ALLELOPATHIC POTENTIAL OF AQUEOUS EXTRACTS OF SOW THISTLE WEED ON EMERGENCE AND SEEDLING GROWTH OF RED RICE

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ABSTRACT

Chemical weed control method caused environmental hazards and residual effects in crops and soil. Alternate approach to control weeds is getting attentions in sustainable production system. Use of aqueous extracts of weed is getting scientific attention as eco-friendly alternative to chemical herbicides especially under scenario of fast increasing herbicide resistance in weeds. To investigate the herbicidal potential of aqueous extract of winter weed of Sonchus oleraceus L. (sow thistle) on summer weed Oryza punctata L. (red rice) seed emergence and initial seedling growth, the present study was planned. In this study, seeds of O. punctata were incubated in seven concentrations (0, 0.25, 0.50, 1, 2, 4, and 8%) of different parts i.e. leaf, stem and flower of S. oleraceus. All the tested concentrations of various plant parts significantly inhibited the mean emergence time, emergence index, emergence percentage (%), time taken to 50% emergence as well as growth of O. punctata. However, maximum mean emergence time (5.26 days), minimum germination index (1.69), germination percentage (40%), root length (2.04 cm), shoot length (5.71 cm), fresh weight (59 g), dry weight (4.06 g) was noted at 8% concentration with fruit aqueous extract. Seeds of O. punctata took maximum time to complete 50% emergence (3.33 days) under control where we applied distilled water. Results suggested that the fruit extract of S. oleraceus at 8% concentration can be used potential bio-herbicide for the control of O. punctata.

Keywords: Chemical, eco-friendly, fruit extract and herbicidal potential,

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INTRODUCTION

Weeds compete with crops for resources like carbon dioxide, water, light, nutrients and space and also create biotic hazards by releasing certain chemicals which results in poor crop production (Rehman *et al.,* 2019). In Pakistan average loss due to weeds in different crops are 20 to 30%, however, overall monitory losses go beyond of rupees 120 billion (Matloob *et al.,* 2019). Yield losses in the range of about 5, 30, 4 and 40 billion rupees have been reported for gram, wheat, maize and rice crop individually (Matloob *et al.,* 2019). So, it is necessary to control the weeds to reduce the weed crop competition and enhance the crop yield (Macias *et al*., 2002). In modern agriculture production system mostly, farmers rely on chemical weed control which results in herbicide resistance in weeds and environment pollution (Rashid *et al.,* 2010). Too much use of herbicides results in contamination of soil, water and atmosphere (Van Bruggen *et al.,* 2019). Furthermore, increasing herbicide resistance in weeds have made chemical weeds control an unsuitable method to sustain crop production (Abbas *et al.,* 2016a). Allelopathy is quite effective to control resistant weeds (Javaid *et al.,* 2010; 2011; Abbas *et al.,* 2016b). Grassy and broad-leaf plants have the potential to suppress parthenium weed (Anjum *et al.,*2005; Javaid and Khan, 2020; Javaid *et al.,* 2020). The use of natural and biological weed control agents is environment friendly and cheap (Ghosheh, 2005). Sorghum, sunflower and oats have been examined for number of allelochemicals that behaved like hormones in low quantities and act as herbicides in high quantities (Weston and Mathesius, 2013). In cultivated fields of rice, *Oryza punctata* is commonly found as anaggressive weed which competes with rice for nourishment and former resources. Wild rice is well thought-out as a challenging weed grows collectively in antagonism with rice. This weed-crop competition causes chief rice yield losses each year (Cao *et al*., 2007). Annual sow thistle (*Sonchus oleraceus* L.) is one of the sophisticated weed species found in miscellaneous places all over the world (Cimmino *et al.,* 2015). It is an annual winter weed growing in and dominating weed communities in agricultural ecosystems, domesticated lands (Gomaa *et al*., 2012) and orchards in Egypt (El-Gawad 2014). This weed affects the crops by challenging with them for resources, room, nutrients as well as affect by liberating different allelochemicals. This weed is known to control the growth of a highly problematic fungal pathogen *Macrophomina phaseolina* (Banaras *et al.,* 2020a, b). Nevertheless, there is not as much of information on the subject of allelopathic potential of *S. oleraceus* against weeds*.* So, the present study was designed to test the allelopathic potential of sow thistle weed on the emergence potential and seedling growth of red rice.

MATERIALS AND METHODS

The aim of this study was to check the allelopathic potential of aqueous extract of winter weed *S. oleraceus* on summer weed *Oryza punctata* L (red rice) at Department of Agronomy, University of Agriculture Faisalabad (UAF). Experiment was laid out in a Completely Randomized Design (CRD) with the factorial arrangement having four replications.

Collection of *S. oleraceus* weed parts

To make aqueous extract of *S. oleraceus* plants were collected from Agronomic Farm, University of Agriculture Faisalabad. To make aqueous extract plants of *S. oleraceus* were harvested above the ground surface at maturity and dried for two weeks at ambient temperature. After drying, different parts of plants were separate and chopped into 2 cm pieces for extract formation.

Preparation of *S. oleraceus* aqueous extracts

S. oleraceus aqueous extracts of various parts were made by adding 10 g of chopped dried plant material into 100ml of distilled water in bottles separately at ratio of 1:10 w/v. At room temperature plant material were soaked in the water for at least 24 hours. These aqueous extracts were made from each desired part of *S. oleraceus* such as leaves, stem, fruit, flower etc. Then the material was passed through a cheese cotton cloth to attain the 10 % water extracts of different parts of *S. oleraceus* which was used as stock solution. The stock solution diluted to prepare the required concentration of 0.25%, 0.5%, 1%, 2%, 4% and 8%.

Laboratory experiment

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. In laboratory experiment the aqueous extracts of *S. oleraceus* various parts (leave, fruit and stem) were used on summer weed *O. punctata*. The experiment was conducted in each 9cm petri plate lined with filter no.10-filter paper.

To estimate the allelopathic effect of different concentration of each plant part of *S. oleraceus* were applied on *O. punctata* seeds separately. A 20 seeds of *O. punctate* were placed in each Petri plates containing filter paper. A 7ml of all *S. oleraceus* extracts dilutions of each part (leaves, fruit and stem) was added in respective petri plates having 4 replications of each dilution. One treatment was kept as control and moist with distilled water. To minimize the excess of evaporation Petri plates were covered and rapped with parafilm. The petri plates were kept at the temperature of 30 ^{o}Cand were again moistened with 3 mL after one week. The data regarding emergence of the seeds were noted every day for 14 days. After the 14 days, harvest the germinated seedlings of *O. punctata* and observed the different parameters like shoot length, root length, fresh and dry weight. Fresh weight was recorded instantly after harvesting while the dry weight of seedling was observed after oven drying for two days at 60 ^{o}C.

Data collection

Mean emergence time of *O. punctate* (day)

Ellis and Reborts (1981) equation were used to examine the mean emergence time (MET).

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

Emergence index of *O. punctata*

By using formula of association of the official seed analysis (1983) we record the emergence index

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

Emergence percentage of *O. punctate* (%)

No of emerged seeds were counted daily according to the method of the association of Official Seed Analysis (1990) and converted into emergence percentage by the following formula.

$$Emergence\ (\%) = \frac{No.of\ emerged\ seeds}{Total\ seeds} \times \mathbf{100}$$

Time taken to 50% emergence of *O. punctate* (day)

The time to the 50% emergence (E_{50}) was recorded by using the formula purposed by Coolbear *et al.* (1984**)**

$$E50 = ti + \left[\frac{\frac{N}{2} - ni}{nj - ni}\right](tj - ti)$$

Growth attributes of *O. punctata*

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

Statistical analysis

Statistics software (version, 8.1Statistix, Tallahassee, FL, USA) was used to analyses the collected data and least significant difference test (LSD) was used to compare the means of treatment at probability level of 5%.

Results and Discussion

Mean emergence time of O. *punctata* (days)

The data presented in table 1 revealed the significant effects of aqueous extracts of the roots, stems and fruits of *S. oleraceus* on the mean emergence time of *O. punctata* seeds. Leaf and fruit extracts showed more time (4.12 days) for mean emergence time of *O. punctate* seeds mean germination stem aqueous extracts (3.81 days). Concentration × plant parts of *S. oleraceus* import significant effect on mean emergence time of *O. punctate* seeds. Maximum time (5.26 days) taken for mean emergence was recorded with fruit extracts at 8% concentration whereas minimum (2.21 days) under stem extract at 8 % concentration. Various concentration produces non-significant effect on mean emergence time of O. *punctata* seeds This showed that high concentrations of fruit extracts may contain more allelochemicals that significantly delayed the germination of red rice seeds. Compared with the distilled water plant parts of *S. oleraceus* weed *viz.* leaf, stem and fruit caused the maximum delay in germination and reduction in seedling growth of red rice. Similar inhibitory effects caused by the weed aqueous extracts were reported by Dongre and Yadav, 2005 and Tanveer *et al*., 2008 and 2010, diverse parts of *Alternanthera* species showed inhibition in the seedling growth significantly.

Germination index of *O. punctata*

The data presented in Table 2 showed that the application of water extracts at different concentrations increase the germination index with leaf extract (4.01) while decreased germination index was observed with fruit aqueous extract (3.12) that was statistically similar to those of stem extracts. Lowest germination index (2.12) was observed especially at higher concentrations (8%) while highest germination index (4.39) under control. Interaction effect of concentration and plant parts influence significant effect on germination index of *O. punctata.* Minimum germination index (1.69) was recoded under fruit extract at 8% concentration and maximum (4.86) at 0.25% by leaf aqueous extract of *S. oleraceus.* Among the water extracts of all weed parts, the leaf water extracts were proved to be least inhibitory towards germination index. Fruit delayed the germination as compared to leaf and stem. This delayed germination and low germination index values could be the result of inhibitory effects of allelopathic substances in the aerial parts of the weedy plants. These findings are supported by the results of Kill and Yun (1992) briefly explained the effects aerial parts. Nadeem *et al.* (2020b) reported that Water extracts of leaf of *C. tinctorius* at 8% concentration result in lowest *E. cruss-galli* emergence index. Aqueous extracts of *Artemisia princeps* on the germination particulars and seedling growth of different plants. Noor and khan 1994 reported the inhibitory effects of different aqueous extracts of *Albizia saman* extract on the seed germination percentage of *Zea mays*. Similar results were also explained that the fruit extracts of A. tenuifolius showed the greater reduction in germination percentage of chickpea seeds strongly indicates the presence of inhibitory allelochemicals in higher concentrations.

Germination percentage of *O. punctata* (%)

Data regarding germination percentage of *O. punctata* as influence by water extract of various parts of *S. oleraceus* showed in table 3 directed that the maximum reduction in germination percentage (68.57%) was caused by the fruit aqueous extracts while the enhanced germination percentage was observed with leaf (83.81%). Various concentration significantly affects the *O. punctata* germination percentage. Maximum reduction in germination percentage (46.67%) was examined with8% while minimum (100%) under control. Interaction of different concentration and plant parts result in significant effect on germination percentage of red rice. Lowest germination percentage (40%) was recorded under fruit extract at 8% whereas highest (100%) at 0% under leaf extract that is statistical at par with stem and fruit extract at same concentration. Fruit aqueous extract show more inhibitory effect on germination percentage of *O. punctata* this might be due to presence of more allelochemical at higher concentration. Similarly, Takao *et al.,* (2011) performed a study to observe the influence of *Ipomoea cairica* aqueous extract on the *Bidens Pilosa, E. cruss-galli, E. heterophylla* and *I. grandifolia*. Results reflects that the test species indicated a significant inhibitory impact on emergence (%) at higher concentrations.

Time taken to 50% germination of *O. punctata* (days)

Water extracts of *S. oleraceus* produce significantly effect on time taken to 50% germination of red rice seeds. Maximum time (3.23 days) taken to complete 50% germination of red rice was estimated with 8% and minimum (1.58 days) at 0.25 % aqueous extract of *S. oleraceus*. Consecutive application of aqueous extracts of diverse plant parts of *S. oleraceus* influence the time taken for 50% germination highest was observed with the fruit extract (3.35 day) and minimum (2.48 days) by stem water extract. Concentration × plant parts statistically significant influence on red rice seeds time take to complete 50% germination. Maximum time given (2.91 days) by fruit extract which statistically similar to leaf extract at 8% concentration. Fruit water extract at 0.25% gave minimum time (1.41 days) to complete 50% germination of red rice which was statistically similar with leaf extract at same concentration. The consecutive application of water extracts of *S. oleraceus* plant parts posed inhibitory effects on the time taken to 50% germination and mean germination time of red rice seeds. The time taken to reach 50% germination with fruit water extract was long as compared to leaf and stem aqueous extracts in accordance with distilled water. These results were in line with that of Kadioglue *et al*., 2005. They reported that the fruits and stem aqueous extracts of A. *Tenuifolius* were proved to be inhibitory than that of leaf and root water extracts. According to Nadeem *et al.* (2020a) who reported that all the concentrations of *C. tinctorius* enhance the time to complete 50% emergence of *O. punctata* with 8% concentration Similar inhibitory effects of aqueous extracts.

Shoot length of *O. punctate* seedlings (cm)

The Table 5 directed that the no significant reduction in shoot length was recorded by the aqueous extracts of plant part and their different concentrations. Interaction effect of different concentration and plant parts produce significantly influence the length of shoot. Maximum reduction was observed with fruits aqueous extract (5.71 cm) at high concentrations (8%). Leaf aqueous extracts showed highest value of seedling shoot length (10.43 cm) at 8% concentration. Leaf extract produced almost similar values as with control (0% aqueous extract). This showed that leaf extract was not having more allelopathic nature as compared to the stem and fruits extracts. The significant reduction in shoot length of seedlings by the *S. oleraceus* extracts might reflect the presence of water-soluble allelochemicals that proved inhibitory towards seedling growth. These results are in line with the findings of (Radhakrishnan *et al.,* 2018) who studied the inhibitory actions of aqueous extracts of the roots, leaves, stems and inflorescence of *Macrotyloma uniflorum* and the seedling growth of (*Arachis hypogea*) ground nuts. The greater reduction in root length was observed than the shoot length might be due to the direct and ease contact with the extracts applied filter paper that contains inhibitory chemicals. These results are in contradiction with the findings of (Mishra *et al*., 2001) who reported that root length was more sensitive to the application of leaf extracts of *A. Tenuifolius* than the shoot length of seedlings.

Root length of *O. punctata* seedlings (cm)

Allelopathic effects of aqueous extracts influenced root length of red rice. Fruit aqueous extracts proved to be inhibitorier towards the root length (2.81 cm) of seedlings. While leaf extracts were not show considerable reduction in root length (5.93 cm). Combined effect of plant part and concentration of extracts were also showed the significant reduction with fruit extracts at high concentrations (4% and 8%). But the value of root length (4.36) at 4% concentration with fruit extract was might be possible due to hermetic effect. Among aqueous extract concentrations maximum root length (4.84cm) and minimum (3.94 cm) was examined at 1% and 0.25% respectively. The fruit extracts of *S. oleraceus* caused the highest significant reduction in the root shoot length of red rice seedlings. These results regarding the inhibitory actions of aqueous extracts of different parts of *S. oleraceus* on the root length were in line with the findings of (Della *et al*., 2009; Aljubory *et al*., 2010). These results are conflicting to those of (Park *et al*., 2011) who reported the harmful effects of higher concentrations of *S. oleraceus* stem extracts on root length. This opposition in results can be credited to the differences in the test crop, conditions from where samples were collected for preparation of extracts. Nadeem *et al.* (2020b) studied the effect of aqueous extracts of various parts of *C. tinctorius* on the root length of barnyard grass results revealed that minimum root length of barnyard grass was produced by produced by safflower leaves aqueous extract whereas, seedlings with lengthiest roots were noted by application of stem aqueous extracts of *C. tinctorius*. 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(g) of *O. punctata* seedlings(g)

The leaf, stem and fruit and their different concentration produced significant effect on fresh weight of *O. punctata* seedlings**.** Maximum (110.94 g) was produced under leaf extract while fruit extract result in minimum (75.21 g) fresh weight. Among different concentration under control (0%) result in maximum (91.91 g) fresh weight and minimum (74.37 g) by 8% concentration. Interactive effect of concentration and plant parts posed significant effect on red rice fresh weight. Fruit extract at 8% concentration produce minimum fresh weight (59.00 g) whereas maximum (118.22 g) under control with stem extract. Increasedin concentrations resulted in decreased mean values showed that stem extracts proved inhibitory towards shoot length of red rice seedlings. These results exhibited the inhibitory activities of allelochemicals in the stem extract. These suppressive effects of higher concentrations of *S. oleraceus* stem extracts also in line with the findings of (Park *et al*., 2011). They made known that phenols and alkaloids were the largely plentiful compounds present in the shoot extracts which impart depressing special effects of *S. oleraceus* stem extracts particularly at higher concentrations on other weeds and crops.

Dry weight(g) of *O. punctata* seedlings(g)

Significant effects of allelochemicals present in water extracts of *S. oleraceus* L. on the dry weight of red rice seedlings presented in table 7. Lowest value of dry weight (6.633 g) was observed with fruit aqueous extracts while the stem extracts showed maximum value (10.516g). Combined effects of water extracts and their concentration produce non-significant effect on dry weight of red rice seedlings. Among various concentrations maximum (9.22 g) and minimum dry weight (7.42g) was examined under control (0%) and 8% concentrations respectively. This might have been due to hormeotic effect of the aqueous extract of the *S. oleraceus*. The results are in agreement with those of Nadeem *et al*. (2017); Nadeem et al., 2021, Nadeem et al., 2020a,b,c who reported that the herbicide may have hormeotic effect. It has phytotoxic effects at higher concentrations but encourage the growth of plants when used at lower concentrations. The results indicated that *Oryza punctata* should not be overlooked because crop losses can occur as a result of its ecological interference with rice crop germination and growth dynamics.

Table 1. Mean Emergence Time (MET) of red rice seeds that were treated with aqueous extracts of *Sonchus oleraceus* L.

Plant Parts	**Mean emergence time**							**Mean**
	Concentration (%)							
	0	**0.25**	**0.5**	**1**	**2**	**4**	**8**	
Leaf	3.98def	3.91d-g	3.95def	3.84e-h	3.75e-i	3.68e-i	3.56f-j	**4.12B**
Stem	4.06cde	3.92d-g	3.45hij	3.24jk	3.61f-j	2.87k	2.21i	**3.81C**
Fruit	3.36ij	3.50g-j	3.45hij	4.50b	4.29bcd	4.47bc	5.26a	**4.12A**
Mean	**3.80^{NS}**	**3.77**	**3.61**	**3.86**	**3.88**	**3.67**	**3.68**	

Means not sharing common letters differ significantly at 5% level of probability.

Table 2. Germination index of red rice seeds that were treated with aqueous extracts of *Sonchus oleraceus* L.

Plant Parts	**Germination index**							**Mean**
	Concentration							
	0	**0.25**	**0.5**	**1**	**2**	**4**	**8**	
Leaf	4.80a	3.86a-e	4.86a	4.27a-d	3.97a-e	3.52a-f	2.77e-h	**4.01A**
Stem	4.47abc	3.39b-f	3.59a-f	3.11c-h	3.00d-i	2.36fgh	1.91gh	**3.12B**
Fruit	3.88a-e	3.33c-g	2.94d-h	2.97d-h	2.42fgh	3.58a-f	1.69h	**2.97B**
Mean	**4.39A**	**3.52B**	**3.80AB**	**3.45B**	**3.13B**	**3.15B**	**2.12C**	

Means not sharing common letters differ significantly at 5% level of probability.

Table 3. Germination percentage of red rice seeds that were treated with aqueous extracts of *Sonchus oleraceus* L.`

Plant Parts	Germination percentage							Mean
	Concentration							
	0	0.25	0.5	1	2	4	8	
Leaf	100a	86.67abc	100.0a	100a	66.67c-f	80.00a-d	53.33efg	**83.81A**
Stem	100a	93.33ab	90.00abc	80.0a-d	73.33b-e	60.00d-g	46.47fg	**77.61A**
Fruit	100a	86.67abc	66.67c-f	73.33b-e	53.33efg	60.00d-g	40.00g	**68.57B**
Mean	**100A**	**88.89AB**	**85.56B**	**84.44B**	**66.67C**	**64.44CD**	**46.67E**	

Means not sharing common letters differ significantly at 5% level of probability.

Table 4. Time to 50% Germination of red rice seeds that were treated with aqueous extracts of *Sonchus oleraceus* L.

Plant Parts	Time to 50% Germination							Mean
	Concentration							
	0	0.25	0.5	1	2	4	8	
Leaf	3.33a	1.41g	2.27def	2.66a-f	2.50b-f	2.87a-d	2.91a-d	**2.60B**
Stem	3.25ab	2.91a-d	1.91fg	2.42c-f	2.65a-f	2.67a-f	2.87a-d	**2.48B**
Fruit	3.11abc	1.41g	2.50a- f	2.41c-f	2.25def	2.76a-e	2.91a-d	**3.35A**
Mean	**2.86AB**	**2.61BC**	**1.58D**	**2.39C**	**2.47BC**	**2.87AB**	**3.23A**	

Means not sharing common letters differ significantly at 5% level of probability.

Table 5. Effect of aqueous extracts of *S. oleraceus* on the shoot length of red rice seedlings

Plant Parts	Shoot length (cm)							Mean
	Concentration							
	0%	0.25%	0.5%	1%	2%	4%	8%	
Leaf	7.73abc	6.23abc	6.62bc	7.15ab	6.58bc	7.44abc	10.43a	**8.03**^{NS}
Stem	7.69abc	8.70bc	8.07abc	7.48babc	7.09abc	7.10c	7.06abc	**7.33**
Fruit	7.45abc	6.92bc	7.24abc	7.00c	8.76abc	5.95bc	5.71c	**7.00**
Mean	**7.59**^{NS}	**7.28**	**7.03**	**7.88**	**7.80**	**6.83**	**7.73**	

Means not sharing common letters differ significantly at 5% level of probability.

Table 6. Effect of aqueous extracts of *S. oleraceus* on the Root length of red rice seedlings

Plant Parts	Root length (cm)							Mean
	Concentration							
	0	0.25	0.5	1	2	4	8	
Leaf	6.32abc	5.79a-d	4.72a-g	6.62ab	4.50a-h	6.86a	6.73ab	**5.93A**
Stem	4.87a-f	4.36b-h	4.86a-f	4.80a-g	5.26a-e	4.36b-h	4.39b-h	**4.57B**
Fruit	3.01e-h	2.22h	2.37gh	3.09e-h	4.36b-h	2.60fgh	2.04h	**2.81C**
Mean	**4.74**^{NS}	**3.94**	**3.99**	**4.84**	**4.71**	**4.58**	**4.38**	

Means not sharing common letters differ significantly at 5% level of probability.

Table 7. Effect of aqueous extracts of *S. oleraceus* on the fresh weight of red rice seedlings

Plant Parts	Fresh weight (g)							Mean
	Concentration							
	0	**0.25**	**0.5**	**1**	**2**	**4**	**8**	
Leaf	59.67c	102.8bc	74.00bc	67.67bc	66.22bc	83.33bc	100.78bc	**110.94A**
Stem	118.22ab	158.67a	105.56abc	102.50bc	100.33bc	96.67bc	94.67bc	**78.29B**
Fruit	95.67bc	83.33c	92.17bc	65.17bc	59.44c	64.00bc	59.00bc	**75.21B**
Mean	**91.19AB**	**114.9A**	**75.57AB**	**78.44B**	**75.33B**	**79.17B**	**74.37B**	

Means not sharing common letters differ significantly at 5% level of probability.

Table 8. Effect of aqueous extracts of *S. oleraceus* on the dry weight of red rice seedlings

Plant Parts	Dry weight (g)							Mean
	Concentration							
	0	**0.25**	**0.5**	**1**	**2**	**4**	**8**	
Leaf	9.33^{NS}	8.33	7.33	8.83	6.22	9.16	10.66	**8.556AB**
Stem	10.66	32.67	9.55	8.50	9.00	9.66	7.55	**10.516A**
Fruit	7.66	8.66	7.00	6.16	8.05	4.80	4.06	**6.633B**
Mean	**9.22B**	**16.55A**	**7.96B**	**7.83B**	**7.75B**	**7.87B**	**7.42B**	

Means not sharing common letters differ significantly at 5% level of probability.

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