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Growth response evaluation of local bermuda grass under different rates of nitrogen

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Abstract: Proper nitrogen application is important since optimal nitrogen levels vary for each species. Knowing the optimal concentration of nitrogen to use for a specific turfgrass could help reduce input in turf management. The purpose of this study was to assess the growth quality of local Bermuda grass cultivars grown under different nitrogen rates. . Higher rate of nitrogen application increased leaf length, shoot density, uniformity, colour, root and shoot fresh weight, root and shoot dry weight, root length and root volume. However, only specific rate of nitrogen application produce the best growth and quality of different types of local Bermuda grass cultivars. The result also showed that higher nitrogen rate (0.6 kg / 100m² / month) produce significantly different leaf length compared to others rates. It states that more nitrogen application in the field work produce longer leaf length with the highest data, 22.61 mm. Cultivar C has the longest internode length with 4.77 mm and significantly different compared to others cultivars. High density requires high nitrogen levels. From the experiment, 0.6 kg/100m²/month rate of nitrogen application produce the highest in Cultivar G. The result showed that cultivar D had the highest shoot dry weight with the mean of 0.66 g at 0.6 kg/100m²/month treatment. The result also showed that 0.6 kg/100m²/month rate of nitrogen produce significantly higher (1.87 g) means root dry weight compared to other rates. cultivar B (1.83 g), followed by cultivar D (1.82 G).

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1. Introduction

Nitrogen is the mineral nutrient required in the greatest quantity by turfgrasses (Bowman et al., 2002). Proper nitrogen application is important since optimal nitrogen varies for each species. High rates of nitrogen are needed to ensure top quality turf, and nitrate is usually the principal source of nitrogen in fertilizers (Epstein and Bloom, 2005). Over-watering of turf often occurs, and this could affect the amount of nitrate leached from the soil (Quiroga-Garza et al., 2001). Too much nitrate application with excess watering could lead to high nitrate leaching, which is a waste of nitrogen and a potential pollutant to groundwater.

Current research shows the use of optical sensing as a dependable test for evaluating the potential for response to additional nitrogen. Soil and tissue nitrate tests combined with real time optical sensing data can produce highly accurate nitrogen application strategies that could further increase profit and production. Through use of new innovative techniques, producers can best achieve high production levels and minimize environmental problems often associated with excess nitrogen

Turf grass is a vegetative ground cover composed of closed cut thickly growing, uniform in characters, interwined stems and leaves of plant which form a kind of mat, sward and sod (Beard, 1973). Turf grass is a monocot plant that belongs to family Poaceae which consist of more than 10000 species. It differs from wild grass due to its aesthetic value such as colour, texture, density and uniformity. Apart from that, turf grasses are able to withstand injury after being regularly maintained and mowed to look always short, neat and clean. However, only a small number of grasses can be considered as turf grasses.

There are only 50 grasses that can be considered as turf grasses (Christians, 2007). Each species of turf grass has different characteristics such as shade tolerant, leaf width and colour, fertility requirements, disease resistance, rate of growth, close mowing tolerance, cold hardiness, heat, salinity and drought tolerance, uniformity and ability to tolerate traffic and establishment rate (Emmons, 2008; Uddin et al., 2009; 2011; 2012; Uddin and Juraimi; 2012).

The functions of turf grasses are to provide beauty and attractiveness for human activities such as in landscape and recreational area (Beard, 1973). A pleasant environment with natural greenness of turf acts as important aesthetic value to mental health. Besides that, turf grasses can use to control water and wind erosion of soil, eliminating dust and mud problems, provide stability to highways, slope and riverbank, and reduce glare, noise air pollution, heat build-up and visual pollution.

Turf grasses also are used for variety of purposes like recreational activities and outdoor sport, such as football, rugby, golf, athlete, baseball and cricket. Turfs provide a cushioning effect that reduce injuries to the participants, particularly in the more achieve sports such as football and rugby. Indeed, turf grasses play the main role in our daily life.

According to Christians (2007), turf grasses can be divided into cool season and warm season species. The example of cool season turf grasses species are creeping bentgrass (*Agrotis stolonifera*), Canada Bluegrass (*Poa compressa*), and Kentucky bluegrass (*Poa pratensis*). Meanwhile, some of the common used warm season turf grasses are carpet grass (*Axonopus compressus*), seashore paspalum (*Paspalum vaginatum*), bermuda grass (*Cynodon dactylon*) and zoysia grass. There are about 17 species of turf grasses are being used in Malaysia.

There are many Bermuda grass varieties that are available for home lawn use and sport field. Hybrid varieties of Bermuda grass, such as Tifway, Tif Dwarf, and Tifsport are usually planted on sports fields or locations with intensive maintenance program. On golf courses Bermuda grass is the number one choice for tee and putting area (Seed Land, 1999). These special Bermuda grass varieties perform best when mowed at heights below 1 inch.

1) To evaluate local Bermuda grass cultivars that is most suitable for football field.

2) To assess the growth quality of local Bermuda grass cultivars grown under different nitrogen rates.

2. Materials and methods

Location and duration of the research

The research was conducted at the Faculty of Agriculture Turf Plot at Taman Pertanian Universiti Putra Malaysia (UPM) of University Putra Malaysia, Serdang, Selangor. It was conducted from 26 May to 20 August 2011.

Planting materials

The planting materials that used in the research were 10 varieties of local Bermuda grass. All the local Bermuda grass was collected from many places throughout the country including University Putra Malaysia (UPM). Table 1 shown the list of 10 varieties of local Bermuda grass that were used in this experiment:

Table 1: List of 10 local Bermuda grass cultivars that were used in this experiment

Local Bermuda grass cultivars	Place taken
A	Bukit ekspo, UPM
B	Glemarie Golf & Country Club
C	Ladang 10, UPM
D	Saujana Golf and Country Club.
E	Fairway Saujana Golf and Country Club.
F	Padang 14, UPM
G	Ladang 10, UPM
H	Ladang sayur, UPM
I	Football field from Melaka
J	Bukit Ekspo walkway

Planting media

Planting media consist of 80% river sand and 20% peat grows. The size of river sand was lower than two milimetres (mm) in diameter. In addition, basic fertilizer phosphorus (P) was used for improve rooting at rate 1.0kg / 100 m². Addition of lime required if necessary at rate 1.0kg / 100 m².

Propagation and planting methods

All cultivars of local Bermuda grass were collected and propagated by sodding, sprigging and plugging. In the experiment, four plugs with the size 7 centimetre (cm) length X 7 cm width of local Bermuda grass were planted in the plastic trays. The plastic tray size was 37 cm length X 27 cm width X 10 cm depth each.

Treatment

The experiment consists of 10 local Bermuda grass cultivars which indicate by the letter from A to J and four different of nitrogen fertilization rates that were 0, 0.2, 0.4 and 0.6 kg / 100m² per month. The fertilizer was applied every two weeks using NPK 18:3:18 (Pro Series-Green Fertilizer) based on treatment.

Experimental design

The design used for this experiment was a Completely Randomized Design (CRD) with two factors. The research was conducted of 10 varieties of local Bermuda grass, four Nitrogen treatments with three replications.

Local Bermuda turf grass care and maintenance

Mowing

The Grass cutter was used to mower the grass after four weeks of planting. Due to fine texture and to follow FIFA football field standard, local Bermuda grass were mowed at the cutting height of 20-25 mm every week and the clipping were removed.

Watering

Watering was applied according to the stage of the turf grass growth. Watering was done three times per day during establishment for the first three week including morning, afternoon and evening. On the other hand, at matured stage, watering was done two times per day. Each watering was last for about 20 minutes by using manual sprinkler system.

Pest and disease control

Pests and diseases were controlled by using fungicide and insecticide sprays. Fungicides such as Thiram and insecticide, Furadan were applied monthly based on their recommended rates.

Weeding

Weeding was done manually using hand when necessary.

Data collection

Bermuda grass cultivars were planted on 26 May 2011. The data were collected based on weekly assessment which started from the tenth week after planting and at the end of the experiment was on 20 August 2011.

Leaf length and leaf width

The leaf length and leaf width were measured using a ruler and were recorded in millimetre (mm) unit. The data were measured from three 25cm² quadrates which randomly taken in each tray. 10 samples of leaves were recorded for each quadrate randomly and the averages of leaf length and leaf width were calculated.

Internode length

The length of internode was measured using a ruler from one node to another node and was recorded in millimetre (mm) unit. The data was measured from three 25cm² quadrates which randomly taken in each tray. Ten samples were recorded for each quadrate randomly and the averages length of internode was calculated.

Shoot density

The number of shoots was calculated manually from each 25cm² quadrates. Three quadrates from each tray were recorded and their average was calculated.

Grass colour

The colour of grass was measured by using Turf Colour Meter (Field Scout TCM 500). The visual rating scale was measured based on evaluation of grass colour system (Beard, 1973) as shown in Table 2.

Table 2: Scale for Evaluation of Grass Colour.

Grade	Leaf colour
1-2	Yellow
3-4	Yellowish green
5-6	Light green
7-8	Green
9-10	Dark green

Source: Beard, 1973

Grass uniformity

Uniformity was measured depends on visual evaluation. The evaluation was done according to the growth habit, density, texture and colour. Low quality of uniformity can be measured by existence of weed and low density of area shoot per unit area that caused usually by pest attack. The visual rating grade was measured based on scale 1 to 10. The highest scale indicates the best uniformity.

Shoot and root fresh weight and dry weight

Three random 25cm² quadrates turf sample were uprooted in each tray to determine the average shoot and root fresh weight. Shoots were separated from the roots by cutting the samples at the soil surface. Each portion was washed and air dried before fresh weight were measured using the electronic balance in gram (g) unit. All samples were than over dried at 60 °C for 72 hours for shoot and root dry weight measurement. The data were taken once at the end of the experiment.

Root volume

Three random 25cm² quadrate from root fresh weight sample were used to determine the average of root volume. The root was soaked into the measuring cylinder that contains water and the different of water level indicate the volume of the root. The data were calculated and recorded in cubic centimetre (cm^3). The data were taken and recorded once at the end of experiment.

Root length

The root length was measured by using a ruler and the unit is centimetre (cm). The samples from three random 25cm² quadrate from root fresh weight were used to determine the average of root length. The data were taken and recorded once at the end of experiment.

Statistical analysis

All data were analyzed using Statistical Analysis System (SAS, 2004 version 9.0). Analysis of variance (ANOVA) was done to all 10 Bermuda grass cultivars and four different nitrogen rates with four replication in the Completely Randomize Design (CRD). Tukey's Studentized Range (HSD) test was used to compare the treatment at $P < 0.05$.

3. Results and discussion

Leaf length

Table 3 showed the leaf length of different Bermuda grass cultivars under several nitrogen rates. There were significant different in leaf length on local Bermuda grass cultivars and different rates of nitrogen. However, the result based on Tukey's Studentized Range (HSD) test showed that there was no interaction occurred between local Bermuda grass cultivars and different rates of nitrogen.

Leaf width

Table 3 showed leaf width of different Bermuda grass cultivars under several of nitrogen rates. There was significant different in leaf width on local Bermuda grass cultivars. However, the result based on Tukey's Studentized Range (HSD) test shown that there was no significant different to different rates of nitrogen and no interaction occurred between local Bermuda grass cultivars and different rates of nitrogen.

The result from Analysis of variance (ANOVA) and Tukey's Studentized Range (HSD) test showed that there was significant different on local Bermuda grass cultivars. Cultivars I and D showed the widest leaf width with the data of 2.28 mm and 2.25 mm respectively. These two cultivars have significant different compared to others cultivars. On the other hand, the narrowest leaf width was recorded for cultivars G with 1.58 mm and significantly different compared to others cultivars.

Turf grass texture is a measure or estimate of leaf width, which are can be done through visual assessment or physical measurement. In this research, evaluation of leaf width was done through physical measurement because it is more precise. Physical measurements are also variable. Measurement was taken when similar age and stage of development of leaf to minimize the error. Narrower leaf width considered more attractive and favourable to produce smooth surface for football filed. According to Emmons (1984) a thin or narrow and fine turf grass is considered high quality grass compare to a wide and coarse leaves grass.

Internode length

The effect of different Bermuda grass cultivars under several of nitrogen rates on internode length was shown in the Fig 1. Through Analysis of variance (ANOVA) and Tukey's Studentized Range (HSD) test at $P < 0.05$, there were significant different in internode length on local Bermuda grass cultivars and interaction occurred between local Bermuda grass cultivars and different rates of nitrogen. However, the result showed that there was no significant different on different rate of nitrogen.

Internode length can be used as one of the indicator to measure turf grass density. Shorter internode length provides higher total shoot per unit area. According to table 6, cultivar G produce the shortest internode length (2.81 mm) and was significantly different compared to others. Cultivar C has the longest internode length with 4.77 mm and significantly different compared to others cultivars. Moreover, only cultivar B showed significant different on several rate of nitrogen.

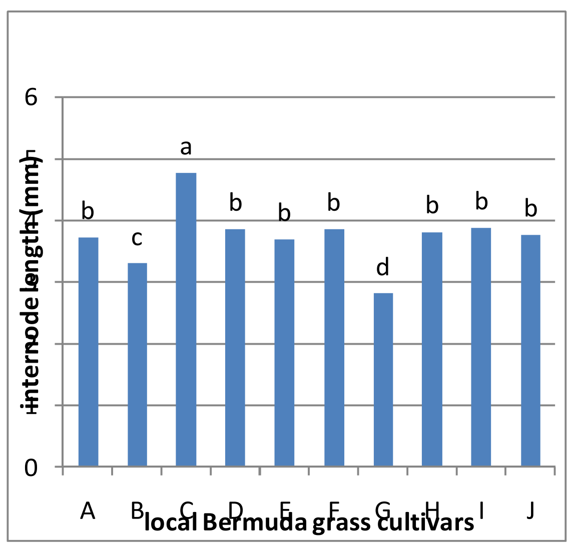

Fig 1. Effect of different level of nitrogen on internode length of different local Bermuda grass

Shoot density

Through Analysis of variance (ANOVA) and Tukey's Studentized Range (HSD) test at $P < 0.05$, there were significant different on local Bermuda grass cultivars and different rate of nitrogen in the number of shoot per 25cm² quadrates. However, there was no interaction occurred between local Bermuda grass cultivars and different rates of nitrogen (Fig 2).

According to the result on Fig 2., the significantly highest density were showed by cultivar D (75.17), cultivar G (73.75), cultivar B (73.58) and cultivar I (73.58) and no significantly different between them. On the other hand, the lowest shoot density was cultivar H with the average about 58.25. The rest of the cultivars also did not perform well in term of shoot density. The data from Analysis of variance (ANOVA) and Tukey's Studentized Range (HSD) test at $P < 0.05$ also showed there was significant different between several rate of nitrogen. High density requires high nitrogen levels. From the experiment, 0.6 kg/100m²/month rate of nitrogen application produce the highest and significantly different compared to others cultivars.

Turf grass density is a visual estimate of living plants or tillers per unit area. Dead patches of turf are excluded. Turf grass density can be determined quantitatively by counting shoots in a specified area. Counting is time consuming and labour intensive. Visual turf grass density ratings are highly correlated to counts and require much less time and labour input. Shoot density varies by time of growth habit. Higher shoot density produce more attractive, uniformity, dense and reduce weeds. It is well said that good football field's turf grass required maximize total shoots per unit area.

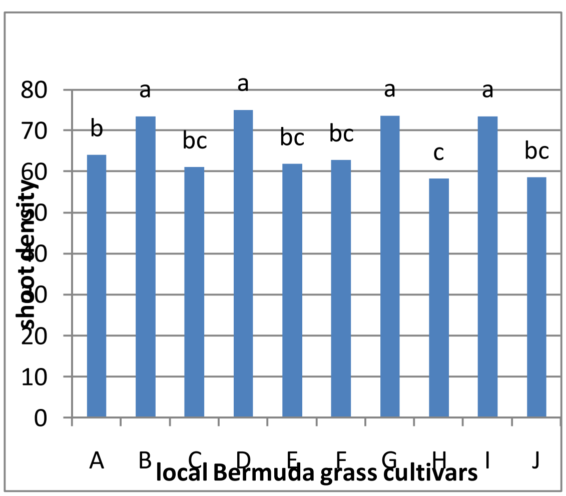

Fig 2. Effect of different level of nitrogen on shoot density of different local Bermuda grass

Grass colour

Table 4 showed turf grass colour of different Bermuda grass cultivars under several rates of nitrogen. There were significant different in turf grass colour on local Bermuda grass cultivars and different rates of nitrogen. However, the result based on Tukey's Studentized Range (HSD) test showed that there was no interaction occurred between local Bermuda grass cultivars and different rates of nitrogen.

Table 4 showed that cultivar B had the greener leaf colour with the mean 6.66, followed by cultivar D and cultivar I with the colour of 6.63 and 6.61 respectively and had significant different compared to the others cultivar and has significant different among four nitrogen treatment. On the other hand, cultivar J shows the lowest value for turf colour with the mean of 6.45 and has significantly different compared to others cultivars. The result also showed that higher rate (0.6 kg / 100m² / month) produced significantly higher turf colour (6.87) compared to others nitrogen rates.

Dark green colour indicates high quality grass (Beard, 1973. The greener or dark green the shoot, the more attractive the grass (Emmons, 1984). Genetic colour reflects the inherent colour of the genotype. It is based on a visual rating scale with 1 being light green and 9 being dark green. Take genetic colour ratings when the turf is actively growing and is not under stress. Chlorosis and browning from necrosis are not a part of genetic colour.

Grass uniformity

Table 4 showed there were significant different in turf grass uniformity on local Bermuda grass cultivars and different rates of nitrogen. However, based on Analysis of variance (ANOVA) and Tukey's Studentized Range (HSD) test at $P < 0.05$ test, the result showed that there was no interaction occurred between local Bermuda grass cultivars and different rates of nitrogen.

The result in table 4 showed that the highest mean data for turf grass uniformity were recorded by cultivar B (7.08), cultivar D (7.00), cultivar G (6.92) and cultivar I (6.67). There were no significant different between them. The rest of the cultivars did not perform well in term of turf grass uniformity. In term of nitrogen rate, 0.6 kg/100m²/month produced significantly higher uniformity for cultivar B (8.33), cultivar D (8.33) and cultivar G (8.0)

Quality of uniformity is based on 9 being best and 1 being poorest. A rating of 6 or above is generally considered acceptable. A uniformity quality rating value of 9 is reserved for a perfect or ideal grass, but it also can reflect an absolutely outstanding treatment plot.

Shoot fresh weight

Table 5 showed shoot fresh weight of different Bermuda grass cultivars under several nitrogen rates. Based on Tukey's Studentized Range (HSD) test there were significant different in shoot fresh weight on local Bermuda grass cultivars , different rates of nitrogen and interaction occurred between local Bermuda grass cultivars and different rates of nitrogen.

The result showed that cultivar D had the highest shoot fresh weight with the mean of 3.11 g, followed by cultivar B (3.03 g) and had significant different compared to the others cultivars. On the other hand, cultivar H showed the lowest shoot fresh weight with the mean of 2.38 g and has no significant different compared to cultivar A, cultivar C, cultivar E, cultivar F. It is also showed that higher nitrogen rates produce higher shoot fresh weight with the highest data recorded by cultivar D (3.74g) for 0.6 kg/100m²/month.

Shoot fresh weight indicates percentage of total water content or water moisture in the grass. Water content influences turf grass tolerance to heat, drought and wear tolerance. Insufficient water content can be seen through foot print effect.

Root fresh weight

Table 5 showed root fresh weight of different Bermuda grass cultivars under several of nitrogen rates. Based on Tukey's Studentized Range (HSD) test there were significant different in root fresh weight on local Bermuda grass cultivars and different rates of nitrogen. However, there is no interaction occurred between local Bermuda grass cultivars and different rates of nitrogen.

The result showed that cultivar B had the highest root fresh weight with the mean of 7.51 g followed by cultivar D (7.47 g), cultivar F (7.39 g) and cultivar I (7.20 g). There were no significantly different between them. On the other hand, cultivar E and cultivar H showed the lowest shoot fresh weight with the mean of 6.20 g. It is also showed that higher nitrogen rates produce higher root fresh weight with the highest data recorded by cultivar D (8.86) for 0.6 kg/100m²/month.

Root fresh weight indicates percentage of total water content or water moisture in the grass. Balance and good water content can provide better wear and drought tolerance but it was different based on species and cultivars. Water content influences turf grass tolerance to heat, drought and wear tolerance. Higher root fresh weight indicates better root development and good absorption of water to maintain vigorous of turf grass. Good rooting was one of the main important recuperative ability for sport field turf grass.

Shoot dry weight

Table 6 showed shoot dry weight of different Bermuda grass cultivars under several of nitrogen rates. Based on Tukey's Studentized Range (HSD) test there were significant different in shoot dry weight on local Bermuda grass cultivars , different rates of nitrogen and interaction occurred between local Bermuda grass cultivars and different rates of nitrogen.

Shoot dry weight indicates percentage of total water content or water moisture in the grass. Water content influences turf grass tolerance to heat, drought and wear tolerance. The result showed that cultivar D had the highest shoot dry weight with the mean of 0.66 g and has significant different compared to the others cultivars followed by cultivar B (0.64 g) and cultivar G (0.61 g). On the other hand, cultivar H showed the lowest shoot dry weight with the mean of 0.51 g and has significant different compared to other cultivars and has significant different among four nitrogen treatment. It is recorded that higher nitrogen rate produce higher shoot dry weight (0.66 g) as shown at 0.6 kg/100m²/month treatment.

Root dry weight

Table 6 there were significant different in turf grass root dry weight on local Bermuda grass cultivars and different rates of nitrogen and interaction occurred between local Bermuda grass cultivars and different rates of nitrogen.

The result showed that the highest root dry weight was recorded by cultivar B (1.83 g), followed by cultivar D (1.82 G) and cultivar F (1.80 g) with no significant different between them. On the other hand, cultivar A has the lowest root dry weight with mean 1.56 g. The rest of the cultivars also did not perform well in term of root length. The result also showed that 0.6 kg/100m²/month rate of nitrogen produce significantly higher (1.87 g) means root dry weight compared to other rates.

Root dry weight was a measurement of total water content or total moisture available in the grass. Balance and good water content can provide better wear and drought tolerance but it was different based on species and cultivars. The result from the research showed different water content available on different local Bermuda grass cultivars with four various rate of nitrogen treatment.

Root volume

Analysis of variance (ANOVA) and Tukey's Studentized Range (HSD) test at $P < 0.05$ reveal that there were significant different on local Bermuda grass cultivars and different rate of nitrogen for root fresh weight (Table7). However, there was no interaction between local Bermuda grass cultivars and different rates of nitrogen.

The highest root volume produced by cultivar B (7.48 cm^3), followed by cultivar D (7.46 cm^3), cultivar F (7.38 cm^3) and cultivar I (7.17 cm^3) with no significant different among them. The result also showed that nitrogen rate of 0.6 kg/100m²/month produced the highest mean with 7.91 cm^3 of root volume and significantly different compared other rates.

Root volume was another evaluation to understand how strong a root can be. Greater root volume determines greater water and nutrient intake of grass and greater root spreading in the media. The result from the research showed different data for root volume on different local Bermuda grass cultivars with four various rate of nitrogen treatment.

Root length

Through Analysis of variance (ANOVA) and Tukey's Studentized Range (HSD) test at $P <$ 0.05, there were significant different on local Bermuda grass cultivars and different rate of nitrogen in root length. However, there was no interaction between local Bermuda grass cultivars and different rates of nitrogen (Table 7).

The result showed that the longest root was recorded by cultivar D (11.66 cm), followed by cultivar F (11.65 cm) and cultivar B (11.61 cm) with no significant different between them. On the other hand, cultivar H has the shortest root with mean 9.95 cm. The rest of the cultivars also did not perform well in term of root length. The result also showed that 0.6 kg/100m²/month rate of nitrogen produce significantly longest (12.45 cm) means root length compared to other rates.

Root length was a measurement to indicate how far that root can penetrate into the soil and how strong that grass can be. The greater penetration of the root into the soil means the greater that turf grass can perform in hot and dry condition. Longer root act as good factor to maximize absorption of water and be able to survive in drought for longer time. Moreover, strong root was a requirement in sport field because it helps the turf to become more resistant to traffic wear. Indeed, root length plays an important role in order to select the best turf grass for football turf in warm climate.

4. CONCLUSION

From the research, different rate of nitrogen application influence growth and quality of different types of local Bermuda grass cultivars. Higher rate of nitrogen application increased leaf length, shoot density, uniformity, colour, root and shoot fresh weight, root and shoot dry weight, root length and root volume. However, only specific rate of nitrogen application produce the best growth and quality of different types of local Bermuda grass cultivars.

Evaluation of local Bermuda grass for football field was carried out based on its growth and quality. 10 variety of local Bermuda grass cultivar showed significant different characteristics on leaf length, leaf width, internode length, shoot density, uniformity, colour, root and shoot fresh weight, root and shoot dry weight, root length and root volume. As the result, only four from 10 local Bermuda grass had the highest potential to be used in football field.

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References

[1]. Bowman, D.C., C.T. Cherney, and T.W. Ruft y, Jr. 2002. Fate and transport of nitrogen applied to six warm-season turfgrasses. Crop Sci. 42:833-841.

[2]. Epstein, E., A. J. Bloom. 2005. Mineral nutrition of plants: Principles and perspectives. 2nd ed. Somaier Associates Inc.Sunderland, Massachusetts. P30.

[3]. Quiroga-Garza et al., 2001 Bermudagrass fertilized with slow-release nitrogen sources: I. Nitrogenuptake and potential leaching losses. J. Environ. Qual. 30:440-448.

[4]. Beard, J. B., & Green, R. L. (1994). The role of turfgrasses in environmental protection and their benefits to humans. Journal of Environmental Quality , 23 (3), 1-16.

[5]. Christians Nick E. (2007) Fundamentals of turfgrass management, In: John Willey & Sons Warm season grasses, 3rd edn. Hoboken, New Jersey, 61-63

[6]. Emmons, R.D. 2008. Turfgrass Science and Management (4th ed.). Delmar Thompson Learning, Inc., New York. pp. 14-34.

[7]. **Uddin, M. K.** A.S. Juraimi, M.R. Ismail, Radziah O. and A.A.Rahim. Growth response of eight tropical turfgrass species to salinity. *African Journal of Biotechnology,* 21: 5799-5806.

[8]. **Uddin**, **M. K.,** A.S. Juraimi, M.R. Ismail, Radziah O. and A.A.Rahim. Relative salinity tolerance of warm season turfgrass species. *Journal of Environmental Biology,* 32:309-312.

[9]. **Uddin**, **M. K.,** A.S. Juraimi, M.R. Ismail, Radziah O. and A. A. Rahim. Physiological and growth response of tropical turfgrass to salinity stress. *The Scientific World Journal*, doi:10.1100/2012/905468

[10]. **Uddin**, **M. K.** and A.S. Juraimi. (2012). Using sea water for weed mangement in turfgrass, LAP LAMBERT Academic Publishing GmbH & Co. KG, Germany, ISBN 978-3-8473-7389-6, p.1-251

[11]. Seed Land. (1999). Bermuda grass. Retrieved (June 29,2010). From http://www.bermudagrass.com

[12]. SAS Institute. 2004. SAS/STAT user's guide. release. Release 9.0. 4th ed. Statistical Analysis Institute, Cary, NC.

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