Urban Forestry & Urban Greening 26 (2017) 178–183

Contents lists available at ScienceDirect

Urban Forestry & Urban Greening

journal homepage: www.elsevier.com/locate/ufug

Original article

The impacts of different management practices on botanical composition, quality, colour and growth of urban lawns☆

Pavel Knot*, Frantisek Hrabe, Stanislav Hejduk, Jiri Skladanka, Michal Kvasnovsky, Lucia Hodulikova, Iva Caslavova, Pavel Horky

Department of Animal Nutrition and Forage Production, Faculty of Agronomy, Mendel University in Brno, Zemedelska 1/1665, 613 00 Brno, Czechia

ARTICLE INFO

Article history:
Received 3 June 2016
Received in revised form 13 January 2017
Accepted 24 January 2017
Available online 2 February 2017

Keywords:
Clippings
Management practices
Mulching
Nitrogen
Urban lawns

ABSTRACT

Mulching has increasingly become a standard method used in maintaining low-input lawns. This can be attributed to cost-savings, as these maintenance systems do not require loading and hauling of grass clippings. It is also possible to reduce the amount of nitrogen (N) fertilization and thus save on fertilizer costs. The effects of mowing management and rate of nitrogen fertilization on quality and growth of urban lawns were studied in a field trial during 2007–2012 on lawns newly sown in autumn 2006 and consisting of a grass–legume mixture (*Lolium perenne* 25%, *Poa pratensis* 25%, *Festuca rubra* 30%, *Festuca ovina* 5%, *Anthoxanthum odoratum* 5%, *Cynosurus cristatus* 5%, *Trifolium repens* 3%, *Lotus corniculatus* 2%). Nitrogen was used at three application levels: 0, 50 and 100 kg of N ha^{-1} $year^{-1}$. Swards were cut to a height of 40 mm five times annually and mulched to the same height. Mulching significantly affected the botanical composition of lawns, wherein a decrease in the portion of legumes (from 32% to 19.1%) was observed. The returned grass matter supported a significant increase in the grass component in the lawns (from 57.8% to 69.7% of total). When the clippings were returned, quality remained the same. Returned clippings had a positive impact on colour and increased the height of cut swards significantly. Application of nitrogen decreased the share of legumes, supported the grass component, statistically increased quality, improved colour, and increased sward height. The results show that returning grass clippings through mulching is beneficial. In any case, it is necessary to apply at least a basal amount of mineral fertilizer in order to preserve the quality of urban lawns over the long term.

1. Introduction

Lawns are an essential part of public greenery. They represent a growing component where insufficiency, poor quality and neglect are among the main aesthetic problems in the cultural environment of landscapes and settlements. Lawns today occupy a great deal of green open spaces in cities. Their share in urban greenery is as high as 70–75% (Ignatieva et al., 2015). They can be found in private gardens and public parks, cemeteries, golf courses, and along roads. Most people in the Western world perceive lawns as a 'natural' and even compulsory element of the urban landscape without questioning their social, ecological or aesthetic values (Stewart et al., 2009). Hrabe et al. (2009) see the main value of a lawn in its ability to form a landscape and in the ecological, stabilizing, recreational, curative and socio-cultural functions. Urban green spaces hold great potential for promoting active lifestyles that allow urban residents to achieve important health benefits (Zhang et al., 2014). In California, for example, children living within 500 m of a park were found to be more active and less likely to become obese (Wolch et al., 2011). Bolund and Hunhamma (1999) present six major groups of important urban ecosystem services: air filtering, microclimate regulation, noise reduction, rainwater drainage, sewage treatment, and recreational/cultural values. Of these six services, the one for which lawns are most important is rainwater drainage. In cities poor in vegetation, up to 60% of rainwater ends up as surface run-off. In areas with permeable surface, such as a lawn, only 5–15% of rainwater becomes surface run-off and the rest evaporates or infiltrates into the ground. That infiltration provides important soil moisture for trees and other vegetation that further contributes to many of the ecosystem services mentioned above. Lawns also may have positive effects on the environment, such as by sequestering carbon in the soil (Qian et al., 2010). Such environmental benefits of lawns largely depend upon the intensity of their management (Cameron et al., 2012).

☆ This article is part of a special feature entitled: 5th ETS 2016 Conference: Turfgrass – towards sustainability and perfection for aesthetic, recreational and sports published at the journal Urban Forestry & Urban Greening 26C.

* Corresponding author.
E-mail address: knot@mendelu.cz (P. Knot).

http://dx.doi.org/10.1016/j.ufug.2017.01.011
1618-8667/

Seed mixtures of *Lolium perenne, Poa pratensis* and *Festuca rubra* are often used in central European lawns. Salehi and Khosh-Khui (2004) compared monoculture and mixtures of different turf grasses, revealing better visual quality from a mixture consisting of *Festuca*, *Poa*, *Lolium* and *Cynodon* as compared to individual species. The advantage of mixing species compared with individual species in order to reduce disease has been reported by Dunn et al. (2002).

Depending on habitat conditions as well as purpose and intensity of use, it is possible to use additional turfgrasses and legume species. In comparison to monocultures, heterogeneity of species provides genetic diversity and greater adaptability of turfgrass while increasing its resistance to pests, diseases and other negative environmental impacts.

Mulching has increasingly become a standard method used in maintaining low-input lawns. The reason can be attributed to cost-savings, as these maintenance systems do not require loading and hauling of the mown material (Knot, 2013). Mulching also makes it possible to reduce N fertilization, thereby saving on fertilizer costs while reducing environmental impact. Low-input lawns are usually not fertilized. In such case, mulching is beneficial because the organic matter left on the ground gradually decomposes and the nutrients it contains become available to plants again. Liu and Hull (2006) reported that the dry matter weight of grass clippings ranged from 3.68 t h^{-1} for perennial ryegrass up to 5.51 t h^{-1} for a tall fescue monoculture. Total N content in the grass clippings was in the range of 111–260 kg h^{-1} per year. Starr and DeRoo (1981) concluded that nitrogen from grass matter remaining on the ground covers as much as 30% of annual N requirements, while Kopp and Guillard (2002) claim clippings met even 50% of N needs. The amount of N in grass material is influenced not only by the grass species but also by its variety (Liu and Hull, 2006). The rate of grass clippings' decomposition is affected by temperature and precipitation amount (Rychnovska, 1993). The greater availability of N from organic material left on the ground leads to faster stand growth, and thus to greater weight of dry matter (Kopp and Guillard, 2002) and taller sward height (Knot et al., 2011). Grass clippings left on the ground positively influence the share of turfgrass species in the lawn (Knot, 2013) and the sward colour while also reducing weed infestation (Heckman et al., 1999).

Because very few studies have examined the effects on turfgrass growth and quality from returning clippings to lawns, the objective of this research was to explore the effects of returning grass clippings and varying N fertilization rates on lawns' quality, botanical composition, colour and growth.

2. Materials and methods

2.1. Site description

This research project was conducted at the experimental station of the Department of Animal Nutrition and Forage Production, Faculty of Agriculture, Mendel University in Brno, Czech Republic (49°31′6″N, 15°58′7″; altitude 560 m a.s.l.). The station is located in a potato-growing production region with average annual temperature of 6.1 °C and total annual precipitation of 737 mm. Meteorological data for the experimental site are shown in Table 1. Soil at the experimental area is cambisol modal mesobasic.

2.2. Experimental design, plant material and its maintenance

The experiment was carried out in a 2 × 3 factorial experiment organized in a randomized complete block design with three replicates. Experimental plots were size 2 × 2 m. Three fertilization variants were used (0, 50 and 100 kg of N ha^{-1} year^{-1}). Nitrogen fertilizer with stabilizer (Entec) was used. The variant with 50 kg of N was applied in a single dose at the beginning of spring. For the variant with 100 kg of N, plots were fertilized with 50 kg of N at the beginning of spring and 50 kg of N after the third cut. Two variants of mowing management – mulching (i.e. returning grass clippings) and collecting – were combined with each variant of fertilization treatment. The experiment was established in the autumn of 2006 using the following grass–legumes mixture: *Lolium perenne* 25%, *Poa pratensis* 25%, *Festuca rubra* 30%, *Festuca ovina* 5%, *Anthoxanthum odoratum* 5%, *Cynosurus cristatus* 5%, *Trifolium repens* 3%, *Lotus corniculatus* 2%. The plots were mown using a Honda HRX537 model rotary mower five times per year at mowing height 40 mm at the following times: second decade of May, second decade of June, third decade of July, second decade of September, and third decade of October.

2.3. Data collection

Sward structure was assessed using the subjective method of evaluating coverage before the first mowing (May). The structure is expressed as the proportions of grasses, legumes, weeds and empty spots. Sward height was determined using a measuring rod prior to each cut. Quality (considering all visual aspects important for extensive turf assessment) and its colour were assessed according to Descriptor list – Grasses (Sevcikova et al., 2002) on a point scale of 1–9 (1 = worst, 9 = best) before the first cut. Data were collected during six growing seasons.

2.4. Statistical analysis

Statistical analyses were performed using repeated measures ANOVA with multiple post-hoc comparisons according to Tukey's test (P-value ≤ 0.05). Statistica 10 software (StatSoft) was used for the analysis.

3. Results

3.1. Botanical composition

Returning grass clippings significantly affected the botanical composition of the lawn, wherein a decrease in the share of legumes (from 32% to 19.1%) was observed (Fig. 1). Meanwhile, the returned grass matter supported a significant increase in the grass component within the lawn (from 57.8% to 69.7%). The significant increase in grasses and reduction in legumes in variants with removal of clippings was observed in the fourth year of the experiment. In the following years, this difference grew such that final values were

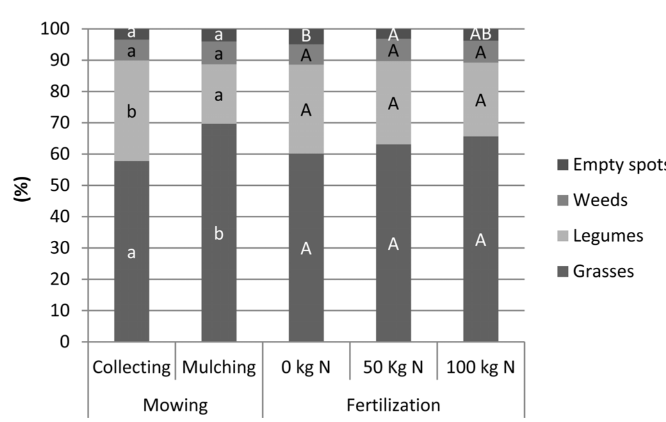

Fig. 1. Effect of different management practices on botanical composition (average for 2007–2012). Different letter labels indicate significant differences between groups (P ≤ 0.05).