Estimation of interrelationship among plant growth related traits of *Portulaca oleracea*

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Abstract: Purslane is an important weed that grows in maize, wheat and cotton fields and caused yield losing effects due to competition for water minerals, nutrients and space. The prescribed study was carried out at the Centre of Excellence in Molecular Biology, University of the Punjab Lahore, Pakistan during February 2016. Data for different morphological traits was recorded and statistically analyzed. Significant differences were found for all studied traits and locations for study. The results from mean performance and GGEbiplot for mean vs stability concluded that the plant growth and development of Purslane was higher under locations 1 & 2. Significant and strong correlations were found among most of the studied traits which indicated the higher survival ability of Purslane under different environmental condition. The traits total inflorescence moisture percentage, total plant moisture percentage, number of plants per square meter, total plant fresh weight and total plant dry weight showed strong but negative interrelationship which clearly indicated that the reduction in one of these traits may be useful to remove or control Purslane growth, development and plant population. It was suggested that the control and removal of weeds should be carried out to less down the harmful effect of weeds for crop plants.
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Introduction

Purslane (*Portulaca oleracea* L.) deserves special attention from farmers and nutritionists. Purslane is a common weed in turfgrass areas and in field crops (Kamal-Uddin *et al.* 2009 and Uddin *et al.*, 2010). *Portulaca oleracea* is species that is cosmopolitan and the genus *Portulaca* belongs to the family Portulacaceae, a small family with 21 genera and 580 species, and is cosmopolitan in distribution, occurring mainly in America have found some species in Arabia (Danin and Reyes-Betancort, 2006). Purslane plants are annual herbaceous, succulent and erect or prostrate up to 30 cm hight. Botanically puslane is known as *Portulaca oleracea* and is also called portulaca. It has been reported that purslane was a common vegetable of the Roman Empire. Purslane origin is still uncertain, but the existence of this plant has been reported about 4,000 years ago. The fleshy leaves and succulent stems of purslane show that it could have originated and adapted to desert climates of the Middle East and India. It can be found in Africa, Europe, North America, Australia, and Asia (Rashed *et al.*, 2003). Purslane has been studied for its relatively high salinity tolerance, particularly as it relates to its use as a vegetable crop (Teixeira and Carvalho, 2009). Purslane is also known to be high in antioxidants and is a rich source of carotenes and essential fatty acids (18:2ω6 and 18:3ω3) which have been shown to have benefits for human health (Guil-Guerrero and Rodriguez-Garcia, 1999). Of the tested edible wild plants, purslane has the highest amount of α- linolenic acid and concentrations of the antioxidants α-tocopherol, β-carotene, and glutathione is also high (Simopoulos *et al.*, 1992). In addition, melatonin has been found in relatively high amounts in leaves of purslane (Simopoulos *et al.*, 2005). The benefits of melatonin in human health have been documented as well as cancer growth prevention (Allegra *et al.*, 2003; Lopez-Burillo *et al.*, 2003; Rodriguez *et al.*, 2004; Tan *et al.*, 1993).

The function of melatonin in plants is less understood. In addition to its antioxidative properties are elieved to perform roles in diurnal regulation as a plant hormone-like molecule (Kolar and Machackova, 2005). Purslane is popular as a traditional medicine in China for the treatment of diabetes and hypotension. It is not proven scientifically that they have any antidiabetic effects, but still people use it for this purpose. An experiment was carried out for crude polysaccharide(s) extraction from purslane to examine the hypoglycemic effects of these constituents with animal tests for the use of this plant in the treatment of diabetes (Simopoulos, 2004). Portulaca oleracea L., purslane, is one of the most aggressive weed in the world, it is noted noted as the eighth most common plant (Coquillant, 1951) and one of the ten most harmful weeds (Singh and Singh, 1967). *Purslane* is a weed of 45 crops in 81 countries (Holm *et al.*, 1977).

To determine the weediness of purslane (Zimmerman, 1976) compared it with two other species of the genera *Portulaca*. Part of characterization as a weed purslane is due to rapid response capability of plant. Purslane thrives under a wide variety of photoperiods and numbers of capsules are positively related to the amount of light received. Purslane can tolerate a wider range of light intensity, soil types, temperature regimes and produces capsules over a wide range of these factors. When these factors occur at optimal levels, purslane quickly produces a large number of capsules (Zimmerman, 1976).

There are several studies on non-pesticide controls for purslane a field work in northern Greece looks mulch effects of three perennial and seven annual aromatic plants as green manure on the growth and emergence of four species of weed and maize. Green manure treated plots reduced common purslane germination by 12-59% compared with green manure free plots and harvest of maize increased by 10-43% (Dhima *et al*., 2009). The use of mustard (*Brassica* spp.) as a cover crop reduces purslane densities in both lettuce and onion crops (Bensen *et al*., 2009; Wang *et al*., 2008). In addition to cultural controls, herbicides are used to control purslane. The lethal dose rate depended on the age of the plant because the purslane is sensitive to dicamba (Stacewicz-Sapuncakis *et al.,* 1973). Purslane control with herbicides is difficult and inconsistent. Leaf morphology, epicuticular wax in particular can affect the effectiveness of control measures herbicides. Leaf surface of purslane has no trichomes or glands and there are relatively few stomata (Sanyal *et al*., 2006). Purslane has more epicuticular wax than velvetleaf (*Abutilon theophrasti* Medik), but less than common lambsquarter (*Chenopodiumalbum* L.). In the test lab, the spread of droplet primisulfuron is greatest when combined with organosilicone wetting agent in comparison with a non-ionic surfactant. Feedback between the size of the epicuticular wax and distribution of the droplet spray was also noted with more wax reduces the spread of the droplet (Sanyal *et al.,* 2006). The present study was conducted to evaluate Purslane for different plant growth and development related traits.

Material and Method

Prescribed study was carried out at the Centre of Excellence in Molecular Biology (CEMB), University of the Punjab Lahore Pakistan during February 2016. The data was recorded for Purslane plants in the area of $1m^2$. This area of $1m^2$ is selected randomly from three different locations with the help of scale. Three plants were selected randomly from that area. After that I checked the height of plants, length and width of leaf. For number of flowers per plant, plucked all the flowers from these plants and were counted. Weight was recorded for fresh and dry plants and flowers with the help of weight balance separately. After that dried these plants and flowers in sun light separately which are covered with paper envelop. All the recorded data was subjected to analysis of variance (Steel *et al*., 1997).

Results and discussions

Significant differences were reported for different morphological and plant growth related traits of Purslane (Table 1). Average plant height was 60.278±5.3576cm, leaf area (7.2611±0.8326), fresh plant weight (63.183±3.9473g), fresh inflorescence weight (10.140±0.8097g), dry plant weight (18.239±1.1512g), dry inflorescence weight (0.1300±0.0097g), number of flowers per plant (987.245±1.204), leaf length (3.0962±0.0092cm), lead width (2.145v0.1024cm), total plant fresh weight (78.908±2.4087g), total plant dry weight (17.209±1.009g), total plant moisture percentage 975.813±0.1761%) and total inflorescence moisture percentage (71.222±1.7427%). The higher plant weigh and moisture percentage in plant body and inflorescence indicated that the plants have ability to survive in harsh environmental conditions, with large number of flowers indicated the ability to grow vigorously and can produce large plant population or plant density. The locations 1 & 2 showed the best suitable locations for growth and development of Purslane (Table 2). Purslane is an important weed that grows in many crop plant fields like maize, cotton and wheat. It competes with crop plants and caused reduction in yield and productivity of crop plants (Dhima *et al.*, 2009). The control of Purslane is much important to reduce such yield losses. Various workers have suggested ways to control its plant population, growth and development in crop plant field areas. The use of transgenic crop plant, mutation breeding for resistant against glyphosate is becoming common and popular technology (Aaliya *et al*., 2016; Brankov *et al*., 2015; Hareem *et al*., 2015; Mobeen *et al*., 2015; Puspito *et al*., 2015; Sadia *et al*., 2015; Qamar *et al*., 2015ab).

Principal component analysis provides information about the performance of crop plant genotypes with respect to variation among the required yield related traits (Filipovic *et al*., 2014; Lakic *et al*., 2015; Aaliya *et al*., 2016). The results indicated that 91.80% variability was recorded for PC1 while 7.4% for PC2 (Figure 1). It was also found that the locations 1 & 2 served as more favorable and suitable locations for healthy growth and development of Purslane plants. The better growth and development indicated that the survival rate in harsh environmental conditions will be higher and helpful to increase plant population or plant density in short time duration

(Anwar *et al*., 2016; Jaffar *et al*., 2016; Ali *et al*., 2016; Qurat-ul-Ain *et al*., 2015). The removal of Purslane plants from crop plant field should be carried out to reduce harmful effect for crop plants. The use of transgenic crop plants resistant against glyphosate (Aaliya *et al*., 2016; Qamar *et al*., 2015ab; Puspito *et al*., 2015), mutation breeding (Rizwan *et al*., 2015), manual removal of weeds from crop plant field and use of plant extract (Falk *et al*., 1994; Elahi *et al*., 2011ab) may be helpful to control weed plants from crop plant field. Correlation provides the extant of association among the traits and opportunity to plant breeder for selection of genotypes on the basis of different studied traits. The results from table 3 indicated that there was a positive and significant correlation among most of the studied traits. The significant correlation indicated that the traits were highly associated with each other which revealed that the reduction in one of the traits may be useful to reduce the growth and development of Purslane. Positive and significant correlation among different traits of weed plant was also recorded by various researchers (Hareem *et al*., 2015; Mobeen *et al*., 2015; Sadia *et al*., 2015; Saira *et al*., 2015). The traits total inflorescence moisture percentage, total plant moisture percentage, number of plants per square meter, total plant fresh weight and total plant dry weight showed strong but negative interrelationship which clearly indicated that the reduction in one of these traits may be useful to remove or control Purslane growth, development and plant population.

Table 1. Analysis of variance for different traits of *Portulaca olereacea*

Source of Variation	Plant Height	Leaf Area	Fresh Plant weight	Fresh Inflorescence Weight	Dry Plant Weight	Dry Inflorescence Weight	No. of flowers per plant
Replication	0.694	0.3969	1.08	0.6722	1.434	0.00030	12.093
Location	242.361*	8.659*	3924.58*	89.149*	343.534*	6.43*	27431.3*
Error	86.111	2.0794	46.74	1.9670	3.976	0.00028	0.00274
Grand Mean	60.278	7.2611	63.183	10.140	18.239	0.1300	987.245
Standard Error	5.3576	0.8326	3.9473	0.8097	1.1512	0.0097	1.204
Source of Variation	**Leaf length**	**Leaf width**	**Total plant fresh weight**	**Total plant dry weight**	**No. of plants/m^2**	**Total Plant Moisture %**	**Total Inflorescence Moisture %**
Replication	0.9281	0.2937	12.033	3.9172	1.089	0.1393	0.0842
Location	7.0493*	6.0342*	362.122*	198.927*	46.248*	12.2849*	14.778*
Error	1.0962	1.0032	3.4975	4.0892	2.049	0.0930	9.1111
Grand Mean	3.092	2.145	78.908	24.093	17.209	75.813	71.222
Standard Error	0.0092	0.1024	2.4087	1.0923	1.009	0.1761	1.7427

* = Significant at 5% probability level

Table 2. Mean performance for different traits of *Portulaca olereacea*

Traits	Location 1	Location2	Location 3
Plant Height (cm)	64.167b	66.667a	50.04c
Leaf Length (cm)	3.167a	3.167a	2.45c
Leaf Width (cm)	2.367a	2.233b	2.167c
Leaf Area (cm^2)	8.283a	8.2b	5.3c
Fresh plant weight (g)	92.167a	74.733b	22.65c
Dry plant weight (g)	26.967a	21.45b	6.3c
Fresh flower weight (g)	16.433a	6.883c	7.103b
Dry flower weight (g)	0.183a	0.107b	0.1c
Total Plant fresh weight (g)	108.6a	81.617b	29.753c
Total Plant dry weight (g)	27.15a	21.557b	6.4c
No. of flowers	1438.667a	886.667b	645.333c
Total Inflorescence moisture percentage	75.283b	75.163c	77.667a
Total plant moisture percentage	76.433a	74.007b	78.073a
Number of Plants (m^2)	21.333a	19.333b	13.113c

Table 3. Correlation among different traits of *Portulaca olereacea*

	PH	LL	LW	LA	FPW	DPW	FFW	DFW	TPFW	TFDW	NF	TIMP	TPMP
LL	0.990*												
LW	0.657*	0.756*											
LA	0.987*	0.900*	0.772*										
FPW	0.927*	0.971*	0.891*	0.976*									
DPW	0.921*	0.966*	0.899*	0.972*	0.900*								
FFW	0.356	0.482*	0.938*	0.504*	0.679*	0.692*							
DFW	0.440*	0.561*	0.966*	0.581*	0.744*	0.755*	0.996*						
TPFW	0.885*	0.942*	0.932*	0.950*	0.995*	0.997*	0.749*	0.807*					
TPDW	0.920*	0.965*	0.900*	0.972*	0.900*	0.980*	0.694*	0.757*	0.997*				
NF	0.633*	0.734*	0.999*	0.751*	0.876*	0.885*	0.949*	0.974*	0.920*	0.886*			
TIMP	0.995*	0.999*	0.727*	0.998*	0.959*	0.954*	-0.445*	-0.525*	-0.926*	-0.954*	-0.705*		
TPMP	0.977*	0.938*	0.483*	0.930*	0.827*	0.818*	-0.150	-0.240	-0.767*	-0.816*	-0.455*	0.952*	
NP	0.854*	0.773*	-0.169	0.757*	0.597*	0.583*	-0.183	-0.092	0.514*	0.581*	0.137	-0.799*	-0.945*

* = Significant at 5% probability level, PH = Plant height, LL = leaf length, LW = Leaf width, LA = Leaf area, FPW = Fresh plant weight, DPW = Dry plant weight, FFW = Fresh flower weight, DFW = Dry flower weight, TPFW = Total plant fresh weight, TPDW = Total plant dry weight, NF= Number of flowers per plant, TIMP = Total inflorescence moisture percentage, TPMP = Total plant moisture percentage, NP= Number of plants per square meter or plant density per square meter

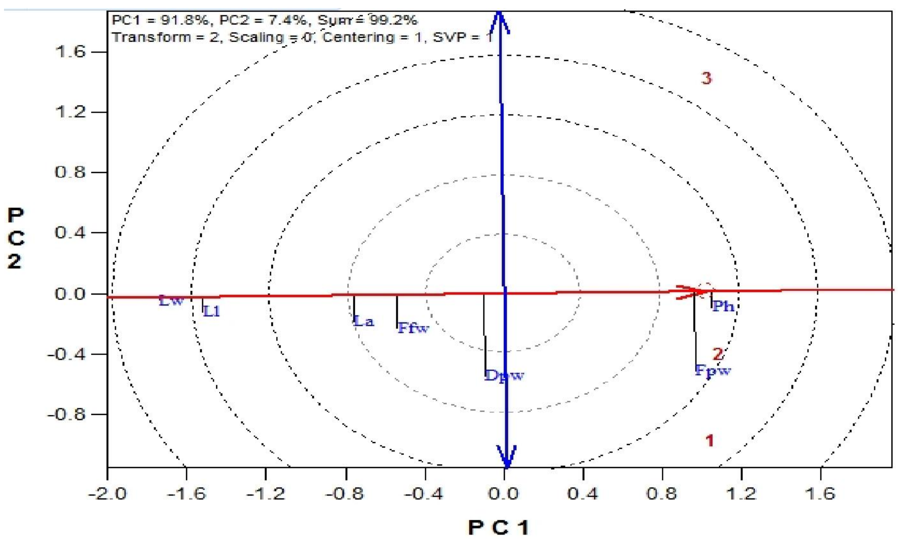

Fig. 1. GGEBiplot showing the mean vs stability for different traits of *Portulaca olereacea* studied at three locations

Conclusion

It was concluded from prescribed study that the plant growth and development of Purslane was higher under locations 1 & 2. Significant and strong correlations were found among most of the studied traits which indicated the higher survival ability of Purslane under different environmental condition. It was suggested that the control and removal of weeds should be carried out to less down the harmful effect of weeds for crop plants.

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