A Methodology for On-Farm Study of Land Preparation : Effect of Seedbed Structure on the Dynamics of Establishment of Rice (*Oryza sativa*) and Wild Rice (*Oryza perennis*) in Dry-seeded Paddies of Songkhla Lake Basin[1]

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ABSTRACT

A method based on cartography was developed in order to characterize seedbed structure for dry seeded rice under farmers' conditions in Sathing Phra area (Songkhla Lake Basin). Seedbed types were clearly identified and varied significantly according to year with the same tillage procedure.

This method was used to study rice and wild rice (*Oryza perennis*) dynamics of establishment as well as their distribution according to seedbed structure type. Rice seeds germinated better in small-sized than in large sized clod seedbeds and mainly in between clods. However, wild rice was shown to germinate mainly from clods which, as a consequence, may delay its germination compared to that of rice.

The definition of an optimum seedbed stucture is discussed.

INTRODUCTION

Tillage practices for land preparation vary widely in rice systems because rice is grown in diverse land and water management systems.

In dry-seeded rice (direct seeded). tillage practices are of particular importance to plant growth during germination, seedling emergence, stand establishment and weed infestation (De Datta 1980).

In rice growing areas of the Songkhla Lake Basin such as Sathing Phra and Ranod, dryseeded rice is the most commonly practised system due to the

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impossibility of control of the water level in the paddies and to labour shortage (CHITAPONG *et al.* 1985). In such systems, land preparation, generally limited to a single ploughing in dry conditions was shown to be determinant for rice establishment and wild rice (*Oryza perennis*) infestation and, in consequence, for rice yield (TREBUIL *et al.* 1984). In addition, a highly significant linear relationship was observed between rice plant density at harvest and grain yield of rico of 15 farmers fields (SITTICHAROENCHAI and CROZAT 1985). These latter data suggested that good rice establishment was a means for improving yields in the area.

This paper aims at presenting a methodology to define optimum seedbed structure referring to rice establishment and wild rice (*Oryza perennis*) infestation under farmers' conditions.

MATERIALS AND METHODS

"*Experimental design*"

Three farmer's fields were selected during 1984-85 rice cultivation and 6 during 1985-86 rice cultivation, Fields were chosen along a line transect in order to cover maximum range of soil type and topography of the Sathing Phra peninsula.

The desing aim was to study within the same field two types of seedbed structure :

Treatment 1 : a seedbed mainly composed of large-sized clods.

This corresponds to most farmers' seedbeds and is the result of a single ploughing in dry conditions in clayey textured soil.

Treatment 2 : a seedbed mainly composed of small-sized clods.

This corresponds to some parts of the field where the hand tractor passed sevreal times (existing heterogeneity) or can be obtained by an additional ploughing or by rolling.

If the existing heterogeneity within the field was not sufficient to distinguish small-sized clod seedbeds, an additional tillages of a part of the field was requested of the farmer in order to obtain treatment 2. In addition, if a third type of seedbed structure (medium-sized clods) was detected during the field survey it was considered as a third treatment (treatment 3). Sowing rate and crop management were similar in all treatments and performed by farmers.

Three observation squares of 1 m^2 per treatments were selected during 1984 and 2 per treatments during 1985.

"Characterization of the seedbed structure"

After preliminary classification of seedbed structure (largesized clods (T. 1), small-sized clods (T. 2) and, in some cases, medium-sized clods (T. 3) had been used to set up the experimental design described above, seedbed structure of 1 m^2 observation squares was characterized in detail. A metallic frame (lm × lm), covered by a plastic sheet, was fixed horizontally to four vertical metallic corner sticks which delimited each observation station. Frame height was adjusted so as to be as close as possible to the soil surface, and the outline of each clod (projected onto the horizontal plane) was recorded on the plastic sheet

Numbers of clods per observation station were determined at the office. Area of each clod was measured by planimeter.

Seedbed structure was characterized by the total number of clods/m^2, the total area covered by clods and the distribution of clod size according to size classes. Distribution was performed by computer using mean and standard deviation of clod size populations to establish 3 classes of clod size.

Afterwards a definitive classification of seedbed structures was established.

"Rice establishment and wild rice infestation"

In 1984, broadcasting rate was 15 kg/rai (9.4 g/m^2) in field A, 17.1 kg/rai (10.7 g/m^2) in field B and 20 kg/rai (12.5 g/m^2) in fiald C while in 1985

24 kg/rai ($15\ g/m^2$) was broadcast in all fields. Seed gemination was tested at the laboratory.

Rice and wild rice plants were plotted on the plastic sheet used previously for clod size characterization. During 1984, rice cultivation a single record was made per observation square one month after broadcasting. During 1985 rice cultivation, number of seeds was checked a few day after broadcasting on .25 m^2 basis close to the observation square and rice and wild rice population was checked periodically in the observation square, until complete submersion of the field.

Rice and wild rice plantules were distinguished with the help of farmers.

Dynamics of rice and wild rice establishment and their spatial distribution were analysed by computer according to the seedbed structure classification.

RESULTS

"*Characteristics of seedbed structures*"

During the 1984 rice cultivation this 3 dimensional characterization showed that seedbed structures from treatment 1 (large-sized clods), 2 (small-sized clods) and 3 (medium-sized clods) were clearly discontinuous except for two observation squares, B_2 and B_5 which should be classified as treatment 3 In addition B_4 seedbed structure appeared discontinuous with treatment 2 group because of particularly low area of small, medium and large sized clods. Type 1 seedbed was characterized by few clods ($< 68/m^2$), more than 50% of the surface area covered by clods and with a majority of large-sized clods ($> 128\ cm^2$). It was the result of a single ploughing traditionalty practised by farmere. Type III seedbed, on the contrary was characterized by more clods than type I seedbed ($> 80m^2$) which covered less than 42% of the area with a majority of small-sized clods ($> 47\ cm^2$).

During 1985 rice cultivation, seedbeds from treatment 1 were also clearly discontinuous with these from treatment 2 Two main groups were distinguished, while observation square D_3 and C_2 were apart. No intermediate group, like that in 1984, appeared because clod size was in general lower than in 1984. Type A group was characterized by more than 48 clods/m^2, covering between 24% to 41% of the area with a majority of clods over 85 cm^2. This seedbed structure, obtained after a single ploughing, was close to the medium-sized clod seedbed structure (Type II) obtained after two tiilages in 1984. On the contrary, type B group had a seedbed structure close to type III seedbed structure but with smaller clods and smaller area covered by clods.

"Dynamics of establishment of rice and wild rice"

Rice germination rates under laboratory conditions ranged from 23% to 96.5% in 1984 and from 94% to 100% in 1985.

Under field conditions, percent germination was lower than under laboratory conditions and increased with proportion of small-sized clods in the seedbed. In 1984, 18% germination was observed in seedbed type I, 23% in seedbed type II and 28% in secdbed type III. Detailed observation performed in 1985 showed that after broadcasing, a large number of seeds could not be recovered from the seedbed of type A. These seeds probably accumulated in deeper layers by rain leashing because of the large-sized clod structure of the seedbeds. On the contrary, most seeds remained on surface layer in seedbed of type B and germinated faster.

Rice population in observation squares confirmed that rice emergence was higher in small clod seedbeds. Rice plants mainly germianted in between clods, even in large-sized clod seedbeds. In 1985 rice emerged quickly after sparse showers and its population remained stable until temporary submersion of the field on the October 8 th. Some plant loss were observed in type A seedbeds after this submersion.

Wild rice infestation was the lowest in small-sized clod seedbeds but was not clearly affected by seedbed structure in 1984. Unlike rice, it germinated mainly on clods in type I seedbeds and less so as the relative area of large-sized clods decreased. Observations during 1985 showed that wild rice germinated much later than cultivated rice and over a longer period of them. Until the heavy rain of October lst, few wild seeds germinated and these germinated perferentially in between clods and in larger numbers in small-sized and seedbeds. On the contrary, after the heavy rain of October 1 st, more wild rice germinated, mainly on clods and in higher numbers in largesized clod seedbeds. Finally, wild rice infestation was lower in small-size clod seedbeds.

DISCUSSION

Research work on soil tillage under farmers' conditions is still very rare, although it is an essential component of cropping systems on small farm because of the rudimentary equipment used. For a long time, studies have been focussed on new tillage method, such as direct drilling and emphasis has been placed on the relationship between the tool and the yield, instead of the relationship between the tool and soil structure. The relationship between the tool and the yield has been demonstrated to be invalid and able to misinterpretation (SEBILLOTTE 1975, WINGATE-HILL 1978). The lack of appropriate field methods to quantify "tool–soil structure" interactions and their consequence on plant growth may explain this situation (MANICHON 1982).

Regarding seedbed structure, the cartography method described here is simple to use and relatively efficient in characterizing seedbeds. Area covered by clods and its distribution according to clod size were utilized to classify yields and treatments. It has also been show that according to the initial state of the soil and its texture, the same tool (one ploughing) can produce a seedbed structures of considerable diversity. In the same field, one ploughing in 1985 resulted in the same seedbed structure as 2 ploughings in 1984 (Type A and III), probably because of differences in soil moisture during ploughing.

In this case an attempt to find a direct relationship between number of ploughings and yield would be futile.

Compared with large-sized clod seedbeds, which usually characterize farmers' fields, small-sized clod seedbeds resulted in a better and faster germination of rice seeds, probably because of a better contact between the seeds and the soil. In large-sized clod seedbeds, numerous seeds were lost to deeper layers and seeds mainly germinated in between clods. As a consequence, the distribution of rice plants was more like a clustered distribution pattern with large areas little colonized (up to 60% in type I). On the contrary, on small-sized clod seedbeds plant distribution was closer to a ramdom pattern, with probably a better uses of the space by plants.

Small-sized clod seedbeds have also been shown to be favorable to wild rice germination. But wild rice seeds required more rainfall than did rice seeds to germinate in the field. Wild rice germination is generally inhibited under submerged conditions (PARKER 1976) and on differences in germination between rice and wild rice seeds were observed in laboratory conditions (HYAKUTAKE and ZUNGSONTIPORN 1984). Similar data were obtained in pot experiments in a greenhouse (CHITAPONG and CROZAT, unpublished data). This would suggest that under field conditions, wild rice seeds need more rainfall to germinate than broadcasted rice seeds because the former are mainly located inside clods. Germination would occur only after sufficient humidification of the clod which would take longer in larger-sized clods.

Data on emergence and distribution of rice obtained are in agreement with this hypothesis. Therefore in conditions of sparse showers, cultivated rice has an advantage over wild rice. If rice distribution is regular, such as in small-sized clod seedbeds and if rice growth is sufficiently advanced, further establishment of wild rice may be limited because of competition for light. This could have been the case of the 1985 rice cultivation. However, in conditions of heavy rainfall small-sized clod seedbeds may lead to a higher wild rice infestation than would the traditional large-sized clod seedbeds.

CONCLUSION

The cartography method developed to characterize seedbed structure appears to be a useful tool to define an optimum seedbed structure regarding rice and wild rice establishment. As rice seeding generally occurs during a period (August-mid September) having a low probability of heavy rainfall (CROZAT *et al.* 1985, APAKUPAKUL 1985), small-sized clod seedbeds may be more favorable than traditional large-sized clod seedbeds for yield of dryseeded rice. Such a seedbed may be obtained by a single ploughing and a rolling or harrowing in ralatively dry conditions.

AKNOWLEDGEMENTS

The authors express their thanks to Mr. Chanchai SANGCHYO-SAWAT for his technical assistance and to Dr. Alan GEATER for reading and correcting the manuscript.

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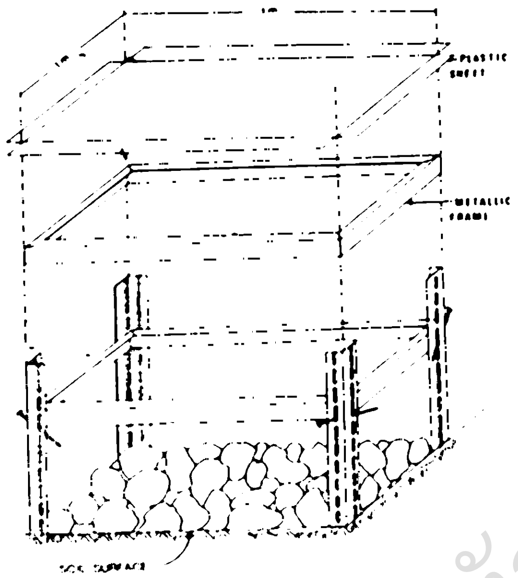

Fig. 1 : Detail of the experimental device used for seedbed structure characterization of an observation square.