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Assessment of nutritional impact of two turfgrass species

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Abstract

Turfgrasses are prime verdure covers on parks, golf courses, athletic fields, airports, schools, cemeteries, home lawns, commercial buildings, and roadsides. The addition of fertilizers in turfgrass is necessary for uniform growth and color. An experiment was conducted to assess the effect of different fertilizers on plant growth of two famous turf grass species viz., Korean (Zoysia japonica)" and Tif way (Cynodon transvaalensis × C. dactylon). Different fertilizers applications viz., urea, diammonium phosphate (DAP), and NPK (20:20:20) were tested and compared with control (no fertilizer) for plant growth of turf grass. All the treatments were applied at 4.68 kgm^{-2}. DAP was applied just before plugging while Urea and NPK (20:20:20) were applied after two weeks of plugging. The experiment was laid down in a randomized complete block design (RCBD) and replicated thrice. Data recorded about Korean grass treated with NPK (20:20:20) depicted maximum numbers of tillers (17.9), height of tiller (7.5 cm), fresh weight of tiller (3.4 g), uniformity (7.1) and smoothness (6.9) while in case of Tif way, maximum numbers of tillers (21.9), height of tiller (9.0 cm), fresh weight of tiller (2.8 g), dry weight of tiller (1.2 g), uniformity (5.3) and smoothness (5.9) were recorded under NPK (20:20:20) too. In short, best fertilizer is NPK (20:20:20) in both turfgrass species.

Keywords: Turfgrass; urea; diammonium phosphate (DAP); NPK; korean; tif way

Introduction

In Pakistan, turf production is flourishing rapidly, linking and being established on large areas. The lifestyle of modern society gives prime importance to the lawn in residential areas. In recent days cities cover with lawn and green spaces has increased considerably up to 70 to 75% consisting of golf courses, public parks, private gardens, and green spaces. According to the western point of view, lawn is compulsory and integral part of landscape. Among 44 types of green spaces, contain zoological and botanical gardens, historic parks, large urban parks, school playgrounds, house gardens, street greens, institutional green areas, lawn are being considered the most important element for cultural, economical, social, and sustainable development of environment. Green spaces have much potential for a healthy lifestyle that allows people to get essential health benefits. Children were found more obese and less active who were living away more than 500 m from parks. (McElroy and Breeden, 2006).

Grasses, members of the Poaceae family, are native to Africa and have high density, high drought resistance, and excellent recuperative ability. On earth, grasses can be established in almost every habitat ranging from tropics to Polar regions. Grasses, along with landscape plants, improve environment and enhance natural features of nature (Woods *et al*., 2006). Golf courses require luxury turf surfaces with perfection of density, uniformity, and aesthetical values, therefore require severe inputs and highly organized maintenance. One of the inputs is fertilizer, Different sources of fertilizers are being used for growth of grasse. Over use fertilizer can greatly affect turfgrass growth and fatal for environment (Perris, 2003; Wu *et al*., 2002). Perfect fertilizer application and weed management practices reduce weed density (Johnson and Duncan. 2000).

Careless techniques or unrestricted quantity of fertilizer used at the wrong time may result in severe harm to turf and contamination of irrigation resources. Excellent turf maintenance requires fertilization that can be assessed by using proper application techniques. Every essential nutrient has a specific function or role in turfgrass plants (Alaturk and Gottuks, 2016). Major essential nutrients like phosphorus and nitrogen influence many important functions in plants while other nutrients may just activate a number of chemical reactions. Anyhow all the nutrients are needed by plant to

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develop naturally either its role is major or minor. Deficiency of any nutrient in turf species can be demonstrated in various ways. The most apparent is yellowing or reddening of leaf tissues. Deficiency may also emerge as stunted growth, stand thinning, and increased susceptibility to attack of the disease. It is recommended that fertilizer must be used before occurrence of deficiency (Kopp and Guillard, 2002). For turf establishment, nutrients are needed in balanced supply. Nitrogen is the most limiting mineral nutrients for growth and development of turfgrass and is frequently required in great amount (Liu *et al*., 2008). It is essential for the function and structure of amides, amino acids, nucleic acids, nucleotides, some hormones, and pigments (Hull and Liu, 2005).

Nitrogen is an essential nutrient as it enhances development and thickness of turfgrasses and essential component in fertility programs of turfgrass (Hull, 2005). Phosphorus also has major role in plant growth. The structures of ATP, DNA, RNA and nucleotides contain phosphorus and therefore it is vital macro-nutrient. Phosphorus fertilizer application enhanced the cold tolerance and drought resistance in Poa paratensis and Cynodon dactylon respectively. Potassium is excellent in enhancing against the various stresses, like chilling, warmth, etc. in turfgrasses and is vital component for the development of plants. Iron improve color recovery and photosynthesis in bermudagrass after its chilling period, but its effects on freezing tolerance is unknown in bermudagrass cultivars. (Heydari and Balestra, 2008).

Generally, burmuda grass is also known as "Couch grass" in various countries and is widely used under sunny grounds of southern US (Emmons, 1995). Bermuda grass is grown almost in whole world including warm-mild, humid, tropical, and sub-tropical areas (Beard, 1973). They have excellent drought resistance, high density, and recuperative ability. They have great variability in thickness, surface, strength, shading, and ecological modifications (Turgeon, 2011). It is extensively used in landscaping due to its extreme invasiveness, high growth rate, and ability to develop well under varied soil conditions (Casler and Duncan, 2003). Bermudagrass on putting greens require full sunlight, routine cultivation, and more nitrogen fertility as they have great wear, salt, and drought tolerances (McCarty and Miller, 2002).

Different turfs are being extensively used in Pakistan at a rapid pace in civic areas. But it was results in poor quality sod formation due to lack of proper fertilizer use. Due to limited research, fertilizer applications have resulted in stunted growth, poor turfgrass quality, wastage of resources, disease or pest attack, and leaching of nutrients (Ali *et al*., 2017). Moreover, inadequate work has been reported on the use of various modern fertilizer or biofertilizers such as polymer-coated DAP or PGPRs. Therefore, a study was conducted with an aim to improve growth and quality of Cynodon dactylon (L.) Pers. using nitrogen only, compound fertilizer containing NPK or Iron, a smart fertilizer, viz. polymer-coated DAP, and a PGPR, viz. Bacterial strain. (MN-54), all applied at recommended rates to sustain and produce eco-friendly and more sustainable turf, It was hypothesized that use of efficient modern fertilization approaches would improve turf growth and quality and reduce cost of fertilization and leaching of excessive nutrients for protecting ecosystem. (Zywocinski *et al*., 2011). Adequate amount of fertilizers are used to supply sufficient quantity of nutrients for better quality and growth of turfgrass and is essential for proper establishment of sprigs. Turfgrass dissipate the impact energy of rainfall and lowers erosion which lowers detachment of sediments and successive ion transport. Late season application of fertilizer enhances the period of color retaining and visual quality of turf grass without negative effect on cold tolerance of bermudagrass Furthermore this has also demonstrated that appropriate application of nitrogen in fall can improve shading maintenance and negative effect on bermudagrass's cold tolerance. During establishment, N fertilizers are heavily applied to facilitate shoot growth at rapid rate (Woods *et al*., 2006) performed an experiment to evaluate potassium impacts on the performance of turfgrass in calcareous soils and explained that potassium contents in tissues varied up to 450 mmol kg^{-1} using different methods of potassium assessment (Munshaw *et al*., 2006). Bermuda grass is the warm-season perennial that spread rapidly and grow vigorously under adequate fertility and moisture. Its origin is supposed to be from Africa or Southeast Asia (Taliaferro, 2003). Among turfgrasses, Bermudagrass is growing widely in Pakistan and throughout the world due to its smoothness, fast growth, greenish color, and fine look. Its quality and development is affected by some factors like dry spells and saltiness (Munns, 2002). Thus, the main objective of this study was to find out the best nutritional plan for growth of two different turfgrass species “Korean and Tif way.

Materials and Methods

In this experiment, different fertilizers applications viz., T_1 Urea, T_2 Diammonium phosphate (DAP) and T_3 NPK (20:20:20) at 4.68 kgm^{-2} were tested and compared with T_0 Control (no fertilizer) for plant growth of turf grass. This experiment was laid down in a randomized complete block design and was replicated thrice. DAP was applied just before plugging while Urea and NPK (20:20:20) were applied after two weeks of plugging.

The most commonly used turf species Korean and Tif way were used as a test crop. The grasses were planted manually through plugging. Each plug was planted at 10 cm distance from row and plant sides. There were twelve plots for each crop in each experiment while size of one plot was 1080cm^2. Land was prepared before arrival on April 19, 2020. Grass plugs were collected from well established and reliable sod production farm located at Ali Pur Chatha, Gujranwala, Pakistan. The grass plugs were harvested early in the morning and brought to the experimental area. On arrival, sods were taken out of bags and placed under shade. All bed contains 3.34 m^2 having 1.82 m width and 1.82 m length and plugging at distance 0.15 m. All cultural practices like irrigation, fertilizers, and mowing were constant for all treatments and data were collected on following parameters.

Data collection

For collection of data, a ring was used of 0.0019 m^2. The ring was thrown randomly three times and three samples of grass were collected form each experimental unit. Then data were collected according to standard and percribed procedures on average number of tillers, height of tillers (cm) and fresh weight of tillers (g). The other parameters recorded are given below:

Density

Density of turfgrass is visual estimation of tillers or living plants per unit area. The dead patches of turfgrass were excluded. It was determined visually through a scale having 1 to 9 rating, where:

1= Minimum density
9 =Maximum density

Texture

Texture of turf was estimated visually by rating texture of the leaf blades based on 1 to 9 rating scale. Where,

1 = Coarse texture
9 =Fine texture

Smoothness

Smoothness of turf is level of the upper leaf blades and degree of the evenness of growth. This was also visually rated using 1 to 9 rating scale. Where:

1 = Uneven growth
9 =Highly even growth

Color

A rating scale 1 to 9 was used for evaluation of turf color visually having, where

1 =Yellow color
5 = Moderate light green color
9 =Dark green color

Statistical analysis

The data were analyzed statistically using Fisher's analysis of variance technique. The least significance difference (LSD) test at 5% probability level was used to compare the treatment means using (Steel *et al*., 1997).

Results

Current investigation was conducted to assess the effect of different fertilizer application for weed management, growth, and quality of two different species viz., Korean and Tif way. Results of this experiment are discussed below.

Among the macronutrients, N is the essential nutrient and is required in the greatest amounts by turfgrasses, followed by P and K. We also observed the same relative importance of N after that P and then K. Figure 1 showed maximum fresh weight of tiller of grass observed in T_3 (3.2 g) in case of Korean grass that is significantly greater than all other treatments. On the other hand, minimum fresh weight of tiller of grass were observed in T_0 (2.3 g). In case of Tif way, maximum fresh weight of tiller of grass observed in T_3 (2.8 g) (Figure 1) is significantly greater than all other treatments while minimum fresh weight of tiller of grass was shown in T_0 (1.7 g). On the other hand, minimum fresh weight of tiller of grass was observed in T_0 (1.0). Mean showed the maximum number of tillers of grass observed in T_3 (16.9) in case of korean (Figure 2) is significantly greater than all other treatments, while on the other hand minimum number of tillers of grass were observed in T_0 (8.0). In case of Tif way, maximum number of tillers of grass observed in T_3 (21.9) (Figure 2) is significantly greater than all other treatments while minimum number of tillers of grass was shown in T_0 (12.0). The maximum height of tillers of grass observed in T_3 (8.5 cm) in case of Korean (Figure 3) are significantly greater than all other treatments. On the other hand, minimum height of tillers of grass were observed in T_0 (4.9 cm). In case of Tif way, maximum height of tillers of grass observed in T_3 (9.0 cm) (Figure 3) is significantly greater than all other treatments while minimum height of tillers of grass was shown in T_0 (5.8 cm).

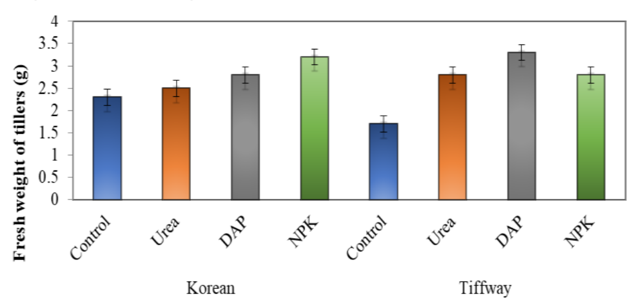

Figure 1: Mean comparison of various fertilizer applications on Fresh weight of tillers of two turf grass species. Data represents means of four samples

Figure 4 showed the maximum uniformity of grass observed in T_3 (7.5) in case of Korean grass are significantly greater than all other treatments. Minimum uniformity of grass was observed in T_0 (4.3). In case of Tif way, maximum uniformity of grass was observed in T_3 (Figure 4) that was significantly greater than all other treatments. Fertilizer applications on density of two turf grass species viz., Korean and Tif way showed the maximum density of grass observed in T_3 (6.9) in case of Korean (Figure 5) significantly greater than all other treatments. Minimum density of grass was observed in T_0 . In case of Tif way, maximum density of grass was observed in T_3 (4.8) (Figure 5), which was significantly greater than all other treatments while minimum density diameter of grass was recorded in T_0 (2.9).

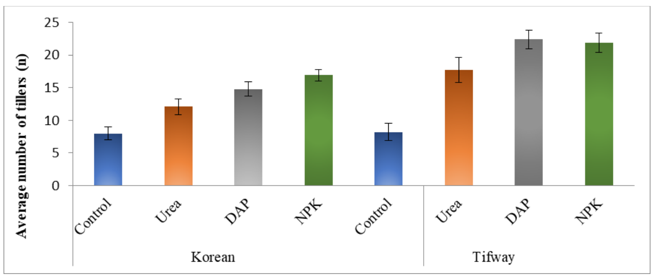

Figure 2: Mean comparison of various fertilizer applications on Average number of tillers of two turf grass species. Data represents means of four samples

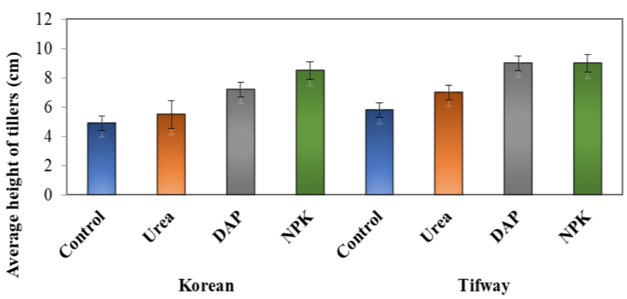

Figure 3. Mean comparison of various fertilizer applications on Average height of tillers of two turf grass species. Data represents means of four sample

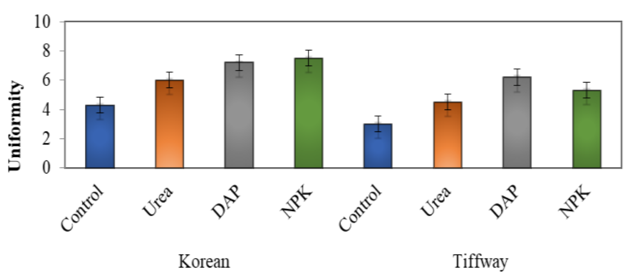

Figure 4. Mean comparison of various fertilizer applications on uniformity of two turf grass species. Data represents means of four sample

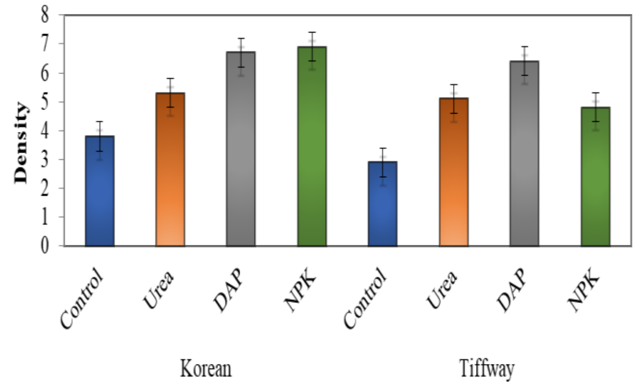

Figure 5: Mean comparison of various fertilizer applications on density of two turf grass. Data represents means of four samples

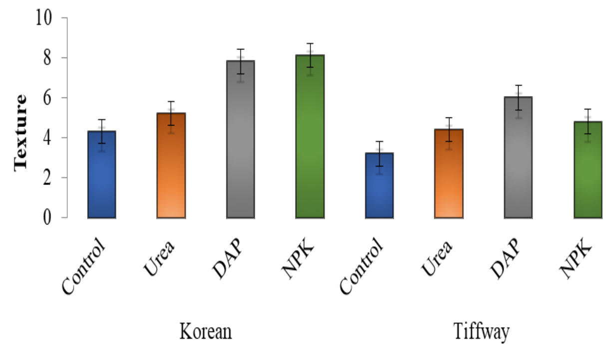

Figure 6: Mean comparison of various fertilizer applications on texture of two turf grass species. Data represents means of four samples

Figure 6 showed the maximum texture of grass observed in T_3 (8.1) in case of Korean grass that was significantly greater than all other treatments, while minimum texture of grass was observed in T_0 (4.3). In case of Tif way, maximum texture of grass was observed in T_3(4.8) (Figure 6) significantly greater than all other treatments and minimum texture diameter of grass was shown in T_0. Figure 7 showed maximum smoothness of grass observed in T_3 (6.7) in case of Korean while minimum smoothness of grass was observed in T_0 (3.8). In case of Tif way, maximum texture (5.9) of grass was observed in T_3 (Figure 7) while minimum smoothness (2.9) of grass was shown in T_0. Figure 9 showed the maximum color of grass observed in T_3 (6.7) in case of Korean grass. On the other hand, minimum color of grass were observed in T_0 (4.3). In case of tifway, maximum color of grass observed in T_3 (5.5) (Figure 8) while minimum color diameter of grass was shown in T_0 (3.3).

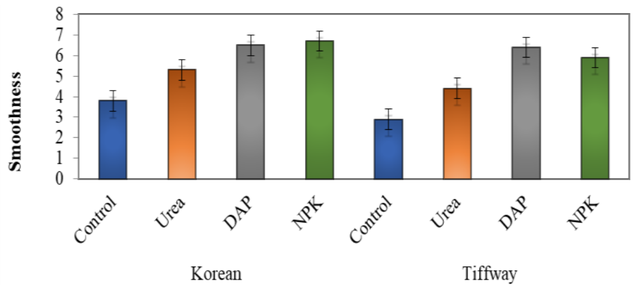

Figure 7: Mean comparison of various fertilizer applications on smoothness of two turf grass species. Data represents means of four sample

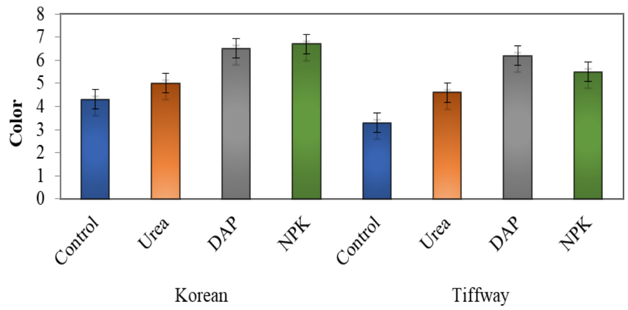

Figure 8: Mean comparison of various fertilizer applications on color of two turf grass species. Data represents means of four sample

Discussion

Among the macronutrients, N is the essential nutrient and is required in the greatest amounts by turfgrasses, followed by P and K. We also observed the same relative importance of N after that P, and then K (Guertal, 2006).

Tiller length and turf density of bermudagrass increased with the incremental addition of N and P, with N being the most effective. High tiller growth rates and densities are desirable traits (Burgess and Huang, 2017). Maximum number of tillers and height of grass in korean and Tifway was observed in the treatment of NPK (20:20:20) compared to all other treatments.

N and P fertilizer application was reported to increase fresh and dry matter accumulation in turfgrasses (Baldi *et al*., 2013). Our study showed that maximum fresh weight of grass tillers was observed observed by the application of NPK (20:20:20) in both Korean and Tif way compared to all orther treatments.

The highest turf density was attained when medium-high amounts of N and P and medium-low amounts of K were applied (T_2). The lowest turf density was found in the control treatment (Ihtisham *et al*., 2020). Therefore, density of both grasses was highest in the treatment of NPK (20:20:20). The interaction between N and P appeared to increase both their uptake and nutrient use efficiencies and to maximize the transformation of sunlight into biochemical energy by the process of photosynthesis. Photosynthesis is the primary driver of tissue formation and biomass allocation (Zlatev and Lidon, 2012). Total chlorophyll levels were significantly enhanced by the combined application of different N, P, and K ratios. Chlorophyll concentrations and leaf color are directly correlated with N content (Saud *et al*., 2017).Our study showed that maximum uniformity and texture of grass was observed in NPK (20:20:20) in case of Korean grass, In case of Tif way, maximum uniformity and texture of grass was observed in NPK treatment and significantly greater than all other treatments.

Similar to our findings, enhanced lateral growth and density with application of N and P were reported in grasses (Lippke *et al*., 2012). It was also found that N and P enhanced relatively greenness in bermudagrass. Nitrogen was found a major factor for promoting turf color. Because N is an integral part of chlorophyll and, thus, is required for chlorophyll to accumulate in plant leaves (Din *et al*., 2017). Our finding showed that maximum smoothness of grass in Korean and Tif way was attaind in the NPK (20:20:20) treatment and it was significantly greater than all other treatments. Little effect of P on the color formation was probably due to a secondary mechanism of this macronutrient as it may be correlated with overall growth enhancement properties (Munshaw *et al*., 2007). The findings of this experiment showed that maximum color in both species was observed in the treatment of NPK compared to all other treatments. Moreover maximum moisture percentage of grass in both species was recorded in the treatment where NPK (20:20:20) was applied.

The application of N promotes growth, density, and color in bermudagrass and is often the most limiting nutrient for turfgrass growth and development (Rowland et al., 2009). So it can be concluded that proper fertilization of nitrogen is necessary to maintain grass growth and quality. The present research work highlighted that balance fertilizer application increased density of grass and reduced weed competition as compared to control where more number of weeds were present.

Conclusion

It is concluded that the application of N:P:K (20:20:20) was the best on turf grasses to enhance the quality, texture, smoothness and good color of the grasses. Furthermore, there was a significant increase in number of tillers on both turf species. The findings of current investigation is that good management practices and proper use of recommended fertilizer can enhance the grass surface and ultimately increase the growth of good quality turf.

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