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Effect of different varieties of *Cynodon dactylon* and Plant Spacing on Growth and Spreading of Turf under South Gujarat condition

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ABSTRACT: *Cynodon dactylon*, popularly known as Bermuda grass, is a typical warm-season grass that can tolerate drought stress and produce high-quality turf. The first and most crucial requirement for a well-established and appealing turf is the selection of the proper grass species and establishment methods. Good ground cover is accomplished with an appropriate planting technique. Therefore, when establishing a lawn, using the right method that is appropriate for particular grass species or varieties is more crucial. An experiment consists two factor, Factor-I was varieties of *Cynodon dactylon* grass (V_1: Tifdwarf, V_2: Selection-1, V_3: Locally available varieties) and factor-II was Spacing (S_1: 10 cm × 10 cm, S_2: 15 cm × 15 cm, S_3: 20 cm × 20 cm). According to the findings, dibble of *C. dactylon* var. Tifdwarf or Selection-1 planted at 10 cm × 10 cm distance favoured quick grass establishment, proper growth habit for less frequent lawn mowing, and higher visual quality score with deprived weed growth. Furthermore, V_3S_3 had the greatest root depth and the longest runner length. V_1S_3 (Tifdwarf planted at 20 cm × 20 cm) had the most nodes on the runner. However, least time for full turfgrass establishment and fresh weight of biomass at 60 DAP, were observed with V_1S_1. According to the findings, dibble of *C. dactylon* var. Tifdwarf or Selection-1 planted at 10 cm 10 cm distance favoured quick grass establishment, proper growth habit for less frequent lawn mowing and higher visual quality score with less weed growth.

Keywords: Establishment, Growth, Lawn, Spacing, Turfgrass, Varieties.

INTRODUCTION

A garden is a deliberately created area, typically outdoors, set aside for the exhibition, cultivation, or pleasure of plants and other natural elements as the perfect backdrop for communal or solitary human life. The millions of acres of turf grass on home lawns, commercial landscapes, road sides, parks, athletic fields, and golf courses have improved our quality of life, increased property value, and ultimately led to the preservation of natural resources in addition to providing open space, recreational facilities, and business opportunities. Any turfgrass needs to be installed and cared for correctly to be healthy for better appearance. With the application of an appropriate planting technique, good ground cover can be swiftly established (Chawla *et al.,* 2018). Turfgrass industry expanded with annual associated revenues in excess of $1.5 billion in the USA and maintained up to 30 million acres of turfgrass including parks, golf courses as well as besides of highway (Bertin and Weston 2002). According to the scarce data gathered by golf associations, sports experts and association of Indian nurserymen, turfgrass industry covers more than 30,000 acres, in which around 6000 acres is under turfgrass cultivation and sod production (Chawla *et al.*, 2018).

Therefore, choosing an appropriate strategy that works with specific grass species is more crucial when establishing a lawn (Christians *et al*., 2017). However, establishment decisions are based on the different grass kinds' and its growth patterns. Also, *Cynodon dactylon* spreads quickly and covers more ground as it is stoloniferous. The amount of space between planted sprigs significantly affects how far the plant spreads. The spacing between planted dibbles has a big impact on how quickly they spread.

MATERIAL AND PROCEDURES

The experiment was conducted from January 2020 to July 2020 at the Polytechnic in Horticulture, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Paria. Different parameters were taken under study and analysed in complete randomised design with factorial concept (FCRD) with nine treatment combinations. Two factors were used in the experiment: factor I, *Cynodon dactylon* grass varieties (V_1: Tifdwarf, V_2: Selection-1, and V_3: locally available variety), and factor II comprised of spacing (S_1: 10 cm × 10 cm, S_2: 15 cm × 15 cm, S_3: 20 cm × 20 cm). Observations were recorded during 30 and 60 days after planting for number of leaves present on runner, length of runner (cm), number of nodes present on runner, root depth (mm), fresh biomass (g/100 cm^2), total chlorophyll content (mg/100g) present in leaf of *Cynodon dactylon*. From the date of planting to the turfgrass's full (100%) establishment, the number of days required for its establishment was calculated. Whereas, visual appearance of turfgrass was recorded at 60, 90 and 150 days after planting.

RESULTS AND DISCUSSION

A. Effect of different varieties of Cynodon dactylon turfgrass

Data from Table 1 that showed how different types affected the overall number of days needed for turfgrass establishment. Turfgrass variety V_2 (Selection-1) required least time (53.11 days), and it was statistically comparable to variety V_1 in terms of establishment time (Tifdwarf). While, delay in fully turfgrass establishment (59.33) was noted in Local variety of *Cynodon dactylon*. Maximum number of leaves (42.87 and 77.98) on longest runner was recorded in variety Tifdwarf (V_1) whereas, minimum number of leaves (14.69 and 26.76) on longest runner was observed in Local varieties of *Cynodon dactylon* (V_3) both at 30 and 60 days after planting. The longest runners (21.31 cm and 33.56 cm) were found in local *Cynodon dactylon* varieties, while the shortest runners (14.98 cm and 24.88 cm) were found in the variety Tifdwarf (V_1) at 30 and 60 days after planting, respectively. Additionally, the variety Tifdwarf (V_1), which was statistically at par with Selection-1 at 30 DAP, had the highest number of nodes (6.36 and 14.87) present on runners at 30 and 60 days after planting. While Cynodon dactylon Local varieties (V_3) had the fewest nodes (4.89 and 11.78) on runners at 30 and 60 days after planting, respectively. The results summarized for number of nodes present on runner due to different varieties was found significant at 30 and 60 days after planting recorded in variety Tifdwarf (V_1), which was statistically at par with Selection-1 at 30 DAP. While the least number of nodes (4.89 and 11.78) present on runner were noted in *Cynodon dactylon* Local varieties (V_3). Root depth was significantly affected due to different *Cynodon dactylon* varieties at 30 DAP and 60 DAP. Significantly deepest root (52.44 mm and 81.44 mm) was noted in Local variety (V_3) at 30 DAP and 60 DAP, respectively. However, shallowest root depth (40.90 mm and 65.42 mm) was observed in Tifdwarf (V_1) at 30 DAP and 60 DAP, respectively. Among the different varieties, Selection-1 noted maximum fresh biomass (7.25 g /100 cm^2 and 23.90 g /100 cm^2) at 30 and 60 days after planting which was statistically at par with variety Tifdwarf (V_1) at 30 DAP. Whereas, lowest fresh biomass (5.78 g/100 cm^2 and 13.79 g/100 cm^2) was recorded in Local variety. The local variety (V_3), which was statistically comparable to variety Tifdwarf at 30 and 60 days after planting, had the highest levels of total chlorophyll (0.489 mg/100g and 0.739 mg/100g, respectively). While Selection-1 variety (V_2) was found to contain the least total chlorophyll (0.338 mg/100g and 0.541 mg/100g).

The least number of days needed for turfgrass establishment could be attributed to *Cynodon dactylon* superior performance and adaptability. Due to their ability to adapt to a specific environment and genetic make-up (Dudeck, 1990), both the variety Selection-1 and Tifdwarf established more quickly under the agroclimatic conditions of south Gujarat. Length of runner may vary from variety to variety and also change due to environmental effect with its adaptability to particular region. Increased in number of leaves and length of runner might be attributed to genetic constitution of varieties apart from various other factor such as hormones production, which was reported to influence the runner growth in turf grass species under stress conditions. Number of nodes per runner increased with the reduce in length of internode (Dhanalakshmi *et al*. 2013) ultimately it enhanced the node number by shorter internode difference. The root system might be varied with variety, management practices and response to weather variables by the cultivar. Genetic variation is the main reason among different grass species or cultivars for wide differences in root depth. Warm season turf grasses generally produced deep root system, highest root shoots growth due to easy and faster establishment, resulting produce more bio mass production and related to better physiological and morphological adaptations as it produced a comparatively higher number of stolons or runners which increased clipping yield (Janakiram and Namita 2014). Chlorophyll concentration is a quantitative quality indicator for turfgrass that represents how intense the colour green is. (Dhanalakshmi *et al*., 2018). The concentration of total chlorophyll in all species increased significantly at the end of summer and during the monsoon season. Because all warm-season grasses are well adapted in the summer, the chlorophyll content increased to its maximum during the warm months. Chlorophyll content is influenced by the species' genetic traits, growth conditions, biotic and abiotic stress, and adaptability to specific environments.

Table 1: Effect of different Varieties of *Cynodon dactylon* and plant spacing on Growth and spreading under South Gujarat Condition.

Treatment	Total days taken for 100 % turf establishment	Number of leaves present on runner		Length of runner (cm)		Number of nodes present on runner		Root depth (mm)		Fresh biomass (g/100 cm^2)		Total Chlorophyll content (mg/100g)	
		30 DAP	60 DAP	30 DAP	60 DAP	30 DAP	60 DAP	30 DAP	60 DAP	30 DAP	60 DAP	30 DAP	60 DAP
V_1: Tifdwarf	54.22	42.87	77.98	14.98	24.88	6.36	14.87	40.90	65.42	6.95	16.19	0.477	0.724
V_2: Selection-1	53.11	31.02	56.42	15.91	26.49	6.24	13.56	45.92	73.76	7.25	23.90	0.338	0.541
V_3: Local	59.33	14.69	26.76	21.31	33.56	4.89	11.78	52.44	81.44	5.78	13.79	0.489	0.739
S.Em. ±	0.40	0.57	1.05	0.38	0.56	0.28	0.24	0.99	1.00	0.11	0.33	0.007	0.010
C. D. at 5%	1.19	1.71	3.13	1.12	1.68	0.83	0.70	2.95	2.98	0.33	0.98	0.020	0.030
S_1: 10 cm×10 cm	51.00	26.02	47.36	16.22	25.03	5.51	11.13	12.44	67.51	7.38	25.55	0.422	0.655
S_2: 15 cm×15 cm	55.56	29.20	53.16	17.44	29.04	5.73	14.16	47.46	73.53	6.87	18.89	0.436	0.668
S_3: 20 cm×20 cm	60.11	33.36	60.64	18.53	30.84	6.24	14.91	49.07	79.58	5.73	9.44	0.447	0.681
S.Em. ±	0.40	0.57	1.05	0.38	0.56	0.28	0.24	0.99	1.00	0.11	0.33	0.007	0.010
C. D. at 5%	1.19	1.71	3.13	1.12	1.68	NS	0.70	2.95	2.98	0.33	0.98	NS	NS
V_1S_1	49.33	39.00	70.93	14.00	23.17	5.87	11.87	37.73	56.93	7.60	24.81	0.457	0.718
V_1S_2	53.33	42.33	77.07	14.87	27.73	6.27	15.53	42.37	64.20	7.00	15.13	0.473	0.717
V_1S_3	60.00	47.27	85.93	16.07	26.73	6.93	17.20	42.60	75.13	6.25	8.64	0.499	0.737
V_2S_1	48.67	26.93	49.07	15.00	25.00	5.67	11.20	42.20	68.13	7.99	33.82	0.340	0.514
V_2S_2	52.67	31.67	57.53	15.93	26.53	5.80	14.60	45.07	73.80	7.58	27.26	0.330	0.547
V_2S_3	58.00	34.47	62.67	16.80	27.93	7.27	14.87	49.60	79.33	6.17	10.61	0.345	0.561
V_3S_1	55.00	12.13	22.07	19.67	26.93	5.00	10.33	47.40	77.47	6.56	18.02	0.468	0.734
V_3S_2	60.67	13.60	24.87	21.53	35.87	5.13	12.33	54.93	82.60	6.03	14.29	0.503	0.740
V_3S_3	62.33	18.33	33.33	22.73	37.87	4.53	12.67	55.00	84.27	4.76	9.07	0.497	0.744
S.Em. ±	0.69	0.99	1.82	0.65	0.98	0.48	0.41	1.72	1.74	0.19	0.57	0.012	0.018
C. D. at 5%	2.06	NS	NS	NS	2.90	NS	1.21	NS	5.16	NS	1.70	NS	NS
C. V. %	2.16	5.83	5.88	6.48	5.98	14.36	5.29	6.44	4.09	5.06	5.53	4.68	4.61

Table 2: Effect of varieties and spacing on visual appearance of turfgrass.

Treatments	visual appearance (out of 10.0) of turfgrass		
	60 days	90days	150 days
V_1S_1	8.0	9.0	9.0
V_1S_2	7.0	9.0	9.0
V_1S_3	6.0	7.0	9.0
V_2S_1	7.0	8.0	8.0
V_2S_2	6.0	8.0	8.0
V_2S_3	5.0	7.0	8.0
V_3S_1	6.0	6.0	7.0
V_3S_2	4.0	5.0	6.0
V_3S_3	3.0	4.0	5.0

B. Effect of different plant spacing of Cynodon dactylon turf grass

The turfgrass was planted at 10 cm × 10 cm (S_1), which resulted in the fastest turfgrass establishment, and at 20 cm × 20 cm (S_3), resulted in the slowest turfgrass establishment (60.11 days). Spacing affects the speed of lawn establishment. The statistical analysis of the data stated that excessive number of leaves (33.36 and 60.64) on runner were found when turfgrass planted at 20 cm × 20 cm (S_3) at 30 DAP and 60 DAP, respectively. While the lowest number of leaves (26.02 and 47.36) on runners was noted when turfgrass planted at 10 cm × 10 cm (S_1) distance at 30 DAP and 60 DAP, respectively. Maximum length of runner (18.53 cm and 30.84 cm) at 30 DAP and 60 DAP was reported in turfgrass planted at 20 cm × 20 cm (S_3). At 30 DAP it was found statistically at par with spacing 15 cm × 15 cm (S_2). Least length of runner (16.22 cm and 25.03 cm) at 30 and 60 days after planting was found when turfgrass planted at 10 cm × 10 cm (S_1). The effect of spacing on number of node present on runner was found no significant at 30 days after planting but it was found significantly maximum number (14.91) at 60 DAP with spacing @ 20 cm × 20 cm (S_3). While, minimum number of nodes (11.13) present on runner after 60 DAP were turfgrass planted at 10 cm × 10 cm (S_1) distance. Maximum root depth (49.07 mm and 79.58 mm) was found at 20 cm × 20 cm (S_3) spacing @ 30 DAP and 60 DAP which was statistically at par with 15 cm × 15 cm (S_2) spacing only at 30 DAP. Moreover, it was observed minimum root depth (42.44 mm and 67.51 mm) with 10 cm × 10 cm (S_1) @ 30 and 60 days after planting, respectively. Significantly highest fresh biomass (7.38 g/100 cm^2 and 25.55 g/100 cm^2) was noted while turfgrass planted at 10 cm × 10 cm (S_1). However, minimum fresh biomass (5.73 g/100 cm^2 and 9.44 g/100 cm^2) was recorded at 30 DAP and 60 were turfgrass planted at spacing 20 cm × 20 cm (S_1). Data revealed that, effect of spacing with respect to total chlorophyll at 30 and 60 days after planting was found non-significant.

Closer spacing 10 cm × 10 cm results faster cover because narrow spacing had a large number of individual plants per unit area. Wide spacing, on the other hand, may have resulted in a poorly established lawn with barren places and patches (Thavaprakaash, 2018). Buffalo grass also showed a similar tendency, according to Johnson *et al.* (1997). The availability of better growth in each individual plant may be the cause of the increase in the number of leaves in the wider spacing (S_3 = 20 cm × 20 cm). Compared to turfgrass planted with narrow spacing, wide spacing got more light, which may have promoted more photosynthesis and healthy development (Bhatia *et al.*, 2017). The reason why runners can develop in sufficient space (S_3 = 20 cm × 20 cm) due to reduced competition for nutrients, light, and water. Additionally, each node developed a sizeable number of roots that were attached to the soil and participated in nutrient acquisition. This could be the reason for the runner's increased length (Dhanasekaran, 2018). The highest number of nodes are found at wider spacings, which gives runners adequate space to grow and due to less nutritional competition, produces the greatest number of runners with good length. This could prove that shorter runners generate more nodes. The result was in conformity with Ganvit *et al*. (2022) and Dhanasekaran (2018). In order for each plant to grow its roots and leaves, there needs to be the proper amount of space between them. In addition, leaving enough space between and around the plant may aid in preventing the transmission of infection while promoting strong and healthy growth (Dhanasekaran, 2018). Higher fresh biomass will come from closer spacing since it gives plants less opportunity to absorb enough water, light, and nutrients to raise fresh biomass, according to Priyadharshini, 2021.

C. Interaction effect of different plant spacing of Cynodon dactylon turf grass

The statistics clearly showed that the interplay between variety and spacing was important for full establishment. Earliness for the number of days needed for turfgrass to fully establish (48.67 days) was noticed in variety Selection-1, variety V2S1, which was statistically on par with variety Tifdwarf, variety V_1S_1 (49.33 days). However, with V_3S_3, the maximum number of days required for full establishment (62.33) was noted. In terms of the length of the runner, the interaction impact of V × S was found to be non-significant at 30 days after planting but significant at 60 days. In V_3S_3, which was statistically comparable to V3S2, the longest runner ever measured (37.87 cm) was received. While minimum length of runner (23.17 cm) was noted in variety Tifdwarf was planted at 10 cm × 10 cm (V_1S_1). Thirty days after planting, the interaction between V and S was found to have no significant impact on the number of nodes present on the runner of *Cynodon dactylon*. However, at 60 days after planting, the interaction effect of V × S with regard to the number of nodes present on the runner was shown to be significant. The greatest number of nodes (17.20) ever received on the runner was in V_1S_3. The local variety of *Cynodon dactylon* was planted at 10 cm × 10 cm (S_1) distance, and had the fewest nodes (10.33) on the runner. V_3S_3 had the largest root depth (84.27 mm), which was statistically comparable to the combination of V_3S_2 and V_3S_3. With V_1S_1, the smallest root depth (56.93 mm) was discovered. In V2S1, the maximum fresh biomass (33.82 g/100 cm^2) was noted at 60 DAP. The lowest fresh biomass measurement (8.64 g/100 cm^2) was made in V_1S_3 at 60 DAP.

Selection-1 and Tifdwarf *Cynodon dactylon* varieties planted with close spacing (10 cm × 10 cm) tend to cover quickly, which promotes early establishment. It might be because both kinds are more capable of adapting to environmental conditions at close plant spacing for rapid establishment. Lawal (2011) found the same results in turfgrass. Length of runner found non-significant at 30 DAP as late establishment of this grass. Later, it showed significant increase in length of runner at 60 DAP due to availability of wider space. The result was also in conformity with Dhanasekaran (2018) and Lawal (2011). The interaction effect was found significant at 60 DAP for number of nodes present on runner is might be due to morphological characters of grass. Number of runners increased with the decreasing in runner length which was completely dependent on internodes length and resulted a greater number of node present on runner. This may confirm that availability of more space allows it to spread more and utilize maximum nutrients from the soil. Maximum root depth may result from modifying the environment and management strategies to promote root growth and is required to maximize the health of a certain kind of plant. Increased glucose production and photosynthesis enable the plant to move more of its carbohydrate supply to the roots, increasing root mass and depth. The genetic feature that causes a higher growth rate may be the cause of the higher fresh biomass. Because there was more chance for nutrient absorption at closer spacing, higher vegetative development was seen.

From Table 2 the visual appearance of *Cynodon dactylon* effect of different varieties and spacing at 60 days, 90 days and 150 days experimentation and it was scored out of 10 which is represented by Table 2. Visual appearance of *Cynodon dactylon* at 60 days was recorded maximum score (8) in V_1S_1 with superior quality followed by V_1S_2, V_2S_1. Whereas, lowest visual score (3) was recorded in V_3S_3. At 90 DAP, visual appearance of *Cynodon dactylon* was noted maximum score (9) in V_1S_1 and V_1S_2 with superior quality followed by V_2S_1 and V_2S_2. Whereas, lowest visual score (4) was observed in V_3S_3. Visual appearance of *Cynodon dactylon* at 150 days was noted maximum visual appearance score (9) in V_1S_1, V_1S_2, V_1S_3 and V_2S_1 with superior quality followed by V_2 S_1, V_2S_2 and V_2S_3. Whereas, lowest visual score (5) was recorded in V_3S_3.

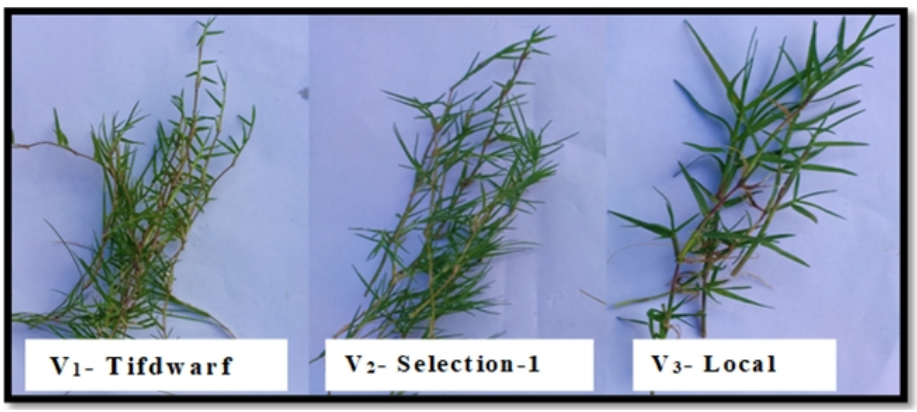

Fig. 1. Different varieties of turfgrass.

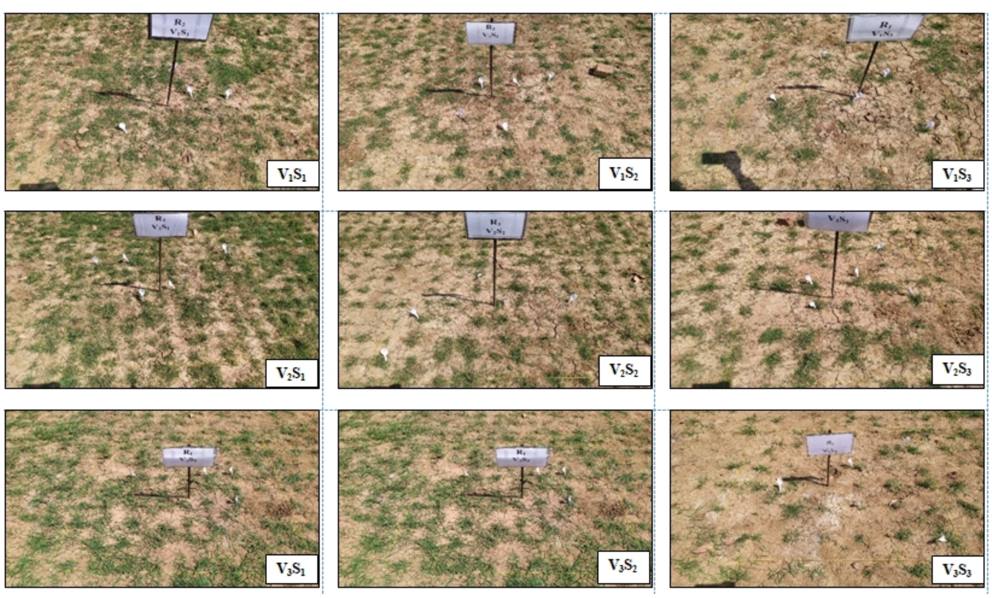

Fig. 2. Effect of varieties and spacing on growth after 30 days of planting.

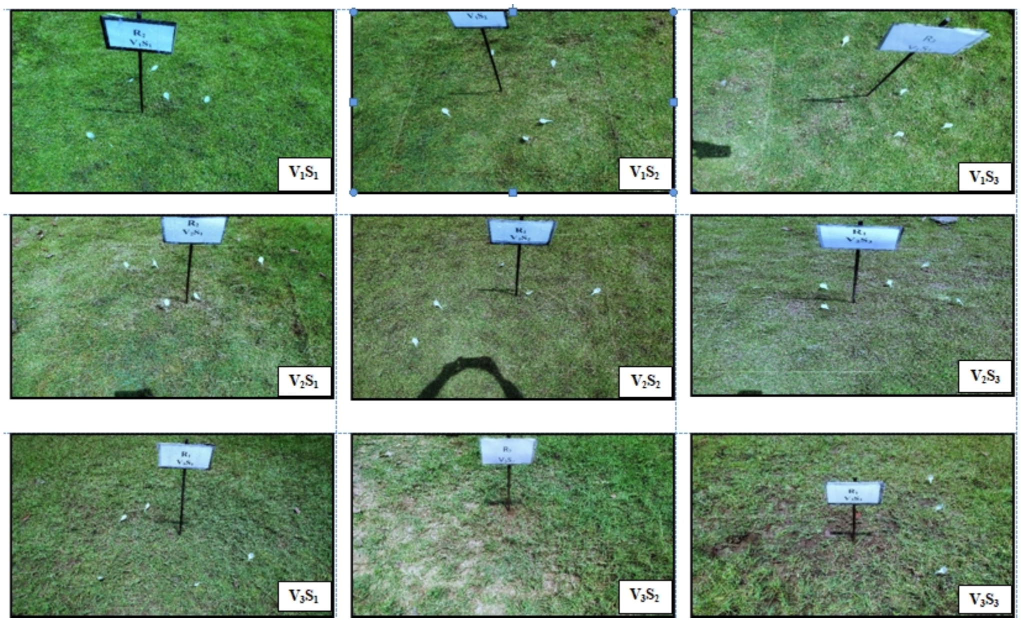

Fig. 3. Effect of varieties and spacing on visual appearance of turfgrass after 60 days of planting.

CONCLUSION

The results and discussion thus far lead to the conclusion that a dibble of *Cynodon dactylon* var. Tifdwarf or Selection-1, favours quick turf establishment, an appropriate growth habit for less frequent lawn mowing, and higher visual quality scores with deprivative weed growth when placed at a distance of 10 cm × 10 cm.

FUTURE SCOPE

The amount of time needed to create a turf depends upon many factors including, the availability of water, the type of grass and the type of soil. Cost of making turf can be reduced by adopting wide spacing for sufficient time for turf making. On the contrary, spacing can be reduced so that turf can be prepared in very short time for better establishment.

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Conflict of Interest. None.

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