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ORIGINAL RESEARCH ARTICLE

Multivariate analysis for morphological traits of *Convulvularis arvensis*

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ABSTRACT: *Convulvularis arvensis* is an important weed found in wheat, maize, rice, sugarcane and cotton growing fields. It caused major yield losses in crop plants through competition for water, minerals and nutrients. Prescribed study was conducted to evaluate *Convulvularis arvensis* for it morphological traits under five different environmental locations. It was found that there was a positive and significant correlation among most of the study traits, fresh plant weight, plant length, leaf length, leaf width leaf area and moisture percentage. The highly contributing trait for fresh weight was found as plant dry weight. From GGE biplot it was found that the location 4 was highly suitable place for better growth and development of *Convulvularis arvensis* plants. It was suggested that the timely removal or control of *Convulvularis arvensis* is much necessary to minimize the yield losses of crop plants.

Keywords: *Convulvularis arvensis*, correlation, regression, morphological, GGE biplot

INTRODUCTION

Convulvularis arvensis of family *Convolvulaceae* is a most devastating weed causes economic losses to some crop plants. In Pakistan it is reported from sugarcane, wheat and maize, but it can compete with all the crop plants in specific conditions. It is commonly known as bind weed or field bind weed. It is dicotyledonous, perennial herb having prostrate nature. Root diameter may be up to 6 m and extends to 9 m in depth (Todd et al., 1995). It has an herbaceous stem having simple, alternate and petiolate leaves with pointed lobes at the base. Inflorescence is single or in clustered form, having pink flowers with white streaks (Holm et al., 1977; Nayyar et al., 2001). Strong and more spreading root system is responsible for the survival of the plant under drought conditions. It is used as a purgative in some parts of the world. Reproduction is through seeds and new shoots are also developed from deep and extensive root system (Gardea-Torresdey et al., 2004). Seeds are 3-5 mm long having coarse and rough surface, dull and brownish grey to black in colour (Oudhia, 2005; Weaver and Riley, 1982; Zameer et al., 2015). These are flat on one surface and round on another. There is lower scar with reddish depression at the basal point of the seed. Seeds can disperse up to thousands of kilometers by sticking with farm vehicles or by contamination into other seed stocks. Viability of seeds is up to 50 years and five days in the bird's stomach. Fruit is ovate in nature and two to four seeded. It has been considered a new alternate host of *Meloidgyneae incognita* in Pakistan. It is

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generally distributed in Asia, Africa, pacific island and America (Gardea-Torresdey et al., 2004; Gianoli, 2004). It can grow on all types of soils but specifically found in waste lands. It requires dry or less moist soils to explore its full potential. It can tolerate long lasting and heavy stress due to its root system. It grows at its best in the soil rich in nutrients and fertile. It contains alkaloids like pseudotropine, tropine, tropinone and meso-cuscohygrine. Its extract is used for manufacturing of antibiotic, antioxidants and drugs, used as medicinal plant (Chhokar, 2002). It is extremely difficult to eradicate it if once established in the area but we can lessen the loss by two methods, cultural and chemical control. Tillage operation proves to be better in gradual but continuous reduction. Due to tillage, less quantity of carbohydrates will be available to weed, as a result less root mass and at last death of the weed. Bar harrow is also proves to be good (Todd et al., 1995). Light is also used as a limiting factor in reduction of the weed. But it is suggested to use the chain of operations rather than single. In cultural control 2-4-D is suggested either once or in combination with 3 cultivations (Bonnett Jr and Torrey, 1966). Previous research work shows that continuous use of similar herbicide can remove other weeds but *C. arvensis* will become the most harmful due to lack of competition with other weeds. Recommended dose of carfentrazone is 25kg/ha. In Pakistan 40-45 days after emergence of weed in wheat crop, application of Aim 40 Df and Buctril M-40 EC is usually given. Weedicides should be used after first irrigation when weed is at 2-3 leaf stage and crop is at 3-4 leaf stage, broad specturum weedicides should be used. For best results it is recommended to use cultural and chemical control both at a time (Haq et al., 2012; Qamar et al., 2015).

MATERIALS AND METHODS

Sample in this study was collected from the population of *convulvulis arvensis* in the form of 3 replications each from five places at Centre of Excellence in Molecular Biology, University of the Punjab Lahore, Pakistan. So, there were total 15 replications along with 5 plants from each repeat (total samples were 75). Sample collected as a whole weed by digging the soil along with weed plant. After collecting, samples were taken into seed biotechnology laboratory for further analysis. The data was recorded for different morphological traits and analysis of variance was performed to access the significance of results (Steel, 1997).

Leaf Length (cm)

Leaf length is measured by using mm Scale. For this purpose three leaves taken from each plant and measured their length and average value was calculated.

Leaf Width (cm)

Leaf width was measured from three places on the leaf from base, center and tip. Three leaves were measured as in leaf length.

Leaf Area (cm^2)

Leaf area is the cross product of leaf length and leaf width and correction factor 0.74 cm. Formula is as follows:-

Leaf area = leaf length × leaf width × 0.74 (Jordan, 1969)

Plant height (cm)

Plant height (length) was measured by starting from the point of attachment of stem with the

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root (base of the stem). Longest shoot was taken on each plant to measure plant length.

Fresh Weight (g)

Fresh weight was measured quickly after the removal of weed sample from the field to avoid drying of sample with the help of electronic weight balance.

Dry Weight (g)

Before taking a dry weight the first step is to dry the sample in oven or under sunlight. Sample was dried in oven because it is quick and efficient way to dry. Sunlight requires a lot of hours to dry. So for this purpose sample was packed in envelops separately. After 10-12 hours, sample was drawn from the oven. Then each sample was weighed on weight balance.

Moisture percentage (%)

Total plant moisture percentage was recorded by using following,

Moisture percentage = [(fresh plant weight – dry plant weight/fresh plant weight) × 100]

RESULTS AND DISCUSSIONS

The results from table 1 revealed that there were significant differences among all the locations and studied traits of *Convulvularis arvensis*. It was found that average leaf length (3.476±0.1596cm), leaf width (1.309± 0.2247cm), leaf area (3.499±0.3251cm^2), plant length (52.373±0.5428cm), fresh weight (6.818±0.4947g), dry weight (2.495±0.5762g) and moisture percentage (63.985±2.503%) for *Convulvularis arvensis* plants collected from four different places. The higher plant weight and moisture percentage in the plant body indicated that the plant have higher ability to withstand under harsh climatic conditions. The removal of *Convulvularis arvensis* plants from filed of crop plants is essential because *Convulvularis arvensis* plant compete with crop plants for food, minerals water and space. The *Convulvularis arvensis* plants whirled out the crop plants and caused to dry out and hence yield of crop plants reduced.

Table 1. Analysis of variance for morphological traits of *Convulvularis arvensis*

SOV	Leaf Length	Leaf Width	Leaf Area	Plant Length	Fresh Weight	Dry Weight	Moisture percentage
Locations	0.805*	3.027*	0.4021*	34.014*	8.041*	4.021*	27.231*
Error	0.018	0.102	0.024	0.0252	0.9122	0.0262	0.1521
Grand Mean	3.476	1.309	3.499	52.373	6.818	2.495	63.985
Standard Error	0.1596	0.2247	0.3251	0.5428	0.4947	0.5762	0.0969
CV	4.120	5.802	8.395	4.015	2.773	4.876	2.503

*=Significant at 5% probability level, CV = Coefficient of variance

Correlation analysis was performed to access the association among the studied morphological traits (Table 2). It was all of the traits showed significant and positive correlation among each other except the correlation between leaf area and dry weight, plant height and fresh weight and dry weight with moisture percentage. The positive and significant correlation indicated that the plants have ability to tolerate harsh and hot environmental conditions. The growth and development of *Convulvularis arvensis* plants may be higher due to higher photosynthetic rate and accumulation of organic compounds in plant body. The removal of *Convulvularis arvensis* plants through manual, chemical use

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is much necessary to avoid yield losses or the use of transgenic crop plants for glyphosate resistance to control weeds (Gianoli, 2004; Harrem et al., 2015; Mobeen et al., 2015).

Table 2. Correlation among morphological traits of *Convulvularis arvensis*

Traits	Leaf Length	Leaf Width	Leaf Area	Plant Length	Fresh Weight	Dry Weight
Leaf width	0.78675*					
Leaf area	0.91634*	0.93319*				
Plant length	0.30688*	0.24844*	0.30652*			
Fresh weight	0.68791*	0.39568*	0.55929*	0.54380*		
Dry weight	0.36209*	0.22829*	0.11329	-0.19429	-0.14932	
Moisture percentage	0.80297*	0.52138*	0.67685*	0.57283*	0.95586*	-0.19024

*=Significant at 5% probability level

Regression analysis revealed that higher contribution for fresh weight was recorded for dry weight (2.198) followed by leaf length (0.804), leaf width (0.948), leaf area (0.172) and moisture percentage (0.136) while negative contribution was found for plant length (-0.009). The regression equation was predicted as,

Y (FW) = -9.995 + 0.804(leaf length) + 0.948(leaf width) + 0.172(leaf area) – 0.009(plant length) + 2.198(dry weight) + 0.136(moisture percentage)

Regression analysis helps plant researchers to select plant genotypes from a large number of studied traits on the basis of most contributing traits towards yield of crop plants. It was found from figure 1 that PC1 showed 95.8% and PC2 3.6% variation for all studied morphological traits. Moreover, it was also predicted from the results that the location 4 serves as most productive place for the growth and development of *Convulvularis arvensis* plants. It was suggested that the plant population should be controlled from location 4 to minimize the yield losses of crop plants (Ali et al., 2012; Anwer et al., 2015; Qamar et al., 2015).

Table 3. Stepwise multiple linear regression for fresh weight of *Convulvularis arvensis*

Traits	Coefficients	Standard Error	t Stat	Partial R^2	Lower 95%	Upper 95%
Leaf length	0.804	0.64	1.257	24.4	-0.671	2.279
Leaf width	0.948	1.15	-0.825	43.3	-3.6	1.703
Leaf area	0.172	0.449	0.383	7.12	-0.863	1.206
Plant length	-0.009	0.004	1.984	8.21	-0.001	0.019
Dry weight	2.198	0.155	14.218	12.43	1.842	2.555
Moisture percentage	0.136	0.023	5.83	5.65	0.082	0.189

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Intercept = -9.995, standard error = 0.3903, Multiple R^2 = 99.64%, R^2 = 98.28%, Adjust R^2 = 96.76%

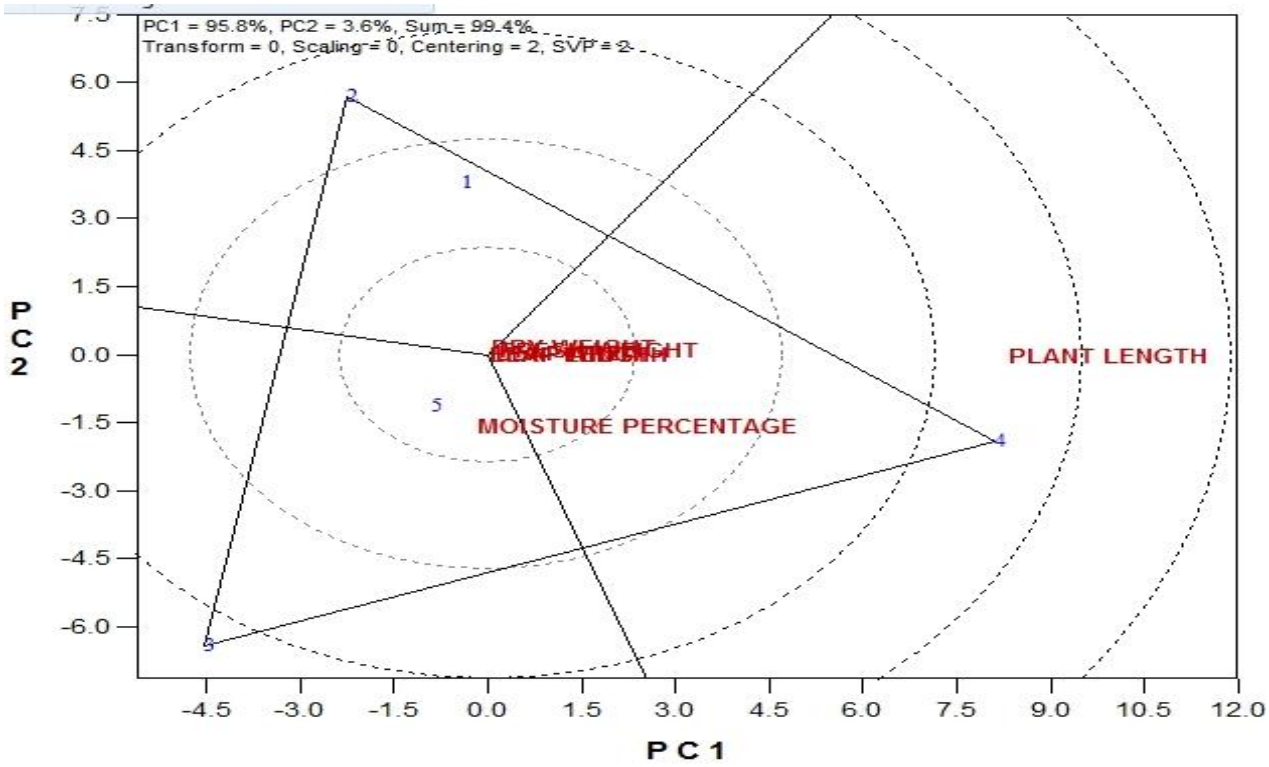

Figure 1. GGE biplot for morphological traits of *Convulvularis arvensis* under 5 different locations

CONCLUSIONS

It was suggested that the plant population of *Convulvularis arvensis* should be controlled to minimize the yield losses of crop plants.

CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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