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Original article

Quantitative seed germination of Brassicaceae family weeds to salinity and drought stresses

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Extended abstract

Introduction

Knowledge on germination ecology of weeds in response to salinity and drought stresses can help to predict weeds population dynamics in the future. Among the family of weeds, the weeds of Brassicaceae family include many important species that contaminate crops and orchards. In addition to the presence of weeds, salinity and drought are also considered as limiting factors in agricultural production. Due to the increase in salinity and drought stresses in agricultural fields, it can be significant expansion and contamination of Brassicaceae weeds, because Physiological dormancy, abundant seed production and emergence at different time, leads to be persistent for long-term in soil. Therefore, the aim of this research was to compare the characteristics of seed germination of four weeds Brassicaceae family to salinity and drought stresses.

Materials and methods

In order to investigate the effects of salinity (0, 50, 100, 150, 200, 250, 300, 350 and 400 Mm) and drought stress (0, -0.2, -0.4, -0.6, -0.8, -1 and -1.2 MPa) on seed germination four Brassicaceae family weeds Rocket (Eruca sativa), Hoary Mustard (Hirschfeldia incana), Wild Mustard (Sinapis arvensis) and Treacle Mustard (Erysimum repandum), two experiments as factorial based on completely randomized design (CRD) were conducted at agricultural sciences and natural resources university of Khuzestan in 2019 with three replications. Optimum Temperature for germination were selected 25°C for Rocket, Hoary Mustard, Wild Mustard and 15°C for Treacle Mustard. Duration of test for two experiments was considered 15 days. Criterion for germination was length radicle 2-3 mm.

Results

By increasing drought stress, germination, vigour index and germination rate were decreased and no germination was observed in drought stress of -1.2 MPa. 50% reduction for germination in four weeds Rocket, Hoary Mustard, Wild Mustard and Treacle Mustard were estimated in -1, -0.49, -0.76 and –0.41 MPa of drought stress respectively. Drought stress required to reduce 50% of germination rate for

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Rocket, Hoary Mustard, Wild Mustard and Treacle Mustard were estimated -0.85, -0.35, -0.28 and 0.22 MPa respectively.

The vigour index of Wild Mustard in conditions without drought stress treatment was more than other weeds. Rocket and Hoary Mustard were introduced as resistant and Wild Mustard was introduced as sensitive to salinity. The salinity required to reduce 50% of germination for Rocket, Hoary Mustard, Wild Mustard and Treacle Mustard were predicted 267, 162, 39 and 46 mM, while 50% reduction for germination rate were 174, 142, 27, 44 Mm respectively. By increasing salinity and drought stresses, mean germination time was increased and maximum mean germination time belonged to Treacle Mustard and the reason for this increase was the lag phase of germination. Germination rate in four weeds was more affected by salinity and drought stresses than germination percentage. Generally the germination rate of Treacle Mustard was much less than other weeds. So that the maximum germination rate of Treacle Mustard was 5 seed/day in control treatment while in Rocket Hoary Mustard, Wild Mustard were more than 30 seed /day.

Conclusions

According to the results, in saline lands, the spread of two weeds Rocket and Hoary Mustard is more expected and in the conditions of drought stress and in rainfed agriculture, presence of Rocket is more evident than Wild Mustard.

***Keywords*:** Germination rate, Hoary Mustard, Rocket, Treacle Mustard, Vigour index, Wild Mustard

Table 1. Estimation of logistic equation parameters on germination percentage of weeds

English name	Scientific name	a	b	X_{50}	R^{sqr}(adj)
Rocket	*Eruca sativa*	99.28 (±0.78)	24.20 (±7.20)	1.00 (±0.002)	0.99
Hoary Mustard	*Hirschfeldia incana*	99.98 (±8.12)	2.82(±0.71)	0.49 (±0.05)	0.94
Wild Mustard	*Sinapis arvensis*	90.58 (±4.88)	7.99 (±2.55)	0.76 (±0.03)	0.95
Treacle Mustard	*Erysimum repandum*	77.04 (±4.18)	2.84 (±0.55)	0.41 (±0.039)	0.97

Numbers in parentheses indicate the standard error.

Table 2. Estimation of logistic equation parameters on vigour index of weeds

English name	Scientific name	a	b	X_{50}	R^{sqr}(adj)
Rocket	*Eruca sativa*	337.94 (±11.25)	15.88 (±4.17)	0.85 (±0.02)	0.97
Hoary Mustard	*Hirschfeldia incana*	442.64 (±33.89)	2.72 (±0.60)	0.35 (±0.04)	0.96
Wild Mustard	*Sinapis arvensis*	1308.78 (±113.63)	2.19 (±0.51)	0.28 (±0.04)	0.94
Treacle Mustard	*Erysimum repandum*	458.21 (±22.84)	2.34 (±0.37)	0.22 (±0.019)	0.98

Numbers in parentheses indicate the standard error.

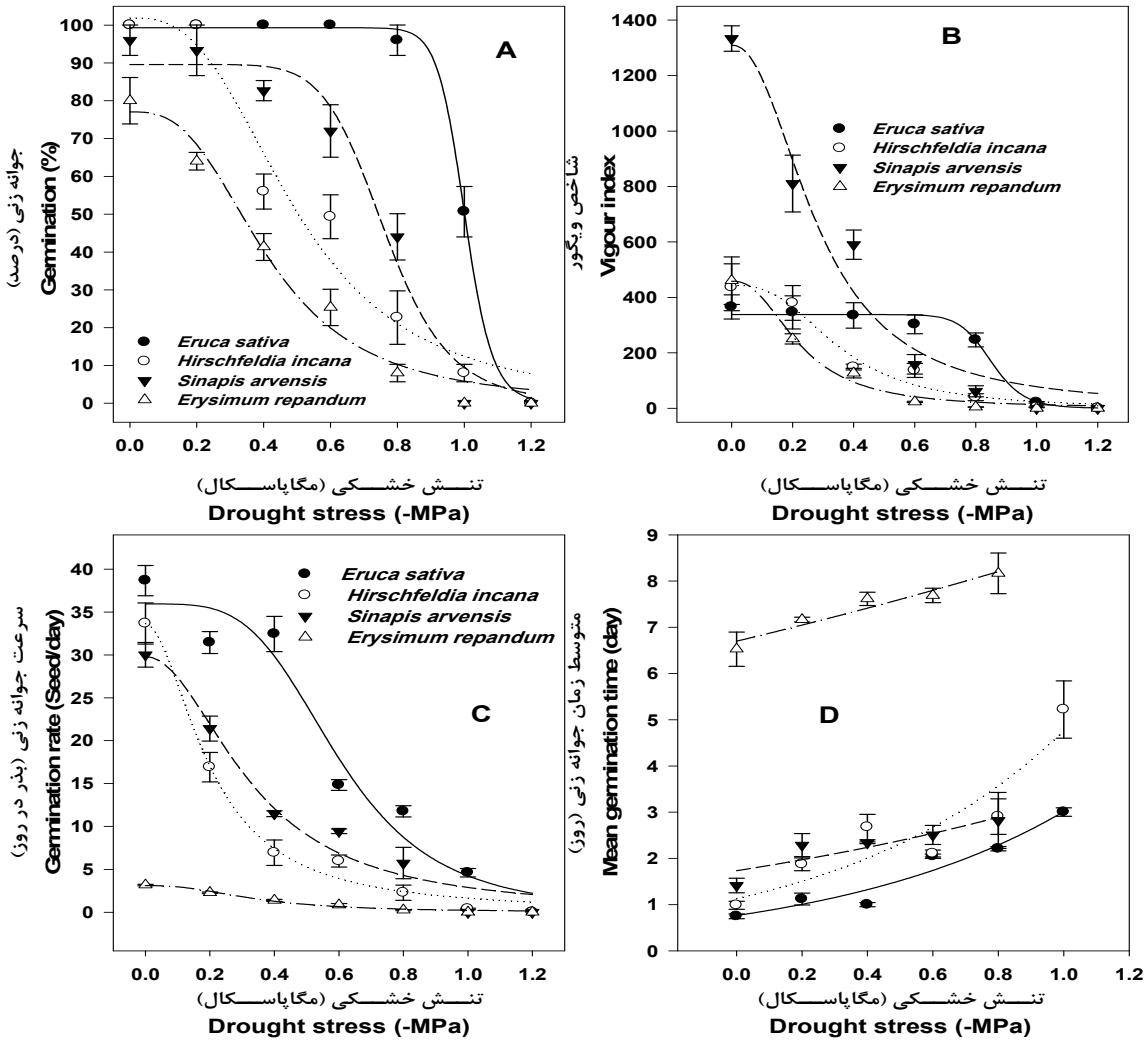

Fig. 1. Effect of different levels of drought stress on germination percentage (A), vigour index (B), germination rate (C), and mean germination time (D) of Brassicaceae family weeds

Table 3.Estimation of logistic equation parameters on germination rate of weeds

English name	Scientific name	a	b	X_{50}	R^{sqr}(adj)
Rocket	*Eruca sativa*	35.94 (±2.71)	3.92 (±1.12)	0.59 (±0.05)	0.94
Hoary Mustard	*Hirschfeldia incana*	33.64 (±1.35)	1.86 (±0.24)	0.20 (±0.01)	0.98
Wild Mustard	*Sinapis arvensis*	29.77 (±2.30)	2.02 (±0.40)	0.33 (±0.04)	0.95
Treacle Mustard	*Erysimum repandum*	3.10 (±0.19)	2.37 (±0.03)	0.34 (±0.03)	0.97

Numbers in parentheses indicate the standard error

Table 4. Estimation of Linear Equation Parameters on mean germination time of weeds

English name	Scientific name	a	b	R^{sqr}(adj)
Rocket	*Eruca sativa*	0.76 (±0.11)	1.37 (±0.19)	0.92
Hoary Mustard	*Hirschfeldia incana*	1.12 (±0.31)	1.44 (±0.33)	0.80
Wild Mustard	*Sinapis arvensis*	1.73 (±0.18)	0.63 (±0.19)	0.73
Treacle Mustard	*Erysimum repandum*	6.69 (±0.13)	0.25 (±0.03)	0.91

Numbers in parentheses indicate the standard error

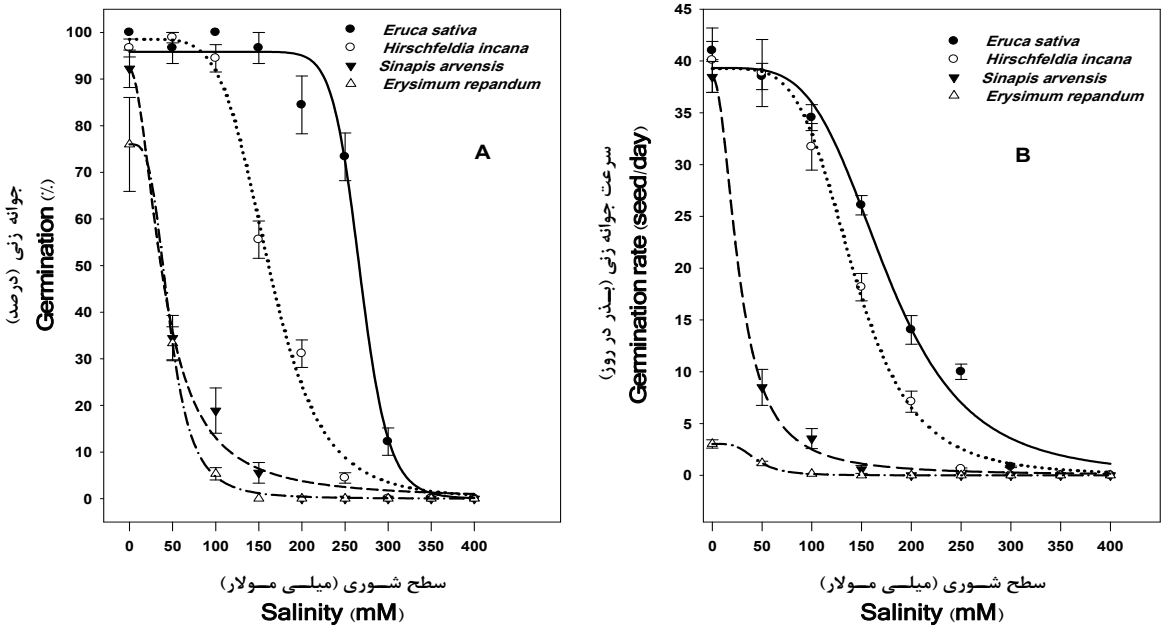

Fig. 2. Effect of different levels of salinity on germination percentage (A) and germination rate (B) of *Brassicaceae* family weeds

Table 5. Estimation of logistic equation parameters on germination percentage of weeds in salinity experiment

English name	Scientific name	a	b	X_{50}	R^{sqr}(adj)
Rocket	*Eruca sativa*	95.86 (±2.28)	16.36 (±2.88)	267.76 (±4.15)	0.98
Hoary Mustard	*Hirschfeldia incana*	98.52 (±2.82)	5.36 (±0.69)	162.28 (±4.84)	0.99
Wild Mustard	*Sinapis arvensis*	92.08 (±3.24)	1.95 (±0.29)	39.86 (±4.00)	0.98
Treacle Mustard	*Erysimum repandum*	75.99 (±0.57)	3.55 (±0.17)	46.69 (±0.49)	0.99

Numbers in parentheses indicate the standard error

Table 6. Estimation of logistic equation parameters on germination rate of weeds in salinity experiment

Weed name	Scientific name	a	b	X_{50}	R^{sqr}(adj)
Rocket	*Eruca sativa*	39.31 (±1.43)	4.26 (±0.59)	174.74 (±7.44)	0.98
Hoary Mustard	*Hirschfeldia incana*	39.25 (±0.88)	4.70 (±0.43)	142.09 (3.65)	0.99
Wild Mustard	*Sinapis arvensis*	38.45 (±0.59)	2.06 (±0.26)	27.52 (±2.78)	0.99
Treacle Mustard	*Erysimum repandum*	3.03 (0.013)	3.81 (±0.14)	44.44 (±0.33)	0.99

Numbers in parentheses indicate the standard error