Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(4): 553-557
Received: 14-05-2018
Accepted: 18-06-2018

M Kichenaradjou
Research scholar, Floriculture and Landscaping, TNAU, Tamil Nadu, India

M Jawaharlal
Dean, HC&RI, TNAU, Coimbatore, Tamil Nadu, India

R Arulmozhiyan
Professor, (Horticulture), TNAU, Killikulam, Tamil Nadu, India

H Vijayaraghavan
Dean, Adiyamaan College of Agriculture, TNAU, Athimugam, Tamil Nadu, India

D Jayakumar
Professor, (SS&AC), HC&RI (W), TNAU, Tiruchirappalli, Tamil Nadu, India

Dr. B Muralidharan
Teaching Assistant, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

Correspondence
M Kichenaradjou
Research scholar, Floriculture and Landscaping, TNAU, Tamil Nadu, India

Evaluation of ornamental groundcovers on physiological and quality parameters in salt affected soil condition

M Kichenaradjou, M Jawaharlal, R Arulmozhiyan, H Vijayaraghavan, D Jayakumar and Dr. B Muralidharan

Abstract
An experiment was performed to study the salinity tolerance of groundcovers under open field condition, on basis of physiological and quality parameters. Ten groundcovers were evaluated by physiological parameters *viz.*, dry weight, proline content and quality parameters *viz.*, scoring for aesthetic value and cost of establishment. Dry weight is associated with the growth rate of a groundcover species. In the present study, the groundcover species *Wedelia trilobata* (13.50g) and *Syngonium podophyllum* (12.80g) has recorded the highest dry weight, in proline content highest proline content recorded in *Wedelia trilobata* (4.75mg g^{-1}) followed by *Portulaca grandiflora* (4.62 mg g^{-1}) and scoring for aesthetic values maximum recorded in *Portulaca grandiflora* (65%), followed by *Wedelia trilobata* (60%) and cost of establishment, the lowest cost recorded in *Portulaca grandiflora* and *Wedelia trilobata* (Rs $90m^{-2}$) compared to remaining groundcovers. Among the ten groundcover species, *Wedelia trilobata* and *Portulaca grandiflora* has shown high salinity tolerance and low cost groundcovers.

Keywords: groundcovers, salinity tolerance, evaluation, proline estimation, dry matter production

Introduction
Groundcovers are another important group of plants which lend beauty, colour, flowers and foliage to the landscapes. They grow to beautify the areas in an economical manner, because they are low cost, permanent in nature and require less maintenance. Their utilization is not limited to one sort of planting. Groundcovers are a diversified group of trailing or spreading species that naturally form a continuous soil covering. They typically range in height from 7.5 cm to nearly 1.0 m tall and may be woody, herbaceous, and succulent. These groundcovers can be hardier and better adapted to a range of conditions than traditional turf grasses. Groundcovers used in landscaping, can be considered all the species and varieties that provide aesthetic pleasure, improve the environment and the quality of our lives. This definition is, however, rather imprecise because these plants are used around the world and consequently the concept of 'ornamental' is ambiguous because it includes very important cultural differences (Savé, 2009) [21]. Groundcover plants are also used to restore disturbed landscapes, control erosion and reduce energy and water consumption, to improve the aesthetic quality of urban and rural landscapes, recreational areas, interiorscapes and commercial sites. evaluate the salt tolerant groundcovers under open field conditions

In addition to shortage of freshwater resources, soil and water salinity problems are increasing in many regions. Saline soil are a major global problem inorganic ions in these soils reduce vegetative vigour, plant growth and health thus, limiting production (Pessarakli and Szabolcs, 1999) [19]. Saline soil covers ~954.8Mha globally and present on every continent (Pessarakli and Szabolcs, 1999 and FAO, 2017) [19, 6]. Approximately 12% of global land area is suitable for agriculture, equating to 1.5 billion ha. However, much of this land is forested, protected as wilderness or in urban use (FAO, 2013) [5]. Arable land is limited by salinity, estimate that, 20% of irrigated land and 2% of dryland agriculture is affected. Environmental salinity is increasing with ever-increasing needs of human population. While FAO, (2005) [7] reported that 397 million ha area is comprised of saline soil and 434 million ha is sodic. In India 8.1 million ha of land have been affected by various soil problems including salinity and alkalinity etc.

Under saline conditions, turfgrass, show reduced growth, tissue dehydration, nutritional imbalances specific ion toxicities, slow recovery from injury and poor soil due to long-term persistence. The grasses do not get food material and result of this tissue dehydration occurs which indirectly affects photosynthesis.

Due to nutritional imbalance and the plants show poor performance and it will be thinned. Under specific ion toxicities, the groundcovers eventually die and their recovery is also very much doubtful.

Scientific research on effect of salinity on groundcovers is in infant stage and the findings of preliminary studies are not well documented. Keeping in view of the above facts, the present study 'Evaluation of groundcovers in salt affected soil ecosystem' was taken up with the objectives, to evaluate the salt tolerant groundcovers under open field conditions.

Materials and Methods

Field experiment was conducted in the Horticultural College and Research Institute for Women, Tamil Nadu Agricultural University, Tiruchirappalli, During 2016-2017. The experimental plot size of 1.00 m X 2.25m, for growing the groundcover species under open field condition. Sandy clay loam parent material basaltic genesis was used as medium. The experimental field was ploughed up to the depth of 30 cm. The soil EC 0.78 to 1.68 dSm^{-1} organic carbon 0.83 per cent, pH ranges from 8.31 to 8.98. Temperatures range between 18.00 to 43.5 ºC, RH 41 to 86 per cent. The irrigation water quality with EC 1.2 dSm^{-1}, pH 9.0, TSS 688ppm, Ca 30 mg g^{-1}, Mg 30 mg g^{-1}, Na 185 mg g^{-1} Bicarbonate 231 mg g^{-1}, SAR 5.3 m^{-2}. Average rainfall during the cropping period was 68.7mm in 2016 and 43.85mm in 2017.

Planting materials of ten groundcovers species were examined in this study, which were salinity tolerance based on earlier findings of Liu *et al*., 2009 [14] seedlings of each groundcovers species were collected from botanical garden Tamil Nadu Agricultural University, Coimbatore and Horticultural College and Research Institute for Women, Tiruchirappalli. Tamil Nadu Agricultural University. *Setcreasea purpurea*, *Wedelia trilobata*, *Verbena officinalis*, *Syngonium podophyllum*, *Hemigraphis colorata*, *Portulaca grandiflora*, *Zebrina pendula*, *Chlorophytum comosum*, *Cuphea hyssopifolia* and *Ficus repens*, were used in this study. The experiment was laid out in randomized block design and planting by raised bed method in 0.30 x 0.30 M in spacing were irrigated with borewell watering twice a day in the initial period by using a hose pipe, after establishment the irrigation frequencies extended based on their requirements. Hand weeding was carried out at frequent intervals in all stages of its growth. The physiological parameters *viz*., Dry matter production (Lee *et al.*, 2004) [12], proline content (Bates *et al*. (1973) [1] and Quality parameters *viz*., scoring for aesthetic value.

Statistical analysis

The experiment was conducted randomized block design to understand the effect of treatments for the different parameters examined in turf and groundcovers in the field and mean comparisons were made after computing LSD values and ANOVA with $P<0.05$ level. All the statistical analysis was achieved utilizing the statistical analysis software AGRES.

Result and Discussion

Physiological parameters

Dry matter production

The significant variations were observed among the groundcover species, growing conditions and their interactions for dry matter production were estimated at the end of the experiment and the results are presented are in the Table 1. Among the ten groundcover species, *Wedelia trilobata* (T_2) showed maximum dry matter production with 13.50 g, followed by *Syngonium podophyllum* (T_4) with 12.80 g and *Verbena officinalis* (T_4) with11.60 g. The minimum value was observed in *Hemigraphis colorata* (T_5) (2.20 g).

Dry weight is associated with the growth rate of a groundcover species. In the present study, the groundcover species *wedelia trilobata* and *Syngonium podophyllum* had higher dry weight compared to *Ficus repens*, which implies that the former two groundcover species had greater growth rate compared to the latter species. This might be due to the inherent genetic trait that is responsible for variation in growth rate. Increased biomass is directly related to greater photosynthetic activity of the groundcover species. Similar observations were reported by Paiva *et al*. (2003) [18] in *Tradescantia pallilda*, Maria (2011) [15] in *Aptenia cordifolia* and Dias *et al*. (2007) [4] in *Lithraea molleoides*. The similar observations have been reported earlier by Grace *et al*. (2015) [8].

Proline (mg g^{-1})

Significant variation in the proline content of all groundcovers species was recorded and the results are presented in Table 2. Among the groundcover species, the highest proline content was recorded in *Wedelia trilobata* (T_2) with 1.81, 4.28 and 8.17 mg g^{-1} at 2 MAP, 4 MAP and 6 MAP respectively, followed by *Portulaca grandiflora* (T_6) of 1.77, 4.19 and 7.89 mg g^{-1} at 2 MAP, 4 MAP and 6 MAP respectively. While the treatment *Zebrina pendula* (T_7) has recorded the least proline content with 0.61, 2.81 and 5.28 mg g^{-1} at 2 MAP, 4 MAP and 6 MAP respectively.

The high proline rates were observed in *Wedelia trilobata* and *Portulaca grandiflora* shows the adaptability of these species to stress conditions and trafficking. This observation reveals the scope of utilizing these groundcover species under abiotic stress conditions, especially salt affected soil condition and drought stress. These results are on par with those of Vivek (2010) [23]; Nithin (2011) [17]. More support to these observations comes from the reports of Shi *et al*. (2012) [22] who had reported about the drought tolerance mechanism promoted in *Cynodon dactylon*, *Cynodon transvaalenis* owing to its high proline content. In *Wedelia trilobata* and groundcovers the similar results have been reported earlier by Grace *et al*., (2015) [8].

Further corroboration comes from Levitt (1980) [13] who has reported on clod Hardiness in *Cynodon dactylon* by high levels of proline. It plays an important role in stress tolerance, including osmotic adjustment, protein and membrane stabilization, gene induction, reactive oxygen scavenging, N and C source and a reduction equivalent source during stress recovery (Rudolph *et al*., 1986; Delauney and Verma, 1993; Hare and Cress, 1997; Iyer and Caplan, 1998; Brugiere *et al*., 1999) [20, 3, 9, 11, 2].

Quality parameters

Scoring for aesthetic value under open field condition

Among the ten groundcover species, *Portulaca grandiflora* (T_6) was rated 'Excellent' by 65 per cent of evaluators followed by *Wedelia trilobata* (T_2) which was rated 'Excellent' by 60 per cent of evaluators. The poorest performing species was *Ficus repens* (T_{10}) with 50 per cent evaluators rating it as 'Very poor'.

Groundcovers attracts aesthetic values of visualizes. In the present study, scoring for aesthetic value revealed that *Portulaca grandiflora* and *Wedelia trilobata* scored the highest value under salt affected soil ecosystem, these two

species along with two more species namely *Chlorophytum comosum* and *Hemigraphis colorata* gained 'Excellent' score and the poorest performer was *Ficus repens*. Further, an overall comparison of the performance of the ten groundcover species based on scoring for overall appeal for aesthetic value has indicated that *Portulaca grandiflora* scored 65 per cent, *Wedelia trilobata* scored 60 per cent of excellent, *Chlorophytum comosum* scored 20 per cent of excellent and 35 per cent in good category, *Hemigraphis colorata* scored 20 per cent of excellent and 25 per cent in good category, *Syngonium podophyllum* scored 15 per cent in excellent and 20 per cent in good category under the salinity ecosystem.

The variations in scoring for the groundcover species might have been due to their inherent variations for quality parameters such as leaf texture, leaf colour, *etc*. Leaf colour is one of the most important quality parameters of the groundcover species which influences its visual appeal to a great extent. In the present study, was observed that the leaf colour of the groundcover species was more appealing under rainy days than under salinity conditions (Table 3). This observation is in agreement with that of Rudy (2004), in *Lamium* spp. that attributed desirability of *Lamium* spp. as ornamental groundcover owning to their attractive leaf forms and colours. Further he opined that the desirability of ornamental groundcover species was also due to the overall plant health and quality. He associated the quality of groundcover plants with their ability to produce continuous mats of foliage without holes or unsightly upright stems. In the present study it could be observed that all the plant species which were rated excellent in scoring had the above attributes. From the results pertaining to scoring, it could be inferred that the performance of most of the groundcover species was good under open salinity condition. Similar observations were reported in *Lantana* sp. and *Verbena* sp. (Hodel *et al*., 1994) [10]. *Achillea* sp. (Ghani *et al*., 2011) and also in *Wedelia trilobata* and *Portulaca grandiflora* by Grace *et al*. (2015) [8].

Cost of establishment

Details of cost of establishment of groundcover using the ten species evaluated in the study are furnished in Table 1 and 2. Of the ten species, *Portulaca grandiflora* (T_6) and *Wedelia trilobata* (T_2) required lowest cost for establishment (Rs.90/m^2) each. These two species were followed by *Verbena officinalis* (T_3), *Setcreasea purpurea* (T_1) and the each requires an establishment cost of Rs.160/m^2, for *Hemigraphis colorata* (T_5) the cost of establishment is Rs 250/m^2 *Syngonium podophyllum* (T_4) and *Chlorophytum comosum* (T_8) the cost of establishment is Rs 320/m^2, *Cuphea hyssopifolia* (T_9), *Ficus repens* (T_{10}) (Rs.135/m^2) and *Zebrina pendula* (T_7) (Rs.550/m^2) required the highest establishment costs.

The establishment cost for the groundcovers varied basically due to variations in plant cost and planting densities. The establishment cost was found to be highest for *Zebrina pendula,* and followed by *Syngonium podophyllum, Chlorophytum comosum* the cost of and *Hemigraphis colorata* were intermediate. The lowest establishment cost was recorded in *Wedelia trilobata* and *Portulaca grandiflora.*

In selecting ornamental groundcover species for landscaping purpose, choice is made based on the location of the landscape. For instance, it would be ideal to select a high cost species such as *Zebrina pendula,* for front portions wherein the groundcover species would serve a dual purpose of masking the ground as well as providing a focal point owing to its attractive flowers.

For certain locations of the landscape wherein the groundcover has to play one role as to masking undesirable areas, selection of low cost species such as *Wedelia trilobata* and *Portulaca grandiflora* is ideal which would create an attractive greenery with its green foliage and contrast yellow and pinkish flowers at reasonable costs.

One of the desirable attributes that an ideal ornamental groundcover species should possess is an ability to adapt to unfavourable sites in our garden such as shady dark corners, (Rudy, 2004). In the present study, the species which have scored high values are, *Wedelia trilobata, Portulaca grandiflora, Chlorophytum comosum, Syngonium podophyllum* and *Hemigraphis colorata* have exhibited such qualities. Based on these observations, it can be inferred that *Wedelia trilobata* followed by *Portulaca grandiflora, Chlorophytum comosum, Syngonium podophyllum* and *Hemigraphis colorata* are ideal groundcovers with low establishment cost as well as good performance under saline ecosystem.

Table 1: Effect of salinity on dry matter production (g) and proline content of ground cover species

Treatments	Groundcover species	Dry matter production(g) 12 MAP	Proline content in mg g^{-1}			
			2 MAP	4 MAP	6 MAP	Mean
T_1	*Setcreasea purpurea*	2.80	0.65	2.92	5.57	3.05
T_2	*Wedelia trilobata*	13.50	1.81	4.28	8.17	4.75
T_3	*Verbena officinalis*	11.60	1.52	3.79	6.85	4.05
T_4	*Syngonium podophyllum*	12.80	1.66	3.87	6.93	4.15
T_5	*Hemigraphis colorata*	2.20	1.21	3.53	6.64	3.79
T_6	*Portulaca grandiflora*	7.98	1.77	4.19	7.89	4.62
T_7	*Zebrina pendula*	6.85	0.61	2.81	5.28	2.90
T_8	*Chlorophytum comosum*	10.40	1.58	4.07	7.68	4.44
T_9	*Cuphea hyssopifolia*	7.75	1.37	3.12	6.52	3.67
T_{10}	*Ficus repens*	4.50	1.71	3.08	6.22	3.67
Mean		8.03	1.39	3.45	6.77	
SEd		0.15	0.02	0.61	0.41	
CD (0.05 %)		0.32 **	0.04 **	1.29 NS	0.29**	

**Highly significant, *Significant, NS Non significant

Table 2: Cost economics for establishment of groundcovers in one square meter area

Treatments	Groundcover species	Cost/m^2	
		Cost per plant	Rs
T_1	*Setcreasea purpurea*	17.77	160
T_2	*Wedelia trilobata*	10.00	90
T_3	*Verbena officinalis*	17.77	160
T_4	*Syngonium podophyllum*	35.55	320
T_5	*Hemigraphis colorata*	27.77	250
T_6	*Portulaca grandiflora*	10.00	90
T_7	*Zebrina pendula*	61.11	550
T_8	*Chlorophytum comosum*	35.55	320
T_9	*Cuphea hyssopifolia*	15.00	135
T_{10}	*Ficus repens*	15.00	135
Mean		24.55	221.00

Table 3: Scoring of groundcover species for aesthetic value under open field conditions

Treatments	Groundcover species	Preference per cent				
		Excellent	Good	Fair	Poor	very poor
T_1	*Setcreasea purpurea*	5	25	30	20	20
T_2	*Wedelia trilobata*	60	35	5	0	0
T_3	*Verbena officinalis*	10	15	25	35	15
T_4	*Syngonium podophyllum*	15	20	35	15	15
T_5	*Hemigraphis colorata*	20	25	40	10	5
T_6	*Portulaca grandiflora*	65	30	5	0	0
T_7	*Zebrina pendula*	0	5	15	45	35
T_8	*Chlorophytum comosum*	20	35	20	15	10
T_9	*Cuphea hyssopifolia*	5	10	15	25	45
T_{10}	*Ficus repens*	0	0	10	40	50

Conclusion

The salt tolerance of landscape plants varies widely with species, environmental conditions and soil or substrate. Landscape plants, most of which are non-halophytes, have similar mechanisms of salt tolerance to agricultural crops, but assessment of salt tolerance for landscape plants should be based primarily on aesthetic value rather than effects on biomass. Among the ten groundcover species, *Wedelia trilobata*, showed maximum dry weight, highest proline content and excellent in scoring for aesthetic value under salinity condition, followed by *Portulaca grandiflora* so both are comes under highly salt tolerance on the other way *Ficus repens*, *Zebrina pendula* and *Hemigraphis colorata* are shown lowest dry weight, lesser proline content and lowest scoring for aesthetic values, which comes under susceptible to salinity condition.

References

1. Bates LS, Waldren RP, Teare ID. Rapid determination of free proline for water- stress studies. Plant Soil, 1973; 39:205-207.
2. Brugiere N, Dubois F, Limami AM, Lelandais M, Roux Y, Sangwan RS *et al*. Glutamine synthetase in the phloem plays a major role in controlling proline production. Plant Cell. 1999; 11:1995-2011.
3. Delauney AJ, Verma DPS. Proline biosynthesis and osmoregulation in plants. Plant J. 1993; 4:215-223.
4. Dias J, Pimenta J, Medri MM, De Freitas Boeger C. Physiological Aspects of sun and shade leaves of *Lithraea molleoides* (Vell.) Engl. (Anacardiaceae). Brazilian Archives of Biology and Technology. 2007; 50(1):91-99.
5. FAO. 2013. http://www.fao.org/ag/AGP/AGPC/doc/GBASE/Default.html.
6. FAO. 2017. http://www.fao.org/ag/AGP/AGPC/doc/GBASE/Default.html.
7. FAO. 2005. http://www.fao.org/ag/AGP/AGPC/doc/GBASE/Default.html.
8. Grace hepsibah B. Evaluation of ornamental groundcovers for open and shady locations under tropical conditions, M.Sc. (Hort.) Thesis submitted to Tamil Nadu Agricultural, 2015.
9. Hare PD, Cress WA. Metabolic implications of stress-induced proline accumulation in plants. Plant Growth Regulation. 1997; 21:79-102.
10. Hodel DR, Pittenger DR. Responses of Eight Groundcover Species to Renovation By Mowing. J Environ. Hort. 1994; 12(1):4-7.
11. Iyer S, Caplan A. Products of proline catabolism can induce osmotically regulated genes in rice. Plant Physiol. 1998; 116:203-211.
12. Lee GJ, Carrow RN, Duncan RR. Salinity tolerance of selected seashore paspalums and Bermuda grasses: root and verdure responses and criteria. Hort. Science. 2004; 39(2):1136-1142.
13. Levitt J. Response of Plants to Environmental Stress. Academic Press. 2nd Edition, 1980, 1.
14. Liu Y, Cheng F, Wang Q, Hu Y, Wang Z. Salinity stress responses and thresholds in four warm-season turfgrasses. Acta Prat. Sin. 2009; 18:192-199.
15. Maria Elena Arboleda. Effect of irradiance on growth and development of *Aptenia cordifolia* (L. f) schwantes as ornamental groundcover. Bioagro. 2011; 23(3):175-184.
16. Munns R, Tester M. Mechanisms of salinity tolerance, The Annual Review of Plant Biology. 2008; 59:651-681.
17. Nithin PT. Growth and morphological adaptations of warm season turfgrasses to different mowing frequencies and water stress. M.Sc. (Hort.) Thesis submitted to Tamil Nadu Agricultural University, Coimbatore, 2011.
18. Paiva E, Isaiah Vale R, Queiroz CF. The Influence of light intensity on anatomical structure and pigment contents of *Tradescantia pallida* (Rose) Hunt. cv. *purpurea* Boom (Commelinaceae) leaves. Brazilian

Archives of Biology and Technology. 2003; 46(4):617-624.
19. Pessarakli M, Szabolics I. Handbook of plant and crop stress. 2nd edition. Marcel Dekker, New York. 1999, 1-16.
20. Rudolph AS, Crowe JH, Crowe LM. Effects of three stabilizing agentsproline, betaine, and trehalose on membrane phospholipids. *Arch. Biochem. Biophys.* 1986; 245:134-143.
21. Savè R. What is stress and how to deal with it in ornamental plants? Acta Horticulturae. 2009; 81:241-254.
22. Shi H, Yanping Wang, Zhangmin Cheng, Tiantian Ye, Zhulong Chan. Analysis of natural variation in bermudagrass (*Cynodon dactylon*) reveals physiological responses underlying drought tolerance. Plos One. 2012; 7(12):1-12.
23. Vivek G. Studies on the growth and adaptations of warm season turfgrasses to different depths of water logging. M.Sc. (Hort.) Thesis submitted to Tamil Nadu Agricultural University, Coimbatore, 2010.
24. Wild A. Russell's soil conditions and plant growth. 11th edn. Harlow, Longman, 1988.