ISSN 1819-1894

Asian Journal of Agricultural Research

Knowledgia
SCIENTIFIC
A Place to Publish Outstanding Research

http://knowledgiascientific.com

Asian Journal of Agricultural Research 6 (2): 83-90, 2012
ISSN 1819-1894 / DOI: 10.3923/ajar.2012.83.90

Effect of the Extract of *Schanginia aegyptiaca* on Seed Germination and Seedling Growth of Roselle (*Hibiscus sabdariffa* L.)

Majeed K. Abbas and Ali Sabah Ali
Department of Plant Production, College of Agriculture, Al-Qadisiya University, Iraq

Corresponding Author: Majeed K. Abbas, Department of Plant Production, College of Agriculture, Al-Qadisiya University, Iraq

ABSTRACT
The present study was conducted to investigate the effect of *Schanginia aegyptiaca* extract at different concentrations on seed germination and seedling growth of two cultivars of roselle (*Hibiscus sabdariffa* L.). Four extract concentrations; 0.5, 1, 1.5 and 2%, in addition to control, were used. Germination percentage was strongly inhibited by all halophyte extract concentrations. Mean germination time was increased at the lower levels of the extract used but it decreased at the higher ones. The two cultivars did not differ from each other in germination rate but they differ in mean germination time, with the red cultivar has the lower MGT. The results show that as the percent of the halophyte extract increases, the germination index decreases. However, coefficient uniformity emergence (CUE) shows no significant differences at all extract concentrations used and at both cultivars. Root and shoot length and dry weight show significant reduction in proportional to increase in halophyte extract concentrations. It is concluded that *Schanginia aegyptiaca* extract has adverse effect on germination and seedling growth of roselle.

Key words: Roselle, germination percentage, mean germination time, coefficient uniformity emergence, dry weight

INTRODUCTION
Germination is pivotal in plant life cycle and its completion sets in motion the growth of the seedling especially under unfavorable environments (Song *et al.*, 2006; Millar *et al.*, 2006). Seed germination begins when a seed uptakes water and is completed with the elongation and emergence of the radicle (Finch-Savage and Leubner-Metzger, 2006). This process is a very complex physiological event that is controlled by the genetic make-up of the seed and a range of developmental and external cues (Gusta *et al.*, 2004). *Schanginia aegyptiaca* (Hasselq.) is common halophytic plants in lower Iraq and it is a well adopted to harsh environment conditions of many arid zones. It is among the commonest on salty ground and occupy the spaces between the bushes (Guest and Al-Rawi, 1966). It belongs to the family Chenopodiaceae. It grows in rather different plant communities and has been seen in various types of salt-marshes, along ditches and even as a weed in irrigated gardens and fields. It has been known that some halophytes have allelopathic potential which might have been caused either by fallen leaves or plant leachates or root exudates (Rice, 1984). Consequently, the release of allelochemicals into the soil have harmful effects on the crops in the ecosystem resulting in the reduction and delaying of germination, mortality of seedling and reduction in growth and yield (Ghafar *et al.*, 2000). The allelopathic effects of some plants were

studied including germination inhibition and seedling growth (Djurdjevic *et al*., 2004; Siddiqui *et al*., 2009; Dhole *et al*., 2011) and other growth parameters (Tobe *et al*., 2000; Turk and Tawaha, 2003; Rafique *et al*., 2003). It has been shown that the aqueous extracts obtained from some plants are rich in phenol compounds which inhibit the germination of seeds and cotyledons of different species of plants (Macias *et al*., 1993; Burhan and Shaukat, 2000; El-Darier, 2002; El-Refai and Moustafa, 2004; Khan *et al*., 2007). On the other hand, some investigators have shown that the negative effect of some halophytes extract on seed germination and seedling growth might be due to the existence of sodium ions (Zia and Khan, 2004). The decrease in germination due to the presence of salinity in the growth media would induce disturbance of metabolic process leading to increase in phenolic compounds (Ayaz *et al*., 2000). The objective of conducting this study was to determine the effect of different concentrations of *Schanginia aegyptiaca* extract on seed germination and seedling growth of two cultivars of roselle.

MATERIALS AND METHODS

Plant material: Samples of halophyte plant; *Schanginia aegyptiaca* (Chenopodiaceae) was collected locally in the autumn of 2010 from Al-Nuriya region, Al-Qadisiyah Province, south of Iraq. Seeds of two cultivars of roselle, red and lined, were used for germination and seedling growth tests which was obtained locally too. Seeds were selected as healthy and uniform in size with initial moisture content of 11.5%.

Extraction: The whole aerial part of the *Schanginia aegyptiaca* was used. After washing, parts were air dried first for three days and then they were dried using an oven at 70°C for 72 hours. Samples were powdered by grinder. Then, 10 g of powder plant was added to 100 mL distilled water and stirred gently for 24 h by a shaker. The suspension was filtered twice by Whatman filter paper No. 2 to remove debris. After preliminary treatments, the test solution was diluted to obtain concentrations of 0.5, 1, 1.5 and 2% while distilled water was used as a control treatment.

Germination tests: Seeds of roselle were surface-sterilized for 3 min with 5% sodium hypochlorite and then rinsed with distilled water and dried to eliminate fungal attack. Seed germination was performed in sterile plastic 9 mm diameter petri dishes. Twenty five seeds were germinated on filter paper soaked in 10 mL of aqueous leachates of different concentrations as mentioned above, while distilled water was used for control. The Petri dishes were kept at room temperature at 27°C. The filter papers were moistened daily using the aqueous extract. There were three replicates for each extract dilution. The number of germinated seeds was counted (rupture of seed coat and emergence of radicle) daily for seven days after which no further seed germination was occurred. Final germination percentages (FGT) were obtained at the end of the experiment. Mean germination time (MGT) was calculated as follows, according to Ellis and Roberts (1981):

$$MGT = \frac{\sum Dn}{\sum n} \text{(days)}$$

where, n is the number of seeds which were emerged on day D and D is the number of days counted from the beginning of emergence.

Germination index (GI) was calculated as described in the Association of Official Seed Analysts (Anonymous, 1983) using the following formulae:

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

Coefficient of uniformity of emergence (CUE) was calculated using the following formulae of Bewley and Black (1994):

$$CUE = \Sigma n / \Sigma[(t'-t)^2 n]$$

where, t is the time in days, starting from day 0, the day of sowing and n is the number of seeds completing emergence on day t and t' is equal to GET.

The experiment was laid out in a completely randomized design (CRD) with three replications. The treatments means were compared by Least Significant Difference (LSD) test at 0.05 probability level (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

Germination percentage of roselle was strongly inhibited by all halophyte extract concentrations bioassayed (Table 1). The germination rate was more reduced by increasing the percent of the extract. The inhibition being strongest particularly at the higher concentrations of extract compare to control. The maximum germination rate was observed at the control treatment (98.66%). However, the two cultivars did not differ significantly from each other in the germination rate. The negative effect on germination might be due to the allelochemical activity of the halophyte used (Rice, 1984). This result agrees with previous ones obtained by other investigators which emphasized that extracts of some plants inhibit germination of other plants (Shaukat *et al*., 2003; Siddiqui *et al*., 2009; Dhole *et al*., 2011). Oudhia (1999) found that extracts of *Calotropis gigantea* weed has allelopathic effects on germination and growth of *Lathyrus sativus*. Also, Allolli and Narayanareddy (2000) observed that treatment with 10% aqueous leaf extract of *Eucalyptus* resulted in 41% lesser germination in cucumber.

Some investigators have attributed the adverse effect of some halophytes on seed germination due to the existence of sodium ions (Zia and Khan, 2004). It appears that a decrease in germination is related to salinity induced disturbance of metabolic process leading to increase in phenolic compounds (Ayaz *et al*., 2000; Pujol *et al*., 2000). Results of Ghoulam and Fares (2001)

Table 1: Effect of percent extract of *Schanginia aegyptiaca* treatments on final germination percent (FGP) and mean germination time (MGT) of roselle

	MGT						FGP					
	Extract (%)						Extract (%)					
Cultivar	0	0.5	1	1.5	2	Mean	0	0.5	1	1.5	2	Mean
Lined	2.37	2.75	3.04	2.63	2.17	2.58	100	89.33	77.33	65.33	42.00	74.80
Red	2.12	2.05	1.79	1.63	2.19	1.95	97.33	86.66	74.66	65.00	50.00	74.73
Mean	2.25	2.40	2.41	2.13	2.18		98.66	88.0	76.00	65.16	46.00	

LSD (5%)			
Variable	Cultivar	Extract	Interaction
FGP	NS	8.55	14.33
MGT	0.24	0.12	0.31

on sugar beet; Soltani *et al.* (2001) on chickpea; Abbad *et al.* (2004) on *Atriplex halimus*; Yuesf (2007) on doum and Heidari (2009), on canola (*Brassica napus* L.) emphasize the effect of salinity on germination. Interaction between cultivars and extract concentrations revealed that the maximum seed germination was obtained at 0.5% of the extract on lined cultivar and the lower percent was obtained at the same cultivar treated with 2% of the extract.

Mean germination time (MGT) was increased at the lower levels of the extract used but it decreased at the higher levels. The two cultivars differ significantly from each other in MGT, as the red cultivar has the lower MGT (1.95). It is known that MGT is related to the time (day) in which the radicle appeared, the lower the MGT, the rapid the germination is. These results are in agreement with the results of Bayuelo-Jimenez *et al.* (2002) who found that MGT of some species of *Phaseolus* increased in proportional to the increase in NaCl concentration. Also, Ghafar *et al.* (2000) reported that allelochemicals produced by sunflower reduce wheat seed germination and seedling growth.

For the interaction, the maximum MGT was obtained at the combination treatment of 1% of the extract on the lined cultivar (3.04) and the lower MGT was obtained at the combination treatment of 1.5% of the extract on red cultivar (1.63).

Results in Table 2 show that as the percent of the halophyte extract increases, the germination index decreases. The highest index was at the control (12.81) whilst the lowest was at 2% of the extract (6.35). The reduction in GI at the highest extract concentration treatment was more than 100% over the control. Red cultivar shows higher GI (10.92) than the lined cultivar (8.51). Coefficient Uniformity Emergence (CUE) shows no significant differences at all extract concentrations used and at both cultivars. Enhanced germination index and CUE appeared to be linked to the efficient mobilization and utilization of seed reserves (Lee and Kim, 2000; Basra *et al.*, 2005), thereby leading to earlier commencement of germination events. It appears that this is not the case with our results. Maximum GI was at the combination treatment of 0.5% of the extract on red cultivar and the minimum GI was at the combination treatment of 2% of the extract on lined cultivar. The results indicated that all leaf extract treatments have resulted in retardation in root and shoot elongation. The average length of root and shoot of seedlings of both cultivars decreased in proportional to increasing levels of the extract used (Table 3). The magnitude of the decrease in length was more than 100% for both cultivars. Lined cultivar shows less root length in compare to red cultivar. However, the two cultivars show no significant differences in shoot length. These

Table 2: Effect of percent extract of *Schanginia aegyptiaca* treatments on germination index (GI) and coefficient uniformity emergence (CUE) of roselle

	GI						CUE					
	Extract (%)						Extract (%)					
Cultivar	0	0.5	1	1.5	2	Mean	0	0.5	1	1.5	2	Mean
Lined	12.17	9.42	7.60	7.67	5.73	8.51	0.227	0.233	0.223	0.226	0.201	0.222
Red	13.45	12.52	11.34	10.36	6.97	10.92	0.252	0.255	0.254	0.214	0.207	0.236
Mean	12.81	10.97	9.47	9.01	6.35		0.239	0.244	0.238	0.220	0.204	

LSD (5%)			
Variable	Cultivar	Extract	Interaction
GT	0.45	0.65	1.05
CUE	NS	NS	NS

Table 3: Effect of percent extract of *Schanginia aegyptiaca* treatments on root and shoot length (cm) of roselle

	Root length (cm)						Shoot length (cm)					
	Extract (%)						Extract (%)					
Cultivar	0	0.5	1	1.5	2	Mean	0	0.5	1	1.5	2	Mean
Lined	3.40	2.80	2.30	1.95	1.70	2.43	7.90	6.60	5.60	5.10	4.20	5.88
Red	3.40	2.70	2.30	1.90	1.30	3.32	8.10	7.20	6.30	5.30	3.30	6.04
Mean	3.40	2.75	2.30	1.92	1.50		8.00	6.90	5.95	5.20	3.75	

LSD (5%)

Variable	Cultivar	Extract	Interaction
Root length	0.33	0.55	0.80
Shoot length	0.40	1.18	1.88

Table 4: Effect of percent extract of *Schanginia aegyptiaca* treatments on root and shoot dry weight (g) of seedlings of roselle

	Root dry weight						Shoot dry weight					
	Extract (%)						Extract (%)					
Cultivar	0	0.5	1	1.5	2	Mean	0	0.5	1	1.5	2	Mean
Lined	0.34	0.33	0.22	0.18	0.14	0.24	0.61	0.44	0.40	0.37	0.31	0.42
Red	0.48	0.32	0.31	0.18	0.14	0.28	0.72	0.53	0.48	0.41	0.26	0.48
Mean	0.41	0.33	0.27	0.18	0.14		0.67	0.49	0.44	0.39	0.29	

LSD (5%)

Variable	Cultivar	Extract	Interaction
Root dry weight	NS	0.13	0.19
Shoot dry weight	NS	0.13	0.18

results agree with the results of Oudhia (1999) who found that the extracts of *C. gigantea* inhibit radicle and plumule growth of *Lathyrus sativus*. Also, it was found that the aqueous extract of *Conyza canadensis*; *Parthenium hysterophous* L., or some cruciferous seeds had strong inhibitory effect on the growth of root and shoot development in some cultivated crops (Shaukat *et al*., 2003; El-Refai and Moustafa, 2004; Dhole *et al*., 2011). El-Darier and Youssef (2000) found a negative relationship among the different concentrations of alfalfa extract on plumule and radicle elongations of *Lepidium sativum*. However, it is worth to note that both root and shoot respond in the same manner to halophyte extract. These results disagree with other studies reporting that water extracts of allelopathic plants had more pronounced effects on radicle growth than on plumule growth (Turk and Tawaha, 2002, 2003). Interaction between the two factors reveals that the use of the highest concentration of the extract on Red cultivar gave the lowest values for both root and shoot length.

Increasing in concentrations of the halophyte extract caused significant reduction in root and shoot dry weights (Table 4). The reduction in dry weight at 2% of the extract over the control was 192.85% for root and 131.03% for shoot. Lined cultivar was more affected than red cultivar. This reduction in shoot and root dry weight may be due to the effect of salinity in the halophyte tissue. This result agrees with the result of Alam *et al*. (2004) and Razzaque *et al*. (2009) who found that seedling growth and roots and shoot total dry matter of rice were significantly decreased by the application of salinity. Akita and Cabuslay (1990) mentioned that by increasing salinity, plumule dry weight decreased which might be attributed to decrease in remobilization of the seed reserves from cotyledons to the embryonic axis. In addition, Lyu *et al.* (1990) stated that, a part of the direct effect of seed germination, some phenols can effect root elongation and accumulation of dry material in shoots and roots of cucumber. Also, El-Darier (2002), attributed the reduction in germination, shoot and root lengths and total dry weight of faba bean and maize using *Eucalyptus* leaf-litter water extract due to the presence of phenols and terpenoid compounds.

In conclusion, it is clear that the *Schanginia aegyptiaca* extract have an adverse effect on all parameters studied which emphasize the fact of its allelochemical potential. The highest the concentration used, the more the effect was.

REFERENCES

Abbad, A., A. El-Hadrami and A. Benchaabane, 2004. Germination response of the Mediterranean saltbush (*Atriplex halimus* L.) to NaCl treatment. J. Agron., 3: 111-114.

Akita, S. and G.S. Cabuslay, 1990. Physiological basis of differential response to salinity in rice cultivars. Plant Soil, 123: 227-294.

Alam, M.Z., M.A.A. Bhuiya, M.A. Muttaleb and M.M. Rashid, 2004. Effect of alternating saline and non-saline conditions on emergence and seedling growth of rice. Pak. J. Biol. Sci., 7: 883-890.

Allolli, T.B. and P. Narayanareddy, 2000. Allelopathic effect of *Eucalyptus* plant extract on germination and seedling growth of cucumber. Karnataka J. Agric. Sci., 13: 947-951.

Anonymous, 1983. Seed vigor testing handbook. Contribution No. 32 to the Handbook on Seed Testing, Association of Official Seed Analysis, Springfield, IL.

Ayaz, F.A., A. Kadioglu and R. Turgut, 2000. Water stress effects on the content of low molecular weight carbohydrates and phenolic acids in *Ctenanthe setosa* (Rose.) Eichler. Can. J. Plant Sci., 80: 373-378.

Basra, S.M.A., M. Farooq and R. Tabassum, 2005. Physiological and biochemical aspects of seed vigor enhancement treatments in fine rice (*Oryza sativa* L.). Seed Sci. Technol., 33: 623-628.

Bayuelo-Jimenez, J.S., R. Graig and J.P. Lynch, 2002. Salinity tolerance of Phaseolus species during germination and early seedling growth. Crop Sci., 42: 1584-1594.

Bewley, J.D. and M. Black, 1994. Seeds-Physiology of Development and Germination. Plenum, New York.

Burhan, N. and S.S. Shaukat, 2000. Effect of phenolic compounds on germination and seedling growth of some crop plants. Pak. J. Biol. Sci., 3: 269-274.

Dhole, J.A., S.S. Bodke and N.A. Dhole, 2011. Allelopathic effect of aqueous leaf extract of *Parthenium hysterophorus* L. on seed germination and seedling emergence of some cultivated crops. J. Res. Biol., 10: 15-18.

Djurdjevic, L., A. Dinic, P. Pavlov, M. Mitrovic, B. Karadzic and V. Tesevic, 2004. Allelopathic potential of *Allium ursinum*. Bio. Syst. Ecol., 32: 533-544.

El-Darier, S.M. and R.S. Youssef, 2000. Effect of soil type, salinity and allelochemicals on germination and seedling growth of a medicinal plant *Lepidium sativum* L. Ann. Appl. Biol., 136: 273-279.

El-Darier, S.M., 2002. Allelopathic effects of *Eucalyptus rostrata* on growth, nutrient uptake and metabolite accumulation of *Vicia faba* L. and *Zea mays* L. Pak. J. Biol. Sci., 5: 6-11.

El-Refai, I.M. and S.M.I. Moustafa, 2004. Allelopathic effect of some cruciferous seeds on *Rhizoctonia solani* Kuhn and *Gossypium barbadense* L. Pak. J. Biol. Sci., 7: 550-558.

Ellis, R.H. and E.H. Roberts, 1981. The quantification of ageing and survival in orthodox seeds. Seed Sci. Technol., 9: 373-409.

Finch-Savage, W.E. and G. Leubner-Metzger, 2006. Seed dormancy and the control of germination. New Phytol., 171: 501-523.

Ghafar, A., B. Saleem and M.J. Qureshi, 2000. Allelopathic effects of sunflower (*Helianthus annuus* L.) on germination and seedling growth of wheat (*Triticum aestivum* L.). Pak. J. Biol. Sci., 3: 1301-1302.

Ghoulam, C. and K. Fares, 2001. Effect of salinity on seed germination and seedling growth of sugar beet (*Beta vulgaris* L.). Seed Sci. Technol., 29: 357-364.

Guest, E. and A. Al-Rawi, 1966. Flora of Iraq. Vol. 1, Ministry of Agriculture of the Republic of Iraq.

Gusta, L.V., E.N. Johnson, N.T. Nesbitt and K.J. Kirkland, 2004. Effects of seeding date on canola seed quality and seed vigor. Can. J. Plant Sci., 84: 463-471.

Heidari, M., 2009. Variation in seed germination, seedling growth, nucleic acid and biochemical component in canola (*Brassica nupus* L.) under salinity stress. Asian J. Plant Sci., 8: 557-561.

Khan, M.A., H. Iqtidar and A.K. Ejaz, 2007. Effect of aqueous extract of *Eucalyptus camaldulensis* L. on germination and growth of maize (*Zea mays* L.). Pak. J. Weed Sci. Res., 13: 177-182.

Lee, S.S. and J.H. Kim, 2000. Total sugars, α-amylase activity and emergence after priming of normal and aged rice seeds. Kor. J. Crop Sci., 45: 108-111.

Lyu, S.W., U. Blum, T.M. Gerig and T.E. Brien, 1990. Effects of mixture of phenolic acids on phosphorus uptake by cucumber seedlings. J. Chem. Ecol., 16: 2559-2567.

Macias, F.A., J.C.G. Galindo, J.M. Massanet, F. Rodriguez-Luis and E. Zubia, 1993. Allelochemicals from *Pilocarpus goudotianus* leaves. J. Chem. Ecol., 19: 1371-1379.

Millar, A., J.V. Jacobsen, J. Ross, C.A. Helliwell and A. Poole *et al*., 2006. Seed dormancy and ABA metabolism in *Arabidopsis* and barley: the role of ABA 80-hydroxylase. Plant J., 45: 942-954.

Oudhia, P., 1999. Allelopathic affects of some obnoxious weeds on germination and seedling vigor of *Lathyrus sativus*. Fabis Newslett., 42: 32-74.

Pujol, A. J., J.F. Calvo and L. Ramirez-Diaz, 2000. Recovery of germination from different osmotic conditions by four halophytes from South Eastern Spain. Ann. Bot., 85: 279-286.

Rafique, H., R. Ahmed, M.B. Uddin and M.K. Hossain, 2003. Allelopathic effect of different concentration of water extract of *Acacia auriculiformis* leaf on some initial growth parameters of five common agricultural crops. Pak. J. Agron., 2: 92-100.

Razzaque, M.A., N.M. Talukder, M.S. Islam, A.K. Bhadra and R.K. Dutta, 2009. The effect of salinity on morphological characteristics of seven rice (*Oryza sativa*) genotypes differing in salt tolerance. Pak. J. Biol. Sci., 12: 406-412.

Rice, E.L., 1984. Manipulated Ecosystems: Roles of Allelopathy in Agriculture. In: Allelopathy, Rice, E.L. (Ed.). Academic Press, Orlando, pp: 8-73.

Shaukat, S.S., M. Nadia and A. Siddiqui, 2003. Allelopathic response of *Conyza canadensis* (L.) cronquist: A cosmopolitan weed. Asian J. Plant Sci., 2: 1034-1039.

Siddiqui, S., S. Bhardwaj, S.S. Khan and M.K. Meghvansi, 2009. Allelopathic effect of different concentration of water extract of *Prosopsis juliflora* leaf on seed germination and radicle length of wheat (*Triticum aestivum* var-lok-1). Am. Eurasian J. Sci. Res., 4: 81-84.

Soltani, A., S. Galeshi, E. Zenali and N. Latifi, 2001. Germination seed reserve utilization and growth of chickpea as affected by salinity and seed size. Seed Sci. Technol., 30: 51-60.

Song, J., G. Feng and F.S. Zhang, 2006. Salinity and temperature effects on germination for three salt-resistant euhalophytes, *Halostachys caspica*, *Kalidium foliatum* and *Halocnemum strobilaceum*. Plant Soil., 279: 201-207.

Steel, R.G.D. and J.H. Torrie, 1984. Principles and Procedures of Statistics. 2nd Edn., McGraw Hill Book Co. Inc., New York, pp: 172-177.

Tobe, K., X. Li and K. Omasa, 2000. Seed germination and radicle growth of halophyte *Kalidium capsicum* (Chenopediaceae). Ann. Bot., 85: 391-396.

Turk, M.A. and A.M. Tawaha, 2002. Inhibitory effects of aqueous extracts of black mustard on germination and growth of lentil. J. Agron., 1: 28-30.

Turk, M.A. and A.M. Tawaha, 2003. Allelopathic effect of black mustard (*Brassica nigra* L.) on germination and growth of wild oat (*Avena fatua* L.). Crop Prot., 22: 673-677.

Yuesf, S.S., 2007. Interaction of salinity and temperature on germination of doum (*Hyphyaene thebaica*) seed in Saudi Arabia. Asian J. Plant Sci., 6: 962-966.

Zia, S. and M.A. Khan, 2004. Effect of light, salinity and temperature on seed germination of *Limonium stocksii*. Can. J. Bot., 82: 151-157.