**Assessment of association among various morphological traits of *Euphorbia granulata, Euphorbia hirta, Fumaria indica and Parthenium hysterophorus***

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**Abstract**: The present study was carried out to access the correlation among various morphological traits of different weeds and their body moisture contents during March 2015. It was found that higher weed plant population was recorded for *Fumaria indica* and higher moisture percentage was recorded for *Fumaria hirta* at most of the studied locations. Plant population was significantly correlated with fresh and dry plant weight, inflorescence dry weight and total inflorescence moisture percentage. Total plant moisture percentage and total inflorescence moisture percentage was significantly correlated with each other. The significant correlation of plant population with inflorescence moisture percentage suggested that the weed plants have ability to survive in hot, harsh and dry environmental conditions. It was concluded that the weed plant should be control to minimize the crop plant yield losses due to competition for water, nutrients and light.

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1. **Introduction**

The term weeds referred as any plant that grows at unwanted place. Taxonomically, the term "weed" has no botanical significance due to the fact that a plant which is a weed in at one place may be not a weed when growing in a situation where it is in fact wanted. Weeds are big issue in crop cultivation because it causes reduction in crop yield: Weeds starts to compete with our precious crop for water, nutrients and light (David 1998). As they are hardy and have vigorous growth habit, they outgrow the crops soon & consume large amounts of water and nutrient that cause heavy losses in yield. It may increase the cost of cultivation.Quality of the field produce also reduced. 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).

* 1. ***Euphorbia granulata***

It is variable densely growing to almost expose much-branched bowed low in nature annual or perennial herb. Its stem 20 cm long Petioles 0.5 mm long. Leaf-blades obviate-oblong in shape, 1-8 x 0.5-5 mm, apex are rounded or emarginated, rounded at the base cornerwise, slightly fleshy and thick in nature. Cynthia axillary is 0.5 mm long, solitary Glands transversely ovate and yellowish or ochreous in color, and sometimes it looks reddish, with unequal white or pink color appendages. Trigonous fruits, keels craniate 1.1 × 1.1 mm, smooth, having simple hairs. Seeds are ovoid-cylindrical, quadrangular in shape and 0.8 x 0.4 mm, having color pinkish grey (Tona *et al.*, 2004; Kumar *et al.*, 2010).

* 1. ***Euphorbia hirta***

It is a tropical weed, probably native to India. It grows on open grasslands pathways and on roadsides having hairs on it. At its growing areas it is used as medicinal plant widely. It is annual herb, erect or prostrate in nature and can grow up to 60cm long. It has a long, solid and hairy stem which produced latex in large quantity. Stipules are present in it. Its leaves are elliptical in shape, simple and hairy and dented margins. Leaves arranged in opposite pairs on the stem. The flowers are present in axillary cymes at each leaf node and unisexual. Generally on a stalk they lack of petals. Its fruit is capsule shaped having three valves. They produce tiny, four-sided seeds of red color, and oblong in shape. It has taproot of white or brown color (Sudhakar *et al*.2006; Kumar *et al.*, 2010).

* 1. ***Fumaria indica***

Indian Fumitory is a elegant much-branched herb. It is annual herb having clusters of tiny flowers of pale-pinkish to whitish color, each 5-6 mm long. Sepals are insignificant. Upper petal has small, partially down-curved sac-like spur. Flower-stalks are shorter than the lace shaped bracts and erect. Leaves are cut for 2-3 times into cramped acuminate segments of about 1 mm broad. Stems are leafy, 5-30 cm long in size. Fruits are round and of about 2 mm. it is found all over the Himalayas, up to elevation of 2400 m. It is at flowering in April-May (Pandey *et al*., 2008; Rao *et al*., 2007).

* 1. ***Parthenium hysterophorus***

It is a [flowering plant](http://en.wikipedia.org/wiki/Flowering_plant) species in the aster family, [Asteraceae](http://en.wikipedia.org/wiki/Asteraceae). It is native to the [American](http://en.wikipedia.org/wiki/Americas) [tropics](http://en.wikipedia.org/wiki/Neotropic_ecozone). Santa Maria Fever few and White top Weed include in its common names. *It* is a much-branched, [annual](http://keys.lucidcentral.org/keys/v3/eafrinet/weeds/key/weeds/Media/Html/glossary.htm#annual), upright growing [herbaceous](http://keys.lucidcentral.org/keys/v3/eafrinet/weeds/key/weeds/Media/Html/glossary.htm#herbaceous) plant. It forms a [basal](http://keys.lucidcentral.org/keys/v3/eafrinet/weeds/key/weeds/Media/Html/glossary.htm#basal) [rosette](http://keys.lucidcentral.org/keys/v3/eafrinet/weeds/key/weeds/Media/Html/glossary.htm#rosette) of leaves during the first stages of growth. It grows 0.5-1.5 m tall, but can hardly reach up to 2 m or more in height. Its Mature stems are greenish in color and longitudinally acclimatized, covered in small stiff hairs called as [hirsute](http://keys.lucidcentral.org/keys/v3/eafrinet/weeds/key/weeds/Media/Html/glossary.htm#hirsute), and at maturity it become much branched plant. The leaves are [alternately arranged](http://keys.lucidcentral.org/keys/v3/eafrinet/weeds/key/weeds/Media/Html/glossary.htm#alternately arranged) and simple up to 2 cm long. The leaves grown at lower side are approximately large 3-30 cm long and 2-12 cm wide and are further divided. Upper Leaves on branches small in size and are less divided as the lower leaves. Various small flower-heads called [capitula](http://keys.lucidcentral.org/keys/v3/eafrinet/weeds/key/weeds/Media/Html/glossary.htm#capitula) are present at the tips of the branches in cluster form. Each flower-[head](http://keys.lucidcentral.org/keys/v3/eafrinet/weeds/key/weeds/Media/Html/glossary.htm#head) is borne on a stalk 1-8 mm long, five tiny petals) 0.3-1 mm long and are f white or cream in color. It infests all disturbed land, along with farms pastures, and roadsides. Outbreaks have been of almost epidemic proportions in some areas that is affecting crop production, livestock and human health. It was firstly present as an adulterant in imported wheat. It can provoke allergies and is a common creator of pollen allergy (Oudhia, 2000abc; Oudhia, (2001).

1. **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 *Euphorbia granulata, Euphorbia hirta, Fumaria indica, Parthenium hysterophorus* 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).

1. **Results and discussions**

It was persuaded form the results that significant differences were found for all studied traits (Table 1). The weed×location interaction was also found significant. The significant interactions suggested that the weeds can grow and can compete with changing environmental conditions. It was found from results that average dryplant weight at all locations was 12.967±0.5713g while fresh plant weight was 52.268±2.1387g. The higher weight difference indicated that the moisture contents were higher in the weed plant body. The fresh inflorescence weight was 4.203±0.9724g while dry inflorescence weight was 1.219±0.0324g. The difference in inflorescence weight indicated that the moisture contents were also higher in inflorescence part of the weeds. The higher moisture contents help the plant to compete with harsh environmental conditions due to which the population of weeds was found higher at all locations as average number of plants per square meter or plant population was 61.888±4.1724m-2 . The total plant moisture percentage (73.779±3.2515%) was found higher as compared with total inflorescence moisture percentage 66.665±5.2022%. The higher moisture contents in the plant body indicated that the weeds used much of the soil water and nutrients. The chemical or manual control of weeds is much important to control yield losses due to weed plant population. The use of transgenic glyphosate (herbicide) resistant crop plants should be encouraged to control weeds in order to maximize crop plant yield (Elahi *et al*., 2011ab; Mobeen *et al*., 2015; Harrem *et al*., 2015; Qamar *et al*., 2015).

It was revealed from results given in table 2 that highest number of plants per square meter or weed plant population was recorded for *Fumaria indica* (60.23), 120.67 and 112.23 at CEMB, Hanjerwal colony and Kasur while *Euphorbia granulate* (80.44) at Institute of Agricultural Sciences, University of the Punjab. The lowest plant population of *Euphorbia granulata* (10.23) was found at CEMB, *Euphorbia hirta* (25.87; 15.23 and 49.25) at Hanjerwal colony, Punjab University and Kasur respectively. The higher weed plant population of *Fumaria indica* indicated that the weed plants have higher ability to withstand in all types of environmental conditions. The completion for nutrients, water and sunlight increased among the weed plants and crop plants that caused reduction in yield of crop plants (Harrem *et al*., 2015 and Mobeen *et al*., 2015). It was revealed from results that highest fresh and dry plants weight of weeds was recorded for *Parthinium hysterophorus* at CEMB (44.21g, 9.61g), Hanjerwal colony (152.05g, 36.38g), Punjab University (119.93g, 28.82g) and Kasur (142.21g, 42.97g) respectively. Lowest fresh and dry weed plant weight was found for *Fumaria granulate at CEMB* (2.24g, 0.77g), Hanjerwal colony (2.28g, 0.79g), Punjab University (1.32g, 0.47g) and Kasur (3.21g, 1.02g) respectively. It was revealed from results that highest fresh and dry inflorescence weight of weeds was recorded for *Parthinium hysterophorus* at CEMB (3.62g, 1.02g), Hanjerwal colony (12.45g, 3.55g), Punjab University (8.48g, 2.56g) and Kasur (11.28g, 2.34g) respectively. Lowest fresh weed plant weight was found for *Fumaria indica* at CMEB (0.037g, 0.01g), Hanjerwal colony (0.8g, 0.41g), Punjab University (0.76g, 0.45g) and Kasur (0.89g, 0.41g) respectively. It was revealed from results that highest plant moisture percentage of weeds was recorded for *Parthinium hysterophorus* at Punjab University (77.637%), *Euphorbia hirta* at CEMB (80.742%), Hanjerwal colony (80.692%) and *Euphorbia indica* Kasur (80.523%). Highest inflorescence moisture percentage of weeds was recorded for *Parthinium hysterophorus* at CEMB (87.017%), *Euphorbia hirta* at Punjab University (79.825%), Hanjerwal colony (79.808%) and *Parthinium hysterophorus* at Kasur (79.255%). Lowest fresh weed plant weight was found for *Fumaria granulata* at CMEB (65.625%, 67.308%), Hanjerwal colony (65.351%, 58.991%), Punjab University (64.394%, 37.975%) and *Euphorbia hirta* at Kasur (55.906%, 70.168%) respectively. The difference between fresh and dry weight of plant and inflorescence indicated that the moisture contents were higher in the fresh weed plant and inflorescence parts. The absorption of water and nutrients in the plant body was higher that caused the reduction of water and nutrient contents in the soil. The biomass of weed plant increased due to which the competition of weed plants with crop plant increased that caused reduction in the yield and crop productivity. It was suggested that the weeds should be controlled through chemical or manual methods. The herbicide (glyphosate) should be used pre-sowing of the crop plants or glyphosate resistant varieties should be developed (Qamar *et al*., 2015; Harrem *et al*., 2015, Mobeen *et al*., 2015).

It was revealed from table 3 that strong positive and significant correlation of dry plant weight was found with inflorescence dry weight, fresh plant weight, inflorescence fresh weight and number of plants per square meter or plant population. Dry inflorescence weight was significantly correlated with fresh and dry plant weight, inflorescence fresh weight, plant population and total inflorescence moisture percentage. It was found that inflorescence fresh weight was significantly correlated with fresh and dry plant weight, total inflorescence moisture percentage and dry inflorescence weight. Plant population was significantly correlated with fresh and dry plant weight, inflorescence dry weight and total inflorescence moisture percentage. Total plant moisture percentage and total inflorescence moisture percentage was significantly correlated with each other. The significant correlation of plant population with inflorescence moisture percentage suggested that the weed plants have ability to survive in hot, harsh and dry environmental conditions. The higher population of weed plants also indicated that the competition of weed plants with crop plant will be higher that may cause the loss of crop plant yield. The loss of crop plant yield may be controlled through the control of weeds. The use of weed management practices should be carried out to less down the hazards caused by weed population (Ali *et al*., 2013; Ali *et al*., 2014abc; Qamar *et al*., 2015; Harrem *et al*., 2015, Mobeen *et al*., 2015; Qurat-ul-Ain *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/m2 | Total plant moisture percentage | Total inflorescence moisture percentage |
| Replications | 2 | 0.14 | 0.1352 | 0.1 | 0.135 | 0.14 | 0.135 | 0.14 |
| Weeds | 3 | 297.6\* | 2.08813\* | 4037.9\* | 16.713\* | 4406.95\* | 48.407\* | 603.14\* |
| Location | 3 | 2095.9\* | 7.81821\* | 32994.9\* | 154.271\* | 4287.44\* | 201.986\* | 1081.35\* |
| Weeds×Location | 9 | 180.04\* | 0.97606\* | 2194.4\* | 10.586\* | 953.19\* | 42.539\* | 59.63\* |
| Error | 15 | 0.04 | 0.21342 | 1.8 | 0.599 | 371.16 | 34.821 | 127.04 |
| Grand Mean | 12.967 | 1.219 | 52.268 | 4.203 | 61.888 | 73.779 | 66.665 |
| Standard Error |  | 0.5713 | 0.0324 | 2.1387 | 0.9724 | 4.1724 | 3.2515 | 5.2022 |

\* = Significant at 5% probability level

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | No of plants/m2 |  |  |
| Weeds/Locations | CEMB | Hanjerwal Colony | Punjab University (IAGS) | Kasur | Average |
| *Euphorbia granulata* | 10.23d | 60.42c | 80.44a | 75.72b | 56.7025b |
| *Euphorbia hirta* | 40.32b | 25.87d | 15.23c | 49.25d | 32.6675d |
| *Fumaria indica* | 60.23a | 120.67a | 45.78b | 112.23a | 84.7275a |
| *Parthinium hysterophorus* | 20.11c | 90.89b | 45.69b | 67.54c | 56.0575c |
| Average | 32.7225d | 74.4625b | 46.785c | 76.185a |  |
|  |  | Fresh plant weight (g) |  |  |
| Weeds/Locations | CEMB | Hanjerwal Colony | Punjab University (IAGS) | Kasur | Average |
| *Euphorbia granulata* | 2.24d | 2.28d | 1.32d | 3.21d | 2.2625d |
| *Euphorbia hirta* | 7.01c | 5.49c | 1.7c | 3.81c | 4.5025c |
| *Fumaria indica* | 25.79b | 84.13b | 7.46b | 37.12b | 38.625b |
| *Parthinium hysterophorus* | 44.21a | 152.05a | 119.93a | 142.21a | 114.6a |
| Average | 19.8125d | 60.9875a | 32.6025c | 46.5875b |  |
|  |  | Inflorescence fresh weight (g) |  |  |
| Weeds/Locations | CEMB | Hanjerwal Colony | Punjab University (IAGS) | Kasur | Average |
| *Euphorbia granulata* | 3.12b | 4.56b | 2.37b | 4.27b | 3.58b |
| *Euphorbia hirta* | 2.75c | 2.08c | 1.14c | 2.38c | 2.0875c |
| *Fumaria indica* | 0.037d | 0.8d | 0.76d | 0.89d | 0.62175d |
| *Parthinium hysterophorus* | 3.62a | 12.45a | 8.48a | 11.28a | 8.9575a |
| Average | 2.38175d | 4.9725a | 3.1875c | 4.705b |  |
|  |  | Plant dry weight (g) |  |  |
| Weeds/Locations | CEMB | Hanjerwal Colony | Punjab University (IAGS) | Kasur | Average |
| *Euphorbia granulata* | 0.77d | 0.79d | 0.47c | 1.02d | 0.7625d |
| *Euphorbia hirta* | 1.35c | 1.06c | 0.49c | 1.68c | 1.145c |
| *Fumaria indica* | 5.56b | 20.35b | 2.09b | 7.23b | 8.8075b |
| *Parthinium hysterophorus* | 9.61a | 36.38a | 26.82a | 42.97a | 28.945a |
| Average | 4.3225d | 14.645a | 7.4675c | 13.225a |  |
|  |  | Inflorescence dry weight (g) |  |  |
| Weeds/Locations | CEMB | Hanjerwal Colony | Punjab University (IAGS) | Kasur | Average |
| *Euphorbia granulata* | 0.47bc | 1.87b | 1.47b | 1.09b | 1.3625b |
| *Euphorbia hirta* | 0.5b | 0.42c | 0.23d | 0.71c | 0.465c |
| *Fumaria indica* | 0.01c | 0.41c | 0.45c | 0.41d | 0.32d |
| *Parthinium hysterophorus* | 1.02a | 3.55a | 2.56a | 2.34a | 2.23a |
| Average | 0.5d | 1.5625a | 1.1775b | 1.1375c |  |
|  |  | Plant moisture percentage (%) |  |  |
| Weeds/Locations | CEMB | Hanjerwal Colony | Punjab University (IAGS) | Kasur | Average |
| *Euphorbia granulata* | 65.625d | 65.351d | 64.394c | 68.224c | 65.899d |
| *Euphorbia hirta* | 80.742a | 80.692a | 71.176b | 55.906d | 72.129c |
| *Fumaria indica* | 78.441b | 75.811c | 71.984b | 80.523a | 76.690a |
| *Parthinium hysterophorus* | 78.263b | 76.074b | 77.637a | 69.784b | 75.439b |
| Average | 75.768a | 74.482b | 71.298c | 68.609d |  |
|  |  | Inflorescence moisture percentage (%) |  |  |
| Weeds/Locations | CEMB | Hanjerwal Colony | Punjab University (IAGS) | Kasur | Average |
| *Euphorbia granulata* | 67.308d | 58.991c | 37.975d | 74.473b | 59.687c |
| *Euphorbia hirta* | 81.818b | 79.808a | 79.825a | 70.168c | 77.905a |
| *Fumaria indica* | 72.973c | 48.750d | 40.789c | 53.933d | 54.111d |
| *Parthinium hysterophorus* | 87.017a | 71.486b | 69.811b | 79.255a | 76.892b |
| Average | 77.279a | 64.759c | 57.100d | 69.457b |  |

**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/m2 | Total plant moisture percentage |
| Inflorescence Dry weight | 0.704\* |  |  |  |  |  |
| P<0.05 | 0.0000 |  |  |  |  |  |
| Fresh plant weight | 0.9871\* | 0.708\* |  |  |  |  |
| P<0.05 | 0.0000 | 0.0000 |  |  |  |  |
| Inflorescence Fresh weight | 0.8194\* | 0.9285\* | 0.8009\* |  |  |  |
| P<0.05 | 0.0000 | 0.0000 | 0.0000 |  |  |  |
| No of plants/m2 | 0.3701\* | 0.2225\* | 0.3905\* | 0.1079 |  |  |
| P<0.05 | 0.0371 | 0.2209 | 0.0271 | 0.5565 |  |  |
| Total plant moisture percentage | 0.2179 | -0.1414 | 0.293\* | -0.0178 | -0.0896 |  |
| P<0.05 | 0.231 | 0.44 | 0.1037 | 0.9229 | 0.6258 |  |
| Total inflorescence moisture percentage | 0.154 | 0.9441\* | 0.1387 | 0.3021\* | 0.5254\* | 0.2551\* |
| P<0.05 | 0.4002 | 0.0291 | 0.449 | 0.0928 | 0.002 | 0.1588 |

1. **Conclusions**

It was concluded from above all discussions that the weeds should be controlled through chemical, manual of by using transgenic crop plant varieties to minimize the crop plant yield losses.

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