

Rice Fact Sheet Abstracts

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Fact Sheets on How to Grow Rice

The references contained in this section are fact sheets produced by the International Rice Research Institute. Each fact sheet is designed to provide quick answers to each of the categories displayed on the left side of the page.

To view a fact sheet, click the appropriate link. To print a fact sheet, click the Print button at the top of the screen.

Title Growing Organic Rice
Keywords technology transfer, organic, safe, alternative
Abstract Organic rice is rice that is certified by an independent body, to have been grown and processed according to set "organic" standards.
Author M A Bell
Date January 2004

Title Rice Fish Systems
Keywords rice, fish, integrated
Abstract A rice-fish system is an integrated rice field or rice field/ pond complex, where fish are grown concurrently or alternately with rice. Fish may be deliberately stocked (fish culture), or may enter fields naturally from surrounding water ways when flooding occurs (rice field fisheries), or a bit of both. Fish yields can range widely from of 1.5 to 174 kg/ha/season depending on the type of rice fish system, the species present, and the management employed.
Author R Gregory, G Jahn, and MA Bell
Date February 2004

Crop Establishment

Crop Establishment



Title Hybrid Rice
Keywords Hybrid, increased yields, increased vigor, Increased resistance, pollination, giberellic acid, flowering, cross
Abstract A hybrid is the product of a cross between two genetically distinct rice parents. When the right parents are selected, the hybrid will have both greater vigor and yield than either of the parents.
Author S.S. Virmani, Fangming Xie and M.A. Bell
Date August 5, 2005

Nurseries

Title Modified Mat Nursery
Keywords A modified mat nursery establishes seedlings in a layer of soil mix, arranged on a firm surface.
Abstract nursery, modified mat, plant establishment
Author V Balasubramanian, M Bell and J Rickman
Date September 2003

Title Reduced Area Wetbed Nursery
Keywords reduced area wet bed nursery, crop establishment
Abstract A reduced area wet-bed nursery is similar to traditional nurseries except that it uses just 1% of land compared to traditional nurseries that require about 5-10% of the land to be planted. Seed is sown at a higher density.
Author V Balasubramanian, M Bell and J Rickman
Date August 2003

Seeding

Title Dry Direct Seeding
Keywords dry direct seeding, broadcast, broadcasting, crop establishment
Abstract In rainfed and deepwater ecosystems, dry seed is manually broadcast onto the soil surface and then incorporated either by ploughing or by harrowing while the soil is still dry. In some cases (e.g., deepwater rice areas), the seed is not incorporated after broadcasting.
Author M Bell, J Rickman, and V Balasubramanian
Date September 2003

Title Wet Direct Seeding
Keywords crop establishment, wet direct seeding
Abstract In wet direct seeding, seed is normally pregerminated prior to broadcasting onto recently drained, well-puddled seedbeds or into prestanding water in the fields. Wet direct seeding more commonly used in irrigated areas.
Author M Bell, J Rickman, and V Balasubramanian

Transplanting

Title Machine Transplanting
Keywords transplanting, machine, crop establishment
Abstract Machine transplanting involves planting young rice seedlings into puddled soil by machine.
Author M Bell, V Balasubramanian, and J Rickman
Date September 2003

Title Manual Transplanting
Keywords transplanting, machine, crop establishment
Abstract Transplanting is the most common method of crop establishment for rice in Asia. Rice seedlings grown in a nursery are pulled and transplanted into puddled and leveled fields 15 to 40 days after seeding (DAS). Rice seedlings can either be transplanted manually or by machine. Broadcasting of seedlings is also practiced in some parts of China.
Author M Bell, V Balasubramanian and J Rickman
Date September 2003

Title Using Good Seed
Keywords Good, Clean, and Healthy Seed
Abstract Good seed leads to lower seed rate, higher crop emergence (>70%), reduced replanting, more uniform plant stands, and more

vigorous early crop growth. Vigorous growth in early stages reduces weed problems and increases crop resistance to insect pests and diseases. All these factors combine to give a 5-20% increase in yield. The poorer the seed presently being used by farmers, the greater is the increase in yield.

Author T Mew, J Rickman, M Bell, V Balasubramanian and D Shires
Date April 2003

Title Variety Selection

Keywords Variety, selection, crop establishment, varieties

Abstract Information for choosing the best variety for local conditions. Use locally adapted varieties to ensure good crop establishment and high yield with acceptable grain quality for market.

Author G Atlin, M Bell, V Balasubramanian

Land Preparation

Land Preparation



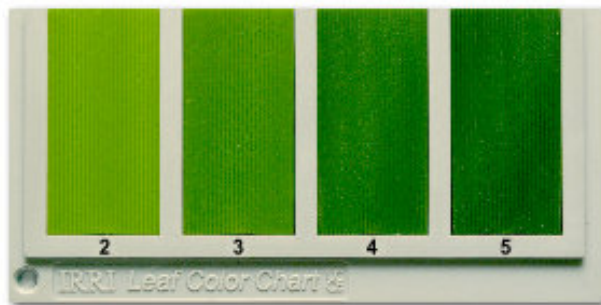
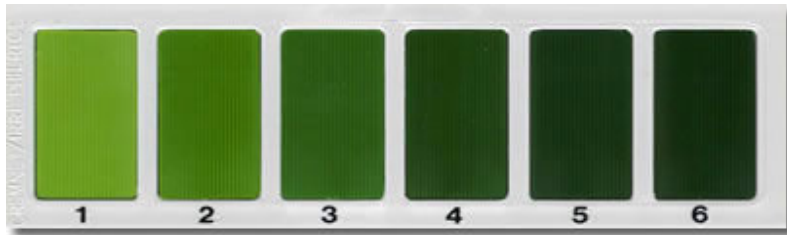
Title Land Leveling
Keywords land preparation, leveling
Abstract Leveling rice fields improves water use efficiency, increases grain yield, and improves grain quality.
Author J Rickman
Date May 2003

Title Types of Farm Power
Keywords power, machinery, horsepower, efficiency
Abstract All farm power operations require a specific amount of energy. The time required will vary according to the size and type of power source used. Power can be supplied by humans, animals, or machines.
Author J Rickman
Date April 2003

Nutrient Management

Nutrient Management

Click any of the following links below the Nutrient Management book on the left side of the screen to view fact sheets concerning Nutrient Management.



Initially IRRI promoted the 6 panel LCC.
More recent research has led to the development of the 4 panel.

Nutrient Management Practices

Title Addition Plots
Keywords n, p, k, nitrogen, potassium, potash, addition plots, nutrient management, integrated
Abstract Addition plots are demonstration plots in farmers' fields where one factor is changed or an additional treatment is included in comparison to the farmer's practice. Treatments may include a change in planting density, a new variety, or additional amounts of a specific fertilizer nutrient.
Author RJ Buresh, C Witt, and M Bell
Date January 22, 2004

Title Composting Rice Residue
Keywords ed dCompost, Rice, Residueuring composting.
Abstract Compost is the relatively stable product that results after organic materials — such as crop residues and animal manure —

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decompose.

Compost usually contains relatively low amounts of major nutrients. In general, carbon (C) is reduced and other nutrients are concentrated

Author M.A. Bell, V Balasubramanian
and J.F. Rickman

Date November 22, 2004

Title Nutrient Omission Plots

Keywords n, p, k, nitrogen, potassium, potash, omission plots, nutrient management, integrated, INM

Abstract The omission plot technique is used to estimate fertilizer requirements. In an omission plot, adequate amounts of all nutrients are applied except for the nutrient of interest (the omitted nutrient).

Author C Witt, RJ Buresh, V Balasubramanian, M Alam

Date December 2003

Title Site Specific Nutrient Management (SSNM)

Keywords n, p, k, nitrogen, potassium, potash, site specific, ssnm, nutrient management, integrated, INM

Abstract Site-specific nutrient management promotes:

- feeding rice with nutrients as needed
- adjusting rates and timing of fertilizer applications to location- and season-specific conditions
- applying N, P, and K in a site-specific ratio required by rice
- applying S, Zn and micro-nutrients as required.

Author R. Buresh, C. Witt, and V. Balasubramanian

Date December 2003

Title Organic Materials and Manures

Keywords organic, nutrient management, alternative sources of nutrients, cattle, straw, compost, green, manure

Abstract Organic material and manures are those materials that come from plant or animal waste or by-products such as cattle or poultry manure, composted rice straw or other crop residues, sewage sludge, oil cakes, green manures, and legume clippings.

Author V Balasubramanian and M Bell

Specific Nutrients

Title Iron (Fe)

Keywords INM, Nutrient management, Iron, Fe, toxicity, deficiency

Abstract Iron is an essential plant nutrient required for electron transport in photosynthesis. It is an important electron acceptor in redox

reactions and an activator for several enzymes. Iron deficiency may inhibit K absorption. Iron is not mobile in the plant or soil.

Author V Balasubramanian, RJ Buresh and M Bell

Nitrogen Management

Title Azolla

Abstract Azolla is a freshwater water fern that lives in ponds, lakes, swamps, and streams in both tropical and sub-tropical conditions. For many centuries, azolla has been used in southern China and northern Vietnam as green manure for rice.

Author JK Ladha

Date October 2003

Title Leaf Color Chart (LCC)

Keywords nitrogen, management, INM, nutrient management

Abstract Nitrogen (N) fertilizer is one of the major inputs in rice production. Inadequate or excessive amount or improper timing of N application may lead to large N losses and poor N use efficiency in flooded rice. New tools are needed to synchronize N application with crop demand and minimize N losses to the environment. Here is a simple and inexpensive tool that could improve farmers' decision making process in N management for rice.

Author Balasubramanian, Bell, Witt, Buresh

Date April 2003

Title Nitrogen

Keywords nitrogen, management, INM, nutrient management

Abstract Nitrogen is an essential plant nutrient being a component of amino acids, nucleic acids, nucleotides, chlorophyll, enzymes, and hormones. N promotes rapid plant growth and improves grain yield and grain quality through higher tillering, leaf area development, grain formation, grain filling, and protein synthesis. N is highly mobile within the plant and soil.

Author V Balasubramanian and M Bell

Date December 2003

Title Nitrogen Split Applications

Keywords nitrogen, management, INM, nutrient management

Abstract The splitting pattern approach provides a recommendation for the total N fertilizer requirement (kg/ha) and a plan for the splitting and timing of applications in accordance with crop growth stage, cropping season, variety used, and crop establishment method. The leaf color chart (LCC) can be used to adjust individual topdressings.

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Author C Witt, A Dobermann, and RJ Buresh
Date December 2003

Title Sesbania
Keywords nitrogen, management, INM, nutrient management, alternative sources of nitrogen
Abstract Sesbania is a legume commonly used as a green manure crop to add nitrogen and organic matter to the soil. The most common species of sesbania used in Asia are Sesbania cannabina (former name acculeata), S. rostrata and S. cannabina (which produces nitrogen-fixing nodules in its roots). Sesbania rostrata (produces nitrogen-fixing nodules in both roots and stems) and is commonly found in Africa.

Author JK Ladha and M Bell
Date January 2004

Title Phosphorus (P)
Keywords INM, n, p, k, phosphorous, nutrient management
Abstract Phosphorous is an essential plant nutrient important for root development, tillering, early flowering, and ripening. It is mobile within the plant, but not in the soil.

Author V Balasubramanian, C. Witt, RJ Buresh, and M Bell.
Date December 2003

Title Potassium (K)
Keywords INM, n, p, k, phosphorous, nutrient management
Abstract Potassium is an essential plant nutrient that improves root growth and plant vigor, helps prevent lodging and enhances crop resistance to pests and diseases. Potassium is mobile in the plant and quite mobile in the soil.

Author V Balasubramanian, C Witt, RJ Buresh, and M Bell
Date December 2003

Title Sulfur (S)
Keywords INM, n, p, k, phosphorous, nutrient management
Abstract Sulfur is an essential plant nutrient required for chlorophyll production. It is needed to produce essential amino acids (cysteine, methionine, and cystine) in plants that are related to human nutrition. S is quite mobile in the plant (though less so than N) but only partially mobile in the soil.

Author V Balasubramanian, RJ Buresh and M Bell
Date December 2003

Title Zinc (Zn)
Keywords INM, n, p, k, phosphorous, nutrient management, zinc
Abstract Zinc is an essential plant nutrient required for several biochemical processes in the rice plant, including chlorophyll production and membrane integrity. Thus, Zn deficiencies affect plant color and turgor. Zinc is only slightly mobile in the plant and quite immobile in soil.
Author V Balasubramanian, RJ Buresh and M Bell
Date December 2003

Pest Management

Pest Management



Diseases

- Title** Bacterial Blight
Keywords Bacterial blight, disease, bacterial ooze, grayish, poorer quality grains
Abstract Bacterial blight (BB) is a disease that affects both seedlings and mature plants. When BB causes wilting in seedlings, it is known as "kresek" and when it attacks leaves, it is known as "bacterial leaf blight".
Author C Vera Cruz, IP Oña and MA Bell
Date September 6, 2004
- Title** Bacterial Leaf Streak
Keywords Bacterial Leaf Streak, lesions, tropical asia, west africa, disease, yellowish gray
Abstract Bacterial leaf streak (BLS) initially causes narrow, dark-green and water-soaked streaks on the interveins usually from tillering to booting.
Author C Vera Cruz, IP Oña and MA Bell
Date September 6, 2004
- Title** Blast
Keywords blast, fungus, disease, fungal disease
Abstract Rice blast is one of the most important diseases found in rice. It is caused by the fungus (*Magnaporthe grisea* (Hebert) Barr) and can affect the leaf, culm, nodes and neck of the panicle. With blast, leaf lesions are distinctively grey in the center, exhibit dark borders and are diamond-shaped (large in the middle and tapering to ends). Leaf symptoms are similar to *Bipolaris* leaf spot (also known as brown spot). When blast attacks nodes on the stem, it can be confused with rat damage (although rats are associated with physical damage). Panicles affected by neck rot can be confused with stemborer damage (except with blast, the panicle is still

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connected to the stem).
Author C Vera Cruz, N Castilla, T Mew and MA Bell
Date April 2004

Title Brown Spot
Keywords brown spot, lesions, brown lesions, discoloration, fungal disease, infection
Abstract Brown spot is a fungal disease that can infect both seedlings and mature plants.

Author C Vera Cruz, IP Oña and MA Bell
Date September 3, 2004

Title Sheath Blight IPM
Keywords IPM, integrated pest management, diseases, fungal
Abstract Sheath blight is a fungal disease caused by *Rhizoctonia solani*. Sclerotia can float to the water surface during land preparation. When sclerotia touch the plant they germinate and the fungi penetrate the plant.

Author G. Jahn, C. Pol, T. Mew and M. Bell
Date October 2003

Title Tungro
Keywords leafhopper, disease, green leafhopper
Abstract Tungro is a rice disease (virus) that mainly affects plants during vegetative growth and causes severe stunting and a reduction in the number of tillers. Both the leaf sheath and leaf blade are shortened and affected leaves are often light yellow to orange-yellow. Young leaves are often mottled or have pale green to white stripes of different lengths running parallel to the veins. Symptoms start at the tips of the older leaves. Leaf yellowing is less when older plants are infected. Normally patches of plants are affected across the field. Two species of green leafhopper (GLH) (*Nephotettix malayanus* and *Nephotettix virescens*) are the primary insects that cause the spread of the virus

Author G Jahn, I. Choi and MA Bell
Date March 2004

Insects

Title Armyworms
Keywords IPM, integrated pest management, pests, insects
Abstract Armyworms are caterpillars that attack rice. At least three species attack rice in Asia: the rice swarming caterpillar (*Spodoptera mauritia* (Boisduval)), the common cutworm (*Spodoptera litura* (F.)), and the rice ear-cutting caterpillar (*Mythimna separata* (Walker)). A single armyworm egg mass contains hundreds of eggs. Each female lays 800- 1000 eggs during its lifetime of about one week.

Author Prepared by G Jahn and C Pol as part of the Cambodia-IRRI-Australia Project (CIAP) IPM Program with the DOA Office of Crop Protection.

Date September 2003

Title Green Leafhopper

Keywords tungro, spread, disease

Abstract Green leafhoppers are the most common leafhoppers in rice fields and are primarily important because they spread the viral disease tungro. Both nymphs and adults feed by extracting plant sap with their needle-shaped mouthparts.

Author G Jahn, I Choi and MA Bell

Date March 2004

Title Plant Hoppers

Keywords IPM, integrated pest management, pests, insects

Abstract Planthoppers are tiny brown-gray insects (0.1 - 0.4 cm long). Long-winged forms of brown planthoppers (BPH), *Nilaparvata lugens* (Stål), and white backed planthoppers (WBPH), *Sogatella furcifera* (Horvarth) develop when food is unavailable, or when they are crowded. Long-winged adults can disperse for hundreds of kilometers.

Author Gary Jahn, Kiev Bunnarith, Pol Chanty & Chhorn Nel; Cambodia-IRRI-Australia Project

Date September 2003

Title Rice Bug

Keywords IPM, integrated pest management, pests, insects

Abstract There are several species of rice bugs, or rice seed bugs, all in the genus *Leptocorisa*. The most common species are *Leptocorisa oratorius* (F.) and *Leptocorisa acuta* (Thunberg). Adults are about 15 mm long and 3 mm wide; have long legs; and a brown-green body. An infested field can be recognized by the rice bugs' offensive odor. Adults are active in the late afternoon & early morning, resting in shaded areas. Each female lays hundreds of eggs during a lifetime of 2-5 months.

Author G. Jahn, P. Chanthy, Pheng Sophea, Khiev Bunnarith & Chhorn Nel of the Cambodia-IRRI-Australia Project

Date September 2004

Title Rice Leaffolder IPM

Keywords IPM, integrated pest management, pests, insects

Abstract The adult rice leaffolder (*Cnaphalocrocis medinalis*) is a yellow-brown moth. Leaffolder caterpillars fold a rice leaf around themselves and attach the leaf margins together with silk strands. Each female lays about 300 eggs at night during its lifetime of 3-10 days.

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Author Prepared by G Jahn, C Pol (as part of the Cambodia-IRRI-Australia Project (CIAP) IPM Program), Cambodian DOA Office of Crop Protection and M Bell.

Date September 2003

Title Stem Borer IPM

Keywords IPM, integrated pest management, pests, insects

Abstract Stem borers are caterpillars that live in rice stems. They eventually turn into yellow or brown moths; usually one larva occurs per tiller. Moths are active at night. A female can lay up to three egg masses during her 7 to 10 day life as an adult. Egg masses of yellow stem borers are disc-shaped and covered by a light brown mat of hair from the female abdomen. Each egg mass contains about 100 eggs.

Author G. Jahn

Date November 2003

Rodents

Title Rodent Control (Non-Chemical) in Lowland Irrigated Rice

Keywords rodents, pests, rice, rat, problems, harvest rice management, ricefield rats, black rats, trap barriers system

Abstract Which rodents are pests in rice? Many rodents cause problems in rice. The main pests are the "Rice field rat" (*Rattus argentiventer*), the Black rat (*Rattus rattus*) and the lesser bandicoot rat (*Bandicotabengalensis*). Various mice can also cause problems. The presence of rats is usually associated with tracks in mud and rat holes in bunds and levees.

Author Grant Singleton (CSIRO; grant.singleton@csiro.au) and MA Bell

Date May 12, 2004

Snails

Title Golden Apple Snails

Keywords snails, preventing field entry, control, snail eggs, ducks, biological control, chemical control

Abstract The golden apple snail [*Pomacea canaliculata* Lamarck] was introduced into Asia during the 1980's from South America as a potential food for people. Unfortunately, the golden apple snail has become a major pest of rice having spread to the Philippines, Cambodia, Thailand, and Vietnam.

Author KL Heong, R Joshi (DA-PhilRice), and M Bell

Date September 24, 2004

Weeds

Title Chemical Weed Control

Keywords IPM, integrated pest management, weeds, herbicides

- Abstract** In chemical weed control, chemicals called herbicides are used to kill certain plants or inhibit their growth. Chemical weed control is an option in integrated weed management that refers to the integrated use of cultural, manual, mechanical and/or chemical control methods.
- Author** M Bell, J Rickman and V Balasubramanian
Date September 2003
- Title** Cultural Weed Control
Keywords IPM, integrated pest management, weeds, herbicides
Abstract Cultural weed control includes non-chemical crop management practices ranging from variety selection to land preparation to harvest and postharvest processing. Cultural weed control is a part of integrated weed management which involves the integrated use of cultural, manual, mechanical and/or chemical control methods.
- Author** M Bell, and J Rickman and V Balasubramanian
Date September 2003
- Title** Main Weeds of Rice in Asia
Keywords IPM, integrated pest management, weeds, herbicides
Abstract A collection of photographs and descriptions of the main weeds of Rice in Asia.
- Author** Developed with input from M Bell, and J Rickman and V Balasubramanian Photos from: Mueller, K.E. 1983. Field Problems of Tropical Rice. Revised. International Rice Research Institute. Los Banos, Philippines
Date September 2003
- Title** Manual Weed Control
Keywords IPM, integrated pest management, weeds, herbicides
Abstract Weeds are removed and collected from crop fields by hand. The collected weeds are piled on bunds or in case of certain weeds, taken home to feed animals. Manual weeding is a part of integrated weed management that involves the integrated use of cultural, manual, mechanical and/or chemical control methods.
- Author** M Bell, V Balasubramanian and J Rickman
Date September 2003
- Title** Mechanical Weed Control
Keywords IPM, integrated pest management, weeds, herbicides
Abstract Weeds are controlled using a rotating hoe (rotary or conical weeder) to cultivate, uproot and bury emerging young weeds between rows of rice plants. Mechanical weeding is a part of integrated weed management that refers to the integrated use of cultural, manual, mechanical and/or chemical control methods.
- Author** M Bell, V Balasubramanian, and J Rickman

Rice Fact Sheet Abstracts

Post-Harvest

Post-Harvest Management

The section on post-harvest management highlights the importance of managing grain moisture at the various stages of post-harvest management. Over time, this section will include fact sheets for all post-harvest operations including grain cleaning and drying, storage, and milling.

Click any of the following links below the post-harvest book on the left side of the screen to view fact sheets concerning post-harvest management.



Title Brown Rice
Keywords Brown rice, white rice, dark coloring, storage, iron deficiency, vitamins, minerals
Abstract Brown rice – in contrast to white rice - still has the bran layer.
Author JF Rickman, M Gummert, M Fitzgerald and M.A. Bell
Date October 18, 2005

Drying

Title Paddy Drying Systems
Keywords drying, paddy, storage, post harvest
Abstract Rice is usually harvested at grain moisture content (MC) between 24 and 26% (wet basis). Any delays in drying, incomplete drying or uneven drying will result in qualitative and quantitative losses including:

- Yellowing or discoloration caused by mold development and heat build-up from respiration.
- Reduced milling yields caused by high temperatures and re-wetting of grains.
- Loss of germination and vigor from grain respiration, mold and insect activities, or from exposure of grains to temperatures above 42°C.
- Damage caused by insects that are more active at higher MC levels.

Author M Gummert, JF Rickman, M Bell, and the IRRI Agricultural Engineering Unit.
Date April 2004

Title Grain Drying - Sun Drying
Keywords paddy, drying, sun, storage, moisture, content, post harvest

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Abstract Sun drying is the traditional method for reducing the moisture content (MC) of paddy by spreading the grains in the sun. The solar radiation heats up the grains as well as the surrounding air and thus increases the rate of water evaporating from the grains.

Author M Gummert, JF Rickman and MA Bell

Date April, 2004

Title Grain Quality

Keywords Grain quality, smell(aroma), cooking characteristics, size, color, nutritional value, percent whole grains, market price, consumer preferences

Abstract Grain quality means different things to different people depending on what they prefer. Thus, grain quality can be a combination of many factors such as smell (aroma), size, cooking characteristics, color, nutritional value, percent whole grains, etc..

Author J.F. Rickman, M Gummert and M.A. Bell

Date September 9, 2005

Title Harvesting

Keywords Harvesting, Manual harvesting, Cutting, Threshing, Cleaning, Field drying, Hauling, Stacking/Piling, Bagging

Abstract Harvesting is the process of collecting the mature rice crop from the field.

Author M Gummert, J Rickman and MA Bell

Storage

Title Grain Storage - Hermetically Sealed Systems

Keywords grain, storage, hematic, container, storage systems

Abstract Hermetically sealed storage involves putting grain into sealed containers that stop the movement of air (oxygen) and moisture between the outside atmosphere and the stored grain. The system can use special plastic containers (such as the volcanic cube and grain cocoons) or smaller containers made of plastic or steel or even clay water pots. The size of the systems can range from 25 litres to 300 metric tons. The system can be used for paddy, milled rice and other cereal crops such as corn.

Author M Gummert, J Rickman and MA Bell

Date March, 2004

Title The IRRI Super Bag

Keywords super bag, storage bag, jute bags, woven polypropylene, control, grain pest, maintain, extend, farmer-friendly

Abstract The IRRI Super Bag is a farmer-friendly storage bag that allows cereal grains and other crops (e.g., coffee) to be safely stored for extended periods. The Super bag fits as a

liner inside existing storage bags
(e.g., woven polypropylene or jute bags).
JF Rickman, M Gummert
February 17, 2005

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