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The evaluation of yield and components as influenced by row spacing and seeding rate in canola

Hossein Bagheri[1*] and Asghar Rezakhanlou[2]

[1]Department of Agriculture, Tabriz Branch, Islamic Azad University, Tabriz, Iran
[2]Department of Agriculture, Saveh Branch, Islamic Azad University, Saveh, Iran

Abstract

In this study, three row spacing (15, 30 and 45 cm) and four seeding rates (80, 180, 280 and 380 viable seeds m^2) on seed yield and some yield components of canola (*Brassica napus* L.) were evaluated under rain-fed conditions in Karaj, Iran during 2008 and 2009. Row spacing and seeding rate significantly affected most yield components measured. The number of plants per unit area increased with increasing seeding rate and decreasing row spacing. Greater plant heights were obtained from narrow row spacing and higher seeding rates. Narrow row spacing and higher seeding rates reduced the number of primary branches and the number of pods per terminal raceme. Also, the number of seeds per pod and 1000-seed weight were not affected by either row spacing or seeding rate. In contrary, the number of pods per plant clearly increased with increasing row spacing but decreased with increasing seeding rate. The highest seed yields were obtained for the 15 cm row spacing (2222 kg/ha) and 180-seeds m-2 seeding rate (2238 kg/ha).

Keywords: Canola, row spacing; seed yield; seeding rate

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Introduction

Oilseed rape is cultivated and processed for many different purposes. The importance of rape has thus increased in recent years and today it is one of the most important oil seed crops in the world (Bybordi and Tabatabaei, 2009). The seed yield of oilseed rape is a function of population density, number of pods per plant, number of seeds per pod and seed weight. However, yield structure is very plastic and adjustable across a wide range of populations. The number of pods per plant is the most responsive of all the yield components in oilseed rape (Diepenbrock, 2000). Low density populations produce more branches that carry fertile pods, thus prolonging the seed development phase. Plants grown at high densities are often more susceptible to lodging and increased disease incidence without the benefit of any yield increase, but the presence of fewer pod-bearing branches should produce more synchronous pod and seed development and result in more uniform seed maturation, improved harvesting ability and possibly lower seed glucosinolate and higher oil contents (Leach et al., 1999). Higher plant population density has been recommended and adopted to ensure a competitive crop and to control weeds in the early growth stages (Morrison et al., 1990a). Angadi et al. (2003) noted that plant populations reduced from 80 to 40 plants m^2 produced similar seed yields when plant stands were uniformly distributed. Chen et al. (2005) found that a seeding rate of 32 to 65 seeds m^2 produced optimum oilseed rape yields. Clarke et al. (1978) reported that *B. napus* grown at 30 cm row spacing in southern Saskatchewan, Canada, yielded more than the broadcast seeding at each of four seeding rates ranging from 2.5 to 20 kg/ha. Greater oil seed rape production when grown in rows was thought to be due to altered plant morphology and enhanced source and sink development. Morrison et al. (1990a) showed that *B.*

Corresponding author: Hossein Bagheri, Department of Agriculture, Tabriz Branch, Islamic Azad University, Tabriz, Iran. Email: Bagheri_hm2000@yahoo.com

napus yield was greater at a 15 cm row spacing compared with those using 30 cm row spacing.

Materials and Methods

A field study was conducted during 2008 and 2009 growing seasons in the experimental plots of the farm of Agriculture, Karaj, Iran to evaluate the integrated effects of row spacing and seeding rate on seed yield and yield components of oilseed rape (*Brassica napus* L. cultivar of Zarfam). According to climatic data taken from the nearest weather station in Karaj, the long term average total precipitation is 353 mm/year. These data indicate that row spacing and seeding rates were evaluated across a considerable range of weather conditions. Factorial arrangements of three row spacing (15, 30 and 45 cm) and four seeding rates (80, 180, 280 and 380 viable seeds m^2) were evaluated in a randomized complete block design with three replications. Seeding rates were 80-380 seedsm^2, equivalent to seeding rates of 485 kg/ha. The individual plot size was 3×5 m=15 m^2. Sowing was done by hand on September 15, 2008 and September 17, 2009, respectively. Nitrogen fertilization of 150 kg/ha after sowing and 60 kg/ha in spring was uniformly applied to all plots as ammonium nitrate. Ten plants from each replication were randomly collected at the full podding stage for morphological measurements. Pod number per plant, seed number per pod, and 1000-seed weight were measured for each individual. Plant stand was counted at harvest along a 1 m length of the interior rows of each plot in two replications.

All data were subjected to analysis of variance for each character using MSTAT-C (Version 2.1, Michigan State University, East Lansing, MI) software. The significance of treatment, main effects and interactions were determined at the 0.05 and 0.01 probability levels by the F-test. The F-protected least significant difference (LSD) was calculated at the 0.05 probability level.

Results and Discussion

An ANOVA of the combined two-year data indicated significant main effects according to year, row spacing and seeding rate for most parameters (Table 1). Apart from the number of seeds per pod, 1000-seed weight and seed yield, year effect was significant for most parameters. Row spacing and seeding rate interactions were not significant except for plant stand and pod number per plant. Therefore, row spacing and seeding rate characteristics are discussed independently for most parameters. Plant stand increased with increasing seeding rate, but the magnitude of the increase in plant stand gradually declined with widening row spacing. The number of pods per plant was greatly affected by both row spacing and seeding rate. The total number of pods increased with increasing row spacing but decreased with increasing seeding rate (Tab. 1). Angadi et al. (2003)

Table 1: Effects of row spacing and seeding rate on agronomy traits of canola cultivar (2-year average)

Treatments		Pod\plant	Seeds/pod	1000-seed weight (g)	Seed yield (kg ha-1)
Row spacing (cm2)					
15		264.7^c	33.0^a	5.2^a	2222^a
30		294.6^b	32.6^a	5.3^a	2133^{ab}
45		349.1^a	32.6^a	5.3^a	2092^b
LSD(0.05)		2.5	ns	ns	82.3
Seeding rate (seed m2)					
80		344.0^a	33.1^a	5.4^a	2009^b
180		314.8^b	32.6^a	5.2^a	2238^a
280		287.2^b	32.8^a	5.2^a	2211^a
380		264.8^d	32.5^a	5.2^a	2137^a
LSD(0.05)		3.05	ns	ns	55.41
S.O.V	df			M.S	
Year(Y)	1	**	ns	ns	ns
Blooks (year)	4	ns	ns	ns	ns
Row spacing (RS)	2	**	ns	ns	*
Seed rate (SR)	3	*	ns	ns	**
RS*SR	6	**	ns	ns	ns
Y*RS	2	ns	ns	ns	ns
Y*SR	3	ns	ns	ns	ns
Y*RS*SR	6	ns	ns	ns	ns
Error	44	10.12	8.7	2.1	12312.56

*=statistical difference at P<0.05; **= statistical difference at P < 0.01; ns= no statistical difference at P<0.05 and P<0.01; d.f.: degrees of freedom; a: data are the means of 2 years, 3 replicates and 4 seeding rate, b: data are the means of 2 years, 3 replicates and 3 row spacing, means within each column followed by the same letter are not different (least significant difference (LSD) test, P<0.05)

reported that the number of pods per plant increased with decreasing plant population density in all environments, although the magnitude of the decline was different. The lowest number of pods per plant was observed when plants were grown at 15 cm row spacing and 380-seeds m^2 seeding rate, whereas other treatments showed higher numbers of pods per plant. The numbers of seeds per pod and 1000-seed weight were not affected significantly by row spacing and seeding rate (Table 1). McGregor (1987) found that the number of seeds per pod and 1000-seed weight was not strongly influenced by plant population density, as was the number of pods per plant. Early formed pods at the top of the canopy or on the main raceme have a developmental advantage (Mendham and Salisbury, 1989), which might explain the smaller variations in number of seeds per pod and 1000-seed weight. Seed yield generally increased as the row spacing decreased. The maximum seed yield occurred at the 15 cm row spacing, with small and non-significant differences with 35.0 cm row spacing. Differences among yields at the three higher seeding rates (180, 280 and 380 seeds m^2) were not significant. However, the 180-seeds m^2 seeding rate had the greatest seed yield (2238 kg/ha) (Tab. 1). Morrison et al. (1990a) reported that B. *napus* yield was greater at a 15 cm row spacing compared with 30 cm row spacing. Plants exhibited greater dry weight per unit area and at certain growth stages, greater leaf area index when grown in rows spaced at 15 cm com- pared with 30 cm (Morrison et al., 1990b). Clarke et al. (1978) reported that winter oilseed rape grown at 30 cm row spacing in southern Saskatchewan, Canada, yielded more than broadcast seeding at each of four seeding rates ranging from 2.5 to 20.0 kg/ha. Hanson et al. (2008) stated that seed yield increased with increasing seeding rates in spring oilseed rape. In the present study, however, there was no obvious relationship between seed yield and number of pods per terminal raceme or number of pods per plant, neither for row spacing nor for seeding rate.

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