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Turf establishment quality as affected by planting density and variety of Doobgrass (*Cynodon dactylon* L.)

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Abstract
The experiment was laid out in a Completely Randomized Design with Factorial concept which replicated thrice and comprised of two factors *viz.*, factor-I Varieties of *Cynodon dactylon* turf (V_1: Tifdwarf, V_2: Selection-1, V_3: Locally available variety and factor-II Planting desnsity (P_1: 100.00 dibble/m^2, P_2: 44.44 dibble/m^2, P_3: 25.00 dibble/m^2). The interaction effect of varieties and planting desnsity were influence on different characters *viz.*, highest number (196.08) of runners per 100 cm^2, earliness for fully establishment of turfgrass (48.67 days), dry biomass (13.24 g/100 cm^2) of doobgrass at 60 DAP. Moreover, maximum root depth (84.27 mm) and longest runner length (37.87 cm) was noted in V_3P_3. Maximum number of nodes (17.20) present on runner found maximum in V_1P_3.In case minimum fresh weed (197.20 g/plot and 43.40 g/plot) and dry biomass of weed (24.64 g/plot and 5.05 g/plot) observed with combination V_1P_1 and V_2P_1 From the results it was revealed that dibble of *Cynodon dactylon* var. Tifdwarf or Selection-1 grown at 100.00 dibble/m^2 planting desnsity favoured quick establishment of turf, appropriate growth habit for less frequency of lawn mowing and minimal weed growth.

Keywords: Turfgrass, quality, planting, density, doobgrass and establishment

Introduction
Bermuda grass which is also known as Doob grass is a major turf species for sport fields, lawns, parks, golf courses and general utility turfs in India, Australia, Africa, South America and the Southern region of the United States. It is found in over 100 countries throughout the tropical and subtropical areas of the world. The genus *Cynodon* comprises nine species with *C. dactylon* being the most widespread. These grasses can easily be grown from their seeds. Common Bermuda grass, *C. dactylon*, is naturalized throughout the warmer regions of the India.

Bermuda grass has numerous turf uses. It is a tetraploid species with broad genetic variability serves to explain its widespread distribution. Other *Cynodon* species have a more limited natural distribution and are often restricted to one particular habitat. *C. dactylon* is highly fertile, whereas the diploid species such as *C. transvaalensis* rarely produce viable seed (Trenholm *et al*., 2011) [15].

Doob grass establishes rapidly and spread by vegetative propagules, both above ground (stolons) and below ground (rhizomes). Roots produced at the distal end of the stolon are much longer and more abundant than those close to the original stem (Brosnan and Deputy, 2008) [3]. Moreover, *Cynodon dactylon* turf is a stoloniferous type of grass, the spread and establishment rate is more rapid. The faster spread is largely depending on the planting density

Materials and Methods
The experiment was conducted at Polytechnic in Horticulture, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Paria during January to July, 2020 with 9 treatment combinations in complete randomized design with factorial concept (FCRD) and were replicated thrice. An experiment comprised of two factors *viz.*, factor- I Varieties of *Cynodon dactylon* turf (V_1: Tifdwarf, V_2: Selection-1, V_3: Locally available variety) and factor -II Planting desnsity (P_1: 100.00 dibble/m^2, P_2: 44.44 dibble/m^2, P_3: 25.00 dibble/m^2). Observations were recorded during 30 and 60 days after planting for leaf lenghth (cm), diameter of runner (mm), number of on runner per 100 cm^2, dry biomass of doobgrass (g/100 cm^2), fresh and dry biomass of weed (g/plot) while chlorophyll content (a and b) present in leaves (mg/100 g) of *Cynodon dactylon* recorded at 60 DAP. Total days taken for turf grass establishment were calculated from date of planting to fully (100%) establishment of the turfgrass. The data were statistically analysed by using Panse and Sukhatme (1985) [10].

Results and Discussion: The results obtained from the present investigation are summarized below:

Effect of different varieties of *Cynodon dactylon* turfgrass

From Table. 1 The data pertaining to total days taken for turfgrass establishment influenced by different varieties was found significant. The minimum days (53.22) taken for 100 per cent establishment was recorded in turfgrass variety V_2 (Selection-1) which was statically at par with variety V_1 (Tifdwarf). Shortest leaf length (1.28 cm and 2.20 cm) was recorded in variety Tifdwarf (V_1) at 30 and 60 days after planting, respectively. In case of diameter of runner, it was recorded maximum diameter (0.94 mm and 1.20 mm) in Local varieties of *Cynodon dactylon* minimum diameter (0.57 mm and 0.73 mm) of runner was registered with variety Tifdwarf (V_1) at 30 and 60 days after planting, respectively. Moreover, maximum dry biomass of doobgrass (3.08 g/100 cm^2 and 9.28 g/100 cm^2) in variety Selection-1 at 30 DAP and 60 DAP and it was statistically at par with variety Tifdwarf (V_1) at 30 DAP. While least number of mowing (7.33) needed in variety Tifdwarf (V_1) at 180 days after planting. The lowest dry biomass of weed (25.41 g/plot and 5.22 g/plot) was noted in variety Tifdwarf (V_1) which was statistically at par with variety Selection-1 (V_2) @ 30 DAP and 60 DAP. In case of chlorophyll content (a and b) present in leaves of *Cynodon dactylon*, maximum chlorophyll-a and b (0.494 mg/100g and 0.245 mg/100g) in locally available variety (V_3) which was statistically at par with variety Tifdwarf at 60 days after planting, respectively.

The minimum days taken for turfgrass establishment might be due to better performance and adaptability of *Cynodon dactylon*. Both the variety Selection-1 and Tifdwarf established faster under south Gujarat agro climatic conditions due to their capacity to acclimatize in particular environment and genetic makeup (Dudeck, 1990) [5]. Shortest leaf length among the tested varieties, might be due to the hereditary characters of Tifdwarf variety. Earlier, Wadekar *et al.* (2018) [18], Undhad (2018) [16], Agnihotri (2015) [1].

The diameter is attributed to its genetic characters of different varieties. Locally adopted variety may found more vigorous which resulted for maximum diameter and length. While Tifdwarf variety may found superior to its slow growing habit. This type result was previously reported by Undhad (2018) [16], Roshni Agnihotri *et al.* (2016) [2] and Malik *et al.* (2014) [9]. Maximum dry biomass of doobgrass variety Selection-1 is due to varietal characters and genetic makeup as it forms vigorous growth, meanwhile Tifdwarf is also found much predominant due to its runners' growth and thick carpet forming ability. Undhad (2018) [16] and Roshni Agnihotri *et al.* (2016) [2].

The amount of grass growing above standard height provide an estimate of mowing requirement as somewhat confounded by leaf blade size and density.

The obvious ground hugging characteristics, fine texture and dwarf growth habit of variety Tifdwarf, which did not allow it to grow more in height (Fucik and Turley, 1991) [6]. Hence, required less mowing in Tifdwarf. Similar finding by Roshni Agnihotri (2015) [1]. It might be due to the genetic makeup and wider adaptability of grass species to the location which allows more vegetative growth of the grass. Crowding of the grass species do not allow weed to grow more. Hence, it produced less weed dry biomass.

Chlorophyll content represent the intensity of the green color and is quantitative quality indicator for turfgrass (Dhanalakshmi *et al.*, 2018) [4]. Concentration of total chlorophyll among all species increased mark in end of summer and monsoon. As all warm season grasses are adapted well in summer season, it increased the chlorophyll to maximum during warm months. Chlorophyll content is influenced by genetic characteristics of the species, growing conditions biotic and abiotic stress as well as adaptability to particular environment.

From Table.2 The data pertaining to the lowest fresh biomass of weed (205.04 g/plot and 45.09 g/plot) was noted in variety Tifdwarf (V_1) and lowest dry biomass of weed (25.41 g/plot and 5.22 g/plot) was noted in variety Tifdwarf (V_1 at which was statistically at par with variety Selection-1 (V_2) at 30 DAP and 60 DAP

Lesser weed counts that may be attributed to their prostrate growth habit and depriving the weed seed from nutrients and sunlight. Crowding of the grass species do not allow weed to grow more. Hence, it produced less weed dry biomass. The result was in obedience with Roshni Agnihotri (2015) [1].

Effect of different plant planting desnsity of *Cynodon dactylon* turf grass: The quickest turfgrass establishment (51.44 days) was observed with 100.00 dibble/m^2 planting density (P_1), while the slowest establishment of turfgrass (60.33 days) was observed when turfgrass grown at 25.00 dibble/m^2 planting density (P_3). Planting desnsity affects the speed of lawn establishment. The least leaf length (2.15 cm and 2.86 cm) at 30 DAP and 60 DAP was obtained when turfgrass grown at 100.00 dibble/m^2 planting density (P_1). At 30 DAP, least leaf length was which was statistically at par with (P_2). Where, the largest leaf length (2.34 cm and 3.22 cm) was reported in turfgrass grown at 25.00 dibble/m^2 planting density (P_3) at 30 DAP and 60 DAP, respectively. The effect of planting desnsity with respect to diameter of runner was found to be non-significant at 30 DAP and 60 DAP. Variety Tifdwarf grown at 100.00 dibble/m^2 planting density (P_1) showed significantly maximum number of runners (35.14 and 140.25) per 100 cm^2 area at 30 and 60 DAP.. The data regarding maximum dry biomass of doobgrass (3.08 g/100 cm^2 and 9.28 g/100 cm^2) obtained in variety Selection-1 at 30 DAP and 60 DAP and it was statistically at par with variety Tifdwarf (V_1) at 30 DAP. Whereas, minimum dry biomass of doobgrass (2.46 g/100 cm^2 and 5.92 g/100 cm^2, respectively) was recorded in V_3 (Local variety). Under the scrutiny data disclosed that lesser number of mowing (7.56) was done when turfgrass at 25.00 dibble/m^2 planting density (P_3). While, Chlorophyll content (a and b) at 60 days after planting was found non-significant.

Closer planting density 100.00 dibble/m^2 results faster cover because narrow planting density had a large number of individual plants per unit area. Conversely, wide planting density may led to poor lawn establishment coverage, bare spots and patches (Qodliyati *et al.*, 2018) [14]. New Similar trend was also noted by Johnson, *et al.* (1997) [17] in buffalo grass. Closer planting density may increase the competition for essential growth factor among individual plant which do not attend their normal size. Hence, decreased leaf length (Dhansekaran, 2018). Hence, maximum leaf length was reported when turfgrass planting density at wider planting density is might be due to the fact that wider planting density reduces competition between plants for nutrients, light, and moisture and enhances growth (Gashaw and Haile, 2020) [7]. Similar trends were reported by Rohidas *et al.* (2010) [8] in Gladiolus and Pednekar (1998) [11] in China aster.

The increased vegetative parameters at close planting density might be because of rapid growth and production of maximum density of grass, a greater number of leaves with appropriate runner growth (Qodliyati *et al.* 2018) [14]. Due to wider planting density, it takes more time for the coverage. Hence, required less frequency of mowing.

From Table.2 The data pertaining to the least fresh biomass of weed (260.64 g/plot and 51.73 g/plot) was noted at planting

density of 100.00 dibble/m^2 (P_1) and minimum dry biomass of weed (32.51 g/plot and 6.28 g/plot) was found at planting density of 100.00 dibble/m^2 (P_1) @ 30 DAP and 60 DAP, respectively, whereas it was found statistically at par with P_2 at 60 DAP. Due to closer planting density, reduced weed growth in narrow rows is quicker row closure which reduces the light penetration to the weeds emerging below the grass.

Interaction effect of different plant planting desnsity of *Cynodon dactylon* turf grass: It was evident from the data, interaction effect of varieties and planting desnsity were found significant for fully establishment. Earliness for days taken for fully establishment of turfgrass (49.00 days) was noted in V_2P_1 *i.e.*, variety Selection-1 grown at 100.00 dibble/m^2 planting density which was statistically at par V_1P_1 *i.e.*, variety Tifdwarf grown at 100.00 dibble/m^2 planting density (49.33 days). However, maximum days taken for fully establishment (62.67) was observed with V_3P_3 *i.e.*, local variety of *Cynodon dactylon* grown at 25.00 dibble/m^2 planting density. The interaction effect of V × P with respect to length of runner at 30 days after planting was found to be non-significant but at 60 days after planting it was found significant. It was found minimum leaf length (2.08 cm) in V_1P_1 *i.e.*, variety Tifdwarf grown at 100.00 dibble/m^2 which was statistically at par with V_2P_1, V_1P_2, V_1P_3 and V_2P_2.

The interaction effect of V × P with respect to diameter of runner was found to be non-significant at 30 DAP and 60 DAP. The interaction effect of V × P with respect to dry biomass of *Cynodon dactylon* at 30 days after planting found non-significant. However, interaction effect of V × P with respect to dry biomass of doobgrass was found significant at 60 days after planting. The maximum dry biomass of doobgrass (13.24 g/100 cm^2) was noted in V_2P_1. Moreover, the lowest dry biomass of doobgrass (3.13 g/100 cm^2) was noted when variety Tifdwarf grown at 25.00 dibble/m^2 (V_3P_3). During 180 days after planting, the interaction effect of V × P with respect to total number of mowing was found to be significant. Total number of mowing (7.00) was reported minimum with V_1P_3 which was found statistically at par with combination of V_1P_2, V_2P_3 and V_1P_1. While maximum number of mowing (10.33) was obtained with V_3P_1 (Local available variety grown at 100.00 dibble/m^2 planting density). Chlorophyll content (a and b) at 60 days after planting was found non-significant.

Cynodon dactylon variety Selection-1 and Tifdwarf grown at narrow planting density (100.00 dibble/m^2) may cover quickly and leads to earliness for establishment. It may be due to both varieties have greater capacity to adopt the environmental condition at narrow plant planting density for quick establishment. Similar results were observed by Kumar (2012) [10] and Lawal (2011) [12] in turfgrass. The interaction effect was found significant for leaf length. This might be due to the hereditary characters of Tifdwarf variety which did not attend their normal size due to closer planting density as it increased the competition for essential growth factor among individual plant (Gashaw and Haile, 2020) [7]. Similar trend was also found by Lawal (2011) [12] as well as Russell and Truman (2004) in different turfgrasses. The interaction of different grass varieties and planting desnsity has non-significant effect on total dry biomass of doobgrass at 30 DAP due to less vegetative growth of *Cynodon dactylon* during initial months. After 60 days poof planting, it showed maximum dry biomass of doobgrass, as growth rate of a grass species was observed *i. e.* number of leaves, number of runners, shoot diameter *etc.* at closer planting density (100.00 dibble/m^2). Increased biomass is also directly related to greater photosynthetic activity of the grass species (Kumar, 2012) [10]. The interaction of Tifdwarf at wider planting density (25.00 dibble/m^2) showed best performance. Tifdwarf showed least amount of mowing frequency at wider planting density. As it is having a dwarf nature and it produces short and fine texture leaf. Hence, least frequency of mowing required in Tifdwarf variety with wider planting density. From Table. 2 It is evident from the data that, interaction effect of varieties and planting desnsity on fresh biomass and dry mass of weed at 30 DAP and 60 DAP was found significant. Minimum fresh biomass of weed (197.20 g/plot and 43.40 g/plot) was noted in variety Tifdwarf grown at 100.00 dibble/m^2 planting density (V_1P_1) which was statistically at par with combination V_2P_1, V_1P_2, V_2P_2, V_1P_3 and V_2P_3 while least dry biomass of weed (24.64 g/plot and 5.05 g/plot) was found in V_1P_1 (variety Tifdwarf grown at 100.00 dibble/m^2 planting density) Morphological characters of grass species and its adaptability to local area increased the vegetative growth of grass. Moreover, closer planting density do not allow weed to grow.

Table 1: Turf Establishment Quality as Affected by Planting Density and Variety of doobgrass (*Cynodon dactylon* L.)

Treatment	Total days taken for 100 turf establishment	Leaf length (cm)		Diameter of runner (mm)		Number of runners per 100 cm^2		Dry biomass (g/100 cm^2)		Dry biomass (g/100 cm2) of doobgrass	Dry biomass of weed (g/plot)		Chlorophyll content present in leaves (mg/100 g) of *Cynodon dactylon* at 60 DAP	
		30 DAP	60 DAP	30 DAP	60 DAP	30 DAP	60 DAP	30 DAP	60 DAP		30 DAP	60 DAP	a	b
V_1: Tifdwarf	54.56	1.28	2.20	0.57	0.73	39.53	154.58	2.94	6.42	7.33	25.41	5.22	0.484	0.240
V_2: Selection-1	53.22	1.75	2.32	0.59	0.76	32.25	127.67	3.08	9.28	8.00	26.22	5.29	0.324	0.217
V_3: Local	60.00	3.70	4.76	0.94	1.20	14.94	55.11	2.46	5.92	9.11	53.33	9.64	0.494	0.245
S.Em. ±	0.421	0.03	0.06	0.014	0.018	1.22	3.83	0.05	0.15	0.14	0.67	0.14	0.009	0.003
C. D. at 5%	1.197	0.01	0.06	0.041	0.053	3.63	11.38	0.15	0.44	0.43	1.99	0.41	0.028	0.009
P_1:100.00dibble/m^2	51.44	2.15	2.86	0.67	0.86	35.14	140.25	3.14	10.43	8.78	32.51	6.28	0.420	0.235
P_2: 44.44 dibble/m^2	56.00	2.24	3.21	0.71	0.91	29.78	117.11	2.91	7.29	8.11	35.56	6.52	0.434	0.234
P_3: 25.00 dibble/m^2	60.33	2.34	3.22	0.72	0.92	21.81	80.00	2.43	3.89	7.56	36.89	7.34	0.448	0.233
S.Em. ±	0.421	0.03	0.06	0.014	0.018	1.22	3.83	0.05	0.15	0.14	0.67	0.14	0.009	0.003
C. D. at 5%	1.197	0.01	0.18	NS	NS	3.63	11.38	0.15	0.44	0.43	1.99	0.41	NS	NS
V_1P_1	49.67	1.21	2.08	0.53	0.68	49.25	196.08	3.21	9.16	7.67	24.64	5.05	0.476	0.242
V_1P_2	53.67	1.25	2.23	0.58	0.75	40.67	161.33	2.94	6.42	7.33	24.68	5.21	0.479	0.238
V_1P_3	60.33	1.37	2.30	0.59	0.76	28.67	106.33	2.66	3.68	7.00	26.90	5.41	0.497	0.241
V_2P_1	49.00	1.64	2.21	0.57	0.73	37.42	160.33	3.40	13.24	8.33	24.74	5.12	0.296	0.217
V_2P_2	52.67	1.76	2.34	0.60	0.77	34.00	134.67	3.23	9.72	8.00	26.57	5.28	0.332	0.215
V_2P_3	58.00	1.86	2.42	0.61	0.79	25.33	88.00	2.62	4.86	7.67	27.36	5.46	0.343	0.218
V_3P_1	55.67	3.59	4.29	0.92	1.17	18.75	64.33	2.79	8.88	10.33	48.16	8.68	0.487	0.247
V_3P_2	61.67	3.71	5.05	0.94	1.20	14.67	55.33	2.57	5.74	9.00	55.44	9.07	0.491	0.249
V_3P_3	62.67	3.78	4.95	0.95	1.22	11.42	45.67	2.02	3.13	8.00	56.40	11.16	0.505	0.239
S.Em. ±	0.729	0.06	0.10	0.024	0.031	2.12	6.64	0.09	0.26	0.25	1.16	0.24	0.016	0.005
C. D. at 5%	2.074	NS	0.31	NS	NS	NS	18.89	NS	0.76	0.74	3.45	0.70	NS	NS
C. V.%	2.257	4.49	5.76	5.94	5.96	12.69	10.22	5.42	6.14	5.28	5.76	6.12	6.43	3.68

Table 2: Effect of weed biomass Quality as Affected by Planting Density and Variety of doobgrass (Cynoon dactylon L.)

Treatment	Fresh biomass of weed (g/plot)		Dry biomass of weed (g/plot)	
	30 DAP	60 DAP	30 DAP	60 DAP
V_1: Tifdwarf	205.04	45.09	25.41	5.22
V_2: Selection-1	207.93	45.67	26.22	5.29
V_3: Local	428.76	83.17	53.33	9.64
S.Em. ±	5.16	1.80	0.67	0.14
C. D. at 5%	15.34	5.35	1.99	0.41
P_1:100.00dibble/m^2	260.64	51.73	32.51	6.28
P_2: 44.44 dibble/m^2	283.67	57.51	35.56	6.52
P_3: 25.00 dibble/m^2	297.42	64.68	36.89	7.34
S.Em. ±	5.16	1.80	0.67	0.14
C. D. at 5%	15.34	5.35	1.99	0.41
V_1P_1	197.20	43.40	24.64	5.05
V_1P_2	201.20	44.27	24.68	5.21
V_1P_3	216.73	47.60	26.90	5.41
V_2P_1	198.27	43.60	24.74	5.12
V_2P_2	204.47	44.93	26.57	5.28
V_2P_3	221.07	48.47	27.36	5.46
V_3P_1	386.47	68.20	48.16	8.68
V_3P_2	445.33	83.33	55.44	9.07
V_3P_3	454.47	97.98	56.40	11.16
S.Em. ±	8.94	3.12	1.16	0.24
C. D. at 5%	26.57	9.27	3.45	0.70
C. V. %	5.52	9.31	5.76	6.12

Conclusion

From the ongoing result and discussion, it can be conclude that *Cynodon dactylon* var. Tifdwarf or Selection-1 grown at 100.00 dibble/m^2 planting desnsity favoured quick establishment of turf, appropriate growth habit for less frequency of lawn mowing and minimal weed growth. Morphological characters of grass species and its adaptability to local area increased the vegetative growth of grass. Moreover, closer planting density do not allow weed to grow. *Cynodon dactylon* variety Selection-1 and Tifdwarf grown at 100.00 dibble/m^2 planting desnsity covered quickly and leads to earliness for establishment due to greater capacity to adopt the environmental condition at narrow planting density for quick establishment.

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References

1. Agnihotri R. Performance of various turfgrass genotype under south gujarat agroclimatic condition. Thesis M.Sc. (Horti.), Navsari Agricultural University. Gujarat, India. 2015, 3.
2. Agnihotri R, Chawla SL, Sudha Patil. Evaluation of warm season turfgrasses for various qualitative and quantitative traits under Gujarat agro climatic conditions. Indian J. Agric. Sci 2016;87(7):83-91.
3. Brosnan JT, Deputy J. Bermuda grass. Turf management 2008, 1-6.
4. Dhanalakshmi R, Bhaksar V, Subbaramamma P. Influence of physiological response on the establishment of turfgrass species under different method of planting. Int. J. Agril. Sci. 2018;14(2):354-361.
5. Dudeck A. Influence of planting method, fertility program, cultivar and soil type on ST. Augustine grass. *Proc.* Fla. State Hort. Soc. 1990;103:355-360.
6. Fucik JD, Turley RM. Preliminary report on the performance of southern turfgrasses. Subtropical Plant Sci. 1991;44:40-46.
7. Gashaw B, Haile S. Effect of different rates of nitrogen and interrow spacing on growth performance of lettuce (*Lactuca sativa* L.). Adv. Agric. 2020, 6.
8. Rohidas SB, Jature SD, Barkule SR, Sinde SJ, Nikam AV. Effect of spacing on growth and yield of gladiolus. Asian J. Hort. 2010;5(2):305-306.
9. Malik S, Rehman S, Younis A, Qasim M, Nadeem M, Riaz A. Evaluation of quality, growth and physiological potential of various turfgrass cultivars for shade garden. J. Hort. Biotech 2014;18(3):110-121.
10. Kumar A. Studies Effect of different grasses and spacing on turfing. Thesis M.Sc. (Horti.), CCS Haryana Agricultural University, Hisar, India 2012, 64.
11. Pednekar DM. Effect of dates of sowing and spacing on growth, flowering yield and quality of china aster (Callistephus chinensis,) var. Ostrich Plume mixed under Konkan agroclimatic condition. Thesis M.Sc. (Agri.); Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli. 1998, 87.
12. Lawal A. Growth Response of Four Lawn Grass species to Spacing. Thesis M.Sc. (Horti.), Federal university of Agriculture, Abeokuta, Nigeria 2011, 40.
13. Panse VG, Sukhatme PV. "Statistical methods for agricultural workers" (*4th edn.*). ICAR Publication, New Delhi 1985, 87-89.
14. Qodliyati M, Supriyono, Nyoto S. Influence of spacing and depth of planting to growth and yield of arrowroot (*Marantha arundinacea*). Earth Environ. Sci. 2018;142(1):12-35.
15. Trenholm LE, Cisar JL, Unruh JB. Bermuda grass for Florida Lawns. University of Florida, Institute of Food and Agricultural Sciences, Electronic data transformation 2011;3:1-6.
16. Undhad K. Studies Performance of lawn species under saurashtra region. Thesis M.Sc. (Horti.), Junagadh Agricultural University, Gujarat 2018, 73.
17. Johnson PG, Rordan TP, Gaussion RE, Schwarze DJ, Kerner KA. Vegetative establishment of Buchole dactyloides (Nutt.) Engelm with plugs. Int. Turfgrass Soc. Res. J 1997;8:467-476.
18. Wadekar V, Patil P, Kadam G, Gawade N, Bhosale P. Evalution of lawn grasses based on the qualitative and morphological traits. Int. J Chem. Studies. 2018;6(4):1175-1.