UDK 630*27:632.51
Scientific paper

Received: 25 September 2025
Revised version accepted: 27 October 2025
Doi number: 10.5937/34ah-61711

The role of maintenance practices in weed management of urban lawns

Stavretović Nenad, Petrović Jovana, Pešikan Marija
University of Belgrade, Faculty of Forestry, Belgrade, Serbia
e-mail: nenad.stavretovic@sfb.bg.ac.rs

SUMMARY

A well-established lawn requires minimal maintenance and is easier to manage. Such lawns are also more cost-effective, with noticeable savings. For companies, cities, districts and states, this way of working and planning contributes to savings in their budget. Weed presence in dense, wellestablished turf is less apparent, and appropriate maintenance practices delay the need for direct weed control. Consequently, certain measures of care and maintenance can be applied less frequently and over longer intervals. In addition to the economic benefits, proper establishment and maintenance provide aesthetic value and ecological advantages.
***Keywords*:** urban lawns, lawn maintenance, weed control, management of green areas.

INTRODUCTION

Maintenance of green areas is the most important task in urban greening management, and a well-maintainend lawn takes the largest share of total resources (time and money). As an example, the green area maintenance sector generated over $58 billion in sales and employed over 1.1 milion people in USA (Hodges et al., 2011) and the benefits of well-maintained landscapes are numerous and well-documented. The reduction of the budget for the maintenance of urban green areas, especially lawns, is reflected in their aesthetic appearance and usage (Randrup and Person, 2009). The basic characteristics of lawns that should be aimed for in the process of

establishing, reconstructing, and maintaining green areas include: uniform color (dark green), uniformity, texture, density, and others (Stavretović, 2008;Turgeon, 2011). Achieving and maintaining the visual and functional lawn quality, in accordance with its type, primary purpose, and function ensures its durability and longevity. The durability and longevity of urban lawns, as well as their visual and functional quality, are affected by the presence of weeds. In urban lawns, weeds are undesirable becaure of their effects on the aesthetic appearance, stabilizing capacity, or overall utility of a turf (Turgeon, 2011). Weeds in urban lawns are a constant, due to insufficient or improper maintenance, and their presence tends to increase over time.

Weeds are opportunists, taking advantage of open spots in thin or weak stands of turf. Although herbicides are often used as a tool for weed control, they are only one component of an integrated weed management program. If the underlying causes are not addressed, weeds will reappear even after existing ones have been eradicated with herbicides. Furthermore, there are relatively few herbicide options for selective weed control (Fennimore and Doohan, 2008), and many of them can cause significant damage to ornamentals in green areas, as well as pose environmental and safety concerns. These issues have led to an increased preference for environmentally-friendly integrated management strategies and non-chemical weed control in urban green areas (Matheny, 2009).

Weed control is an important component of green area maintenance from both aesthetic and biological perspectives (Marble et al., 2015). It is essential to determine the reasons for weed invasion and to address the underlying problems. The best defense against weeds is a dense, healthy, and vigorous lawn, which can only be achieved through proper maintenance measures. Every lawn maintenance measure contributes to reducing the presence of weeds, while the absence of care and maintenance favors their appearance and spread. Each maintenance measure helps to suppress certain types of weeds or even eliminate them completely. It should also be mentioned that weed control continues to be one of the most expensive and time-consuming aspects of landscape maintenance (Marble et al., 2015), and proper maintenance measures are an important factor in reducing the costs and human resources required in the management sector (Stavretović, 2012; Petrović, 2015).

This paper outlines the basic concepts of weed control in urban lawns and provides a guide for the effective use of maintenance measures to manage undesirable plants.

ANALYSIS OF LAWN CONDITION

In order to determine the necessary measures and practices for lawn improvement, it is essential to conduct an analysis of the lawn's condition beforehand. This analysis includes a field inspection to identify visible phenomena and defects, and, if necessary, sampling for laboratory analysis.

During the inspection, attention should be paid to the leveling of the terrain, slopes and cuts on the lawn, bulges and depressions, mowing height, grass height, presence and types of weeds, as well as borders, curbs, flower beds, groups of shrubs and trees, and the number and species of weed plants, among other factors.

CLEARING OPERATIONS

This measure involves the removal of debris, both plant and solid materials, from the lawn. Plant debris includes branches, twigs, and grass clippings. Branches and twigs end up on the lawn after tree maintenance, pruning, crown shaping (trimming and thinning), shrub pruning, leaving high grass clippings, or leaving them for an extended period. Beneath this type of biological debris, especially grass clippings, mold develops quickly, the grass decomposes, and the bare spots created after decomposition are immediately colonized by nitrophilous weed species (e.g., *Agropyrum repens* L., *Alopecurus pratensis* L., *Arrhenatherum elatius* (L.) P.Beauv. ex J.Presl & C.Presl, *Hordeum murinum* L., *Trifolium repens* L., *Poa annua* L., *Lolium multiflorum* Lam., etc.).

On green areas, solid waste such as stones, rubble, bottles, and cans can also often be found. Beneath or near solid waste, thermophilic weed species most commonly appear (e.g., *Aegilops cylindrica* Host, *Cynodon dactylon* (L.) Pers., *Bromus japonicus* Houtt., *Trifolium patens* Schreb., *Medicago sativa* L., *Cichorium intybus* L., *Hordeum murinum* L., etc.).

The practice of cleaning the area from debris is carried out throughout the year, twice a week during the growing season.

The procedure itself is simple and not physically demanding: the area is inspected by walking over it or using a vehicle designed for this purpose (e.g., an electric vehicle), during which the condition of the lawn is assessed, and a cleaning order is issued if necessary. Although this practice is easy and simple to perform, its significance is not diminished; it still plays an important role as a preventive measure for weed control in urban lawns.

LAWN MOWING

Lawn mowing involves cutting off parts of plants that exceed the recommended height for a particular type of lawn (Stavretović and Petrović, 2025). Not all lawns are mowed to the same height (Nikolai et al., 2004). The mowing height and the frequency of this practice are closely related to the lawn's visual characteristics, such as plant cover and density, as well as to its functionality. High lawn cover is ensured by a large number of shoots per unit area. When a lawn is viewed from standing height and the substrate beneath the plants (i.e., bare soil) is not visible, the lawn cover can be considered good. On the other hand, the number of shoots per unit area decreases as grass height increases because less light penetrates the lawn canopy, and tall grass cannot provide the full cover. Therefore, plant height is directly proportional to the cover of the lawn. Regular mowing increases the number of shoots per unit area and promotes vegetative reproduction. It also stimulates leaf growth near the ground (in the sod), reduces leaf growth on stems (their size not the number of leaves), and prevents stem thickening. This characteristic is referred to as lawn density (Stavretović, 2008; Turgeon, 2011). In a quality lawn, dense growth of healthy plants prevents weed establishment. As soon as bare patches appear, weed seeds present in the soil germinate, forming weed plants.

Each turfgrass has its mowing tolerance. Lawns requiring perfect leveling are mowed very low, sometimes just a few millimeters above the soil (Nikolai et al., 2004). However, such lawns cannot withstand intensive trampling, as found on football fields, playgrounds, or other recreational areas (Stavretović, 2004; Mihajlović et al., 2017; Petrović et al., 2018). These lawns need to be mowed at a higher, but not excessive, height.

Low-cut lawns have minimal leaf mass and cannot withstand intensive and frequent trampling, as is common on sports fields where running, jumping, and play occur. Conversely, lawns cannot endure heavy use because plants may break, bend, or lodge under pressure or activity. On the other hand, erosion-control lawns are intended to mitigate wind and water erosion, so they are mowed very infrequently, depending on their location—urban areas, roadside strips, rural areas, or natural landscapes.

Low mowing weakens seeded plants and reduces their competitiveness against weeds. On lawns mowed too short in spring, species such as *Poa bulbosa* L., *Poa annua* L., and *Sclerochloa dura* (L.) P.Beauv. appear. During the summer months, the dominant species include *Cynodon dactylon* (L.) Pers., *Hordeum murinum* L., *Polygonum aviculare* L., and *Erodium cicutarium* (L.) L'Hér.

Mowing is also used to control certain weed species in the lawn, especially those that do not tolerate mowing. For instance, the common weed *Agropyron repens* L. disappears from lawns only if the lawn is mowed regularly. The same applies to *Aegilops cylindrica* Host, *Avena fatua* L., and *Cynosurus cristatus* L.

Mowing urban lawns is of great importance as it represents a regular practice in the process of maintenance and management of urban greening, involving substantial financial investments. Proper application of lawn mowing ensures improvement of the aesthetic quality of the lawn and the entire green space, reduces maintenance costs, and provides ecological benefits.

MOWING LAWN EDGES

The edges of lawns are often difficult to access because they are located next to or along various structural elements in green areas, such as walls, buildings, garden furniture, flower beds, shrubs, trees, or similar features. As a result, turfgrass grows close to obstacles, protrudes in height, and disrupts the aesthetics of the lawn and the entire area. Additionally, performing mowing practices is more difficult because the mower blade has limited reach to the plants that need to be cut. Sometimes the mower blade can cut plants in the edge zones, but this carries the risk of the machinery hitting a wall or other obstacle, which could pose a danger to the surroundings or cause damage to or breakage of the mower or its blade.

Experience has shown that the risks are high when edge mowing is performed in the same way as standard mowing, using lawn mowers and costs can increase significantly. Therefore, edge mowing has been separated as a distinct lawn maintenance measure, which is planned and carried out independently. Mowing lawn edges requires greater precision during work, as well as specialized tools or machinery, and even when it is possible to use a regular mower,

the process proceeds more slowly. Edge mowing pratcices are planned exclusively along the lawn edges, and their importance lies in preventing the spread of weeds onto paths, walkways, flower beds, crops, and other surrounding abiotic or biotic elements within the green area.

LAWN EDGING

Lawn edging is often equated with mowing lawn edges, but there is nevertheless a difference. Edges of the lawn represent a barrier between the lawn and the surrounding space, paths, water or sand surfaces, stones, walls, edges with flowerbeds, rock gardens, and similar areas.

The purpose of this measure is to separate the lawn from other elements of the green area, such as flowerbeds, hedges, paths, etc. The plants that are within the lawn, both the quality species and those that are considered weeds in the lawn, spread into the surrounding space by generative and vegetative propagation. For example, in a flowerbed, the presence of turfgrasses can disrupt the aesthetic appearance of the planting and when it appears in a flowerbed, it should be treated as a weed and removed. This measure aims to prevent such occurrences, or to end them.Thermophilic plant species (*Polygonum aviculare* L., *Cynodon dactylon* (L.) Pers., *Digitaria sanguinalis* (L.) Scop., *Portulaca oleracea* L., etc.) the most often appear and spread on lawn edges.

Lawn edges are often separated from other elements of the green area with barriers that can be made from various materials (plastic, metal, etc.). Materials may be of natural or artificial origin. Natural materials include: stone, wood, brick, mulch, bamboo stalks or gravel. Artificial materials include: plastic, concrete, metal, rubber, composite materials or geotextile.

Natural materials used for lawn edging do not bring significant ecological benefits, but there are certain advantages in the context of environmental protection, as they represent a better choice compared to artificial materials. What all lawn edges made of artificial materials have in common is the complete absence of ecological benefits for the environment, plants, or soil, even at a minimal level.

The choice of material depends on many different factors, such as: the purpose of the entire space, location, design, soil stability, cost-effectiveness, etc. However, in the context of controlling the spread of weeds, the aim should be to use edging that completely separates two surfaces, meaning there should be no gaps between the constructive elements from which the edging is made. The type of material itself does not play a decisive role and is left to the designer's decision.

In addition to their role in weed control, the use of landscape edging also has other benefits, such as: improvement of the aesthetic quality of green areas (promoting a tidy, well-managed space); defining spaces in green areas (creating a sense of order and organization); increasing the hygiene of green areas; effective addition to the green area and increase of its overall value; preventing dust, soil, and mud from being transferred from the lawn to paved surfaces; preventing the penetration and spreading of roots from the lawn into other zones of the green area; keeping soil and mulch in place, preventing erosion; reducing green area maintenance

costs; reducing lawn maintenance costs (making some practices easier, reducing the frequency of some practices, or eliminating the need for them) (Stavretović et al., 2025).

CLIPPING REMOVAL

After measures such as lawn mowing and mowing lawn edges, the lawn edge clippings remain on the lawn surface in smaller or larger clumps. A long-standing concern in lawn culture is whether to catch clippings during those practices. Accumulation of clippings on the lawn excludes light and creates unhealthy conditions, leading to decomposition and putrefaction, resulting in infections which may spread throughout the entire lawn. At the end, it may be necessary to implement additional protective measures (application of pesticides), sometimes further actions like renovation, and partial or even complete lawn reconstruction (Stavretović et al., 2003; Christians, et al., 2016).

If clippings are left on the lawn, leaf blade remnants may start to rot, wither, and readily decompose. These spots can quickly be invaded by weeds, primarily annual species, including the highly aggressive annual weeds, such as Annual bluegrass (*Poa annua* Schltdl. & Cham.), Wall Barley (*Hordeum murinum* L.), Barren Brome (*Bromus sterilis* L.), Bermudagrass (*Cynodon dactylon* (L.) Pers.), Dandelion (*Taraxacum officinale* F.H.Wigg.), etc. Although clippings are a source of plant nutrients and contain especially large amounts of nitrogen, arguments in support of their removal prevail and beside reduced disease incidence they include reduced thatching tendency, reduced injury from heavy deposits of clippings and generally improved turfgrass quality (Turgeon, 2011).

ROLLING OF THE LAWN

Rolling should be done when there is an urgent need for it. This measure should correct minor disruptions in the turf's surface. Also, this practice is applied to press heaved turfgrasses back into the soil and protect it from desiccation or scalping with mowing. The rolling is needed at sport fields to press uprooted turf back into the soil which is provided by intensive foot traffic or when the digging of an animal (mole, bird or earthworm) or insect is evident on the lawn.

Rolling includes the use of lightweight units to avoid excessive soil compaction and the expulsion of air from the soil (DiPaola, J.M. and C.E. Hartwiger., 1994; Vrbničanin and Božić, 2021; Stavretović and Petrović, 2025).

Rolling additionally compresses the soil and could favour the appearance of weeds on the lawn, as most weeds thrive in compacted soils. Some weed species that appear on compacted soils are *Polygonum aviculare* L., *Cynodon dactylon* (L.) Pers., *Plantago lanceolata* L., *Plantago major* L., *Plantago minor* Garsault, *Poa annua* Schltdl. & Cham., *Sclerochloa dura* (L.) P.Beauv., etc.

When microdepressions on the lawn are present, water accumulates and hydrophilic weed species may develop (*Trifolium pratense* Schreb., *Calystegia sepium* (L.) R.Br., *Euphorbia palustris* L., *Juncus articulatus* L., *Lysimachia nummularia* L. *Persicaria hydropiper* (L.) Delarbre, and *Solanum dulcamara* L.). In lawns where minor elevations exist, xerophilic species are commonly found, such as: *Erodium cicutarium* (L.) L'Hér., *Erodium ciconium* (L.) L'Hér., *Brachypodium sylvaticum* (Huds.) P.Beauv., *Geranium dissectum* L., *Lactuca serriola* L., *Leontodon crispus* Vill., *Ballota nigra* L., and *Poa bulbosa* L.

Rolling should be carried out only when necessary and the soil should be moist, but not wet, at the time of rolling. Excessively wet soils are highly susceptible to sompaction from rolling, while dry soil resist the pressing of plants into the soil (Turgeon, 2011). Grass in the lawn should be dry at the time of rolling, meaning that rolling isn't recommended immediately after irrigation.

Overall, rolling is not a measure for weed control and may even have the opposite effect. For this reason, continuous professional specialization, attending courses, and acquiring new knowledge are important, as they contribute to the care and maintenance of green areas (Dowling and Gross, 2019), and consequently to economic savings and environmental protection.

SLICING AND SPIKING

Due to excessive soil compaction caused by trampling the lawn or maintenance measures, particularly rolling, the amount of air in the soil decreases. Fagerness (2001) notes that the impact of children trampling during their play on the lawn affects the top 2.5 cm of soil, whereas impact of heavy construction machinery is evidenced to a depth of 15 cm of soil. Many weed species thrive in compacted soil, quickly colonizing it and suppressing high-quality species that require a favorable water-air regime for successful growth and development.

Therefore, to reduce or eliminate the number of weed plants favored by compacted soil, it is necessary to increase the amount of air in the soil, i.e., to improve the soil's water-air regime. One lawn maintenance measure that suppresses the appearance of undesirable plants while enhancing soil aeration is slicing and spiking. This measure should be understood literally—as a physical slicing of the soil.

Slicing and spiking is performed using V-shaped knives mounted on disks which cut the soil to a specified depth. By slicing a turf is penetrated to a higher depth (mostly 7.5-10 cm), while spiking is limited to approximately 2.5 cm and the length of the perforations along the turf's surface are shorter (Turgeon, 2011). The planned depth of this practice should be determined by the depth of the impervious compacted soil layer. The blade should penetrate this layer, allowing gravitational drainage of excess water from the lawn into deeper soil layers, while also enabling air to reach layers that were previously inaccessible. With improved water drainage and air penetration into deeper soil layers, the root system can utilize a larger

amount of minerals necessary for growth and development, penetrate deeper into the soil, and simultaneously enhance the stability of the lawn.

Slicing and spiking-stimulates root and shoot growth in the immediate vicinity of the perforations (Turgeon, 2011), while stolons, rhizomes, and turf sod are cut during this measure, increasing the number of plants per unit area and stimulating their development, thereby improving lawn density and cover (Stavretović and Petrović, 2025). This maintenance measure enhances vegetative growth, i.e., tillering in some species (*Lolium perenne* L., *Festuca rubra* L., etc.), and in others it stimulates propagation through rhizome cutting (*Poa pratensis* L., *Agrostis alba* L., etc.). Furthermore, this measure can remove shallow-rooted weed species, such as *Poa annua* Schltdl. & Cham. and *Sclerochloa dura* (L.) P.Beauv., from lawns.

CORING/CORE CULTIVATION/AERIFICATION

Aerification is similar to the slicing and spiking but is a much more effective and complex lawn maintenance measure. It is performed on lawns to improve soil aeration. aerification is not carried out on every type of lawn. On some lawns aerification is never performed, while on others it should be done once every few years, and on some it is performed several times a year. This is the case for highly decorative type of lawns or golf courses. The implementation of this maintenance measure is carried out under the recommendation and supervision of an experienced professional. The time of performing this practice and method which will be used are proposed by the expert, who also bears professional and financial responsibility. Aerification enhances and improves the visual quality of the lawn (Atkinson et al., 2012).

Lawns that are exposed to frequent foot traffic or pressure often have compacted soil. Even in older lawns without direct anthropogenic impact, soil is settling and becomes compacted.

The problems of compacted lawns are numerous: compacted soil impedes water infiltration into deeper soil layers, hinders surface drainage, prevents gravitational water flow, retains excessive moisture, and reduces the air supply necessary for root growth and development. In compacted soils, roots become shallow and poorly branched, the root weakly binds the soil, lawn may tear, and sections of the lawn may heave under sudden pressures (e.g., player movement). Compacted lawns are also more sensitive to drought and excessive moisture, reducing nutrient uptake. All these conditions favor the establishment of various weed species.

Aerification involves soil perforation, but instead of cutting with knives as in the slicing and spiking measure, it is done using hollow, sharpened round tines or spoons. It is crucial that the tines or spoones used for aerification are sharp in order for them to reach the desired depth. The diameter of the tines should not be large, ideally around 10±2 mm, and their length slightly exceeds the desired depth of the practice. During aerification, soil cores are removed, with the volume of each core corresponding to the volume of the hollow tine. The depth of aerification (or length of the removed soil cores) ranges from 6-12 cm, rarely shallower or deeper. Shallow aerification has limited significance and does not substantially improve the lawn (Christians and Ritchie, 2002). Deeper aerification may cause

damage to the turf immediately or in the following days (Stavretović, 2012; Stavretović and Petrović, 2025).

A well-aerated lawn is not colonized by plant species that thrive in compacted soil, because the aerated substrate primarily supports the growth of desired turfgrasses used for seeding.

LAWN SCARIFICATION

Plants in lawns are constantly growing and changing. Each year, leaves, flower stems, seeds, and other plant parts fall and accumulate on the soil. On regularly mowed lawns, a significant amount of clippings is present. After mowing, it is never possible to completely remove all clippings. The remaining clippings, together with dead plant material, accumulate around the crown of the plants and gradually form a layer of organic matter near the soil, similar to forest litter. In practice, this phenomenon is referred to as "thatch" (Stavretović and Petrović, 2025).

Withered plant material accumulated at the soil surface (thatch) acts like a sponge, retaining water. The turfgrass root grows and spreads in search of water, and if water is available in the surface layer, the roots remain shallow. This disrupts the stability of the lawn. Mineral and organic fertilizers are also retained at the surface; even dissolved fertilizers mostly remain in the thatch. Consequently, the root does not develop downward but stays in the surface layer where food and water are present, within the thatch (Cockerham and van Dam, 1992; Turgeon, 2011; Stavretović and Petrović, 2025).

The formation of a thatch restricts air infiltration into the soil and to the root, drastically reducing processes necessary for plant nutrition, pathogen protection, and environmental stress mitigation. Plants become less prone to infestation and eventually die (Korniichuk, 2020). In this environment, where water and nutrients are concentrated at the soil surface, high-quality turfgrasses with deep root systems (*Poa pratensis* L., *Lolium perenne* L., *Festuca rubra* L., *Agrostis tenuis* Vasey) become less competitive and gradually disappear, while highly competitive shallow-rooted weeds, such as annual bluegrass (*Poa annua* L.) appear and spread.

Annual bluegrass represents the most dangerous weed species in urban lawns. It has a shallow root, light green color, flowers several times a year, and its inflorescence is below mowing height, allowing seeds to spread across surrounding areas. Its competitiveness under these conditions suppresses quality turfgrasses. The only way to control this weed in lawns is by applying a total herbicide or completely reseeding the lawn. Other common weeds include *Cynodon dactylon* (L.) Pers. (Stavretović and Manjasek, 2008), *Convolvulus arvensis* L., *Trifolium* spp., and others.

Lawn scarification is the practice of removing withered plant material from the soil surface, primarily leaves. Some of this material is a result of natural plant processes, while other parts are clipping fragments left after mowing (Cockerham and van Dam, 1992). Scarification can also be performed manually using rakes, slightly pressing them into the soil. Traditional rakes have wide tines that do not pass smoothly through the grass; therefore, specialized rakes with

short or long knives attached to the handle have been developed. Attachments for tractor trailers and specific tools have also been designed for this practice to facilitate handling.

The penetration depth of the blades during this practice is 1-3 mm (Turgeon, 2011). Grass without a strong root, or with diseased or undeveloped roots, may be heaved, pulled out, or overturned onto the lawn surface. Scarification measure leaves healthy, well-rooted plants in the lawn, which provide shade and protect seeds that will be used in subsequent maintenance practices, such as overseeding.

After scarification, it is advisable to apply additional maintenance measures, such as irrigation, aerification, overseeding, or substrate addition, depending on the needs of the lawn and the funds available (Korniichuk, 2020).

This practice is complex, and the knowledge and experience of the person performing it are very important. Scarification is particularly useful as a preventive measure of weed control, especially when performed in combination with aerification and overseeding.

OVERSEEDING

Overseeding is carried out on lawns that have become thin or sparse in certain areas. Regardless of the cause of the low cover and density, weeds quickly emerge in these spots, either through germination of the seeds already present in the soil or those that reach the soil by wind, via animals or other pathways. Weeds that appear in these areas can be low-growing (*Poa annua* Schltdl. & Cham., *Sclerochloa dura* (L.) P.Beauv, *Cynodon dactylon* (L.) Pers., *Lysimachia nummularia* L., *Viola* spp., *Ajuga reptans* L., *Bellis perennis* L., *Taraxacum officinale* F.H.Wigg., *Ranunculus repens* L., *Trifolium repens* L., *Lotus corniculatus* L., *Glechoma hederacea* L., etc.) or tall-growing (Bromus inermis Leyss., *Lepidium draba* L., *Stenactis annua* (L.) Cass. ex Less., *Hordeum murinum* L., *Agrostis stolonifera* L., *Rumex crispus* L., *Silene vulgaris* (Moench) Garcke, *Achillea millefolium* L., etc.).

Lawns are overseeded with species characterized by rapid germination, fast growth, and quick establishment. If the sowing period is suitable, Kentucky bluegrass (*Poa pratensis* L.) and red fescue (*Festuca rubra* L.) can also be used.

Before overseeding, it is recommended to remove any thatch present. After thatch removal, aerification can also be performed. Create well-aerated lawn prior to overseeding makes better conditions for seed germination and seedling development (Stavretović, 2008; Stavretović and Petrović, 2025). Overseeding bare spots with high-quality turfgrasses prevents the development and spread of weeds.

If the lawn is very sparse, overseeding should not be performed; instead, complete lawn renovation using one of the turf establishment methods is recommended, as this option is easier and more cost-effective.

TOPDRESSING

This practice involves thin layer of soil which is applied to an established turf or a new turfgrass planting (Turgeon, 2011) by adding substrate. By performing this practice, the substrate in which the lawn develops is enriched; in fact, the substrate is improved through proper application of topdressing. Additionally, this practice helps to correct disruptions in a turf's surface if they exist (Stavretović and Petrović, 2025).

The type and quality of substrate used in this practice largely depend on the mechanical composition of the soil in which the lawn grows. Of course, climatic factors and the intended use of the lawn also play a role. When substrate selection is based solely on climatic conditions, the recommendations are as follows:

In arid, dry climates, where heat-tolerant plant species are planted (*Cynodon dactylon* (L.) Pers., *Polygonum aviculare* L., *Bromus* spp., *Hordeum spp*., *Medicago* spp., *Ambrosia artemisiifolia* L., *Malva sylvestris* L., *Matricaria chamomilla* L., *Ranunculus arvensis* L., *Salvia pratensis* L., *Viola odorata* L.), fine peat or well-rotted manure is used for topdressing. This helps to adjust soil conditions to be suitable for species that provide good visual and functional quality of the lawn (Stavretović, 2008; Turgeon, 2011).

In conditions of high moisture, fine sand is added. Coarse sand can damage machinery during other practices (Barden, 2018). Added sand improves soil drainage and reduces the presence of hydrophilic plant species (*Trifolium patens* Schreb., *Bidens tripartita* L., *Calystegia sepium* (L.) R.Br., *Lysimachia nummularia* L., *Mentha longifolia* L.). Additionally, in shaded areas, sand reduces moss growth and presence.

In moderate conditions, a mixture of sand, peat, and garden soil is used. If the existing soil is of good quality, it should be simply "refreshed" with a new layer of the same composition.

When considering different soil types, the recommendations are as follows:

On clay soils, adding sand facilitates faster surface water drainage and improves air penetration into deeper soil layers.

On sandy soils, peat (or similar organic material) is used to increase soil fertility, improve water retention, and enhance soil structure.

Depending on the soil texture and mechanical composition, different types of substrates can be combined, and garden soil or similar components may also be added. As the basic substrate in which the lawn develops determines the occurrence of weed species, thus the substrate added during topdressing also affects weed presence. Therefore, it is essential to apply a substrate suitable for the growth of desirable turfgrasse (Stavretović, 2008).

IRRIGATION

Irrigation is performed primarly to provide an adequate supply of moisture for turfgrass growth and development, to wash fertilizers and some pesticides following application or maintain sufficient surface moisture to promote germination of seeded turfgrasses (Turgeon, 2011).

The quality of irrigation water is extremely important. Water used for irrigation of lawns must not be contaminated in any way. Consequently, any pollution of water sources, waterways, or water in general is highly detrimental (Sokolova-Djokić et al., 2009).

The most desirable soils have a pH range of 5.5-6.5 (Cook, 2004). The same applies to water: prolonged use of water with a high pH affects soil acidity. If a lawn is irrigated for a long period with acidic water, species such as *Bromus inermis* Leyss., *Avena fatua* L., *Brachypodium pinnatum* (L.) P.Beauv., *Astragalus onobrychis* L., *Lotus corniculatus* L., *Medicago falcata* L., *Onobrychis sativa* Lam., *Symphyotrichum lanceolatum* (Willd.) G.L.Nesom, *Lamium purpureum* L., and others may appear. Conversely, irrigation with water closer to neutral or slightly basic pH favors species such as *Sorghum halepense* (L.) Pers., *Vulpia ciliata* Dumort., *Vulpia myuros* (L.) C.C.Gmel., *Rumex acetosella* L., *Thymus serpyllum* L., and *Viola canina* L. In addition to water quality, the water source is also important. A water source should be adequate to provide sufficient quantities of water during the entire growing season.

Irrigation rate is a rate at which irrigation water is applied to a turf, and should not exceed the irrigation capacity of the soil. Optimal irrigation rate is from 5-10 L m^{-2}, with a best recommendation for applying 7 L m^{-2}, creating favorable environmental conditions for quality plant growth (Stavretović, 2008). Applying water in amounts above the recommended range encourages hydrophilic plant species, while lower amounts favor xerothermic species.

The irrigation rate depends on other factors also, such as local climate conditions, season, soil properties, time of day, and more. Irrigation frequency, timing of irrigation and irrigation intensity are additonal parametars which one has to known to create successful irrigation program for maintaining the lawn. The presence of a landscape architect or expert is essential during this practice as well as other lawn care and maintenance measures.

FERTILIZATION

When establishing a lawn, it is important to distinguish between fertilization, basic fertilization (prior to planting), and soil modification. Although the same fertilizers may be used in both cases, the doses, aims, and methods of application differ. Proper fertilization directly affects not only the growth and development of plants, but also the occurrence and control of weeds (Vrbničanin and Božić, 2021).

Regular fertilization is a necessary practice that ensures high aesthetic and functional quality of the lawn throughout the year. Frequent mowing removes a significant portion of the plant biomass, which depletes the plants, reduces their regenerative capacity, and requires additional input of readily available nutrients to allow recovery and further development of the plants.

The main macronutrients important for lawn development are nitrogen (N), phosphorus (P), and potassium (K) (Candan, 2013).

Nitrogen (N) gives the plants in a lawn a dark green color, promotes leaf development, and increases lawn density. High doses of nitrogen can promote the occurrence of nitrophilous

plants, such as: *Poa trivialis* L., *Lolium perenne* L., *Agropyrum repens* L., *Alopecurus pratensis* L., *Hordeum murinum* L., *Symphyotrichum novi-belgii* (L.) G.L.Nesom, and *Lamium purpureum* L.

One should be careful when applying nitrogen, as some studies have shown that certain weed species, such as *Amaranthus* sp., dramatically increase in size with higher nitrogen rates (Blackshaw et al., 2003).

Phosphorus (P) plays a crucial role in the development of roots and rhizomes and promote plant maturation.

Potassium (K) ensures plant vitality and strength and influences resistance to drought and cold.

Compost has a beneficial ameliorative effect on the water, air, thermal, and biological regime of the soil due to its high organic matter content. Because it contains higher levels of minerals compared to farmyard manure, it can replace mineral fertilizers.

Well-rotted manure is the oldest and most commonly used organic fertilizer (Nikolić, 2016). Horse and sheep manure contain higher levels of N, P, and K and more dry matter, making them "hotter" fertilizers, thus more suitable for heavy soils. In contrast, cow and pig manure are more suitable for light, sandy soils because they have higher moisture content, are cooler and more acidic, and decompose more slowly (Nikolić, 2016). Properly rotted manure is fine-textured, odorless, and ready for use.

Weed presence is significantly lower in substrates enriched with peat compared to substrates where vermicompost or garden soil was used (Stavretović and Vilotić, 2004).

However, proper fertilization requires professional knowledge. Lawns under intensive use, such as sport lawns, require more frequent and abundant fertilization compared to lawns along roadways (Stavretović et al., 2021). Sunlight exposed lawns (consist of heliophytes plants) also require more intensive fertilization compared to shade-tolerant lawns (consist of sciophytes plants), which need roughly half the dose (Soldat et al., 2022).

Fertilization with mineral fertilizers is also important for weed control in lawns. The use of slow-release fertilizers is recommended because it reduces applying of some maintenance measures and environmental pollution. Plants gradually absorb all the elements needed for optimal growth, ensuring effective nutrition for useful lawn species.

CONCLUSION

Effective maintenance of urban lawns plays a crucial role in weed control by creating a healthy environment that favors turfgrasses and discourages weed growth. This involves a combination of practices such as proper mowing, targeted irrigation, appropriate fertilization, and soil management.

Described care and management measures and the whole process of lawn maintenance, when properly implemented, reduces or even eliminates the possibility of weed occurrence as well as infestations caused by insects, diseases or other pests. A healthy and well-maintained lawn has the ability to limit weed development, functioning as a biological barrier, thereby

reducing the need for applying chemicals. However, chemicals (pesticides) are applied when harmful factors expand significantly, representing a last measure in lawn maintenance and its protection.

For this reason, weed control measures represent an important strategic element of proper urban green space management, directly affecting the ecological, aesthetic, and functional characteristics of the lawn, and thereby its longevity, which is especially important in urban environments.

The best method, i.e., combination of practices in urban lawn maintenance, will depend on the present weed species, aesthetic goals and preferences, costs, and effectiveness. With proper planning and the use of appropriate methods, satisfactory weed control can be achieved without chemicals. However, relying solely on non-chemical methods requires a significant investment of money, time, or labor, as well as constant monitoring to reduce weed germination and growth before infestations become unmanageable.

ACKNOWLEDGMENTS

This research was funded by The Ministry of Science, Technological Development, and Innovation of the Republic of Serbia which is financing the scientific research work of the University of Belgrade - Faculty of Forestry on the basis of the Agreement on the realization numbers: 451-03 65/2024-03/ 200169, 451-03- 137/2025-03/ 200169 and 451-03-136/2025-03/ 200169.

REFERENCES

Atkinson, L. J., McCarty, L. B., Bridges, W. C.: Effect of Core Aerification Frequency, Area Impacted, and Topdressing Rate on Turf Quality and Soil Physical Properties. Agronomy Journal, 104 (6), 1710, 2012.

Barden, A.: Benefits of light and frequent topdressing USGA Green Section Record, April 6. 56 (7), 1-3, 2018.

Blackshaw, R. E., Brandt, R. N., Jansen, H. H., Entz, T., Grant, C. A., Derksen, D. A.: Diffrential response of weed species to added nitrogen. Weed Science, 51, 532-539, 2003.

Candan, C. K.: Lawns and Ground Covers in Landscape Design. Advances in Landscape Architecture, 905-924, 2013.

Christians, N. E., Patton, A. J., Law, Q. D.: Fundamentals of Turfgrass Management. John Wiley & Sons, Inc., Hoboken, New Jersey, USA, 2016.

Christians, N., Ritchie, A.: Scotts Lawns Your guide to a Beautiful yard. Meredith Corporationa, USA, 2002.

Cockerham, S. T., van Dam, J. A.: Turfgrass Managment Operations. - Turfgrass - Agronomu Monograph no. 32, USA, California, Riverside, 1992.

Cook, T.: Practical Lawn Establishment and Renovation. Oregon State University, the U.S. Department of Agriculture, 23, USA, 2004.

DiPaola, J. M., Hartwiger, C. E.: Green speed rolling and soil compaction. Golf Course Management, 62 (9), 49-51, 78, 1994.

Dowling, E., Gross, P.: Mowing And Rolling Greens To Manage Green Speed And Turf Performance. - USGA Green Section Record, 57 (15), 2019.

Fagerness, M. J.: Aerating your lawn. Horticultural report, Kansas State University Agricultural Experiment Station and Cooperative Extension Service, 2001.

Fennimore, S. A., Doohan, D. J.: The challenges of speciality crop weed control, future directions. Weed Technology, 22, 364-372, 2008.

Hodges, A. W., Hall, C. R., Palma, M. A.: Economic contributions of the green industry in the United States, 2007. Southern Cooperative Series Bulletin, 413, 2011.

Korniichuk, S.: Lawn Aerators with Lawn Aeration Explaned. Independently Published, str. 26, 2020.

Marble, S. C., Koeser, A. K., Hasing, G.: A review of weed control practices in landscape planting beds: Part I-Nonchemical weed control methods. HortScience, 50 (6), 851-856, 2015.

Matheny, A. L.: Home gardener preferences, perceptions, knowledge and behaviors associated with pest management strategies and information acquisition. Thesis, University of Maryland, College park, M.D, pp.175, 2009.

Mihajlovic, M., Rekanovic, E., Hrustic, J., Grahovac, M., Pešić, B.: Methods for management of soilborne plant pathogens. Pesticidi i fitomedicina, 32, 9-24, 2017.

Nikolai, T., McKinnon, C. D., Jonson, C.: Green maintenance studies. – Poroceedings of the 75th Annual Michigan Turfgrass Conference, Michigan State University, 1-10, 2004.

Nikolić, O.: Đubrenje u organskoj poljoprivredi. TEMPUS projekat: Izgradnja kapaciteta srpskog obrazovanja u oblasti poljoprivrede radi povezivanja sa društvom (CaSA). Univerzitet u Beogradu, Poljoprivredni fakultet, Edukons Univerzitet, 2016.

Petrović, J.: Strukturna, ekološka i sociološka istraživanja travnjaka rekreativnih površina, doktorska disertacija, Univerzitet u Beogradu - Šumarski fakultet, 2015.

Petrović, J., Stavretović, N., Đukin, A., Mihailović, M.: Značaj održavanja sportsko-rekreativnih površina u gradu. U: Hilčenko S. (Ed.), Zbornik radova sa 10. međunarodne interdisciplinarne stručno-naučne konferencije „Horizonti", Subotica, str. 324-330, 2018.

Randrup, T. B., Persson, B.: Public green spaces in the Nordic countries: Development of a new startegic management regime, Urban Forestry & Urban Greening 8, 31-40, 2009

Sokolova-Djokic, L. Pantovic, R., Stavretovic, N., Igić, R.: Origin of Arsenic in Drinking Waters in the West Backa District of Serbia. Water Treatment Technologies for the Removal of High-Toxity Pollutants, 41-50, 2009.

Stavretović, N., Erić, P., Čupina, B.: Nega travnjaka hortikulturnog zelenila. Revija agronomska znanja, naučno-stručni časopis, 3, 54-56, Novi Sad, 2003.

Stavretović, N.: Funkcije zelenih površina vojnih objekata. Zbornik radova naučno-stručnog skupa o prirodnim vrednostima i zaštiti životne sredine, Ekološka istina, Bor, 316-318, 2004.

Stavretović, N.: Korisne vrste i korovi u travnim površinama urbanih područja. Monografija, Unija Bioloških naučnih društava Srbije, (Acta Bilogica Serbica, Posebna serija, Biblioteka Acta Biologica Iugoslavica), str. 212, Beograd, 2008.

Stavretović, N.: Proizvodnja travnih tepiha, monografija. Srpsko biološko društvo, str. 108, Beograd, 2012.

Stavretović, N., Manjasek, S.: Use of Bermuda grass [*Cynodon dactylon* (L.) Pers.] on ash and slag dumps of thermoelectric power plants. Archives of Biological Sciences, 60 (2), 255-263, 2008.

Stavretović, N., Novaković, A., Petrović, J., Stojanović, N.: Mere nege i održavanja travnjaka saobraćajnica u Beogradu. XI Kongres o korovima i savetovanje o herbicidima i regulatorima rasta, Zbornik rezimea, Palić, Srbija, str. 93-94, 2021.

Stavretović, N., Petrović, J.: Podizanje i negovanje travnjaka. Univerzitet u Beogradu-Šumarski fakultet, Beograd, 2025.

Stavretović, N., Petrović, J., Pešikan, M.: Importance and types of landscape edging on urban green areas, In: Zorić A. (Ed.), International Conference Sinergy of Architecture and Civil engineering, Congress proceedings, Niš, pp. 1075-1087, 2025.

Soldat, D., Koch, P. L., John, C. Stier, J. C.: Lawn maintenance. The Learning Store – division of extension, University of Winsconsin – Madison, USA, pp. 1-8, 2022.

***Stavretović*, N., Vilotić, D.**: Pojava korovskih biljaka u različitim supstratima sejanaca smrče *Picea abies* (L.) karst. Acta herbologica, 13 (1), 213-218, 2004.

Turgeon, A. J.: Turf grass management (sixth edition). Copyright by Pearson Education, Inc. Uppere Saddle River, New Jersey 07458 (USA), pp. 398, 2011.

Vrbničanin, S., Božić, D.: Korovi. Univerzitet u Beogradu, Poljoprivredni fakultet, Zemun BiroGraf, str. 432, 2021.

Mere održavanja kao faktor suzbijanja korova u urbanim travnjacima

REZIME

Dobro zasnovan travnjak je lako održavan travnjak. Dobro održavan travnjak je lak za upravljanje. Isto tako ovaj travnjak je mnogo jeftiniji za održavanje, uštede su primetne. Za velika preduzeća, gradove, okruge i države ovakav način rada i planiranja doprinosi uštedama u budžetu. Prisustvo korova u dobro zasnovanom travnjaku se ne zapaža brzo, a primena adekvatnih mera održavanja produžuje potrebu za merama borbe protiv korova u njemu. Primena pojedinih mera nege i održavanja se odlaže za dugi period, a i njihova učestalost sprovodjenja. Pored ekonomske dobiti, koriti od primene pravilnog zasnivanja i održavanja je i estetska, ali i ekološka.

Ključne reči: urbani travnjaci, održavanje travnjaka, suzbijanje korova, upravljanje zelenim površinama.