Genetic variability among different traits of *Convolvulous arvensis*

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Abstract: Weeds caused an adverse effect on crop plant yield and also act as major competitor to crop plants. *Convovulous arvensis* is an important weed plant that caused loss in various crop plant species as it enroll the whole plant body and compete for water, nutrients, minerals and even sunlight. A study was conducted at Centre of Excellence in Molecular Biology, University of the Punjab Lahore, Pakistan during February 2016. Data on various morphological traits was recorded by collecting *C. arvensis* from three different locations. Significant differences were found among the locations and traits studied. GGEbiplot indicated that the plant growth and development of *C. arvensis* plants was found higher at location 1 as compared with other both locations. Strong and significant correlation was reported among most of studied traits. It was suggested that the *C. arvensis* must be controlled to reduce crop plant yield losses through the use of manual, chemical and agronomic practices for removal of weeds. The use of transgenic crop plants may be an advantage for improving yield and production of crop plants.

[Jaffar MAB, Ali Q, Ali MZ, Anwar MW, Khan FA and Nasir IA. **Genetic variability among different traits of *Convolvulous arvensis*.** *Nat Sci* 2016;14(5):62-65]. ISSN 1545-0740 (print); ISSN 2375-7167 (online). http://www.sciencepub.net/nature. 9. doi:10.7537/marsnsj14051609.

Keywords: *Convovulous arvensis*, weeds, locations, correlation, genetic variability, GGEbiplot,

Introduction

Convolvulous arvensis is a persistent perennial weed which belongs to family Convolvulaceae. It is commonly known as field bindweed, creeping jenny and morning glory. Its origin is Europe and Asia and it is present in tropical and temperate regions throughout the world. It is found in orchards, cultivated fields, lawns, home landscapes, waste lands and alongside the roads. It propagates through seeds and roots. Once this weed is established it is difficult to eradicate it (Morishta, 2005; Jacob, 2007). It is a noxious weed which causes formidable yield losses to agricultural crops. The weed competes for macro and micro nutrients, space, sunlight and moisture (Hussain *et al*., 1991). It is a host for pathogens and insect pests (Akhtar *et al.,* 2011). It has little fodder value and it contains anti-nutritional compounds like saponins, alkaloids and tannins (Todd *et al.,* 1995; Khan *et al.,* 2015). It also affects the growth of agricultural crops due to its allelopathic effects (Baličević *et al*., 2014). It can cause up to 50% losses to agricultural crops (Bisen *et al*., 2008). The herbaceous field bindweed produces an extensive taproot system which can penetrate 0.5-3m deep. This root system enables it to survive drought. Buds are produced along the roots capable of producing new plants. The stems are slender, pubescent or glabrous and creeping or climbing in nature. They form a mat because the stems move in every direction. The stems cause lodging by intertwining the other crop plants. The stem can attain a height of 0.5-2m. The arrow or spade shaped leaves are 2-5cm long. The leaves have two lobes at the base which is a distinguished characteristic. The trumpet or funnel shaped flowers consist of five completely fused petals. The petals are white or pink in color with dark pink radial stripes. Field bindweed produces hard, impermeable seeds which can survive up to 50 years (Saira *et al*., 2015; Jacob, 2007; Morishta, 2005). The weeds caused reduction in yield of crop plants (Babar et al., 2015; Sadia et al., 2015; Mubeen et al., 2015). The weeds should be controlled to reduce the losses of crop plant yield. Weeds are usually removed through use of herbicides like glyphosate to reduce their competition with crop plants (Aaliya et al., 2016; Puspito et al. 2015; Qamar et al., 2015ab). The use of transgenic crop plants resistant against glyphosate may help to reduce effect of weeds in yield reduction. The use of mutations may also be helpful to improve resistant against herbicides (Rizwan et al., 2105). The prescribed study was conducted to evaluate the *Convovulous arvensis* for different morphological traits.

Materials and Methods

The *Convovulous arvensis* was collected from three distinct locations at Centre of Excellence in Molecular Biology, University of Punjab Lahore, Pakistan during the month of February 2016. The data were collected for fresh plant weight (FPW), dry plant weight (DPW), fresh inflorescence weight (FIW), number of flowers per plant (NFP), dry inflorescence weight (DIW) with the help of electronic balance. The total plant moisture percentage (TPM) and total inflorescence moisture percentage (TIM) were determined by (fresh plant weight – dry plant weight / fresh plant weight) × 100 and (fresh inflorescence weight – dry inflorescence weight / fresh inflorescence weight) × 100 respectively. The population density (NP) was recorded for one meter square area for each location. The data were statistically analyzed by using the technique of analysis of variance (Steel *et al*., 1997).

Results and Discussion

The results from table 1 indicated that there were significant differences found among the locations and traits studied for *Convovulous arvensis.* The GGE biplot (Fig. 1) was drawn to access the best and suitable location for better growth and development of *C. arvensis*. Principal component biplot indicated that the PC1 showed 68.8% and PC2 31.2% variation for studied traits of *C. arvensis*. It was revealed from figure 1 that the location I showed as potential area for higher growth and development of *C. arvensis*. The location 3 showed non-potential area for healthy growth and development while at location 2 plant height and leaf area was observed as better performing traits. Principal component analysis provides information about the variation in traits and opportunity to select genotypes of crop plant from large number of studied traits (Ali et al., 2016). The growth and development of weed plants largely depends upon the environmental conditions (Qurat-ul-Ain et al., 2015). The favorable environment caused the weeds to grow and reproduce with good potential and ability to withstand the environmental changes. The *C. arvensis* caused damage in crop plants by overlapping the whole plant body and compete for water, minerals nutrients and sunlight (Saira et al., 2015). From results given in table 2 indicated that *C. arvensis* performed better at location 1 for almost all the traits except plant height and leaf area which conformed the results shown in figure 1. Correlation analysis was performed to find out the association of traits with each other. The results from table 3 indicated that there was a significant correlation of plant height with leaf area, number of flowers, total plant plants/m^2 and total plant moisture percentage. Leaf area was positively and significantly correlated with total plant moisture and plants/m^2 while negatively and significantly correlated with all other studied traits except fresh plant weight and number of flowers per plant. Fresh and dry plant weight was significantly and positively correlated with all traits except plant height and total plant moisture. Dry plant weight showed negative and significant correlation with leaf area. Fresh inflorescence weight showed significant and positive correlation with all traits except plant height and leaf area. The strong and positive correlation was found between plant height and number of plants/m^2, total plant moisture, fresh plant weight and dry plant weight, fresh/dry inflorescence weight and total inflorescence moisture percentage. The positive and significant correlation among the traits indicated that the growth and development of weed plant may be higher due to favorable environmental conditions (Hareem et al., 2015). The control of weeds is essential to reduce the losses caused by weeds as the weed plant serve as hiding places for insects (Sabbir et al., 2014; Saeed et al., 2015), caused loss of water, mineral and nutrients availability to crop plants (Babar et al., 2015). The weeds may be controlled by using herbicides, crop plant extracts and transgenic plant species (Elahi et al., 2011ab; Qamar et al., 2015a; Puspito et al., 2015).

Table 1. Analysis of variance for different traits of *Convovulous arvensis*

Source of Variation	Plant Height	Leaf Area	Fresh Plant weight	Fresh Inflorescence Weight	Dry Plant Weight	Dry Inflorescence Weight	No. of flowers	Total Plant Moisture %	Total Inflorescence Moisture %	No. of plants/m^2
Replication	2.33	0.012	4.8307	0.02631	0.3301	0.00101	266.78	5.722	4.0034	4.000
Location	1197*	0.701*	48.8191*	0.88634*	4.192*	0.03088*	1258.11*	101.979*	31.6847*	337.00*
Error	18.83	0.06851	2.0923	0.03551	0.1905	0.00204	72.11	10.759	3.2962	4.000
Grand Mean	62.333	4.3922	8.4289	2.0122	2.5189	0.4878	64.444	69.327	73.849	35.333
Standard Error	2.505	0.1511	0.8351	0.1088	0.2520	0.0261	4.9028	1.8937	1.0482	1.1547

Table 2. Mean performance of *Convovulous arvensis* for different traits under three locations

Location	Plant Height (cm)	Leaf Area (cm^2)	Fresh Plant weight (g)	Dry Plant Weight (g)	Fresh Inflorescence weight (g)	Dry Inflorescence weight (g)	No. of Flowers	Total Inflorescence Moisture Percentage	No. of Plants/ m^2	Total Plant Moisture Percentage
1	57.33b	3.79b	12.88a	7.56a	2.58a	0.60a	81.33a	77.38a	37.00a	75.28a
2	84.33a	4.95a	7.40b	2.20b	1.96b	0.41b	70.33b	73.18b	45.00b	69.18b
3	45.33c	4.13ab	5.01c	1.53c	1.50b	0.45b	41.67c	70.98c	24.00c	63.53c

Table 3. Correlation among traits of *Convovulous arvensis*

Traits	Plant Height	Leaf Area	Fresh Plant Weight	Dry Plant Weight	Fresh Inflorescence weight	Dry Inflorescence Weight	No. of Flowers	Total Plant Moisture %	Total Inflorescence Moisture %
Leaf Area	0.8286*								
Fresh Plant weight	0.0830	-0.4891*							
Dry Plant weight	-0.1157	-0.6519*	0.9803*						
Fresh Inflorescence weight	0.2200	-0.3638	0.9904*	0.9435*					
Dry Inflorescence Weight	-0.3742	-0.8292*	0.8931*	0.9644*	0.8223*				
No. of Flowers	0.5284*	-0.0374	0.8899*	0.7821*	0.9444*	0.5895*			
Total Plant Moisture %	0.9778*	0.6929*	0.2900	0.0950	0.4195*	-0.1716	0.6946*		
Total Inflorescence Moisture %	0.1264	-0.4506*	0.9990*	0.9707*	0.9955*	0.8726*	0.9090*	0.3315	
No. of Plants/m^2	0.9376*	0.5823*	0.4243*	0.2369	0.5454*	-0.0284	0.7907*	0.9896*	0.4635*

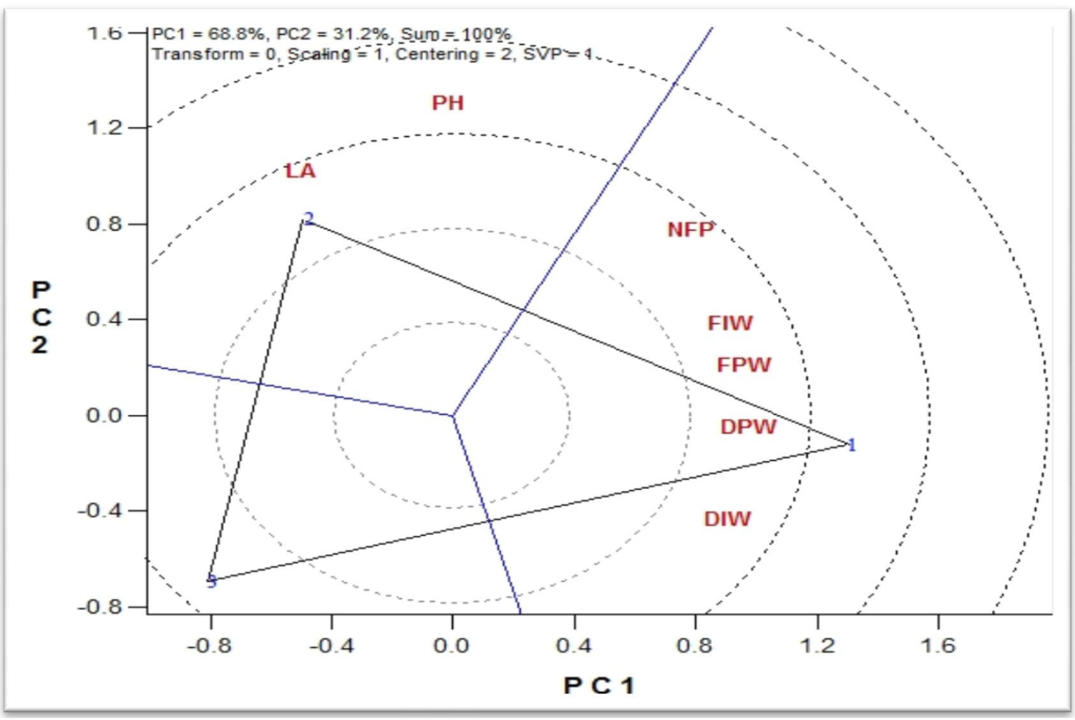

Fig. 1. GGEbiplot for performance of *Convovulous arvensis* under three different locations

Conclusion

It was concluded that the *C. arvensis* must be controlled to reduce crop plant yield losses through the use of manual, chemical and agronomic practices for removal of weeds. The use of transgenic crop plants may be an advantage for improving yield and production of crop plants.

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4/6/2016