Scientific Papers. Series A. Agronomy, Vol. LXVII, No. 1, 2024
ISSN 2285-5785; ISSN CD-ROM 2285-5793; ISSN Online 2285-5807; ISSN-L 2285-5785

PRODUCTIVITY ASPECTS OF SOME ANNUAL FORAGE MIXTURES IN THE CONDITIONS OF BANAT PLANE

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Abstract

The current trends in agriculture in recent years are to considerably reduce the intake of chemical fertilizers, use of pesticides, and the costs of the energy consumption. Thus, the current focus is directed towards finding technological solutions to meet these requirements. One viable solution is mixes made from annual legumes and grasses. They constitute an important energy-protein source in the nutritional balance of the fodder ration. The purpose of this experiment was to identify the most efficient ratio (forage pea – oats) in terms of dry matter production (DM) and raw protein (CP). In the experimental device, two oat varieties (O) were sown in the spring and then used mixed with a pea variety (P). The proportions in which they were sown are P 33% + O 66%, P 50% + O 50%, P 66% + O 33%. For both varieties of oats, we used the same shares. According to the results obtained, the highest production of dry matter (DM) was obtained with P 50% + O 50% and the highest raw protein content was obtained with M 66% + O 33%.

Key words*: dry matter, forage mixtures, productivity, raw protein.*

INTRODUCTION

The study of intercropped mixtures of plants to be cultivated has become a topic of interest for scientists in agriculture, biology, and ecology. (Brooker et al., 2014)

Although it is an ancient practice, it has been placed on the fringes of modern resource-consuming but witch high-yield agriculture (Brooker et al., 2014), generating large amounts of manure and organic waste. (Urechescu et al., 2022) but with loss nutrients and enegy, negatively affecting the functionality of ecosistems (Golińska et al., 2023).

Intercropping of forage species has become a common strategy on crop farms to ensure consistent sustainable production in low-output, low-input forage production systems resilient to climate stress conditions (Salama, 2020).

The yield level of plants is affected by drought-caused stress, water availability being one of the limiting factors of production (Vasilescu et al., 2023).

The fibber richness of forages, together with mineral lipid proteins, is one of the most important starting points in the composition of forage plant mixtures used in animal feed.

The latest trends in human and animal nutrition show that there is an increase in the consumption of food and feed with a rich nutritional and functional profile. (Sterna et al., 2016)

Cultivation of plant mixtures are attracting increasing interest in developed countries since it can provide increased yields in an ecologically sustainable manner (Neumann et al., 2009).

Feed mixtures in which there is oats and peas are a very good option in terms of quality and good yield in feeding animals and milk producers (Isleib, 2011), providing a non-negligible amount of protein and fibber.

The production and use of cereal and legume mixtures for animal feed is beneficial for several reasons. Nitrogen fixation by leguminous crops provides an important benefit to cereals and by eliminating nitrogen fertilization. (Kondo et al., 2006)

Another important aspect is that mixtures of legumes with oats are an effective tool contributing: (i) to the control of diseases and pests; (ii) to reducing weed invasion and responding differently to soil and climate conditions, thus reducing the risks of the harvesting system. (Lithourgidis et al., 2011; Salama, 2020), (iii) to improving the nutritional value of the mixed crop compared to oats alone. (Undersander, 2003)

MATERIALS AND METHODS

The aim of this study has been to investigate the optimum proportion of peas and oat mixture in terms of dry matter amount (DM t/ha) and crude protein content (CP%).
The experimental field was in the soil and climate conditions of the University of Life Sciences in Timișoara Educational Station, where the multiannual average of temperatures is between 10-12°C and the multiannual amount of precipitation is 500-650 mm.

Figure 1. View from experimental field
(original foto Carmen Claudia Durău)

As for the soil, it is a cambic chernozem, moderately glazed, medium clay loam/medium clay loam with a slightly alkaline pH, and with a humus concentration characteristic of the soil type mentioned above.
The investigated biological material was composed of the following varieties: fodder peas variety Boxer variety (Mab), oats variety Lovrin 1 (OL1) and oats variety Ovidiu (OO).
Mixtures were performed as follows: Mab + OL1 and Mab + OO, respectively. From each of these two mixtures, the following peas-oat proportions were made: 1/1 (50%:50%), 1/2 (33%:66%), 2/1 (66%:33%) and three variants with three repetitions were sowed in the spring in the last week of March.
The culture technology applied ensured a favourable growth under non-irrigated conditions and no fertilization was done.
The time of harvesting was at the budding of the legumes and the spiking of the grasses in accordance with the BBCH decimal unit code for grasses and legumes (Maier, 2001).
Vegetal mass samples were collected from each variant per m^2 and the results represent an average.

Figure 2. Sample from the experimental field
(original foto Carmen Claudia Durău)

One of the most important elements in the chemical composition of fodder is nitrogen (N), therefore its quantification and equivalence in crude protein (CP) is important in animal nutrition. (Quirino et al., 2023)
Thus, the Kjedahl method was used to determine the crude protein content (CP%) (determination of protein percentage by evaluating the nitrogen content).
Statistical calculations were performed using SPSS Version 20, IBM and Microsoft Excel (2016, Microsoft Corporation, Redmond, WA, USA). Elements of descriptive statistics were determined (mean, standard deviation, minimum and maximum values and 95% confidence interval for the mean) and to determine significant differences, the Kruskal-Wallis test and the Mann Whitney test were applied.

RESULTS AND DISCUSSIONS

Analysing the production of dry matter (DM t/ha) and crude protein CP% depending on the oat varieties under discussion (OO and OL1), a statistically significant difference is obtained only in the case of CP N (%) 1/2. (*p<0.05). (Table 1, Figures 3 and 4).

Table 1. Numerical characteristics associated with the mixtures according to the oat varieties analysed (OO and OL1) and the proportions in which the mixtures are found

		Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum	Mann-Whitney U (p)
				Lower Bound	Upper Bound			
DM (t/ha) 1/1	Mab OO	6.45	0.57	5.04	7.86	5.80	6.85	2.00 (p=0.275)
	Mab OL1	7.24	0.96	4.86	9.61	6.30	8.21	
DM (t/ha) 1/2	Mab OO	4.23	0.81	2.23	6.24	3.50	5.10	3.00 (p=0.513)
	Mab OL1	4.78	0.94	2.44	7.11	3.78	5.65	
DM (t/ha) 2/1	Mab OO	3.82	0.49	2.60	5.04	3.25	4.10	2.00 (p=0.268)
	Mab OL1	4.72	1.09	2.02	7.42	3.55	5.70	
CP (%) 1/1	Mab OO	13.85	1.98	8.92	18.77	11.65	15.50	4.00 (p=0.827)
	Mab OL1	13.49	1.56	9.63	17.36	11.70	14.50	
CP (%) 1/2	Mab OO	13.05	0.43	11.99	14.11	12.65	13.50	0.00 (p=0.048*)
	Mab OL1	11.29	1.01	8.78	13.80	10.40	12.39	
CP (%) 2/1	Mab OO	17.13	1.80	12.66	21.61	15.30	18.90	3.00 (p=0.513)
	Mab OL1	16.13	1.76	11.77	20.50	14.30	17.80	

This could be explained by the fact that the two oat varieties have similar production characteristics. This difference in the percentage of crude protein (CP%) in the proportion 1/2, where the OO variety accumulated a higher percentage of CP% compared to the OL1 variety, shows that, for the moment, it exploited the resources better in partnership with peas (Mab).

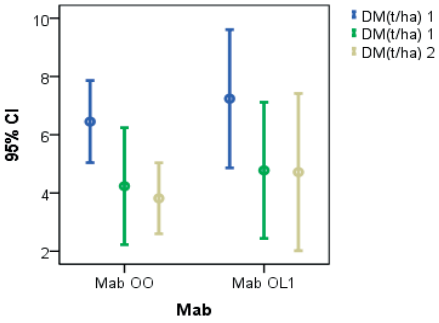

Figure 3. Mean and 95% CI for Mab-**DM**

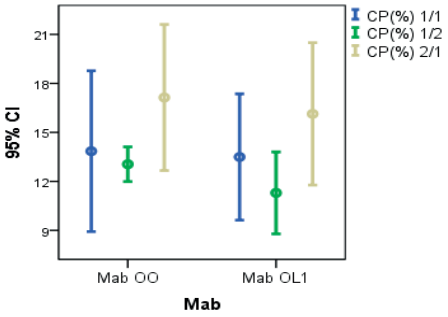

Figure 4. Mean and 95% CI for Mab-CP

Another aspect analysed in this trial was the analysis of the differences between the proportions of the same mixture (Table 2, Figure 5). Thus, the results of the statistical analyses show that there are significant differences between the proportions of 1/2, 2/1 and 1/1 in both mixtures, the highest values for dry matter (DM t/ha) being 1/1. (Table 3, Figure 6)

Table 2. Numerical characteristics associated with the Mab+OO mixture in dry matter (DM) t/ha depending on the proportion

		Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
				Lower Bound	Upper Bound		
Mab+OO DM (t/ha)	1/1	6.45[a]	0.57	5.04	7.86	5.80	6.85
	1/2	4.23[b]	0.81	2.23	6.24	3.50	5.10
	2/1	3.81[b]	0.49	2.60	5.04	3.25	4.10

Means followed by the same letter do not differ statistically (Mann-Whitney U test) *p<0.05

Table 3. Numerical characteristics associated with Mab + OL1 in dry matter (DM) t/ha depending on the proportion

		Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
				Lower Bound	Upper Bound		
Mab + OL1 DM (t/ha)	1/1	7.23[a]	0.96	4.86	9.61	6.30	8.21
	1/2	4.77[b]	0.94	2.44	7.11	3.78	5.65
	2/1	4.71[b]	1.09	2.02	7.42	3.55	5.70

Means followed by the same letter do not differ statistically (Mann-Whitney U test) p<0.05

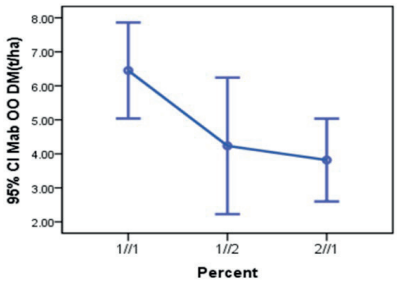

Figure 5. Mean and 95% CI for Mab + OL1 DM (t/ha)

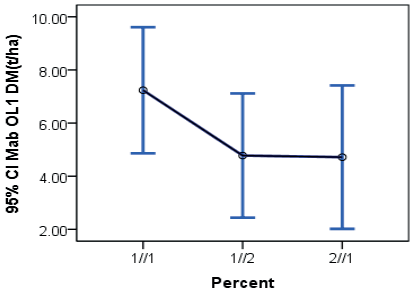

Figure 6. Mean and 95% CI for Mab + OL1 DM (t/ha)

Table 4. Numerical characteristics associated with Mab + OO in CP% protein content according to proportion

		Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
				Lower Bound	Upper Bound		
Mab OO CP%	1/1	13.84[b,a]	1.98	8.92	18.77	11.65	15.50
	1/2	13.05[a]	0.43	11.99	14.11	12.65	13.50
	2/1	17.13[b]	1.80	12.66	21.61	15.30	18.90

Means followed by the same letter do not differ statistically (Mann-Whitney U test) p<0.05.

The nutritional value of the fodder is considerably marked by the time of harvesting, more precisely by the stage of vegetation in which the mixture is located. (Gruber et al., 2008).

The same aspect is also noted in literature by Tsialtas et al. (2018) such that peas have a high nitrogen fixation potential and, obviously, contribute to the accumulation of crude protein in oat mixtures. In this case, a significant difference between the crude protein content (CP%), between the proportion 2/1 and 1/1, and 1/2 and 1/1, respectively.

The highest crude protein content (CP%) was highlighted for the proportion 2/1, 17.13% in the Mab + OO mixture (Table 4, Figure 7) and 16.13% Mab + OL1, respectively (Table 5, Figure 8).

Table 5. Numerical characteristics associated with Mab + OL1 in CP% protein content according to proportion

		Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
				Lower Bound	Upper Bound		
Mab OL1 CP%	1/1	13.49[a,b]	1.56	9.63	17.36	11.70	14.50
	1/2	11.29[a]	1.01	8.78	13.80	10.40	12.39
	2/1	16.13[b]	1.76	11.77	20.50	14.30	17.80

Means followed by the same letter do not differ statistically (Mann-Whitney U test) $p<0.05$.

In literature, Varga *et al*. (1998) states that a good quality forage has a high palatability and a value of crude protein (CP%) between 7-18%, being correlated with the phenophase in which it was harvested.

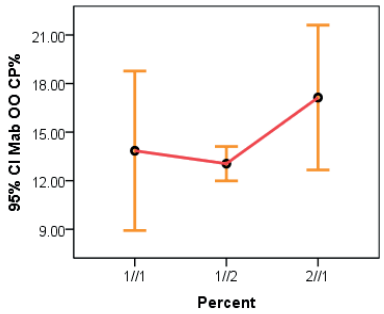

Figure 7. Mean and 95% CI for Mab OO CP%

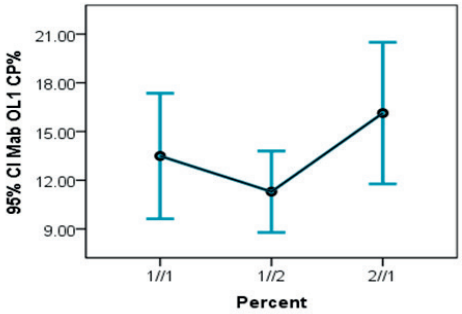

Figure 8. Mean and 95% CI for Mab OL1 CP%

Although oat ranks fifth in world production with a production of 23 million t (Morcia et al., 2024), grown alone it has a low crude protein content (in hay) that can be improved by adding forage peas to the seeding mix. (Isleib, 2011) Therefore, the mixed culture of peas with oats can be a reasonable alternative in the production of fodder with low consumption of inputs (Neugschwandtner et al., 2015).

CONCLUSIONS

Kruska-Wallis and Mann Whitney statistical tests applied to the trial data obtained show that there are significant differences (*$p<0.05$) between some analysed parameters.

Thus, by comparing the Mab + OO and Mab +OL1 mixtures, a significant difference was revealed only in the case of a 1/2 ratio (33%: 66%) in the crude protein content (CP% = 13.05) in the Mab + mixture OO, while in the case of dry matter production (DM t/ha), no significant differences were obtained.

Through the statistical analysis of the proportions within each mixture, it can be concluded that there are significant differences in dry matter production (DM t/ha). Thus, the highest values were obtained in the proportions 1/1 (50%: 50%) for both mixtures.

In terms of crude protein content (CP%), the proportion with the highest value was 2/1 (66%: 33%) for both mixtures.

For this case study, the results confirm that, in addition to the reduced costs due to technology, the benefits are considerably materialized in dry matter productions (DM t/ha) and crude protein content (CP%). The researches were carried out in the short term, but they will continue in the coming years to strengthen some hypotheses, and they will also include other directions such as weed and disease control, soil improvement, etc.

ACKNOWLEDGEMENTS

This paper is published from the own research funds of the University of Life Sciences "King Mihai I" from Timisoara

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