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Effects of over-seeding and fertilization on yield and quality of pasture

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Abstract. This research was conducted at a pasture in Ondokuz Mayis town of Samsun between 2013-2015 (41° 21'N 36° 15'E, elevation 10 m). Main plots were the two treatments (non over-seeding and over-seeding) and sub-plots were the 18 fertilization combinations. Nitrogen was applied as ammonium nitrate with rates of 0, 6 and 12 kg N da^{-1}. Phosphorus was applied as triple superphosphate with rates of 0, 6 and 12 kg P da^{-1}. Potassium was applied as potassium sulphate with rates of 0 and 8 kg K da^{-1}. Alfalfa (*Medicago sativa* L.), white clover (*Trifolium repens* L.), cocks foot (*Dactylis glomerata* L.), wheatgrass (*Agropyron intermedium* (Host.) Beauv.) and perennial ryegrass (*Lolium perenne* L.) seeds were used for over-seeding in the experiment. Dry matter production in rangeland can be increased with fertilization and over-seeding. In the study, N fertilization stimulated the growth of grasses, P and K fertilizations promoted the growth of legumes. The concentration of Mg and Ca in forages were stimulated with P and K fertilization, but they were decreased with N fertilization.

Keywords. Top seeding – Rangeland – Forage Yield – Hay Quality.

Les effets du sursemis et de la fertilisation sur le rendement et la qualité des pâturages

Résumé. *Cette recherche a été menée, en 2013-2015, près d'une ville nommée Ondokuz Mayis, à Samsun, dans un pâturage naturel (41°21'N 36°15'E, altitude 10m). On a utilisé le dispositif suivant: deux traitements sur les parcelles principales (sans sursemis et avec sursemis) et 18 combinaisons de fertilisation sur les sous-parcelles. L'azote a été appliqué sous forme de nitrate d'ammonium aux doses de 0,6 et 12 kg par décare. Le phospore a été appliqué sous forme de triple superphospate aux doses de 0,6 et 12 kg par décare. Quant au potassium, il a été appliqué sous forme de sulphate de potassium aux doses de 0 et 8 kg par décare. On a utilisé des graines de* Medicago sativa *L.*, Trifolium repens *L.*, Dactylis glomerata *L.*, Agropyron intermedium *(Host.) Beauv. et* Lolium perenne *L. Le rendement de matière sèche dans les pâturages a montré une augmentation grâce à ces pratiques de fertilisation et de sursemis. Dans ce travail, on a remarqué que d'une part, la croissance des graminées s'est élevée avec la fertilisation en N et d'autre part, celle de légumineuses avec la fertilisation en P et K. La concentration en Ca et Mg des fourrages était stimulée avec la fertilisation en P et K, mais diminuait avec la fertilisation en N.*

Mots-clés. *Sursemis – Pâturage - Rendement en fourrage – Qualité du foin.*

I – Introduction

Pastures should contain nearly 20-30% legumes for attaining high quality and sustainable yield (Aydin and Uzun, 2005). Excessive nitrogen application (above 5-6 kg da^{-1}) without regarding its negative affect on botanical composition led to vicious circle in terms of productivity. It is not possible to attain sustainability with present fertilization practices at pastures with destroyed botanical compositions found in Black-Sea region (Alp *et al.,* 2001).

Fertilization with N stimulates growth of grasses, but depresses the legumes growth (Lee and Lee, 2000). K and P fertilizers promote legumes (Snyman, 2002; Mosquera-Losada *et al.,* 2004; Aydin and Uzun, 2008) at pastures. But, generally it is not possible to improve the imbalance in favor of grasses cereals, which occurred due to the use of high amounts of nitrogenous fertilizers, by using other fertilizers (Aydin and Uzun, 2005). New approaches are needed to attain sustainable productivity at pastures found in Turkey. The aim of this study was to

determine the effects of over-seeding and fertilization with different levels of N, P and K on hay yield, botanical composition and some mineral contents of rangeland.

II – Materials and methods

This research was conducted at a pasture in Ondokuz Mayis town of Samsun during 2013-2015. (41° 21'N 36° 15'E, elevation 10 m). In the region, the 50-year mean precipitation was 705.4 mm, the annual precipitations were 614.2 and 956.1 mm for 2014 and 2015 (Fig. 1.). Soil characteristics of experimental area were as follows; soil texture is loamy; organic matter is 2.0%; extractable P is 2.6 mg kg^{-1}; K extraction is 43.0 mg kg^{-1}; pH is 7.1 saturation extract.

Main plots were the two treatments (non over-seeding and over-seeding) and sub-plots were the 18 fertilization combinations. Treatments were $N_0P_0K_0$, $N_0P_0K_8$, $N_0P_6K_0$, $N_0P_6K_8$, $N_0P_{12}K_0$, $N_0P_{12}K_8$, $N_6P_0K_0$, $N_6P_0K_8$, $N_6P_6K_0$, $N_6P_6K_8$, $N_6P_{12}K_0$, $N_6P_{12}K_8$, $N_{12}P_0K_0$, $N_{12}P_0K_8$, $N_{12}P_6K_0$, $N_{12}P_6K_8$, $N_{12}P_{12}K_0$, $N_{12}P_{12}K_8$. Nitrogen was applied as ammonium nitrate with rates of 0, 6 and 12 kg N da^{-1}. Phosphorus was applied as triple superphosphate with rates of 0, 6 and 12 kg P da^{-1}. Potassium was applied as potassium sulphate with rates of 0 and 8 kg K da^{-1}. Half of the N, all of P and K were applied at the end of October**.** Before the experiment started, botanical composition of the experimental area based on dry weight was determined in eight squares (1 m^2 each) in May 2013. Botanical composition of the experimental area consisted of, 20% legumes, 35% grasses and 45% plants of other families. Legumes in the botanical composition were mostly alfalfa (*Medicago sativa* L.). Grasses were kentucky bluegrass (*Poa pratensis* L.), perennial ryegrass (*Lolium perenne* L.) and orchardgrass (*Dactylis glomerata* L.). Other plants were star-of-bethlehem (*Ornithogalum orthophyllum* Ten.), daisy (*Bellis perennis* L.), dandelion (*Taraxacum scaturiginosum* G. Hagl), ribwort plantain (*Plantago lanceolata* L.) red stem filaree (*Erodium cicutarium* (L.) Her.), buttercup (*Ranunculus* sp.) and shepherd's purse (*Capsella bursa-pastoris* (L.) Medik.). Alfalfa (*Medicago sativa* L.), white clover (*Trifolium repens* L.), cocks foot (*Dactylis glomerata* L.), wheatgrass (*Agropyron intermedium* (Host.) Beauv.) and perennial ryegrass (*Lolium perenne* L.) seeds were used for over-seeding in the experiment. Seeds are supplied from the seed company. In over seeding application total 3 kg seed/da, alfalfa and white clover (legumes) and cocks foot, wheatgrass and perennial ryegrass (grasses) in equal amounts spreaded seed in October. Herbaceous vegetation was annually harvested within 6 m^2 area when grass plants reached full flowering stage in May. Plants within 1 m^2 quadrate in each plot were classified as legumes, grasses and the others as well as determining the dry weight ratio of each group. All the data were pooled across 2014 and 2015 years because variance was homogeneous. Data were analyzed by using SPSS 17.0.V packet programme (SPSS Inc., 2008).

III – Results and discussion

1. Hay yield (kg da^{-1})

The effects of over-seeding and fertilization on dry matter (DM) production were significant (Table 1). The DM increased 7.8% by the over-seeding. The DM production increased 57.4%, 33.0% and 11.3% with N, P and K fertilization, respectively. This situation can be resulted in to the changes in botanical composition of rangeland depending on fertilization and including new forage species.

Table 1. Dry matter (DM, kg da^{-1}), botanical composition (%) and contents of crude protein (CP) and some mineral (g kg^{-1}) of in rangeland with (OS) and without (NOS) over-seeding and fertilization

	DM	Botanical composition			CP	Minerals			
		Legum.	Grass.	Oth.		Ca	Mg	K	K/(Ca+Mg)
NOS	307 **b**	30.2	45.5	24.3	159	10.3	3.1	24.3	0.80
OS	331 **a**	31.0	45.2	23.8	157	10.2	3.2	24.2	0.80
N_0	258 **c**	48.1 **a**	29.7 **c**	22.2	166	11.5 **a**	3.4 **a**	24.3	0.68
N_6	293 **b**	29.0 **b**	46.0 **b**	25.0	155	10.3 **b**	3.1 **b**	24.3	0.82
N_{12}	406 **a**	14.6 **c**	60.4 **a**	25.0	153	9.0 **c**	2.9 **c**	24.3	0.90
P_0	276 **c**	20.0 **c**	54.3	25.7	154	9.8 **b**	3.1	24.3	0.77
P_6	314 **b**	31.7 **b**	46.9	21.4	160	10.3 **a**	3.1	24.5	0.80
P_{12}	367 **a**	40.1 **a**	34.9	25.0	160	10.6 **a**	3.2	24.0	0.83
K_0	302 **b**	27.5 **b**	47.2	25.3	156	9.8 **b**	3.1	24.3	0.77
K_8	336 **a**	33.7 **a**	43.5	22.8	161	10.7 **a**	3.2	24.3	0.83

[a, b,] Values within columns with different letters differ significantly (p< 0.01).

2. Botanical composition (%)

N application decreased the ratio of legumes (33.5 point) and increased the ratio of grasses (30.7 point) in vegetation, but it did not change the other families (Table 1). The ratios of legumes and grasses increased approximataly 20.1 point and decreased 19.4 poind due to P application, respectively. Similarly, K fertilization increased the ratio of legumes (6.2 point). As raported by Aydin and Uzun (2005), these findings show that while N fertilization stimulates the growth of grasses, P and K fertilizations promote the growth of legumes.

3. Crude Protein (CP) Ratio (g kg^{-1})

The CP ratios in samples from all treatments were ranged from 153 to 166 g kg^{-1}. Although the studied factors affected the botanical composition of rangeland, the values were not affected by any treatment (Table 1). This indicate that the ratio of grasses with high protein in rangeland may increased.

4. Mineral concentration (g kg^{-1})

The Mg and Ca contents of hays were decreased (21.7 and 14.7%, respectively) with N applications (Table 1). The P and K aplications increased Ca concentration (8.2 and 9.2 respectively). Mineral contents and having the correct ratios of minerals (e.g. Ca/P, Ca/Mg, K/(Ca+Mg) and K/Mg ratios) in the forage as well as DM and CP contents of feeds play important role in animal development and growth. The Ca and Mg contents pasture forages in the present study were enough to meet the requirements in terms of these minerals of livestock, but the content of K was higher than value reported by NRC (2000; 2001).

5. K/(Ca+Mg) ratio

The K/(Ca+Mg) ratios ranged from 0.68 to 0.90 (Table 1). The K/(Ca+Mg) ratio in all treatments were lower than the critical value of 2.2 for tetany (Grunes and Welch, 1989).

IV – Conclusions

Dry matter production in rangeland can be increased with fertilization and over-seeding. In the study, N fertilization stimulated the growth of grasses, P and K fertilizations promoted the growth of legumes. The concentrations of Mg and Ca in forages were stimulated with P and K fertilizations, but they were decreased with N fertilization.

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