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Investigation Effect of Flooding and Burial Depth on Germination and Percentage of *Lepyrodiclis holosteoides* Fenzl

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ABSTRACT: *Lepyrodiclis* is one of the most problematic weeds in wheat and canola in several regions of Iran. Laboratory studies were conducted at laboratory of department of Weed Research, Iranian Research Institute for Plant Protection in 2013. The study was established on two separate experiments based on complete randomized design (CRD) with 4 replications. Flooding stress included (0, 1, 2, 4, 8, 16 and 32days) and burial depth included (0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 5.5, 6, 6.5 cm).The results showed that flooding stress had a significant influence on germination percentage and germination rate of Lepyrodiclis. According to the other experiments, burial depth had a significant influence on emergence percentage of Lepyrodiclis. The results on mean comparison showed that the emergence percentage and germination percentage of lepyridiclis decreased when burial depth and flooding time increased, respectively.

Key words: Lepyrodiclis, germination and emergence percentage, burial depth, flooding stress

INTRODUCTION

Farmers need satisfactory ways to relate levels of weed infestation to reductions in crop yields to decide whether weed control is economical (Aldrich, 1987). Knowledge of weed biology has aroused interest in the context of weed management strategies in the recent years (Bhowmik 1997).

Ecological factors have been shown to play a major role by inducing or inhibiting germination including light (Ballare´ *et al.* 1992), temperature (Lablance *et al,* 2003), soil water content (Gummerson, 1986), flooding (Pana *et al,* 2008) and soil depth (Holm 1972; Stoller and Wax 1973).

The biological reason for depth inhibition has not yet been fully clarified (Benvenuti, *et al*, 2001). Previous studies suggest that this may not only be merely due to lack of light (Benvenuti 1995), but also to decreasing thermal fluctuation and increasing burial depth, as thermal fluctuation constitutes a known germination trigger (Roberts and Totterdell1981). Higher plants have an absolute requirement for oxygen for growth and, as gases diffuse 10 000 times slower in water than in air (Mohanty *et al*, 2000), flooding results in decreased oxygen availability, ranging from deficiency (hypoxia) to absence (anoxia) in highly reduced soils (Pena *et al,* 2008). Ledyrodiclis is a native to central Asia, Asian minor, Russia, Iraq, Iran and Armenia (Anonymous, 2013). In 1977 a USDA publication, "Economically Important Foreign Weeds, Potential Problems in the United States," reported that Iepyrodiclis is a serious weed in Russia (Anonymous, 2013). Wheat fields are infested with Lepyrodiclis (Zhang, 2003). Benvenuti *et al,* (2001) during a research on 20 weed species, it was reported that the number of seedlings and rate of seedling emergence decreased when burial depth increased. Barid and Dicknes reported that flooding led to an increase in Diodiavirginiana's germination. Also Reddy and Singh (1992), reported the same result on Bidenspilosa's seeds. Very little academic attention has been paid to biological properties of this weed. The major objective of this study was therefore, to investigate the biological interactions of *Lepyrodiclisholosteoides* Fenzl to select better weed control strategies by using these results.

MATERIALS AND METHODS

A. Seed collection and storage

Previous to the germination tests, lepyridiclis seeds were collected during summer in 2012 from weedy wheat fields at Shahriar region, Iran. These seeds were stored in dark and dry conditions at room temperature.

B. Germination experiments

Before using the seeds in germination tests, they were subjected to surface disinfections with sodium hypochlorite (10%) by treatment in 5 minutes. Seed germination study was conducted based on complete randomized design (CRD) with 4 replications for each study (flooding stress and burial depth) at the laboratory and greenhouse of department of Weed Research, Iranian Research Institute for Plant Protection, Tehran, Iran in 2013.

In laboratory part of the experiment, 25 seeds were placed on a filter paper in a 9-cm petri dish in a programmed germinator at 8/16, (dark : light) and 20 C temperature regimes with 7 levels of flooding stress by distilled water (0, 1, 2, 4, 8, 16 and 32 days). In greenhouse part of this study, 13 levels of burial depth(0, 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 5.5, 6 and 6.5cm) were used. In this part, weed seeds were sown in pods(10 seed per plastic pod of 12 cm diameters) then were placed in a greenhouse in natural light thermo period of 25/15, respectively. The soil, used in this study had a loam-clay texture.

Final germinated seeds (visual appearance of the radicle of at least 1 mm) (Dorado *et al*, 2009) was recorded as germination percentage after 15 days. Germination percentage was determined based on this equation:

$GP = \Sigma n / N \times 100$

Where, n is the number of germinated seeds at each counting and N is the total seeds in each treatment. The same equation was used to determine the emergence percentage.

Germination rate (GR), defined as the relationship between the number of germinated seeds and the germination time (González-Zertuche and Orozco-Segovia, 1996), and calculated by this equation (Valerio *et al*, 2007):

$$GR = \Sigma (ni) / t$$

Where ni is the number of seeds germinated per day, and t is the germination time from seeding to the germination of the last seed (GR was measured each day for three days).

C. Statistical analysis

Data analysis was done by ANOVA in order to determine the statistical significance of the data and was followed by the Duncan test when appropriate using SAS (9.1) software and non-linear regression procedures outlined by Sigma plot software (12.5). Before statistical analysis, all data were passed normality test and were transformed were needed.

RESULTS AND DISCUSSION

A. Flooding stress

The results in ANOVA table (Table 1) show that flooding had a significant influence on germination percentage and germination rate of Lepyrodiclis. Comparing the means of these traits also reveals that there were significant differences betweenthe means in different flooding-times (Fig. 1 and 2). According to these results, seeds of lepyrodiclis showed tolerance to flooding stress for 4 days, but much flooding-time led to a meaningful decrease in germination percentage and germination rate. Flooding during germination reduced survival (Ismail, *et al.* 2008) because under anoxia, carbohydrate catabolism shifts from aerobic to anaerobic pathways for generating ATP for growth and maintenance processes. However, ATP production is 18-fold less efficient in this process than in aerobic respiration (Greenway and Setter, 1996). The results of regression analysis showed that increasing the flooding-time led to a decrease in germination percentage and germination rate with a non-linear pattern (Fig. 3 and 4).

Table 1: Analysis of variance of the effect of flooding on germination percentage and germination rate of Lepyrodiclis.

Treatment	df	Mean Square	
		Germination percentage	Germination rate
Flooding	6	3022.95**	90.48**
Error	21	93.90	1.95

**Significant at 1% probability

Table 2: Analysis of variance of the effect of burial depth on emergence percentage, fresh and dry weight of Lepyrodiclis.

Treatment	df	Mean Square		
		Emergence percentage	Dry weight	Fresh weight
Burial depth	12	1620.19**	0.21**	1359
Error	39	241.97	0.04	5.48

**Significant at 1% probability

B. Burial depth

According to the analysis of variance results (Table 2) burial depth had a significant influence on the emergence percentage of Lepyrodiclis. Mean comparisons showed that there were significant differences between emergence percentages in different burial depths (Fig. 5). Based on these results, there was a meaningful difference between emergence percentage in 1 and 1.5 cm burial depth and 5 and 5.5 cm burial depth. These results showed that emergence percentage decreased when burial depth increased. According to the results of regression model (Fig. 6), there was an increase in emergence percentage when burial depth increased from 0.5cm to 1 and 1.5 cm and then decreased with more burial depth.

Benvenuti and Macchia (2001) during a study on effects of seed burial depth on seedling emergence rate of 20 weed species reported that depth-mediated inhibition sigmoidal (polynomial regression) in all species.

In addition, the number of seedlings and rate of seedling emergence decreased when depth of burial increased. Soil compaction can directly affect seeds by limiting germination (Pereja and Staniforth1985) or even by inducing dormancy (Terpstra 1995).

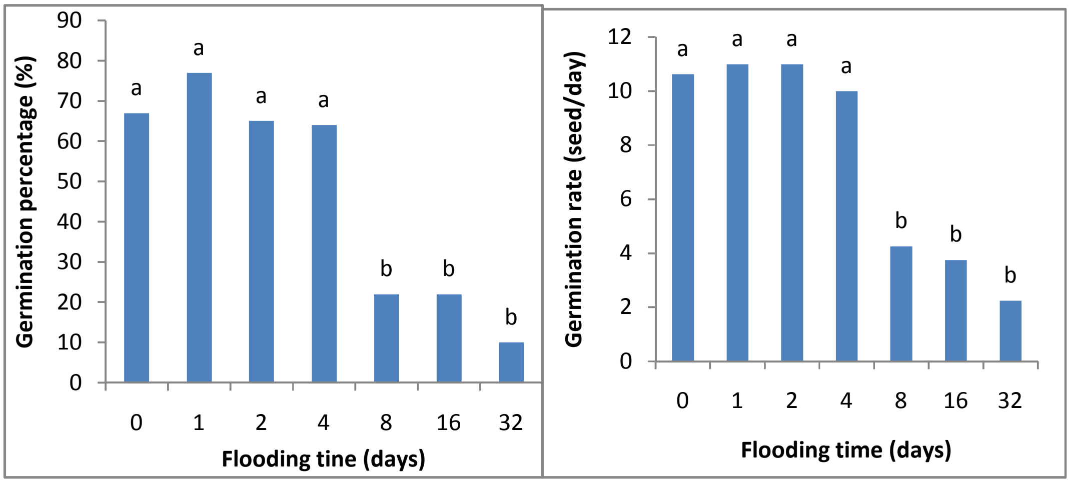

Fig. 1and 2. The effect of flooding time on germination percentage and germination rate of Lepyrodiclis.

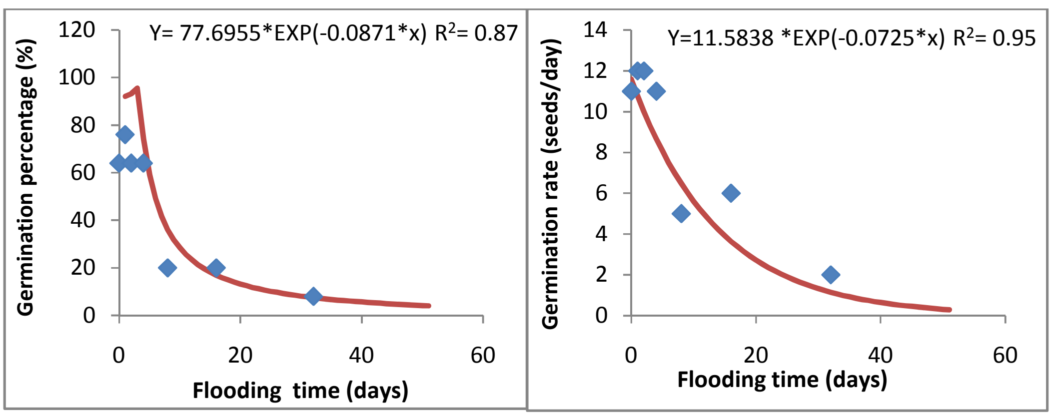

Fig. 3and 4. The model of non-linear regression of flooding time on germination percentage and germination rate of Lepyrodiclis.

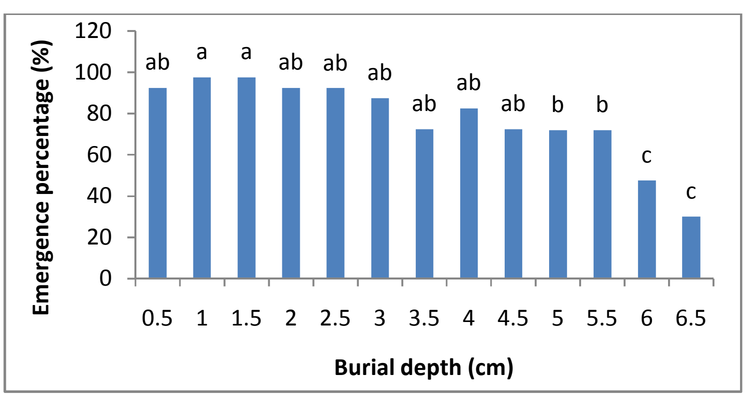

Fig. 5. The effect of burial depth on emergence percentage of Lepyrodiclis

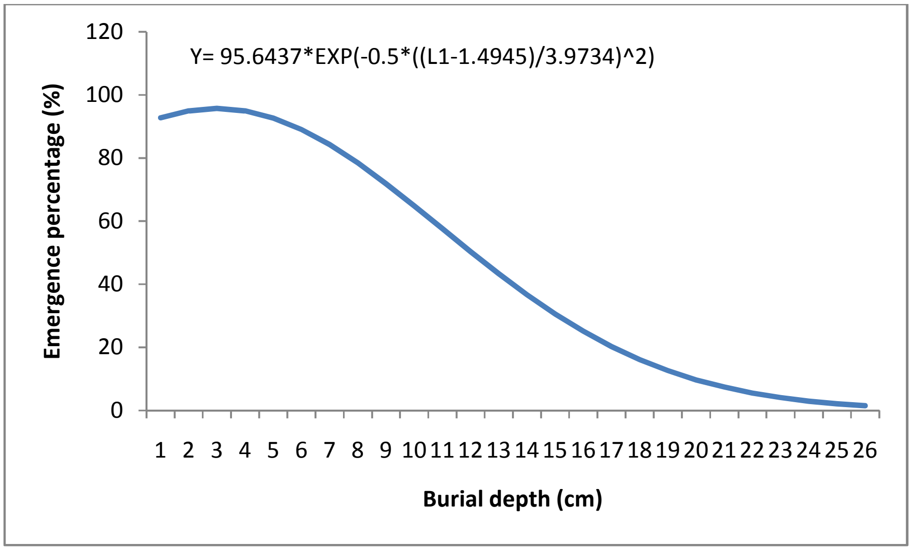

Fig. 6. The model of non-linear regression of burial depth on emergence percentage of Lepyrodiclis.

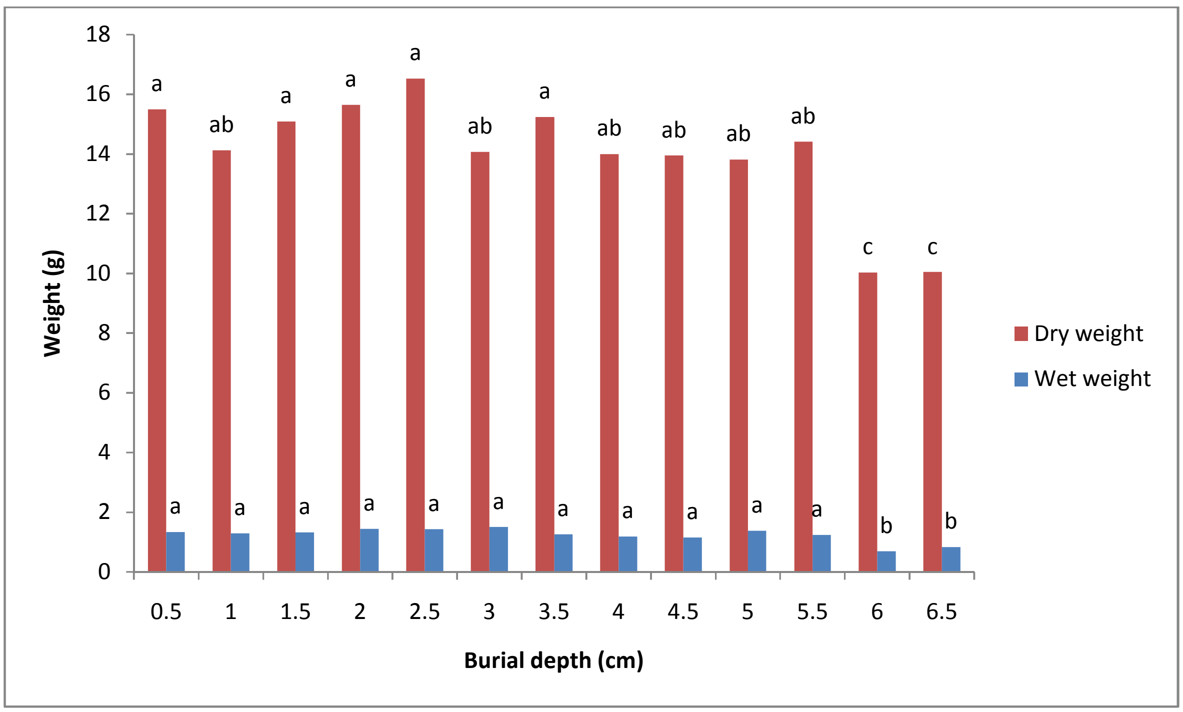

Fig. 7. The effect of burial depth on fresh and dry seedling weight of Lepyrodiclis.

Our study showed that burial depth of 6 cm and more, leads to much decrease in emergence percentage. The same results were obtained in seedling fresh and dry weight (Fig. 7). Based on the results, burial depth of 6 cm and more leads to a decrease in seedling fresh and dry weight.

CONCLUSION

According to this study, we can say that seeds of lepyrodiclis can be tolerant towards flooding stress for 4 days but much flooding-time, leads to less germination ability. Therefore in a region with enough water resources, this method (flooding) can be an effective managing way to control of lepyrodiclis. Also we found that increasing burial depth leads to a decrease in emergence percentage of lepyridiclis seedling. Based on these results, this weed can be managed by burying seeds below the maximum depth of emergence using deep tillage and subsequently only using shallow tillage to avoid bringing back the seeds on to the soil surface.

Further research is required to determine the impact of burial depth, due to different tillage systems, on seed bank and seed emergence.

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