Manual of Rice Variety Releasing Process in Sri Lanka

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Foreword

Department of Agriculture has made tremendous effects towards food security in the country by developing and recommending rice varieties and disseminating to the farming community. Paddy production can be increased by making high-quality seed availability among farmers. Rice breeders of the Rice Research and Development Institute, over the years directed their long term focus on increasing rice productivity either through variety improvement or developing improved management practices. Releasing a rice variety is a series of events, which occurs over a period of time. The Department of Agriculture in Sri Lanka has a well defined variety releasing process.

I am very happy to provide a "foreword" for this book and also grateful to staff of RRDI for undertaking this valuable and timely task. I am sure book will be a very useful resource for breeders and other people who work with rice breeding in the country.

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Content

1. Introduction

Rice is the staple food crop in Sri Lanka. It is cultivated in all the districts of Sri Lanka during two cropping seasons (*Yala* and *Maha*). Crop improvement has been the most essential component of Sri Lanka's national effort to increase agricultural production. Improved rice varieties play an important role not only to enhance the productivity but also to mitigate adverse effect of biotic, abiotic stresses and adverse weather conditions, which affect rice production. The most cost effective and environmental friendly method to withstand adverse conditions is the development of tolerant rice varieties. Paddy production can be increased by making high-quality seed available among the farming communities of the country. Department of Agriculture of Sri lanka has made a significant contribution to fulfill this objective by establishing a strong seed paddy production program with government farms and contract growers.

The Department of Agriculture in Sri Lanka has the authority for formal variety releasing process in Agricultural Crops. Releasing a rice variety is a series of events, which occurs over a period of time and therefore, the term "Releasing Process" is used. The sequences of major events in a 'Releasing Process' include variety development, evaluation, description, release proposal, review by releasing committee, decision to release and post release follow up. Thus, it is seen that the Releasing Process actually involves many technical as well as administrative and non-technical steps. Often, in varietal improvement and release, the technical steps become the focus of attention.

2. Past Efforts to Improve Rice Cultivation

2.1 Use of traditional rice variety and pure line selection I

There was no proper program for rice varietal development in Sri Lanka prior to 1930s. A collection of around 300 traditional rice varieties throughout the island was exhibited in Agricultural and Horticultural exhibition held in Kandy in 1902 by Nugawela Disawa. In 1940s, the Sri Lankan population was around 6 million and about 75% of the rice requirement was imported. During that period national average yield was 0.65 t/ha (13 bu/ac) due to the cultivation of old traditional type which having low grain yield potential. Although, there was a little interest in improving rice varieties, pure line selection (purification of land races) was identified as a possible mean of rice variety improvement. Rice land race is a mixture of rice cultivars varying morphological features such as plant height, maturity duration, grain type etc. Pure-lines are developed by purification and selection of land races and they are morphologically uniform. Such selections carried out at Mahailluppallama and at Gannoruwa paddy stations demonstrated that, about 15% yield increase over the mixed or land races under experimental conditions. However, those selections had no significant impact on the rice production in the country.

During the Second World War, the country underwent a severe shortage of foreign exchange and as a result food importation drastically reduced resulting in severe shortage of rice. The colonial authority recognized the importance of agricultural development, particularly on rice, the staple food. Two basic requirements were considered to increase the rice production in the country i.e. expanding the cultivated extent and intensifying the production per unit area of

land using improved seeds. Expanding the extent under cultivation was not possible leaving the other alternative as the only approach. Since there was little or no research carried out in the country to improve rice varieties, the Department of Agriculture took over the responsibility for that. At that time there were around 150 traditional rice varieties, which belonged to 4 different age classes i.e. 5 - 6 months, 4 - 4.5 months, 3.5 months and 3 months. Each age class was dominated by one or few varieties. Fifty percent of the cultivated varieties belonged to photoperiod sensitive, 5 - 6 months age class, 31% to medium age class (4 - 4.5 months) and 10% to short duration (3 - 3.5 months or less) cultivars. Most of the rice lands were cultivated during *Maha* season with long age varieties.

2.2 Pure line selection II

In 1940s, The Department of Agriculture considered pure-line selection as the most appropriate method for the improvement of rice crop. The failure of the earlier attempt to develop pure lines was due to the non-isolation of the most desirable pure lines. This could be due to the large number of selections followed by the failure in seed production and distribution. Therefore, the best from the earlier selection and several other pure-lines from popular traditional varieties were isolated and released for cultivation. The best of those were Podiwee A8 (5 - 6 months), Vellai Illankayan 28061 (4 - 4.5 months), Vellaiperumal 28724 (3.5 months) and Pachchaperumal (3 months).

Since the use of synthetic fertilizer was considered as the quickest way of increasing yield, they were introduced to the cultivation of pure line varieties. Application of fertilizer, especially N increased the susceptibility to rice blast disease. The most popular pure line

varieties Vellaiillankayan 28061 and Murungakayan 302 were found to be resistant to blast disease while all others were susceptible. Further, pure line varieties had excessive vegetative growths due to nitrogen fertilizers and resulted in lodging, limiting increased rice production. Therefore, high fertilizer response and blast resistance were identified as major objectives in rice variety improvement.

2.3 Introductions from other countries

Some of the rice varieties were introduced from other tropical countries i. e: Ptb 16 from India, Mas and Sigadis from Indonesia. Those introductions were also not successful because of the susceptibility to blast disease. Therefore, the second phase of the variety improvement work ended without a success, leaving the sole option of converging beneficial traits scattered in many different rice varieties into one variety by hybridization. That was followed by selection and screening of segregating populations for pests and diseases and for other stress conditions.

2.4 Old improved varieties

In 1952, the hybridization program was initiated at the Agricultural Research Station in Mahailluppallama and was later shifted to Batalagoda. It became the Central Rice Breeding Station and subsequently named as the Rice Research and Development Institute of Sri Lanka in 1994. As a result of variety development through hybridization and selection, a series of varieties referred as H series varieties emerged and released for general cultivation. At present they are named as Old Improved Varieties (OIV). Those were resistant to blast and moderately responsive to added fertilizers and thus fulfilled the basic requirements for increasing rice production. However, those varieties also possessed some undesirable traits such as lodging and

heavy canopy structure, which prevented in obtaining higher grain yields. Therefore, rice breeders changed their strategies to develop New Improved Varieties (NIV).

2.5 New improved varieties

Development of Taichung Native 1 (TNI) in Taiwan, IR 8 and IR 262 at the International Rice Research Institute, Philippines paved the way to introduce the improved plant types to modern varieties. The major attributes of NIVs were improved photosynthetic efficiency, enhanced fertilizer response and resistance to lodging. Stabilizing rice yield was attempted through breeding for resistance /tolerance to biotic or abiotic stresses. Among the biotic factors diseases, Rice Blast (BL), Bacterial Leaf Blight (BLB) and Sheath Blight (SB) are considered as major diseases. Among the insects, Brown Plant Hopper (BPH), Rice Gall Midge (RGM) and Rice Thrips (TH) are considered the major pests. Rice varieties resistant to BL, BLB, BPH and RGM have been developed and released for cultivation. Short duration varieties (3 - 3.5 months) are more economical over the long aged varieties. At present, more than 93% of the paddy extent in the country is grown with short duration varieties and about 6% is grown with medium aged varieties. The area cultivated under long aged varieties is less than 1% of the total cultivated extent. At present more than 99% of the rice area is under NIVs.

3. Varietal Development and Release

Main steps of the rice varietal releasing procedure of the DOA.

- Hybridization and Selection
- Evaluation by Breeder
- National Coordinated Rice Varietal Testing (NCRVT)
- Variety Adaptability Testing (VAT)
- Large Scale Variety Adaptability Testing (LSVAT)
- Distinctness Uniformity and Stability Test (DUST)
- Variety Releasing Committee (VRC) Procedures
- Naming of Varieties

3.1 Breeding and selection

During the past few decades, the Department of Agriculture placed its topmost priority on rice breeding. Breeding programmes were implemented to developed rice varieties under different age categories (2.5, 3, 3.5 and 4 months) to meet different requirements. Ultra short-age varieties (2.5 months) have been developed for water dificit rainfed areas and 3 months varieties have been introduced to less water available areas. 3.5 months varieties are the most popular age group and cover the large extent of rice cultivation area of the Island. Long aged varieties (4 months) have been developed and introduced to the areas where water is available throughout the season to obtain higher yields. Currently rice breeders practice Modified Bulk Method for varietal improvement process. It involves both bulk selection (up to F_4 Generation) and pedigree selection (after F_4 Generation) procedures. In addition, biotechnological tool are used to incorporate the specific traits/ genes to overcome the drawbacks of available varieties in rice breeding.

3.2 Evaluation by breeder

Initial evaluation by breeders start with screening and observational studies. These evaluations include the preliminary and major yield trials. They are supported by other scientists such as pathologists, entomologists and grain quality scientists, to evaluate the selected lines for pest, disease and grain quality characters. The optimum plot size and populations are maintained in all yield trials. Identified promising rice lines are introduced to the next step with continuous purification and multiplication.

Introduced foreign rice varieties/ lines with permission from the country of origin, which are identified for special purpose through screening and evaluation process, are also evaluated through the same process.

3.3 National Coordinated Rice Varietal Testing (NCRVT)

The promising rice lines developed by breeders are further evaluated in the NCRVT. The objective of the NCRVT is to identify the most adaptable rice lines with reasonable high yield, better grain quality and biotic and abiotic stress tolerance over diverse agroecological environments under researcher managed conditions. Therefore, the trials are conducted in 12 research stations located in diverse agro-ecological zones in Sri Lanka. Separate trials for each age group are established in Randomized Complete Block Design with 4 replicates and the trials are conducted for 3 consecutive cropping seasons. The plot size is 6m x 3m. The new rice lines are always compared with the most popular high yielding, quality and recently released variety of the respective age group as standard checks. These NCRVT are assessed by a multidisciplinary team working in different research stations.

A group of scientists including breeders, agronomists, pathologists, entomologists, grain quality scientists, soil scientists visit the trials every season and evaluate the field performance of the tested lines in different research stations. The most adaptable and stable lines selected through the statistical analysis and performances over the standard check in relation to yield and other supporting data are nominated to test in VAT.

3.4 Variety Adaptability Testing (VAT)

The promising rice lines selected for high yield and tolerance to biotic /abiotic stresses in the NCRVT are tested in a wide range of agro-ecological environments to evaluate their adaptability under small scale farmer managed conditions. The plot size is 6m x 4m and the testing is conducted at least in 2 consecutive seasons with a standard check as described in section 3.3. The tests are carried out under the supervision of both research and the extension staff. The most adaptable lines with high yield potential and other desirable characters in farmer field conditions are further tested in large scale VAT.

3.5 Large-Scale Variety Adaptability Testing (LS VAT)

These trials are basically conducted to identify the farmers' preference to the selected lines in relation to the growth behavior, grain quality, cultivation preference and marketability and compared with a standard check of the same age group. The plot size for one variety should be ¼ Ac. These trials are also supervised by the extension staff and conducted during two consecutive seasons. The rice lines, which are highly accepted by farmers can be nominated to the Variety Releasing Committee (VRC) after the DUS test is completed.

3.6 Distinctness Uniformity and Stability Test (DUST)

The testing of varieties for DUS was originally adopted by the Union for the Protection of new Varieties of Plants (UPOV). This Union was inaugurated in 1961. In Sri Lanka, the testing of candidate varieties for distinctness, uniformity and stability was introduced in 1984 as a requirement for the official release of varieties.

Comprehensive guidelines on DUS testing procedure have been issued by the Seed Certification Service (SCS) of the Department of Agriculture. The responsibility to describe a variety is primarily lied with the breeder. When a sample is submitted, the breeder is expected to submit a varietal description on a standard form. The SCS checks the variety in relation to these characters. Under normal circumstances, the SCS submits a report indicating whether a variety is distinct, uniform and stable, on a standard format. If the DUS test of a variety is accepted, a description of the variety is also given by the SCS.

3.7 Variety Releasing Committee (VRC) Procedures

3.7.1 The release proposal

The breeder should submit the variety releasing proposal directly to the Secretary, Varietal Releasing Committee of the Department of Agriculture. Some guidelines have been issued to the breeders regarding the contents and format of the proposal. The proposal should contain an introduction describing the reasons for developing the variety, the origin and development of the variety, its description, data pertaining to its agronomic performance and special merits in comparison with existing varieties, justification for release, a proposed name for the new variety and an indication of seed availability.

3.7.2 The decision to release

The following are the guide lines considered in decision making to release a new variety

(a) The completeness of the release proposal

(b) The comparative merits of the new variety if developed to replace an existing variety

(c) Whether the variety is to be national or regional recommendations. On some occasions, release of varieties is withheld when the proposal is incomplete.

As in rice where there are large numbers of recommended varieties, the release of new varieties has to be based on significant comparative merits. This aspect is given careful consideration in the evaluation process of the variety and has to be highlighted in the release proposal. The debate as to whether a variety should be a national release or a regional release is considered based on the adaptability and performance of the variety.

3.7.3 Release announcement and availability of seed

After a new variety is released, a formal announcement is released. Further, an announcement of a variety leads to a process of public awareness about the variety, which is an advantage in varietal spread. The breeders should work on pre-release seed multiplication.

3.7.4 Naming of varieties

During the earlier days, the introduced varieties were referred to by their original names. Later on, a sub-committee appointed by the VRC for naming and numbering paddy varieties submitted a proposal, to the VRC meeting of 10 July 1986. A decision was taken to retain the station code e.g Bg (Bathalagoda), Bw (Bombuwala), At (Ambalanthota), Ld (Labuduwa) etc and numbering systems as follows based on age class.

Table 01. Numbering system for naming varieties based on the age classes

Age class of the rice variety	Number	
	From	To
2.5 months	250	299
3 months	300	349
3.5 months	350	399
4 months	400	449
4.5 months	450	499
5 months	500	549
5.5 months	550	599

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