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The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; SP-12(9): 1143-1147

www.thepharmajournal.com
Received: 01-08-2023
Accepted: 04-09-2023

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Effect of different weed management practices on vegetative growth of turf grasses under Chhattisgarh plains condition

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Abstract
The present investigation entitled Effect of different weed management practices on vegetative growth of turf grasses under Chhattisgarh plains condition accomplished at Thakur Chhedilal College of Agriculture and Research Station in Bilaspur Chhattisgarh during the year 2021-2023. The experiment was conducted in factorial randomized complete block design (FRCBD) with two turf grasses *Cynodon dactylon* × *C. transvelensis* var. 'Tifdwarf' (C_1) and *Zoysia japonica* (C_2) and six weed management practices W_1- Weedy check, W_2- Soil Solarization, W_3- Pendimethalin 1.0 kg ha^{-1} PE fb HW 50 and 75 DAP, W_4- Metsulfuron methyl 4 g ha^{-1} + sulfosulfuron 25 g ha^{-1} (20 to 25 DAP) fb HW 50 and 75 DAP, W_5- Pendimethalin 1.0 kg ha^{-1} + Metsulfuron 4 g ha^{-1} + sulfosulfuron 25 g ha^{-1} (20 to 25 DAP) one HW 75 DAP and W_6- Weed free (three HW 20,40 and 60 DAP) replicated thrice at a time with twelve interaction. Significantly early new growth appearance, fast 90% area coverage recorded under C_1W_5, shortest length of internode, longest length of leaves, highest number of leaves, longest shoot length, highest shoot density, root density and highet root length recorded under C_1W_5.

Keywords: Turf, weed management practices and vegetative growth

Introduction
The centrepiece of any landscape and a necessary component of any garden is the lawn. Any lawn must be properly installed and maintained in order to be healthy and appear its best (Randhawa and Mukhopadhyay, 1986) [18]. According to its use lawn is also called as turf, pitch, field, yard and sod. At least 60%-75% area of a garden should be devoted to lawn (Bhargav *et al.* 2020) [3]. Super most important component in lawn is the grasses that create mat like structure which serves the aesthetic and recreational impetus. A well established lawn is a best place to adore the beauty and loveliness of the garden plants with various garden features. Lawn participate in social harmony and also furnish better exercise space for humnan well being to being healthy (Jankiram and Namita 2015) [15]. On the basis of climatic requirements, grasses are categorize into two major group first one is cool season grasses and second one is warm season grasses. Warm season grasses are thrive in temperatures between 25 and 35 degrees Celsius. example: zoysia grass (*Zoysia species*), Bermuda grass (*Cynodon species*), St. Augustine grass (*Paspalum species*), centipede grass (*Eremachloa*), carpet grass (*Axonopus*), buffalo grass, and grama grass.

Cynodon dactylon, frequently referred to as Bermuda grass (Fishel and Coats, 1994; Samples and Sorochan, 2007) [10, 19] this plant is indigenous to Africa. Dub grass is a perennial that produces dense sods and spreads through stolons, rhizomes, and seed. The nodes quickly generate stolons. At the nodes, lateral buds emerge to produce 5–40 cm tall, erect or ascending stems. The offspring of interspecific crossings between *Cynodon dactylon* and *Cynodon* transvalensis are hybrid Bermuda grasses. These hybrids should be multiplied by sprigs, stolons, or sodding as their seeds are infertile. Tifgreen, Tifdwarf, Tifsport, Tifton 85, Tifton 78, and Coastal are examples of common hybrids.

Zoysia species: The attractive turf-forming *Zoysia* grasses (Zoysia spp.) are importation from Asia to the United States. Numerous *Zoysia* grass species and cultivars are used for lawns in private residences, including Cashmere zoysiagrass, Japanese or Korean Lawngrass, Meyer zoysiagrass, Matrella zoysiagrass or Manilagrass, Mascarenegrass, Emerald zoysiagrass, Belaire zoysiagrass, and El Toro zoysiagrass. (Unruh *et al.*, 2006; Samples and Sorochan, 2007) [21, 19].

Materials and Methods

The present investigation entitled Effect of different weed management practices on vegetative growth of turf grasses under Chhattisgarh plains condition accomplished at Thakur Chhedilal College of Agriculture and Research Station in Bilaspur Chhattisgarh during the year 2021-2023. The experiment was conducted factorial randomized complete block design in twelve treatments with three replication where two turf two turf grasses *Cynodon dactylon* × *C. transvelensis* var. 'Tifdwarf' (C_1) and *Zoysia japonica* (C_2) and six weed management practices W_1- Weedy check, W_2- Soil Solarization, W_3- Pendimethalin 1.0 kg ha^{-1} PE fb HW 50 and 75 DAP, W_4- Metsulfuron methyl 4 g ha^{-1} + sulfosulfuron 25 g ha^{-1} (20 to 25 DAP) fb HW 50 and 75 DAP, W_5- Pendimethalin 1.0 kg ha^{-1} + Metsulfuron 4 g ha^{-1} + sulfosulfuron 25 g ha^{-1} (20 to 25 DAP) one HW 75 DAP and W_6- Weed free (three HW 20,40 and 60 DAP) interact with each other. The treatment combination of present investigation are T_1- C_1W_1, T_2- C_2W_1, T_3- C_1W_2, T_4- C_2W_2, T_5- C_1W_3, T_6- C_2W_3, T_7- C_1W_4, T_8- C_2W_4, T_9- C_1W_5, T_{10}- C_2W_5, T_{11}- C_1W_6 and T_{12}- C_2W_6.

All the parameters are recorded in 2021-2022 and 2022- 2023. Only pooled data are presented here. Length of leaves, number of leaves and shoot density recorded under March, April and May month after dibbling of grasses and only may month data of both year are presented here.

Results and Discussion

New growth appearance (DAP)

Cultivars tifdwarf recorded earliest new growth appearance under tifdwarf (9.31 DAP) while slowest under *Zoysia* (22.36 DAP) whereas for best weed management practices to enhance early growth of lawn grasses was under W_5 (13.93 DAP) while slowest growth appearance under W_1 (19.25 DAP). However, interaction effect fastest new growth appearance was found under T_9 (8.20 DAP) and delayed growth observed under T_2 (27.50 DAP).

90% Lawn establishment (DAP)

Pooled mean for both the year for cultivars tifdwarf has early coverage of 90% of given area (18.36 DAP) while *Zoysia* is too late in growth and also found very delayed coverage (53.48 DAP). Weed management practices to enhance early ninety percent growth of lawn grasses was resulted under W_5 (31.72 DAP) and lowest under W_1 (42.90 DAP) however, interaction effect highest seen in T_9 and earliest 90% growth resulted (13.33 DAP) and lowest effect was seen under T_2 (58.67 DAP) which take longest time for ninety percent emergence of new leaves. Among all the grasses, Bermuda grass which is scientifically known as *Cynodon dactylon* and its cultivars (planting through dibbling) has the fastest rates of growth. It colonises quickly and creates a dense mat the reason may be its habitat, its genotypic makeup, and its superior adaptability (Beard, 1989 and Croce *et al.* 2003) [2, 7] whereas *Zoysia* species took longest time for new growth appearance and had slowest development rate. The findings is supported by Severmutlu *et al.* (2011) [20], Geren *et al.* (2009) [11], Harivandi *et al.* (1984) [13].

Length of internode

Variety "tifdwarf" resulted shortest length of internode (1.080 cm) whereas under *Z. Japonica* recorded longest intermodal length (1.140 cm respectively). Among weed management practices W_5 resulted shortest intermodal length (0.993 cm) followed by W_3 (1.071 cm) and the longest intermodal length (1.203 cm) was recorded under W_1 (control) where no weed management practices applied. Longest length of internode (1.218 cm) was recorded under treatment T_2 (C_2W_1) where *zoysia* planted at control plot whereas shortest length of internode (0.916 cm) was observed under treatment T_9 (C_1W_5) followed by T_5 (1.020 cm). Denser turf is the result of shorter intermodal length. Longer intermodes make appearance thin and sparse, shoot density also reduces drastically which makes turf grass less appealing. (Komma, 2003) [16].

Length of leaves

Length of leaves significantly affected by different weed management practices. Maximum length of eaves observed under tiffdwarf C_1 (2.23) and lowest with *Zoysia japonica* C_2 (1.75). Longest length of leaves (2.63) was found under W_5 whereas lowest under W_1 (1.77). Longest length of leaves resulted in treatment T_9 (2.85) which was statistically *at par* with T_5 (2.59) while minimum length of leaves resulted under T_2 (1.71).

Number of leaves per shoot

Number of leaves per shoot was highest (21.35) under "Tifdwarf" (C_1) and lowest (20.50) in cultivar Z. Japonica (C_2). Highest number of leaves per shoot (25.61) was recorded under W_5 followed by W_3 (24.20) whereas lowest number of leaves per shoot (16.71) recorded in control plot (W_1). Highest number of leaves observed under treatment nine C_1W_5 (26.86) whereas lowest number of leaves per shoot recoded under treatment two C_2W_1 (15.95). Variety tifdwarf was better performing than zoysia japonica the reason may be that the herbicide application in the early stages of grass development, followed by hand weeding in the later stages of growth, may have resulted in decreased weed competition. (Chandolia *et al.* 2010) [6]. The plant has favourable environment to grow its leaf blades to their fullest potential with low density of weeds. T_1 and T_2 Recorded the fewest number of leaf blades. Reason may be more number of weed species which has made it harder for doob grass to flourish effectively. The same results were noted by Edossa (2015) [9].

Shoot length

Shortest shoot length (15.30) recorded under *Z. Japonica* (C_2), whereas variety "Tifdwarf" resulted longest length of shoot (16.11). W_5 resulted longest shoot length (18.41) followed by W_3 (16.98) whereas shortest length of shoot (13.64) recorded under control plot *i.e.* W_1. Longest shoot length (9.00) was recorded under the treatment nine (C_1W_5) where turf variety "Tifdwarf" treated with pre and post emergence herbicide with one hand weeding, whereas shortest shoot length (13.31) recorded in treatment two T_2 (C_2W_1) where turf variety *Z. Japonica* dibbled with no weed management practices. Cultivar tifdwarf was performing better with different weed management practices the reason may be, the conditions of minimal crop-weed competition, availability of adequate sun light, optimal temperature, adequate space leads to improvements in the physiological and morphological characteristics of the plants which can lead to higher photosynthetic rates resulted in more accumulation of plant dry matter and longer shoots (Duncan, 1971) [8]. similar results were found by Chattha *et al.* 2007 [5].

Shoot density

Highest shoot density recorded under Tifdwarf C_1 (247.38)

and lowest shoot density resulted under *Zoysia Japonica* C_2 (225.88). Highest shoot density found under weed management practices W_5 (338.97) whereas lowest under W_1 (151.62). Highest shoot density recorded under treatment nine C_1W_5 (374.48) whereas minimum shoot density observed under T_2 (150.38). Treatment nine (C_1W_5- Tiffdwarf+ Pendimethalin 1.0 kg ha^{-1} + Metsulfuron 4 g ha^{-1} + sulfosulfuron 25 g ha^{-1} (20 to 25 DAP) one HW 75 DAP) resulted significantly highest shoot density the reason may be sulfosulfuron inhibits the synthesis of *acetolactate synthase* (ALS) which is an enzyme involved in the synthesis of the branched-chain amino acids isoleucine, valine, and leucine in susceptible plants according to Chaleff and Mauvais 1984 [4]. Susceptible species are generally not capable of metabolizing sulfonylreas by hydroxylation of the phenyl ring by cytochrome P-450 (Hinz *et al.* 1997) [14]. I annual grasses weed, patterns of susceptibility are related to their ability to metabolize sulfosulfuron. Weed species responces to sulfosulfuron show reductions in shoot biomass (Blackshaw and Hamman 1998) [1] and overall growth of weeds which increases number of shoots of beneficial plants (Geier and Stahlman 1996) [12].

Root length

Tifdwarf had significantly longest root length (17.60) while short length of root recorded under *z. Japonica*. (16.31). W_5 resulted longest length of root (19.42) which was *at par* with W_3 (18.30) while minimum root length (14.03) recorded under W_1. However highest interaction effect with maximum root length found under T_9 (20.28) which was *at par* with T_5 (19.28) and T_{10} (18.55) whereas minimum root length recorded under T_2 (13.54).

The result revealed that significantly highest root length found under treatment nine. The reason behind better root length in T_9 may be due to in the early stages suppression of weeds by the herbicide and at later stage due to the hand weeding. Under lowest crop-weed competition, adequate availability of light, favourable temperature, availability of adequate space along with improvement in physiological and vegetative characters of the plant may be responsible for better and greater photosynthetic rate for more accumulation of plant dry matter and increased root length the result are in conformity with Duncan, 1971 [8].

Root density

Highest root density recorded under cultivar tifdwarf (41.75) whereas lowest root density (38.25) was recorded under *zoysia japonica*. Among weed management practices highest root density (50.96) was reported in W_5 while lowest root density (30.88) was recorded in control plot (W_1). Interaction effect of turf grasses with different weed management practices significantly influence the density of root. Highest root density (54.01) recorded under C_1W_5 (T_9) whereas Lowest root density (29.73) was observed under T_2 where *Zoysia* planted under control plot (C_2W_1).

Treatment nine had both pre and post emergence herbicide so significantly keeled the weed and increases number of desired plants in field and root density increases proportionally with increasing number of desired turf shoot (Willard and Currey 1985) [22].

Table 1: Effect of different weed management practices on vegetative growth of turf grasses under Chhattisgarh plains condition

Treatments		New growth (DAP)	90% Growth (DAP)	Length of Internode (cm)	Length of leaves (cm)	Number of leaves
Turf variety (C)						
C_1	Tifdwarf	9.31	18.36	1.080	2.23	21.35
C_2	*Zoysia Japonica*	22.36	53.48	1.140	1.75	20.50
SE(m)		0.33	0.33	0.013	0.045	0.33
C.D. at 5%		0.98	0.98	0.038	0.12	0.96
Weed Management Practices (W)						
W_1	Weedy check	19.25	42.90	1.203	1.77	16.71
W_2	Soil Solarisation	16.33	36.90	1.157	1.86	18.87
W_3	Pendimethalin 1.0 kg ha^{-1} PE fb HW 50 and 75 DAP	14.67	33.75	1.071	2.07	24.20
W_4	Metsulfuron methyl 4 g ha^{-1} + sulfosulfuron 25 g ha^{-1} (20 to 25 DAP) fb HW 50 and 75 DAP	15.58	35.18	1.105	1.82	20.82
W_5	Pendimethalin 1.0 kg ha^{-1} + Metsulfuron 4 g ha^{-1} + sulfosulfuron 25 g ha^{-1} (20 to 25 DAP) one HW 75 DAP	13.93	31.72	0.993	2.63	25.61
W_6	Weed free (three HW 20,40 and 60 DAP)	15.25	35.08	1.127	1.82	20.86
S.E(m)		0.57	0.58	0.023	0.075	0.58
C.D. at 5%		1.69	1.69	0.067	0.22	1.66
Interaction		S	S	S	S	S

Note: Pooled data from 2021-2023

Table 2: Interaction effect of grasses and weed management practices on vegetative growth of turf grasses under Chhattisgarh plains condition

Treatments		New Growth (DAP)	90% Growth (DAP)	Length of Internode (cm)	Length of leaves (cm)	Number of leaves
T_1	C_1W_1	11.00	27.13	1.188	1.81	17.47
T_2	C_2W_1	27.50	58.67	1.218	1.71	15.95
T_3	C_1W_2	9.67	19.40	1.138	1.98	18.79
T_4	C_2W_2	23.00	54.40	1.175	1.73	18.95
T_5	C_1W_3	9.00	15.76	1.020	2.59	24.98
T_6	C_2W_3	20.33	51.73	1.130	1.54	23.43
T_7	C_1W_4	9.50	17.93	1.106	2.15	21.47
T_8	C_2W_4	21.66	52.43	1.105	1.48	20.17
T_9	C1W5	8.20	13.33	0.916	2.85	26.86
T_{10}	C_2W_5	19.67	50.10	1.073	2.41	24.36
T_{11}	C_1W_6	8.50	16.63	1.116	2.00	21.55
T_{12}	C_2W_6	22.00	53.53	1.138	1.64	20.18
S.E(m)		0.80	0.81	0.033	0.105	0.82
C.D. at 5%		2.39	2.40	0.095	0.31	2.36

Table 3: Effect of different weed management practices on vegetative growth of turf grasses under Chhattisgarh plains condition

Treatments		Shoot length (cm)	Shoot density (no./100 cm^2)	Root length (cm)	Root density (no./100 cm^2)
Turf grasses					
C_1	Tifdwarf	16.11	242.6	17.60	41.75
C_2	*Zoysia Japonica*	15.30	215.7	16.31	38.25
SE(m)		0.11	2.81	0.37	0.54
C.D. at 5%		0.32	8.11	0.59	1.56
Weed management practices					
W_1	Weedy check	13.64	150.9	14.03	30.88
W_2	Soil Solarisation	14.50	172.1	15.89	33.11
W_3	Pendimethalin 1.0 kg ha^{-1} PE fb HW 50 and 75 DAP	16.98	269.0	18.30	45.69
W_4	Metsulfuron methyl 4 g ha^{-1} + sulfosulfuron 25 g ha^{-1} (20 to 25 DAP) fb HW 50 and 75 DAP	15.07	226.8	16.71	38.96
W_5	Pendimethalin 1.0 kg ha^{-1} + Metsulfuron 4 g ha^{-1} + sulfosulfuron 25 g ha^{-1} (20 to 25 DAP) one HW 75 DAP	18.41	315.4	19.42	50.96
W_6	Weed free (three HW 20,40 and 60 DAP)	15.65	240.9	17.40	40.40
SE(m)		0.19	4.87	0.66	0.94
C.D. at 5%		0.56	14.05	1.89	2.71
Interaction		S	S	S	S

Table 4: Interaction effect of grasses and weed management practices on vegetative growth of turf grasses under Chhattisgarh plains condition

Treatments		Shoot length (cm)	Shoot density (no./100 cm^2)	Root Length (cm)	Root density (no./100 cm^2)
T_1	C_1W_1	13.95	151.8	14.53	32.03
T_2	C_2W_1	13.31	150.0	13.54	29.73
T_3	C_1W_2	15.08	177.2	16.05	34.13
T_4	C_2W_2	13.92	167.0	15.73	32.10
T_5	C_1W_3	17.70	290.3	19.28	49.51
T_6	C_2W_3	16.27	247.6	17.31	41.86
T_7	C_1W_4	15.28	242.1	17.65	39.80
T_8	C_2W_4	14.85	211.5	15.76	38.13
T_9	C1W5	19.00	343.7	20.28	54.01
T_{10}	C_2W_5	17.82	287.1	18.55	47.91
T_{11}	C_1W_6	15.64	250.5	17.83	41.00
T_{12}	C_2W_6	15.66	231.4	16.96	39.80
SE(m)		0.28	6.89	0.93	1.33
C.D. at 5%		0.79	19.87	2.68	3.84

Conclusion

Early new growth appearance, fast 90% area coverage recorded under C_1W_5, shortest length of Internode, longest length of leaves, highest number of leaves, longest shoot length, highest shoot density, root density and highest root length recorded under C_1W_5, The reason behind may be having both pre-emergence and post- emergence herbicide along with one hand weeding provided more space and less crop weed competition to turf grasses and Tifdawrf also having genetic makeup for fast growth than *Zoysia japonica*

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