Calcium peroxide as a seed coating material for padi rice

II. Chemical and physical requirements of the coating

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Summary Redox and chemical analysis techniques have measured the decomposition of calcium peroxide-coated rice seed (Oryza sativa L.) under flooded padi conditions. Decomposition rates, even in acid soils at high temperatures, are slow enough to extend over the oxygen demand period of the germinating seed.

Rice seeds coated with calcium peroxide are relatively stable and viable over a wide range of storage conditions.

Magnesium peroxide coatings decompose at approximately half the rate of calcium peroxide coatings. Differences in alkalinity, cation and oxygen release rate make magnesium peroxide a useful alternative system to calcium peroxide.

Introduction

Broadcast seeding of rice (Oryza sativa L.) onto flooded fields is a major production technique in the U.S.A. Problems associated with this practice contribute to the necessity of high seeding rates and even then problems in stand establishment arise. Previous work by the authors has demonstrated that a germinating rice seed requires 900 μg of oxygen to produce a 1 cm coleoptile irrespective of temperature within the range 21-35°C. To benefit a germinating seed under anoxic conditions it is possible to coat the seed with 60% calcium peroxide powder at a level of 35% on seed weight which supplies 1000 μg of oxygen per seed.

Although rice seed can germinate and grow at low oxygen concentrations, germination is poor and seedlings have low vigour. Coated seed has an oxidized peripheral zone when sown in an anoxic environment with good germination and normal seedling development. Information on the oxygenating properties of the coating is required as a function of time, soil pH and temperature together with development of special analytical techniques in order to assess that the coating can withstand the wide environmental conditions. Comparisons in oxygen release rates are
required for magnesium and zinc peroxides as alternatives. Stability studies of coated seed under typical storage conditions are necessary to ensure that seed viability is unimpaired.

Materials and methods

Seeds

Samples of two cv.s Labelle long grain and Saturn medium grain of *Oryza sativa* L. var indica were used.

Chemicals

*Calcium peroxide* The material contained 60% (w/w) calcium peroxide.

*Magnesium peroxide* The material contained 50% (w/w) magnesium peroxide.

*Zinc peroxide* The material contained 55% (w/w) zinc peroxide.

Coating of seed with inorganic peroxide

All seed was coated according to the method described previously.

Chemical determination of available oxygen in an inorganic peroxide

Weigh 0.2 g of sample and place into 50 ml of phosphoric acid solution (1:9) in a 600 ml beaker and dissolve.

100 ml of sulphuric acid solution (1:9) is added before titrating with 0.1 N potassium permanganate solution to the appearance of a faint permanent pink colouration.

Available oxygen, % w/w = \( A \times N \times 0.8/S \)

or expressed as calcium peroxide % w/w = \( A \times N \times 3.604/S \)

where \( A \) is the titre in ml, \( N \) is the normality of the potassium permanganate and \( S \) is the weight of inorganic peroxide taken.

Measurement of redox potential

a) *Platinum electrode* Platinum wire (diameter 0.376 mm) was soldered to an electrical connector, the platinum cleaned in acid and the tip polished on carborundum paper until smooth. All but the tip was coated with clear nail varnish.

Each electrode was checked in a ferrous ion/ferric ion solution of known redox potential, unsatisfactory electrodes were discarded.

A rice seed, coated or uncoated, could be attached (using cotton) to the electrode so that the two were in close proximity to one another.

The redox potential was measured using an calomel electrode as reference. Results are compared to the standard hydrogen electrode with no correction for temperature.

b) *Redox potential measurement in buffered agar at various pH’s* Purified agar may be buffered to various pH values using a dipotassium hydrogen phosphate/citric acid buffer. Buffering was achieved by addition of the following solution (ml per 100 ml agar):

<table>
<thead>
<tr>
<th>pH</th>
<th>0.4 M dipotassium hydrogen phosphate</th>
<th>0.2 M citric acid</th>
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<tr>
<td>5.7</td>
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