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Germination Biology of Mariacus Longibracteatus Cherm and Oryza Barthii A. Chev.

B. O. OBADONI, J. K. MENSAH and H. O. JEROME

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ABSTRACT

The germination biology of two most abundant and frequent weeds of lowland rice in Edo state was studied. The two species varied in their temperature requirements for germination: the optimum temperature for the germination of M. longibracteatus 40°C while O. barthii was 32°C. M. longibracteatus did not germinate at temperatures below 25°C but O. barthii germinated at 20°C. Optimum seedling emergence was recorded at a depth of 0.5cm in M. longibracteatus whereas O. barthii emerged most at depths of 2.0 and 3.0cm. Both species showed controlled seed germination as a survival mechanism. Simulated moisture stress and hydrogen ion activity adversely affected the germination of seeds of both species indicating high sensitivity to moisture stress and solute concentrations. Treatments that would increase the soil pH would limit the spread of both species.

KEYWORDS: Germination Biology, Weeds, Lowland Rice

INTRODUCTION

Mariscus longibracteatus Cherm and wild rice (Oryza barthii A. Chev) are members of Cyperaceae and Poaceae families respectively. They are the most prevalent weeds in the lowland rice growing areas of Edo State (Obadoni and Remison, 2002). These two weed species grow abundantly on the west bank of River Niger in the portions within Edo State. These areas have vast expanse of fertile lowland that is usually flooded during the rainy season and suitable for rice cultivation. How these species colonized these areas is not known; and today, they constitute a serious problem to lowland rice farmers in Edo State.

Weed seeds will germinate when favourable conditions are present where the seeds are deposited. A site that provides these conditions is known as a safe site (Harper 1977). Weed seed germination as affected by micro-site, physical stimuli and environmental factors has been the subject of many laboratory and greenhouse investigations (Singh and Achhireddy 1984; Gealy et al., 1985; Hemmat et al., 1985; Shaw et al., 1987 and Eke and Okereke 1990). Some species can emerge from seed at a wide range of planting depths (Wilson, 1979; Singh and Achhireddy, 1984), whereas seeds of others must be close to the soil surface (Balyan and Bahn, 1986 and Shaw et al., 1987), and temperature (Wilson, 1979; Gealy et al., 1985 and Hemmat et al., 1985) requirements for germination vary tremendously according to the species studied.

David et al., (1991) reported that the optimum temperature for germination and emergence of redvine (*Brunnichia ovata*) seeds in either petri dishes or soil was 35°C while temperatures above or below this, reduced germination and emergence. Planting seeds at 0.5 cm deep favoured the emergence (74%) of redvine seedlings; redvine germination was not affected by pH whereas germination did not occur when osmotic stress of as little as – 200kPa was applied to seeds (David et al., 1991). James and Ray (1991) showed that optimum germination of virginia buttonweed (Diodia virginiana) occurred under a regime of light-period temperatures at 25 and 30°C combined with dark-period temperatures at 15 to 25 and 20 to 30°C, respectively. Germination of virginia buttonweed was reduced under simulated water stress conditions with less than 10% of seeds germinating at osmotic potentials below – 0.3Mpa; and overall seed germination was reduced by simulated flooding.

Little or no information is available on the effect of environment on the germination of wild rice (O. barthii) and M. longibracteatus in Nigeria. This information would enable researchers understand the species' adaptive capabilities and the development of effective control practices. The objectives of this research were to determine: a) the effect of temperature, water stress, pH on the germination of these weed species; and b) the effect of varying depths of planting on the emergence of their seedlings.

MATERIALS AND METHODS

The seeds of M. longibracteatus and O. barthii were collected in November 2001. The seeds were cleaned, dried to safe moisture content and stored in an incubator at a temperature of 10°C for 4 months before being used for the experiments. A week before commencement of the studies, the seeds were removed from the incubator for exposure at room temperature. Representative samples were tested for viability by staining in 1% solution of 2,3,5- triphenyltetrazolium chloride for 24hr at 30°C (Moore, 1973). The result showed that 98% of the seeds were viable. A randomized complete block design with four replications was used in all studies. All trials were repeated, and germination data represent the average of two experiments since they did not vary. Germination or emergence was monitored every two days for a total of 21 days after planting (DAP). The pooled data were subjected to an analysis of variance to

B. O. OBADONI, Department of Botany Ambrose Alli University, Ekpoma - Nigeria
J. K. MENSAH, Department of Botany Ambrose Alli University, Ekpoma - Nigeria
H. O. JEROME, Department of Botany Ambrose Alli University, Ekpoma - Nigeria

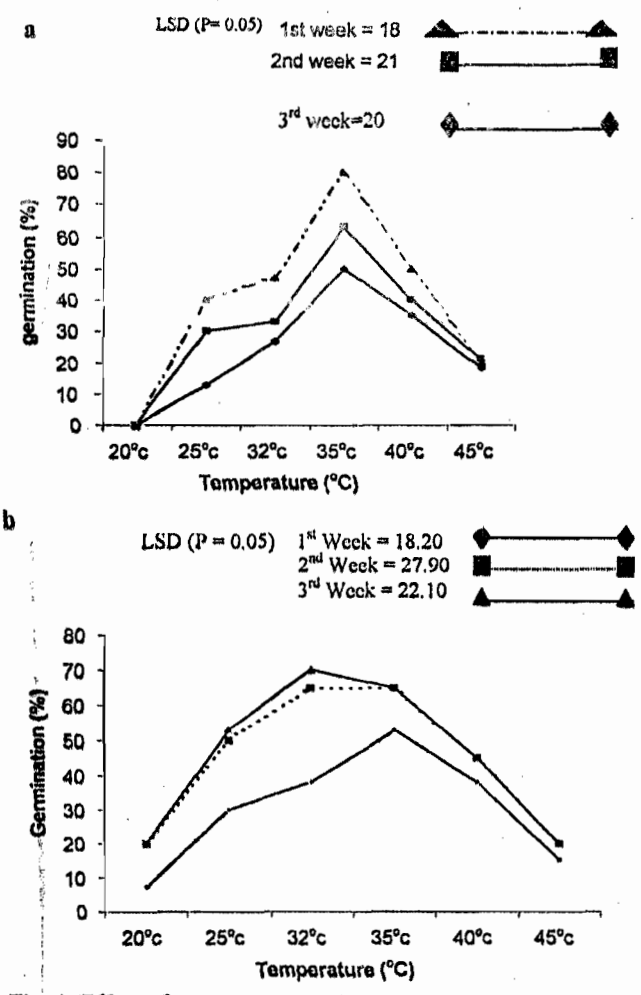

Fig. 1 Effect of temperature on the germination of (a) *M. longibracteatus* and (b) *Oryza barthii* seeds.

test the significance of treatment effects, and LSD at the 5% was used too compare treatment means. The germination study experiments were designed as outlined by David et al. (1991) with some modifications.

Temperature. Germination was determined in darkened incubators at constant temperatures of 20, 25, 32, 40 and 45°C for M. longibracteatus and 20, 25, 32, 35, 40 and 45°C for O. barthii. Another batch of experiments were carried out under light at room temperature for both species; this was 30± 2°C during the day and 25± 2°C at night. Twenty seeds were placed on two sheets of filter paper in 9-cm petri dishes. The filter paper was moistened with 5 ml of distilled water and, if needed, an additional 2 to 4 ml was added to each dish to maintain adequate moisture necessary for germination. Seeds were considered germinated when radicle was 1mm long.

Depth of planting. Twenty seeds were planted in 11-cm-diameter nursery polyethylene bags on the soil surface and at depths of 1.0, 2.0, 3.0, 4.0, 5.0 and 6.0 cm for O. barthii but in M. longibracteatus, planting depths were 0, 0.5, 1.5, 2.0, 2.5, 3.0, 4.0 and 6.0 cm. These experiments were conducted in the laboratory at room temperatures. The polybags were watered as needed to maintain optimum moisture throughout the study. Plumules that just emerged above the soil were considered germinated. The depths varied because the seeds of M. longibracteatus were very small. At the termination of the studies, all ungerminated seeds were exhumed separately and tested for viability as earlier described.

pH. Twenty seeds were placed on two sheets of filter paper in 9-cm petri dishes and moistened with 5 ml of each pH solution. Studies were conducted in incubators adjusted to provide a constant temperature of 32°C. Additions of 2 to 4 ml of the appropriate pH solutions were made as needed to maintain adequate moisture for germination. A 0.2M boric acid solution and 0.5M borax solution were used to prepare buffered solutions of 7.6, 8.0, 8.4 and 8.8 pH as described by Brown and Creedy (1971). De-ionised water was also included for comparison at pH 7.

Osmotic stress. Water solutions with osmotic pressures of –200, -400, -600, -800 and –1000 kPa were prepared by dissolving 154, 191, 230, 261 and 297g respectively of polyethylene glycol[1] in 1 litre of deionized water (Parmar and Moore, 1966). Deionized water alone was used as a OkPa standard. Petri dishes were incubated at 35°C. Each petri dish received 5 ml of the appropriate solution and 20 seeds of each species at the commencement of the experiment; and supplemental solution was added daily in 2-ml aliquots throughout the duration of the experiments.

1 Carbowx PEG 8000

RESULTS

Temperature. M. longibracteatus Cherm germination in petri dishes was first observed on day 5 at 40°C. Germination gradually increased from the fifth to the twenty-first day of incubation. At three weeks after planting, germination at 40°C was significantly higher than at other temperatures. Germination at 25 and 30°C was similar (Fig. 1a) especially at 2nd and 3rd weeks after incubation. Seeds did not germinate at temperatures below 25°C (Fig. 1a). At the culmination of these trials at 21 days after incubation, a maximum germination of 80% was recorded at 40°C while at 25 and 32°C, 40 and 47% germination respectively were observed. No seed germinated beyond three weeks after incubation; temperatures above 40°C was not favourable to its germination.

The germination of O. barthii seeds was first noticed on day 5 at 35°C. During the first week of incubation, seeds germinated at all temperatures but lowest at 20°C. Germination was the same at 32 and 40°C (38% each) and highest at 35°C (Fig. 1b). Emergence of radicle gradually increased from the first to the second week of incubation with the maxima at 32 and 35°C (65% each); as was the case during the first week of incubation, 20°C still recorded the lowest germination. At the conclusion of the experiments at 3 weeks after incubation (3 WAI), 20% germination was observed at 20°C, 53% at 25°C and the peak of 70% at 32°C, while 65 and 45% were recorded respectively at 35 and 40°C. This showed that the optimum temperature for its germination was 32°C. In the light experiments that were conducted at room temperature for both species, the results were similar to the ones carried out in darkened incubators: the percentage germination recorded in M. longibracteatus was 47% while that of O. barthii was 74%.

Depth of planting. In M. longibracteatus, seedling emergence occurred 7 days after planting (7 DAP) from depths of 0.0, 0.5, 1.0, 1.5 and 4.0cm except at 6.0cm

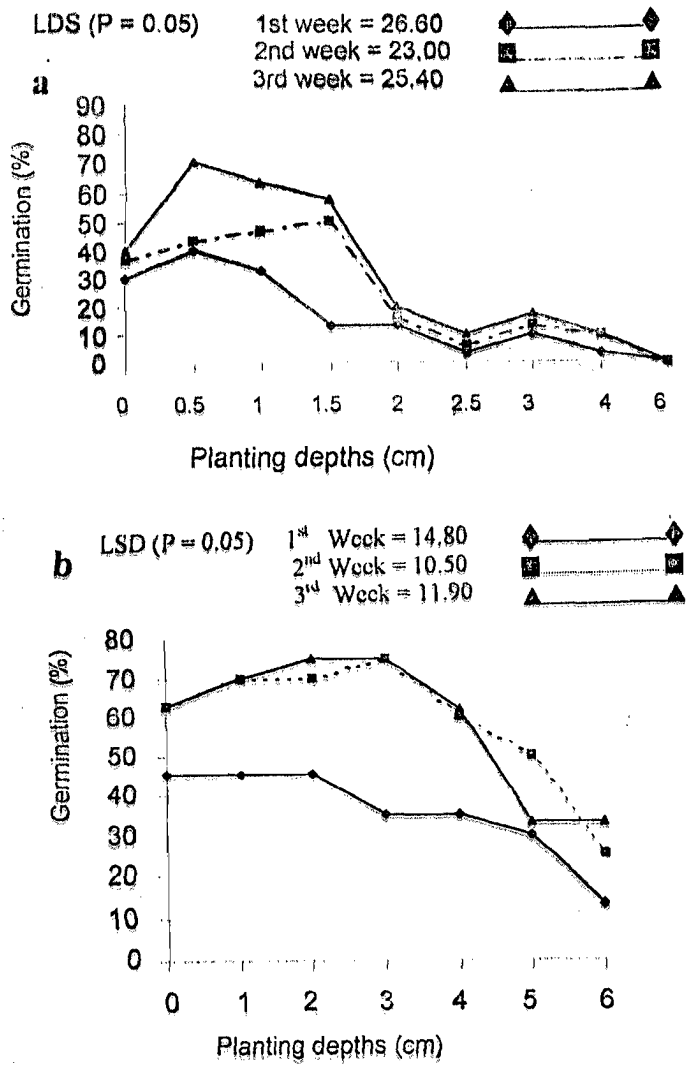

Fig. 2 Effect of planting depths on the emergence of (a) *M. longibracteatus* and (b) *O. barthii* seedlings

(Fig. 2a). In the second week, seedling emergence was similar from 0.0 to 1.5cm but significantly (P≤0.05) decreased beyond this depth. At the termination of the studies at 3WAP, seeds planted on the surface showed mean germination of 40%; whereas emergence at 0.5, 1.0 and 1.5 cm did not significantly (P≤0.05) vary (Fig 2a). Increasing planting depths beyond 2.0 cm significantly reduced emergence of seedlings. At 6.0cm, there was no seedling emergence on the final observation data. Some of the exhumed seeds had germinated but seedlings could not push through the soil; this observation was made as from 2.0 cm planting depth and beyond, while all ungerminated seeds were viable.

In O. barthii, seedling emergence was observed first on day 5 at depths of 0. and 1.0 cm. Percentage emergence in the first week was similar at depths of 0, 1.0 and 2.0 cm (45% each) but declined to 35% each at 3 and 4.0 cm deep. A significant (P≤0.05) decrease from 30 to 13% was recorded from 5.0 to 6.0 cm deep. In the second week, the same trend of seedling emergence was recorded at 1.0, 2.0 and 3.0 cm (70, 70 and 75%) respectively (Fig. 2b). At a planting depth of 6.0 cm, only 25% of the seedlings emerged in the second week, but this increased insignificantly to 33% in the 3rd week (Fig. 2b). Beyond 21DAP, no seedling emerged again. Maximum seedling emergence of 75% each was recorded 3WAP at 2.0 and 3.0 cm planting depths. From 4.0 cm and beyond, seedling emergence significantly (P≤0.05) decreased as shown in Figure 2b. Final emergence data showed 63 and 70% at depths of 0.0 and 1.0cm respectively at 3WAP. Unlike the case of M. longibracteatus, no exhumed seed showed signs of germinating but all were viable.

pH. There was no germination of M. longibracteatus seeds in boric acid and borax-buffered solutions (data not shown). Germination however did occur in distilled water (60% germination was recorded). The same trend was observed in O. barthii seeds except that 80% germination was recorded in distilled water used as a control.

Osmotic stress. As little as –200kPa osmotic stress in petri dishes inhibited the germination of M. longibracteatus seeds, whereas in O. barthii, 10% germination was recorded at –200kPa. Trials in distilled water with 0kPa recorded 56% germination in M. longibracteatus and 75% in O. barthii.

DISCUSSION

The studies have identified many specific parameters needed for the germination of M. longibracteatus and O. barthii seeds. The two species varied in their temperature requirements for germination; the optimum temperature for the germination of M. longibracteatus was 40°C while O. barthii was 32°C. At lower temperatures, the germination of both weed seeds was inhibited. The weeds are tropical species and would not probably germinate at low temperatures. Germination under light and dark conditions at the same temperature was similar; this indicated that seeds of these species are not strongly photoblastic and germinate in both light and dark environments when other required conditions exist. Thomson and Witt (1987) reported that light did not affect the germination of cutleaf groundcherry (Physalis angulata L) seeds; but light is required for the germination of Florida pusley seeds (Biswas et al, 1975).

The optimum depth for the emergence of M. longibracteatus seedlings in 0.5 cm. This weed has very small seeds and seedlings would not be able to emerge if seeds are planted deep. This implies that deep ploughing and harrowing would control this weed in rice fields. Reduced emergence of the seeds planted on the soil surface noticed in M. longibracteatus was most likely due to fluctuating moisture conditions. Balyan and Bahn (1986) reported decreased germination of horse purslane (Trianthema portulacastrum L.) seeds placed on the soil surface, probably due to poor seed-soil contact and drying. Both weeds exhibited controlled seed germination (Palmblad, 1968); some of their seeds germinated while others remained dormant. This is a survival mechanism that enables weeds to overcome unfavourable environmental conditions like drought, extreme high and low temperatures, consumption by herbivores in case of palatable species and even weeding by farmers.

The lack of germination at the various pH levels indicated that the species studied were sensitive to solute concentration. Liming, therefore would limit the establishment of these weeds. Singh and Achhireddy (1984) reported a similar inhibitory effect of buffers on

germination of milkweedvine seeds. Also similar results were obtained by Wilson (1979) on the germination of Canada thistle (Cirsium arvense L. SCOP). Seeds of M. longibracteatus and O. barthii were sensitive to simulated water stress; this was evident from the only 10% germination recorded in O. barthii and none in the other. These results are consistent with observations that both weeds are well adapted to wet environments. Singh and Achhireddy (1984) had shown that milkweedvine was sensitive to water stress; similar result was reported by Johnston et al (1979) on ballonvine (Cardiospermum halicacabum L.).

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REFERENCES

Balyan R. S. and Bahn V. M., 1986. Germination of horse purslane (Trianthenia Portulacastrum) in relation to temperature, storage conditions and seedling depths. Weed Sci 34: 513-515.

Biswas, P. K., Bell, P. D., Crayton, J. L. and Paul , K. B., 1975. Germination behaviour of Florida pusley seeds. I. Effects of storage, light, temperature and planting depths on germination. Weed Sci. 23: 400 –403.

Brown, G. D. and Creedy . J., 1971. Experimental biology manual. Heinemann Educational Books Ltd. London. P. 264.

David, R. S., Mark, R. E. and Smith, C. A., 1991. Redvine (Brunnichia ovata) germination and emergence. Weed Sci. 39: 33-36.

Eke, A. O. and Okereke O. U., 1990. Seed germination and growth of Eeleucine indica and Euphorbia heterophylla as influenced by depth of planting and glyphosate. Ghana Jnl agric. Sci: 20-23: 77- 83

Gealy, D.R., Young, F. L. and Morrow L. A., 1985. Germination of mayweed (Anthenius cotula) achenes and seed. Weed Sci. 33: 69 – 93.

Harper, J. L., 1977. Population biology of plants. Academic Press, London pp 892.

Hemmat, M., Zeng, G. W. and Khan A. A., 1985. Responses of intact and scarified curly dock (Rumex crispus) seeds to physical and chemical s timuli. Weed Sci. 33: 658 – 664.

James, H. B. and Ray, D., 1991. Germination and emergence of virginia Buttonweed (Diodia virginiana). Weed Sci. 39: 37-41.

Johnston, S. K., Murray, D. S. and Williams, J. C., 1979 Germination and emergence of balloonvine (C. halicacabum) Weed Sci, 27: 73 – 76.

Moore, R. P., 1973. Tetrazolium staining for assessing seed quality. In Seed ecology, ed. W. Heydecker. Butterworths, London, pp. 347-66.

Obadoni, B. O. and Remison, S. U., 2002. Phytosociological studies of the weed flora and weed interference in rice. Ph. D. Thesis, Ambrose Alli University Ekpoma, Edo state, Nigeria.

Palmblad, I. G., 1968. Competition in weed populations. Ecology 49(1): 28-34.

Parmar, M. T. and Moore, R. P., 1966. Effects of simulated drought by polyethylene glycol solutions on corn (Zea mays L.) Agron. J. 58: 391-392.

Shaw, D. R., Smith, H. R., Cole, A. W. and Snipes, C. E., 1987. Influence of environmental factors on smallflower morningglory (Jacquemontia tamnifolia) germination and growth. Weed Sci: 35: 519 – 523.

Singh, M. and Achhireddy, N. R., 1984. Germination ecology of milkweedvine (Morrenia odorata). Weed Sci. 32: 781 – 785.

Sotores, J. K. and Murray, D. S. 1981. Germination and development of honeyvine milkweed (Ampelamus albidus) seed. Weed Sci. 29: 625-628.

Thomson, C. E. and Witt ,W. W., 1987. Germination of cutleaf ground cherry (Physalis angulata), smooth ground cherry (Physalis virginiana), and eastern black nightshade (Solanum ptycanthum). Weed Sci. 35: 58-62.

Wilson, R. G. Jr., 1979. Germination and seedling development of Canada thistle (Cirsium arvense) Weed Sci. 27: 146-151.