ALLELOPATHIC EFFECTS OF *PAPAVER SOMNIFERUM* ON GERMINATION AND INITIAL SEEDLING GROWTH OF *ECHINOCHLOA CRUSS-GALLI*

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Abstract

Weeds are unwanted plants in crop that can be controlled by different methods among them use of aqueous extracts of crops is an imperative method. In this method allelochemicals present in crop plant help in suppressing or inhibiting weeds. Therefore, this study was planned to investigate the allopathic potential of aqueous extract of winter crop Papaver somniferum (opium) on summer weed Echinochloa cruss-galli (barnyard grass. The experiment comprised of seven concentrations (0, 0.25, 0.50, 1, 2, 4, and 8%) of different plant parts i.e., leaves, stem and flower of P. somniferumwere. All the tested concentrations and plant parts of P. somniferum significantly reduced mean emergence time, germination index, germination percentage, time to 50% germination as well as well growth of E. cruss-galli weed. However, maximum mean emergence time (9.07 days), time to 50% germination (3.67 days) was noted by applying leaves and stem extract, respectively. Application of aqueous extract of stem at 8% concentration resulted in greatest time to complete 50% germination (5.42 days) and lowest fresh weight (6.28 g), dry weight (1.00 g) and root length (0.33 cm) of E. cruss-galli. Whereas leaf extract at 8% concentration produces less shoot length (1.13 cm) and more emergence time (9.18 days). Lowest emergence percentage (6.67%) and germination index (0.89) were produced by aqueous extract of fruit at 8% concentration. On the basis of this experiment, it can be concluded that higher concentration (8%) of stem extract of P. somniferum was used to biologically control the infestation of E. cruss-galli weed.

Keywords: Allelopathic effect**,** seedling growth, Echinochloa cruss-galli, *Papaver somnifrum*

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Introduction

Weeds are unwanted plants in crops that compete with crop for water, nutrients, place and sunlight for growth that resulted in poor yield and quality of crop (Gallandt and Weiner, 2001). In Pakistan average loss due to weed in different crops are 20 to 30% (Shad, 1987). In cereal crops, the losses due to weed infestations are approximately 30, 40, 4 and 5 billion rupees for wheat, rice, maize and gram, respectively (Anonymous, 2005; Nadeem et al., 2021). So, it is necessary to control the weeds to reduce the competition and enhance the crop yield (Macias *et al.*, 2002; Nadeem et al., 2020). In modern agriculture production system weeds can be controlled efficiently with the use of chemical herbicides (Bajwa, 2014). Use of chemical for effective weed control results in low quality of product, weed resistance, environmental pollution (Macias *et al.*, 2002; Nadeem et al., 2020b). Different methods are used to control weeds such as biological, chemical, mechanical, and cultural control (Melander *et al*.,2005). Extreme and continuous use of herbicides has resulted in resilient weed populations and this phenomenon urged upon the misuse of allelopathic possible of crop plants (Ferreira and Reinhardt, 2010). Allelochemicals could be used as tool for controlling weeds (Nadeem *et al*., 2020a; Nadeem *et al*., 2020b; Jabran *et al.,* 2015). Allelopathic crops have potential to inhibit the growth of weeds (Chung *et al.,* 2006).

Opium (*Papaver somniferum*) is a medicinal plant and many researchers reported that opium has allelopathic potential (Labanca *et al.,* 2018). Opium crop release different allelochemicals at maturity which have potential to control weeds in different crops (Nadeem et al., 2020a). The grassy plant had herbicidal potential on the parthenium weed (Anjum *et al.*, 2005; Javaid*et al.*, 2005). Kadioglu *et al.,* (2005) and Nadeem et al., (2020b) depicted that germination, shoot and root length and dry weight of different crop species inhibited with foliar application of water extract of weeds. Water extract of weeds might have inhibitory or promotry effect on germination and seedling growth (Alam and Islam, 2002). Different plants have different potential on target weed or crop plant. Water extract of wild onion leaves produced inhibitory effect on germination and crop seedling growth (Baber *et al*., 2009). Opium is most important dominant and competitive broad-leaves weed in winter cereals (Ravlić *et al.,* 2012). Allelopathic effect of opium on germination capacity of cereals, also indicated that water extracts from fresh plant parts of opium significantly reduced germination of both wheat and barley (Ravlić *et al.,* 2012). By blocking nutrient reserve hydrolysis, allelochemicals inhibit germination of seed (Ghodake *et al.*, 2012).

The mixture of allelochemical with low dose of herbicide can be used for effective weed control (Bhowmik, 2003). Cheema *et al.* (2000) directed that the dose of herbicide in cotton is reduced to 5-60 % while applied with sorghum extract (with rate of 12 L ha^{-1}). Crop plants for example opium (*Papaver somniferum*.) sunflower (*Helianthus annuus*), eucalyptus (*Eucalyptus camaldulensis*) and other species had allelopathic effects against weed growth (Skrzypek *et al..,* 2015). It is needed to examine the phytotoxic effects of opium (*Papaver somniferum)* (opium) water extracts on *E. cruss-galli*. To control weeds there are many alternative strategies such as non-chemical control by using aqueous extracts (bio herbicides) of weed plants (Cirujeda *et al.,* 2008). Bio herbicides have the potential to create friendly eco-products for weed management and are easily biodegradable than synthesized herbicides (Nadeem *et al*., 2021; Nadeem *et al*., 2020c; Ghafarbi *et al.,* 2012). Water extract of opium is natural and has no chemical hazards on target crop and helpful to control weeds and increase the productivity of crop. The present study was carried-out to explore the allelopathic effect of water extracts of the opium plant parts such as stem, leaves and flower to control the

germination and seedling growth of *E. cruss-galli* weed specifically.

Materials and Methods

The experiment was carried out in the weed science laboratory at Department of Agronomy, University of Agriculture Faisalabad. The objective of this study was to check allelopathic effects of aqueous extracts of winter crop *Papavare somniferum* **(**opium) on summer weed *Echinochloa cruss-galli* the experiment was arranged in factorial under CRD with three replications and seven treatments.

Collection of plant parts

To make aqueous extract of *P. somniferum* (opium) plants were collected from weed bank of Agronomy Farm, University of Agriculture Faisalabad. To make aqueous extract plants of *P. somniferum* (opium) were harvested above the ground surface at maturity and dried for two weeks at ambient temperature. After drying properly different parts of plants were separated and chopped into 2 cm pieces for extract formation.

Preparation of aqueous extracts

Plant aqueous extracts of different parts of *P. somniferum* (opium) were made by adding 10 g of chopped dried plant material into 100ml of distilled water in bottles separately with 1:10 w/v ratio. Plant material were soaked in water for at least 24 hours at room temperature. These aqueous extracts were made from each desired part of opium such as leaves, stem, fruit, flower etc. then the decanted material was passed through a cotton cloth to attain the water extracts of different parts of *P. somniferum* (opium). That process gave 10% extract, from this 67.2ml extract were added in 16.8ml distilled water due to this the final volume was 84ml that was act as stock solution. From this stock solution we made further dilutions that are (0.25%, 0.5%, 1%, 2%, 4% and 8%). These dilutions were made by using the following equation.

$C_1V_1=C_2V_2$

Each dilution has 42ml total volume. Each dilution of each extract placed in separate bottles and then tagged these bottles by name of each dilution with its plant name too carefully for their easy utilization in next procedure.

Laboratory Experiment

In laboratory experiment the aqueous extracts of *P. somniferum* (opium) different parts such as leave, stem, fruit and flower were used on summer weed *E. cruss-gall*. The experiment was conducted in each 9cm petri plates. Filter papers were used as a sowing medium. To check the allelopathic effect 21 treatment combinations of *P. somniferum* (opium) were applied on *E. cruss-gall.* Each petri plate contains five seed of *E. cruss-gall*. Whatman filter papers No 1placed in each petri plate before adding the seed on it. Then 7ml of all opium extracts dilutions of each part i.e., leaves, stem, flower and fruit were added in all the petri plates having 3 replications for each dilution. One treatment was kept as control and moist with distilled water. Then to reduce the excess of evaporation petri plates were covered and rapped with parafilm. The petri plates were kept at 30°C temperature and treatments were again moistened after one week. The experiment was laid out under completely randomized design with factorial arrangement. The experiment consist of different concentration of water extracts 0.0 %, 0.25 %, 0.5 %, 1%, 2%, 4 %, 8 % and Plant parts of *Papaver somniferum* (opium) (Leaves, Stem, Flower).

Observation:

The data regarding germination of seeds were recorded every day for 14 days. After the 14 days, harvest the germinated seedlings of *E. cruss-gall* observed the different parameters like shoot and root length, fresh and dry weight. Fresh weight was recorded immediately after harvesting while dry weight seedlings were observed after drying in oven for two days at 60 °C.

Mean Emergence Time (MET)

It was examined by using equation of Ellis and Reborts (1981).

$$MET = \frac{\sum(Dn)}{\sum n}$$

Germination index of *Echinochloa cruss-galli*

Germination index was observed as per association of official seed analysis (1983) by using formula

$$GI = \frac{No.of\ germinated\ seeds}{Days\ of\ first\ count} + - - - - + \frac{No.of\ germinated\ seeds}{Days\ of\ final\ count}$$

Emergence percentage of *E. cruss-galli*(%)

Germinated number of seeds was counted daily up to 14 days after which germination ceased. The germination % was calculated by using following formula.

$$Germination\ percentage = \frac{No.of\ germinated\ seeds}{Total\ No.of\ seeds} \times 100$$

Time to 50% germination of *Echinochloa cruss-galli*

The time to obtain 50% emergence or germination (E_{50} or T_{50}) was calculated according to the following formula of Coolbear *et al.* (1984**)**

$$T\mathbf{50} = ti + \left[\frac{\frac{N}{2} - ni}{nj - ni}\right](tj - ti)$$

Growth attributes of *Echinochloa cruss-galli*

All seedlings from each petri plate were separate 14 days after germination. After that shoot and root length was calculated by using meter rod from base level to top of the plants. Fresh weight of seedlings was examined by separating seedlings from petri dish and measuring by using digital weight balance. Seedlings dry weight was observed by oven drying the seedlings for 48 hours at 60^0C then weighted to get average dry weight of seedling by using digital balance.

Statistical analysis:

Collected data were analyzed by using the Statistics software (version, 8.1Statistix, Tallahassee, FL, USA) and least significant difference (LSD) test was used to compare the means at 5% probability level. Microsoft office 2010 was used to draw figures using standard error (± SE).

Results and Discussions

Mean Emergence Time of *Echinochloa cruss-galli*

Aqueous extract of *P. somniferum* had significant impact on mean emergence time of *E. cruss-galli* seedlings (Table 1). All the plant parts significantly delayed mean germination time of barnyard grass seedlings. Leaves extract of *P. somniferum* exhibited maximum mean emergence time (9.07 days) of weed while in fruit extract minimum mean emergence time (3.45 days) was noted.The impact of extracts concentration on mean emergence time on *E. cruss-galli* seedlings was no-significant. Interaction effect of concentration and extract interaction was significantly different according to mean emergence time of *E. cruss-galli* seedlings. Highest value of mean emergence time (9.18 days) was given with higher concentration (8%) of leaves and lower concentration (0.25%) of fruit gave the lower mean emergence time (3.10 days). A significantly inhibitory effect of water extracts of *E. hirta* with different concentration on groundnut mean emergence time was exposed (Rose and Anitha, 2012).

Germination Index of *Echinochloa cruss-galli*

The different concentrations of aqueous extracts of *P. somniferum* affected germination index of *E. cruss-galli* seedlings significantly. Lowest value of germination index (3.96) was observed at 8% and the highest value of germination index (5.49) was observed in control 0%. There was significant difference among different plant parts of *P. somniferum*in which fruit showed the inhibitory effects. While the leaves showed the promontory effects. Stem also showed somewhat inhibitory effects. Interaction effects of parts and concentration of *P. somniferum* aqueous extract was found significant. Higher values of germination index (9.15) at 4% was obtained by leaves, while lower value of germination index (0.89) at 1% was obtained by fruit. Same findings were attained by Khan *et al.* (2011) performing an experiment to

observe effect of *S. marianum* aqueous extracts on*C. arietinum,V. radiata, P. vulgaris* and *Glycine max* germination. Effect of extracts on test species was significant which reduced the germination index as compared to control and inhibitory effect was increased by enhancing the extracts concentration.

Emergence Percentage of *Echinochloa cruss-galli* (%)

Influence of water extracts of different plant part (stem, fruit and leaves) of *P. somniferum* on emergence percentage of *E. cruss-galli* seedlings was significantly different (Table 3). Fruit extracts inhibited the emergence percentage of *E. cruss-galli* seedlings in comparison to leaves and stem. Maximum germination percentage (88.57%) was calculated for leaves. And minimum value (63.81%) was calculated fruit extract application. A significant difference found in emergence percentage of *E. cruss-galli* by the action of aqueous extracts concentrations. Higher emergence percentage (93.3%) was observed at control 0%. While the lowest values of emergence percentage (48.89) were showed by 8% concentration. Interaction influence of different concentrations and plant parts was observed significantly different. Fruit gave the inhibitory effect for emergence percentage while the leave showed the stimulatory emergence percentage the stem gave somewhat low dose response. Fruit also gave low dose response up to 0.5% concentration. Takao *et al.* (2011) performed atrial to observeimpact of *Ipomoea cairica* aqueous extract on *E. cruss-galli, Bidens Pilosa, I. grandifolia and E. heterophylla*. Outcomesdepicted that the test species showed a significant inhibitory response on emergence percentage. As compared to lower concentrations, higher extract concentrations effectively reduced the emergence percentage. Nadeem *et al*., 2020c reported that the different concentration of aqueous extracts P. somniferum produce significant influence on emergence percentage of O. punctata (red rice), highest concentration (8%) significantly reduced emergence of red rice (48.89%) while 0% concentration result in maximum emergence of red rice (93.33%).

Time to 50% Germination of *Echinochloa cruss-galli*

Allelopathic influence exerted by different plant parts of opium on time to 50% germination of *E. cruss-galli* seedlings was found significant (Table 5). Leaves gave the lowest time (2.81 days) to 50% germination values while stem extract take more time (3.67 days) to complete 50% germination. Different concentrations of extracts of opium have significant effects on time to 50% germination of *E. cruss-galli* seedlings. Maximum valueof time to 50% germination (3.56 days) was showed by 2% concentration and minimum value of time to 50% germination (2.74 days) was given by 0.25% concentration. Interaction of different plant parts and concentration on time to 50% concentration was observed significant. Leaves gave the inhibitory effect at all concentrations but the lowest value of time to 50% germination at 4-8% concentration. The stem gave the stimulatory effect and it showed the highest time to 50% germination at 8% concentration. Fruit showed the low dose response up to 0.5% concentration. Similar results were observed as, allelopathic influence of *R. dentatus* aqueous extracts was shown effective in enhancing the time to 50% germination of *Helianthus annus* and *T. aestivum* seedlings. With the use of extract of *R. dentatus*, an increment in time to 50% germination was observed at higher concentration as compare to control (Anjum & Bajwa, 2005).

Shoot length of *Echinochloa cruss-galli* (cm)

Aqueous extracts of *P. somniferum* (opium) different plant parts had significant influence on shoot length of *E. cruss-galli* (Table 5). The lowest value of shoot length (2.82 cm) was recorded among different plant parts with the aqueous extracts of stem of opium whereas, longest shoot lengths (3.42 cm) were noted with application of leaves aqueous extracts of *P. somniferum*. The

interaction among different concentration and plant parts was also significant. It is recorded that the concentration which was kept as control gave the longest shoots that might be statically similar with the leaf extract application at the concentration of 0.25%. The fruit extract of opium had stimulatory influence on the shoot length of *E. cruss-galli* at lower concentrations at 2.00% concentration. Whereas, leaf demonstrated low-dose response at 0.25% other than this value or concentration all other values of concentrations of leave reduced the shoot length of *E. cruss-galli*. Among different concentration highest shoot length (5.10 cm) was examined under control (0%) whereas, lowest shoot length (1.510 cm) at higher concentration (8%). The delayed germination and slow growth of seedlings can be attributed to the reduction in shoot length. The allelochemicals of opium aqueous extracts at lower concentration of different plant parts might be act as hormones for *E. cruss-galli* to enhance its growth. The lower concentrations hormetic influence of aqueous extracts of different plant parts as they act as hormones for plant growth has also been described by (Cheema *et al.,* 2003). Instead of 0.25% concentration, at all other concentrations, the extracts of leaves indicate the inhibitory effect. The shoot length was suppressed by inhibitory influence of opium water extracts has also been reported by the verdicts of (Khaliq *et al.,* 2009). Nadeem *et al*., 2020a revealed that 2% concentration with fruit extract of C. tinctorius produced the longest (7.91 cm) shoot length of O. punctata. The higher concentration (8%) with aqueous extracts of C. tinctorius leaves gave the lowest (4.51 cm) shoot length of O. punctata.

Root length of *Echinochloa cruss-galli* (cm)

Effect of different plant partsextract of *P. somniferum* (opium) on root length of *E. cruss-galli* was significantly different. The lowest value of root length (0.63 cm) was recorded among different plant parts with the aqueous extracts of fruit of opium whereas, longest root lengths (1.29 cm) were noted with application of leaves aqueous extracts of *P. somniferum*. The interaction among different concentration and plant parts was non-significant. It is recorded that the concentration which was kept as control gave the longest roots that might be statically similar with the stem extract application at the concentration of 0.25%. The leaf extract of opium had stimulatory influence on the root length of *E. cruss-galli*at lower concentrations at 2.00% concentration. The stem and fruit extracts gave the stimulatory influence at lower extract concentrations. The lower concentration application of stem extracts caused in significantly higher concentration associated with control. While, the fruit extract application enhanced the root length up to the concentration of 0.25% also at 4.00%. Among different concentration longest root length (1.63 cm) was recorded at and shortest (0.75 cm) by 8%. The allelochemicals of opium aqueous extracts at lower concentration of different plant parts might be act as hormones for *E. cruss-galli* to enhance its growth. The lower concentrations hormeotic influence of aqueous extracts of different plant parts as they act as hormones for plant growth has also been described by (Cheema*et al.,*2003). Nadeem *et al*., 2020d depicted that among the various concentrations of S. oleraceus maximum (1.63 cm) and minimum (0.44 cm) root length of E. cruss-galli was examined at 1% and 8% concentrations, respectively. Nadeem *et al*., 2021 reported that among different concentrations of weeds extracts of S. oleraceus, the highest length of root of O. punctata (4.83 cm) was examined at concentration 1% while lowest length of root (3.94 cm) was recorded at concentration 0.25%.

Fresh weight of *Echinochloa cruss-galli* (g)

Aqueous extract of *Papaver somniferum* (opium) had significant influence on fresh weight of *E. cruss-galli.* Lowest values of fresh weight (10.35 g) were recorded among different plant parts with the aqueous extracts of stem of

opium because of reduced growth of barnyard grass seedlings whereas, higher values of fresh weight (16.93 g)were noted with application of leaves aqueous extracts of *P. somniferum*. The interaction among different concentrations and plant parts was non-significant. The lowest fresh weight (11.06 g) was examined under fruit extract at 1% concentration while highest fresh weight (22.50 g) at 0.25% concentration by leaves extract.The fruit and stem extracts gave the stimulatory influence at lower extract concentrations. The lower concentration application of stem extracts caused in significantly higher concentration associated with control. While, due to the fruit extract application it enhanced the fresh weight values up to the concentration of 0.5%. Different concentration of aqueous extract of *P. somniferum* significantly influence on fresh weight of weed. Maximum fresh weight (15.91 g) under control (0%) whereas minimum (12.28 g) by 8% concentration. The lower concentration of aqueous extract of opium allelochemicals might be act as hormones for barnyard grass to enhance its growth as the growth of seedlings were enhanced seedlings weight also increased. The delayed germination and slow growth of seedlings can be attributed to the reduction in fresh weight. The significant modifications were detected between water extract of different plant parts concerning fresh weight. The lower concentrations hormeotic influence of aqueous extracts of different plant parts as they act as hormones for seedlings growth has also been described by (Cheema *et al.,* 2003). At all concentration, the extracts of stem indicate the inhibitory effect. As, seedlings growth was inhibited by the inhibitory influence of opium water extracts, fresh weight also reduced has also been reported by the verdicts of (Khaliq *et al.,* 2009).

Dry weight of *Echinochloa cruss-galli* (g)

The aqueous extracts of *P. somniferum* (opium) had statistically non-significant influence on the dry weight of *E. cruss-galli (barnyard grass)*. The lowest values of dry weight (3.18 g) were recorded among different plant parts with the aqueous extracts of fruit of opium because of reduced growth of barnyard grass seedlings whereas, higher values of dry weight (4.43 g) were noted with application of leaves aqueous extracts of *P. somniferum*. The interaction among different concentrations and plant parts was also found non-significant. Highest dry weight (8.17g) was observed under stem extract at 0.25% while lowest dry weight (1.00 g) at 8% by stem extract. The leaves and stem extracts gave the stimulatory influence at lower extract concentrations. The lower concentration application of stem extracts caused in significantly higher concentration associated with control. While, due to the leaves extract application it enhanced the dry weight values up to the concentration of 0.5%. Among different concentration maximum dry weight (5.55 g) under control (0%) whereas minimum (1.52 g) at 8% concentration. The leaves and stem showed the stimulatory effect at low concentrations. Might have been due to hormeotic effect the dry weight enhanced because at lower concentrations seedlings were grow too efficiently. The lower concentration of aqueous extract of different plant parts of opium allelochemicals might be act as hormones for barnyard grass to enhance its growth as the growth of seedlings were enhanced seedlings weight also increased. At all concentration, extracts of stem indicate the inhibitory effect. As, seedlings growth was inhibited by the inhibitory influence of opium water extracts, dry weight also reduced has also been reported by the verdicts of (Khaliq *et al.,* 2009). The delayed germination and slow growth of seedlings can be ascribed to the reduction in dry weight. Nadeem et al., 2020a coniform that at 0.25% concentration with leaf extract of C. tinctorius produced the least (0.80 g) dry weight of O. punctata. Nadeem et al., 2021 Different concentration of water extracts of S. oleraceus produced significant influence on fresh weight of red rice. Seedlings with

highest fresh weight (114.94 mg) were recorded at 0.25% concentration, while lowest fresh weight of seedlings (74.37 g) at 8% concentration of aqueous extracts of S. oleraceus.

Conclusion:

On the bases of this experiment, it was concluded that higher concentration (8%) with stem extract of *P. somniferum* was used to biologically control the infestation of *E. cruss-galli* weed

Table 1: Mean emergence time of *E. cruss-galli* as influenced by different concentration of different plant parts of *P. somniferum* aqueous extracts

Plant Parts	Concentration (MET)							
	0%	**0.25%**	**0.5%**	**1%**	**2%**	**4%**	**8%**	**Mean**
Leaf	9.07a	8.96a	9.09a	9.16a	9.06a	8.90a	9.18a	9.07a
Stem	3.70de	3.87cde	3.87cde	4.26cd	3.83cde	4.31cd	5.91b	4.25b
Fruit	3.76cde	3.10def	3.62cde	2.78ef	4.78bc	4.48bc	1.67f	3.45c
Mean	5.51a	5.31a	5.53a	5.40a	5.93a	5.89a	5.54a	

Table 2: Germination index of *E. cruss-galli* as influenced by different concentration of different plant parts of *P. somniferum* aqueous extracts

Plant Parts	Concentration (GI)							
	0%	**0.25%**	**0.5%**	**1%**	**2%**	**4%**	**8%**	**Mean**
Leaf	8.21ab	7.17ab	7.19ab	6.86b	6.85b	9.15a	8.65ab	7.72a
Stem	3.97c	3.16c	4.14c	3.97c	3.31c	2.56cde	2.34cd	3.35b
Fruit	4.30c	3.11cd	3.56c	0.89e	2.14cde	0.94de	0.92c	2.27c
Mean	5.49a	4.48ab	4.96ab	3.90b	4.11b	4.22ab	3.96b	

Table 3: Emergence percentage (%) of *E. cruss-galli* as influenced by different concentration of different plant parts of *P. somniferum* aqueous extracts

Plant Parts	Concentration (EP)							
	0%	**0.25%**	**0.5%**	**1%**	**2%**	**4%**	**8%**	**Mean**
Leaf	86.67a	93.33ab	80.00abc	73.33abcd	86.67a	100.00	100.00	88.57
Stem	93.33ab	86.67ab	100.00	100.00a	93.33ab	93.33a	40.00e	86.66
Fruit	100.00a	86.67ab	86.67a	53.33cde	66.67bcde	46.67d	6.67f	63.81
Mean	93.3a	88.88ab	88.88a	75.56b	82.22ab	80.00a	48.89c	

Table 4: Time to 50% germination of *E. cruss-galli* as influenced by different concentration of different plant parts of *P. somniferum* aqueous extracts

Plant Parts	Concentration (T_{50})							
	0%	0.25%	0.5%	1%	2%	4%	8%	Mean
Leaf	2.83bcd	2.67bcd	2.75bcd	3.17bc	3.25bc	2.50cd	2.50cd	2.81b
Stem	3.06bc	3.25bc	3.17bc	3.50bc	3.42bc	3.92b	5.42a	3.67a
Fruit	3.08bc	2.31cd	3.00bc	2.33cd	4.00b	3.42bc	1.50d	2.81b
Mean	2.99ab	2.74b	2.97ab	3.00ab	3.56a	3.28ab	3.14ab	

Table 5: Shoot length of *E. cruss-galli* as influenced by different concentration of different plant parts of *P. somniferum* aqueous extracts

Plant Parts	Concentration (SL)							
	0%	0.25%	0.5%	1%	2%	4%	8%	Mean
Leaf	6.01a	7.88a	4.74b	4.02b	3.11bc	2.87bcd	1.13e	3.43a
Stem	3.86b	4.03b	3.45b	2.76bcde	2.98bc	2.39cde	2.12cd	2.82a
Fruit	5.45a	5.67a	4.61b	2.28cde	3.63bc	2.05cde	1.28de	2.94a
Mean	5.10a	5.86a	4.27a	3.02b	3.24b	2.44bc	1.51c	

Table 6: Root length of *E. cruss-galli* as influenced by different concentration of different plant parts of *P. somniferum* aqueous extracts

Plant Parts	Concentration (RL)							
	0%	0.25%	0.5%	1%	2%	4%	8%	Mean
Leaf	1.63a	1.80a	1.25a	1.62a	1.42ab	1.03bc	0.77cd	1.29a
Stem	1.41ab	1.40ab	1.30a	0.83cd	0.45cd	0.34d	0.33d	0.91b
Fruit	1.47ab	1.68a	1.20b	0.80cd	0.71cd	0.84cd	0.72cd	0.63b
Mean	1.51a	1.63a	1.25a	1.08b	0.86bc	0.75bc	0.61c	

Table 7: Fresh weight of *E. cruss-galli* as influenced by different concentration of different plant parts of *P. somniferum* aqueous extracts

Plant Parts	Concentration (FW)							
	0%	0.25%	0.5%	1%	2%	4%	8%	Mean
Leaf	16.94bc	20.83a	22.50a	21.33ab	19.72a	13.06c	13.61cd	16.93a
Stem	14.30cd	14.5c	14.33c	12.67cd	10.33d	8.17de	6.28e	10.35
Fruit	16.5bc	14.5c	14.66c	11.06d	14.50c	18.89b	16.94bc	15.58a
Mean	15.91b	16.61a	17.16a	15.02b	14.85b	13.37c	12.28d	

Table 8: Dry weight of *E. cruss-galli* as influenced by different concentration of different plant parts of *P. somniferum* aqueous extracts

Plant Parts	Concentration (DW)							
	0%	**0.25%**	**0.5%**	**1%**	**2%**	**4%**	**8%**	**Mean**
Leaf	5.48a	5.25a	6.75a	5.69a	4.75a	4.33a	1.92a	4.43a
Stem	7.50a	8.17a	7.00a	5.33a	4.50a	2.13a	1.00a	4.09a
Fruit	3.66a	3.87a	3.40a	3.70a	2.83a	4.04a	1.64a	3.18a
Mean	5.55a	4.47a	5.72a	4.91a	4.03a	3.50a	1.52a	

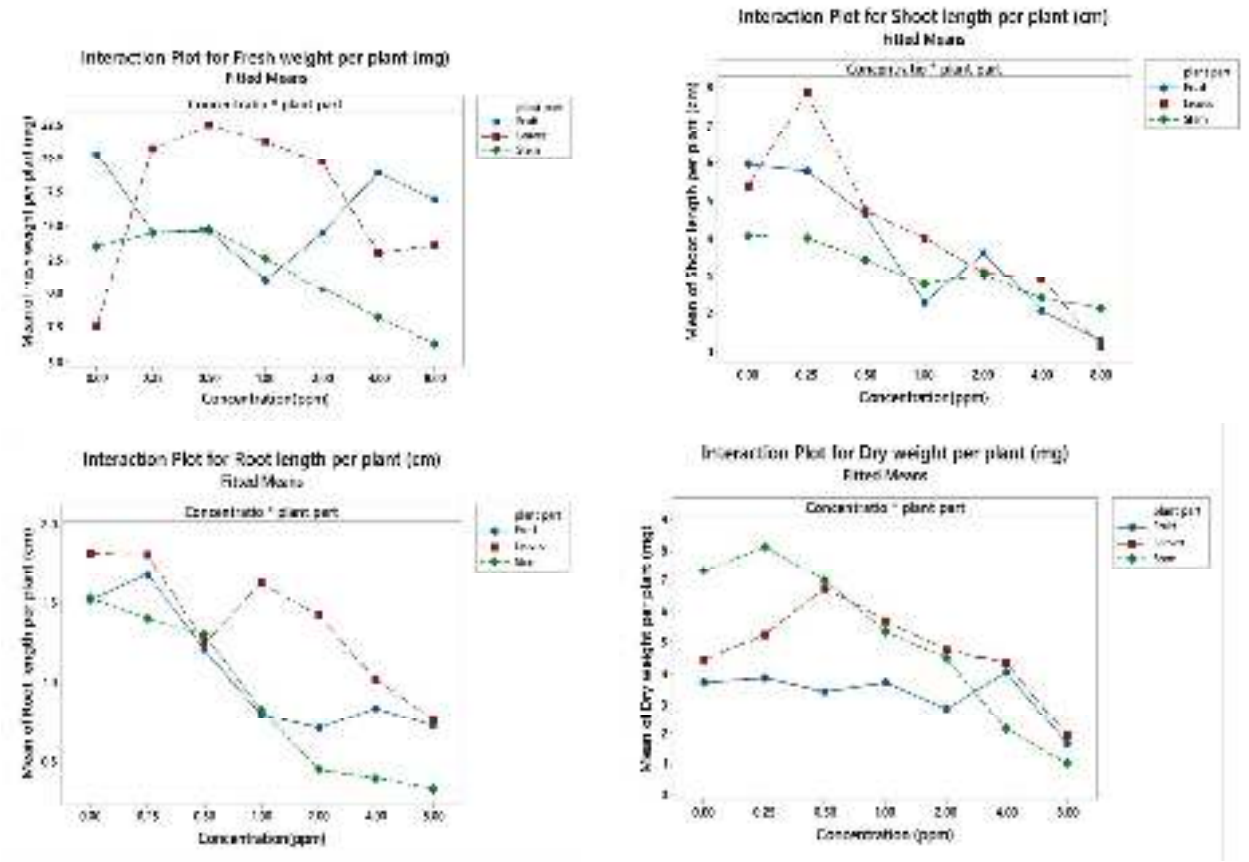

Figure 1: Interaction between treatment means of shoot length, root length, fresh weight, and dry weight of *E. cruss-galli*under the influence of aqueous extracts of different parts of *Papaver somniferum*

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