

EFFECT OF FREQUENCY AND INTENSITY OF DEFOLIATION ON OAT - VETCH MIXTURE

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ABSTRACT

An experiment was conducted to evaluate the effect of different cutting regimes on productivity and complementarity between oat and vetch in a mixture. The treatments were allocated in a factorial design on a split-split-plot disposition: they were 3 cutting frequencies (each 35, 70 and 105 days), 3 cutting heights (2, 8 and 14 cm above ground) and 3 crops (oat, vetch and the 1:1 mixture). Forage production (dry matter per hectare) and complementarity between species Relative Yield Total (RYT) were evaluated. The highest forage production ($p < 0.05$) was obtained with a cutting height of 2 cm and a frequency of 70 days, both in mixture and pure crops. Mixture production was significantly higher than pure stands ($p < 0.01$) and RYT was higher than unity ($p < 0.01$) under all defoliation regimens. Defoliation treatments did not modify RYT. In these experimental conditions, cutting frequency and cutting height affected forage production but did not modify complementarity between species.

KEYWORDS

Oat-vetch mixture, defoliation, production, complementarity

INTRODUCTION

In a great area of the Humid Pampa, oat (*Avena sativa*) grazing is the main resource for meat and milk production during winter. The forage production of oat crop varies from 3 to 7 tonnes of dry matter per hectare (Rosso and Chifflet de Verde, 1992). One of the most important factors in this variation is soil nitrogen availability. Under these circumstances, mixtures with vetch (*Vicia* spp) by means of nitrogen fixation, could raise forage production of oat crop, and furthermore contribute to improve forage quality (Moreira, 1989).

Oat and other winter annual pastures are used under different grazing systems, from continuous to rotational with high grazing pressure during a few hours in each lot. In addition, a wide diversity of defoliation frequency and intensity is generated.

Under local conditions, it has been found out that oat forage yield increases while cutting frequency decreases (Hernández and Lemes, 1978), but there is no information about the combined effect of frequency and intensity.

Due to differences in plant structure between oat and vetch, the effect of a specific defoliation might be different on each one. Therefore, the defoliation applied to a mixture might affect its botanical composition, complementarity between species and the potential profit of legume inclusion. The effect of different cutting frequencies and cutting intensity on forage yield and complementarity between vetch and oat is analysed.

METHODS

The experiment was seeded on March 26, 1990, on a Typical Hapludol soil in Pasman (37°11' S, 62° 11' W), Buenos Aires Province, Argentina. A 3 x 3 x 3 factorial was allocated in a split-split-plot design on 4 randomised blocks. The factors were 3 cutting frequencies (35, 70 and 105 days), 3 cutting heights (2, 8 and 14 cm above ground), and 3 crops (oat cv Cristal, vetch cv La Vincha and the 1:1 mixture of both), in this order from the main plot to the smallest one. The sowing rate used, in both pure and mixture stands, was 350 viable seeds m⁻².

Each plot measured 1.4 x 6 m and yield evaluation was made on a 1 x 5 central area using a sickle-bar mowing. Botanical composition was estimated by hand separation of a sample of fresh herbage and

plant material which was dried for 24 hours at 90°C in a forced-draught oven.

Cutting dates were fixed, beginning at April 30, June 6, and July 9 for high, middle or low frequency, respectively, and finishing by October 20 with all treatments. Forage yield results are the whole of 2, 4 and 6 harvests, for 35, 70 and 105 days frequency treatments, respectively. The complementarity between species was evaluated by means of the relative yield total (RYT) according to the following formula of de Wit and van den Bergh (1965): $RYT = Om/Op + Vm/Vp$ where Om and Vm are yields of oat and vetch in mixture, and Op and Vp in pure stands.

An analysis of variance was performed for whole forage production including the following factors: frequency, intensity, crop and their interactions. In the analysis of the forage yield of mixture, oat and vetch pure or in mixture, and RYT, the sources of variation were frequency, intensity and interaction. When significant differences appear, means were compared using Duncan's test ($\alpha = 0.05$). The difference to unity of the RYT values were analysed with test 't'.

RESULTS AND DISCUSSION

The whole forage production of the experiment was affected by frequency, intensity, crop and frequency x intensity interaction (table 1). Means for the 3 crops throughout all defoliation treatments were: 4248, 4669 and 6669 / (198) Kg of dry matter ha⁻¹, respectively in oat, vetch and mixture. In multiple comparison test, mixture yield was significantly higher than the others.

The RYT index calculated was significantly higher than 1 ($p < 0.01$) on all the treatments of defoliation with a whole mean of 1.47 (± 0.15). This parameter was not significantly modified by cutting treatment (Table 2).

Within the mixture, the effects of frequency and intensity on forage production were significant but not the interaction (Table 1). In the information presented in table 2 the forage yield has higher values in defoliation treatment that combine the highest intensity (2 cm) with a cutting frequency of 70 days. This fact stays the same in the mixture as well as their components or pure stands of oat and vetch.

The increasing yield found with the lower cutting height is in agreement with Binnie and Harrington's work (1972) on Italian ryegrass. Other studies, however have reported a decrease of yield at lower cutting height (Elder, 1960) at the end of the growing season in winter cereals. Probably, in these cases the yield decrease was related to removal of the growing points. During this experiment oat was in vegetative stage, except on the last cutting date, with growing points at ground level.

As regards the effect of frequency, the increase of forage yield from 35 to 70 days coincides with the studies quoted, which show an increase up to 70 days (Binnie and Harrington, 1972) or 60 days (Elder, 1960). In the conditions of this experiment, the frequency of 105 days resulted in a low yield, probably related to losses of dry matter by decay of the older leaves.

The results of this study show that the regimen of defoliation equally affects both species, which attain their higher productivity on the same combination of frequency and intensity of cutting. Likewise, the complementarity of the mixture, as it has not been affected by defoliation, should be attained on a wide variation of management

conditions. However, the greatest forage yield attained with an intensity of 2 cm and frequency of 70 days suggests an advantage of a rotational grazing system.

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Table 1

Results of analysis of variance. **: ($p < 0.01$), *: ($p < 0.05$), and ns: not significant effect ($p > 0.05$), and CV%: coefficient of variation.

Factor	Whole Yield	Pure oat	Pure vetch	Mixture	Oat in mixture	Vetch in mixture	RYT
Frequency(F)	**	*	ns	**	ns	*	ns
Intensity (I)	**	*	*	**	**	ns	ns
F x I	*	*	*	ns	*	*	ns
Crop (C)	**	-	-	-	-	-	-
F x C	ns	-	-	-	-	-	-
I x C	ns	-	-	-	-	-	-
F x I x C	ns	-	-	-	-	-	-
CV %	21.76	18.18	13.99	15.29	19.59	18.92	22.57

Table 2

Effect of frequency and intensity of defoliation on the forage production of oat and vetch pure, mixture and RYT index.

Frequency	Cutting height (cm)				Cutting height (cm)			
	2 cm	8 cm	14 cm	Mean	2 cm	8 cm	14 cm	Mean
	Pure oat kg DM ha ⁻¹				Pure vetch kg DM ha ⁻¹			
35 days	5003 _a	3215 _c	3379 _{bc}	3866	4295 _{cd}	4656 _{bc}	4696 _{bc}	4549
70 days	5440 _a	5107 _a	4888 _a	5154	5984 _a	5568 _{ab}	4202 _{cd}	5251
105 days	4602 _{ab}	4841 _a	3482 _{bc}	4308	4688 _{bc}	4349 _{cd}	3584 _d	4207
Mean	5015	4388	3916	4989	4858	4161		
	Mixture kg DM ha ⁻¹				RYT			
35 days	5776	5628	5375	5593 _B	1,23	1,48	1,37	1,36
70 days	8928	6928	7463	7773 _A	1,56	1,30	1,65	1,50
105 days	7687	7237	4999	6641 _B	1,65	1,57	1,41	1,54
Mean	7464 _A	6598 _B	5946 _C		1,48	1,45	1,48	

A,B,C: means of frequency or intensity followed by the same letter are not significantly different ($\alpha=0.05$; Duncan's test).

a, b, c: means of frequency and intensity combined within pure crops followed by the same letter are not significantly different ($\alpha=0.05$; Duncan's test).