Bulletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. Agriculture
Open Access

Research on Row Spacing and Sowing Period Influence on Rapeseed Production Parameters

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RESEARCH ARTICLE

Abstract

Rapeseed (*Brassica napus* L.), is an important annual species from the *Brassicaceae* family, being related to plants such as mustard, broccoli, cauliflower and cabbage. It is a plant with uses in various fields, especially in oil production. The study was carried out at the Jucu plant station in Cluj County. Two canola cultivation parameters were considered: row spacing and sowing time. The impact of these two characteristics was studied on rapeseed growth and development. Row spacing was established using the following intervals: 25 cm, 37.5 cm and 50 cm. A McCormick Cmax100 tractor with 3-body reversible Vogel plow and Kverneland rotary harrow was used to prepare the seedbed. Sowing was done with the Winterstaiger experimental seeder in three periods: August 20, August 30 and September 10. All data were collected and presented statistically in tables. Branch number, plant height and silique mass were influenced by row spacing and sowing time.

Keywords: Rapeseed; between rows distance; plants height; siliques mass.

Received: 07 March 2024
Accepted: 01 November 2024
Published: 15 November 2024

DOI: 10.15835/buasvmcn-agr:2024.0002

INTRODUCTION

Rapeseed (*Brassica napus* L.) is an important annual species of the *Brassicaceae* family and has been cultivated since ancient times in the Mediterranean area and in the Middle East. The species has been known for 2000 years in India, China and Korea. In Romania, it has been cultivated for the first time between 1840-1850, being brought from England (Muntean et al., 2014). Rapeseed is related to plants such as mustard, broccoli, cauliflower and cabbage and is used in various fields, especially in oil production. Rapeseed is the second most abundant edible oil produced in the world, with low erucic acid and low glucosinolate levels in modern hybrids (Przybylski and Roman, 2011). The quality of rapeseed oil has attracted worldwide attention, the oil cold-pressed rapeseed oil is much preferable to refined oil because it is solvent-free (Piazza et al., 2001). Cold-pressed rapeseed oil finds applications in animal feed, chemicals and fuel, it also offers benefits for health due to its unique fatty acid profile and high concentration of bioactive compounds (McDowell et al., 2019). Global rapeseed production has grown enormously over the past two decades. Compared to other crops, it is the second most abundant producer of edible oil in the world, after soybean. New rapeseed varieties with low erucic acid and low glucosinolate have attracted worldwide attention and are considered a valuable source of edible oil (Rękas et al., 2016). The plant and oil were used as a renewable source of biodiesel using the methyl ester (Ismail et al., 2017). A research stated that rapeseed oil is close to olive oil in terms of taste, which makes it good for consumption (Ozerova et al., 2020). Rapeseed is a plant with high potential contributing to many fields. It

has been tested that from one tone of rapeseed raw materials can be extracted, about 300 kg of oil and 700 kg of sprat (Savenkov et al., 2017). In oilseed rape, row spacing or plant density varies considerably worldwide, depending on environment, production system and variety. Previous studies have shown that plant spacing is an important factor affecting production (Al-Barzinjy et al., 1999). Leach et al. (1999) also reported that plants grown at long distances had fewer pod-bearing branches per plant but produced more branches and that with increasing distance, seed weight increased by 1000. Rapeseed resembles sometimes in rows spaced far enough apart to allow mechanical cultivation. In most areas where herbicides are used, the crop is either broadcast or sown in seed rows spaced 15-20 cm apart (Le Roux et al., 2018). Morrison et al. (1990) said that larger row spacings resulted in increased plant height, better plant branching and increased number of siliques per plant. The same researchers also observed that there was no effect of distance on seed oil content (Zhang et al., 2012). Plants growing in wider rows may not efficiently use natural resources such as light, water and nutrients, while growing in narrow rows may result in severe competition for row spacing (Ali et al., 1999). Appropriate row spacing of a particular crop is a significant agricultural factor and has an impact on yield and its components (Diepenbrock, 2000). Oad et al. (2001) observed that at a greater distance between rows, the number of seeds increases, and at small distances between rows, the amount of seeds decreases. Shahin and Valiollah (2009) found that taller plants were found at higher row spacings, and shorter plants were found at short row spacings, row spacing contributes to plant height. Chaniyara et al. (2002) conducted a study in India for an inter-impact probe and row spacing on growth and yield. From this experiment they observed an increase in yield and seeds in narrow rows. Radjabian et al. (2009) planned and carried out a process to evaluate different row spacings to assess yield and weed competition. They observed weeds throughout the growing period at a large distance between rows. Siag et al. (1993) documented that as row spacing increases, the number of plants/m^{-1} decreases. This study aimed to test the influence of row spacing and sowing time on rapeseed production parameters. In our research we want to establish the optimal row spacing in rapeseed so that the plants have the best conditions to produce as many siliques and large seeds as possible.

MATERIALS AND METHODS

The research was carried out in the 2022-2023 agricultural year, in pedoclimatic conditions from Jucu Experimental Field of USAMV Cluj-Napoca. The experimental area was 1200 sq m (square meters), divided into 27 experimental plots, each of 14.4 sq m (12 x 1.2 m), representing 9 variants with 3 repetitions.

The experience was of bifactorial type, the factors experienced were:

- Factor A, sowing time: August 20, August 30, September 10, 2022.
- Factor B, row spacing: 25 cm, 37.5 cm and 50 cm (keeping the same amount of seed/hectare).

Sowing was done between August and September 2022, in 3 repetitions, with the rapeseed hybrid PT 275 (Corteva), a hybrid with high production potential.

Location of the study

The commune of Jucu is located 20 km N-E from Cluj-Napoca, at the interference of two large relief units: The Someşan Plateau in the western part and the Transylvanian Plain in the eastern part, being crossed from south to north by the Someşul Mic River. The Jucu experimental field is located on the eastern slope of the hill to the left of the Someşul Mic River, with coordinates 46°52'16'' north latitude and 23°45'27'' east longitude. The Jucu experimental farm of the Cluj-Napoca University of Agricultural Sciences and Veterinary Medicine has 35 ha of agricultural land.

Land preparation and sowing

The equipment used to prepare the land for rapeseed crop was a McCormik Cmax100 tractor with a 3-body reversible Vogel plow (Figure 1 a). Plowing was at a depth of 25 cm, and for the seedbed preparation, a Kverneland rotary harrow work (Figure 1. b) with a working width of 2.5 meters was used. Sowing was done with the Wintersteiger experimental seeder, with a working width of 1.2 meters.

Pedoclimatic conditions

The amount of precipitation for the period August 2022-July 2023 was 642,54 mm. During this period, the highest amount of precipitation was recorded in August 2022 (86.10 mm) and the lowest precipitation was in March 2023 (19.8 mm). The water deficit has considerably influenced the evolution of rapeseed cultivation. The average annual temperature during the same period was 12.2°C and a minimum temperature of 4.6°C. The soil in the experimental field is a Phaeozem Argic-Stagnant type. It has a good content of nutrients, the amount of humus being between 5.33 and 5.5.7 in the first 50 cm of soil. The texture is loamy-sandy, in the first 80 cm, with a high content of clay. The structure of the soil is glomerular.

In the experimental field, before harvesting, it was made the following observations and measurements: the number of branches, the plant height and the mass of siliques per plant. From each repetition, 5 plants were randomly harvested at full maturity. Seed moisture at harvest was 9.2%.

Figure 1. (a) McCormik Cmax 100 tractor and Vogel plow; (b) Rotary harrow.

Statistical analysis

Statistical analysis was performed with POLIFACT software, and the two-factor ANOVA test was used. Testing for normality of data distribution was performed with the Shapiro-Wilk test and testing for homogeneity of variance (if variances across samples are equal) was performed with Bartlett's test using statistical software R4.3.1 (R Core Team, 2024).

RESULTS AND DISCUSSIONS

The results are presented in the following tables for each determined parameter. Regarding the number of branches/plant depending on the distance between the rows and the sowing season, a significantly negative difference was identified at the distance between the rows of 50 cm in season 1 (August 20), and in season 2 (August 30) they found significantly negative differences compared to the control. At epoch 3 (September 10), differences in branch counts were small and not statistically significant by analysis of variance (Table 1).

Table 1. Distance between rows influence in interaction with the sowing season on the number of plant branches, Jucu, 2023

Sowing season	Distance between rows (cm)	Branches nr.	Difference		Significance
			%	No.	
20 aug 2022	25	7.67	100.0	0.00	Mt.
	37.5	7.60	99.1	-0.07	-
	50	6.40	83.5	-1.27	0
30 aug 2022	25	7.65	100.0	0.00	Mt.
	37.5	6.00	78.4	-1.65	00
	50	6.00	78.4	-1.65	00
10 sept 2022	25	5.93	100.0	0.00	Mt.
	37.5	5.93	100.0	0.00	Mt.
	50	6.00	101.1	0.07	-
DL (p 5%)					1.09
DL (p 1%)					1.53
DL (p 0.1%)					2.16

Note: Mt – control sample; DL – significance thresholds.

Rapeseed plant height was influenced by row spacing and sowing season. At the distance between the rows of 50 cm, significantly negative differences were found in the first sowing period and distinctly significant differences

in the 2nd period. Sowing on September 10, at different distances between the rows, influenced the height of the plants, but the differences are small and not statistically assured (Table 2).

Table 2. Distance between the rows influence in interaction with the time of sowing on the plant height, Jucu 2023

Sowing season	Distance between rows (cm)	Plant height	Difference		Significance
			%	cm	
20 aug 2022	25	117.53	100.0	0.00	Mt.
	37.5	112.53	95.7	-5.00	-
	50	100.27	85.3	-17.27	0
30 aug 2022	25	121.40	100.0	0.00	Mt.
	37.5	123.20	101.5	1.80	-
	50	103.53	85.3	-17.87	00
10 sept 2022	25	128.87	100.0	0.00	Mt.
	37.5	129.40	100.4	0.53	-
	50	121.00	93.9	-7.87	-
DL (p 5%)					12.55
DL (p 1%)					17.61
DL (p 0.1%)					24.87

Note: Mt – control sample; DL – significance thresholds.

The largest mass of siliques per plant was found at a distance of 50 cm between rows regardless of the sowing season. At the 2nd sowing period compared to the control (25 cm), very significantly positive differences were found at the distance of 50 cm (Table 3).

Table 3. Distance between rows influence in interaction with the sowing season on the average mass of siliques/plant, Jucu, 2023

Sowing season	Distance between rows (cm)	Siliques mass (g)	Difference		Significance
			%	g	
20 aug 2022	25	46.40	100.0	00	Mt
	37.5	42.73	92.1	-3.67	-
	50	50.67	109.2	4.27	-
30 aug 2022	25	38.87	100.0	0.00	Mt
	37.5	27.57	70.9	-11.30	-
	50	88.07	226.6	49.20	***
10 sept 2022	25	31.53	100.0	0.00	Mt
	37.5	26.53	84.1	-5.00	-
	50	31.27	99.2	-0.27	-
DL (p 5%)					19.57
DL (p 1%)					27.47
DL (p 0.1%)					38.79

Note: Mt – control sample; DL – significance thresholds.

CONCLUSIONS

In recent years, rapeseed growers have faced various problems that have affected this crop to some extent. Severe drought around sowing periods, low temperature in winter, early spring frosts, heat in the last part of the growing season influence the rapeseed production. In this context, identifying the optimal moments for sowing in the Someşan Plateau would contribute to the development of culture in this area. Following the research carried out in the agricultural year 2022-2023 in the research field from Jucu, Cluj County, it emerged that, for the best results regarding the mass of siliques per plant, the best time to sow is at the end of August and the optimal distance between rows was 50 cm. From the point of view of plant height and the number of branches per plant, both in 1st and 2nd sow time, they presented negative values compared to the control sample at both distances from the control (25 cm). Although the size and the number of branches presented higher values regardless of the age at the distance of (25 cm), for the mass of siliques, the highest value was recorded at the distance of 50 cm.

Author Contributions: D.L.S and M.M.D. Conceived and designed the analysis; D.L.S, V.H. and C.M. Collected the data; D.L.S. and A.D.C. Performed the analysis; D.L.S. and M.M.D. Wrote the paper.

Funding Source: The research was carried out with the material support of the Doctoral School of Agricultural Engineering Sciences of the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Romania.

Conflicts of Interest

The authors declare that they do not have any conflict of interest.

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