extent that turns canola production agronomically viable with the "Hyola" hybrids. The results suggested that the altitude of 600 m can be used as reference to increase research and development (R&D) efforts at latitudes starting around 7 degrees, and to expand R&D and commercial production at latitudes as low as 17 degrees South.

Introduction

Canola (*Brassica spp.*) is a typical oilseed of temperate regions and its main research, development and commercial production efforts were directed to latitudes between 35º and 55º. In Brazil, since 1974, canola has been grown mainly in the South, in subtropical areas, at latitudes between 24º and 29º. Canola production in Brazil is based solely on spring types of *Brassica napus* L. and reached 45,900 ha in 2010. Yield, over the last years, averaged 1,656 kg.ha^{-1}. The canola growing area and production has increased annually and meets the demand of the edible oil market. Increases in canola production in Brazil and neighbouring countries may start meeting part of the requests of European companies interested in sourcing large amounts of canola oil for biodiesel production.

Brazil has millions of hectares of land where soybean and maize are produced in the summer which also allow growing a second crop, such as canola, in the same year during the months of lower temperatures. Both in tropical, as well as, in subtropical regions of the country there are under-utilised land. Just in the state of Rio Grande do Sul (RS) about two million hectares of canola could be grown annually in rotation with wheat and other crops.

The Brazilian savannah region, also called the "cerrado", is said to be the world's largest continuous area of land suitable for agriculture (HOPKIN, 2004). Part of the 137 million hectares of land suitable for agriculture of this region are at altitude above 600 m with adequate climatic conditions for growing a second crop in the year. The possibility of growing canola could lead to more efficient use of current agricultural land, machinery, personnel, etc., while meeting the growing demand for food and renewable energy, avoiding the need for expansion into land under

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pastures and forests and their associated environmental problems. Thus, the objective of this work is to evaluate the viability of producing canola in tropical areas aiming at providing insights about the latitude and altitude limits of adaptation of the hybrids employed in Brazil.

Methods

Data of field experiments, with four replicates, following the Randomized Complete Block Design (RCBD), of *B. napus* L. Hyola hybrids, as well as of *B. juncea* L., conducted during the last seven years, provided the basis for this work. This network of field trials, was carried at locations in Brazil ranging from the Southernmost state (at Encruzilhada do Sul, RS, Latitude 30º32'38" S, altitude 432 m) to the Northernmost state (at Boa Vista, state of Roraima, Latitude 2º49'11" S, altitude 85 m). In addition, since 2004, the performance of canola hybrids was evaluated under commercial production at latitudes as low as 16º South.

Results and discussion

Rainfall in the Brazilian grain production regions of latitudes bellow 23.5°S (tropical areas) decrease after February, when summer crops are harvested and canola should be sown. For example, the long term (1980-1999) monthly precipitation (mm) at Maringá, state of Paraná (Latitude 23^{o} 28' S, Longitude 52^{o} 00' W, and altitude de 505 m) from March to October, is respectively: 146.8; 148.4; 132.6; 117.0; 51.7; 47.4; 145.8; 152.2; (ANJOS & NERY, 2000).

Commercial fields in the state of Mato Grosso do Sul, at Maracajú (Latitude 21º 47' 03" S, altitude of 442 m), even when sown in mid April, a month later than the recommended seeding time, yielded 1,074 kg.ha^{-1} (area of 340 ha) and 1,100 kg.ha^{-1} (area of 320 ha).These yields were obtained with rainfall, from seeding to harvest, of only 126 and 92 mm, respectively. Samplings at a farmer's canola field that visually suggested higher yield, reached 2,664 kg.ha-1 (TOMM et al, 2007).

The average yield of eight canola genotypes at Chapadão do Céu, state of Goiás (Latitude 18º 29' 59" S, altitude 815 m) was 1,949 kg.ha^{-1} (TOMM et al, 2004). Commercial production of canola in the state of Goiás, Central Brazil, started in 2004 following promising experimental results such as this in the previous year.

The number of days from emergence to the beginning of flowering, and the number of days from emergence to maturation is lower under tropical (**Table 1**) than under subtropical conditions. For example at Três de Maio, state of Rio Grande do Sul (Latitude 27^{0} 47' 2" S, Longitude 54^{0} 14'55" W, altitude 333 m) they were respectively, 77 days, and 131 days (TOMM et al, 2004a) in comparisson with 40 days, and 87 days, in the tropical areas at Sapezal, state of Mato Grosso (Latitude 13^{0} 27´17" S, Longitude 58^{0} 54´09"W, altitude of 530 m).

The lowest latitude at which promising performance was achieved is located in Northeastern Brazil, at Areia, state of Paraíba (Latitude 6º57'48" South, altitude 618 m) **(Figures 1a, and 1b)**. were the hybrids yielded up to 2,268 kg.ha-1 (TOMM et al, 2008). However, in the experiment sown in August 2007, at Boa Vista, state of Roraima (Latitude 2º49'11" S , Longitude 60º40'24" W, Altitude 85 m), the *B. napus* hybrids tested (Hyola 43; Hyola 60; Hyola 61; Hyola 401; Hyola 432; Hyola 50; Hyola 433; Hyola 411 and H4815), flowered and developed pods **(Figures 1c, and 1d)** but, none produced grain. Flowering started only 18 days

Figure 1. *Brassica napus* hybrids at Areia (Latitude 6º57'48" South, altitude 618 m), a) of short cycle, b) of long cycle (Photo by R.W.C.RAPOSO) and, c) and d) at Boa Vista (Latitude 2º49'11" S , Longitude 60º40'24" W, Altitude 85 m), showing adequate plant development and flowering, but

Table 1. Performance of canola genotypes at Sapezal, state of Mato Grosso (Latitude 13^0 27´17" S, Longitude 58^0 54´09"W, altitude of 530 m above sea level), sown on 18 February, 2006.

Genotype	Emergence to beginning of flowering (days)		Duration of flowering (days)		Emergence to maturation (days)		Plant height at maturation (cm)		Grain yield (kg/ha)	
Hyola 401	34	bc	25	ab	84	c	128	d	2390	a
Hyola 43	45	a	21	bc	90	a	155	ab	2068	ab
Hyola 61	46	a	16	c	89	ab	145	bc	1281	b
Hyola 432	47	a	22	bc	90	a	168	a	1519	ab
Hyola 433	41	ab	20	bc	87	abc	151	b	2120	ab
Hyola 411	43	a	22	bc	87	abc	140	bcd	2033	ab
H4815	34	bc	27	ab	85	bc	148	bc	1776	ab
H4481	43	a	19	bc	87	abc	147	bc	1604	ab
H4592	42	ab	18	bc	87	abc	145	bc	2490	a
Y3000	28	c	33	a	85	bc	134	cd	2081	ab
Mean	40		22		87		146		1936	
CV (%)	9		17		2		4		23	
Pr>F	>0.	01	<0.	01	0.	01	<0.	01	0.	78
Correlation with grain yield										
R^2	(-)0,	08	0,	02	0.	10	(-)0.	19	-	-
Pr>F	0,	07	0,	42	0.	05	0.	23	-	-

Means in the same column, followed by the same letter do not differ by the Tukey test, at the 5% probability level.

after emergence and plant height averaged 100 cm. Likely, the frequent temperatures above 27º C affected pollen viability. However, in the same experiment *Brassica juncea* (hybrid Q650, also identified as P432) yielded on average 563 kg ha^{-1}, and thousand kernel weight was 1.2 g under the same environmental conditions.

Conclusions

Experiments and the world's first commercial production of canola at tropical conditions have shown, since 2004, its potential role to increase the Brazilian grain production, increase production of high quality oil and protein for food or biodiesel reducing world pressure to increase farming area. The effect of higher altitude on environmental conditions can compensate for the lower

latitudes to an extent that turns canola production agronomically viable with the “Hyola” hybrids. The results suggested that the altitude of 600 m can be used as reference to increase R&D efforts at latitudes starting around 6 degrees, and to expand R&D and commercial production at latitudes as low as 17 degrees South. Likely, there is much potential for yield improvements since these results were obtained without breeding and selection for these specific growing conditions, and research for adjusting management practices was scarce.

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