MAKÜFEBED

ISSN Online: 1309-2243
http://dergipark.org.tr/makufebed
https://doi.org/10.29048/makufebed.1171903

Mehmet Akif Ersoy Üniversitesi Fen Bilimleri Enstitüsü Dergisi 13(Ek Sayı 1): 388-395 (2022)
The Journal of Graduate School of Natural and Applied Sciences of Mehmet Akif Ersoy University 13(Supplementary Issue 1): 388-395 (2022)

Araştırma Makalesi / *Research Paper*

Effect of Different Ammonium Nitrate Levels on the Performance of Cool-Climate Grass Species Grown in Çanakkale Conditions

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ABSTRACT

This study was conducted to investigate effects of different levels of ammonium nitrate (33% N) dose (0, 50 and 100 g m-2) on morphological and quality traits of 3 different commonly cultivated turfgrass species (*Lolium perenne* 'TOP-GUN', *Festuca rubra* 'SERGEİ' and *Poa pratensis* 'AVALANCHE') which are widely preferred in grass mixtures prepared for green areas in Çanakkale (Turkey). Fertilization treatments had positive effects on morphological parameters, except for germination power and germination rate parameters. In terms of landscape related aesthetic quality and growth percentage, 50 g m^{-2} and fertilization was found to be more suitable for *Lolium perenne*, while 100 g m^{-2} fertilization provided better performance for *Festuca rubra*. The 50 and 100 g m^{-2} fertilization rates yielded similar results for *Poa pratensis* in terms of general grass quality. It was observed that 50 g m^{-2} ammonium nitrate had a positive effect on root area and volume compared to other applications. In this application (50 g m-2 ammonium nitrate), the positive features of the root (high root area and volume) are the features that can prevent the grass plant from breaking off from the soil.

Keywords: Çanakkale, ammonium nitrate, fertilization doses, grass quality, turfgrass species

Farklı Amonyum Nitrat Seviyelerinin Çanakkale Koşullarında Yetiştirilen Serin-İklim Çim Türlerinin Performansları Üzerine Etkisi

ÖZ

Çalışmada Çanakkale (Türkiye) ilinde yeşil alanlar için hazırlanan çim karışımlarında yaygın olarak tercih edilen 3 farklı çim türünde [*Lolium perenne* TOPGUN (İngiliz Çimi), *Festuca rubra* SERGEİ (Kırmızı Yumak) ve *Poa pratensis* AVALANCHE (Çayır Salkım Otu)], 0, 50, ve 100 g/m^2 dozlarında amonyum nitrat (% 33 N) gübresi uygulamalarının etkisi araştırılmıştır. Gübreleme uygulamalarının kardeşlenme hızı, çimlenme gücü ve hızı parametreleri dışındaki morfolojik parametrelere pozitif etki ettiği belirlenmiştir. Genel çim kalitesi ve alan kaplama hızı açısından *Lolium perenne* türünde 50 g/m^2 gübreleme daha uygun bulunmuşken, *Festuca rubra* türünde 100 g/m^2 gübreleme daha uygun sonuçlar vermiştir. *Poa pratensis* türünde ise her iki gübreleme uygulamasının genel çim kalitesi açısından çok farklı olmadığı görülmüştür. 50 g/m^2 gübreleme uygulamasının kök alan ve hacmine diğer uygulamalardan daha fazla katkı yaptığı görülmüştür. Bu uygulamadaki (50 g m^{-2} amonyum nitrat) kökle ilgili olumlu özellikler (yüksek kök alanı ve hacmi) çim bitkisinin topraktan kopmasını engelleyebilecek özelliklerdir.

Anahtar Kelimeler: Çanakkale, amonyum nitrat, gübreleme dozları, çim kalitesi, çim türleri

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INTRODUCTION

Turfgrasses were used in establishment of lawns, sport fields and other green field surfaces. Because of different growth patterns and stress tolerance ability of each species, the use of a mixture of two or more turfgrasses is a common practice to provide both functional and esthetic improvement in turfgrass quality. Fertilization of turfgrasses is generally done especially for obtaining uniform turf cover for preventing and avoiding the dust problem, better visual appearance in urban areas and prevent soil to scattering (Alkan et al., 2019). The parks and picnic areas are the main green spaces that contribute to reducing people's longing for nature. The most important reason why these areas are preferred to reduce the longing for nature is the turfgrasses and trees used in these areas. The increase in these green spaces is extremely necessary for people to get away from the crowded and reinforced concrete areas of the city and demoralize them in a quieter place. Turfgrasses need nitrogen fertilization, which is especially necessary for the development of above ground (green) parts, to reach the biological capacity that can fulfill the above-mentioned tasks expected from them. Generally plants need external application of plant nutrients to meet the demand necessary for growth and development. Nitrogen is one of the most required elements for successful plant growth. Excessive accumulation of nitrogen element in nature can cause events such as eutrophication by which a water body becomes overly enriched with nitrogen, leading to plentiful growth of living things such as algae. As a result of this situation, the presence of dissolved oxygen in that aquatic ecosystem decreases. This situation can cause the death of various living things in the mentioned ecosystem due to not getting enough oxygen. Because of excessive nitrogen-containing fertilizer use, nitrate can also mix with drinking water and cause various diseases. Therefore, there is a need for more studies that will prevent fertilizer applications harming nature. There are many studies regarding the effects of different fertilizer on various turfgrass species. It is important to classify turfgrasses within such studies for determining the appropriate climate or growing conditions that they need and suitable fertilization dose for prevention of extensive use of fertilizers. Gültekin and Tansı (2009) conducted a study in Çukurova Region (Türkiye) and investigated the influences of different forms and levels of farm manure (burnt solid farm manure + liquid manure, liquid manure + liquid manure, separated solid farm manure + liquid manure, Mixture + liquid manure, control) on hay and seed yield and hay quality of annual grass (L. *multiflorum* Lam.). The greatest total green herbage, dried matter, crude protein and assimilateable dried matter yields were obtained from separated solid farm manure + liquid manure treatments; the greatest seed yield was obtained from liquid manure + liquid manure treatments. It was indicated that grass quality parameters changed significantly with different fertilization treatments and fertilization applications had a positive effect on grass quality parameters. Bilgili and Açıkgöz (2005) applied three different nitrogen doses (2.5 g N m^{-2}, 5.0 g N m^{-2}, 7.5 g N m^{-2}) to grass mixture (L. *perenne* L., F. *arundinacea* Schreb., P. *pratensis* L., F. *rubra* var. rubra L., F. *rubra* var. commutata Gaud., F. *rubra* var. trichophlla, A. *tenuis* L.). The greatest quality, green cover, clipping weight parameters were obtained from 7.5 g N m^{-2} treatments and the lowest values were obtained from 2.5 g N m^{-2} treatments. The greatest root weight was obtained from 2.5 g N m^{-2} treatment and the least from 7.5 g N m^{-2} treatment. Khan et al. (2019) cultivated different grass species (Korean grass (*Zoysia japonica*), Australian grass (*Xanthorrhoea australis*), Fine Dhaka (*Zoysia matrella*) grass) at different nitrogen levels (control, 50 kg ha-1, 100kg ha-1, and 150kg ha-1). Although they are in the same group statistically, the maximum length of leaves (7.3 cm), length of shoots (30.2 cm) and appearance (7.4) values were obtained as a result of 150kg ha-1 nitrogen application in Fine Dhaka. Considering the average values of nitrogen applications in the Korean grass, the maximum leaf number (2008.9), internode length (2.85 cm) and the number of days until propagation (129.9) values were obtained in the control application. In addition to the increase in the number of buildings in cities in recent years, there is a need for these buildings to have sufficient landscape area. The same is true for various constructions. This situation causes an increase in landscape areas. Studies on breeding and identifying more resistant species that are compatible with the ecosystem in which the landscape areas are located have increased. It was known that some varieties prove better performance in some regions. Alagöz and Türk (2017) conducted a study to investigate the green field performance of some turfgrasses and their mix in Isparta conditions. Perennial ryegrass (*L. perenne* L.), meadow blue grass (*P. pratensis* L.), tall fescue (*F. arundinacea* L.), red fescue (*F. rubra* L. var. rubra) and chewing fescue (*F. rubra* L.). var. commutata) were used as plant material. In their research, they determined the parameters of emergence rate, establishment speed and ratio, winter resistance, the color, strength of regeneration, the leaf texture, number of tillers, general view, infrequency degree and yield of hay. They reported that perennial ryegrass showed the best performance in terms of emergence rate, establishment speed and rate,

sparseness and general appearance in pure sowing, while red fescue gave the best results for winter resistance, color, hay yield and regeneration power. When mixes were compared, they found that the mixes with perennial ryegrass performed better than others. They stated that perennial ryegrass can be used purely or as a mixture in the grass field in Isparta conditions. In a study conducted by Arslan and Çakmakçı (2004) in the coastal zone of Antalya (Türkiye), various turfgrass species and varieties were used as plant material. It was stated that summer emergence parameter of the varieties belonging to *Poa pratensis* L. species were higher than the other species (*L. perenne, F. rubra, F. arundinacea, F. ovina*) and initial developments of this species was quite fast and visually quite good. It was also stated that the Bermudagrass (*Cynodon dactylon* Pers.) could successfully be used to create green areas in the coastal zones of Antalya province in summer. Çelebi et al. (2009) conducted an experiment with 20 different mixtures of various turfgrass species (*L. perenne, F. rubra var. rubra, P. pratensis, F. rubra var. commutata, F. rubra var. trichophylla, F. arundinacea, A. tenuis, A. stolonifera, F. ovina*) to determine proper turf mixtures for Van (Türkiye) ecology. In terms of green coverage (or establishment) rate and level, color and grass quality parameters, positive outcomes were obtained from *Agrostis stolonifera* and *Agrostis tenuis* mixtures.

In the light of above-specified studies, objectives of the study were set as:

- To identify the differences in establishment rate, visual appearance and growth levels of turfgrasses under different ammonium nitrat fertilizer doses
- To determine optimum nitrogen fertilization practice for cool-season grass growth.

MATERIAL AND METHOD

Material

The *L. perenne* 'TOPGUN' (Perennial ryegrass)-LP, *Festuca rubra* 'SERGEI' (Red fescue)-FR and *Poa pratensis* 'AVALANCHE'(Smooth meadow-grass)-PP were used as the plant material of the present study. Ammonium nitrate (33% N) fertilizer was applied to turfgrasses at 0, 50 100 g m^{-2} doses (Table 1). Seeds were manually sown into equal-size boxes (40x60x10 cm) filled with equal quantity of soil (Clay-Loam). Boxes of grass varieties irrigated daily with a watering can until excess water seeps out of the holes in the bottom of the boxes. Each box sown with 8g seed. A plastic sheet was kept ready next to the trial in case the newly planted grass seeds would come out of the container in case of rain. In order to protect the grass seeds from excessive heat and sunlight until germination, the seeds were covered with a net shading material with 40% light transmission until germination was completed. The experiment was conducted in open and sunny conditions in a part of a field between dates of 24/06/2020-4/09/2020.

Method

Experiments were built in completely randomized design with 4 replications using a total of 36 pots (3 turfgrasses x 3 treatments including control x 4 replicates).

In addition to the measurements taken from a single plant, turfgrasses were evaluated especially in terms of appearance and quality. In addition to visual quality parameters, quality parameters such as weight (unclustered-single plant, shoot+root) and volume measurement were included in the study and grass plants were compared in terms of various properties including soil adhesion.

Table 1. Grass varieties and fertilizer doses used in the study

Grass Varieties	*Fertilizer Doses ($g.m^{-2}$)*	*Code*	*Replicate*
Lolium perenne TOPGUN (Perennial ryegrass)	0	LP0	4
	50	LP50	4
	100	LP100	4
Festuca rubra SERGEI (Red fescue)	0	FR0	4
	50	FR50	4
	100	FR100	4
Poa pratensis AVALANCHE (Smooth meadow-grass)	0	PP0	4
	50	PP50	4
	100	PP100	4

Statistical analyses were conducted on measurement, observation and analysis data.

Morphological parameters (Measurement and weighing-based parameters) of grass plants: For the determination of fresh weight per plant (unclustered-single plant, shoot+root) 10 randomly selected plants from each replication were weighed with using a precision scale and averaged. To asses dry weight per plant; freshly weighed plants were dried in an oven at 60 °C until a constant mass and average of them was taken. Fresh weight to dry weight ratio per plant was

determined using fresh weight / dry weight ratio of 10 randomly selected plants from each replicate. The root area per plant was determined with the use of leaf area measurement programme- (The University of Sheffield, 2003) using average of 10 randomly selected plants from each replicate. To determine root volume per plant; roots of 10 plants randomly selected from each replicate were placed into a water-filled graduated cylinder, over-flowed water was measured and average of measurements was taken.

Observation-based parameters of grass plants: Uniform appearance of vegetation in grass areas is expressed as uniformity and it is assessed over the observational scores visually assigned based on different methods. Commonly used methods include 1-5 scale of Likert (1932) and a 1-9 scale of Mehall et al. (1983) (1; worst, 5 or 9; best). In grass area studies of Türkiye, researchers mostly used a 1-5 scale (Turgut, G. E., 2020; Metin, E., 2021) and rarely used 1-9 scale (Dereli, 2017). Therefore, a 1-5 scale was used in the present study to assess the uniformity of vegetation. Observation-based parameters of grass plants (germination power, germination rate, tillering rate, tillering percentage, growth percentage, colour, texture, effective root depth) were determined with the use of 1-5 Likert (1932) scale as indicated by Joshi et al. (2015).

Observation-based parameters were evaluated by considering the definitions described below and by giving points by observation.

Tillering rate: Tillering size in a cluster of turfgrass.

Tillering percentage: Percentage of clustered turfgrass.

Growth percentage: Dimensional average of the turfgrasses in a plant cluster

Colour: Level of bold green colour.

Texture: Percentage of unbroken and unwrinkled turfgrass.

Germination power: Percentage of emerged turfgrass in 2 weeks after sowing.

Germination rate: The ratio of how fast turfgrasses emerged in 2 weeks. Rate 5 as fastest, rate 1 as lowest.

Effective Root Depth: Rating of root length.

Experimental soil properties: Sand 35%, Silt 29%, Clay 36% -textured field soil taken from Lapseki (Çanakkale/Türkiye) location was used in present experiments. Soil samples were initially dried at shade, then fragmented with using wooden hammer and passed through a 2 mm sieve. Samples were made ready for analysis as indicated by Müftüoğlu et al. (2014). Soil samples were analyzed for the relevant parameters in accordance with the relevant methods and results are provided in Table 2.

Table 2. Experimental soil properties

Soil properties	Analysis value	Unit	Method
Soil reaction (pH) 1:2.5 aqueous mixture	6,44 (Slight acidic)	--	(Richards, 1954)
Soil salinity (EC) 1:2.5 aqueous mixture	0,23 (Unsaline)	dS m^{-1}	(Richards, 1954)
Soil organic matter (OM)	1,82 (Low)	%	(Jackson, 1958)
Lime ($CaCO_3$)	3,86 (Low)	%	(Allison ve Moodie, 1965)
Texture (Sand-Silt-Clay)	35-29-36 (Clay-Loam-CL)	%	Bouyoucos (1951)
Total nitrogen	0,12	%	Bremner (1965)
Available phosphorus	10	ppm	Olsen et al. (1954)

Statistical analysis: In the experiment, analysis of variance was performed using the SAS (9) computer package program for statistical analysis and the LSD ($P<0.05$) test was used to compare the differences between the means of the data. In the study, principal component analysis was conducted using the Bi-plot analysis. Bi-plot analysis used for interpretation of data on morphological and chemical parameters and the data were evaluated on the graph.

RESULTS AND DISCUSSION

Significant differences were observed in investigated parameters of turfgrasses based on species and fertilization doses. Under non-fertilized conditions (control), the highest values in tillering rate, rooting percentage, texture effective root depth, fresh and dry weight, root area parameters were observed in LP variety. The highest value in the growth percentage parameter was observed in FR variety. The lowest tillering rate, tillering percentage, growth percentage, color, texture, fresh and dry weight per plant values were observed in PP variety. These findings revealed that PP variety was worse than the other varieties in terms of growth percentage, colour, tillering percentage, tillering rate. While LP variety had the greatest rooting percentage, effective root depth, root area and root volume parameters, PP variety had the lowest values (Table 3 and 4).

Table 3. Change in measurement and weighing based morphological parameters of different grass varieties with nitrogenous fertilizer treatments (measurement-based traits)

Varieties	Nitrogen Dose g m^{-2}	Fresh weight per plant (g)	Dry weight per plant (g)	Root area (mm^2)	Root volume (ml)	Fresh weight / dry weight per plant
Lolium perenne Topgun (LP)	0	0.372 BC*	0.169 B	1584 BC	0.630 DE	2.240 C
	50	0.398 B	0.175 AB	3358 A	1.430 A	2.280 C
	100	0.497 A	0.192 A	1675 BC	1.180 B	2.590 AB
Festuca rubra Sergeı (FR)	0	0.324 BCD	0.131 CD	1063 CD	0.580 DE	2.470 ABC
	50	0.394 B	0.153 BC	2157 B	0.800 C	2.580 AB
	100	0.390 B	0.164 B	1084 CD	0.530 EF	2.390 BC
Poa pratensis AVALANCHE (PP)	0	0.166 E	0.074 F	394.5 E	0.400 F	2.240 C
	50	0.298 CD	0.110 DE	782.0 DE	0.680 CD	2.700 A
	100	0.276 D	0.101 E	725.8 DE	0.600 DE	2.720 A
LSD		0.0821	0.0221	647.66	0.1319	0.2767

*: Means indicated with different capital letters in the same column are significantly different

Table 4. Change in some observation based parameters of different grass varieties with nitrogenous fertilizer treatments (measurement-based traits)

Varieties	Nitrogen dose, g m^{-2}	Tillering rate	Tillering percentage	Growth percentage	Colour	Texture	Germination power	Germination rate	Effective root depth
									Scored over 1-5 Likert scale
Lolium perenne Topgun (LP)	0	4.87 A*	1.70 DE	3.63 EF	3.71 E	4.75 A	4.75 A	4.87 A	4.50 AB
	50	4.00 CD	3.12 A	5.00 A	4.77 A	4.75 A	3.88 DE	3.62 B	4.88 A
	100	3.50 E	2.03 CD	4.75 AB	4.6 B	4.75 A	4.00 CDE	3.50 B	4.50 AB
Festuca rubra Sergeı (FR)	0	4.25 BC	1.73 DE	3.75 DEF	3.90 D	4.13 BC	4.50 AB	4.5 A	3.75 DE
	50	3.66 DE	2.41 B	4.33 BC	4.40 C	4.00 C	3.68 EF	3.66 B	4.18 BC
	100	4.12 BCD	2.25 BC	4.13 CD	4.63 B	4.50 AB	4.25 BCD	4.50 A	3.88 CDE
Poa pratensis Avalanche (PP)	0	4.50 AB	1.53 EF	3.50 F	3.36 F	4.13 BC	4.38 ABC	4.38 A	3.50 E
	50	3.25 E	1.51 EF	4.00 CDE	4.63 B	4.50 AB	3.38 F	3.50 B	4.00 CD
	100	4.33 BC	1.23 F	4.18 CD	3.97 D	4.83 A	4.33 ABCD	4.33 A	4.50 AB
LSD		0.4998	0.3554	0.4941	0.1313	0.4066	0.4947	0.5732	0.4017

*: Means indicated with different capital letters in the same column are significantly different

A similar trend was observed in germination power values (Table 4). Arslan and Çakmakçı (2004) conducted a study in the coastal zone of Antalya province and reported greater summer emergence scores for *P. pratensis* than the other species including for *L. perenne, F. arundinacea*, *F. rubra* L. subsp. rubra, *F. ovina* L., *F. rubra* L. subsp. commutata, *C. dactylon*. Arslan et al. (2020) conducted a study under ecological conditions of Samsum province and reported greater number of shoots and general appearance parameters for *L. perenne* and the other species (*F. rubra* L. subsp. commutata, *F. rubra* L. subsp. rubra, *F. rubra* trchophyla) than for *P. pratensis* L. Such findings revealed that ecological conditions were also effective in development of turfgrasses. Alagöz and Türk (2017), obtained similar results in terms of better performance of perennial ryegrass including leaf texture and the number of tillers.

Fertilizer treatments all had significant positive effects on growth percentage, color, fresh weight, per plant, dry weight per plant parameters. Similar to the present findings, Gültekin and Tansı (2009) indicated that farmyard manure treatments in different forms and doses generally had positive effects on the quality parameters of *L. multiflorum* Lam.

Germination power and germination rates generally decreased with fertilizer treatments. Lower values were also seen in tillering rate with the fertilizer treatments. Dubetz et al. (1959) investigated the effects of osmotic pressure and fertilization treatments on the germination of canning corn (*Zea mays*), field beans (*Phaseolus vulgaris*) and sugar beets (*Beta vulgaris*). And it was observed that moisture levels applied together with nitrogen fertilization reduced germination. It was also determined that nitrogen treatments were more effective in reducing germination than mannitol or P_2O_2. In addition, it was stated that such a decrease in germination might be due to the osmotic effect, which is based on the high solubility of ammonium nitrate or its toxic effect on germinating seeds.

PC1 (1st component) and PC2 (2nd component) are the two main components used to achieve the biplot. In study, PC1 and PC2 scores describe the interaction of 3 grass varieties and 2 fertilization applications for 14 morphological traits by 76.9%.

Similarly, L0, F0 and P0 treatments were located on the same axis (PC1<1, PC2>0) with the germination power, germination rate and tillering rate (time of tillering) parameters in the Biplot plot (Figure 1) indicating that these treatments yielded greater values of these parameters. It could be stated that fertilization treatments increased all other quality parameters as they (L50, L100, F50, F100, P50, P100) were located closer to these parameters.

While tillering percentage, an important indicator of degree of spreading, increased with fertilization treatments in LP and FR varieties, there was no significant difference in tillering percentage with 50 g m^{-2} fertilization treatment and tillering percentage decreased with 100 g m^{-2} fertilization treatment in PP variety. With fertilizer treatments, significantly greater increases were seen in the rooting percentage of LP and FR varieties than of PP variety. This may indicate that LP and FR varieties were more suitable for present fertilization treatments (Table 4). Tillering rate, tillering percentage, growth percentage, color, texture are important parameters of turfgrass quality. Moreover, fresh weight per plant can be evaluated as another important component of esthetic quality. In the LP, the majority of these parameters (Tillering rate and percentage, growth percentage, color, texture) were higher in 50 g m^{-2} fertilization treatments than in 100 g m^{-2} fertilization treatments. In FR variety majority of these parameters (tillering rate, color, texture and had similar results in fresh weight per plant) had better results in 100 g m^{-2} fertilization treatments than in 50 g m^{-2} fertilization treatments. Such a trend indicated that while 50 g m^{-2} fertilization was more appropriate in LP variety, 100 g m^{-2} fertilization might be more appropriate rate in FR. When PP variety observed fresh weight per plant and color parameters had better results in 50 g m^{-2} and growth percentage and texture percentage had better results in 100 g m^{-2} fertilization treatments (Table 3 and Table 4).

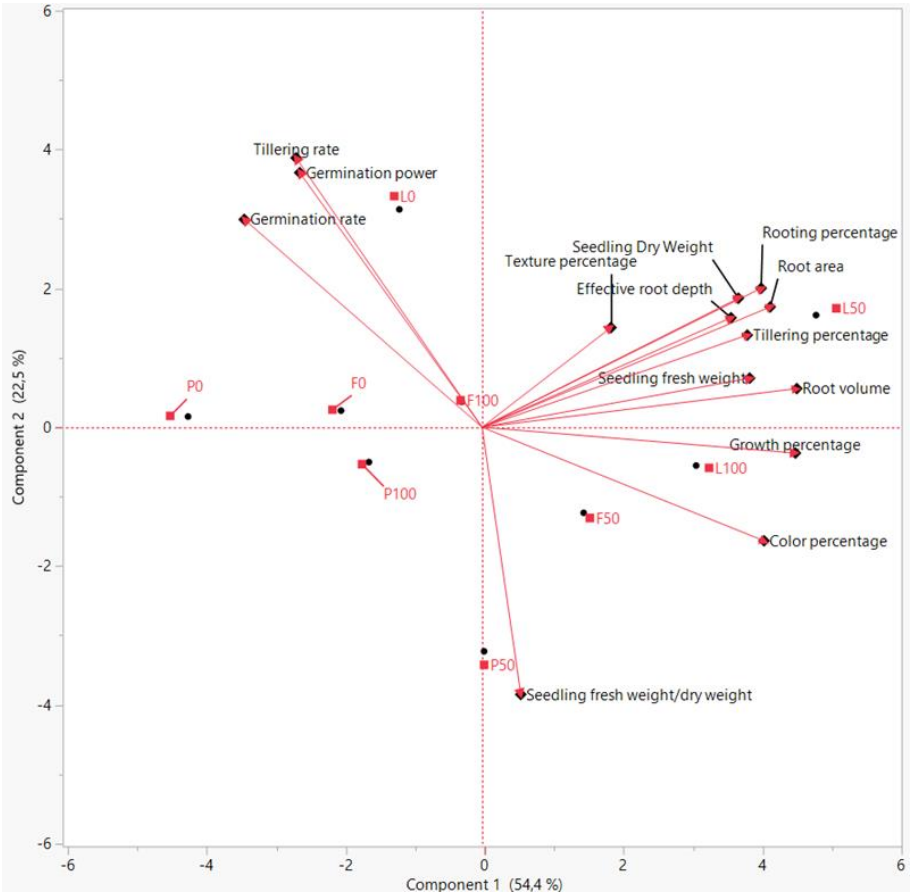

Figure 1. Biplot graph for changes in morphological traits based on grass varieties and fertilizer treatments

When the biplot figure (Figure 1) was observed, most of the quality parameters were in the same axis with L50 treatment compared to L100 treatment indicating that 50 g m^{-2} fertilization shall be enough for LP variety. In PP variety, when P50 and P100 treatments were compared, they both in opposite directions (PC2<0) with the general quality parameters. P50, P100, F50 and F100 were not in axis (PC1>0, PC2>0) which includes most of the quality parameters. However, when the figure was evaluated generally all fertilization treatments were closer to quality parameters except tillering rate, germination power, germination rate when compared to their unfertilized treatments. It was also shown that fertilization treatments had a negative effect on tillering rate, germination power, germination rate parameters.

CONCLUSION

The visual quality of the turfgrasses were positively affected by the fertilization applications. In terms of visual quality, 50 g m^{-2} fertilization was found to be more suitable for *L. perenne* while 100 g m^{-2} fertilization provided better results for *F. rubra* SERGEİ. Although there was no much difference among fertilization treatments in *P. pratensis* AVALANCHE for most of the traits studied 50 g m^{-2} fertilization can be used instead of 100 g m^{-2} fertilization to improve overall visual turf quality. In the present study, FR variety had greater growth percentage and fresh/dry weight parameters than the other varieties. A high wet/dry weight parameter indicates less dry matter accumulation. In terms of all the other morphological parameters, the LP variety had the best values. In terms of morphological parameters, PP variety generally had the lowest values. Under present ecological conditions, LP and FR varieties had the best values, respectively, followed by PP variety. While the tillering rate, germination power and rate were negatively influenced by fertilization treatments, enhancement was observed in the other morphological parameters studied. Such a trend indicated that nitrogen application had positive effects on grass species in terms of visual appearance and turf quality that are important traits in landscape planning and design. Greater root area and root volume parameters of 50 g

m^{-2} nitrogen treatment than that of 100 g m^{-2} treatment revealed that root spread was greater in low nitrogen dose. It may benefit in preventing the moving of soil to unwanted areas. However, revising the important parameters in terms of general appearance, it was determined that 50 g m^{-2} fertilization was more appropriate in LP variety, while 100 g m^{-2} fertilization was more appropriate in FR variety. In PP variety there was not any visible difference between fertilization applications when parameters were examined and 50 g m^{-2} fertilization seem to be more appropriate considering economical value. Further research is recommended with different grass mixtures, different fertilizers and different soil types for longer durations.

ACKNOWLEDGEMENTS

This study was supported by Çanakkale Onsekiz Mart University Scientific Research Project Unit. Project Number: FBA-2020-3129.

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