Genetic variability among different traits of *Lepidium draba*

Muhammad Zeeshan Ali[1*], Qurban Ali[2], Muhammad Abu Bakar Jaffar[1], Muhammad Waqar Anwar[1], Hafeez Ahmad Sadaqat[1] and Idrees Ahmad Nasir[2]

[1.] Department of Plant Breeding and Genetics, University of Agriculture Faisalabad, Pakistan
[2.] Centre of Excellence in Molecular Biology, University of the Punjab Lahore, Pakistan
Corresponding author's email: zeeshan.ali9292@gmail.com

Abstract: *Lepidium draba* or whitetop is one of most rapidly growing weed throughout the world. It caused major losses in yield of crop plant due to its higher plant population, body size and surviving ability under harsh environmental conditions. The prescribed study was conducted at Center of Excellence in Molecular Biology, University of the Punjab Lahore, Pakistan. The data were recorded from three different locations during the start of February, 2016. Significant differences were recorded among the locations and traits under study. It was found from mean performance and GGEbiplot that locations 1 & 2 served as suitable locations for better growth and development of *L. draba*. The significant and positive correlation was recorded for inflorescence weight and moisture percentage with different plant growth traits, which indicated that the survival and stability of *L. draba* is higher under different environmental conditions. It was suggested that the *L. draba* should be properly controlled to reduce yield losing effects on crop plant yield. However, the use of transgenic crop plants and mutation breeding may be an advantage to control weeds and their harmful effects.
[Ali MZ, Ali Q, Jaffar MAB, Anwar MW, Sadaqat HA and Nasir IA. **Genetic variability among different traits of *Lepidium draba*.** *Nat Sci* 2016;14(4):109-113]. ISSN 1545-0740 (print); ISSN 2375-7167 (online). http://www.sciencepub.net/nature. 14. doi:10.7537/marsnsj14041614.

Keywords: *Lepidium draba*, whitetop, weed plant, GGEbiplot, correlation, harsh environmental condition

Introduction

Lepidium draba (Whitetop or hoary cress) is rapidly growing weed and its overnight growth is an alarming situation to all agricultural countries, commonly called white top or hoary cress. It decreases the biodiversity, different wild life habitats (Caesar *et al.* 2010). White top is a perennial rhizomatous weed, belonging to Cruciferae family and native to Turkey, Russia, and Israel (Aksakal *et al.* 2010). This weed reproduces with the dispersal of seed and also with creepy roots. It originated in Asia and now it almost occurs in temperate regions of the world. In Great Britain *L. draba* is the only weed competing with the wheat, oat and alfafa (Francis & Warwick 2008). This weed adapted itself to moist habitats including roadsides, ditch banks, rangelands and pastures. White top contains secondary glucosinolates compounds that are poisonous to grazing animals especially cattle when consumed in large quantity. Although white top has low palatability and sheep graze it before the flowering stage. Before flowering stage it contain relative high amounts of protein and can be digestible but after flowering its protein levels decreases and never satisfies the energy and protein requirement of healthy livestock (Fumanal *et al*. 2004). This weed competes for numerous nutrients with the other plants and drastically decreases the yield of valuable cash crops. It commonly nourishes well in alkaline soils. It is a perennial weed having multi branched with thin rhizomes budding from the nodes which later produces aerial shoots. Stem is tough, branched above the ground. *Lepidium draba* has erect to nearly procumbent stem (Francis & Warwick 2008). Each shoot can produce 850 silicles, each consisting two seeds. About three-quarters of the plant parts of *Lepidium draba* are underground which provides high capacity for the re-growth and also enables high competitive ability (McInnis *et al.* 1990). The competitive ability of *L. draba* is controlled and enhanced by the allelopathic glucosinolates which inhibits the growth of other competitors (Cripps *et al*. 2006). Root system of *L. draba* has primary and several to thousand permanent lateral roots. Root-born buds are the alternative source for the shoots other than the plumule, developing leafy-shoots directly or either give rise to rhizomes (Frazier 2016). Single plant of white top can produce 1200 to 4800 seeds each successful year and few to 850 seeds can be produced on a single flowering stem (Kiemnec *et. al.* 2002). The viability percentage of white top seed is relatively high. White top seed can remain viable for about three years if buried in soil. Seeds of heart podded white top have the capability to tolerate salt stress and germinate in stress environment (McInnis *et al*. 1993). For the white top, early eradication after infestation is the effective strategy for control. Different chemicals such as *Chlorsulfuron* or *metsulfuron* methyl provide effective results when applied at bud to early flowering stage and can burke

the white top for about two years (Ball *et al.* 2006). The present study was carried out to evaluate the growth and development of *L. draba* under different locations along with the association among different growth traits.

Material and Methods

The prescribed study was conducted at Center of Excellence in Molecular Biology, University of the Punjab Lahore, Pakistan. The data was recorded from three different locations during the start of February, 2016. Each location has 1×1m dimensions. Each location was treated in Randomized complete block design with three replications. From each location, 3 plants were randomly selected and sampled for the data. Data for plant height, leaf area (leaf length × leaf width), fresh plant weight, dry plant weight, fresh inflorescence weight, dry inflorescence weight with the use of electric balance, total plant moisture percentage [(fresh plant weight) – (dry plant weight/fresh plant weight)× 100], total inflorescence moisture percentage [(fresh inflorescence weight) – (dry inflorescence weight / fresh inflorescence weight) × 100] , plant population/1m^2 and number of flowers/plant were recorded and subjected to analysis of variance (Steel *et al*., 1997).

Results and discussions

The results from table 1 indicated that there were significant differences among all the studied traits of *Lepidium draba* and locations of recording data of study. It was also revealed from table 2 that the average performance of *L. draba* for different studied traits was higher on location 1 and location 2 as compared with location 3 which was also confirmed figure 1. The figure 1 also indicated that the principal components PC1 contributed 47.80% and PC2 25.20% variation in overall variation among the traits. The traits number of flowers per plant and plant height contributed higher for better performance of *L. draba* on locations 1 & 2 as compared with other traits. Principal component analysis provides an opportunity of selection in crop plants and GGEbiplot showed the performance of crop plants under varying environmental conditions (Aliya *et al*., 2016; Brankov *et al*., 2015; Dalovic *et al*., 2015; Filipovic *et al*., 2014; Lakic *et al*., 2015). The weed plant that can grow vigorously under different environmental conditions indicated tolerance for stress conditions. The *L. draba* showed better performance under locations 1 & 2 which described higher survival rate. The *L. draba* has been declared as serious weed of various crop plants that caused losses of crop plant yield and productivity. The large number of weed plants in crop plant field provides an opportunity for shelter to insects that caused damage in crop plants in reducing the production and productivity of crop plants (Saeed *et al*., 2015; Qurat-ul-Ain *et al*., 2015; Qamar *et al*., 2015a). The use of crop plant extracts like sorghum may also be used to control weed plants from crop plant filed (Elahi *et al*., 2011ab). The use of transgenic crop plants provides an opportunity to compete with weeds and can tolerate the insect attack (Alyia *et al*., 2016; Jaffar *et al*., 2016; Puspito *et al*., 2015; Qamar *et al*. 2015b). It was found that average plant height of *L. draba* was recorded as 86.511±2.8509, leaf area (113.55±4.7628), fresh plant weight (199.19±4.6703), fresh inflorescence weight (10.417±1.1145), dry plant weight (40.868±0.9560), dry inflorescence weight (3.7056±0.1326), number of flowers per plant (729.33±40.680), total plant moisture percentage (25.322±0.9476), total inflorescence moisture percentage (26.323±0.7278) and total number of plants per square meter (16.667±0.9428). The higher amount of inflorescence moisture percentage indicated that the plants have higher tolerance to stress environmental conditions. The survival rate will be higher under varying environmental conditions. The weed plant compete with crop plants for water, minerals and nutrients which caused low availability to crop plants due to large number of weed plants. The removal of weeds from crop plant field area is always very important to reduce yield losses (Anwar *et al*., 2016; Hareem *et al*., 2015; Mobeen *et al*., 2015; Sadia *et al*., 2015). *L. draba* is an important weed plant which grows nearly too all crop growing areas of country. It is also known as whitetop (Cripps *et al*., 2006).

The results from table 3 indicated that positive and significant correlation of plant height was recorded for all traits except number of plants per square meter and dry inflorescence weight. Leaf area was positively and significantly correlated with plant height, dry plant weight, total plant and inflorescence moisture percentage. Strong, positive and significant correlation of fresh plant weight was recorded for dry plat weight and plant height. There was strong, positive and significant correlation of total inflorescence moisture percentage was found for plant height, number of flowers per plant and total plant moisture percentage. The significant correlation of inflorescence weight and plant traits indicated that the survival rate of *L. draba* will be higher under harsh and stress environmental conditions. The large plant population and moisture contents in the weed plant body revealed that the growth and development of plant is higher which may help in surviving and reproducing for next generation. The *L. draba* seeds remain dormant till to next generation and grow rapidly under favorable environmental conditions. The use of chemicals like glyphosate before sowing of crop plants may help to control weeds. The use of

transgenic crop plants and mutation breeding may be an advantage in controlling and removing weeds from crop plant field (Puspito *et al*., 2015; Qamar *et al*., 2015ab; Rizwan *et al*., 2015; Zameer *et al*., 2015).

Table 1. Analysis of variance for different traits of *Lepidium draba*

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	16.591	10.9	30	1.7580	0.23	0.1179	20.50	0.4127	0.8640	3.00
Location	621.95*	14784.0*	117159*	72.7445*	2711.45*	14.2956*	41395*	11.2744*	17.596*	142.33*
Error	12.191	34.0	33	1.8633	1.37	0.0264	2482	1.3468	0.7946	1.333
Grand Mean	86.511	113.55	199.19	10.417	40.868	3.7056	792.33	25.322	26.323	16.667
Standard Error	2.8509	4.7628	4.6703	1.1145	0.9560	0.1326	40.680	0.9476	0.7278	0.9428

* = significant at 5% probability level

Table 2. Mean performance of *Lepidium draba* 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 Plant Moisture Percentage	Total Inflorescence Moisture Percentage	No. of Plants/m^2
Location 1	57.33b	3.79c	12.88a	7.56a	2.58a	0.60a	81.33a	69.28b	77.38a	37.00b
Location 2	84.33a	4.95a	7.40b	2.20b	1.96b	0.41b	70.33b	75.18a	73.18b	45.00a
Location 3	45.33c	4.13b	5.01c	1.53c	1.50c	0.45b	41.67c	63.53c	70.98c	24.00c

Table 3. Correlation among different traits of *Lepidium draba*

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	0.7199*								
Fresh Plant weight	0.7206*	0.6548*							
Dry Plant weight	0.7894*	0.6284*	0.99*						
Fresh Inflorescence weight	0.6355*	-0.0619	0.4381*	0.5528*					
Dry Inflorescence Weight	-0.3091	-0.4049	0.3336	0.2887	0.1746				
No. of Flowers	0.7896*	0.1513	0.3688	0.496	0.9277*	-0.1995			
Total Plant Moisture %	0.9402*	0.8033*	0.522*	0.5832*	0.4063	-0.6014*	0.6687*		
Total Inflorescence Moisture %	0.8905*	0.5618*	0.3265	0.4254	0.5674*	-0.6477*	0.8264*	0.9432*	
No. of Plants	0.3088	-0.1252	-0.4134	-0.291	0.4166	-0.703*	0.645*	0.4318	0.6884*

* = significant at 5% probability level

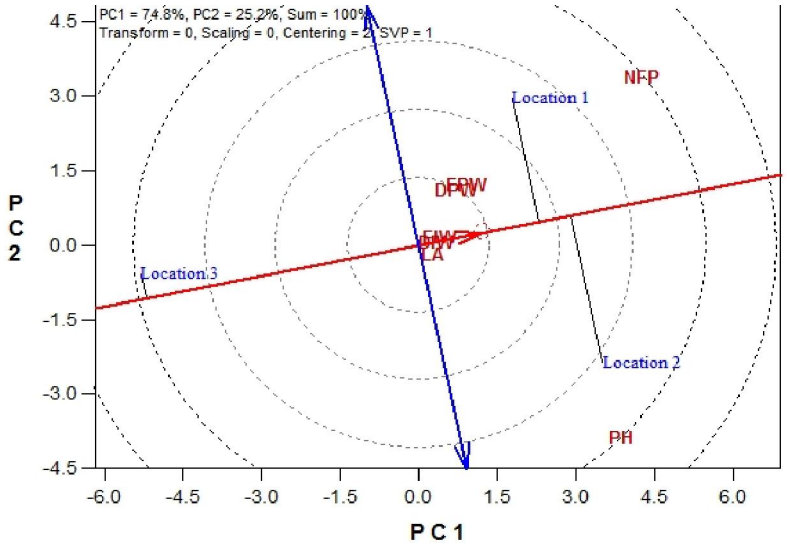

Fig. 1: GGEbiplot for performance of *Lepidium draba* under three different locations

Conclusion

It was concluded form above study that the growth and development of *L. draba* or whitetop was better under locations 1 and 2. It was suggested that the removal of whitetop should be carried out to minimize yield losses of crop pants. There should be enhanced the use of transgenic crop plants or induced mutation breeding to control weed plants from crop plant field.

References:

1. Aaliya K, Qamar Z, Nasir IA, Ali Q, Farooq AM and Husnain T. (2016). Transformation, evaluation of GTGene and multivariate genetic analysis for morpho-physiological and yield attributing traits in *Zea mays*. Genetika. 48(1).
2. Aksakal, O. *et al*., 2010. Genetic Diversity Within and Among Lepidium draba Populations from Eastern Anatolia Based on RAPD Analysis. Biochemical Genetics, 48(7), pp.603–611.
3. Ali, Q., Ahsan, M., Kanwal, N., Ali, F., Ali, A., Ahmed, W., ... & Saleem, M. (2016). Screening for drought tolerance: comparison of maize hybrids under water deficit condition. *Advancements in Life Sciences*, *3*(2), 51-58.
4. Anwar MW, Ali Q, Ali MZ, Jaffar MAB, Khan TM and Nasir IA. Genetic association among morphological and plant growth related traits of *Medicago polymorpha*. *N Y Sci J* 2016;9(4):27-31.
5. Babar, Y., Ali, Q., Mahmood, S., Ahmad, A., Ali, A., Samiullah, T. R., ... & Nasir, I. A. (2015). Correlation analysis for various morphological traits of Chenopodium album, Amaranthus viridis, Anagallis arvensis and Asphodelus tenuifolius. *Academia Arena*, *7*(4).
6. Ball, D.A., D. Cudney, S.A. Dewey, C.L. Elmore, R.G. Lym, D.W. Morishita, R. Parker, D.G. Swan, T.D. Whitson, and R.K. Zollinger. 2006. Weeds of the West. Grand Teton Lithography, Jackson, Wyoming. 628 pp.
7. Brankov, M., Simić, M., Dragičević, V., Vrbničanin, S., & Spasojević, I. (2015). Genotype dependent tolerance to herbicides of maize (Zea mays L.) inbred lines. *Genetika*, *47*(1), 97-106.
8. Caesar, A.J., Caesar, T. & Maathuis, M.H., 2010. Pathogenicity, characterization and comparative virulence of *Rhizoctonia* spp. from insect-galled roots of Lepidium draba in Europe. Biological Control, 52(2), pp.140–144.
9. Cripps, M.G. *et al*., 2006. Biocontrol Science and Technology Comparative survey of the phytophagous arthropod faunas associated with *Lepidium draba* in Europe and the western United States, and the potential for biological weed control. , 3157(March 2016).
10. Dalovic I., D. Jocković, y. Chen, G. Bekavac, S. Šeremešić, G. Jaćimović, M. Brdar–Jokanović (2015): *Maize nutrient uptake affected by genotype and fertilization.* Genetika, 47(3): 941-950.
11. Elahi, M. Z. A., and S. M. A. Cheema. "Basra and Q. Ali, (2011a). Use of allelopathic extracts of sorghum, sunflower, rice and Brassica herbage for weed control in Wheat (Triticum aestivum L.)." 488-496.
12. Elahi, M., Cheema, Z. A., Basra, S. M. A., Akram, M., & Ali, Q. (2011b). Use of allelopathic water extract of field crops for weed control in wheat. *Int. Res. J. Pl. Sci*, *2*, 262-270.
13. Filipovic, M., M. Babic, N. Delic, G. Bekavac and V. Babic, 2014. Determination of relevant breeding criteria by the path and factor analysis in maize. Genetika, 46:41-49.
14. Francis, A. & Warwick, S.I., 2008. The biology of Canadian weeds. 3. Lepidium draba L., L. chalepense L., L. appelianum Al-Shehbaz (updated). Canadian Journal of Plant Science, 88(2), pp.379–401. Available at: http://dx.doi.org/10.4141/CJPS07100.
15. Frazier, J.C., 2016. Nature and Rate of Development of Root System of Lepidium draba Author (s): John C . Frazier Published by : The University of Chicago Press Stable URL : http://www.jstor.org/stable/2472207 Accessed : 14-03-2016 05 : 49 UTC Your use of the JSTOR archive, 105(2), pp.244–250.
16. Fumanal, B. *et al*., 2004. Host range of Ceutorhynchus assimilis (Coleoptera: Curculionidae), a candidate for biological control of Lepidium draba (*Brassicaceae*) in the USA. , 30, pp.598–607.
17. Harrem, K., Ali Q, Sadia, A., Mobeen, A., Ali, A., Arfan, A., ... & Tayyab, H. (2015). Biodiversity and correlation studies among various traits of Digeria arvensis, Cyperus rotundus, Digitaria adescendense and Sorghum halepense. *NY Sci J*, *8*(4), 37-42.
18. Jacobs, J. 2007. Ecology and Management of Whitetop. USDA/NRCS Technical Note MT-12. Available at Site: http://www.mt.nrcs.usda.gov/technical/necs/invasive/ management/technotes-ai.html (accessed Sept. 2010).
19. Jaffar MAB, Ali Q, Ali MZ, Anwar MW, Khan FA and Nasir IA. 2016. Genetic variability among different traits of *Convolvulous arvensis*. *Nat Sci* 14 (5):62-65.
20. Khan M.U., Ghori N.H., Hayat M.Q. Phytochemical Analyses for Antibacterial Activity and Therapeutic Compounds of

Convolvulus arvensis L., Collected from the Salt Range of Pakistan (2015). Adv. Life Sci. 2(2). pp: 83-90.
21. Kiemnec, G.L. and M.L. McInnis. 2002. Hoary cress (*Cardaria draba*) root extract reduces germination and root growth of five plant species. Weed Technology. 16:231-234.
22. Lakic, Z., Balalic, I., & Vojin, S. (2015). Interpretation of genotype× environment interaction in perennial ryegrass (Lolium perenne L.). *Genetika*, *47*(2), 509-522.
23. McInnis, M.L., L.L. Larson, and R.F. Miller. 1990. First year defoliation effects on whitetop. Northwest Science. 64:107.
24. McInnis, M.L., L.L. Larson, and R.F. Miller. 1993. Nutrient composition of whitetop. Journal of Range Management. 46:227-231.
25. Mobeen, A., A.li Q, Sadia, A., Harrem, K., Ali, A., Arfan, A., ... & Tayyab, H. (2015). Estimation of Correlation among various morphological traits of Coronopus didymus, Euphorbia helioscopia, Cyperus difformis and Aristida adscensionis. *NY Sci J*, *8*(4), 47-51.
26. Puspito, Agung N., Abdul Q. Rao, Muhammad N. Hafeez, Muhammad S. Iqbal, Kamran S. Bajwa, Qurban Ali, Bushra Rashid *et al*. "Transformation and Evaluation of Cry1Ac+ Cry2A and GTGene in Gossypium hirsutum L."*Frontiers in plant science* 6 (2015).
27. Qamar, Z., Aaliya, K., Nasir, I. A., Farooq, A. M., Tabassum, B., Qurban, A., ... & Husnain, T. (2015b). An overview of genetic transformation of glyphosate resistant gene in Zea mays. *Nat Sci*, *13*(3), 80-90.
28. Qamar, Z., Riaz, S., Nasir, I. A., Ali, Q., & Husnain, T. (2015a). Transformation and transgenic expression studies of glyphosate tolerant and cane borer resistance genes in sugarcane (Sccharum officinarum L.). *Molecular Plant Breeding*, *6*.
29. Qurat-ul-Ain, S., Ali, Q., Ali, A., Arfan, A., Saeed, A., Samiullah, T. R., ... & Haidar, M. U. (2015). Study of association among various morphological traits of *Paspalum distichum, Marsilea minuta, Vicia sativa* and *Scirpus meritimus*. *World Rural Observ*, *7*(2), 36-41.
30. Rizwan, M., & Akhtar, S. (2015). Development of herbicide resistant crops through induced mutations. *Advancements in Life Sciences*, *3*(1), 01-08.
31. Sadia, A., Ali Q., Mobeen, A., Harrem, K., Ali, A., Arfan, A., ... & Tayyab, H. (2015). Assessment of association among various morphological traits of Euphorbia granulata, Euphorbia hirta, Fumaria indica and Parthenium hysterophorus. *Nat Sci*, *13*(4), 47-51.
32. Saeed, A., Ali, Q., Qurat-ul-Ain, S., Ali, A., Arfan, A., Samiullah, T. R., ... & Rao, A. Q. (2015). Correlation analysis for various morphological traits of *Solanum nigrum, Setaria pumila, Leptochloa chinesis, Phalaris minor*. *Academ Arena*, *7*(1).
33. Saira, M., A Q., Yusra, B., Ali, A., Arfan, A., Samiullah, T. R., ... & Rao, A. Q. (2015). Estimation of correlation among various morphological traits of *Carthamus oxycantha, Cirsium arvense, Cleome viscose* and *Convolvulus arvensis*. *World Rural Observ*, *7*(2).
34. Steel, R.G.D., Torrie J.H., and Dickey D.A., 1997. Principles and Procedures of Statistics: A biometrical approach. McGraw Hill Book Co. New York. USA. pp: 400-428.
35. Zameer, M., Munawar, S., Tabassum, B., Ali, Q., Shahid, N., Saadat, H. B., & Sana, S. (2015). Appraisal of various floral species biodiversity from Iskandarabad, Pakistan. *Life Sci J*, *12*(3s), 77-87.

4/25/2016