TURFGRASS GROWN ON SAND-BASED ROOTZONE MIXTURE FOR INDOOR PURPOSE

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Abstract

Sand-based rootzone mixtures used in establishing turfgrass areas have many advantages such as: reduced compaction from traffic and a fast rate of water infiltration. At the same time rapid draining and the lightweight of secondary materials used along with sand, such as peat or composted manure result in an overall lower weight of such rootzones compared to soil. This experiment studied the performance of some species of perennial cool season grasses for turf grown on four different rootzone mixtures in greenhouse conditions. Results demonstrated that a rootzone made by sand and sphagnum peat mixed in a ratio of 2:1 by volume considerations, obtained the highest turf quality in terms of establishment capacity, recovery after cutting, vertical growth, turf density, percent ground cover, thermo-hydric stress tolerance and general ornamental appearance. Compared with the rootzone made from 100% soil, sand + peat mixture offered a better availability of water and nutrients for plants. But using sand as a primary material for growing turf recommends a greater attention for supplying water and nutrients to the plants, imposing an intensive management where irrigation and fertilization should be done with smaller but more frequent doses.

Key words: *Festuca arundinacea*, *Festuca rubra*, sand, sphagnum peat, composted manure, soil

Lawns are generally outdoor areas sown with perennial grass species, found in gardens, public parks or sports fields. The ornamental and recreational value, as well as the social importance of lawns made them to be created in other, more special locations and sometimes in indoor areas (Dunn J., and Diesburg K., 2004). Growing turfgrasses indoor poses big problems related to plant survival, mainly due to insufficient lighting and air flow restriction. At the same time, environmental factors may be more easily controlled in a protected space, factors such as temperature, water and even the rootzone layer (Christians N., 2004; Johnson P.G., 2003).

Rootzone mixtures that are based on sand as a primary material are used overwhelmingly in areas where different sports such as football, golf or tennis are played, due to some advantages such as: reduced compaction and rapid infiltration of water in depth. Besides these advantages turfgrass grown on a substrate based on sand raise numerous issues such as availability of water and nutrients for plants. Usually, such sports fields also benefit from an intensive management aiming a constant and frequent supply of water and fertilizing chemicals, application of treatments to combat pests and diseases plus many other special maintenance treatments such as scarification, aeration, dethatching, overseeding, decompaction (Morhard J.M., 2004; Rowland J.H., 2010).

The use of sand and other materials for rootzones has been standardized by USGA which recommends the creation of a special rootzone mixture in which sand material with a grain size of 0.25-1.0 mm, to be used at a procentage of 80-85% along with sphagnum peat at a procentage of 15-20%. This ratio between the two materials is made based on volume and not by weight because there is a big difference between the two in terms of volumetric weight. While other components have been tested to be used as a secondary raw material with sand, such as: composted manure, soil, plant compost, sludge, various organic waste materials from the textile industry, the best results were obtained when it was used sphagnum peat in addition to sand.

Perennial grass species used for turf belong to different botanical genera, with large differences at both morphological level but also in terms of adaptation to specific environmental conditions such as soil texture, pH, depth of rootzone, lighting, level of nutrient supply and others (Burt M.G. and Christians N.E., 1990; Danneberger K. T., 1993; Morris K., 2006; Veronesi, F., 1997).

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Some grass species could adapt to a growing media based on sand as a primary material, developing a deep root system and producing a high shoot density. Other species may not meet the best growing conditions on such rootzone substrate while they may prefer a soil substrate.

MATERIAL AND METHOD

The experiment was conducted in a greenhouse that simulates conditions of an indoor area. The greenhouse has an automated climatized system so that ecological factors can be controlled. Average temperature was about 20^{0}C and light intensity was around 80% of outside light intensity.

In this study were used as biological material two turfgrass mixtures with different structures in terms of grass species components. The first mixture had the following structure: 65% *Festuca arundinacea* Schreb. + 20% *Lolium perenne* L. + 15% *Poa pratensis* L. The second mixture had the following structure: 65% *Festuca rubra* L. var. *rubra* + 30% *Lolium perenne* L. + 15% *Poa trivialis* L. The rootzone layer used for growing the two turfgrass mixtures was composed of four materials: sand, sphagnum peat, composted manure, soil. Using these materials were constructed three rootzone mixtures which had the primary material sand, to which the other three components were added separately. The ratio between sand and the second material was 2:1 calculated on the basis of volume. The fourth substrate was made entirely of soil. Rootzone materials were placed in rectangular trays with an area of approximately 0.2 m^2 and a depth of 5 cm. Sowing was done using a rate of 40 g/m². Irrigation was done at intervals of 3-5 days, fertilization was done using liquid fertilizer with macro and micronutrients.

RESULTS AND DISCUSSIONS

Observations showed differences between rootzones of sand mixed with different materials, both in terms of speed of installation of turf mixtures and subsequent performance. Differences were found in the dynamics of plant emergence, plant size and vigor of their sprouts, density, coverage, overall quality, tolerance to thermal and hydric stress, accumulation of biomass. These differences are due to different physic-chemical properties of the rootzones used. The first turfgrass mixture had a very good establishment compared to the second but other differences were also observed at both mixtures influenced by rootzones. In the case of the first turfgrass mixture, the rootzone constructed from sand + peat produced the best establishment results while the second turfgrass mixture had the best establishment using soil rootzone (*figure 1*). The rootzone with sand + soil had the worst result in both mixtures. The rate of plant vertical growth was different depending on the substrate, better at sand rootzone mixed with peat or composted manure and weaker at sand rootzone mixed with soil (*figure 2*).

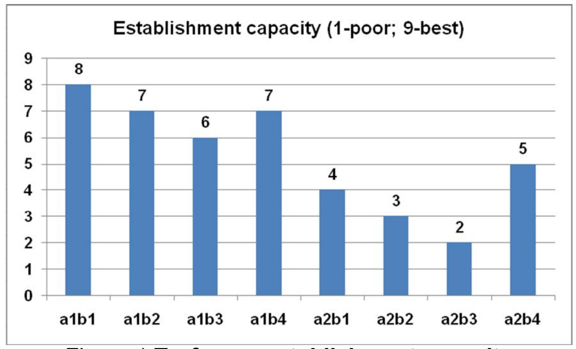

Figure 1 **Turfgrass establishment capacity**

In the case of the first turfgrass mixture it was observed a sustained regeneration of plants at the first two substrates based on sand with vigorous vertical growth of 2.6 mm/day while at the third substrate sand + soil the growth had a slower rate of 1.8 mm/day. The second turfgrass mixture had a good vertical growth ranged between 2.3 – 2.5 mm/day, on behalf of the *Lolium perenne* species but the growth of *Festuca rubra* var *rubra* was poor.

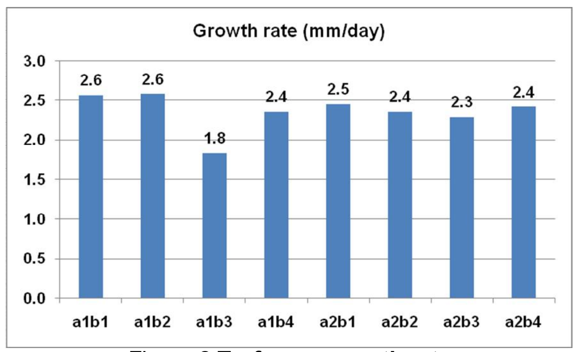

Figure 2 **Turfgrass growth rate**

Sand + peat rootzone produced the best results also regarding the percent ground cover, overall quality, tolerance to hydric and thermal stress and biomass accumulation.

Results showed large difference of the percent ground cover between the two turfgrass mixtures but also within rootzone substrates. The first turfgrass mixture had an average cover of 63-94% while the second turf mixture had a cover of 54-60% (*table 1*). The large variation of cover at the first mixture was caused by rootzone substrate. The best cover was registered at the substrate sand + peat, with little variation, ranged between 90-95%. Also a good cover was observed at the rootzone substrate sand + composted manure ranged between 85-90%.

Table 1

Percent ground cover (%)

Variant	Jan	Feb	Mar	Apr	May	Mean
a1b1	90	95	95	95	95	94
a1b2	85	85	85	90	90	87
a1b3	80	85	90	30	30	63
a1b4	85	85	85	70	70	79
a2b1	65	70	70	30	65	60
a2b2	65	65	65	35	40	54
a2b3	60	60	65	40	45	54
a2b4	65	75	75	35	45	59

The lowest ground cover was observed at the rootzone substrate sand + soil with an average value of 63%. In the case of the second turfgrass mixture the low ground cover values may have been caused by the poor establishment but also by reduced tolerance to heat stress. The lowest coverage of 54% was observed in the second turfgrass mixture grown on a substrate made of sand + soil. The best average coverage was registered at the rootzone substrate sand + peat (60%) with a peak of 70% in two consecutive months and at the substrate made from 100% soil (59%) with a peak in February and March of 75%.

Regarding overall quality, in the case of the first turfgrass mixture, the highest quality was observed at the rootzone with sand + peat generally characterized by high density of shoots, high ground coverage, good general appearance and resistance to heat and water stress. The worst results were recorded in sand + soil substrate. In the case of the second turf grass mixture the best overall quality was observed at the soil substrate. The first turfgrass mixture displayed acceptable quality at all rootzone substrates (*table 2*). The rootzone substrate sand + peat produced a constant and high quality rated with 8 in every single month, while the largest variation of overall quality was observed at the sand +soil rootzone substrate with quality ratings ranged between 4 to 8.

Table 2

Overall quality (1-poor; 9-best)

Variant	Jan	Feb	Mar	Apr	May	Mean
a1b1	8	8	8	8	8	8
a1b2	7	7	7	8	8	7.4
a1b3	6	8	8	4	6	6.4
a1b4	7	8	8	6	7	7.2
a2b1	5	3	4	4	6	4.4
a2b2	4	3	3	4	6	4.0
a2b3	4	4	4	4	5	4.2
a2b4	6	6	5	5	6	5.6

In the case of the second turfgrass mixture acceptable overall quality was determined at the rootzone substrate made from 100% soil with ratings of 6 in three months and ratings of 5 in two months. The lowest quality was registered at the sand + soil substrate with ratings from 4 to 5.This demonstrates that not all species of grasses used for turf are suitable to be grown on a substrate based on sand.

Table 3

Biomass accumulation (kg/ha)

Variant	Jan	Feb	Mar	Total
a1b1	1155	520	585	2260
a1b2	1175	425	510	2110
a1b3	955	180	395	1530
a1b4	1190	155	450	1795
a2b1	1220	680	685	2585
a2b2	910	540	555	2005
a2b3	380	550	530	1460
a2b4	680	610	545	1835

Hardy species used in football fields which are constructed using sand as a primary material to relieve compaction and to maintain a high rate of water infiltration in depth, mixed with various organic materials, species such as *Lolium perenne, Poa pratensis* and *Festuca arundinacea* may find good conditions to grow on sand, while ornamental species such as *Festuca rubra* grow better on a substrate made from nothing but soil.The rate of aboveground biomass accumulation may provide information on plant capacity to use environmental resources such as water, nutrients and heat. In this case the type of rootzone substrate, its texture, its components and physico-chemical characteristics can influence the absorption dynamics of water and nutrients by plants and a faster accumulation of biomass. There was a rapid accumulation of biomass in larger quantities in the case of rootzone substrate made of sand + sphagnum peat. At the first mixture of turfgrass total biomass amount accumulated over a period of three months ranged from 1530 kg/ha (sand + soil) and 2260 kg/ha (sand + peat). At the second mixture of turfgrass biomass ranged from 1460 kg/ha (sand + soil) and 2585 kg/ha (sand + peat). Both the first and second turfgrass mixtures had the largest amount of biomass at the sand + peat substrate (*table 3*).

Rootzone substrate influenced the drought and heat tolerance capacity of plants (*table 4*). At the first turfgrass mixture the best results were obtained from the rootzone substrate sand + peat rated 8 and the rootzone sand + composted manure rated 7. At the second turfgrass mixture the best results were obtained at the rootzone substrate sand + peat but also at the substrate made from soil which were rated with 7 respectively 6.

Table 4

Heat and drought stress tolerance (1-poor; 9-best)

Variant	Mean
a1b1	8
a1b2	7
a1b3	3
a1b4	5
a2b1	7
a2b2	4
a2b3	6
a2b4	6

The worst results regarding heat and water stress has been determined for both turfgrass mixtures at the rootzone substrate formed from sand + soil. These two materials combined displayed little of the advantages but more of the negative charactersistics.

CONCLUSIONS

Differences were found in terms of establishment capacity, coverage, density, resistance to thermo-hydric stress differences due to different physico-chemical properties of rootzone substrates used for growing turfgrasses.

The most suitable rootzone substrate in the greenhouse experimental conditions was the one consisting of sand + sphagnum peat in the case of the turfgrass mixture based on *Festuca arundinacea* species.

The turfgrass mixture that is composed of *Festuca rubra*, obtained best quality results when cultivated on a rootzone made from soil.

Rootzone substrate using sand as a primary material and other organic materials allows better root development, water and nutrients are more readily available for plants but it is advisable to adopt a more precise management regarding irrigation and fertilization of turfgrass species grown on such media.

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