Germination Behavior of Weedy Rice at Different Sowing Depths under Field Conditions

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Abstract

Weedy Rice (*Oryza sativa* complex) becomes the most dominant and competitive weed in Sri Lanka. Seed shattering and seed dormancy have enriched the soil seed bank. Weedy rice seeds remain longer period in soils at different depths and that contribute to the success of weedy rice as a "weed." Hence study about the level of longevity, dormancy and germination behavior of weedy rice under the conditions similar to those of field conditions is important to implement efficient control measures. In this study, weedy rice seeds were collected from 6 infested locations from Matara district and two widely grown improved varieties (At 362 and Bg 379-2) were included as check lines. Thirty panicles were randomly collected from each location and 5 seeds from each panicle were taken and mixed thoroughly. From that 100 seeds were randomly selected for each test with 3 replicates for viability and germination testing. Seeds of the weedy and cultivated rice were placed separately in nylon bags and buried at 15 and 30 cm depths (in soil). Seed germination and viability were tested before burial and in two week intervals after burial. Both weedy rice and improved rice varieties showed more than 85% viability before burying. Weedy rice seeds could remain viable under soil for more than 24 weeks compared with the improved rice varieties, which did not remain viable beyond 16 weeks after burial in both depths tested. Viability and germination ability were always higher in seeds buried at 30 cm depth when compared with those buried at 15 cm depth for both weedy and improved rice. These results help to understand the persistent nature of weedy rice and it will help to adopt efficient control measures for weedy rice.

Key words: Weedy rice seeds, Viability, Germination, Burial depths

Introduction

Weedy rice, locally known as *Wal Vee/ UruVee,* is the most dominant and competitive weed that occurs in rice fields' worldwide. At present weedy rice is spread over all rice growing areas in Sri Lanka. Weedy rice is the main competitor with cultivated rice, affecting both growth and yield, especially with regard to space and nutrient uptake (Zainudin *et al.*, 2010). The superior competitive ability of weedy rice over cultivated rice has contributed to its rapid spread within the country. Weedy rice is morphologically and behaviorally very similar to cultivated rice but has some key differences: shattering seed dispersal, red pericarp pigmentation, and the ability of seeds to persist in the soil (Delouche *et al.*, 2007). The management of weedy rice infestations is much more difficult than that of other rice weeds because of the high biological similarity with cultivated rice and the extended germination over a long period of rice growth (Fogliatto *et al.*, 2010). Lack of a selective herbicide for the control of weedy rice, or other effective measures, has made its control a subject of national significance. Higher levels of seed shattering and seed dormancy have enriched the soil seed bank of weedy rice in infested fields. A part of soil seed bank may germinate as soon as conditions are favorable (e.g. soil moisture, oxygen, and temperature), while the other part will germinate at later dates or when other factors change. The variable and prolonged periods during which seeds remain dormant are major factors that contribute to the success of weedy rice as a "weed." Strategies for the control of weedy rice are diverse and their implementation depends on the specific site

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conditions. However, any control measure should aim to reduce the weedy rice seed bank in soil in the medium or long term (Labrada., 2010). Weedy rice seed banks therefore play an important role in determining the severity of infestation in rice fields. In this context, studies about the germination behavior of weedy rice under conditions similar to those of field conditions are important to formulate efficient control measures.

Materials and Methods

Sample collection

Weedy rice seeds were collected from 6 weedy rice infested locations (Thihagoda, Hakmana, Mulatiyana, Pitabeddara, Kotapola and Akuressa) from Matara district. Thirty weedy rice panicles were randomly collected from each location. Five seeds were collected from each of the 30 panicles of a one location. The seeds were mixed well and 100 seeds were randomly selected for viability and germination testing. The same procedure was done for other populations too. In addition to weedy rice, two widely grown improved varieties (At 362 and Bg 379-2) were also included in the study as check lines.

Viability test

Germination and viability were tested in weedy rice and two improved varieties before conducting the experiment. After soaking the seeds for 18 hours in water 100 seeds were selected and they were split into two halves through embryo. Split seeds were kept in the 1% triphenyl-tetrazolium chloride (TTC) solution for two hours in dark conditions and thenTTC stained seeds were counted as viable seeds.

Germination test

Rice seeds were soaked in water for 24 hours and kept covered by cloth bags for further 24 hours. Then the seeds were kept on a moistened filter paper in a Petri dish and incubated under natural light. The numbers of germinated seeds were counted (as seeds had radical appearing).

Burial test

The experiment was conducted during 2013 in the rice field of the experimental garden at Faculty of Agriculture, University of Ruhuna. Weedy rice seeds collected from different locations were mixed well to get a representative sample, and they were put into separate nylon bags. Each bag contained 200 seeds. The seeds of two cultivated rice varieties also put into separate nylon bags and buried at 15 and 30 cm depths in soil. All the simulations had three replicates. Over a period of 24 weeks, the buried seeds bags were dug up at two week intervals commencing from the fourth week after burying (WAB) and tested for their viability and germination ability.

Results and Discussion

Both weedy rice and improved rice varieties showed more than 85% viability and more than 80%

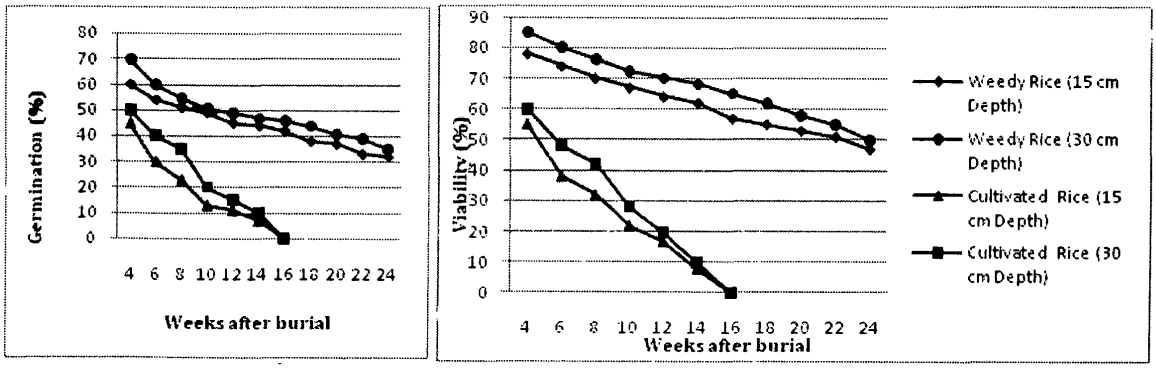
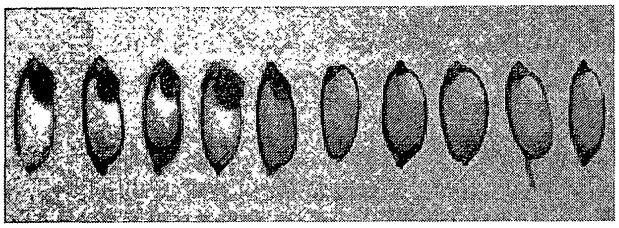


Fig.1. a Fig.1. b

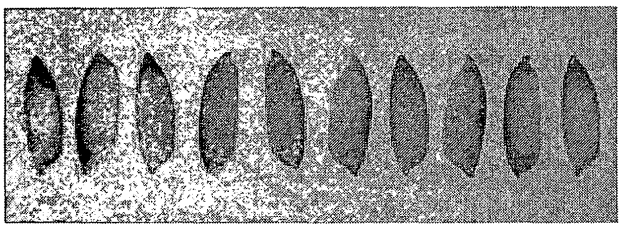
Figure 1. Effect of burial time and depth on the germination ability (1.a) and viability (1.b) of weedy rice and improved rice varieties

germination before burying. The difference between viability and germination of weedy rice was low, thus it can be concluded that the degree of seed dormancy of weedy rice was not very high in this area.

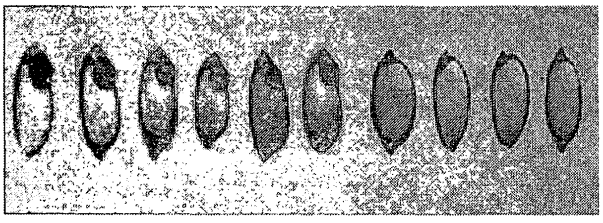
Germination percentage of improved rice buried at 15cm and 30cm depth was 45% and 50%, respectively at 4WAB and it declined sharply to zero at 16WAB (Fig.1.a). The results followed a similar pattern for the two improved rice varieties. Germination percentage of weedy rice buried at 15 cm and 30 cm depth was 60% and 70%, respectively by 4WAB and it declined gradually to 32% and 35%, respectively by 24 WAB. Viability percentages also followed a similar pattern (Fig.1.b) for improved and weedy rice buried at 15 cm and 30 cm depths.



Weedy rice seeds at 15 cm depth



Improved (At 362) seeds at 15 cm depth



Weedy rice seeds at 30 cm depth

Improved (Bg 359) seeds at 30 cm depth

Figure 2. Comparison of seed viability in weedy and improved rice at two different depths (15 cm &30 cm) at 12 WAB by using TTC test.

These experiments revealed that weedy rice seeds could remain viable under soil for more than 24 weeks compared to the improved rice varieties, which did not remain viable beyond 16 WAB. Viability and germination ability of seeds always higher in deep soil (30 cm) compared to surface soil (15 cm depth) for both weedy and improved rice (Fig. 2). These results support the observations of the persistent nature of weedy rice. Further, the findings highlight the importance of management measures to decrease the weedy rice soil seed bank of infested fields and of long-term strategies to minimize the soil seed bank of weedy rice.

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