RESULTS OF 2001 SRI TRIALS

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1. Introduction

Following the first exploratory trials in the 1999 WS and 2000 WS, we repeated the lowland trial during the 2001 DS and conducted five more trials during the WS; one being a continuation of lowland fertility trial and one being a slightly revised version of the lowland trial conducted during the 2000 WS and 2001 DS. Two of the 2001 trials looked at agronomic variables related to nursery management and to transplanting practices for several varieties under SRI type management. All these trials were conducted under lowland conditions; one trial was implemented on the uplands.

For all the trials “factorial designs “ were employed to permit exploratory comparisons between the conventional and the SRI systems and for different rice cultivars (ranging from very early NERICA hybrids to late maturing locals). Superimposed were various variables (e.g. plant density/spacing, seedling age at transplanting) to improve our understanding of the SRI growth features in comparison with the conventional irrigated system. Since the SRI practice places a particular emphasis on early plant development (nursery and transplanting methods) in combination with reduced intra-species competition, this aspect was explored in the two small factorial agronomy trials of a single replication each.

The M’be Farm personnel and the research technicians have by now gained experience with the SRI practices, so that the results can be interpreted with more confidence, than in the two previous seasons. However, the high level of soil variability in both lowland and upland fields continues to be a problem. Moreover, so far the SRI trials at M’be have never been planted at the optimum period (month of March) for obtaining the highest possible yields. The statistical analyses of the results has been incomplete, because of the current absence of a biometrician.

2. Results

2.1. Impacts of nursery management (seed rate; seedling age at transplanting) and of transplanting technique (1 or 3 plants/hill) on the vegetative development of rice varieties.

In the SRI method the early (0 to 6 weeks) seedling development is considered crucial for the subsequent crop performance. This starts with the development of seedlings in the nursery and subsequently their “age” and “method” (clumps or individual) of transplanting; these factors were studied in two trials.

A. “Seedling development” was studied in a small nursery trial, using the regular nursery management practices (for water and fertilisers, etc.), and the spacing between rows.

Treatments for nursery (phase 1):

Varieties:
- V1: WAB 450-IBP-65-4
- V2: Bouaké 189
- V3: WITA 12
- V4: Suakoko 8
- V5: WITA 7
- V6 : IR 22-107-19-2-1

Nursery Seed rates:
- S1: (20g/m): regular seeding rate
- S2: (4g/m): 1/5th of regular seeding rate

Design:
Randomised blocks in 2 replications; "varieties" as main plots and "seed rates" as sub plots (a total of 12 plots per replication.

Follow-up treatments at transplanting (phase 2):

The seedlings from the nursery (6 varieties at 2 seed rates = 12 lots of seedlings) were transplanted after 10 and 30 days to SRI-managed plots.

Treatments (phase 2):

- **seedling age** :
  - T1 : 10 days
  - T2 : 30 days

Design: an (exploratory) factorial trial (6 varieties x 2 nursery seed rates x 2 seedling ages) laid out in one replication with two sub-blocks of 12 plots for "seedling ages" (or time of transplanting); "varieties" are in main plots and "nursery seed rates" in sub-plots. Statistical analyses were performed by using the higher order interactions as the error term.

Table 1: Impact of nursery management (seed rate) on the subsequent plant development following early (10 days) and late (30 days) transplanting.

	Tillers/Hill at flowering	Panicles/hill harvested	Plant height (cm)	Days to 50% flowering
Varieties (V)				
WAB 450-IBP-65-4	17.4	7.6	109	98
Bouake 189	22.8	14.0	106	115
WITA 12	19.5	12.6	110	118
Suakoko 8	26.3	15.8	145	143
WITA 7	23.8	11.9	104	109
IR 22-107-19-2-1	19.4	14.4	111	116
Nursery Seed Rates (S)				N.S.
S1 (20g/m)	22.7	12.5	111	116
S2 (4 g/m)	20.4	13.0	117	116
Seedling age (A)				
A1: 10 days	23.2	11.9	115	111
A2: 30 days	19.9	13.7	113	121
Signif. Interactions				
C.V.(%)				

Results: the nursery measurements (seedling height; seedling weight) show some consistent differences in response to the seed rate factor over the 5 week monitoring period. While height and weight are always superior for the low seed rate (S2), the major divergence between the two curves only occurs after the first two weeks; it is most pronounced for the seedling weight. An extended period in the nursery will thus greatly reduce the development of seedlings in the high seed rate plot. Thus it may be postulated that by drastically lowering the nursery seed rate, the early transplanting date (as recommended for SRI), will become less critical.

The above conclusion appears to be confirmed by the results in the 2nd phase of the experiment: the impact of seedling age at transplanting (10 or 30 days) has had only modest effects on tillering and the number of panicles/hill (see Table 1). More interestingly is the effect of delayed transplanting (at 30 days) on the length of the vegetative growth period, which became extended by some 10 days. A similar effect is recorded also in the 2001 WS lowland trial (section 2.3.).

Interactions between varieties, seed rates and seedling age at transplanting, show that there are considerable differences between varieties in the way these can cope with the delay in transplanting. In that respect the late maturing Suakoko 8 has the most potential to overcome the initial unfavourable early growth conditions.

B. Transplanting techniques were studied as a follow up to the previous trial using 9 varieties (early, intermediate and late maturing; rainfed and irrigated types) that were transplanted after 15 or 30 days in the nursery, and as single plants or as clumps of 3 plants/hill. Again a single replicate of a 9 x 2 x 2 factorial was used to make a preliminary evaluation of the vegetative development features in terms of tillering.

Table 2: Vegetative growth characteristics for the exploratory “method of transplanting” trial for 9 varieties representing early to late materials.

Varieties	Maturity	Tillers/hill at 45 days	Nb pan/hill	Plant Height (cm)
		**	**	**
WITA 7	interm.	26.9	17.9	99
WAB 326 BB-2 H 5	early	18.5	12.5	110
WAB 176-8-HB	early	10.6	18.3	97
IDSA 78	early	14.4	13.6	85
WITA 12	interm.	27.1	27.4	131
IDSA 6	early	16.6	14	96
WAB 337 BB 13 H 3	late	23.0	24.7	128
FARO 8	late	30.0	17.0	144
IR 22-107-19-2-1	interm.	27.2	23.1	115
<u>Transpl. Method (m)</u>		**	**	NS
3 pl/hill		19.7	18.9	112
1 pl/hill		14.6	16.0	111
<u>Seedling age (A)</u>		**	**	**
At transpl				
A1 15 days		**21.6**	**20.0**	**117**
A2 30 days		**12.7**	**14.9**	**107**
Signif. Interactions		NS	NS	V x A **
C.V.%		16.6	14.0	1.8

Results and conclusions

The limited data recorded for this trial are presented in Table 2, and demonstrate several vegetative plant characteristics and features that are of great relevance to the SRI practice. Notably:

- There are large and highly significant differences between the 9 varieties with respect to “early tillering,, “number of panicles at harvest,” and “plant height” (at flowering); for the early transplanting treatment at 1 plant/hill the number of tillers after 60 days ranged from only 11 and 13 for WAB 176-8-HB and IDSA 78 (early maturing materials) to 54 for the late maturing WAB 337-B-B-13-H3;
- Low tillering rates are associated with early maturing, and short straw varieties; high tillering rates tend to be associated mostly with full-season and tall varieties, although some of the intermediate materials also tiller profusely,
- From the tillers present at flowering only about half tend to produce a panicle at harvest,
- When transplanted early (15 days old) the single seedling/hill manages to catch up with the clump (3 pl/hill) transplanted material and produce an equal number of larger panicles (see next experiment),

- When transplanting is delayed to 30 days after seeding, the plants will no, longer catch up in tillering, nor in plant height. The highly significant interaction "Variety x Seedling age" for height indicates that some varieties in particular the late and some intermediate materials are better able to compensate for delayed transplanting than are the early varieties.

The overall conclusion from these data is that there exist major differences between varieties in their potential to respond to an SRI type cropping system, i.e. there will be important "variety x system" interactions. Secondly, the rice plant appears to have a considerable capacity through tillering and through an extension of the vegetative growth period, to compensate for delayed transplanting. Furthermore this can be achieved by increasing the transplanting density as the age of the nursery seedlings increases (this latter technique is practised already by farmers in the vicinity of M'be: Defoer; pers. comm.).

Finally it appears that a delay in transplanting from 10 to 30 days will reduce the number of tillers and panicles/hill significantly, but the rice plant counters this negative effect by extending its vegetative growth cycle. Moreover, the effect of delayed transplanting can be further reduced by using more plants/hill and by increasing plant population. Though this was not studied in the present trial, it is likely however that panicle size (grains/panicle) and grain size will be negatively affected, as will be the overall resource use efficiency.

2.2. DS 2001 Lowland comparison between conventional irrigated and SRI method: 4 varieties x 2 plant densities

This trial was earlier conducted during the 2000WS and involved an initial comparison between the conventional method (full irrigation, high plant density; regular nitrogen topdressings) and the SRI method (moist soil; low plant density and NO nitrogen topdressings). The conventional irrigated system yielded significantly better than the SRI, however it also showed highly significant differences among the varieties in terms of grain yield, total biomass, number of days to 50% flowering, plant height and number of fertile panicles/plant. Moreover a number of interactions (variety x density; variety x density x method) are significant, thus confirming that the adaptation to either one of the systems (conventional or SRI) is highly variety specific.

For the 2001DS the trial was redesigned to eliminate water seepage between the treatments by using a design in two blocks (conventional irrigated and SRI), and by using the same fertilizer regime in both blocks (also for the N topdressings). The treatments and factors studied were:

Methods: M1 : **conventional irrigated**
Transplanting in clumps (3 plants/hill)
M2 : **SRI water management**
Transplanting of individual plants (1 plant/hill)

Varieties: V1: WAB 450-IBP-65-4-1
V2: Bouake 189
V3: WITA 12
V4: Suakoko 8

Spacing: D1 = 30 x 30 cm
D2 = 30 x 15 cm

Design: Two sub-blocks for methods (conventional irrigated and SRI-water management), and four replications of randomised plots of "4 varieties x 2 seedling ages" treatments within the sub-blocks. A combined statistical analysis was conducted for a single replication, using the higher order interactions as error term.

Results: the data are presented in Table 3 and in a summarized form these are compared to the results obtained in the earlier and similar 2000WS experiment in Table 4

- In the first trial during WS 1999 the "irrigated system" outyielded the "SRI" by 48%; in WS 2000 the difference has been 21% (both HS); in DS 2001 the difference was 8% (NS), while for WS 2001 it was 3% (NS) in favour of SRI. This reflects the progressive mastering of the SRI practices by scientists and farm supervisors.
- **The interaction "Method x Variety"** has been S to HS for grain yield and for several other plant characteristics, indicating a "variety-specific" adaptation.
- **Number of harvested panicles/hill**: in "irrigated system" 3 plants/hill, in SRI 1 plant/hill (hill spacings the same in either system): 1 plant/hill in SRI compensates entirely for the 3 plants/hill in "irrigated system".
- Doubling of the plant density has had no effect on grain yield in either system, although it greatly reduced the number of panicles/hill as well as the number of grains/panicle. Yet there is a significant interaction between varieties and plant density. This confirms that some varieties (the intermediate and late materials in particular), have a remarkable potential to effectively utilise available "space" through increased tillering.
- **Plant height**: SRI plants are shorter (HS): Suakoko 8 lodged only in the "irrigated system".

Under SRI shorter plant height and increased tillering have resulted into lower total biomass production; simultaneously grain size increased (HS in DS2001). Together these effects have caused a significant increase in "Harvest Index" for SRI as compared with the "irrigated system". This implies that under SRI the efficiency of grain formation and filling are increased, but also of water use, nutrient uptake and nutrient utilisation.

Table 3: Summary of results from the 2001 DS experiment comparing the conventional Irrigated system with SRI for 4 varieties planted at two spacings.

	Grain Yield (t/ha)		Days to 50 % flow		Height (cm)		Panicles/hill		1000 gra weight(	
Method	NS		NS		**		NS		**	
Conv. Irrigated	4.0		114		121		11.4		25.2	
SRI	3.7		115		111		11.3		27.2	
	Conv.Ir.	SRI	Conv.Ir.	SRI	Conv.Ir.	SRI	Conv.Ir.	SRI	Conv.Ir.	
Varieties (V)	**	**	**	**	**	**	**	**	**	
WAB 450-IBP-65-4	3.6	2.6	108	104	110	99	7.4	7.2	26.3	
Bouake 189	6.1	4.1	113	115	111	101	11.0	13.2	27.4	
Wita 12	3.6	4.0	111	114	122	116	11.8	11.2	26.0	
Suakoko 8	2.8	4.1	124	128	141	128	15.2	13.6	21.2	
Hill spacing (S)	NS	NS	NS	NS	NS	NS	**	**	NS	
30 x 30	4.0	3.7	114	116	120	111	14.7	14.4	25.1	
30 x 15	4.0	3.7	113	115	121	110	8.0	8.2	25.2	
V x S	NS	NS	NS	NS	NS	NS	NS	NS	NS	
V x M	**		**		*		*		NS	
M x S	NS		NS		NS		NS		NS	
VxMxS	NS		NS		NS		NS		NS	
C.V (%) method blocks	24.3	21.4	4.0	1.8	7.1	3.9	19.3	18.3	6.4	
C.V. (%) Combined analysis	23.0		3.1		5.9		18.8		8.8	

*:significance at 5% level

**:significance at 1% level

NS:non-significant

A more detailed analysis reveals that the early maturing WAB 450-IBP-64-4 shows by far the least tillering and the lowest grain yield under both systems; the late maturing Suakoko 8 has the greatest tillering ability in particular under SRI, its total biomass is greatest and its grain yield is the same (3.7 ton/ha) for either system (tables 3 and 3a). The popular variety Bouake 189 – commonly known for its wide adaptation, its tillering ability, and high yield -- outyields all other varieties in both systems. However, the yield under the conventional system is only 12% higher than under SRI; for the WITA 12 this difference is 34%; for WAB 450-IBP-64-4, it is 18% (Table 3b).

Table 3a: Summary of major results: "Systems comparisons" for WS 2000 and DS 2001

A) VARIETIES	WS 2000		DS 2001	
	Grain yields (ton\ha)		Grain yields (ton\ha)	
	Irrigated	SRI	Irrigated	SRI
WAB 450-1BP65-4	3.5	2.9	3.6	2.6
Bouaké 189	5.2	4.6	6.1	4.1
WITA 12	5.2	3.5	3.6	4.0
Suakoko 8	3.8	3.7	2.8	4.1
B) Plant characteristics	Irrigated	SRI	Irrigated	SRI
Grain yield (ton\ha)	4.4	3.7 (HS)	4.0	3.7 (NS)
Bio mass	8.5	7.1 (HS)	6.1	4.6 (HS)
Plant height (cm)	122	115 (HS)	121	111 (HS)
Panicles\hill	14.4	11.7	11.4	11.5 (NS)
1000 grain weight	25.5	25.1 (S)	25.2	27.2 (HS)
harvest Index	0.52	0.52 (NS)	0.36	0.45 (S)

2.3. WS 2001 Lowland comparison between conventional irrigated and SRI method: 4 varieties x 2 seedling ages

The previous (DS 2001) trial investigated the impact of intra rice plant competition by comparing two plant densities/spacings. The other critical factor in realising the potential of SRI appears to be **the age of the transplanted seedling**. This factor was studied by modifying the previous trial and replacing the density variable by "seedling age"; the interspecific variety (WAB-450-IBP-4-1) was replaced by WITA 7, because of the good early tillering ability of the latter.

Treatments:

Methods: M1 : **conventional irrigated**
Transplanting in clumps (3 plants/pocket); 30 x 15 cm

M2 : **SRI water management**
Transplanting of individual plants (1 plant/pocket): 30 x 30 cm

Varieties: V1: WITA 7
V2: Bouake 189
V3: WITA 12
V4: Suakoko 8

Seedling age: A1 = 10 days
A2 = 20 days

Design: Two sub-blocks for methods (conventional irrigated and SRI-water management), and four replications of randomised plots of "4 varieties x 2 seedling ages" treatments within the sub-blocks. A statistical analysis was conducted for a single replication, using the higher order interactions as error term.

Table 4: Summary of data for the 20001 WS lowland trial

	Grain yield (t/ha)		Nb of days to 50% flowering		Height (cm)		Panicles/hill		Biomass (t/ha)		1000 grain weight (g)	
Systems	NS											
SRC (M1)	3.86		98		108		11		6.84			
SRI (M2)	3.98		105		97		15		5.63			
	SRC	SRI	SRC	SRI	SRC	SRI	SRC	SRI	SRC	SRI	SRC	SRI
Varieties	*	*	**	**	**	**	**	**	**	**	**	**
WITA 7 (V1)	4.5	4.0	90	97	91	76	10	14	5.8	5.4		
Bouake 18 g (V2)	3.3	3.8	92	98	93	85	12	14	4.7	4.4		
WITA 12 (V3)	3.8	3.4	96	104	104	92	12	17	4.8	4.9		
Suakoko 5 (V4)	4.4	4.3	114	121	143	134	10	15	12.1	7.9		
Seedling Age	NS	*	**	**	NS	NS	NS	NS	NS	NS		
10 days (A1)	4.0	3.6	95	102	108	97	11	15	6.9	5.6		
20 days (A2)	4.0	4.1	101	108	108	97	11	16	6.7	5.7		
Interactions												
V x A	NS	NS	**	**	NS	NS	NS	NS	NS	NS		
M x V												
M x A												
M x V x A												
C. V (%) method	22.1	14.0	1.7	3.0	1.8	2.3	11.2	11.5	19.6	29.1		
C.V. (%) combined												

Results: The trial has confirmed the major trends signalled for the previous WS 2000 and DS 2001 experiments: under SRI, plant height and biomass production are reduced, while the grain yields remain the same under either system, leading to an increase in "harvest index". The variety responding most prominently in that way is the late maturing Suakoko 8, which lodges seriously under the conventional irrigated system but not under SRI. In addition the "seedling age" factor has provided important additional information: delayed transplanting had no effect in the conventional system, while significantly increasing yields under SRI. This response is explained by another unexpected result, namely the extended vegetative growth phase (days to 50% flowering), that results under SRI, but also from the delayed transplanting. (the same effect was noticed in the nursery trial reported under section 2.1.). The conclusion here is that under the non-flooded SRI condition, rice plants are able to extend their vegetative growth phase, because their extensive root systems remain active for a longer period (as shown by comparing uprooted plants).

The absence of negative responses from delayed transplanting on plant development (biomass) and grain yield is a potentially very important result, because it indicates *that widely spaced,* *single transplants* and *non-flooded conditions* are more critical components of the SRI technology, than the very early/young transplants are. While this issue requires still further study, it has important practical ramifications, permitting greater flexibility at transplanting and a much easier weed control situation during the early vegetative development phase.

2.4. WS 2001 Upland trial: thinning and date of thinning for 4 upland varieties.

The crucial element in SRI theory (explaining the tillering and subsequently high yields) is the importance of the **very early development of the individual rice plants.** Therefore the present trial is designed (for research purposes of clarifying the process!!) around the two factors of "thinning" and "time of thinning" for four varieties representing different maturities (ranging from very early to late).

Treatments:

Varieties:	V1: WAB 450-IBP-38-HB (NERICA 1) V2: WAB 56-50 V3: WAB 96-1-1 V4: Moroberikan
Thinning:	D1: 1 plant/pocket (spacing 30 x 30 cm) D2: 3 plants/pocket (spacing 30 x 30 cm)
Time of thinning:	T1: 8 days after seeding T2: 20 days after seeding

Design: 4 x 2 x 2 factorial (= 16 treatment combinations) in three replications with a split-block design (the V x D interaction being confounded with blocks).

Table 5: Upland 2001 WS trial: the effect of thinning and date of thinning on plant development and on grain yield.

	Grain yield (t/ha)	Nb of Tillers at flowering	Panicles/hill (harvest)	Nb of grain/ panicles
Varieties				
NERICA-1 (WAB 450 - IBP-38-HB)	3.51	296	6.94	182
WAB 56-50	2.60	211	4.96	176
WAB 96-1-1	3.15	242	5.81	204
Moroberikan	2.18	153	3.57	201
Thinning				
1 pl / hill	2.48	174	4.09	212
3 pl / hill	3.23	277	6.55	169
Time of thinning		NS	NS	NS
8 days (after seeding)	3.10	224	5.39	200
20 days (* *)	2.61	227	5.25	181

Results: the outcome of this trial has been greatly affected by extreme soil heterogeneity that has seriously influenced the data from the 2nd and 3rd replication. Therefore only a tentative analysis was made based on the two least affected replications; these data are summarised in Table 5.

The data show very distinct differences between varieties for grain yield as well as for other plant characteristics (maturity cycle, height, tillering, panicles/hill and numbers of grain/panicle) with the NERICA 1 outyielding all others.

The NERICA 1 confirmed its superiority in tillering, number of pancles/hill and grain yield. Consequently this variety responded (as the only one) particularly well to the "early thinning," while one plant/hill was able to compensate entirely for 3 plants/hill. For the other 3 varieties, early thinning to 3 plants/hill gave the highest grain yields.

The importance of the early (8 days) thinning main effect was confirmed, but surprisingly its impact on grain yield was brought about by an increase in the number of grains/panicle (and not by more panicles/hill). Overall the results confirm the importance of timeliness in early stand establishment and the potential of NERICA 1 to perform also under very low plant densities, due to its tillering ability. Its high yield and short maturity cycle point to a very high efficiency in resource use.

In conclusion the SRI principles with respect to the importance of early plant development is confirmed (particularly for the NERICA 1), but there are also substantial "variety x cultural practices" interactions with some varieties responding distinctly different than NERICA 1.

2.5. Soil fertility / organic matter management for SRI under lowland irrigated/rainfed rice growing conditions.

A critical factor for the long-term sustainability of SRI (but also for the conventional practice) is the soil fertility / soil organic matter management aspect. This aspect requires monitoring for a number of years. A first effort was made by retaining the design and field layout of the 1999 exploratory trial, but replacing the variety variable by "crop residue management" and the date of transplanting variable by "green manure" during the pre-rice cropping period of April till late July 2000. Thereafter the entire trial was prepared for transplanting with one rice variety (BG 90-2). The rice was grown according to the 2 methods (conventional and SRI), using the same plot allocation and layout as used in 1999 to test the residual effects of the dry season "crop residue" and "green manure" treatments on the performance of a rice crop.

The **specific objective** is to explore the impact of dry season fallow management with respect to "crop residus" and "green manure cultivation" on the subsequent performance of rice grown according to the conventional as compared with the SRI practices.

Treatments:

Production methods (M)

M 1: Conventional practices for irrigated systems, (close spacing 20 x 20 cm; clumps of 3 plants/hill)

M 2: SRI method: no flooding, yet moist soil; wide spacing 30 x 30 cm with 1 plant/hill

Green manure (G)

G 0: No green manure

G 1: Crotolaria/Sesbania (at a rate of 2 ton dry matter/ha)

Crop residue management (R)

R 0: Removal of crop residues

R 1: Incorporation of rice straw residues at a rate of 2 ton dry matter/ha (R 1)

Experimental design

The 1999 experiment had factorial combinations for M x D x V = 2 x 2 x 2 = 8 treatment combinations in four replications. For field management reasons the M x V interaction is confounded with blocks. Treatments for M x V and "Dates" were randomized among sub-blocks and plots respectively. For the 2000 season starting in April the very same plot allocation is used: "D" is replaced by "green manure" (G) and "V" by "crop residue management" (R).

The "production method" variable (M) is retained as in the original 1999 trial; however the variable is only implemented starting in July/August with the preparation and subsequent transplanting of rice (one variety) by contrasting the conventional irrigated method with the SRI method.

Table 6: Lowland 2001 WS soil fertility management trial; comparison with 2000 WS grain yields

	Grain WS 2000 t/ha	Yield WS 2001 t/ha	Nb of days to 50% flow	Panicles/hill	Grains/Panicle	Plant height (cm)
Method. (M)	**					
Conv. Irrigated	5.63	6.20	100.3	14.9	190	102
SRI	3.86	5.90	98.3	23.8	212	100
Crop residue (R)	NS					
- removal	4.82	5.93	99.6	18.2	197	99
- incorporation	4.67	6.17	99.1	20.5	206	102
Green manure (G)	NS					
- none	4.57	5.87	100.1	18.4	194	99
- clotolaria (dry season)	4.91	6.23	98.6	20.3	208	103
Interactions		RxG (?) MxG (?)				

Results:

The data for the WS 2001 have been tentatively analysed and are compared with the results of the previous year in Table 6. A major result of the 2001 trial is the improvement (by some 50 %) in the grain yield of the SRI treatments as compared with the previous year, being only 5% less than for the conventional irrigated treatment. This will be mainly due to the improved SRI water management and the modest N topdressing (50kg N/ha) that was also applied to the SRI treatments. There are indications of a positive response to the green manure treatment and to a “method x green manure” interaction. The features signalled in the earlier trials are reconfirmed: SRI practices lead to greatly increased tillering and numbers of panicles/hill (thereby compensating completely for the greatly reduced plant density), decreased plant height and an increased panicle size (12% more grains/panicle).

3. Conclusions from the exploratory SRI trials

While not achieving the Madagascar yield levels, the trials conducted at the WARDA M'be Farm over the period 1999 till 2001 on the SRI method have provided some unexpected, yet fundamentally important, results for rice growing in general. In spite of the usual seasonal and annual variations, certain particular responses were recorded repeatedly and across different experiments.

In all the experiments comparing different varieties there have every time been (highly) significant interactions between varieties and "cultural practices" (conventional and SRI) for grain yield and several other plant characteristics. This implies that in trying to capitalise on the SRI potential, the varietal choice is crucial. Moreover evidence was obtained that the most suitable varieties will be of the intermediate to late maturity types, will tiller profusely and may be somewhat taller than most of the modern varieties (to achieve canopy closure under the wide spacing conditions of SRI).

Most importantly it was shown that by changing agronomic management practices (irrigation regime; plant spacing and plant density), one could greatly improve basic crop characteristics like "harvest index", "grain size" and "number of grains/panicle", that are normally the prerogatives of plant breeders.

These improvements were associated with greatly increased numbers of tillers/plant and panicles/plant, reduced plant height (and therefore no lodging of the taller varieties) and a more profuse and active root system. Moreover, the absence of flooding (as in SRI) has extended the vegetative growth phase (i.e. number of days to 50% flowering) by some 7-10 days. Taken together these features point to a much improved efficiency in resource use: less biomass and more grain were produced with less water and the same dose of fertiliser.

The importance of transplanting very young seedlings (of 10 days), was not confirmed. The 2001 WS trial that studied this factor showed non-significant differences between the "10 and 20 days seedlings" treatments, whereas the earlier mentioned effects were all reconfirmed. The nursery and early vegetative growth trials suggest that in any case, there would be an advantage in decreasing substantially (by at least 50%) the seed rates used in the nursery, and particularly in situations where delays in transplanting are likely to occur.

The overall conclusion is therefore that among the SRI components, the **wide spacing** (30 x 30 cm), the **single plant/hill** and the **absence of flooding** are crucial and lead to more efficient systems in terms of resource use (time, space, water, seeds and plant nutrients). While seedling age at transplanting appears less critical than suggested by the Madagascar experience, it is still desirable not to delay transplanting much beyond 20 days.

While the concept of the "phyllochron" has been useful in clarifying the vegetative development pattern of individual rice plants, it has proved not to be a generally valid concept, given the considerable variations in tillering abilities that were recorded between varieties. Breeders and agronomists should therefore pay increased attention during the early selection and testing phases to the *behaviour of individual plants* by providing sufficient space for these to express their characters particularly with respect to tillering.

The SRI technique is fundamentally different in several respects from the conventional practice. Moreover, there are considerable interactions/synergies between the technological components for each of the techniques (SRI or conventional). As a result comparisons between the two techniques become extremely complex and can hardly be accommodated in a single experiment without confounding several main effects. This exploratory research shows definitely that not all varieties will respond equally well to SRI. Moreover, for the potential varieties one will need to work out the appropriate agronomy in terms of the optimum plant density/spacing, of the water management regime in relation to the various growth stages of the crop, and of the soil nutrient regime and its dynamics.