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Allelopathic Effect of Leaf Extract of Two Wild Plants on Seed Germination, Shoot and Root Lengths of Two Weed Species; *Portulacaoleracea* and *Chenopodium murale*

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The present study aims to evaluatethe effect of leaf extract of *Rhanteriumepapposum* and *Salsola imbricata*at various concentrations (20%, 40%, and60%) on the germination and shoot and root lengths oftwo weed species; *Portulacaoleracea* and *Chenopodium murale*. The present study findings proved that the inhibitory effect of seed germination and shoot and root lengths of the studied species was largely dependent on the concentration of *R. epapposum* and *S.imbricata* leaf extract. The results showed that the highest all elopathic effect on the germination of the seeds of *C.murale* by leaf extract of *R.epapposum* and *S.imbricata* especially at concentration of 40% and 60% .While the lowest effect was of theleaf extract of *S.imbricata.* However the concentration of 60% was higher on the germination of the seeds *C.murale* and *P.oleracea*. Results also showed that the root and shoot lengths of *C.murael* was more sensitive to all elochemicals of *R.epapposum* leaf extract compared to *S.imbricata* leaf extract. However, the root and shoot lengths of *P.oleracea* was more sensitive to all elochemicals of *S.imbricata* leaf extract compared to *R.epapposum* leaf extract. Hence, the present findings recommended using the *R.epapposum* leaf extract and *S.imbricata* leaf extractas a tool for weed managemente specially *C.murale* and *P.oleracea*.

Keywords: *Portulacaoleracea*; *Chenopodium mural*; *Rhanteriumepapposum*; *Salsolaimbricata*; allelopathy; weed; plant extract.

It is widely known that weeds have special concern on agricultural production as they compete crops for the water and nutrients (Mo¿d¿eñ and Repka, 2014; Al-Harbi, 2017; Glab*et al*., 2017; Oliwa*et al*., 2017). Hence, this has negative impact on economic value and production of the crop yield. (Navas, 1991). The weeds are of importance in agriculture and crop production for their harmful effect which is known as allelopathy. The term "allelopathy" is the ecological interference of the weeds through chemical compounds released from them which eventually inhibit the crop germination and growth. These allelochemicals differ from weed species to another (Zimdahl, 2007; Glab*et al*., 2017). In the last few decades, there is a growing interest to among ecologist to apply examine the allelopathy potential of wild plant species on specific weed species. Many field experiments have shown that allelopathic substances affect plants (Lawrence, 1991, Inderjit and Dakshini, 1994; Tanveer*et al*., 2014; Mo¿d¿eñ and Repka, 2014; Oliwa*et al*., 2017). Allelopathy is defined as the direct or indirect harmful of one plant on another by releasing of some chemical compounds in the environment (Ashrafi *et al*. 2008). In fact, allelochemicals are the secondary

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metabolites that have a remarkable potential as natural pesticides and as growth control (Chon *et al*., 2005). Allelopathy plays a very important role in natural ecosystem and its management (Inderjit*et al*., 2005; Glab*et al*., 2017). Allelochemicals found in any part of the plant, but the greatest amounts are often located in the roots and leaves (Inderjit and Dakshini, 1994; Oliwa*et al*., 2017).

C. murale is a wide spread harmful weed grows in more than 25 crop species and tree orchards in more than 57 countries (Lazarides*et al*., 1997), and it is affects cultivated plants and native plants (Al-Harbi, 2017). Weeds are considered that a major constraint and important problems to agriculture production for all world (Al-Harbi, 2017). In agricultural ecosystems there are many technologies to control weeds by producing chemicals from plant parts of different species (Naseem *et al*., 2009; Glab*et al*., 2017). There is a current worldwide demand for environmentally safe for modern weed control methods on the allelopathic potential of some plant species (Al-Harbi, 2017; Glab *et al*., 2017). Therefore, weeds have been identified as very important factor in crop quality reduction, so weed control is crucial. Mechanical, chemical and biological methods are the major factors in weed management, allelopathic properties of plants is an alternative way of improving weed management. (Tanveer*et al*., 2014; Motamedi, 2016; Glab*et al*., 2017; Oliwa*et al*., 2017) *R. epapposum* is a perennial plant in the genus *Rhanterium* belonging to the *Asteraceae* family. It is native to that Arabian Peninsula, in Saudi Arabia it grows widely in several areas.

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It is a bushy shrub approximately 75 cm height. *S.imbricate* is a species of the genus *Salsola* and in the *Cheanobodum* family. Also, it is a bushy shrub approximately 85 cm height.

Recent research work done on allelopathic potential of wheat highlighted a variety of studies which includes natural herbicides derived from allelochemicals could be used to control several weeds (Al-Sherif*et al*., 2013). The present study was carried outtodetermine the allelopathic effects of R.*epapposum* and *S.imbricata* aqueous extracts obtained from leaves, and their uses as control on seed germination and growth of two weed species *Portulacaoleracea* and *Chenopodium murale*.

MATERIALS AND METHODS

Collection of Plant Materials

The experiment was carried out at Biology laboratory in Faculty of Science,Tayma Branch, Tabuk University. Leaf samples of selected plants (*R.epapposum* and *S.imbricata)* were collected from several locations inTaymaregion during the spring (April 2017). The collected samples were cleaned and dried at room temperature 23 ± 2ºC, then shredded into small pieces and grounded into fine powder by electrical grinder and stored in paper bags until use. The seeds of C.*murald* and *P.oleracea* were collected and cleaned by the distilled water and their surface were sterilized with 3% sodium hypochlorite for 4 min to avoid the effects of fungal contamination, and then dried and stored in paper bags until use.

Preparation of Extract

Leaves extract was obtained by soaking 100 g of fine powder in 1000 ml of distilled water at room temperature (23 ± 2ºC) for 48 hours with occasional shaking. The mixture of the extract was filtered twice by two layers of cotton to prevent any plant particulate material from being in the extracts. The extract were saved in the refrigerator at 5ºC until used, the different concentrations (0%, 20%, 40% and 60%) were mad from the stock solution of the extract in addition to the control (distilled water).The concentrations (0, 20, 40 and 60%) were obtained by adding distilled water to the leaves solution. For instance, the 0% control had no leaves extract, while the 20% concentration means of 20% leaf extract and 80% distilled water.

Germination of seeds

To study the allelopathic effect of aqueous extract of *R.epapposum* and *S.imbricata* leaf aqueous extract on germination and root, shoot length growth of *C.murale* and *P.oleracea* was conducted in four treatments and three replications of both extracts for each of the selected weed species. Twenty seeds of each weed species (*C.mural* and *P.oleracea*) were placed in 12 cm diameter Petri-dishes lined with three discs of Whatman No.1 filter paper for control and test, and a 12 ml of the aqueous extract from each concentration were added to each Petri-dish.

After three days, germination and root and shoot lengths of the tested species were measured. The measurements were repeated for three times for three days until the end of the experiment (approximately after 15 days).

Calculations

Germination percentage (GP)

$$GP = \frac{\text{number of germinated seeds}}{\text{total number of seeds}} \times 100$$

The Reduction percentage in root and shoot Length (RP)

$$RP = \frac{\text{control} - \text{allelopathic}}{\text{control}} \times 100$$

RESULTS

The present study revealed that the concentration of the plant extract is an important factor in the allelopathy effect on the *P. oleracea* and *C. murale*. All parameters (germination %, shoot length and root length) showed significant differences in their means regardless the extracts used (i.e. *R. epapposum* and *S. imbricata*). The

Table 1. Results of One-way ANOVA showing the effect of extracts concentrations (*R. epapposum* and *S. imbricata*) on the germination percentage and shoot and root lengths of *P. oleracea* and *C. murale*

	R. epapposum				*S. imbricate*			
	P. oleracea		C. murale		P. oleracea		C. murale	
	F-value	P-value	F-value	P-value	F-value	P-value	F-value	P-value
Germination %	6875	<0.05	5808	<0.05	648.688	<0.05	3253.5	<0.05
Shoot Length (cm)	4.688	<0.05	165.578	<0.05	135.212	<0.05	130.667	<0.05
Root Length (cm)	4.320	<0.05	34.942	<0.05	97.688	<0.05	177.211	<0.05

Table 2. Allelopathic effect of different concentrations of *R.epapposum* and *S.imbricata*aqueous extracts on germination percentage of *P. oleracea* and *C.murale*

Concentrations	Germination (%)			
	P. oleracea		*C. murale*	
	R. epapposum Extract	*S. imbricata* Extract	*R. epapposum* Extract	*S. imbricata* Extract
0%	100	97	88	94
20%	100	83	0	60
40%	50	50	0	0
60%	0	33	0	0

Table 3. Allelopathic effect of different concentrations of *R. epapposum* and *S. imbricata*aqueous extracts on Shoot length (cm) and Root length (cm) of *C. mural*

Concentrations	*C. murale*			
	Shoot length (cm)		Root length (cm)	
	R. epapposum Extract	*S. imbricata* Extract	*R. epapposum* Extract	*S. imbricata* Extract
0%	2.5	2.5	2.4	2.4
20%	0	0.5	0	0.5
40%	0	0	0	0
60%	0	0	0	0

results of One-way ANOVA of the parameters means are shown in Table 1.

The present study found that there was no significant effect of the plant extract species on the three parameters measured of the targeted plant species. For example, the percentage of germination of *P. oleracea* exposed to either extract (*R. epapposum* or *S. imbricata*) showed no significant difference (t=-0.221, P=0.827).

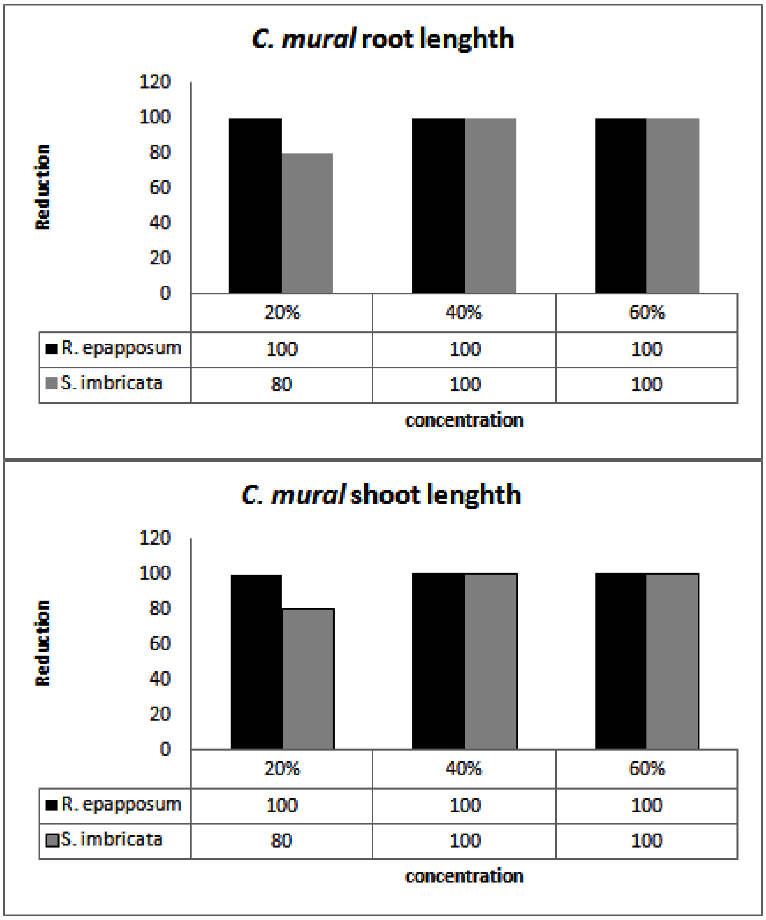

Fig. 1. Reduction percentages of *C. mural*root and shoot length under the different concentrations of *R. epapposum* and *S. imbricata* aqueous extract

Table 4. Allelopathic effect of different concentrations of *R. epapposum*and *S. imbricata* aqueous extracts on shoot length (cm) and root length (cm) of *P. oleracea*

concentrations	*P. oleracea*			
	Shoot length (cm)		Root length (cm)	
	R. epapposum Extract	*S. imbricata* Extract	*R. epapposum* Extract	*S. imbricata* Extract
0%	2.6	2.6	2.3	2.3
20%	2.25	1	2.2	1.1
40%	1	0.4	1.1	0.35
60%	0.8	0	0.9	0.2

Seed germination

Based on the results of this study the aqueous extracts of *R.epapposum* and *S.imbricata* had an inhibitory effect on seed germination of *C.murale* and *P.oleracea* at both concentrations, but in *P.oleracea* seed germination inhibitory effect of *R. epapposum* extract higher than *S.imbricata* extract specially concentration of 60%, and in *C.mural* seed germination inhibitory effect of *R.epapposum* extract higher than *S.imbricata* extract in all concentrations 20%, 40% and 60% (Table 1).

Root and shoot length

The study showed that aqueous extracts of *R.epapposum* and *S.imbricata* had an inhibitory effect on shoot and root length of *C.murale* and *P.eoleracea* at both concentrations, but in *C.murale* shoot and root lengths inhibitory effect of *R.epapposum* extract higher than *S.imbricata* extract especially concentration of 40% and 60%, generally *C.murale*shoot and root lengthmore sensitive than *P.oleracea* in all concentrations of *R.epapposum* and *S.imbricata* aqueous extracts (Tables 2 and 3).

The results showed that the reduction percentages of *C. murale* root and shoot length under the different concentrations of *R. epapposum* and *S. imbricata* aqueous extract is higher than the reduction percentages of P. oleracea root and shoot length under the different concentrations of *R. epapposum* and *S. imbricata* aqueous extract (Fig. 1 and 2)

DISCUSSION

The present study aims to examine the effects of the leaf aqueous extracts of*Rhanterium epapposum* and *Salsola imbricata*at different concentrations (20%, 40%, and 60%) on the germination and shoot and root lengths of two weed species;*Portulacaoleracea* and *Chenopodium murale*. Results proved that the inhibitory effect

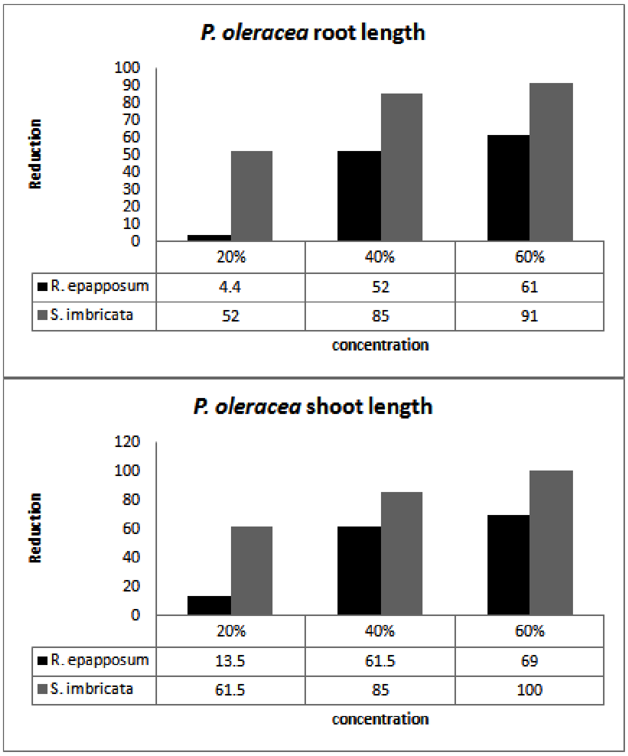

Fig. 2. Reduction percentages of *P. oleracea* root and shoot length under the different concentrations of *R. epapposum* and *S. imbricata* aqueous extract

of seed germination and shoot androot lengthsof the studied species was largely dependent on the concentration of *R. epapposum*and *S.imbricata* leaf extracts. It is acceptable fact that the allelpathic effect of growth inhibition of plant aqueous extracts is proportionally increased with the concentrations. Several studies had found that the inhibitory or stimulatory effect of allelochemicals is notably dependent on their concentrations (Purvis *et al.*, 1985; Sinha *et al.*, 2004; Swain *et al.*, 2005). The involvement of chemical compounds in the allelopathy is evident, hence the higher concentration of these chemical compounds result in more significant effect on the target plant species. According to Tantiado and Saylo (1993), it is difficult to isolate the effect of a single chemical compound and accuse it for growth inhibition effect as the allelopathy process is complicated. Furthermore, this process may involve other ecological influences on the microbial and chemical nature of the soil (Kaur *et al*., 2009; Weidenhamer *et al*., 2009).

The allelopathiceffect of the two plants in the present study showed remarkable variation of their effect on the germination and shoot and root lengths. This is evident as the seed germination can be inhibited by other allelopathy effect usually between 5-10%. However, this inhibition can increase with higher concentrations of the plant extracts. The allelopathic chemicals have the potential to damaging the seeds structure which results in changing the growth rate (Coder, 1999). The quality of germination of plant species under unfavourable conditions can be indicated by two interacted parameters; number of germinated seeds and how fast the germination is (Tanveer*et al*., 2014).

In this study, application of the germination percentage is good indicator for the allelopathy effect. This is in agreement with previous studies (e.g. Bewley*et al*., 2012). Many studies emphasized that germination bioassays are potential indicators to assess the influence of one or more chemical compounds either in laboratory of field (Tanveer*et al*., 2014). The process of seed germination is more difficult than we thought. It involves various biochemical, physiological and morphological changes in appropriate sequence (Bewley*et al*., 2012). If any of these changes are interrupted this will eventually results in hindering proper germination and growth and this can be through presence/absence of certain chemical substances.

It is recommended that the extracts of these two plant species; *R. epapposum* and *S. imbricate* can be applied in the field to control the invasive weed species which is responsible for remarkable loss of the yield in the agricultural production scale. Further studies in this context are needed to better understand the mechanisms behind the inhibitory/stimulatory effect of plants extracts on weeds species. This includes investigating the chemical constitution of the plant extracts to determine any synergetic effect of these chemicals and their potential in changing the biochemical and physiological structure of the seeds/plants.

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