Influence of Sowing Time on Growth, Yield and Nutritional Quality of Forage Rape in Spring

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ABSTRACT

To determine as optimal sowing time of forage rape in spring time in southern areas of Korea, forage rape cv. Velox, the highest yielding variety among introduced varieties of forage rape, was grown under five different sowing times. Yield components such as plant length, number of branches and number of leaves etc. were higher at the sowing time of Mar. 15 and Mar. 25. The plants sown at Mar. 15 and Mar. 25 also showed highest fresh and dry matter yield. When plants were grown under later sowing time, they showed higher values in content of crude protein and lower values in contents of crude fiber such as Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), cellulose and lignin. There was no relationship between variation of In Vitro Dry matter Digestibility (IVDMD) and sowing time. The plants sown at Mar. 15 and Mar. 25 showed highest digestible dry matter yields.

Key Words : Forage rape, Growth, Nutrient quality, Sowing time, Yield

INTRODUCTION

There have been many reports about the effects of the sowing date on yield and nutrient quality of forage rape (Harper and Compton, 1980; Kalmbacher et al., 1982; Timirgaziu, 1983). However, the effects of the sowing date on the yield and nutritional quality will vary largely depending upon places. This experiment was conducted to evaluate the effects of the sowing date on yield components, yield and nutrient quality of forage rape at the southern part of Korea in spring.

MATERIALS AND METHODS

The experiment was conducted at the experimental farm of Sunchon National University from September 1999 to May 2000. Variety used in the trial was Velox, which was the most promising variety of forage rape at the southern area of Korea. There were five levels of the sowing date, Mar. 5, Mar. 15,Mar. 25, Apr. 5 and Apr. 15, at the interval of ten days were tested. The 500 g seeds/10a were sown by drilling methods with 30 cm row spacing and 20 cm width. The complete

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randomized block design was used with three blocks and each experimental unit was 12.5 m^2 (2.5 m x 5 m).

Fertilizers were applied at the rate of 8-6-6 kg/10a of N-P_2O_5-K_2O. One third of the total N, total P_2O_5 and K_2O and manure of 1,000 kg/10a were incorporated into the soil before sowing and the rest of N fertilizer was applied in late April. Ten plants were randomly sampled from each plot at flowering stage, and plant length, stem diameter and number of main stem leaves were measured. To determine yield, all the plants in 1m^2 from each plot were harvested by cutting at about 3cm above soil level. After determining fresh yield, plant materials of about 600g were sampled and separated into stems and leaves and their respective weights were determined. Dry matter weight of each samples were measured after drying for 30 min. at 105℃, then for 72 hour at 70℃ in a forced-air oven.

The dried samples were grounded by a Wiley mill and seived with 18-mesh screen and stored at 18℃ and then were analyzed to chemical components. Kjeldahl procedure was used to estimate crude protein (CP) (AOAC, 1970).

Contents of fiber such as neutral detergent fiber (NDF), acid detergent fiber (ADF), permanganate lignin (PL) and cellulose were determined by in Goering and Van Soest (1970).

The contents of hemicellulose were estimated by the difference between NDF and ADF. The procedure of pepsin-cellulose assay (Goto & Minson, 1977) was used to determine in vitro dry matter digestibility (IVDMD). Digestible dry matter yield (DDMY) was calculated by the product of dry matter yield and IVDMD.

RESULTS AND DISCUSSION

Yield components and yield

The means of plant length, stem diameter, number of branches, number of leaves, fresh yield and dry matter yield are presented in Table 1. Plant length was higher at the sowing date of Mar. 15th and Mar. 25th and it ranged from 102 to 109 cm. The earlier or the later sowing dates showed lower values in plant length ranged from 82 to 92 cm. Stem diameters at the sowing date of Mar. 15th and Mar. 25th were 23.4 to 23.8 mm and other sowing dates showed lower values in stem diameter from 17.9 to 20.7 mm. The plants at sowing date of Mar. 15 and Mar. 25 showed higher values in number of branches, number of leaves, fresh yield and dry matter yield than plants at any other sowing date. Especially in dry matter yield, it ranged 530 kg/10a at Mar. 15th and 552 kg/10a at Mar. 25th which was higher than that of any other sowing date ranged from 319 to 506 kg/10a. The results may be attributable to facts that high temperature in early March increased early growth of forage rape which is winter annual crop and in Apr. high temperature decreases sharply, so that growth is also depressed from the flowering stage of growth. On the contrary Kwon et al. (1984) reported

Table 1. Variations of yield and agronomic characters of forage rape under different sowing times in spring.

Sowing time		Plant leanth (cm)	Stem diameter (mm)	No. of branch	No. of leaf			Fresh yield(kg/10a)			Dry matter yield (kg/10a)		
					Total	Main stem	Branch	Total	Stem	Leaf	Total	Stem	Leaf
Mar.	5	91.8	20.1	16.2	134.6	16.4	118.2	3,948	2,439	1,510	506.2	330.7	175.5
	15	102.1	23.4	17.9	137.5	17.9	119.6	4,539	2,818	1,721	530.0	346.8	183.2
	25	109.6	23.8	18.6	147.4	18.7	128.7	4,981	3,062	1,919	552.2	353.7	198.5
Apr.	5	88.8	20.7	9.9	61.1	12.9	48.2	3,831	2,329	1,502	362.8	224.7	138.1
	15	81.7	17.9	8.1	52.7	12.3	40.4	3,648	2,134	1,514	319,2	191.8	127.4

that oil seed rape showed higher seed yield at the sowing date of late Sep. than early or mid Oct. Kalmbacher et al. (1982) conducted an experiment with the sowing date from Oct. to Jan. at the southern area of U.S.A. and reported that dry matter yield of forage rape decreased as growing period was shortened. Harper and Compton (1980) reported that in forage rape dry matter yield did not increase when plants were sown after Oct. and it was depend upon the duration of growth from sowing to harvest. The results of above reports were consistent with those of this experiment. Based on the results from analyses of variance (Table 2), all the characters showed significant differences among the sowing dates, so that the sowing date had large of forage rape seems to be ranged from Mar. 15 to Mar. 25 in spring at southern area of Korea.

Nutrient quality and digestible dry matter yield (DDMY).

Contents of crude protein and fiber such as NDF, ADF, hemicellulose, cellulose and lignin, IVDMD and DDMY were presented in Table 3 and the results of analyses of variance were shown in Table 4.

Content of crude protein ranged from 20.0 to 22.0% and it was increased at the harvest date with progressively later sowing. Since content of crude protein in forage rape is high at the beginning stage of growth and it decreases as plants grow older, the results may come from the fact that as the sowing date is later, plants are younger at harvest date.

Content of NDF ranged from 30.92 to 35.86%, ADF from 27.10 to 30.18%, cellulose from 21.65 to 24.35%, and lignin from 1.62 to 1.81%. All the contents

Table 2. Analysis of variance for agronomic characters of forage rape under different sowing times.

SV	df	No. of branch	No. of leaf			Fresh yield(kg/10a)			Dry matter yield (kg/10a)		
			Total	Main stem	Branch	Total	Stem	Leaf	Total	Stem	Leaf
Sowing time	4	29.0284**	151.4770**	12481.000**	46.2266**	12566.3000**	12566.3000**	1872000.000**	222016.000**	69865.9000**	37556.0760**
Error	8	0.0134	0.0678	12.6912	0.0430	7.0812	7.0812	7921.000	2400.000	124.6230	368.1253
C.V.(%)		0.51	1.32	3.52	0.96	3.12	3.12	3.12	3.26	2.71	5.12
L.S.D.(05)		0.41	0.52	6.77	0.44	6.21	6.21	1.8863	121.67	31.81	44.21

** $P < 0.01$.

Table 3. Comparisons of chemical compositions (DM%), *in vitro* dry matter digestibility and digestible dry matter yield under different sowing times.

Sowing time	df	CP	NDF	ADF	Hemicellulose	Cellulose	Lignin	IVDMD(%)		DDMY(kg/1ha)		
								Stem	Leaf	Total	Stem	Leaf
	5	20.04	35.86	30.18	5.51	24.35	1.81	73.76	82.17	437.46	270.40	167.06
Mar.	15	20.08	35.54	30.12	5.42	24.21	1.79	73.24	82.34	473.93	290.60	183.33
	25	20.34	35.21	29.29	5.40	23.40	1.76	73.17	82.65	483.97	296.97	186.96
Apr.	5	20.96	34.25	28.74	5.38	22.95	1.73	72.89	81.66	320.85	190.02	130.83
	15	22.10	30.92	27.10	4.01	21.65	1.62	72.74	81.50	297.75	162.78	134.97

*CP: crude protein, *NDF: Nutral Detergent Fiber, *ADF: Acid Detergent Fiber,
*IVDMD: In Vitro Dry Matter Digestibility, *DDMY: Digestible Dry Matter Yield.

Table 4. Analysis of variance for chemical compositions((DM%), *in vitro* dry matter digestibility and digestible dry matter yield.

SV	df	CP	NDF	ADF	Hemicellulose	Cellulose	Lignin	IVDMD(%)		DDMY(kg/1ha)		
								Stem	Leaf	Total	Stem	Leaf
Sowing time	4	1.6479**	8.4545**	3.4785**	0.0950**	3.1254**	0.0142**	0.4467**	2.3630**	28280.000**	13250.000**	2812.0000**
Error	4	0.0027	0.0056	0.0037	0.0043	0.0035	0.0004	0.0269	0.0341	0.5162	0.5960	0.2440
C.V.(%)		0.28	0.24	0.22	1.09	0.24	1.03	0.20	0.21	0.12	0.22	2.75
L.S.D.(0.05)		0.34	0.49	0.69	0.36	0.34	0.11	0.92	1.02	3.87	4.25	0.25

** $P < 0.01$

*CP: Crude Protein, *NDF: Nutral Detergent Fiber, *ADF: Acid Detergent Fiber,

*IVDMD: In Vitro Dry Matter Digestibility, *DDMY: Digestible Dry Matter Yield.

significantly decreased at the harvest date with later sowings. The results reveal that contents of fiber increase at the harvest date with earlier sowings.

IVDMD was determined in leaves and stems. IVDMD of stems ranged from 72.74 to 73.36% and that of leaves from 81.50 to 82.65%. No simple relationship between IVDMD and the sowing dates. According to the reports by Berendonk (1982a, 1982b, 1983a, 1983b) as growing period was longer, yield increased and the ratio of leaf weight to plant weight to decreased but IVDMD remained almost unchanged from 72 to 81%.

Digestible dry matter yield at the sowing date of Mar. 15 to 25 ranged from 473 to 483 kg/10a, which was the highest value compared with DDMY of any other sowing date ranged from 297 to 437 kg/10a.

Judging from the results, the optimal sowing date of Velox seems to be ranged from mid Mar. to late Mar. at the southern area of Korea.

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