

CANOLA AGRONOMIC PERFORMANCE IN THREE SOWING DATES IN JATAÍ-GO

DESEMPENHO AGRONÔMICO DA CANOLA EM TRÊS ÉPOCAS DE SEMEADURA EM JATAÍ-GO

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ABSTRACT: Canola (*Brassica napus* L. var. *oleifera*) is a potential crop due to the growing world demand for vegetable oil. This work aims to evaluate the performance of five canola hybrids in three sowing dates in Jataí-GO. The experiment was conducted in the year of 2017, in a randomized block design, with subdivided plots and four replications. Plots were composed by three sowing dates (03/03, 03/10 and 03/17) and subplots by the canola hybrids Hyola 50, Hyola 61, Hyola 433, Hyola 571CL and Hyola 575CL. Seedling emergence, inicial and final plant population, flowering, maturation, plant height, plant survival index and grain yield were evaluated. The thermal sum calculation was performed with the phenological data. Results were submitted to analysis of variance and means were compared by Scott Knott test at 5% of probability. The plants survival index highlighted Hyola 433, Hyola 571CL and Hyola 575CL hybrids. Grain yield varied according to hybrid and sowing date. In the edaphoclimatic conditions of this study, in the year of 2017, the best agronomic performance was observed in the first sowing date for the canola hybrids Hyola 433 and Hyola 575CL and in the second sowing date for the canola hybrid Hyola 571CL.

KEYWORDS: *Brassica napus* L. var. *oleifera*. Phenology. Productivity. Tropicalization.

INTRODUCTION

Canola (*Brassica napus* L. var. *Oleifera*) is one of the most important oilseeds in the world and one of the main sources of edible vegetable oil, being preferred because its low saturated fatty acid content (TAN et al., 2009). Over the past 40 years global canola production has grown rapidly, ranking from sixth to second most produced oilseed crop in the world (USDA, 2017).

The main canola growers are European Union, Canada, China, India, and Australia (USDA, 2017), all of them located at high latitudes, between 35° and 55°. In Brazil, research on canola cultivation began in 1974 in Rio Grande do Sul State and in the 1980s in Paraná State, where it was grown the spring specie, *Brassica napus*, since it does not require vernalization and has low photoperiod sensitivity (MORI et al., 2014; TOMM et al., 2009b).

Canola plant is originally adapted to mild conditions and regularly distributed rain throughout its growth period (MENDONÇA et al., 2016). Genotypes cultivated in Brazil present lower photoperiod sensitivity and higher response to air temperature (thermal sum) instead of rapeseed open pollination varieties grown in the past

(MONTEIRO, 2009). The air temperature is the most important environmental factor in regulating canola growth and development (THOMAS, 2003).

Commercial crops in Brazil are concentrated in the southern region. According to CONAB (2018), an average yield of 1,358 kg ha⁻¹ is expected and a 48 thousand tons production in 35.5 thousand hectares area. Canola cultivation is expanding to lower latitudes in Brazil, a process called tropicalization. There was a commercial crop in Goiás, in 2004, partially encouraged by the results of a trial in five different places, in which it was obtained grain yields from 2,100 and 2,400 kg ha⁻¹. In the southwest Goiás, canola crop can be an alternative for diversification and income generation as a second harvest (EMBRAPA, 2017).

Brazilian demand for canola crop is a great incentive for research works, considering that there are limited technical scientific information regarding crop management in Brazil especially in low latitude regions. The highest grain yield is obtained when canola is cultivated at 17 cm between rows and density of 45 plants per square meter. Best yield results were observed by spacing rows until 45 cm (BANDEIRA et al., 2013; TOMM, 2007).

According to Mendonça et al. (2016) the best sowing period recommended for Goiás State is

from early February to mid-March, respecting agricultural zoning indications by the country's agriculture department (BRASIL, 2012).

Although its importance as an alternative crop in Brazil's Midwest, there are few studies on canola cultivation at that important agricultural area, considering the most adapted hybrid to that edaphoclimatic condition and the best sowing dates. This work aims to evaluate the performance of five canola hybrids in three sowing dates in Jataí-GO.

CONTENTS

Trial was carried out at the experimental farm of Federal University of Jataí, located at 17° 55

'25' 'S and 51° 42' 51 " W, and 696 m of altitude. According to Köppen climatic classification, it is located at a tropical savanna area, Aw, mesothermic, with a rainy summer and an expressive drought winter. Local soil is classified as Dystroferic Red Latosol.

Local climatic data during the canola crop development (March to July 2017) was obtained from a national meteorological station (INMET conventional database) (Figure 1). The experimental design was the randomized block and treatments were arranged in a subdivided plots scheme with four replications. Plots were composed by three sowing dates and subplots by five canola hybrids

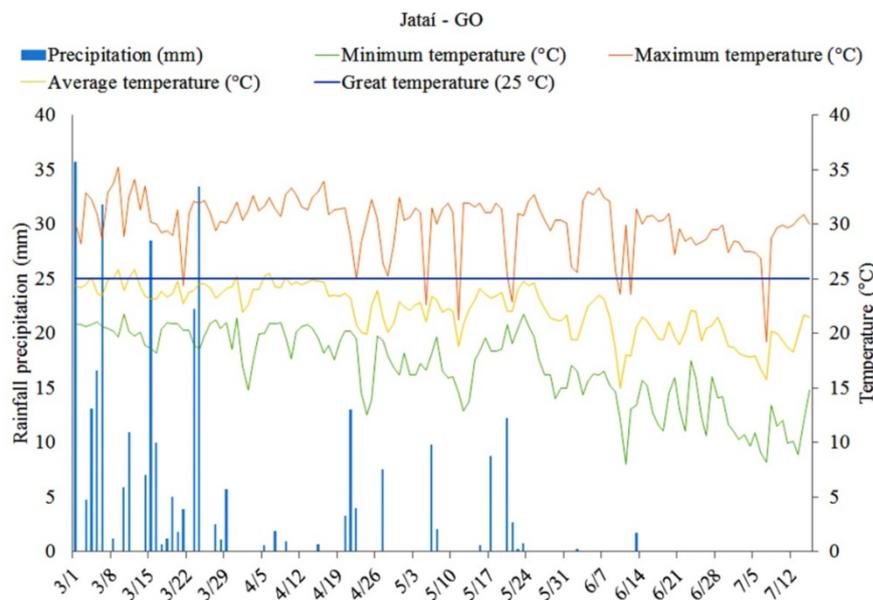


Figure 1. Precipitation (mm), minimum, average and maximum temperature (°C) from March to July of 2017 in Jataí-GO. Source: INMET (2017).

An uniform plot of 843.75 m² was selected and rice straw was incorporated to soil by the conventionally tillage system.

Sowing was carried out with Hyola 50, Hyola 61, Hyola 433, Hyola 571CL and Hyola 575CL canola hybrids (Chart 1), in the following sowing dates: 03/03, 03/10 and 03/17, 2017.

Chart 1. Main characteristics of canola hybrids sowed in the experiment.

Hybrids	Cycle	Characteristics
Hyola 50	Medium	Indicated for planting in opening areas and in combination with other hybrids. High yield potential.
Hyola 61	Medium	Yield stability and rusticity under dry stress and frost.
Hyola 433	Early	Indicated for succession with maize crop. Requires high fertility soils to express its potential.
Hyola 571CL	Early	Resistant to imidazolinones group herbicides.
Hyola 575CL	Early	Resistant to imidazolinones group herbicides.

Source: Adapted from Tom and Ferreira (2016).

Each plot consisted of five sowing lines, five meters each, 0.45 m spacing and 62 seeds per m². Sowing was hand done by the adhesive tape technique. In the laboratory, seeds were arranged in an adhesive tape, which were later taken to the field and placed in the planting line, previously prepared by an automatic planter.

Planting fertilization was done by 30 kg ha⁻¹ of N, 60 kg ha⁻¹ of P₂O₅ and 50 kg ha⁻¹ of K₂O applied in the soil surface, using as source, urea, triple superphosphate and chloride potassium, respectively. When seedlings were in rosette stage, 50 kg ha⁻¹ of nitrogen fertilizer was applied, using ammonium sulfate as source of N. Fertilization was performed according to results obtained from soil analysis and from the Brazilian agricultural research company's recommendations (TOMM, 2007) for canola cultivation.

During crop development, hand weeding, herbicides and insecticides were used for the control of weeds, *Myzus persicae*, *Brevicoryne brassicae*, *Diabrotica speciosa* and *Ascia* spp.

Hybrids performance and sowing date influence were evaluated by the following phenological and phenometric variables:

Seedlings emergence - when 50% of seedlings were emerged in each plot; Initial plant population - based on the number of plants in a row (4 meters long), one month after sowing; Flowering - when 50% of plants had at least one flower; Maturation - when 50% of seeds changed to dark color in pods located in the middle of the plant's main raceme; Plant height - using a graduated ruler, plant height was measured from soil surface to the top of the largest raceme with pods; Final plant population - based on the number of plants

harvested in the useful area (4.05 m² on each subplot); Grain yield - grains from useful area were harvested, weighed and moisture was determined and corrected to canola moisture reference of 9% for yield calculation; Plants survival index was calculated by the survival percentage from early to late plant population. The accumulated thermal sum calculation was performed from the phenological data according to Arnold (1960):

$$TS = \sum TSd;$$

$$TSd = Ta - Tb; \text{ on what:}$$

TS = accumulated thermal sum;

TSd = daily thermal sum;

Ta = Average air temperature;

Tb = basal temperature.

The basal temperature of 5 °C was considered as indicated by Morrison et al. (1989), Nanda et al. (1995), Iriarte and Valetti, (2008) and Dalmago et al. (2009). The thermal sum was obtained for the following development subperiods: emergence to early flowering (EM-EF), early to late flowering (EF-LF) and emergence to physiological maturation (EM-PM).

Data were submitted to analysis of variance and means were compared by Scott Knott test at 5% of probability.

Table 1 shows the results of the analysis of variance for initial and final plant population, plants survival index, days between emergence to early flowering (EM-EF), early to late flowering (EF-LF), emergence to physiological maturation (EM-PM), thermal sum for each subperiod expressed in degree-day, plant height, and grain yield of five canola hybrids, in three sowing dates.

Table 1. Summary of analysis of variance (F value) for initial plant population (IPP), final plant population (FPP), plants survival index (PSI), thermal sum expressed in degree-day (DD) and subperiods duration in days (days) between emergence to early flowering (EM-EF), early to late flowering (EF-LF), emergence to physiological maturation (EM-PM), plant height (PH) and grain yield (GY) of five canola hybrids in three sowing dates.

Variation Source	DF	IPP	FPP	PSI	EM-EF (DD)	EM-EF (days)	EF-LF (DD)	EF-LF (days)	EM-PM (DD)	EM-PM (days)	PH (cm)	GY
Bloc	3	6.3*	0.8 ^{ns}	0.4 ^{ns}	0.6 ^{ns}	4.5 ^{ns}	1.5 ^{ns}	0.4 ^{ns}	2.64 ^{ns}	1.3 ^{ns}	1.5 ^{ns}	0.9 ^{ns}
Date (D)	2	48.0***	25**	3.0 ^{ns}	1.2 ^{ns}	15.3**	3.6 ^{ns}	3.4 ^{ns}	74.76***	13.2**	6.5*	9.67*
Hybrid (H)	4	32.6***	50.5***	25.6***	51.5***	134.3***	11.7***	21.9***	35.53***	10.73***	0.86 ^{ns}	15.4***
D x H	8	11.3***	5.1***	3.3**	1.5 ^{ns}	6.37***	1.1 ^{ns}	2.2 ^{ns}	3.0*	1.3 ^{ns}	1.0 ^{ns}	7.5***
CV D (%)		6.90	15.37	15.97	7.46	3.01	9.95	10.63	1.55	5.68	6.54	17.08
CV H (%)		9.37	9.96	11.33	8.54	5.98	11.80	8.25	2.40	5.24	5.22	15.70

*, **, ***, ^{ns}: significant at 0,05, 0,01, 0,001 probability and not important (p >= 0,05) by F test, respectively DF: Degrees of freedom. CV: coefficient of variation.

There was interaction between hybrids and sowing dates for initial and final population, plants survival index, days between emergence to early flowering, days between emergence to physiological maturation, and grain yield. For the emergence to early flowering and for the early to late flowering thermal sum, there was only hybrid significant effect, as well as for days from the early to late

flowering. Regarding the days between emergence to physiological maturation, there was no interaction, but there was hybrid and date effect. For plant height there was no interaction, except for sowing dates effect.

Table 2 shows the interaction between hybrid and sowing dates for the variable initial plant population.

Table 2. Initial plant population (plants ha⁻¹) of five canola hybrids in three sowing dates.

Hybrids	Sowing date		
	03/03	03/10	03/17
	Initial plant population (plants ha ⁻¹)		
Hyola 50	320,367 bB	468,051 aA	340,738 aB
Hyola 61	266,664 cA	305,553 cA	187,035 dB
Hyola 433	370,367 aA	301,386 cB	253,701 cC
Hyola 571CL	407,402 aA	338,886 bB	349,997 aB
Hyola 575CL	281,479 cB	351,848 bA	294,442 bB

Means followed by the same lowercase letter in the column and upper case in the row do not differ statistically from each other according to Scott-Knot test at 0.001 probability.

Considering the different sowing dates, Hyola 50 and Hyola 575CL, sowed on 03/10 allowed a larger initial plant population, with 468,051 and 351,848 plants ha⁻¹, respectively. For Hyola 61, there was no significant difference between the first and second date, 266,664 and 305,553 plants ha⁻¹, respectively, while Hyola 433 presented better performance in the first date, 370,367 plants ha⁻¹. In relation to hybrid performance, Hyola 571CL and Hyola 433 were highlighted in the first date. In the second date, Hyola 50 presented the highest initial population, 468,051 plants ha⁻¹. There was no statistical difference between Hyola 50 and Hyola 571CL in the third sowing date.

One of the biggest challenges for canola growers is the stand establishment. Several factors affect seed mortality and seedling emergence, such

as soil moisture, soil texture and temperature, seeding depth, diseases, insects, and climatic factors (HANSON et al., 2008).

Planting depth is a seedling emergence important factor. According to Tomm et al. (2009a), seeds should be evenly deposited at 1-2 cm, and they should remain on the moist soil surface, rather than very deep. Possibly, seeds physiological quality and sowing depth are decisive for initial plants population. The establishment of a proper canola population is essential to achieve high grain yield (SHAHIN; VALIOLLAH, 2009).

Final plant population (Table 3), in general, was lower than initial plant population and below expectations. The largest final population observed was for Hyola 433 in the first date, with 316,046 plants ha⁻¹, and the lowest was for Hyola 61 in the third date, with 127,571 plants ha⁻¹.

Table 3. Final plant population (plants ha⁻¹) of five canola hybrids in three sowing dates.

Hybrids	Sowing dates		
	03/03	03/10	03/17
	Final plant population (plants ha ⁻¹)		
Hyola 50	197,529 cB	250,615 aA	160,492 bB
Hyola 61	155,554 dB	197,529 bA	127,571 bB
Hyola 433	316,046 aA	270,985 aB	190,122 aC
Hyola 571CL	306,170 aA	298,762 aA	223,866 aB
Hyola 575CL	232,096 bB	270,779 aA	214,813 aB

Means followed by the same lowercase letter in the column and upper case in the row do not differ statistically from each other according to Scott-Knot test at 0.001 probability.

In general, the first and second dates presented better results for final plant population. In

the first sowing date, Hyola 433 and Hyola 571CL stood out, with 316,046 and 306,170 plants ha⁻¹,

respectively. In the second date, Hyola 61 differed from the others with the lowest final population, and in the third date, there was no statistical difference between Hyola 433, Hyola 571CL and Hyola 575CL.

Arruá et al. (2014), evaluating the agronomic characteristics of Hyola 61 and Hyola 433, observed an average number of 252,500 plants ha⁻¹, lower than it was expected, about 488,888

plants ha⁻¹. It is recommended, according to Chavarria et al. (2011), a uniform plant population of 450,000 plants ha⁻¹ to guarantee hybrids yield potential.

Table 4 presents the variable plants survival index, which is the difference between the initial and final plant population, and it was possible to observe that there was interaction between hybrids and sowing dates.

Table 4. Plants survival index (%) of five canola hybrids in three sowing dates.

Hybrids	Sowing dates		
	03/03	03/10	03/17
	Plants survival index (%)		
Hyola 50	61.76 bA	53.35 cA	47.62 bA
Hyola 61	57.99 bA	65.07 cA	70.03 aA
Hyola 433	85.60 aA	89.84 aA	75.39 aA
Hyola 571CL	75.36 aB	88.51 aA	64.02 aB
Hyola 575CL	82.45 aA	77.03 bA	74.07 aA

Means followed by the same lowercase letter in the column and upper case in the row do not differ statistically from each other according to Scott-Knot test at 0.01 probability.

Plants survival index was not influenced by sowing date for Hyola 50, Hyola 61, Hyola 433 and Hyola 575CL. For Hyola 571CL, the second date presented higher index than the others.

In the first sowing date, hybrids Hyola 433, Hyola 571CL and Hyola 575CL stand out. In the second, there was no difference between Hyola 433 and Hyola 571CL. In the third date, Hyola 50 differed from the other hybrids with lower survival.

Considering the difference of initial and final plant population (plants survival index), it is

recommended the use of more seeds in sowing, with high physiological quality and it also should be considered the local altitude, because these factors may interfere in plant's survival index, which influences the appropriate final stand.

For the phenological observations, there was interaction between hybrids and sowing date for the variable days between emergence to early flowering. However, when evaluating the thermal sum, in degree-day, there was difference only between hybrids (Table 5).

Table 5. Emergence to early flowering in degree-day and days of five canola hybrids in three sowing dates.

Hybrids	Days			Degree-day
	Sowing date			
	03/03	03/10	03/17	
Hyola 50	56 aC	68 aA	60 aB	1102 a
Hyola 61	46 bA	44 bA	44 bA	858 b
Hyola 433	38 cB	38 cB	43 bA	748 c
Hyola 571CL	40 cA	41 bA	42 bA	777 c
Hyola 575CL	39 cA	38 cA	42 bA	748 c

Means followed by the same lowercase letter in the column and upper case in the row do not differ statistically from each other according to Scott-Knot test at 0.001 probability.

For days between emergence to early flowering, Hyola 50 and Hyola 433 were the only ones that showed differences for the sowing date. For Hyola 50 a longer period is observed in the second sowing date, 68 days. For Hyola 433, it was longer in the third date, with 43 days. In all sowing dates, Hyola 50 hybrid stands out with the longest

period between emergence to early flowering, with 56, 68 and 60 days for first, second and third sowing dates, respectively. In the first date, there was no difference between Hyola 433, Hyola 571CL and Hyola 575CL, with shorter vegetative period. In the second, Hyola 433 and Hyola 575CL also presented a shorter period, and in the third only Hyola 50 was

different from the others, with 60 days. Due to climatic conditions, a short vegetative period is beneficial. The higher precocity for the early flowering, that is, short vegetative period, is important in environments where water deficit is accentuated at the end of the crop cycle (NIED, 2013).

Nied (2013), evaluating Hyola 61 and Hyola 432 hybrids in Passo Fundo - RS, observed that during the vegetative period canola required 526 and 629 degrees-day in 63 and 69 days in 2010 and 2011, respectively. In the present work, hybrids presented a shorter period in days, however, the thermal sum needed to complete it was higher, in which Hyola 61 required 858 degree-day in 46 days for the first date, and 44 days for the second and third sowing dates.

The highest thermal sums observed are due to the high air temperature. Parts of these high air temperature values are counted in the thermal sum, but do not contribute to the crop development, since they are above the optimal canola values (NIED, 2013). The ideal temperature ranges from 12 to 30 °C and the growth optimum temperature is 25 °C,

with thermal stress above it (EDWARDS; HERTEL, 2011; MENDONÇA et al., 2016).

Luz et al. (2012) observed that for Hyola 61 and Hyola 433 in Santa Maria – RS, the vegetative period last from 52 to 78 days and from 49 to 76 days, respectively, according to the sowing date.

The overall average temperature from emergence to early flowering was 24.1 °C, with the maximum reaching 31 °C. The precipitation was more concentrated until the end of March, with an average of 127.7, 124.24 and 90.5 mm in this subperiod from emergence to early flowering for each date (Figure 1). According to Tomm et al. (2014), in general, smaller durations of these subperiods occur at higher temperatures and lower altitude, conditions of the present experiment.

In relation to early to late flowering duration in degree-day and days, there was no interaction between hybrids and sowing dates, with significant effect only for hybrids (Table 6). For emergence to physiological maturation in days, there was no interaction between those factors, with significant effect for hybrids (Table 6) and sowing dates (Table 7).

Table 6. Early to late flowering (days), early to late flowering (degree-day) and emergence to physiological maturation (days) of five canola hybrids.

Hybrid	Early to late flowering (days)	Early to late flowering (degree-day)	Emergence to physiological maturation (days)
Hyola 50	34 c	566 c	104 a
Hyola 61	45 a	760 a	97 b
Hyola 433	44 a	769 a	94 b
Hyola 571CL	41 b	698 b	94 b
Hyola 575CL	42 b	697 b	92 b

Means followed by the same letter in the column do not differ statistically from each other according to Scott-Knot test at 0.001 probability.

Hyola 50 was different from the other hybrids, with lower early to late flowering duration, 34 days, and lower thermal sum, 566 degrees-day. Hyola 61 and Hyola 433 presented the early to late flowering duration longer and a bigger thermal sum.

In Santa Maria – RS, Hyola 61 and Hyola 433 early to late flowering duration ranged from 34 to 81 days, according to sowing date (LUZ et al., 2012). Nied (2013) observed that in the reproductive period the average thermal sum was 823 and 846 degree-day at 79 and 63 days, in 2010 and 2011, respectively, considering the average thermal sum for each year, for both Hyola 432 and Hyola 61 hybrids.

The flowering duration ranged from 34 to 45 days for Hyola 50 and Hyola 6 respectively and it was required less thermal accumulation from 566

degree-day for Hyola 50 and 769 degree-day for Hyola 433. The early to late flowering duration in days, and the thermal accumulation were lower due to high air temperatures above 25 °C (Figure 1), which reduce the flowering and maturation period (MENDONÇA et al., 2016).

According to Tomm (2007), the long flowering period is typical of canola, and can vary from 20 to 45 days, which compensates the flowers loss. During the flowering period, temperatures above 27 °C are harmful because they reduce the phase duration and can affect pollen viability and flowers receptivity, resulting in grain yield reduction, about 50%, due to the flowers abortion (ANGADI et al., 2000; MENDONÇA et al., 2016). In the present experiment, the maximum temperature that occurred in this period was 31 °C.

For emergence to physiological maturation (days), Hyola 50 differed from the other hybrids presenting a longer cycle, with 104 days duration. The other hybrids did not present statistical difference, ranging from 92 days for Hyola 575CL, 94 days for Hyola 433 and Hyola 571CL and 97 days for Hyola 61. Luz et al. (2012), in Santa Maria - RS, observed 134 days duration for Hyola 433 and 147 for Hyola 61. In the same study it was evaluated the relative development of plants according to air temperature, it was concluded that a negative linear relationship between air temperature and cycle duration indicates that the decrease in air

temperature determines an increase in cycle durations and subperiods for the two genotypes.

There was a statistical difference to the sowing date for emergence to physiological maturity in days and average plant height (Table 7). For emergence to physiological maturation in days, it was observed that, the later the sowing date, the bigger the plant cycle.

Hrchorovitch et al. (2014), evaluating six sowing dates in Dois Vizinhos - PR, observed a bigger canola cycle in later sowing dates until the fourth date, for Hyola 61, Hyola 76, Hyola 411 and Hyola 433. For the two later dates, there was a decline in cycle length.

Table 7. Emergence to physiological maturation (days) and average plant height (m) in three sowing dates.

Date	Emergence to maturation (days)	Average plant height (m)
03/03	92 c	1.12 a
03/10	96 b	1.05 b
03/17	101 a	1.12 a

Means followed by the same letter in the column do not differ statistically from each other according to Scott-Knot test at 0.001 probability.

The air temperature is the meteorological element that most influences plants phenology and development (STRECK, 2002) and, therefore, the cycle duration can be affected by lower and higher critical limits of air temperature for the crop, being able to promote alterations in the development of plant subperiods duration and in the plant total cycle.

Plants average height varied according to sowing date, 1.12 m in the first and third dates and

1.05 m in the second. Rigon et al. (2017), evaluating Hyola 433, Hyola 50, Hyola 61, Hyola 76, Hyola 571CL and Hyola 575CL in two sowing dates in Santa Maria – RS, reported that canola hybrids sown in the first date showed higher values for this variable.

For emergency to physiological maturation in degree-day there was interaction between hybrids and date (Table 8).

Table 8. Emergency to physiological maturation in degree-day of five canola hybrids in three sowing dates.

Hybrids	Sowing date		
	03/03	03/10	03/17
Hyola 50	1720 aB	1814 aA	1856 aA
Hyola 61	1676 aB	1731 bB	1864 aA
Hyola 433	1628 bB	1633 cB	1701 bA
Hyola 571CL	1661 aA	1668 cA	1689 bA
Hyola 575CL	1613 bB	1604 cB	1686 bA

Means followed by the same lowercase letter in the column and upper case in the row do not differ statistically from each other according to Scott-Knot test at 0.001 probability.

In general, the later the sowing date, the bigger the thermal sum needed to complete the cycle; however, this is dependent on the hybrid. Hyola 571CL was the only hybrid that did not present statistical difference of the thermal sum between the three dates, varying from 1,661 degree-day for first date and 1,689 for the third. Hyola 61, Hyola 433 and Hyola 575CL showed the highest

sum in the last sowing date, with 1,864, 1,701 and 1,686 degree-day, respectively.

Thermal sums obtained in the total canola cycle resemble those found by Fochesatto (2012), 1,674 degree-day, who worked with different canola genotypes in two Rio Grande do Sul municipalities. Equivalent results were also observed by Luz et al. (2012) for Hyola 433 and Hyola 61, which were 1,515 and 1,644 degree-day, respectively.

Tesfamarian (2004), in a work conducted in Africa with Hyola 60, also reported similar value, 1,742 degree-day.

The most important effect of air temperature lies on the canola plant stages definition. Each stage progresses from a certain amount of temperature accumulation, expressed by degree-day index (DALMAGO et al., 2009). Thus, at elevated temperatures, there is an increase in the metabolic process, which shortens the plant cycle, reducing its height.

Although the number of days is an indicator for definition of canola crop cycle, it should be remembered that it is a form that presents great variability, and the rate of plant development responds to the air temperature, defining, then, the

phenological stages. The increase in temperature accelerates the plant growth stages, which can cause great difference in terms of total cycle, shortening it (MENDONÇA et al., 2016; DALMAGO et al., 2009). High values were observed for the thermal sum of the culture cycle, since the temperature values above the optimum were frequent (25 °C), Figure 1.

In Table 9, the average values of hybrids and sowing dates are displayed for grain yield. For Hyola 61 and Hyola 575CL hybrids, there was no statistical difference between sowing dates, ranging from 512.70 to 637.04 kg ha⁻¹ and 717.50 to 869.75 kg ha⁻¹, respectively. Hyola 50 and Hyola 433 showed higher grain yield in the first sowing date, with 711.27 and 932.27 kg ha⁻¹, respectively.

Table 9. Grain yield of five canola hybrids in three sowing dates.

Hybrids	Sowing dates		
	03/03	03/10	03/17
Hyola 50	711.27 bA	443.57 cB	437.50 cB
Hyola 61	628.58 bA	512.70 cA	637.04 bA
Hyola 433	932.27 aA	713.24 bB	725.63 bB
Hyola 571CL	745.55 bB	965.65 aA	439.60 cC
Hyola 575CL	869.75 aA	717.50 bA	844.73 aA

Means followed by the same lowercase letter in the column and upper case in the row do not differ statistically from each other according to Scott-Knot test at 0.001 probability.

In the first sowing date, Hyola 433 and Hyola 575CL stood out, being statistically the same. In the second, the best performance was for Hyola 571CL and in the third for Hyola 575CL.

In the present work, grain yield was below the 2017 national average, 1,552 kg ha⁻¹ (CONAB, 2017). However, in places with similar soil and climatic conditions, such as in Mato Grosso do Sul, grain yield of 969 kg ha⁻¹ was found by Tomm (2007) for Hyola 61 and by Ito et al. (2014) an average yield of 687 kg ha⁻¹ for Hyola 571CL, 798 kg ha⁻¹ for Hyola 61 and 1,341 kg ha⁻¹ for Hyola 433. This is justified due to the low plant population (Table 3) and possibly by temperatures above 27 °C during flowering (Figure 1), which associated with water deficit reduce this phase duration, causing grain yield reduction due to the abort of flowers and pod (MENDONÇA et al., 2016; TOMM et al., 2009b).

Although there is an association between decreased grain yield and flower abortion, Battisti et

al. (2013), studying flowers dynamics and flowers abortion for canola and brown mustard hybrids in Santa Maria - RS, pointed out that there was no clear relationship between yield and flower total emission rate.

In different oilseeds, it has been observed a discrepancy in grains yield, which may originate from genotype, plant density and nitrogen fertilization, and the effects provided by the crop year influences production more than the cultivar potential. In addition, among the factors related to the environment, improved crop management can provide beneficial effects on grain yield (KRÜGER et al., 2011).

In the edaphoclimatic conditions of this study, in the year of 2017, the best agronomic performance was observed in the first sowing date for the canola hybrids Hyola 433 and Hyola 575CL and in the second sowing date for the canola hybrid Hyola 571CL.

RESUMO: Canola (*Brassica napus* L. var oleífera) é uma cultura de potencial devido a crescente demanda mundial por óleo vegetal. Diante disso, objetivou-se com este trabalho avaliar o desempenho de cinco híbridos de canola, em três épocas de semeadura em Jataí-GO. O experimento foi conduzido em delineamento

de blocos casualizados, com parcelas subdivididas com quatro repetições. Nas parcelas foram avaliadas as três épocas de semeadura (03/03, 10/03 e 17/03) e nas subparcelas os híbridos (Hyola 50, Hyola 61, Hyola 433, Hyola 571CL e Hyola 575CL) no ano de 2017. Foram avaliadas: emergência de plântulas, populações inicial e final, florescimento, maturação, altura de planta, índice de sobrevivência de plantas e produtividade de grãos. Com os dados fenológicos foi realizado o cálculo da soma térmica. Foram efetuadas as análises de variância e as médias foram comparadas pelo teste de Scott Knott a 5% de probabilidade. Para o índice de sobrevivência, destacaram-se os híbridos Hyola 433, Hyola 571CL e Hyola 575CL. A produtividade variou de acordo com híbrido e época. Nas condições edafoclimáticas deste estudo, no ano de 2017, o melhor desempenho agrônomo foi observado na primeira época de semeadura para os híbridos de canola Hyola 433 e Hyola 575CL e na segunda época de semeadura para o híbrido de canola Hyola 571CL.

PALAVRAS-CHAVE: *Brassica napus* L. var oleífera. Fenologia. Produtividade. Tropicalização.

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