COMPETITION BETWEEN OATS AND ANNUAL RYEGRASS UNDER GRAZING

R.D. Améndola Massiotti and B. Morales Méndez
Universidad Autónoma Chapingo Chapingo, Edo. México CP 56230, México

ABSTRACT
A replacement series experiment was carried out at Chapingo, México aimed to study the seasonal evolution of growth rates of oats (*Avena sativa* L.) and annual ryegrass (*Lolium multiflorum* L.) in monocultures and mixtures. Three grazing cycles took place in a period of 181 days. Herbage mass on offer and residual herbage mass were measured, allowing the calculation of herbage accumulation rates. Aggressiveness of oats was higher during the first 105 days growth period, later in the season annual ryegrass was more aggressive than oats. The advantage of the mixture compared to monocultures, depends on a more efficient use of environmental resources due to the combination of the earliness of oats with the higher growth rates of annual ryegrass later in the season.

KEYWORDS
Avena sativa, *Lolium multiflorum*, mixture, interference, replacement series, herbage accumulation rates, tiller densities, grazing

INTRODUCTION
Year round grazing systems in temperate regions usually face severe herbage shortage during the winter. Forage crops are therefore used, due to their higher growth rates during that season (Sevilla et al., 1995). The mixture of oats (*Avena sativa* L. or *A. byzantina* L.) with annual ryegrass (*Lolium multiflorum* L.) used under grazing is an option for coping with winter herbage shortage in temperate regions of México (Améndola et al., 1995). Carámbula (1977), states that the mixture outyields respective monocultures due to the combination of the earliness of oats with the higher growth rates of annual ryegrass later in the season. The approach of Hall (1978) for the analysis of species interference in mixtures, leads to the hypothesis that niche differentiation between oats and annual ryegrass depends on the different exploitation of environmental resources in time; meaning that aggressiveness of species in the mixture should shift from early higher aggressiveness of oats to later higher aggressiveness of ryegrass.

Better understanding of species interference in the mixture should enable the design of managerial decisions with specific objectives. A replacement series experiment was designed to study the evolution of interference during the season.

METHODS
The experiment was carried out at the experimental station of Chapingo University, located at 19°29' N, 98°53' W. and 2250 m above sea level. Climate is temperate and sub-humid with summer rains, average annual rainfall is 636 mm, while mean temperature is 15.2°C. Soils are clay-loam of volcanic origin, deep, neutral and fertile.

Treatments consisted of a replacement series of oats (cv. Cockker 227) by annual ryegrass (Westerwolds, commercial seed). Proportions of substitution in the series (as percentage of seed density in monoculture) were: 0, 25, 50, 75 and 100%. Seed densities in monoculture were 100 and 30 kg pure germinating seed per ha for oats and ryegrass respectively. A random block design with three replicates was used, plots size was 75 m^2. The experiment was sown on October 28 1993 with a basal dressing of 50 N and 60 P_2O_5 and received top dressings with 50 N/ha after each grazing. Sprinkling irrigation took place every 15 days. Plots were rotationally grazed by replacement heifers and the animals were removed when target stubble mass (visually assessed) was reached. The first grazing took place 105 days after sowing while the second and third grazings were at 38-day intervals. Herbage mass on offer and residual herbage mass were estimated by cutting six 0.25 m^2 samples per plot. Subsamples were taken for estimation of dry matter (DM) content and botanical composition. Oats and ryegrass plants were counted on six 0.25 m^2 samples per plot and tillers per plant were counted on 12 plants per plot. Mean tiller weight was calculated by dividing the weight of the component in herbage on offer by respective tiller density.

To avoid discussion of differences in species utilization, which affect net herbage production, analysis of interference between species is based on herbage accumulation rates. According to Hodgson (1979), herbage accumulation rates of the mixtures and the components were calculated as the quotient between the difference in herbage mass at consecutive grazing cycles and the number of days in regrowth.

Regression equations using second degree polynomials were developed with the proportion of oats at seeding as the independent variable.

RESULTS AND DISCUSSION
Significant ($p<0.05$) regression equations are presented in Table 1; graphics of some of these equations are presented in Figure 1. As equations for growth rates of the mixture were not significant with the exception of the first grazing, means of treatments are presented in Figures 1.1, 1.3 and 1.4.

Mean herbage accumulation rates of species in monocultures and mixtures (Table 1 and Figure 1.1) lead to the conclusion that niche overlap between these species is rather small, meaning differential exploitation of environmental resources (Hall, 1978). Mean growth rates of monocultures are almost the same and intraspecific competition appears to be stronger than interspecific competition; therefore average growth rate of the mixture tends to be higher than those of monocultures.

Changes in herbage accumulation rate of individual species during the experimental period enable the interpretation of niche differentiation. During the first grazing (Table 1 and Figure 1.2), oats (the "highest yielding species") was more aggressive than ryegrass, and as a consequence growth rates of the mixtures were higher with higher proportions of oats at seeding. Aggressiveness of oats was evident on tillers per plant of ryegrass (Table 1), which were at 50 and 75% oats, less than half of those at ryegrass monoculture. A similar trend ($p=0.19$) was detected for tillers per plant of oats. No effect of treatments was found on mean tiller weight of both species. That means that during the first 105 days, plants (and not tillers) of these annual species should be considered as individuals.

According to herbage growth rates during the second grazing (Table 1 and Figure 1.3), it appears that intraspecific competition was stronger than interspecific competition. However, data on number of tillers per plant (Table 1) show that ryegrass was more aggressive than oats in this second growth period. Even though tillers per plant of ryegrass decreased with oats proportion, changes (related to numbers of tillers at first grazing), show that while tillers per plant decreased by 31% at ryegrass monoculture, they increased by 8 and

12% at treatments with 50% and 75% of oats respectively. A general decrease of tillers per plant was observed in the case of oats, but that decrease was less severe (-12%) in the case of oats in monoculture and 75% oats than in the case of 25% oats (-41%); consistently, mean weight of oat tillers was lower at higher ryegrass densities (Table 1). During the third growth period (Table 1 and Figure 1.4) ryegrass was much more aggressive than oats, leading to oats disappearance at oats seed proportions lower than 75%.

Results agree with the statement of Carámbula (1977), he advantage of the mixture (compared to monocultures) depends on a more efficient use of environmental resources, due to the combination of the earliness of oats with the higher growth rates of annual ryegrass later in the season. Higher proportions of oats at seeding lead to higher yields early in the season and conversely, higher proportions of ryegrass cause a delay in the achievement of the highest growth rates.

REFERENCES

Améndola R., M. García, J. Hernández and V. López. 1995. Avena (*Avena sativa* L. y *A. byzantina* L.) y ballico anual (*Lolium multiflorum* L.) bajo pastoreo en Chapingo, México. Proceedings 25 Reunión de la Asociación Mexicana de Producción Animal. La Paz, B.C.S., pp 215-219.

Carámbula, M. 1977. Producción y manejo de pasturas sembradas. Hemisferio Sur. Montevideo. 464 p.

Hall R.L. 1978. The analysis and significance of competitive and non-competitive interference between species. Pages 163-174 *in* J.R. Wilson, Ed. Plant Relations in Pastures. CSIRO. Melbourne.

Hodgson J. 1979. Nomenclature and definitions in grazing studies. Grass and Forage Sci. **34:** 11-18.

Sevilla G., A. Pasinato and J.M. García. 1995. Producción de forraje de especies perennes y anuales bajo riego. Revista Argentina de Producción Animal. Memorias XIV Reunión ALPA. **15:** 371-374.

Table 1

Regression equations for herbage accumulation rates (HAR in kg DM ha-1 day-1), and tiller density and weight of oats and annual ryegrass as functions of proportions of oats seed density in the mixture

GRAZING	VARIABLE	COMPONENT	$ß_0$	$ß_1$	$ß_2$	R^2	model p>F
FIRST	HAR	oats	1.18	0.853	-0.0053	0.81	0.0001
FIRST	HAR	ryegrass	16.83	-0.271	0.0011	0.84	0.0001
FIRST	HAR	mixture	21.47	0.436	-0.0029	0.54	0.0092
SECOND	HAR	oats	-0.27	2.036	-0.0162	0.49	0.0172
SECOND	HAR	ryegrass	48.94	-0.237	-0.0028	0.74	0.0003
THIRD	HAR	oats	-1.40	-0.310	0.0057	0.52	0.0022
THIRD	HAR	ryegrass	34.88	0.247	-0.0061	0.81	0.0001
AVERAGE	HAR	oats	-0.16	0.859	-0.0052	0.64	0.0022
AVERAGE	HAR	ryegrass	33.55	-0.087	-0.0026	0.90	0.0001
FIRST	tillers/plant	ryegrass	15.36	-0.273	0.0021	0.86	0.0020
SECOND	tillers/plant	oats	7.55	0.023	0.0003	0.73	0.0029
SECOND	tillers/plant	ryegrass	10.65	-0.106	0.0009	0.59	0.0183
SECOND	mg/tiller	oats	470.25	27.81	-0.2687	0.57	0.0214

Figure 1

Herbage accumulation rates (kg DM ha-1 day-1) of oats and annual ryegrass in monocultures and mixtures during three grazing cycles at Chapingo, Mexico.