Correlation analysis for various morphological traits of *Solanum nigrum, Setaria pumila, Leptochloa chinesis* and *Phalaris minor*

Amna Saeed[1], Qurban Ali[2], Qurat-ul-Ain Sajid[1], Ali Ahmad[3], Arfan Ali[2], Tahir Rahman Samiullah[2], Saira Azam[2], Saira Mahmood[4], Yusra Babar[4], Syed Bilal Hussain[1], Rao Abdul Qayyum[1], Idrees Ahmad Nasir[2] and Tayyab Husnain[2]

[1.] Department of Plant Breeding and Genetics, Bhauddin Zikarya University Multan
[2.] Centre of Excellence in Molecular Biology, University of the Punjab Lahore, Pakistan
[3.] Department of Agronomy, University of Agriculture Faisalabad, Pakistan
[4.] Department of Horticulture, Bhauddin Zikarya University Multan
Emails: saim1692@gmail.com, qurban.ali@cemb.edu.pk, amnasaeed067@yahoo.com
Cell No: +92(0)321-9621929

Abstract: The present study was carried out to access relationship among various traits of weeds. Higher weed plant population was recorded for *Phalaris minor*. It was found that *Solanum nigrum* showed higher fresh plant weight, dry plant weight, plant and inflorescence weight and moisture percentage. It was found that total plant moisture percentage and total inflorescence moisture percentage was strongly and significantly correlated with each other. It was suggested from correlation of plant population and total plant and inflorescence moisture percentage that the weed plants used much of the input sources of crop plants. The higher plant population also provides a shelter for insects/pests that caused damage in crop plants to reduce crop yield. The competition of crop plant with weeds increased due to higher weed population and adversely effects water and nutrient requirements. It was suggested that the herbicide resistant varieties should be developed of use herbicide before sowing of crop plants.
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1. Introduction

Weeds are the plants growing where it is not sown. Weeds cause trouble when grow in desirable field as it compete with required crop as a result it directly effects the yield of crop. It is a source of contamination. It interferes with harvest. Weeds are very common .although weeds have some positive aspects but they must be controlled in order to increase yield, quality of desired crop. Weeds also give shelter to various insect pests & disease pathogens and they may serve as alternate hosts for spread of pest and disease (Qamar *et al*., 2015; Harrem *et al*., 2015; Sadia *et al*., 2015; Mobeen *et al*., 2015; Sajid *et al*., 2015 and Yusra *et al*., 2015).

1.1. *Solanum nigrum:*

It belongs to genus solanum. It is firstly introduced in Americas, Australasia and Southafrica. It is known as weed and is dangerous to livestock and humans. It also contains some edible strains whose berries, cooked leaves are used as food source. It is commonly called 'makoy'. This is used for medicinal purpose as for treatment of cirrhosis liver, ferifuge, in eye diseases, hydrophobia. Carl Linnaeus gave description on six varieties of *Solanum nigrum* in Species Plantarum (David, 1998).

1.2. *Setaria pumila*

It is known by different names as yellow foxtail, yellow bristle grass, pigeon grass and cattail grass. It is known as a weed throughout the world. It is basically grown in lawns, side walk, roadside, cultivated field. This is annual grass grows up to 20 meter in height. Having hairless stem colour ranges from green to purple tinged and color of panicle is yellow and yellow-tinged. Its germinating period is from mid November to February at this time soil temperature (above 20^0C) is suitable for its germination (Steinmaus *et al*. 2000).

1.3. *Leptochloa chinesis*

This genus is a member of Poaceae family which includes 45 species found in tropical and subtropical regions (MacFarlane, 1987). It plant have C4 pathway (Lazarides, 1980).It plant grows up to 1 meter in height. Their leaves are very smooth, 10-20cm long. It reproduction is basically sexual but can also reproduce

by vegetative propogation (Hafliger & Scholz, 1981). It is annual grass.

1.4. *Phalaris minor*

Phalaris minor belongs to grass species. Local and common names include small-seeded canary grass, small canary grass, guli danda (Hindi) and in Urdu basically called sittee booti. It can grow up to 1.8 meters in height and having spike like panicle. It can be grown naturally anywhere. Its main drawback is that it is poisonous to some mammals and it is a source of contamination in seed crops. It is edible for livestock and birdseed. It is a serious weed in wheat which directly affects the yield of wheat crop. This weed was previously controlled by spraying crop with isoproturon but resistance to isoproturon were observed firstly by (Malik and Singh 1995)

2. Materials and methods

The present study was conducted at Centre of Excellence in Molecular Biology, University of the Punjab Lahore, Pakistan during March 2015. The of *Solanum nigrum, Setaria pumila, Leptochloa chinesis* and *Phalaris minor* weeds was collected from 4 different locations *viz*. Centre of Excellence in Molecular Biology, University of the Punjab Lahore, Institute of Agricultural Sciences (IAGS), University of the Punjab Lahore, Hanjerwal colony near Centre of Excellence in Molecular Biology, University of the Punjab Lahore and Road side area of Ferozepur Road Kasur. The data was recorded for fresh plant weight, fresh inflorescence weight, dry plant weight, dry inflorescence weight by using an electronic balance (OHAUS-GT4000, USA), 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] and number of plants per square meter area. The data was statistically analyzed by using analysis of variance technique (Steel *et al*., 1997).

3. Results and discussion

It was revealed from table 1 that significant differences were reported for all studied traits. Significant interactions were also recorded for weeds×locations. It was found that average dry plant weight for all locations was 0.7781±0.0012g while fresh plant weight was found as 2.3438±0.8778g. There was a significant difference between fresh and dry weed plant weight. As total plant moisture percentage 62.5050±3.0731% was also higher that revealed the facts about water contents in the weed plant body. The higher plant moisture percentage indicated that the weed plants absorbed much higher moisture from soil that caused competition of crop plants with weeds for water absorption and nutrients availability. The dry inflorescence weight was 0.4619±0.0319g which showed higher difference for fresh inflorescence weight (1.2733±0.6871g). The inflorescence moisture percentage (72.972±3.0922%) which was low as compared with plant moisture percentage showed that the weeds plant store much of the water contents in their plant body to survive in harsh, hot and dry conditions. It was found that average number of plants per square meter or weed plant population was 44.3350±3.0281. The higher weed plant population suggested that the competition of weed plant with crop plants will be higher. The loss of input will be higher as the absorption of water and nutrients increased due to higher weed plant population. The weed plants also offer a covering shelter for insects that caused damage in crop plants (Sabbir *et al*., 2014). The weeds should be controlled to minimize the harmful effects of weeds for crop plants (Qamar *et al*., 2015; Harrem *et al*., 2015; Sadia *et al*., 2015; Mobeen *et al*., 2015; Qurat-ul-Ain *et al*., 2015; Saira *et al*., 2015 and Saeed *et al*., 2015).

It was revealed from results (Table 2) that higher weed plant population was recorded for *Phalaris minor* at CEMB (78.890), Hanjerwal colony (56.320), Kasur (84.220) and *Setaria pumila* at Institute of Agricultural Sciences (IAGS), Punjab University (75.130). Lowest weed plant population was recorded for *Leptochloa chinesis* at CEMB (13.120), Hanjerwal (14.220), Punjab University (16.260) and Kasur (15.780). It was revealed from results (Table 2) that higher fresh and dry weed plant weight was recorded for *Solanum nigrum* at CEMB (5.460g, 1.79g), Hanjerwal (5.760g, 0.97g), Kasur (3.12g, 1.45g) and Punjab University (5.00g, 1.34g) respectively. Lowest fresh and dry weed plant weight was recorded for *Leptochloa chinesis* at CEMB (0.820g, 0.560g), Hanjerwal (0.830g, 0.540g) and Kasur (0.98g, 0.560g) respectively, *Leptochloa chinesis* showed lower fresh plant weight at Punjab University (0.790g) and *Setaria pumila* showed lower dry plant weight at Punjab University (0.490g). It was revealed from results (Table 2) that higher fresh and dry inflorescence weight was recorded for *Solanum nigrum* Hanjerwal (2.860g, 0.97g), Kasur (3.12g, 1.09g) and Punjab University (2.650g, 0.91g) respectively, *Solanum nigrum* showed higher fresh inflorescence weight at CEMB (1.683g) and *Phalaris minor* showed higher fresh inflorescence weight at CEMB (0.49g) . Lowest fresh and dry inflorescence weight was recorded for *Leptochloa chinesis* at CEMB (0.560g, 0.11g), Kasur (0.490g, 0.11g) respectively and *Leptochloa chinesis* showed lower dry inflorescence weight at Hanjerwal (0.11g). It was revealed from results (Table 2) that higher plant moisture percentage was recorded for *Solanum nigrum*

at CEMB (67.216%) and at Hanjerwal (83.160%). *Leptochloa chinesis* showed higher plant moisture percentage at Punjab University (78.481%) and *Phalaris minor* at Kasur (90.374%). Lowest plant moisture percentage was recorded for *Phalaris minor* at CEMB (44.776%), Hanjerwal (38.217%), Punjab University (47.904%) and *Setaria pumila* at Kasur (33.663%). It was revealed from results (Table 2) that higher total inflorescence moisture percentage was recorded for *Solanum nigrum* at Punjab University (65.660%), *Leptochloa chinesis* at CEMB (80.357%), *Phalaris minor* at Hanjerwal (88.889%) and *Leptochloa chinesis* at Kasur (77.551%. *Phalaris minor* showed lowest inflorescence moisture percentage at Punjab University (46.847%), at CEMB (60.163%), *Setaria pumila* at Kasur (52.239%) and *Solanum nigrum* at Hanjerwal (66.084%). Higher plant and inflorescence moisture percentage indicated that the weed plants used much of the soil water and nutrients that caused loss of inputs. The higher weed plant population caused intensive crop plant competition for water, nutrients and light. The insects get shelter place in weeds that lead towards the intensive attack of insects/pests on crop plants. The weeds should be controlled to minimize the yield loss effects on crop plants. There must be the use of chemical, manual methods to remove field weeds. The use of transgenic plants should also be encouraged (Elahi *et al*., 2014ab; Ali *et al*., 2014abc; Ali *et al*., 2013; Harrem *et al*., 2015; Sadia *et al*., 2015; Mobeen *et al*., 2015; Qurat-ul-Ain *et al*., 2015; Saira *et al*., 2015 and Saeed *et al*., 2015).

It was persuaded from the results (Table 3) of correlation analysis among different studied traits of weeds that there was a significant correlation of dry plant weight with inflorescence dry weight, fresh plant weight plant population, total plant moisture percentage and total inflorescence moisture percentage. Inflorescence dry weight was significantly correlated with dry plant weight, fresh plant weight, total plant moisture percentage and inflorescence fresh weight. There was a significant correlation between fresh plant weight and dry plant weight, plant population, inflorescence dry and fresh weight and total plant moisture percentage. Inflorescence fresh weight was significantly correlated with inflorescence dry weight, fresh plant weight, total plant moisture percentage. Plant population was significantly correlated with fresh plant weight, total plant and inflorescence moisture percentage. It was found that total plant moisture percentage and total inflorescence moisture percentage was strongly and significantly correlated with each other. It was suggested from correlation of plant population and total plant and inflorescence moisture percentage that the weed plants used much of the input sources of crop plants. The higher plant population also provides a shelter for insects/pests that caused damage in crop plants to reduce crop yield. The competition of crop plant with weeds increased due to higher weed population and adversely effects water and nutrient requirements. It was suggested that the herbicide resistant varieties should be developed of use herbicide before sowing of crop plants. The positive correlations also suggested that the weeds have higher growth rate and water use efficiency as compared with crop plants (Elahi *et al*., 2014ab; Ali *et al*., 2014abc; Ali *et al*., 2013; Harrem *et al*., 2015; Sadia *et al*., 2015; Mobeen *et al*., 2015; Qurat-ul-Ain *et al*., 2015; Saira *et al*., 2015 and Saeed *et al*., 2015).

Table 1. ANOVA for various morphological traits of weeds

Source of variation	DF	Dry plant weight	Inflorescence Dry weight	Fresh plant weight	Inflorescence Fresh weight	No of plants/m^2	Total plant moisture percentage	Total inflorescence moisture percentage
weeds	3	1.9083*	0.7488*	40.7190*	7.0079*	4387.650*	824.3230*	170.6450*
Location	3	0.1168*	0.0890*	0.2654*	0.0976*	89.7698*	122.3230*	747.8620*
weeds×Location	9	0.1802*	0.0760*	0.1257*	0.2502*	388.8360*	603.1960*	189.2710*
Error	15	0.00002	0.00006	0.00005	0.00001	0.00007	0.00002	0.00007
Grand Mean		0.7781	0.4619	2.3438	1.2733	44.3350	62.5050	67.3400
Standard error		0.0012	0.0319	0.8778	0.6871	3.0281	3.0731	4.3136

* = Significant at 5% probability level

Table 2. Mean performance of weeds for various morphological traits at different locations

No of plants/m^2					
Weeds/Locations	**CEMB**	**Hanjerwal Colony**	**Punjab University (IAGS)**	**Kasur**	**Average**
Solanum nigrum	37.120c	44.220c	34.520c	31.110c	36.743c
Setaria pumila	67.290b	56.190b	75.130a	34.870b	58.370b
Leptochloa chinesis	13.120d	14.220d	16.260d	15.780d	14.845d
Phalaris minor	78.890a	56.320a	49.220b	84.220a	67.163a
Average	49.105a	42.738c	43.783b	41.495d	
Fresh plant weight (g)					
Weeds/Locations	**CEMB**	**Hanjerwal Colony**	**Punjab University (IAGS)**	**Kasur**	**Average**
Solanum nigrum	5.460a	5.760a	5.000a	6.230a	5.613a
Setaria pumila	0.820c	0.950c	0.850c	1.010c	0.908c
Leptochloa chinesis	0.820c	0.830d	0.790d	0.980d	0.855d
Phalaris minor	2.010b	1.570b	1.670b	1.870b	1.780b
Average	2.278b	2.278b	2.078c	2.523a	
Fresh inflorescence weight (g)					
Weeds/Locations	**CEMB**	**Hanjerwal Colony**	**Punjab University (IAGS)**	**Kasur**	**Average**
Solanum nigrum	1.683a	2.860a	2.650a	3.120a	2.578a
Setaria pumila	0.790c	0.630c	0.490d	0.670c	0.645c
Leptochloa chinesis	0.560d	0.540d	0.650c	0.490d	0.560d
Phalaris minor	1.230b	0.990b	1.110b	1.030b	1.090b
Average	1.066d	1.255b	1.225b	1.328a	
Dry plant weight (g)					
Weeds/Locations	**CEMB**	**Hanjerwal Colony**	**Punjab University (IAGS)**	**Kasur**	**Average**
Solanum nigrum	1.79a	0.97a	1.34a	1.45a	1.3875a
Setaria pumila	0.43c	0.28c	0.33c	0.67b	0.4275c
Leptochloa chinesis	0.27d	0.29b	0.17d	0.45c	0.295d
Phalaris minor	1.11b	0.97a	0.87b	0.18d	0.7825b
Average	0.9a	0.6275d	0.6775c	0.6875b	
Inflorescence Dry weight (g)					
Weeds/Locations	**CEMB**	**Hanjerwal Colony**	**Punjab University (IAGS)**	**Kasur**	**Average**
Solanum nigrum	0.37b	0.97a	0.91a	1.09a	0.835a
Setaria pumila	0.23c	0.12c	0.22d	0.32c	0.2225c
Leptochloa chinesis	0.11d	0.13b	0.27c	0.11d	0.155d
Phalaris minor	0.49a	0.11d	0.59b	0.47b	0.415b
Average	0.3d	0.332b	0.4975a	0.4975a	
Total plant moisture percentage (%)					
Weeds/Locations	**CEMB**	**Hanjerwal Colony**	**Punjab University (IAGS)**	**Kasur**	**Average**
Solanum nigrum	67.216a	83.160a	73.200b	76.726b	75.075a
Setaria pumila	47.561c	70.526b	61.176c	33.663d	53.232d
Leptochloa chinesis	67.073ab	65.060c	78.481a	54.082c	66.174b
Phalaris minor	44.776d	38.217d	47.904d	90.374a	55.318c
Average	56.657d	64.241b	65.190a	63.711c	
Total inflorescence moisture percentage (%)					
Weeds/Locations	**CEMB**	**Hanjerwal Colony**	**Punjab University (IAGS)**	**Kasur**	**Average**
Solanum nigrum	78.015b	66.084d	65.660a	65.064b	68.706b
Setaria pumila	70.886c	80.952b	55.102c	52.239d	64.795c
Leptochloa chinesis	80.357a	75.926c	58.462b	77.551a	73.074a
Phalaris minor	60.163d	88.889a	46.847d	54.369c	62.567d
Average	72.355b	77.963a	56.518a	62.306c	

Table 3. Pooled correction among various morphological traits of weeds

Traits	Dry plant weight	Inflorescence Dry weight	Fresh plant weight	Inflorescence Fresh weight	No of plants/ m^2	Total plant moisture percentage
Inflorescence Dry weight	0.6937*					
P<0.05	0.0296					
Fresh plant weight	0.953*					
P<0.05	0.0000					
Inflorescence Fresh weight	0.9754*	0.8241*	0.7447*			
P<0.05	0.0057	0.0000	0.0000			
No of plants/m^2	0.0553	0.8357*	0.9328*	0.6216*		
P<0.05	0.7635	0.0000	0.0000	0.0001		
Total plant moisture percentage	0.5579*	0.4305*	0.4112*	0.6726*	0.3971*	
P<0.05	0.1076	0.0139	0.0194	0.0677	0.0244	
Total inflorescence moisture percentage	0.3075*	0.0065	-0.0816	0.065	0.3962*	0.826*
P<0.05	0.0869	0.9718	0.6572	0.7236	0.0248	0.0405

Conclusions

It was concluded from all of the above study that the weeds should be controlled through chemical, manual of through the use of transgenic crop plants to minimize the yield loss due to weeds.

Correspondence:
Dr. Qurban Ali (PhD)
Assistant Professor
Centre of Excellence in Molecular Biology,
University of the Punjab Lahore, Pakistan
saim1692@gmail.com, qurban.ali@cemb.edu.pk
Cell No: +92(0)321-9621929

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