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Effect of Different Planting Distributions on Yield and Forage Quality of Common Vetch (*Vicia sativa* L.)

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ABSTRACT

In order to select the best planting distributions on the rows and study their effects on morphological traits and uptake amount of some nutrients including nitrogen, phosphorus, potassium and calcium in forage of common vetch (*Vicia sativa*) a factorial experiment was carried out with randomized complete block design and 3 replications in research field of Mohaghegh Ardabili University in Ardabil, Iran. The first factor was the distance between rows including 25, 35 and 50 cm and the second factor was the distance between plants on the rows including 10, 15 and 20 cm. Results demonstrated that the effect of distance between rows was significant on green cover percentage. But the main effects and interaction of distance between rows and between plants on the rows were not significant on traits including number of secondary branches, plant height and plant weight at 10 percent flowering stage. Also, effect of distance between rows and between plants was not significant on fresh forage yield and by decreasing these distances, the yield increased. Mean comparisons demonstrated that planting distributions of 35×20, 35×15 and 50×20 cm increased phosphorus percentage of plants compared to other treatments and the least amount of phosphorus was acquired by planting distribution of 20×20 cm. The effect of planting distribution was not significant on potassium and calcium percentage. Generally, in this experiment the best planting distribution in order to acquire maximum amount of fresh and dry forage in vetch was 20×20 cm, but for the maximum protein content the pattern of 20×50 cm is recommended.

Keywords: Common vetch, Distance between rows and between plants, Forage yield, Planting distribution

INTRODUCTION

Winter vetch (*Vicia sativa*) has been used as human food since many years ago. Vetch is planted to protect the soil, improve its structure and is used as green manure, dry forage, silage

and green forage. Forage of vetch is useful for livestock and its protein during the best harvest time is about 15-20 percent (Karimi, 2007). Nutritional value of vetch is as much as alfalfa, but vetch is better because of no bloat in livestock (Kurdalli *et al*., 1996). Forage quality represents the nutritional value and energy content that it transfers to livestock.

The distance between rows and between plants on the rows determines growth space for plants and consequently obtainable yield (Sarmadnia and Koochaki, 1989). Mohyi (2004) evaluated the effect of intensity on quantitative and qualitative yield of common vetch and bitter vetch lines and, concluded that among three intensities used (50, 75 and 100 plant per m^2), the highest values for dry forage yield, days to harvest stage and flowering stage were acquired by the intensity of 100 plants per m^2. Also the most fresh forage yield was observed in the intensity of 100 plants per m^2. Habibzadeh *et al* (2007) studied the effect of different intensities on yield and yield components of a vetch species (*Vigna radiata*). In this experiment the distance between plants was in four levels of 15, 20, 25 and 30 centimeters. Results demonstrated that the distances of 20 and 30 centimeters on the row, produced the most and least grain yield and protein, respectively. In this study by increasing the intensity (decreasing distance between plants on the row), plant height increased. Mohyi (2004) reported that among three intensities of 50, 75 and 100 plants per m^2, the intensity of 50 plants per m^2 had the most number of first and second secondary branches in common vetch and bitter vetch plants. Lyaghat (2006) reported that by increasing plant intensity in alfalfa, plants weight and number of stems and nodes decreased. Khalilimahalleh *et al.* (2007) declared that in Johnson grass, increasing of plant intensity increases fresh forage yield and decreases the number of secondary branches in tillers. Planting distribution and suitable distance between rows and on the rows is a factor which could be effective on the yield and desired traits of plant. Proportion of plants intensity in the field affects uptake and exploitation by plants regarding environmental factors and competition inside plant and between plants and also is an effective factor on yield and plants nutritional value. The distance between rows and on the row determines the reachable space for each plant, leading to an obtainable yield (Sarmadnia and Koochaki, 2007). Agha alikhani *et al*. (2007) reported that effect of distance between rows on forage quality of pearl millet (amount of calcium and ash) was not significant due to its high tillering ability. Furthermore, Baghestanimeibodi *et al*. (2006) and this experimend was undertakn since reported that effect of distance between rows was not significant on energy content, crude protein percentage, calcium and phosphorus content. *Atriplex lentiformis*, Experiments of Cuomo *et al.* (1998) indicated that forage nutritional value of field corn is not affected by plant intensity and the distance between rows. Since little experiments have done about this subject on forage crops specially winter vetch and adaptability to Ardabil climate.

MATERIALS AND METHODS

This study was conducted in Research Field of Agricultural College of Mohaghegh Ardabili University, Ardabil, Iran, as factorial experiment with randomized complete block design with 3 replications. The first factor included three levels of distance between rows (20, 35 and 50 cm) and the second factor was three levels of distance on the rows (10, 15 and 20 cm). Cultivation activities included a surface tillage in spring (in the depth of 25-30 cm), disc and buckboard. Plot size was 2.5×2.5 meters. Irrigation was done once each 10 days considering seasonal

precipitation and plants water requirement. Weed control was done 3 times manually. Sixty kg/h net nitrogen was applied as urea (46%) at two times, once in the beginning of growth and the second application was one month after the first one. During the beginning of flowering, green cover percentage was measured by 0.5×0.5 meter quadrate. Final harvest was at 50 percent flowering stage on 21 of September considering marginal effect from 2 m^2 of each plot. Nitrogen content of shoot was measured using Kjeldahl method (Nelson and Sommers, 1980). Potassium, sodium and calcium content were determined by flame photometer and phosphorus content of samples was measured using spectrophotometer in wavelength of 660 nanometers. Data were analyzed using SAS software and Duncan test was used for mean comparison at 5 % probability level.

RESULTS AND DISCUSSION

According to analysis of variance results, effect of distance between rows was significant on green cover percentage of vetch (Table 1). By increasing row distance, green cover percentage decreased, so that, it's most value was acquired from 20 centimeters distance and the least value from 50 centimeters row distance.

Table 1. Results of analysis of variance for measured traits in vetch

Sources of Variation	Degrees of Freedom	Mean squares			
		Green Cover %	Number of Secondary Branches	Plant Height	Plant Weight at 10 % Flowering
Replication	2	3402.926**	1.902**	96.219**	0.559**
Distance Between Rows	2	2062.370**	0.665	7.991	0.007
Distance Between Plants	2	564.481**	0.793	2.729	0.084
Interaction	4	20.870	0.279	1.860	0.034
Error	16	80.759	0.303	6.306	0.044
Coefficient of variation		19.43	19.20	9.37	26.85

*and** significant at 5 and 1 percent probability levels, respectively.

Variance analysis demonstrated that effect of distance between plants on green cover percentage was significant (Table 1). By increasing the distance between plants, green cover percentage decreased and distances of 10 and 20 cm had the most and least green cover percentages (55% and 38%), respectively (Figure 1).

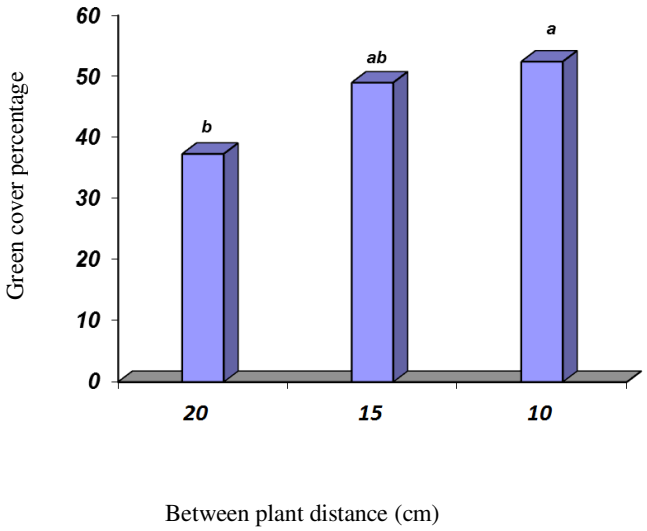

Figure 1. Mean comparison of the effects of between plants distance on green cover percentage of vetch

According to analysis of variance, simple effects and interaction of distance between rows and between plants was not significant for number of secondary branches, plant height and plant weight at 10 percent flowering stage (Table 1). Ramana and Singh (1989), in a study on cowpea concluded that plant intensity didn't have any significant effect on number of secondary branches.

Nutrients Percentage of Ash

Results of variance analysis showed that effect of distance between rows and interaction of two factors (planting distribution) were significant on plant phosphorus percentage (Table 2). The most phosphorus content by 0.31% was acquired in the distance of 50 centimeters and its least amount (27.7%) in the distance of 20 centimeters (Figure 2). Mean comparisons indicated that planting distributions of 35×20, 35×15 and 50×20 centimeters increased phosphorus content of plant compared to other treatments, and the least phosphorus content was acquired in planting distribution of 20×20 centimeters (Table 3). According to variance analysis table (Table 2), treatments of distance between rows and between plants and their interactions (planting distributions) didn't have any significant effect on calcium and potassium percentage of plant. These results were confirmed by Cuomo *et al*. (1998), Agha Alikhani *et al*. (2007) in pearl millet and Baghestani Meibodi (2006) in Atriplex lentiformis.

Table 2. Analysis of variance for measured traits in vetch

Sources of variation	Degrees of Freedom	Mean Squares							
		Sodium	Potassium	Calcium	Phosphorus	Fresh yield	Dry yield	Nitrogen	Protein
Replication	2	0.361	0.000	0.000	0.001	141956.259**	9968.839**	0.043*	1.665*
Distance Between Rows (R)	2	0.074	0.000	0.001	0.003*	655310.259**	46019.975*	0.0427**	16.622**
Distance Between Plants (D)	2	0.203	0.007	0.000	0.001	870407.815**	61123.344*	0.776**	30.145**
Interaction (R × D)	4	0.324	0.001	0.000	0.003*	11074.870*	777.726*	0.034*	1.346*
Error	16	0.106	0.002	0.000	0.001	7448.801	423.080	0.011	0.446
Coefficient of variation	-	11.37	13.59	16.81	8.84	8.62	8.62	4.74	4.72

*and** significant at 5 and 1 percent, probability levels, respectively

Table 3. Mean comparison of interaction effect of between and within row distance on some traits of vetch

Row Distance (cm)	Plant Distance Plant per (m^{-2})	Phosphorus (%)	Fresh yield ($g.m^{-2}$)	Dry yield ($g.m^{-2}$)	Nitrogen (%)	Protein (%)
20	20	0.252 b	1537 a	407.3 a	1.85 f	11.6 f
	15	0.273 ab	1248 bc	330.8 bc	2.08 de	12.98 de
	10	0.273 ab	997 d	264.2 d	2.24 cd	13.98 cd
35	20	0.33 a	1330 b	352.5 b	1.93 ef	12.09 ef
	15	0.33 a	1010 d	267.7 d	2.3 c	14.39 c
	10	0.272 ab	3.719 e	190.6 e	2.5 b	15.61 b
50	20	0.33 a	1124 cd	297.9 cd	2.07 de	12.94 de
	15	0.292 ab	621 e	146.6 e	2.53 b	15.79 b
	10	0.289 ab	421.3 f	111.7 f	2.87 a	17.96 a

Within each column, means followed by the same letter are not significantly different at $p<0.05$ according to Duncan's test.

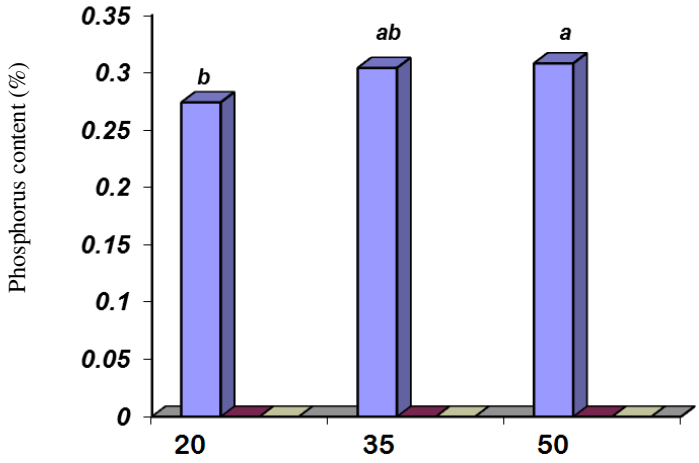

Figure 2. Mean comparisons of the effects of between rows distance on shoot phosphorus content of vetch

Fresh and Dry Forage Yield of Vetch

According to analysis of variance, distance between rows had a significant effect on fresh forage yield (Table 2). By increasing distance between rows, fresh forage yield decreased, so that, the highest yield was observed in the least distance (20 cm) (Figure 3).

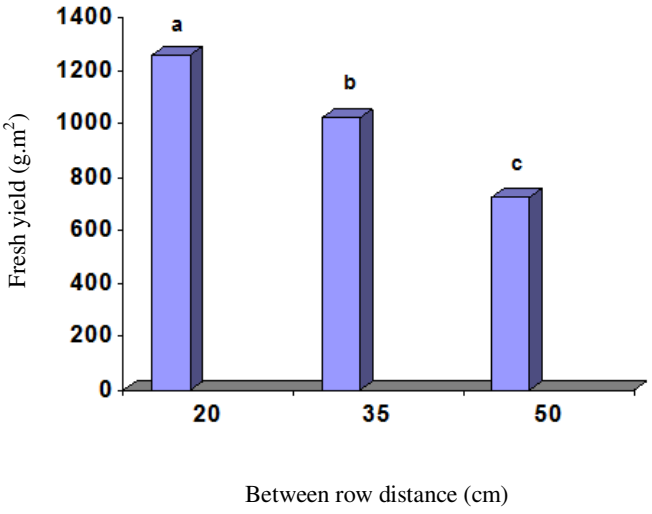

Figure 3. Mean comparisons of the effects of between rows distance on fresh yield of vetch

Results of analysis of variance indicated that effect of distance between plants was significant on fresh and dry forage yield of vetch (Table 2). The most amount of fresh and dry forage yields were acquired in the most plant spacing (20 centimeters). By decreasing distance between plants, fresh and dry forage yields decreased.

Nitrogen and Protein Percentage

According to results of variance analysis, effects of distance between rows and between plants were significant on nitrogen and protein percentage of vetch ($p \leq 1\%$) (Table 2). The most and least nitrogen and protein percentages were acquired in 50 and 20 cm row apacing, respectively. Also by increasing the distance between plants, nitrogen and protein percentage of plant decreased, so that, the most and least nitrogen and protein percentage were observed in 10 and 20 cm plant spacing, respectively.

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