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Effect of Temperature, Submergence and Seed Placement Depths on Germination Behaviour of Red Sprangletop [*Leptochloa chinensis* (L.) Nees]

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ABSTRACT

One year old *Leptochloa chinensis* seeds' germination ranged from 25 to 29% at temperatures ranging from 25° to 45°C. The fresh and two years' old seeds did not germinate irrespective of the temperature. Submergence periods ranging from 1 to 5 weeks were equally effective in preventing the seedling emergence during the period of submergence. However, at 15 days after the termination of each submergence, the seedling emergence was significantly less under more than two week submergence treatments than one week submergence. No seedling emerged beyond the submergence depth of 2.5 cm, whereas at 2.5 cm, 4.7% seedlings emerged from the soil but failed to emerge out of the water surface.

INTRODUCTION

Rice (*Oryza sativa* L.) is a major food crop in Asia and many other tropical and sub-tropical countries of the world. Weed infestation is one of the major barriers responsible for its low productivity. Replacement of the traditional tall rice cultivars by modern short statured ones has increased the problem of annual grass weeds in tropical Asia (De-Datta, 1981). *Leptochloa chinensis* synonym *Poa chinensis* is emerging as a new weed of rice crop in Punjab. It originated in tropical Asia and is distributed throughout South-East Asia, Burma, Sri Lanka, India, China, Japan, Australia and from East to South Africa (Mannetje, 2005). Holm *et al.* (1977) reported *L. chinensis* an important weed species found in the paddy field ranked at the same outbreak level as *Echinochloa crusgalli.*

L. chinensis is a C_4 annual grass of family Poaceae (Gramineae). It is variably known as Asian sprangletop, Red sprangletop, Chinese sprangletop, Feather grass and Mole plant. Rooting at nodes, it may grow upto 150 cm. Its leaves are smooth and linear and inflorescence is 20 to 60 cm long composed of numerous slender racemes scattered along an elongated central axis. It is distributed from sea level to 1400 m altitude and propagates mainly through seed but also through rooted tillers (Mannetje, 2005). In transplanted rice, it grows on bunds and in well-drained fields where water ponding is not adequate.

Benvenuti *et al.* (2004) in a laboratory study in Italy found that *L. chinensis* germination was strongly influenced by temperature and the optimum temperature was 25°- 35°C. They also reported that increasing depths of its seed burial progressively reduced its emergence. Wu *et al.* (2003) in a pot experiment observed more than 90 and negligible per cent of total seedling emergence in a soil depth of 0-2 and 6 cm, respectively.

A study on the biology of a particular weed generates information on the growth and development behaviour, which can be exploited while working out an effective weed management programme. In India, at present no systematic work on the biology and control of this weed is available. So, the present studies were undertaken with the objective to study the germination behaviour of *L. chinensis* under variable environment.

MATERIALS AND METHODS

Laboratory experiments were conducted to know the germination behaviour of *L. chinensis* during 2003 and 2004 in the Department of Agronomy and Agrometeorology at Punjab Agricultural University, Ludhiana. Completely randomized experimental design was adopted for these experiments. Loamy sand soil free from the weed seeds was used for pot experiments. The details of materials and methodology adopted are as under :

Effect of Temperature

To know the effect of temperature on germination of *L. chinensis*, fresh, one and two year old seeds were taken. One hundred seeds each were soaked for 24 h in water and then placed in petri dishes lined with moist filter paper and were incubated at 25°, 30°, 35°, 40° and 45±1°C in an incubator for 15 days and gennination count was recorded in four replicates.

Effect of Submergence Depth and Duration

To ascertain the effect of depth and duration of submergence on the weed emergence, one hundred one year old weed seeds per pot were used. For studies on submergence depths, 2.5, 5.0, 7.5 and 10.0 cm submergence depths were maintained for five weeks and for studies on submergence periods, a submergence depth of 7.5 cm was maintained for one, two, three, four and five weeks alongwith a moist control. The seeds were placed in soil at a uniform depth of 2.5 cm. Data on emergence and establishment of the weed were recorded in four replicates.

Effect of Depth of Seed Placement in Soil

One hundred one year old weed seeds were placed at 0 (surface), 2.5, 5.0, 7.5 and 10 cm depths in the soil in pots and emergence counts were taken periodically. The pots were kept moist for 15 days. Each treatment was replicated four times.

RESULTS AND DISCUSSION

Effect of Temperature

There was no seed germination in case of fresh and two season old seeds at all temperature regimes during both the years. One season old seeds germinated at all the temperatures ranging from 25.0 to 29.4%. The difference in germination due to temperature was non-significant (data not presented). The majority of the seeds germinated at three days after incubation between temperature range of 30° to 40°C and at five days after incubation at 25° and 45°C (Table 1). Benvenuti *et al.* (2004) also reported that *L. chinensis* seeds needed higher temperature to germinate. It reveals that fresh seeds might have innate dormancy and required rest period before these germinate. Galinato *et al.* (1999) also reported dormancy in seeds of *L. chinensis*. They further reported that dormancy could be broken when seeds were placed on a moist filter paper subjected to a regime of 12 h light and then dark at 40°C and 12 h light at 30°C and 12 h dark at 15°C.

Effect of Submergence Periods and Depth

L. chinensis seedlings under continuous submergence failed to emerge but after the termination of submergence, some seedlings were able to emerge (Table 2). There was a decline in

Table 1. Periodic germination of *L. chinensis* seeds (two seasons' mean) at different temperatures

Temperature (°C)	Days after sowing							Total gemination (%)
	3	5	7	9	11	13	15	
25	2 (1.72)	20 (4.58)	3 (1.99)	0 (1.00)	0 (1.00)	0	0	25
30	12 (3.60)	6 (2.64)	8 (2.99)	0 (1.00)	0 (1.00)	0	0	26
35	23 (4.90)	2 (1.72)	1 (1.37)	0 (1.00)	0 (1.00)	0	0	26
40	27 (5,29)	2 (1.66)	0 (1.00)	0 (1.00)	0 (1.00)	0	0	29
45	8 (2.99)	10 (3.31)	0 (1.00)	5 (2.45)	2 (1.68)	0	0	25
LSD (P=0.05)	(0.36)	(0.51)	(0.36)	(0.11)	(0.34)	-	-	-

Figures in parentheses are $\sqrt{X+1}$ transformed data.

Table 2. Effect of submergence periods on per cent seedling emergence of *L. chinensis* at 15 days after submergence termination

Submergence period (Weeks)	2003	2004	Mean
1	6.7 (2.77)	10.0 (3.32)	8.3 (3.05)
2	3.0 (2.01)	4.0 (2.24)	3.5 (2.13)
3	3.0 (2.00)	4.1 (2.25)	3.5 (2.13)
4	2.2 (1.79)	3.4 (2.10)	2.8 (1.95)
5	2.4 (1.84)	3.2 (2.05)	2.8 (1.95)
Moist (Control)	15.4 (4.05)	16.7 (4.21)	16.1 (4.13)
LSD (P=0.05)	(0.61)	(0.39)	-

Figures in parentheses are $\sqrt{X+1}$ transformed data.

Table 3. Effect of submergence depths on seedling emergence (%) of *L. chinensis*

Submergence depths (cm)	Emergence from soil surface			Emergence from water surface		
	2003	2004	Mean	2003	2004	Mean
Moist	14.4 (3.92)	17.2 (4.26)	15.8	14.4 (3.92)	17.2 (4.26)	15.8
2.5	4.3 (2.30)	5.0 (2.45)	4.7	0.0 (1.00)	0.0 (1.00)	0.0
5.0	0.0 (1.00)	0.0 (1.00)	0.0	0.0 (1.00)	0.0 (1.00)	0.0
7.5	0.0 (1.00)	0.0 (1.00)	0.0	0.0 (1.00)	0.0 (1.00)	0.0
10.0	0.0 (1.00)	0.0 (1.00)	0.0	0.0 (1.00)	0.0 (1.00)	0.0
LSD (P=0.05)	(0.10)	(0.18)	-	(0.08)	(0.13)	-

Figures in parentheses are $\sqrt{X+1}$ transformed data.

emergence from 16.1% in moist control to 2.8% both in four and five weeks submergence. Submergence periods of two, three, four and five weeks were statistically on par with each other with respect to emergence percentage but were significantly better than one-week submergence in preventing seedling emergence. The seedling emergence under two to five weeks submergence periods ranged between 2.8 to 3.5%, whereas it was 16.1 and 8.3% under moist conditions and one week submergence, respectively.

The decreased seedling emergence under submergence could be due to reduced oxygen level and accumulation of certain toxic substances due to anaerobic decomposition (Smith and Fox, 1973). Poolkumlung *et al.* (2001) concluded from their laboratory experiments that water management could control *L. chinensis* by keeping submerged condition in their early stages for 7 to 10 days.

The seedlings of *L. chinensis* were unable to emerge under submergence depths of 5.0, 7.5 and 10.0 cm (Table 3). However, under submergence depth of 2.5 cm, 4.7% of seedlings were able to emerge from the soil but failed to emerge out of water surface. The weed seedlings were able to emerge to the extent of 15.8% under moist control. Poolkumlung *et al.* (2001) reported remarkable suppression of *L. chinensis* with flooding at 2.5 and 5 cm deep water at pre-emergence.

Effect of Seed Placement Depths in Soil

The emergence of *L. chinensis* decreased as the depth of seed placement in soil increased (Table 4). No seedling emerged beyond the placement depth of 5.0 cm and it was only 0.6% at placement depth of 5.0 cm. Mean of two years' data showed that 18.0 and 14.2% seeds emerged when seeds were placed at the surface and at 2.5 cm depth in soil, respectively. The seedling emergence from the surface placed seeds was significantly higher than all other placement depths. It is thus clear that *L.*

Table 4. Effect of seed placement depths on emergence (%) of *L. chinensis* seedlings

Depths of seed placement (cm)	2003	2004	Mean
0.0	17.5 (4.3)	18.4 (4.4)	18.0 (4.4)
2.5	14.2 (3.9)	14.2 (3.9)	14.2 (3.9)
5.0	0.2 (1.1)	1.0 (1.4)	0.6 (1.3)
7.5	0.0 (1.0)	0.0 (1.0)	0.0 (1.0)
10.0	0.0 (1.0)	0.0 (1.0)	0.0 (1.0)
LSD (P=0.05)	(0.22)	(0.35)	-

Figures in parentheses are $\sqrt{X+1}$ transformed data.

chinensis seedlings emerge only from shallow depths of the soil and seeds located deep in the soil beyond 2.5 cm, would not emerge. The findings are in conformity with the results of Benvenuti *et al.* (2004) who reported progressive decline in seedling emergence of *L. chinensis* with increasing depth of seeding.

REFERENCES

Benvenuti, S., G. Dinelli and A. Bonetti, 2004. Germination ecology of *Leptochloa chinensis* : a new weed in the Italian rice agro-environment. *Weed Res.* **44** : 87-96.

De-Datta, S. K. 1981. *Principles and Practices of Rice Production.* John Wiley and Sons. p. 618.

Galinato, M. I., K. Moody and C. M. Piggin, 1999. Upland rice weeds of South and South-East Asia. Makati city, IRRI. p. 87.

Holm, L. G., D. E. Plucknett, J. V. Pancho and J. P. Herberger, 1977. *The World's Worst Weed : Distribution and Biology.* The University Press of Hawaii. p. 629.

Mannetje, L. 2005. *Leptochloa chinensis* (L.) Nees. www.fao.org/ag.

Poolkumlung, P., P. Zaprong, K. Yanagisawa, M. Yokoyama and K. Kondo, 2001. Influence of submergence on emergence and growth of *Leptochloa chinensis*. Proc. Asian-Pacific Weed Science Society Conf., May 28-June 2, Beijing, China. pp. 80-84.

Smith, R. J. and W. T. Fox, 1973. Soil water and growth of rice and weeds. *Weed Sci.* **21** : 61-63.

Wu, J. L., Y. S. Li, Z. Y. Zhang and L. P. Liu, 2003. Effect of different soil depths on emergence of weed seedlings and their growth in the rice field. *Jiangsu J. Agric. Sci.* **19** : 170-173.