Genetic association among morphological and plant growth related traits of *Medicago polymorpha*

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Abstract: Weeds are plants which grow voluntarily at place where it is not wanted and also grow in where there is crop plants plantation. Weeds are interfere with the utilization of natural resources, persistent, resistant, prolific, competitive, and harmful even poisonous in nature and can grow under adverse climate conditions. The prescribed study was conducted at the Centre of Excellence in Molecular Biology, University of the Punjab Lahore, Pakistan to evaluate the genetic variability and biodiversity of *Medicago polymorpha* from three different locations. The data was recorded for different morphological traits and statistically analyzed for significance of the results. It was found from results that significant correlations among the morphological traits, mean performance and from GGEbiplot showed the *Medicago polymorpha* at location 1 with higher ability to withstand in harsh environmental conditions which help to survive much better as compared with sensitive weed and crop plants. It was concluded that the use of manual, chemical and agronomic practices for the removal of the *M. polymorpha* should be carried out to reduce crop plant yield losses and use of transgenic crop plants may be an advantage to compete and improve the yield potential of crop plants.

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Introduction

Weed plants have no values where it is grow and is usually of vigorous growth, especially one that intend to overgrow or check out more desirable plant. It have deep root system, morphological similarities, similarity of seeds, early seed setting, high seed output, allelopathy effect and problems are yield losses, poor quality of produce, economic losses, decrease grazing capacity, force the crop to lodge, and animal health problems cause. Weeds act as an alternative host to pest and diseases in off-season which infect the crop later and caused severe damage and benefits of weeds are provide ground cover, protect soil surface from heavy rain fall soil erosion, act as green manure increase soil fertility, seeds for food of some species and for fodder. Weeds compete for water, light and nutrients against our essential crops (David, 1998). Weeds can be controlled by cultural, biological, chemically methods or by cultivation of allelopathic crops e.g. sunflower. The English name of *Medicago polymorpha* is bur clover an annual winter herbaceous plant. It has papilionaceae family. It has 2n-14. It is cool season legume grow in winter that originated in Mediterranean region of Europe and has become established throughout the most world (Muir *et al*., 2001). It is nutritious palatable plant for fodder as well as eaten as food in some regions. It is nitrogen fixing forage legumes for pasture improvement (Graziano. *et al.,* 2010). It grows all types of soil but loam is more appropriate and well adapted in alkaline soil. It prefers moist and well-drained soil. It adapted to a region where temperature are low. Most studies show that it is tolerated to frost in mild region well. It tolerate freeze of 22-24F but kill at 18F (Loi *et al*., 1993; Cock *et al*., 1993). It germinated by seeds in winter and comes flower in mid-winter in Feb to mid-March and mature in early summer in April May. Optimum rain fall required 15-25 inch. Bur clover has weak stem, trifoliate leaves, and stipules at the base of leaf, yellow flowers and shallow root system (FAO, 2007). It is an autogamous, hard seed, self-re-seeding in winter annual legumes native to Mediterranean region, where it is widely distributed as wild plant (Graziano *et al*., 2010). It profuse branches at base and can attain height of about 6-10 inches. It is posturate but in dense condition is somewhat erect. It is prolific seed producer. It has mostly hairless leaves. The leaflets are wide and flat on top, have sometime purple and white marking on upper side of leaflets, small inverted V mark at the base of leaf. It yellow flowers 3-5mm long arrange in clusters of 5-10. The fruit are hairless and 2-6 coils and 6-8 seeds per pods. Well-developed plant has more than 1000 pods. Mature pods have coiled seeds that have spines forming bur. Seeds are yellow or tan and kidney shape. Bur flowers come after 100-125 days of planting and then seed ripe in June-July. These plants grow in rainfall area

which has lower temperature and low vapor-transpiration rate (Del Pozo *et al*., 2002). The nutrient contents of leaves were analyzed in bur clover in Pakistan are: ash (11.3%); crude fiber (18.8%); crude protein (21.5%); acid detergent fiber (53.6%); NDF (42.8%) (Khan and Khan *et al*., 2012). It can be controlled by cultural, biological and chemical management practices or through the use of transgenic crop plants (Brankov *et al*., 2015; Qamar *et al*., 2015ab; Puspito *et al*., 2015; Sadia *et al*., 2015; Saira *et al*., 2015). Mutation breeding may also be use to induce mutations in crop plants that are resistant to herbicides for the efficient control of weeds (Rizwan *et al*., 2015). The chemical extract of various crop plants like sorghum, sunflower, rice and *Brassica* herbage may also be used for the control of weeds (Elahi *et al*., 2011ab). Chemicals used for the control of *medicago polymorpha* are Triasulfuron, metasulfuron, mesosulfuron, idosulfuron, Fluroxypyr in wheat and Pendimethalin, S-metolachlor in winter pulses and several vegetable crops (Ashiq *et al*., 2013). The prescribed study was conducted to evaluate the morphological traits of *medicago polymorpha* under three different locations and best suggestion about the control of weed plants.

Material and Method:-

This data was conducted at the Center of Excellence in Molecular Biology, University of Punjab Lahore, Pakistan during February 2016. The weed *Medicago polymorpha* was collected from three different locations *viz*. Center of Excellence in Molecular Biology, University of Punjab Lahore. This data was recorded for plant height (PH), leaf area (LA) (leaf length*leaf width), number of flowers per plant (NFP), fresh plant weight (FPW), fresh inflorescence weight (FIW), dry plant weight (DPW), dry inflorescence weight (DIW) by using an electronic weigh balance (OHAUS-GT4000, USA), total plant moisture percentage (TPM) [(fresh plant weight-dry plant weight)/ fresh plant weight*100], total inflorescence moisture percentage (TIM) [(fresh inflorescence weight-dry inflorescence weight)/ fresh inflorescence weight*100] and number of plants per square meter area (TNP). The data was statistically analyzed by using the analysis of variance technique (Steel *et al*., 1997).

Results and discussions

Weeds are undesirable plants grown among the crop plants which compete for mineral, water and nutrients and ultimately caused reduction in crop plant yield, growth and development. Various researchers have conducted experiments to access the yield losing effects of weeds and ways how to control weeds under different environmental conditions and crop species. The biodiversity of weeds depends upon the environmental conditions and type of soil. Most of the weeds grow faster and with huge body biomass in fertile and high humus soils (Saaed *et al*., 2015; Del *et al*., 2002; Qurat-ul-Ain *et al*., 2015). In our study there were significant difference found among the locations and traits of *Medicago polymorpha* (Table 1). It was found from results shown in table 2 that average performance of *M. polymorpha* was better for all studied traits except number of flowers per plant, total plant moisture percentage and number of plants per square meter area at location 1 as compared to other locations 2 and 3. The better performance of *M. polymorpha* at location 1 indicated that the soil and environmental conditions were most suitable and favorable as compared to other locations for growth and development of *M. polymorpha* plants. The results were confirmed by GGEbioplot (Fig. 1) that the location 1 was more favorable for growth and development. The variation for principal component PC1 was recorded as 72.20% and PC2 27.80%. Filipovic *et al*., (2014) suggested that principal component analysis is suitable statistical tool to select genotypes among the large number of genotypes and large number o studied traits. Our study reflects that the variation among the traits was higher and may be helpful to develop more next generations of *M. polymorpha* with greater potential of survive in harsh and stress environmental conditions. The findings were reflecting the results reported by Ali *et al*., (2016); Aalyia *et al*., 2016; Jafar *et al*., (2016) and Mobeen *et al*., (2015). The large number of weed plants in crop plant filed also provides a shelter to insects to hide and attack crop plants with favorable and optimum environmental conditions. Lakic *et al*., (2015) reported that the environmental changes caused a major effect on growth and development of crop plants to show their potential for yield. The uptake of mineral salts, water and nutrients is highly affected due to the presence of weeds in the crop plant field (Dalovic *et al*., 2015).

The results form table 3 indicated that most of the correlations among all studied traits were strong and significant. The plant height showed significant and strong positive correlation with fresh plant weight, total plant moisture, dry inflorescence weight and total inflorescence moisture percentage. Leaf area showed strong and positive correlation with dry and fresh inflorescence weight and number of plants per square meter area. Fresh inflorescence weight showed strong and positive correlation with all traits except plant height, fresh plant weight and dry plant weight. Dry inflorescence weight was strongly and positively correlated with all traits except fresh plant weight and dry plant weight. A very strong positive and significant correlation was recorded for total plant

moisture percentage and total inflorescence moisture percentage. The significant and positive correlation of inflorescence moisture percentage and plant fresh and dry weight indicated that the weed plants have ability to withstand in harsh environmental conditions which help to survive much better as compared with sensitive weed and crop plants. The use of manual practices to control weed plants is always relatively costly also cannot be done properly due to which much of crop plant yield losses are happened (Lakic *et al*., 2015; Sadia *et al*., 2015). The transgenic crop plants must be used to reduce the weed removal input cost and adverse effects on crop yield also various researcher have suggested the use of transgenic crop plants to compete with weeds (Saira *et al*., 2015; Puspito *et al*., 2015; Qamar *et al*., 2015ab).

Table 1. Analysis of variance for different traits of *Medicago polymorpha*

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	20.083	0.07241	7.168	.00288	0.1419	0.00121	0.444	4.20218	16.7778	20.861
Location	161.58*	0.6782*	242.272*	0.4440*	15.1863*	0.02954*	160.778*	5.15108*	14.778*	162.694*
Error	14.167	0.857	11.016	0.00098	0.3756	0.00014	10.111	1.85551	9.1111	14.278
Grand Mean	20.883	0.8811	11.633	0.4178	2.9789	0.1189	21.889	73.846	71.222	21.056
Standard Error	2.1731	0.1690	1.9162	0.0181	0.3538	6.939E-03	1.8359	0.7865	1.7427	2.1816

*= Significant at 5% probability level

Table 2. Mean performance for different traits of *Medicago polymorpha*

Location	Plant Height (cm)	Leaf Area (cm^2)	Fresh Plant weight (g)	Dry Plant Weight (g)	Fresh Inflorescence weight (g)	Dry Inflorescence weight (g)	Total Fresh weight (g)	Total Dry Weight (g)	No. of Flowers	Total Plant Moisture Percentage	Total Inflorescence Moisture Percentage	No. of Plants/ m^2
1	28a	0.6b	21.49a	5.41a	0.86a	0.23a	22.35a	5.62a	17.33c	74.53b	73.66a	65b
2	12c	0.62b	3.91c	0.97c	0.23b	0.066b	4.14c	1.03c	18b	75a	70.66b	87a
3	21.83b	1.43a	9.49b	2.55b	0.16b	0.056b	9.65b	2.86b	30.33a	72.33c	70b	48c

Table 3. Correlation among traits of *Medicago polymorpha*

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	-0.6475*								
Fresh Plant weight	0.8742*	-0.5282							
Dry Plant weight	0.2913*	0.1191	0.6935*						
Fresh Inflorescence weight	-0.7665*	0.8685*	-0.3946	0.3838					
Dry Inflorescence Weight	0.8182*	0.8132*	-0.4851	0.2921	0.9940*				
No. of Flowers	0.6770*	-0.2847	0.2600	-0.3353	0.8248*	0.7893*			
Total Plant Moisture %	0.8237*	-0.8413*	0.5080*	-0.2681	0.9880*	0.9986*	0.7577*		
Total Inflorescence Moisture %	0.8482*	-0.8401*	0.5452*	-0.2255	0.9825*	0.9970*	0.7572*	0.9990*	
No. of Plants	0.5408*	0.9439*	0.2810	0.2369	0.8620*	0.8712*	0.4334	0.8864*	0.8725*

*= Significant at 5% probability level

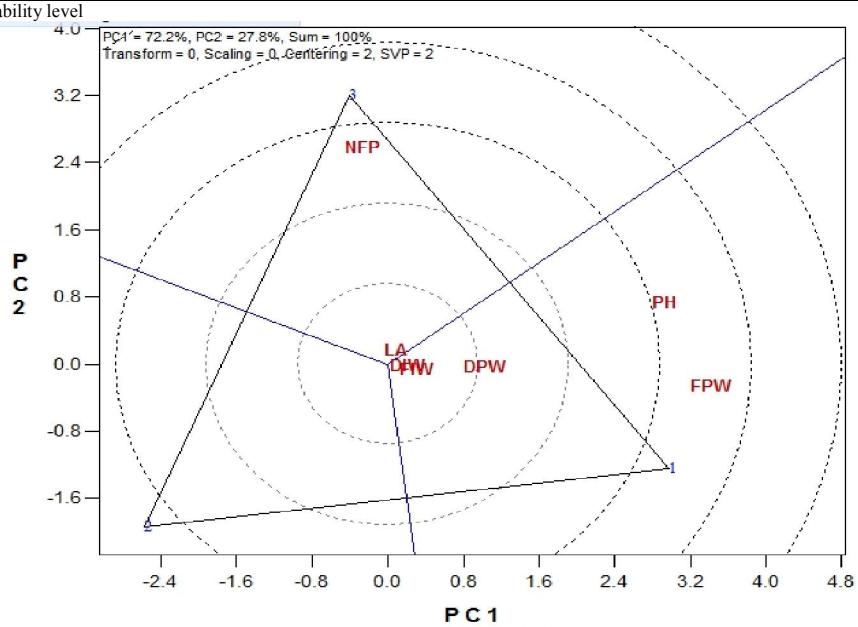

Fig. 1. GGEbiplot for performance of *Medicago polymorpha* under three different locations

Conclusion

The significant correlations among the morphological traits and better performance of *Medicago polymorpha* at location 1 indicated that the plants have ability to withstand in harsh environmental conditions which help to survive much better as compared with sensitive weed and crop plants. It was suggested that the *M. polymorpha* must be controlled to reduce crop plant yield losses through the use of manual, chemical and agronomic practices for its removal. However, the use of transgenic crop plants may be an advantage for improving yield and production of crop plants.

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