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Research Article

Effect of *Setaria verticillata* Aqueous Extracts on Germination and Growth of Different Varieties of Wheat

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Abstract

Background and Objective: *Setaria verticillata* is a species of grass known by the common names bur bristlegrass. This study is aimed to use *Setaria verticillata* extract on the germination and growth of two beneficial Yemeni wheat varieties. **Materials and Methods:** The effect of aqueous extracts of the vegetation of *Setaria verticillata* on the germination and growth of Hadhramout 3 and Cleanson with four different concentrations of 0.0, 5.0, 10.0 and 15.0% were studied. Ten seeds of these crops were germinated in the Petri dishes and 10 mL of the extract was added with three replicates in each treatment. The measurements were taken for seed germination percentage, germination speed, hypocotyls and radicle elongation. **Results:** The results showed that Cleanson was significantly higher than Hadhramout 3 in seed germination percentage. On the other hand, Hadhramout 3 showed the best germination speed. There is a proportional ratio between the concentration and the germination speed. Cleanson gave the best hypocotyls and radicle elongation compared to Hadramaut 3. **Conclusion:** It was concluded that high concentration of *Setaria verticillata* inhibited seed germination percentage hypocotyls and radicle elongation and improved seed germination speed for both Hadhramout 3 and Cleanson.

Key words: *Setaria verticillata*, hadhramout 3, cleanson, hypocotyls, radicle elongation

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Setaria verticillata belongs to the family of Poaceae (Gramineae)¹. This family contains a large number of phenolic compounds, alkaloids, glycosides and saponins as well as fatty acids²⁻⁴. Wheat is an important crop and is considered one of the oldest cereal crops worldwide. Moreover, other studies showed the allelopathy effect of five winter weeds namely, *Raphanus raphanistrum*, *Eruca sativa*, *Silybum marianum*, *Malva rotundifolia* and *Sonchus oleraceus* on the growth and seed germination of *Trinervia flaveria*, the result indicated that hypocotyls length was significantly reduced. On the other hand, it showed the highest inhibitory effect from four plants extracts (*Raphanus raphanistrum*, *Eruca sativa*, *Malva rotundifolia* and *Sonchus oleraceus*) against wheat length and dry weight⁵⁻⁷.

The allelopathy effect of *Convolvulus arvensis* showed that 60% concentration of weed extract affected the growth and characteristics of wheat crop⁸. Another allelopathy study of some selected weeds such as *Phalaris minor* L., *Chenopodium murale* L., *Sonchus oleraceus* L., *Cyanodon dactylon* L. and *Convolvulus arvensis* L. on seed germination and growth of *Trinervia flaveria* found that all aquatic extracts of weeds under study caused inhibitory effects on seed germination, seedling length and dry weight, which gradually increased by increasing the concentration of extracts of weeds⁶. Gaddawi and Sa'eed⁹ reported that the vegetative extracts of *Euophorbia* sp. showed inhibitory effect on the germination and seedling growth of *Hordeum vulgare* L. and *Triticum aestivum*. The leaves aquatic extracts of Eucalyptus, Myrtus and Nerium had inhibited wheat percentage and germination of *Trinervia flaveria*¹⁰. Daoud¹¹ emphasized that the cold and boiled extract of *Phalaris minor* Retz inhibited germination percentage germination speed, hypocotyls and radicle elongation of *Trinervia flaveria* wheat plant. In the study of the response of wheat varieties, it was found that the addition of *Olea sativa* L., had a disincentive effect in the most treatments¹².

It showed that Halian root extract affected the hypocotyls and radicle elongation of *Zea mays* L. and *Triticum aestivum* L. (wheat) growth seedling¹³. Baharmaz⁵ determined four concentrations (0, 10, 20 and 30%) vegetative and root extract of *Trinervia flaveria* on the germination and growth of Hadhramout 3 wheat (*Triticum aestivum* L.). The result of this study showed that the root extract of the *Trinervia flaveria* had a significant effect on the germination rate, germination speed and radicle elongation. Moreover the concentrations significantly affected the germination rate, hypocotyls and radicle elongation. The inhibition was increased by the

increasing concentration of the extract. On the other hand, increasing the concentration played a positive role with germination speed. The rationale reason for selecting Hadhramout 3 and Cleanson wheat varieties in the current study was that these two varieties are capable of adapting to the local conditions, especially the temperature compared with the other common wheat varieties. In addition both give high productivity yield. The objective of this study was to investigate the *Setaria verticillata* aquatic extract on the germination and growth of Hadhramout 3 and Cleanson wheat varieties.

MATERIALS AND METHODS

Vegetative aquatic extract of *Setaria verticillata*: The experiment was carried out from March-December, 2018 in the laboratory No. 1, Biology Department, Faculty of Science, Hadhramout University, Yemen. *Setaria verticillata* was cleaned from soil. The good morphological qualities and those free from any infection were selected. About 250 g were weighed, cut into small pieces and mixed well with 500 mL distilled water. The mixture was blended for 5 min (moulinex blender, French), then the mixture was filtered using cellulose filter paper no. 1 (Double Rings, China). The sediment was discarded and the supernatant was centrifuged (Hermle_{z333M-2} Germany) at 3000 rpm for 10 min. After centrifugation the mixture was filtered again with cellulose Whatman filter paper no. 1, the sediment was discarded and the supernatant was used as stock (100%). From stock four concentration 0, 5, 10 and 15% v/v were prepared.

Seeds collection: Seeds of Hadhramout 3 and Cleanson wheat were brought and classified from Seyon Agricultural Research Center, Hadhramout, Yemen.

Preparation of wheat seeds : The seeds of Hadhramout 3 and Cleanson wheat were soaked with a commercial cleaning solution containing 10% v/v sodium hypochlorite for 5 min with continuous stirring to eliminate any contamination in the seeds. The seeds were washed with tap water for several times to remove the residue of the cleaning solution. Seeds of Hadhramout 3 and Cleanson wheat were germinated individually in a 90 mm glass Petri dish. For each treatment, three replicates of 10 seeds each were used. Ten milliliter of each concentration was poured into each dish. The plates were incubated at 24°C (Memmert, Germany) protected from light for 15 days. After incubation period, germination percentage, germination speed, hypocotyls and radicle elongation varieties were calculated.

Seed germination percentage: Seed germination percentage was calculated using the following formula¹⁴:

$$\text{Seed germination (\%)} = \frac{\text{Number of germinated seeds}}{\text{Total number of seeds}} \times 100 \quad (1)$$

Seed germination speed (day) : Speed of germination was calculated using the following formula¹⁵:

$$\text{Speed germination speed} = \frac{n1}{d1} + \frac{n2}{d2} + \frac{n3}{d3} + \quad (2)$$

where, n is number of germinated seeds and d is number of days.

The decrease in the germination value of speed indicated that the seeds had the highest germination rate.

Hypocotyls and radicle elongation: The hypocotyls and radicle elongation average were calculated by dividing the total lengths of each dish to the number of plants. The length of three seedlings was selected randomly from each petri dish and the average was calculated.

Statistical analysis: Results were reported as Mean $\pm$ standard deviation (SD). Completely Randomized Design (CRD) was used for analyzing data. Two way analysis of variance (ANOVA) was used for statistical analysis. The results were analyzed with the least significant difference of LSD ($p > 0.05$) to assess significant differences between means of samples.

RESULTS AND DISCUSSION

Seed germination (%): Data in Table 1 showed that the *Setaria verticillata* extract had a significant effect on the germination percentage of Hadhramout 3 and Cleanson wheat. The highest average germination (%) was 62.50% with Cleanson, while Hadhramout 3 showed 48.33% germination (%). In addition, the concentration levels significantly affected the germination (%) of both Hadhramout 3 and Cleanson. The average germination (%) was 90.0, 56.7, 45.0 and 30.0% for 0, 5, 10 and 15% concentrations, respectively. It is clear from Table 1 that the lowest seed germination which was 26.67 and 33.33% at 15% concentration for both Cleanson and Hadhramout 3, respectively. These findings were similar to previous studies by Makred *et al.*⁷. Ali *et al.*¹⁶ indicated the significant effect of radicle exudates of the three crop plants that affect the elongation and dry weight of bread wheat variety. It was clear

from the result that the greater inhibitory effect correlated with higher concentration as the germination (%) decreased. This result was in agreement with other researches¹⁷⁻¹⁹.

Seed germination speed (day) : Results in Table 2 showed that the germination speed of both Cleanson and Hadhramout 3 did not significantly affect the *Setaria verticillata*. It was observed that germination speed decreased with concentration. In the other studies the effect of extracts was depended on their kind, the time of action and the species of studied plants¹⁹.

Hypocotyls length: Data in Fig. 1 showed that *Setaria verticillata* extract did not significantly affect the hypocotyls length of Hadhramout 3 and Cleanson wheat varieties. The best hypocotyls length was 7.10 cm with Cleanson. There was significant difference ($p > 0.05$) in hypocotyls length between 5 and 15% concentrations. At 5% concentration, the hypocotyls length was the highest (8.30 cm), while at 15% concentration, the hypocotyls length was the lowest which was because of the toxic effect of the extract. Similar finding was observed from other researchers by Ali¹⁶, Joshi and Joshi²⁰ and Mahdir *et al.*²¹. The inhibition elongation of the hypocotyls was due to increasing the extract which contained chemicals that inhibit the development and growth. This result was in agreement with other researchers who concluded that the lower concentration of some extracts had a catalytic effect^{22,23}.

Table 1: Effects of *Setaria verticillata* extract concentrations on the seed germination percentage of two wheat varieties

Concentration	Varieties		
	Cleanson (%)	Hadhramout 3 (%)	Average (%)
0.0%	100.00	80.00	90.00
5.0%	73.33	40.00	56.70
10.0%	50.00	40.00	45.00
15.0%	26.67	33.33	30.00
Average	62.50	48.33	
LSD ($p > 0.05$)	Con = 19.00	Var = 13.00	Var x Con = 27.95

LSD: Least significant difference, Var: Variety, Con: Concentration, Var x Con is interaction

Table 2: Effect of *Setaria verticillata* extract concentrations on the germination speed of two wheat varieties

Concentration	Varieties		
	Cleanson	Hadhramout 3	Average
0.0%	2.57	1.80	2.20
5.0%	1.20	0.63	0.90
10.0%	0.83	0.90	0.90
15.0%	0.50	1.03	0.80
Average	1.28	1.09	
LSD ($p > 0.05$)	Con = 0.62	Var = NS	Var x Con = 0.87

LSD: Least significant difference, Var: Variety, Con: Concentration, Var x Con is interaction, NS: Non significant

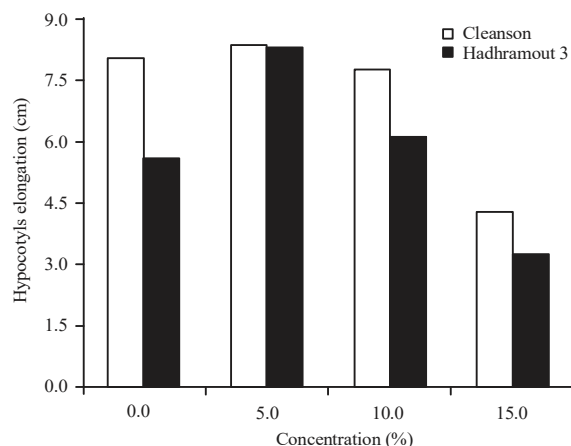


Fig. 1: Effect of *Setaria verticillata* extract concentrations on the hypocotyls length of two wheat varieties

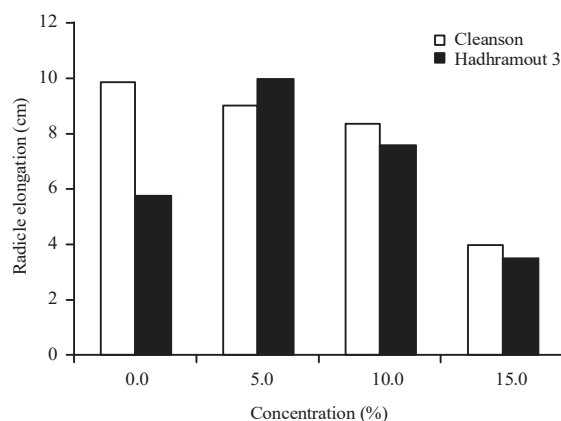


Fig. 2: Effect of *Setaria verticillata* extract concentrations on the radicle elongation of two wheat varieties

Radicle elongation: Cleanson showed the least inhibitory effect, which gave a radicle elongation of 7.75 cm. On the other hand there was significant difference ($p > 0.05$) between the concentrations^{17,19}. It was clear from Fig. 2 that the highest radicle elongation was 9.50 cm at 5% concentration, while the lowest radicle elongation was 3.80 cm at 15% concentration with Hadhramout 3 (Fig. 2). This finding was compatible with other studies by Daoud¹¹, Chandra *et al.*¹⁸, Mahdir *et al.*²¹ and Tessema and Tura²³.

CONCLUSION

Setaria verticillata (L.) extract had an inhibitory effect on the germination percentage, germination speed, hypocotyls and radicle elongation of Hadhramout 3 and Cleanson wheat varieties. Cleanson was the most sensitive to the effect of high

concentration of the extract in the germination percentage and also it had best response to germination speed. Hadhramout 3 was more sensitive to both hypocotyls and radicle elongation.

SIGNIFICANCE STATEMENT

This study discovered the inhibitory effect of *Setaria verticillata* (L.) extract on two Yemeni wheat varieties namely Hadhramout 3 and Cleanson in the terms of germination percentage, germination speed, hypocotyls and radicle elongation. This study helped the researchers investigate the two new wheat varieties in Yemen and its activities which were not studied before.

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