Annex 4

Training for the Sierra Leonean Counterparts

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The Japanese experts trained the Sierra Leonean counterparts through a series of lecture, exercise and field practice in 2008, recognizing that the capacity of the counterparts in designing, implementing, and monitoring the PP had not been built up.

Inadequate capacity of the Sierra Leonean counterparts has been recognized in various occasions during the implementation period of PP 2007: miscalculation of fertilizer requirement, irregular shape of the PP plots, setting monitoring sub-plots at inappropriate locations, improper way of counting tiller numbers, etc. Actually, most extension workers have not had opportunities of having training for long time, and they needed to refresh their memory or supplement new knowledge based on those they have.

To develop the capacity of extension workers in crop cultivation, field experiment monitoring, etc., a series of training have been conducted by the Japanese experts.

Total of 20 training courses have been conducted during the period of 7 months from May to December, 2008. Date, subject, and materials used in each training session are shown in Table 4-1.

Table 4-1 Subject and Materials Used in Each Training Session

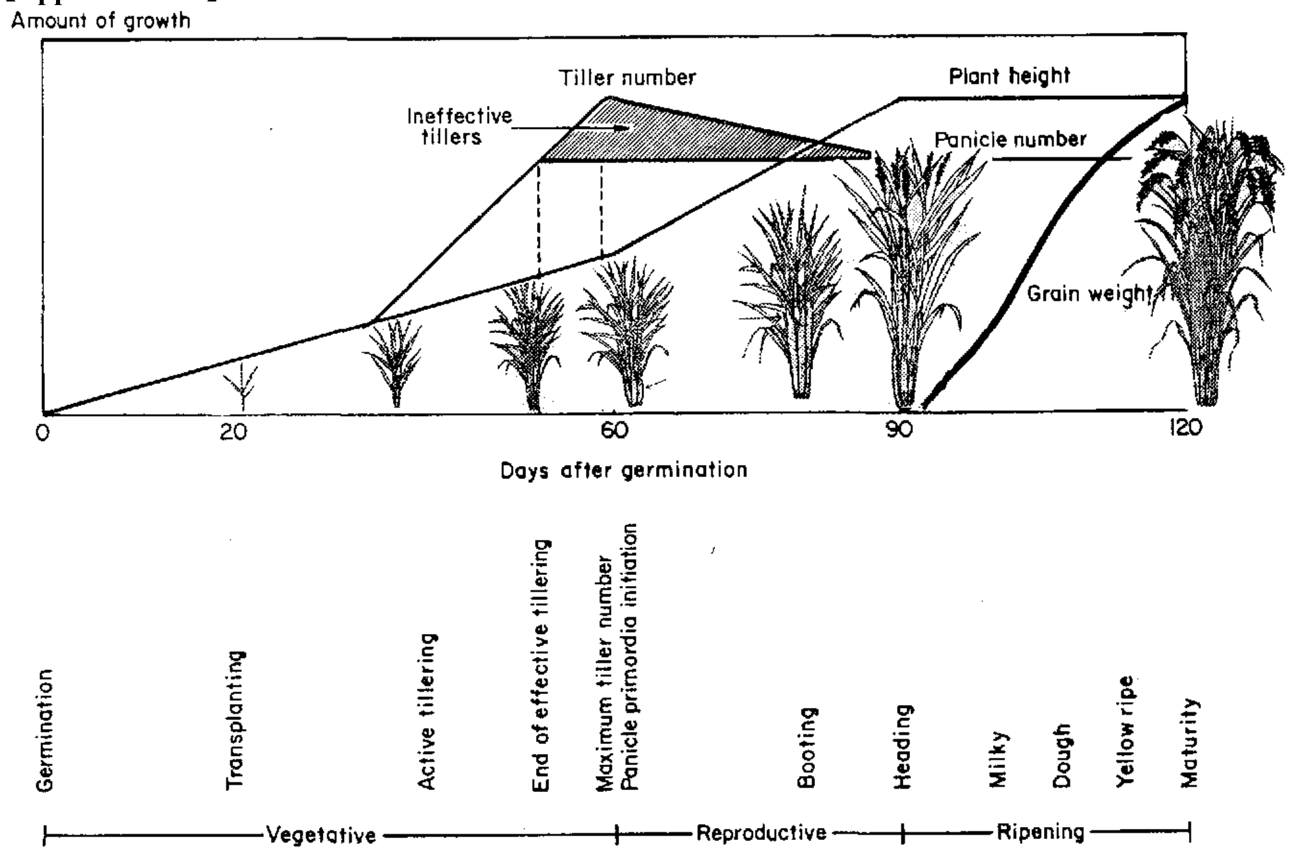
No.	Date	Subject	Materials used for training,	Lecturer
1	28/05	Importance of timely farming practice in relation to the life cycle of rice plant	Properties showing weekly calendar, on which farming practice and growth stage of rice are indicated	Mr. T. Kimijima
2	04/06	Life cycle of rice plant and calculation of seed requirement	Hand outs, and exercise (Appendix A4-1)	Mr. T. Kimijima
3	11/06	Seed requirement	Exercise (Appendix A4-2)	Mr. T. Kimijima
4	26/06	Re-appraisal of the workshop on the PP 2007 held in Feb. 2008 and fertilizer exercise	PowerPoint presentation, handouts, and exercise (Appendix A4-3)	Dr. J. Yamaguchi
5	02/07	Additional Information, labor cost confirmation, and yield components	PowerPoint presentation, and homework (Appendix A4-4)	Dr. J. Yamaguchi
6	03/07	Field practice of growth monitoring at Robennah upland (field)	Handouts (Appendix A4-5)	Dr. J. Yamaguchi
7	09/07	Field practice of plot layout at Robennah IVS (field)	Announcement	Dr. J. Yamaguchi
8	16/07	Yield components, Refreshers and Growth Monitoring	PowerPoint presentation (Appendix A4-6)	Dr. J. Yamaguchi
9	23/07	Fertilizer calculations and some comments on transplanting	PowerPoint presentation, exercise, homework (Appendix A4-7)	Dr. J. Yamaguchi
10	30/07	Field practice on plant growth: leaf development and tillering habit of various cultivars	Exercise	Dr. J. Yamaguchi
11	13/08	Fertilizer calculation and yield	Power point presentation	Dr. J. Yamaguchi

		components	(Appendix A4-8)	
12	03/09	Refresher course on timely farming practice, especially nursery period and transplanting in relation to crop growth duration	Properties showing weekly calendar, on which farming practice and growth stage of rice are indicated	Mr. T. Kimijima
13	17/09	Several faults found in farming practices in the PP sites	Power point presentation (Appendix A4-9)	Mr. T. Kimijima
14	24/09	Cost and benefit analysis of rice farming	Handout (Appendix A4-10)	Dr. T. Mizobe
15	08/10	Project Progress (presentation of the summary of Progress Report 5)	Power point presentation (Appendix A4-11)	Mr. T. Kimijima
16	22/10	Plant nutrients and fertilizer application	Handout (Appendix A4-12)	Dr. J. Yamaguchi
17	05/11	Introduced techniques and presentation of watermelon disease in vegetable production for the support of women's group	Power point presentation (Appendix A4-13)	Ms. A. Mishima
18	03/12	Post-harvest handling of rice	Handout (Appendix A4-14)	Mr. H. Inoue
19	10/12	Vegetable production techniques	Handout (Appendix A4-15)	Mr. J. Harada
20	19/12	Moisture adjustment	Exercise (Appendix A4-16)	Dr. J. Yamaguchi

The subjects for training have been selected carefully from those which are familiar with the counterparts or those necessary to acquire the knowledge. For example, in the training course No.12 "Several faults found in farming practices in the PP sites", we explained about undesired farming practices that have been found in the PP sites by a Japanese expert. Necessary skill and knowledge in monitoring the PP sites have been transferred through the training courses No.6 through No.9.

A training certificate was issued to the participants who have attended more than 80% of the training sessions.

Materials used in the training sessions are presented in the appendix of this annex.



1.1. Life history of a 120-day variety grown in the tropics under the transplanting cultivation system (schematic).

The rice plant usually takes 3-6 months from germination to maturity, depending on the variety and the environment under which it grows. During this period, rice completes basically two distinct sequential growth stages: vegetative and reproductive. The reproductive stage is subdivided into pre-heading and post-heading periods. The latter is better known as the ripening (or maturity) period. Yield capacity, or the yield, which is based on the amount of starch that fills spikelets, is largely determined during post-heading. Hence, agronomically, it is convenient to regard the life history of rice plant in terms of three growth stages: vegetative, reproductive, and ripening. The vegetative stage refers to a period from germination to the initiation of panicle; the reproductive stage, from panicle initiation to heading (or flowering); and the ripening period, from heading to maturity (Fig.1.1). A 120-day variety, when planted in a tropical environment, spends about 60 days in the vegetative stage, 30 days in the reproductive stage, and 30 days in the ripening period.

The vegetative stage is characterized by active tillering, gradual increase in plant height, and leaf emergence at regular intervals. All contribute to increasing the leaf area that receives sunlight. Tillering may start when the main culm develops the 5th or 6th leaf. The maximum tiller number stage is a stage when tiller number per plant or per square meter is maximum – before or after the initiation of panicle, depending on a variety's growth duration. Because tiller number declines after the maximum tiller number stage, there is a period before that stage (often called the end of stage of effective tillering) when the tiller number becomes numerically equal to panicle number at maturity. Tillers developed at early growth stages normally produce panicles, while those developed later may or may not.

modified, S. YOSHIDA, Fundamentals of Rice Crop Science, 1981, IRRI.

04/06/08 1

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The reproductive growth stage is characterized by culm elongation (which increases plant height), decline in tiller number, emergence of the flag leaf (the last leaf), booting, heading, and flowering. Initiation of panicle usually dates back to about 30 days before heading.

Agronomists often refer to topdressing nitrogen fertilizer at panicle initiation – a stage about 25 days before heading when the panicle has grown about 1mm long and can be recognized visually or with a magnifying lens. Internode elongation usually begins around the initiation of panicle and continues until heading. The top five internodes may be elongated at heading. For this reason, the reproductive growth stage is sometimes called the internode elongation stage.

Heading means panicle exsertion. Spikelets anthesis (or flowering) begins with panicle exsertion, or on the following day. Consequently, heading is considered a synonym for anthesis in terms of calendar days in the life history of rice. It takes 10 – 14 days for a crop to complete heading because there is variation in panicle exsertion within tillers of the same plant and between plants in the same field. Agronomically, heading is usually defined as the time when 50% of panicle have exserted. Anthesis normally occurs between 0800 and 1300 in tropical environments. Fertilization is completed within 5-6 hours later. Only a very few spikelets have anthesis in the afternoon. When the temperature is low, however, anthesis may start late in the morning and last until late afternoon. Within the same panicle it itakes 7-10 days for all the spikelets to complete anthesis; most spikelets complete anthesis within 5 days.

Ripening follows fertilization, and may be subdivided into milky, dough, yellow-ripe, and maturity stages. These terms are primarily based on the texture and color of growing grains. Ripening is characterized by leaf senescence and grain growth – increases in grain size and weight and changes in grain color. During active grain growth, both fresh and dry grain weights increase. Toward maturity, however, dry weight increases slowly but fresh weight decreases as a result of water loss. The length of ripening, largely affected by temperature, ranges from about 30 days in the tropics to 65 days in cool, temperate regions such as Hokkaido, Japan, and New South Wales, Australia.

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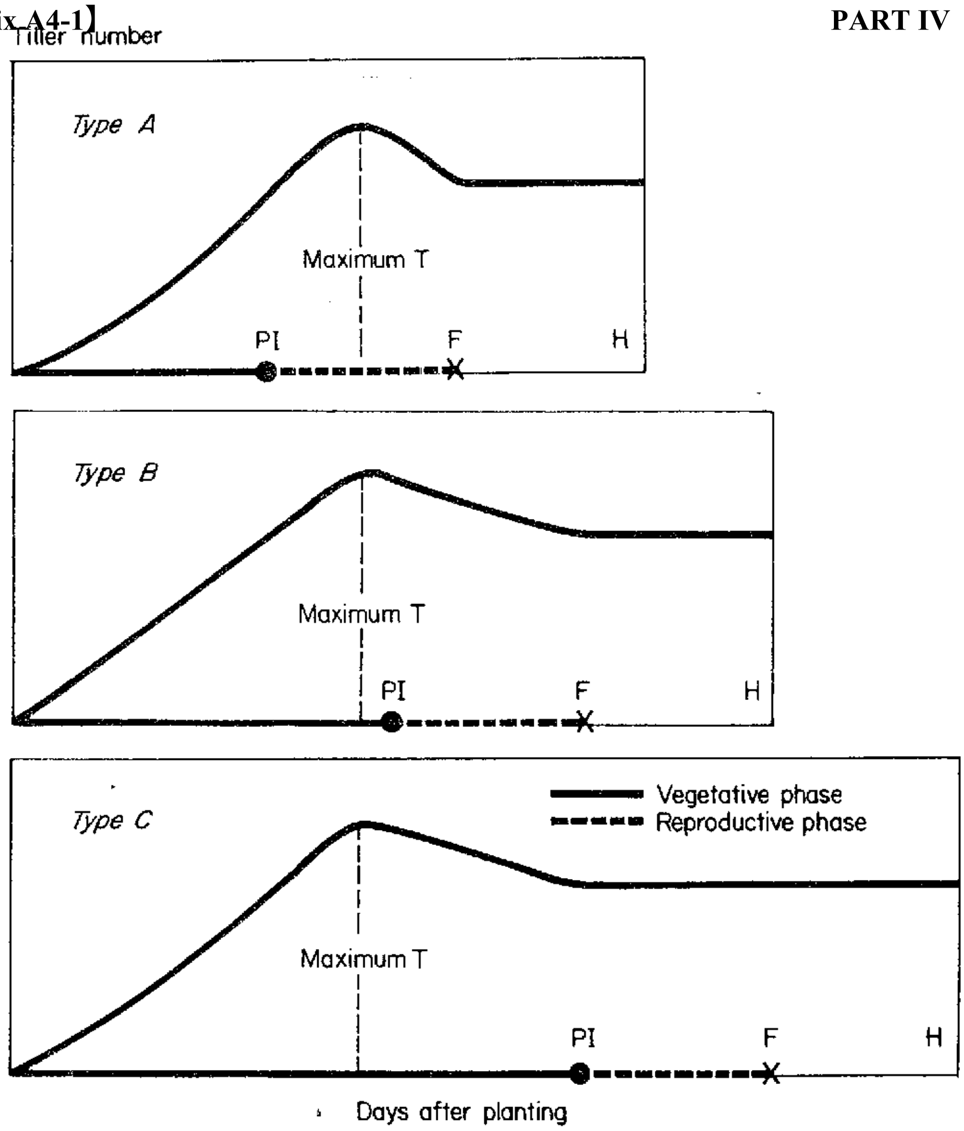

1.2. Phasal development of the rice plant (adapted from Tanaka 1976). PI = panicle primordia initiation, F = flowering, H = harvest, Maximum T = maximum tiller number stage.

The basic processes in the life history of rice can be applied to any cultivation system, with some modifications.

First, differences in growth duration are primarily due to differences in the length of the vegetative growth stage. The length of the reproductive stage plus the ripening period may be considered about the same for any variety under a given environment. Early maturing varieties have short vegetative stages. As a consequence, they may initiate panicle primordia before the maximum tiller number stage (Type A in Fig. 1.2) and heading may be staggered because later tillers may produce panicles. Late-maturing varieties have long periods of vegetative stage and may reach the maximum tiller number stage before initiation of panicle primordia (Type C in Fig. 1.2). The period from the maximum tiller number stage to initiation of panicle primordia is sometimes referred to as *vegetative-lag phase* (Tanaka et al 1964). When the length of the vegetative stage is adequate, the plant initiates panicle primordia right after the maximum tiller number stage (Type B in Fig. 1.2). In the tropics, this is normally attained by a 120-day variety.

Second, direct-seeded rice normally starts tillering earlier than transplanted rice because its growth proceeds without the setback caused by growth damage during uprooting. Each direct-seeded rice plant, however, usually produces 2–5 tillers while each transplanted rice plant produces 10–30. Thus, tillering is much less important in direct-seeded rice.

Third, growth duration of the same variety may be slightly different between the transplanted and direct-seeded crops. Transplanted rice usually takes about 1 week more to mature because its growth has been disturbed by uprooting.

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Exercise: (Seed requirement)

Calculate the required amount of seed rice (kg) per one hectare under the following conditions.

1. Use ROK10 (1,000 grain weight of 20.0 grams, germination rate of 90%) on mangrove swamp, transplanting, planting spacing with 20cm x 25cm, three (3) seedlings per hill.

1-1. Same as above except for planting spacing with 20cm x 20cm

1-2. Same as above except for planting four (4) seedlings per hill

2. Use ROK3 (1,000 grain weight of 27.6 grams, germination rate of 95%) on upland, broadcast, sowing 250 grains per square meter.

2-1. Same as above except sowing 400 grains per square meter.

2-2. Same as above except sowing 300 grains per square meter.

3. Use Yam Besay (1,000 grain weight of 26.8 grams, germination rate of 92%) on IVS, transplanting, planting spacing with 20cm x 20cm, four (4) seedlings per hill.

3-1. Same as above except for planting two (2) seedlings per hill.

3-2. Same as above except for planting spacing with 30cm x 20cm

4. Use Lasana Conteh (1,000 grain weight of 30.0 grams, germination rate of 90%) on IVS, transplanting, planting spacing with 30cm x 20 cm, two (2) seedlings per hill.

4-1. Same as above except for germination rate of 100%.

4-2. Same as above except for four (4) seedlings per hill.

Answer (Seed requirement)

1.

(1) Planting spacing of 20cm x 25 cm means that one hill occupies 500cm^2 (20cm x 25cm = 500 cm^2). So planting density (no. of hills per square meter) is calculated at 20 (10,000 cm^2 (1 m^2) / 500 cm^2)

(2) No. of seedlings to be planted per square meter is 60 (20 hills/m^2 x 3 seedlings/hill).

(3) No. of seedlings to be planted per hectare is 600,000 (60 seedlings/m^2 x 10,000 m^2).

(4) Considering 90% of germination rate, required number of seedlings per hectare is 667,000 (600,000 / 0.9) seedlings.

(5) As 1,000 grain weight is 20g, seed requirement per hectare is calculated at 13.4 kg (667,000 grains x 20g / 1,000grains / 1,000 g/kg).

1-1

(1) The difference is the planting spacing only: not 20cm x 25 cm, but 20cm x 20cm. One hill occupies 400cm^2. So planting density is calculated at 25 hill/m^2.

(2) No. of seedlings to be planted per square meter is 75 (25 hills/m^2 x 3 seedlings/hill).

(3) No. of seedlings to be planted per hectare is 750,000 (75 seedlings/m^2 x 10,000 m^2).

(4) Considering 90% of germination rate, required number of seedlings per hectare is 833,000 (750,000 / 0.9) seedlings.

(5) As 1,000 grain weight is 20g, seed requirement per hectare is calculated at 16.7 kg (833,000 grains x 20g / 1,000grains / 1,000 g/kg).

1-2

(1) The difference is the number seedlings only: not 3, but 4.

(2) No. of seedlings to be planted per square meter is 80 (=20 hills/m^2 x 4 seedlings/hill)

(3) No. of seedlings to be planted per hectare is 800,000 (=80 seedlings/m^2 x 10,000 m^2).

(4) Considering 90% of germination rate, required number of seedlings per hectare is 889,000 (=800,000 / 0.9) seedlings.

(5) As 1,000 grain weight is 20g, seed requirement per hectare is calculated at 17.8 kg (=889,000 grains x 20g / 1,000grains / 1,000 g/kg).

2.

(1) As 250 grains are sown in one square meter, necessary number of seed grains for one hectare is 2,500,000 (=250 grains/m^2 x 10,000 m^2/ha).

(2) Considering 95% of germination rate, required number of grain is 2,630,000 (=2,500,000 / 0.95).

(3) As 1,000 grain weight is 27.6g, seed requirement per hectare is 72.6 kg (=27.6 g / 1,000 grain * 2,630,000 grain / 1,000 g/kg)

2-1

(1) The difference is the number of grains per square meter only: not 250 grains but 400 grains

(2) Necessary number of seed grain for one hectare is 4,000,000 (=400 grains/m^2 x 10,000 m^2/ha)

(3) With the germination rate of 95%, required number of grain is 4,211,000 (=4,000,000 / 0.95)

(4) Given the 1,000 grain weight of 27.6 g, seed requirement per hectare is 117 kg (=27.6 g / 1,000 grain * 4,211,000 grain / 1,000 g/kg)

2-2

(1) The difference is the number of grains per square meter only: not 250 grains but 300 grains

(2) Necessary number of seed grain for one hectare is 3,000,000 (=300 grains/m^2 x 10,000 m^2/ha)

(3) With the germination rate of 95%, required number of grain is 3,158,000 (=3,000,000 / 0.95)

(4) Given the 1,000 grain weight of 27.6 g, seed requirement per hectare is 87.2 kg (=27.6 g / 1,000 grain * 3,158,000 grain / 1,000 g/kg)

3.

(1) Planting spacing of 20cm x 20 cm means that one hill occupies 400cm^2 (=20cm x 20cm). So planting density (no. of hills per square meter) is calculated at 25 (=10,000 cm^2 (1 m^2) / 400 cm^2)

(2) No. of seedlings to be planted per square meter is 100 (=25 hills/m^2 x 4 seedlings/hill).

(3) No. of seedlings to be planted per hectare is 1,000,000 (=100 seedlings/m^2 x 10,000 m^2/ha).

(4) Considering 92% of germination rate, required number of seedlings per hectare is 1,087,000 (=1,000,000 / 0.92).

(5) As 1,000 grain weight is 26.8g, seed requirement per hectare is calculated at 29.1 kg (=1,087,000 grains x 26.8g / 1,000grains / 1,000 g/kg).

3-1

(1) The difference is the number seedlings only: not 4, but 2.

(2) No. of seedlings to be planted per square meter is 50 (=25 hills/m^2 x 2 seedlings/hill)

(3) No. of seedlings to be planted per hectare is 500,000 (=50 seedlings/m^2 x 10,000 m^2).

(4) Considering 92% of germination rate, required number of seedlings per hectare is 543,000 (=500,000 / 0.92) seedlings.

(5) As 1,000 grain weight is 26.8g, seed requirement per hectare is calculated at 14.6 kg (=543,000 grains x 26.8g / 1,000grains / 1,000 g/kg).

3-2

(1) The difference is planting spacing only: not 20cm x 20cm, but 30cm x 20cm. One hill occupies 600cm^2. So planting density is calculated at 16.7 hill/m^2 (=10000 cm^2/m^2 /600cm^2).

(2) No. of seedlings to be planted per square meter is 66.8 (=16.7 hills/m^2 x 4 seedlings/hill)

(3) No. of seedlings to be planted per hectare is 668,000 (=67 seedlings/m^2 x 10,000 m^2).

(4) Considering 92% of germination rate, required number of seedlings per hectare is 726,000 (=668,000 / 0.92).

(5) As 1,000 grain weight is 26.8g, seed requirement per hectare is calculated at 19.5 kg (=726,000 grains x 26.8g / 1,000grains / 1,000 g/kg).

4.

(1) Planting spacing of 30cm x 20 cm means that one hill occupies 600cm^2 (=30cm x 20cm). So planting density (no. of hills per square meter) is calculated at 16.7 (=10,000 cm^2 (1 m^2) / 600 cm^2)

(2) No. of seedlings to be planted per square meter is 33.4 (=16.7 hills/m^2 x 2 seedlings/hill).

(3) No. of seedlings to be planted per hectare is 334,000 (=33.4 seedlings/m^2 x 10,000 m^2/ha).

(4) Considering 90% of germination rate, required number of seedlings per hectare is 371,000 (=334,000 / 0.9).

(5) As 1,000 grain weight is 30.0g, seed requirement per hectare is calculated at 11.1 kg (=371,000 grains x 30g / 1,000grains / 1,000 g/kg).

4-1

(1) The difference is the germination rate only: not 90%, but 100%. So the calculation step from (1) to (3) above is the same: No. of seedlings to be planted per hectare is 334,000 (=33.4 seedlings/m^2 x 10,000 m^2/ha).

(2) Considering 100 % of germination rate, required number of seedlings per hectare is 334,000 (=334,000 / 1.0).

(3) As 1,000 grain weight is 30g, seed requirement per hectare is calculated at 10.0 kg (=334,000 grains x 30g / 1,000grains / 1,000 g/kg).

4-2

(1) The difference is the number seedlings only: not 2, but 4.

(2) No. of seedlings to be planted per square meter is 66.8 (=16.7 hills/m^2 x 4 seedlings/hill)

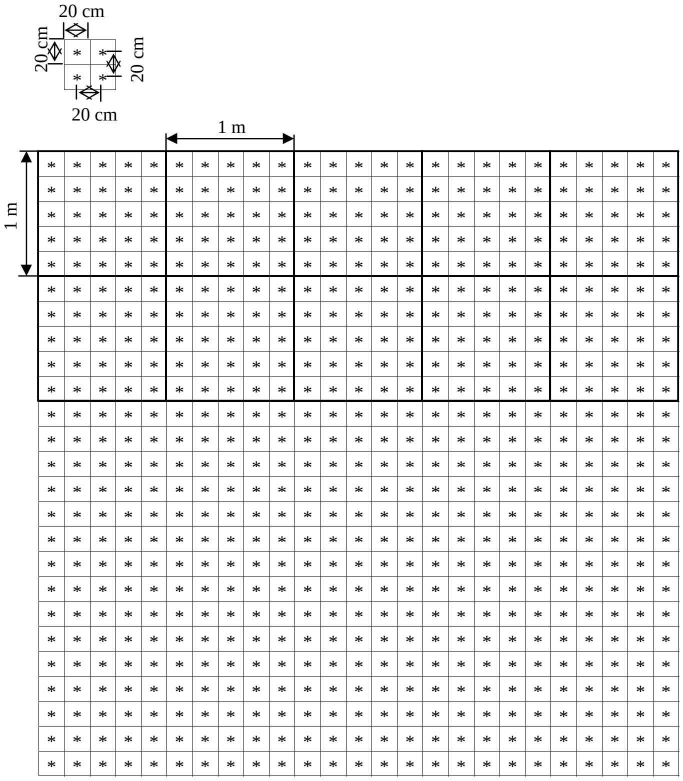
(3) No. of seedlings to be planted per hectare is 668,000 (=66.8 seedlings/m^2 x 10,000 m^2).

(4) Considering 90% of germination rate, required number of seedlings per hectare is 742,000 (=668,000 / 0.92) seedlings.

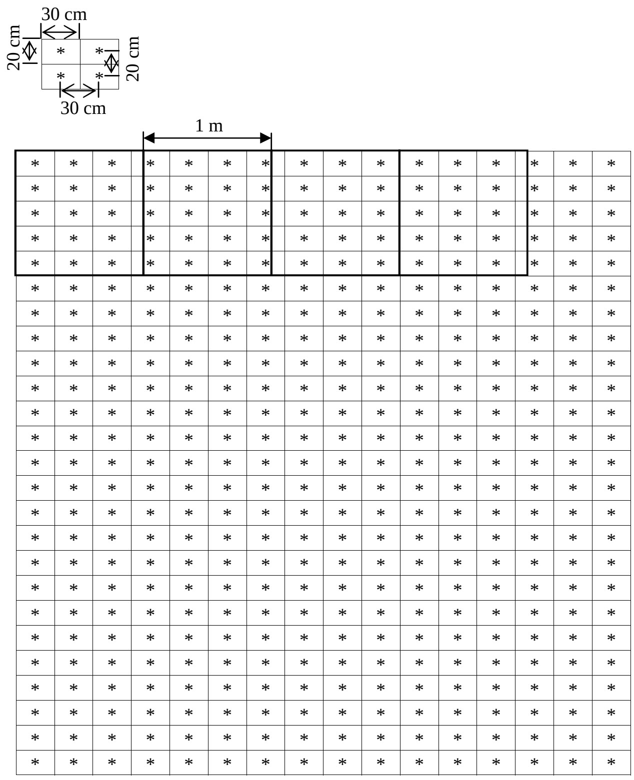
(5) As 1,000 grain weight is 30g, seed requirement per hectare is calculated at 22.3 kg (=742,000 grains x 30g / 1,000grains / 1,000 g/kg).

Planting space and the number of hills in unit area

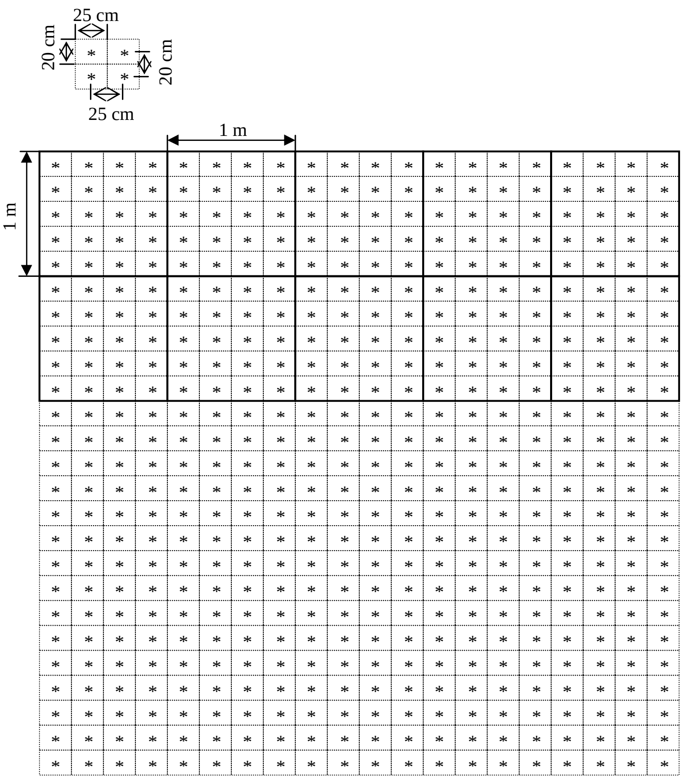
Case 1: 20cm x 20cm

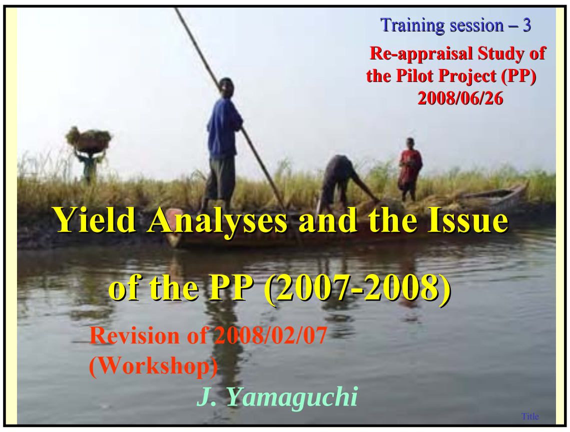


Case 2: 30cm x 20cm



Case 3: 25cm x 20cm





Training session – 3

Re-appraisal Study of the Pilot Project (PP)
2008/06/26

Yield Analyses and the Issue of the PP (2007-2008)

Revision of 2008/02/07
(Workshop)

J. Yamaguchi

Title

Yield Analyses and the Issue of the PP (2007-2008)

1. Some aspects of grain yields measured
2. Profitability by fertilizer
3. Problems, defects, etc.
4. Additional information

Sub titles

1. Some aspects of grain yields

1) **Grain yield measured**
2) **Yield variation in the fields**
3) **Fertilizer response**
4) **Calculation of total production**

Sub.1 GY

1) Grain yield (GY) measured

Table 1. Grain yield and 1,000-grain weight at the pilot project sites (2007-2008)

Agro-ecology	Site (village)	Cultivar	Treatment: Specific	Treatment: Fertilizer	Date of harvest	Grain yield (ton/ha)	(error)	1,000-grain weight (g)
Mangrove swamp	Macoth	ROK 10	-	-F	2007/12/29	1.00	*	21.6
			-	+F (1)		1.32	*	20.7
			-	+F (2)		1.52	**	21.4
	Rosmor	ROK 10	-	-F	2007/12/26	0.89	**	21.1
			-	+F (1)		1.38	*	21.2
			-	+F (2)		1.57	**	21.8
Associated mangrove swamp	Rohat	ROK 10	-	-F	2007/12/22	2.12	*	20.9
			-	+F (1)		2.24	**	20.4
			-	+F (2)		2.54	***	20.9
Boliland	Kalintin	ROK 10	-	-F	2007/12/3	0.38	**	22.0
			-	+F	2007/12/15	0.40	****	23.2
IVS	Robennah	ROK 3	Lower site	-F	2007/10/12	1.21	**	29.5
				+F		1.80	*	29.9
			Upper site	-F	2007/10/25	0.64	**	28.4
				+F		1.05	*	29.3
	Sabuya	ROK 5	Dry nursery	-F	2007/10/15	1.38	**	28.6
				+F		1.60	**	28.7
			Wet nursery	-F	2007/10/19	0.85	***	28.3
				+F		0.98	*	28.5
	Kunthai	Butter cup	-	-F	2008/1/15	0.14	*	20.0
			-	+F		1.29	*	22.4
Upland	Kunthai	ROK 3	Rice	-F	2007/11/4	0.33	**	26.8
				+F	2007/11/3	0.72	**	27.1
			Rice + sorghum	-F	2007/11/4	0.46	**	26.7
				+F	2007/11/3	0.82	**	27.4
	Robennah	ROK 3	Rice	-F	2007/10/30	1.21	**	26.6
				+F	2007/10/31	1.87	**	27.0
			Rice + sorghum	-F	2007/10/30	0.99	*	26.0
				+F	2007/10/31	1.24	*	27.5

The result were already delivered to all staff.

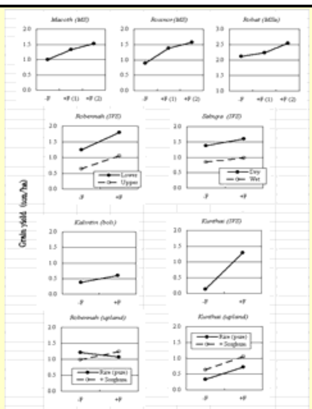


Fig. yy Grain yield response to fertilizer application at the pilot project sites (2007-2008)

The result were already delivered to all staff.

GY meas., fig

Main results - 1

(1) GY, 1 ton/ha, was attained in many sites of various ecologies with certain improvement of cultural practices.

Exceptions were; for instance,

Kunthai IVS (-F): delayed T/P

Kalintin (boliland): early and prolonged flooding

Robennah IVS (upper site): delayed T/P, water shortage

T/P: transplanting

Main results -1

1

Main results - 2

(2) No significant difference of rice GY with and without sorghum was observed in upland.

(3) GY was similar between the two treatments of fertilizer application: one and two split-application.

(4) Fertilizer response was about 0.5 ton/ha with an application rate of 4 bag/ha: 2 bag/ha each of compound fertilizer (15-15-15) and urea.

Main 2-4

2) Yield variation in the fields

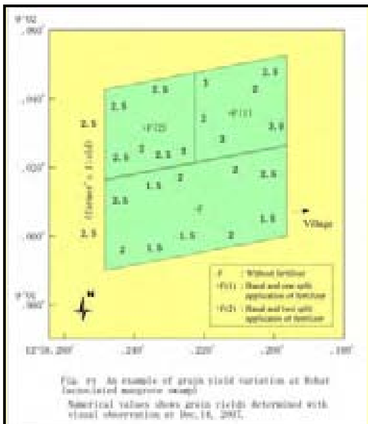
Grain yield per unit field area (GY) was measured at about 50 m^2, setting the 2 yield-plots each treatment :

the area was practically 48 m^2 simply because of easiness of measuring a rectangle (6 m x 8 m).

Error of the GY was 10%-40% (Table 1).

Besides, the actual GY varied in a treatment greatly: some examples are:

1-2. GY variation



Yield variation: an example at Robat

GY var. Robat

Another example of yield variation at Sabuya

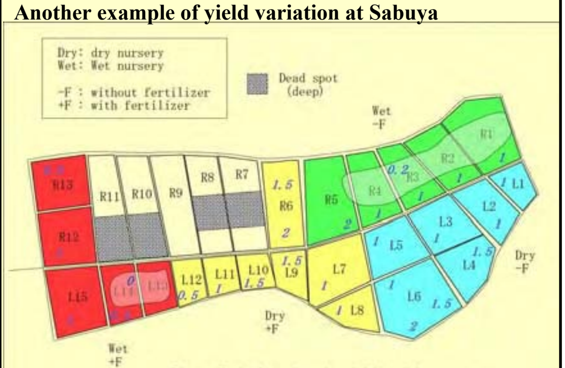
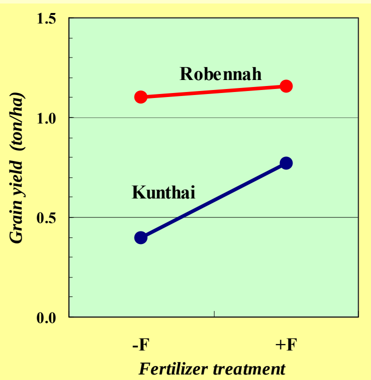


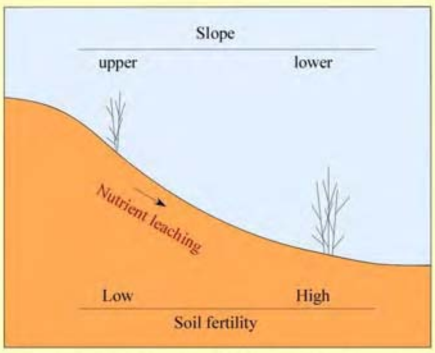
Fig. sy Variation of grain yield at Sabuya
Blue, slant values signify the yield (ton//ha)

3) Fertilizer response

What is the cause of the difference?



1-3. Fert. resp



Schematic illustration of the soil fertility difference on upland slope
Note that crop production is often proportional to (dependent on) soil fertility under the nutrient limiting condition.

slope

2

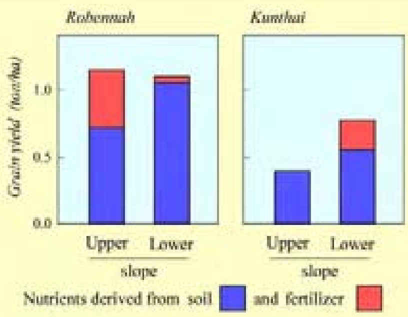


Fig. 1 Plausible difference of fertilizer effect on grain yield of upland rice at Robennah and Kunthai

Kunthai

* The reason for low fertilizer response at Kunthai is likely due to wrong choice of fertilizer (urea) used for top-dressing.

Excess nitrogen supply induced severe leaf scald development. Mal-, or imbalanced nutrition encourages many fungus diseases, so that they are often called physiological diseases.

Wrong fert.

4) Calculation of total production with the sampling method

Total production = GY x Area x Ec

GY: grain weight per unit field area (ton/ha) at 14% moisture

Area: real acreage. Many PP sites was not a regular square, being deformed, and thus, net total acreage was less than 1 ha (projected).

Ec, Effective coverage: Proportion of field area represented (covered) with the GY measured: varied 0-1 depending on uniformity of rice growth.

1-4. Prod cal

Table py. Effective coverage of the grain yield measured (Ec)

Place	Ecology	Treatment	Ec	Cause of reduction
Macoth	MS	-F	0.80	H_2S toxicity
		+F(1)	0.90	*ditto*
Kunthai	upland	-F	0.90	Bird damage at emergence
	IVS	+F	0.90	Former compost & stream
Kalintin	boli	-F	0.70	Early and prolonged flood
		+F	0.60	*ditto*
Sabuya	IVS	Dry (-F)	0.95	Fe excess
		Wet	0.85	*ditto*

Ec: Proportion of the field area effective with the measured grain yield for calculating tatal production in a whole area. Ec was visually estimated.

For example at unfertilized plot (-F) in Macoth, 20% (1-Ec) of the plot area was seriously damaged with H_2S toxicity, where the GY was nominal .

Ec in another (ordinary) sites should be one (1).

Effect. coverage

Table 3. Calculated result of the total production (rough rice at 14% moisture) at the PP sites and its comparison with the total production harvested by farmers - 1

PP site	Agro-ecology & cultivar	Treatment: Specific	Treatment: Fertilizer	Grain yield (ton/ha)	Field area (ha)	Effective coverage	Production (kg) Calculated: Within a treatment	Calculated: Total at the site	Harv. by farmers: Within a treatment	Harv. by farmers: Total at the site
Macoth	Mang.	-	-F	1.00	0.49	0.75	366	1,000	-	870
	swamp	-	+F (1)	1.33	0.25	0.90	275		-	
	ROK 10	-	+F (2)	1.52	0.24	1.00	359		-	
Rokut	As swamp	-	-F	2.12	0.48	1.00	1,023	2,175	-	2,385
	swamp	-	+F (1)	2.24	0.24	1.00	539		-	
	ROK 10	-	+F (2)	2.54	0.24	1.00	613		-	
Rosner	Mang.	-	-F	0.89	0.25	1.00	223	921	274	905
	swamp	-	+F (1)	1.38	0.24	1.00	326		300	
	ROK 10	-	+F (2)	1.57	0.24	1.00	371		332	
Kunthai	Upland	Rice	-F	0.33	0.25	0.90	75	565		520
	ROK 3		+F	0.72	0.25	1.00	181			
		Rice +	-F	0.46	0.25	0.90	105			
		sorghum	+F	0.82	0.25	1.00	204			
[illegible]	IVS	-	-F	0.14	0.17	1.00	23	341		
	Butter cup	-	+F	1.29	0.26	0.95	318			

Production-1

Table 3. Calculated result of the total production (rough rice at 14% moisture) at the PP sites and its comparison with the total production harvested by farmers - 2

PP site	Agro-ecology & cultivar	Treatment: Specific	Treatment: Fertilizer	Grain yield (ton/ha)	Field area (ha)	Effective coverage	Production (kg) Calculated: Within a treatment	Calculated: Total at the site	Harv. by farmers: Within a treatment	Harv. by farmers: Total at the site
Robennah	Upland	Rain	-F	1.21	0.25	1.00	302	1,127		1,462
	ROK 3		+F	1.07	0.25	1.00	268			
		Rain +	-F	0.99	0.25	1.00	247			
		sorghum	+F	1.24	0.25	1.00	309			
Robennah	IVS	Lower	-F	1.25	0.25	1.00	313	1,185	310	820
	ROK 3	site	+F	1.80	0.25	1.00	450		450	
		Upper	-F	0.64	0.25	1.00	159			
		site	+F	1.05	0.25	1.00	263			
Kalintin	Boliland	-	-F	0.38	0.40	0.70	106	245		
	ROK 10	-	+F	0.60	0.38	0.60	139			
Sabuya	IVS	Dry	-F	1.38	0.27	0.95	359	1,129	-	1,225
	ROK 3	nursery	+F	1.60	0.24	1.00	384		-	
		Wet	-F	0.85	0.27	0.85	195		-	
		nursery	+F	0.98	0.23	0.85	191		-	

Production-2

3

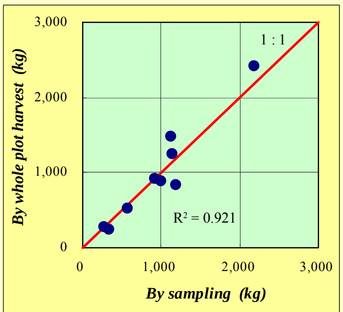


Fig. Rp Relationship between total production of a whole field calculated on the basis of grain yield measured with the sampling method and that havested by farmers

Relation bn

2. Profitability by fertilizer application

Result from the PP:

The maximum GY increment by fertilizer application (200 kg/ha) was about 0.5 ton/ha (= 500 kg/ha).

Is this increment profitable?

Sub.2 Profit

Assuming that

(1) fertilizer cost is Le150,000/bag (50 kg/bag),
(2) fertilizer rate is 4 bag/ha, and
(3) price of rough rice is Le30,000/bu (50 kg/bu).

Total cost = Le150,000 x 4 = Le600,000
Rice price of 1,000 kg = Le30,000/50 x 1,000
= Le600,000

Thus, the marginal production to recover fertilizer cost is 1 ton/ha under the present economic condition in Sierra Leone.

Cal marginal

The GY increment by fertilizer application (a) was expected and is possible to be 1 ton/ha at least.

a) Fertilizer response

Why was not this target attained?

Why not?

3. Problems , defects, etc. in various aspects

1) Cultural practices

2) Field layout

3) Wrong monitoring

3-1) Growth monitoring

3-2) Labor requirement

Sub.3

1) Problem of cultural practices - transplanting

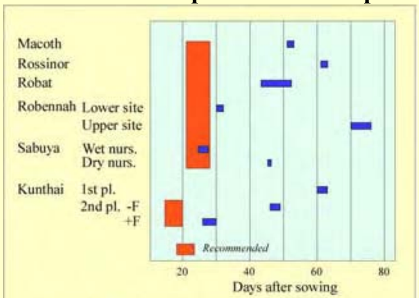
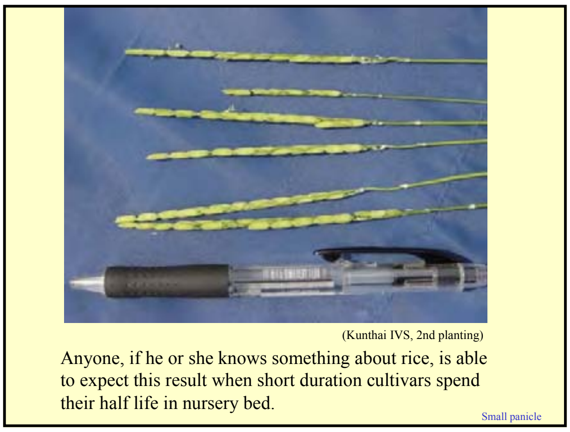


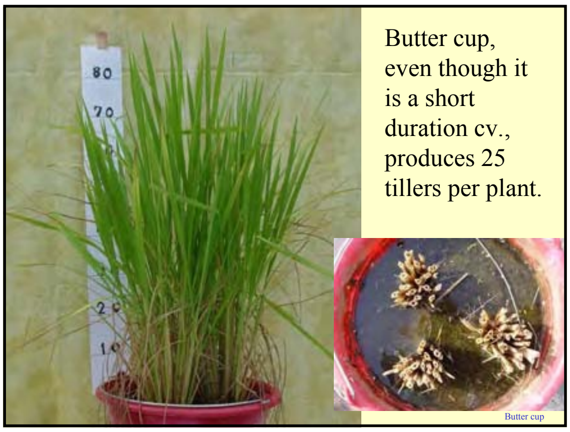
Fig. dt Days after sowing and duration of transplanting at the PP sites.

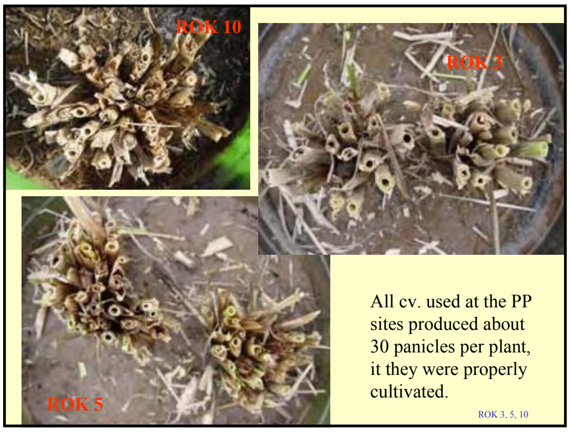
Delayed and prolonged T/P in almost all sites: why?

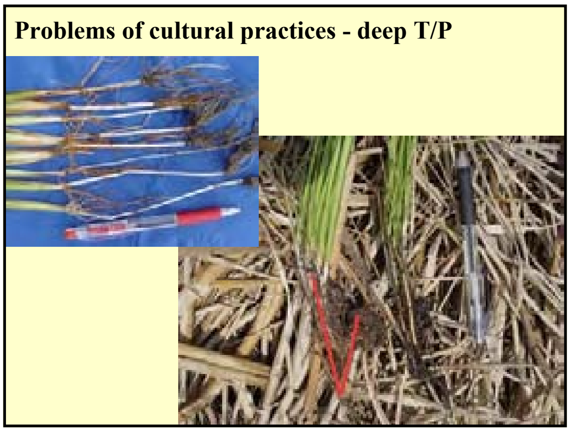
3-1 cult- delay T/P

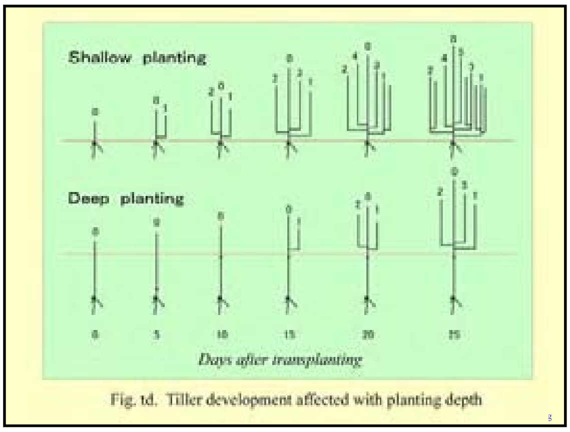
4

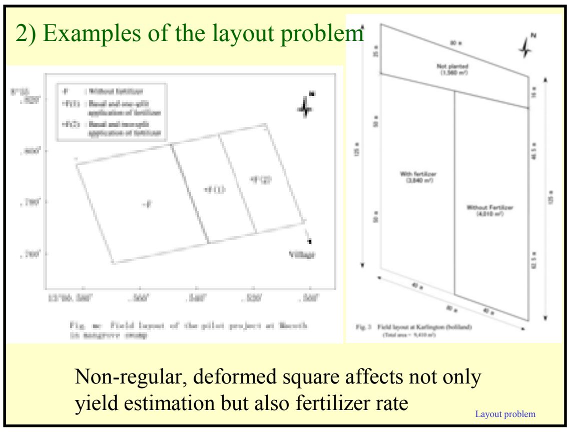

(Kunthai IVS, 2nd planting)
Anyone, if he or she knows something about rice, is able to expect this result when short duration cultivars spend their half life in nursery bed.
Small panicle


Butter cup, even though it is a short duration cv., produces 25 tillers per plant.
80
70
Butter cup


ROK 10
ROK 3
ROK 5
All cv. used at the PP sites produced about 30 panicles per plant, it they were properly cultivated.
ROK 3, 5, 10


Problems of cultural practices - deep T/P


Shallow planting
Deep planting
0
5
10
15
20
25
Days after transplanting
Fig. 1d. Tiller development affected with planting depth


2) Examples of the layout problem
Non-regular, deformed square affects not only yield estimation but also fertilizer rate
Layout problem

5

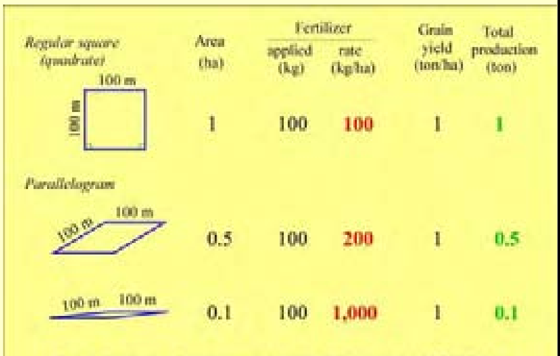


Fig. pl. Examples of problems caused with different shapes of field layout

Rect-angle

3-1) Wrong growth monitoring: e.g.,

YC (yield component) analysis

Grain yield = C x D x E x G

Each YC is determined at the different growth stage, and thus, the YC analysis will provide us which growth stage induces low yield.

The handout was already delivered to all staff.

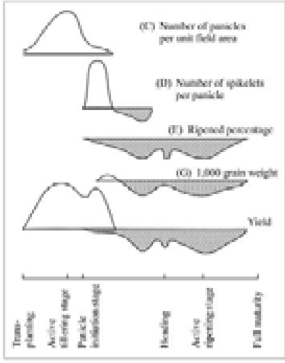
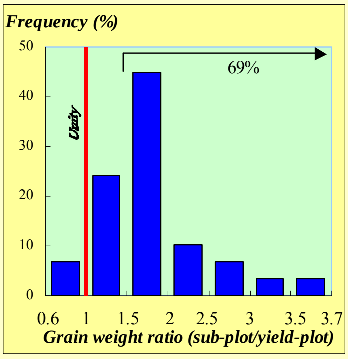


Fig. Schematic illustration of processes of yield and yield component formation in rice plant (Modified Matsushima, 1959) Positive (blank) and negative (hatch) effect of environment.



Grain weight at about 70% sub-plots was 1.5 times or larger than that at the respective yield-plots.

This result induces the difficulty of YC analysis.

sub-/yield plot

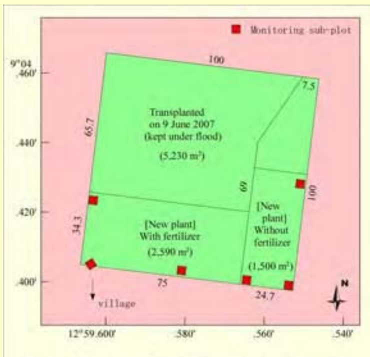


Fig. 3 Allocation of the sub-plots at inland valley swamp (IVS), Kunthai (the second planting)

Kunthai IVS: the worst case of the sub-plot allocation.

Plant growth at the border is several times vigorous than that inside: more number of tillers (panicles) per plant and larger panicles.

Kunthai sub-plot

3-2) Invalid labor requirement

Table 3. Total labor requirement for each hectare of rice cultivation in various agro-ecologies

Agro-ecology	PP site	person ·hour	person ·day
Mangrove swamp	Macoth	1763	220
	Rosinor	906	113
Mangrove swamp (assoc)	Robat	1965	246
Bolland	Karlington	6786	848
Inland valley swamp	Robennah	2933	367
	Sabuya	5219	652
Upland	Robennah	1947	243
	Kunthai	3596	450

a) Summarized data on the Farming Activities presented by 2008/01/28
b) assoc: associated
c) Conversion rate: 8 working hours a day

The result shows that there was a big difference in the labor requirement (110-850 person.d/ha) among the sites, reflected with the natural status and socio-economic condition among them. Is it feasible? . . . No!

Labor req.

Table lt4. Summarized labor requirement of transplanting (included uprooting) of rice plants

Place (PP site)	Agro-ecology	Labor requirment / ha p.h	p.d
Macoth	MS	211	26
Rosinor	MS	287	36
Robat	MSa	310	39
Robennah	IVS	349	44
Kunthai	IVS	207	26
Sabuya	IVS	353	44

Abbreviation; MS: mangrove swamp, MSa: MS associated, IVS: inland valley swamp.
p.h: person x h, p.d: person x day

Originally it varied 24-65 p.d/ha.

Note that labor requirement for transplanting in IVS was 49-90 p.d/ha among chiefdoms (Table 7.12(2) in the baseline survey).

Labor TP

6

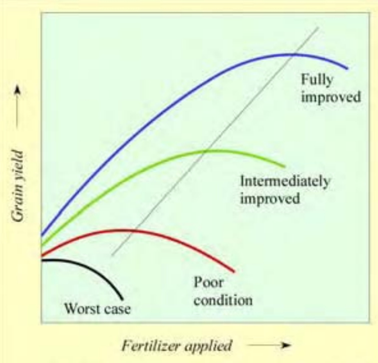


Fig. if. Interaction between cultural condition and grain yield under ordinary environmental condition

4. Additional information

Low fertilizer response at the PP sites indicates that crop management practiced was still poor.

interaction

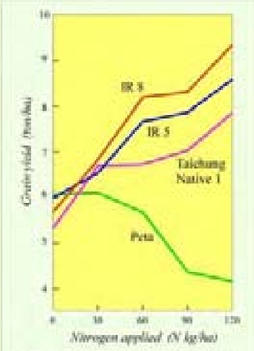


Fig. VII-9 Varietal difference of nitrogen response of rice plant (Los Banos in the rainy season, 1967) (Tanaka, 1971)

An example of the interaction between fertilizer response and crop management (cultivar).

IR8: modern, improved, high-yielding cv. (short stature, non-photo-sensitive)

Peta: traditional, native cv. (tall stature, photo-sensitive)

Note that all cultivars were grown under the favorable cultural condition.

cv x fertilizer

Potential rice GY in Kambia district is likely about 5 ton/ha, when one considers her climatic condition during the rainy season: main rice growing season.

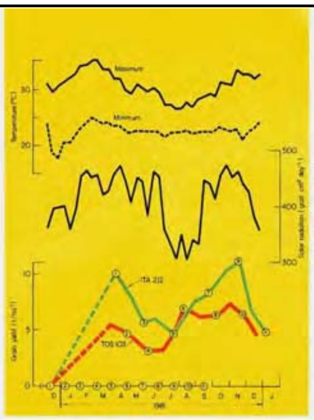


FIGURE 2. Climatic effect on the grain yield of rice plants. (The numbers in the circles indicate the date of transplanting and the corresponding date of full maturity.)

Y

Let's think and work together!

a) Polish your skill and use your bean through practices

b) Watch carefully rice plants in the field

Thank you!

fin

7

2008/06/25
JPT

Appendix A4-3 Yield Analyses and the Issue of the PP (2007-2008)

Re-appraisal study of the Pilot Project (PP)
(Essentially similar to the workshop on 2008/02/07)

Note 1) Bring all handouts and documents delivered in the past.
Ref.. 1: Grain yield at the PP (2008/01)
– Date of harvest, grain yield and its error, 1,000-grian weight, and fertilizer response
Ref.. 2: Key farming activities (2007/10/03 & 2007/11/27)
Ref.. 3: Labor requirement for T/P (2007/10/03 & 2007/11/07)
Ref.. 4: Grain yield and yield components (2007/10/30)
Ref.. 5: Measurement of grain yield (2007/10/03)
Ref.. 6: Summarized Answers to the Questionnaire for the Pilot Project (2007-2008)
Ref.. 7: Survey result of the baseline survey (Dec. 2007)

Note 2) Exercise will be given at the end of lecture.
Note 3) Table and figure numbers cited in the text are not well ordered.

1. Some aspects of grain yields
1) Grain yield (GY) measured (Ref.. 1)
(1) GY, 1 ton/ha, was attained in many sites of various ecologies with certain improvement of cultural practices.
(2) No significant difference of rice GY with and without sorghum was observed in upland.
(3) GY was similar between the two treatments of fertilizer application: one and two split-application.
(4) Fertilizer response was about 0.5 ton/ha with an application rate of 4 bag/ha: 2 bag/ha each of compound fertilizer (15-15-15) and urea.

2) Yield variation in the fields (Ref. 1)
Grain yield per unit field area (GY) was measured at about 50 m^2, setting the 2 yield-plots each treatment: the area was practically 48 m^2 simply because of easiness of measuring a rectangle (6 m x 8 m). Error of the GY was 10%-40% (Table 1) (Ref.. 1).
Besides, the actual GY varied in a treatment greatly: some examples are:

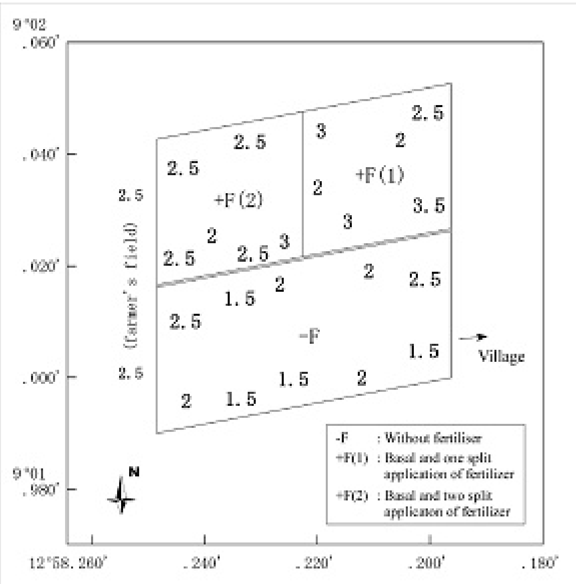


Fig. ry An example of grain yield variation at Robat (associated mangrove swamp)
Numerical values shows grain yields determined with visual observation at Dec.14, 2007.

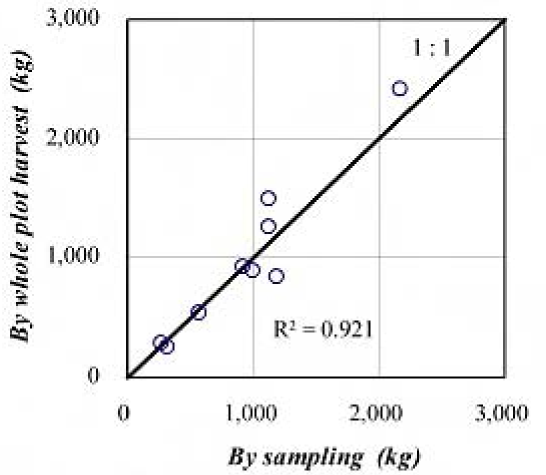


Fig. Rp Relationship between total production of a whole field calculated on the basis of grain yield measured with the sampling method and that havested by farmers

3) Fertilizer response: an example on upland
a) Treatment allocation at sloppy land
b) The reason for low fertilizer response at Kunthai is likely due to wrong choice of fertilizer (urea) used for top-dressing. Excess nitrogen supply induced severe leaf scald development. Mal-, or imbalanced nutrition encourages many fungus diseases, so that they are often called physiological diseases.

4) Calculation of total production with the sampling method (Ref. 5)

Total production = GY x Area x Ec

Where,
GY: grain weight per unit field area (ton/ha) at 14% moisture
Area: real acreage. Many PP sites was not a regular square, being deformed, and thus, net total acreage was less than 1 ha (projected).
Ec: Effective coverage: Proportion of field area represented (covered) with the GY measured: varied 0-1 depending on uniformity of rice growth.

Table py. Effective coverage of the grain yield measured (Ec)

Place	Ecology	Treatment	Ec	Cause of reduction
Macoth	MS	-F	0.80	H_2S toxicity
		+F(1)	0.90	*ditto*
Kunthai	upland	-F	0.90	Bird damage at emergence
	IVS	+F	0.90	Former compost & stream
Kalintin	boli	-F	0.70	Early and prolonged flood
		+F	0.60	*ditto*
Sabuya	IVS	Dry (-F)	0.95	Fe excess
		Wet	0.85	*ditto*

Ec: Proportion of the field area effectivce with the measured grain yield for calculating tatal production in a whole area. Ec was visually estimated.

For example at unfertilized plot (-F) in Macoth, 20% (1-Ec) of the plot area was seriously damaged with H_2S toxicity, where the GY was nominal. Ec in another (ordinary) sites should be one (1).

Results: see Ref. 1 and Table 1.

Fig. Rp (p.1) shows the relationship between total production of a whole field calculated on the basis of grain yield measured with the sampling method and that harvested by farmers

2. Profitability by fertilizer application

Result from the PP: The maximum GY increment by fertilizer application (200 kg/ha) was about 0.5 ton/ha (= 500 kg/ha). Assuming that (1) fertilizer cost is Le150,000/bag (50 kg/bag), (2) fertilizer rate is 4 bag/ha, and (3) price of rough rice is Le30,000/bu (50 kg/bu).

Total cost = Le150,000 x 4 = Le600,000
Rice price of 1,000 kg = Le30,000/50 x 1,000 = Le600,000

Thus, the marginal production to recover fertilizer cost is 1 ton/ha under the present economic condition in Sierra Leone.

Fertilizer response (GY increment by fertilizer application) was expected and is possible to be 1 ton/ha at least. Why was not this target attained? Many defects, for which you were responsible, were found.

Table 1. Total grain production (rough rice at 14% moisture) at the PP sites with the sampling method and with harvesting a whole plot by farmers.

PP site	Agro-ecology & cultivar	Treatment: Speci-fic	Treatment: Ferti-lizer	Grain yield (ton /ha)	Field area (ha)	Effec-tive cover-age	Production (kg) Calculated: Within a treat-ment	Calculated: Total at the site	Harv. by farmers: Within a treat-ment	Harv. by farmers: Total at the site (a)
Macoth	Mangr.	-	-F	1.00	0.49	**0.75**	366	1,000	-	890
	swamp	-	+F (1)	1.32	0.23	**0.90**	275		-	(870) b
	ROK 10	-	+F (2)	1.52	0.24	1.00	359		-	
Robat	As. mangr.	-	-F	2.12	0.48	1.00	1,023	2,175	-	2,420
	swamp	-	+F (1)	2.24	0.24	1.00	539		-	(2,385) c
	ROK 10	-	+F (2)	2.54	0.24	1.00	613		-	
Rosinor	Mangr.	-	-F	0.89	0.25	1.00	223	921	278	924
	swamp	-	+F (1)	1.38	0.24	1.00	326		307	(905) b
	ROK 10	-	+F (2)	1.57	0.24	1.00	371		339	
Kunthai	Upland	Rice	-F	0.33	0.25	**0.90**	75	565		532
	ROK 3		+F	0.72	0.25	1.00	181			(520) d
		Rice +	-F	0.46	0.25	**0.90**	105			
		sorghum	+F	0.82	0.25	1.00	204			
Kunthai	IVS	-	-F	0.14	0.17	1.00	23	324		250
	Butter cup	-	+F	1.29	0.26	**0.90**	301			(242) e
Robennah	Upland	Rice	-F	1.21	0.25	1.00	302	1,127		1,485
	ROK 3		+F	1.07	0.25	1.00	268			(1,462) f
		Rice +	-F	0.99	0.25	1.00	247			
		sorghum	+F	1.24	0.25	1.00	309			
Robennah	IVS	Lower	-F	1.25	0.25	1.00	313	1,185	316	844
	ROK 5	site	+F	1.80	0.25	1.00	450		459	(820) g
		Upper	-F	0.64	0.25	1.00	159			
		site	+F	1.05	0.25	1.00	263			
Kalintin	Boliland	-	-F	0.38	0.40	**0.75**	114	264	152	280 h
	ROK 10	-	+F	0.60	0.38	**0.65**	150		128	(275)
Sabuya	IVS	Dry	-F	1.38	0.27	**0.95**	359	1,129	-	1,250
	ROK 5	nursery	+F	1.60	0.24	1.00	384		-	(1,225) i
		Wet	-F	0.85	0.27	**0.85**	195		-	
		nursery	+F	0.98	0.23	**0.85**	191		-	

a) Values in parentheses show grain production reported from each PP site. Production taken for GY determination at 48 m^2 + (1 m^2 x 3) = 51 m^2 was added.
b) By actural weighing
c) 45 bag x 53 kg/bag = 90 bu x 26.5 kg/bu = 2,385 kg
d) 17 baff-pan x 30.6 kg/baff-pan = 520.2 kg
e) e-mail from E.E. Bangura through T. Kimijima on 2008/02/21.
f) 34 bag x 43 kg/bag = 1,462 kg
g) 820 kg as a total? GY at upper site = 820 - (310+450) = 60 kg: too small?
h) no valid information
i) 35 bu (by Baf pan) x 35 kg/bu = 1,225 kg (air-dried weight)

3. Problems , defects, etc. in the past PP

1) Problems of cultural practices: for instance,
   a) Delayed and prolonged T/P in almost all sites (Fig. dt). What was a cause?
   b) Deep T/P (Fig. td)

2) Deformed field layout; e.g., Fig. mc and Fig. 3.
   Non-regular, deformed square affects not only yield estimation but also fertilizer rate

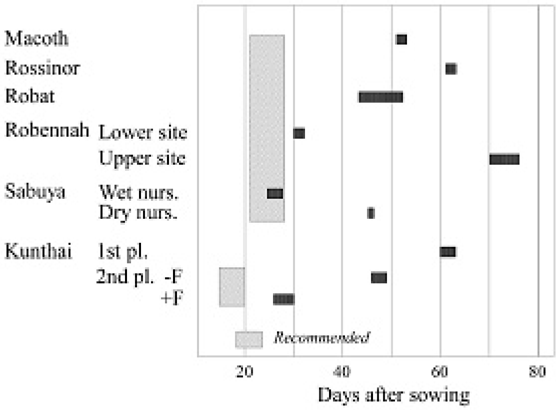


Fig. dt Days after sowing and duration of transplanting at the PP sites.

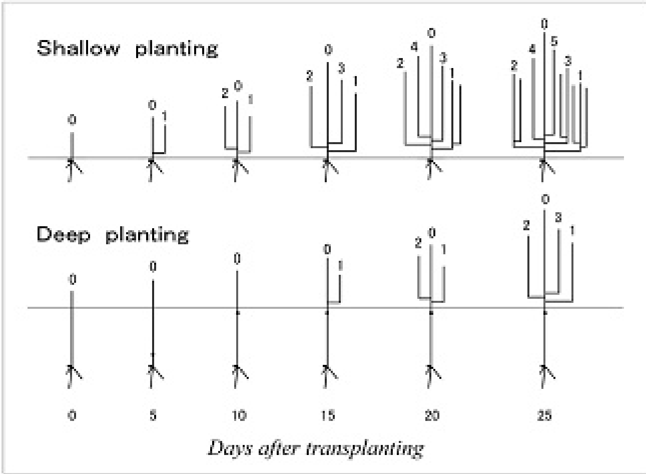


Fig. td. Tiller development affected with planting depth

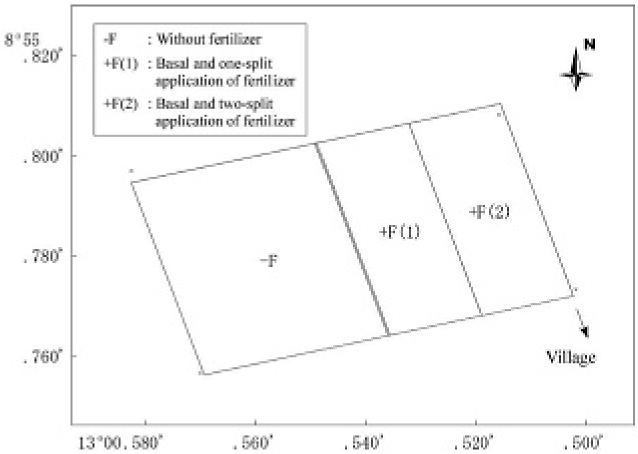


Fig. mc Field layout of the pilot project at Macoth in mangrove swamp

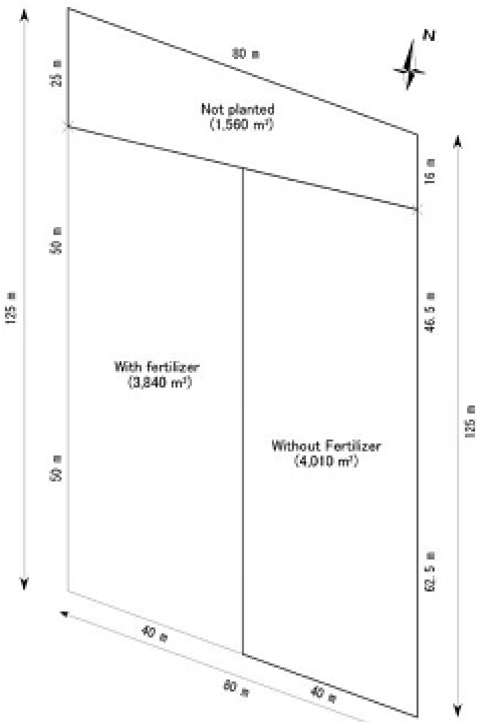


Fig. 3 Field layout at Karlington (boliland)
(Total area = 9,410 m²)

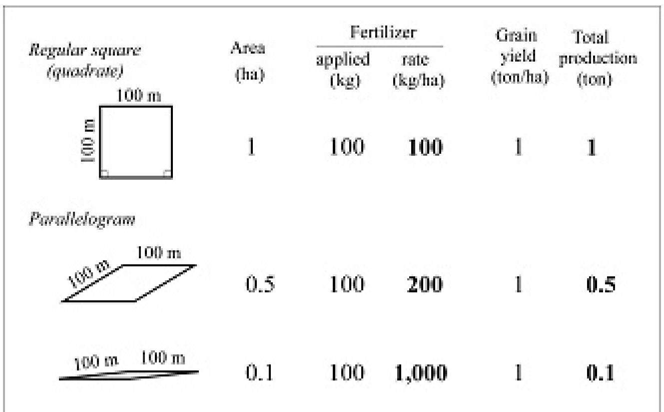


Fig. pl. Examples of problems caused with different shapes of field layout

3) Wrong monitoring results

3-1) Plant growth monitoring: yield component (YC) analysis (Ref. 4)

Grain yield = C x D x E x G

Each YC is determined at the different growth stage, and thus, the YC analysis will provide us which growth stage induces low yield.

Grain weight at about 70% sub-plots was 1.5 times or larger than that at the respective yield-plots (Fig. Gw). This result induces the difficulty (made impossible) in YC analysis.

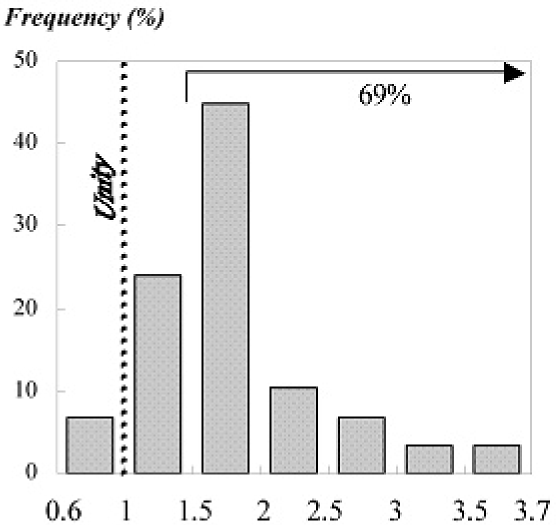


Fig. Gw. Grain weight ratio (sub-plot/yield-plot)

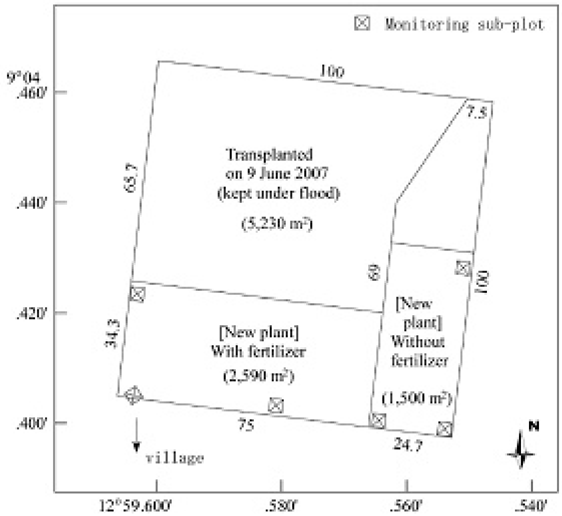


Fig. 3 Allocation of the sub-plots at inland valley swamp (IVS), Kunthai (the second planting)

Wrong allocation of sub-plots: the worst case at Kunthai IVS (Fig. 3). Plant growth at the border is several times vigorous than that inside: more number of tillers (panicles) per plant and larger panicles.

3-2) Farming activity records: e.g., Labor requirement

The result (Table 3) shows that there was a big difference in the labor requirement (110-850 person.d/ha) for rice culture in one cropping), reflected with the natural status and socio-economic condition of each PP site. Is it feasible? Definitely, no!

Table lt4. Summarized labor requirement of transplanting (included uprooting) of rice plants

Place (PP site)	Agro-ecology	Labor requirement / ha p.h	p.d
Macoth	MS	211	26
Rosinor	MS	287	36
Robat	MSa	310	39
Robennah	IVS	349	44
Kunthai	IVS	207	26
Sabuya	IVS	353	44

Abbreviation; MS: mangrove swamp, MSa: MS associated, IVS: inland valley swamp.
p.h: person x h, p.d: person x day

Table 3. Total labor requirement for each hectare of rice cultivation in various agro-ecologies

Agro-ecology	PP site	person -hour	person -day
Mangrove swamp	Macoth	1763	220
	Rosinor	906	113
Mangrove swamp (assoc)	Robat	1965	246
Boliland	Karlington	6786	848
Inland valley swamp	Robennah	2933	367
	Sabuya	5219	652
Upland	Robennah	1947	243
	Kunthai	3596	450

a) Summarized data on the Farming Activities presented by 2008/01/28
b) assoc: associated
c) Conversion rate: 8 working hours a day

Tentative result of labor requirement of transplanting (Table lt4) (Ref. 3): Did you find any rational reason for such a big difference (26-44 p.d/ha) among the PP sites?

Note 1) The first version was presented to the task-force meeting on 2007/10/03 (varied 24-65 p.d/ha) and tentatively finalized on 2007/11/07 through repeated corrections.
Note 2) The average labor requirement of transplanting was about 14 p.d/ha in Japan.
Note 3) Total labor requirement or rice cultivation was 178-585 p.d/ha for IVS and 185-635 p.d/ha for upland in the baseline survey (Table 7.12 in Ref. 6).

c) Farming activity: e.g., no record of (a) flowing date in all PP sites except Robat (still the record was ambiguous) and (b) even of harvesting date at Robat, Kunthai (two ecologies) and Kalintin (Ref. 2).

4. Additional information

a) Low fertilizer response at the PP sites indicates that crop management practiced was still poor.
b) Potential rice GY in Kambia district is likely about 5 ton/ha, when one considers her climatic condition during the rainy season: main rice growing season.

5. Requests to MAFFS-K staff (responses to the answers at the appraisal workshop on 2007/02/07)

a) Follow strictly the cropping calendar instructed in the technical package (TP).
b) Avoid deep T/P by puddling deep enough.
c) Participate actively into all farming practices.
d) Standardize the recording system in farming activity sheets. All data in the past year should be reassessed by your own responsibility. At the same time, provide the background data on grain yield, especially when no valid information is shown in Table 1.
e) Consult farmers closely in the group activity
f) Watch carefully plant growth: plants never tell you lie.
g) Find any problem in the TP for realization of the sustainability
h) Show us how much and how often you have claimed or approached to your government on your requests.
i) JPT will not support any simple introduction of mechanization or credit system. Find the results in our farm machinery survey. Besides, bear in mind that how many machinery and credit systems were introduced into the country after the independence: all projects failed.
j) Always think about what you can do by yourself. All foreign aid
k) Any proposal or request to the JPT should be presented with full background: e.g., animal draft.

Important notes:

1) The JPT have provided every opportunity for capacity building of the MAFFS-K staff, especially through on-the-job training (Ref.. 6), and is willing to do so this year too as far as you are keen in your own skill-up. The evaluation of the JPT attitude as being 'down to earth' is highly appreciated by one of the FEWs in Answers to the Questionnaire (Ref.. 6), because he himself understand the importance. Yet, unfortunately, any training on soil analyses is not planned.

2) The JPT is paying close attention to sustainable agricultural development through technical assistance, not through material provision that is ephemerally vanished into air.

3) The JPT is looking forward to having your positive suggestion or advice to improve the project.

2008/06/26

Name: ___________________________________

Short Exercise

Q: When a recommended rate of nitrogen is at 40 kg/ha and urea (46% N) as a f ertilizer is provided, calculate how much fertilizer you have to apply into one (1) acre field area?

Ans. (show an equation too):

Today's topic

- Last week exercise
  Fertilizer calculation
- on the PP
  Some additional information
- Labor cost
  Confirmation
- Today's main topic
  Grain yield and its components

Sub titles

Fertilizer calculation

What is the percentage?

None of you understands it, at least practically.

Sub 1- Fert

The similar example;

Formulation of Draft Technical Package (page 4) describes that 'apply 40 kg P_2O_5/ha and xxx for IVS rice as a basal fertilizer'.

Yet, the description is simply a copy of a textbook without real (practical) understanding, isn't it ?

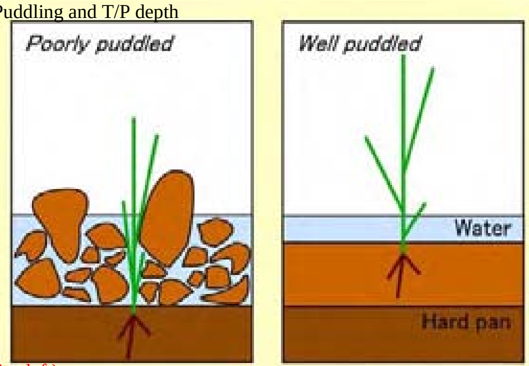
TP – P2O5

Some additional information on PP

1. T/P depth
2. Cultivation procedure in fields
3. Tillering
4. Salt tolerance

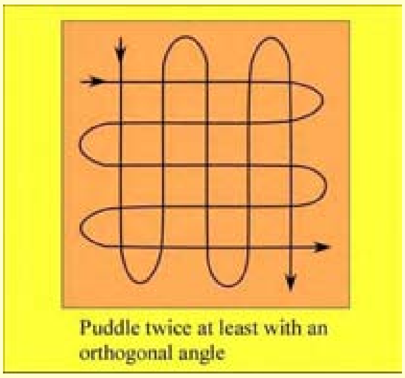
Sub 2- inf

Puddling and T/P depth



(See left)
Difficulty of shallow planting due to poor puddling

Strong (obligatory/compulsory) recommendation:

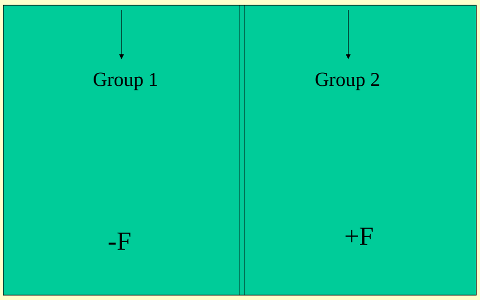


Otherwise, the same result as last year would be obtained.

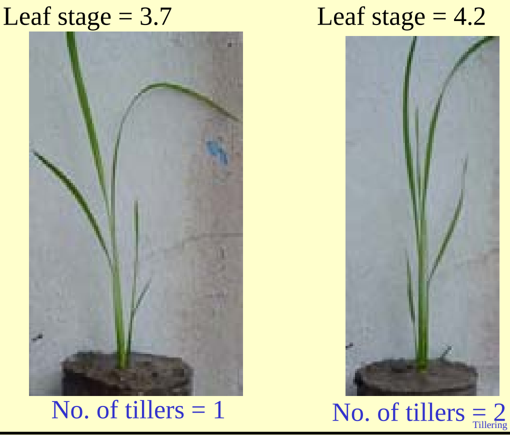
Puddling

2. Cultivation procedure

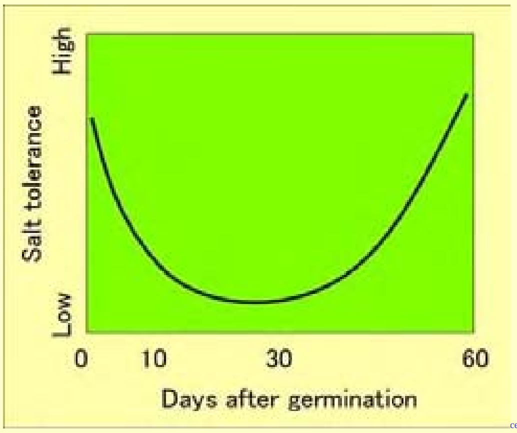
(puddling and T/P)



Cult. proced.



Tillering



Final confirmation

Table Irl. Total labor requirement for each hectare of rice cultivation in various agro-ecologies

Agro-ecology	PP site	person -hour	person-day as 8 h/d	person-day as 6 h/d
Mangrove swamp	Macoth	1763	220	294
	Rosinor	906	113	151
Mangrove swamp (assoc)	Robat	1965	246	328
Boliland	Karlington	6786	848	1131
Inland valley swamp	Robennah	2933	367	489
	Sabuya	5219	652	870
Upland	Robennah	1947	243	325
	Kunthai	3596	450	599

a) Summarized data on the Farming Activities presented by 2008/01/28

b) assoc: associated

Table Irt. Summarized labor requirement of transplanting (included uprooting) in lowland rice cultivation

Place (PP site)	Agro-ecology	Labor requirement/ha person h	person d as 8 h/d	person d as 6 h/d
Macoth	MS	211	26	35
Rosinor	MS	287	36	52
Robat	MSa	310	39	58
Robennah	IVS	349	44	48
Kunthai	IVS	207	26	34
Sabuya	IVS	353	44	59

Abbreviation; MS: mangrove swamp, MSa: MS associated, IVS: inland valley swamp.

h: hour, d: day

cf) Labor requirement for T/P was about 14 person d/ha in Japan.

LaborRq T/P

2

YC (yield component) analysis

Each YC is determined at the different growth stage, and thus, the YC analysis will provide us which growth stage induces low yield.

The handout was already delivered to all staff.

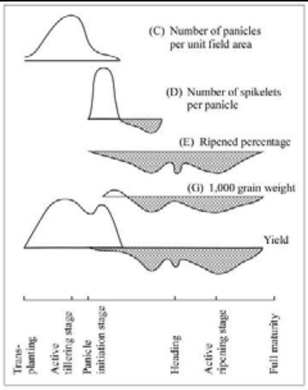


Fig. Schematic illustration of processes of yield and yield component formation in rice plant (Modified Matsushima, 1959) Positive (blank) and negative (hatch) effect of environment.

Grain yield and yield components

(See the handout on 14 Nov. 2007)

Relationship between grain yield and yield components (YCs)

Yield = A x B x D x E x G = A x B x F x G = C x F x G

where,

Yield : Grain weight per unit field area

Yield components		(For example)
A :	Number of hills per unit field area	15 hills/m^2 = 150,000 hills/ha
B :	Number of panicles per hill	8 panicles/hill
C :	Number of panicles per unit field area	= A x B = 120 panicles/m^2
D :	Number of spikelets per panicle	100 spikelets/panicle
E :	Proportion of ripened (filled) grains (often called as ripened percentage)	0.85 (85% filled grains in the total no of spikelets)
F :	Number of filled grains per panicles	= D x E = 85 grains/panicle
G :	1,000-grain weight	25 g/1,000 grains = 25 mg/grain = 0.025 g/grain

Yield = 15 x 8 x 85 x 0.025 = 255 g/m2 = 2.55 ton/ha

Modification of the equation

Yield = A x B x F x G (1) principal eq.

When,

Yield = 2.55 ton/ha = 255 g/m^2

A : Number of hills per unit field area = 15 hills/m^2

B : Number of panicles per hill = 8 panicles/hill

G : 1,000-grain weight = 25 g/1,000 grains = 0.025 g/grain

F : Number of filled grains per panicle ??

F = Yield / (A x B x G) (2) modified eq.

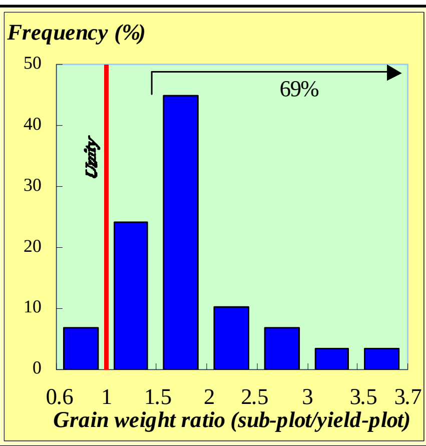
= 255 / (15 x 8 x 0.025) = 85 grains/panicle

Please bear in mind that

each value of yield and every components are assumed to be, and should be, an average over a given plot (treatment).

However, it was not in the case of sub-plots in the Pilot Project (2007).

note



This is the result of last year's trial.

GW at sub-plot

This year, we will adopt another approach to the growth monitoring.

See a handout.

New approach

2008/07/02 (Modified 7/03)

Measurement of Plant Density and Growth

1. Measurement of plant (hill) density

1-1) Refer to Table 1 for the growth stage to be measured and the sub-plot size.

Table 1 Time and the size of a sub-plot for plant (hill) density measurement

Growth stage	Size of a sub-plot	
	Upland	Lowland
2 weeks after sowing	1 m x 2 m	-
Immediately after T/P	-	1 m x 3 m
Immediately after harvest	2 m x 2 m	2 m x 3 m

T/P: transplanting.

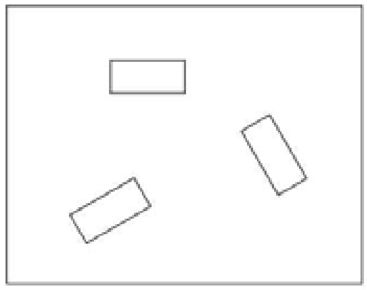


Fig. 1 Three replications of monitoring sub-plots in a treatment plot.

1-2) Watch carefully the plant growth and density in an entire treatment plot from all four peripheries.

1-3) Find three locations (replications) of the average plant density (the number of plants [hills] per unit field area) (Fig. 1). They should be three-meter away, at least, from all sides of a treatment plot.

1-4) Count and record the number of plants (hills) in the sub-plots with the help of sticks, twigs, leaves, drawing lines, etc.

2. Measurement of plant height and the number of tillers

2-1) The measurement should start at the time of plant density measurement, and continue until harvest by a two-week interval.

2-2) Carefully watch and select three (3) plants (hills) each in the monitoring plot (Fig. 2): the plants (hills) should be representatives of average growth of whole plants in a treatment plot. Measurement should be made on the same plants throughout the plant growth (until harvest).

2-3) Measure plant height and count the number of tillers of selected plants (hills), and record them in a monitoring sheet.

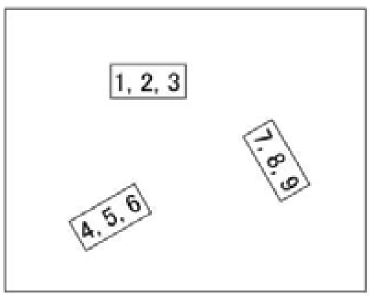


Fig. 2 An example of plant (hill) selection for growth monitoring.

1. Comments on the homework:
   yield components

2. Refresher items:
   various topics –
   lessons from failures

3. Modified method
   of growth monitoring

Sub titles

Homework:

Result of pre-pilot project (2006)

Technology package	Panicle m^{-2}	Grains per panicle	Filled grains (%)	1,000 grain wt (g)	Grain yield (kg/ha)
Improved technology	334	144	97.2	28.9	3,318
Farmers' practice	140	113	93.8	21.5	1,104

We could apparently deduce from the result: e.g.,

1) Improved technology contributed greatly in GY increase,
2) YC was xx times larger with improved technology compared with farmers' practice,
3) Profit by fertilizer application was Le1,000,000 ???

1. YC

Result of pre-pilot project (2006)

Technology package	Panicle m^{-2}	Grains per panicle	Filled grains (%)	1,000 grain wt (g)	Grain yield (kg/ha)
Improved technology	334	144	97.2	28.9	3,318
Farmers' practice	140	113	93.8	21.5	1,104
	A	B	C	D	E

A x B x C x D = E

Improved tech.:
334 x 144 x 0.972 x 28.9 x 10,000/1,000
= 13,511 kg/ha

Farmers' practice:
140 x 113 x 0.937 x 21.5 x 10,000/1,000
= 3,190 kg/ha

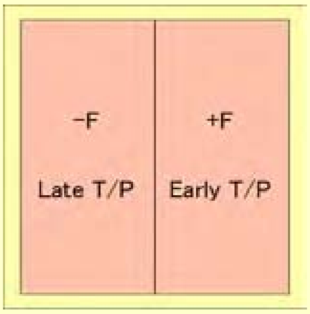
Wrong data

2. Refresher items:
   lessons from failures

2-1) T/P sequence
2-2) Old seedlings
2-3) Tiller number counting
2-4) Field layout

2. RefresherD

2-1) T/P sequence



How can you distinguish the effect of two treatments (comparisons), when the two treatments were combined?

e.g., GYs (bu/acre) are:
20 30

2-1) T/P sequence P

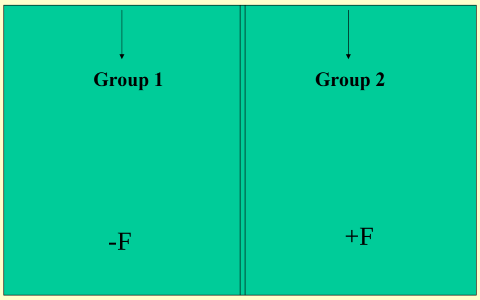
1

-F Early T/P	+F Early T/P
-F Late T/P	+F Late T/P

To find the effect of two treatments, the comparison with four (4) plots is essential at least.

Double layout

Cultivation procedure (presented 02/07/2008)
(puddling and T/P)



Cult. proced.

2-2) Old seedlings (poor quality)

Kalintin, 08/7/2008

2-2) Poor seedlings

Kunthai, 10/7/2008

PP site

Farmer's nursery

Poor Kunthai

Negative effect of fertilizers

(presented twice already!)

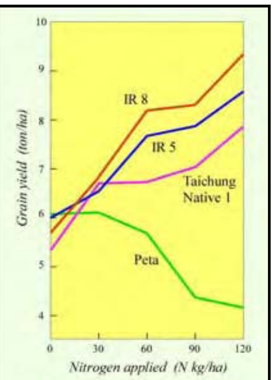


Fig. VII-9 Varietal difference of nitrogen response of rice plant (Los Banos in the rainy season, 1967) (Tanaka, 1971)

2-3) Tiller number counting

No. of tillers = 1

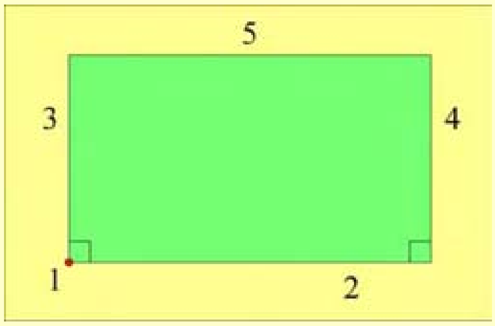
No. of tillers = 2

2-3) tillers

2

Tiller - 2

2-4) Field layout



Keep the measurement sequence!

Meas. order

Learn from the failures.

I

3. Modified method of growth monitoring

4

Thank you!

bkg

(modified on 2008/07/24)

Training course 8
at MAFFS-K
2008/07/23

J. Yamaguchi

Title

Today's topics

1. Fertilizer calculation

2. Some comments on transplanting

Sub titles

Homework on 02/07/2008

Result of pre-pilot project (2006)

Technology package	Panicle m^{-2}	Grains per panicle	Filled grains (%)	1,000 grain wt (g)	Grain yield (kg/ha)
Improved technology	334	144	97.2	28.9	3,318
Farmers' practice	140	113	93.8	21.5	1,104

The improved technology practice consisted of . . . . . the recommended fertilizer dose of 100:60:60 kg NPK per ha

RRSR

---

100 : 60 : 60 kg NPK per ha

➔ 100 : 60 : 60 kg of N : P_2O_5 : K_2O per ha

Total quantity of fertilizer
= 100 + 60 + 60 = 220 kg/ha ???

NPK

Several lessons from the recent events at the PP sites (2008)

Poor examples:

a) Deep planting depth
b) Many number of seedlings per hill
c) Folded stem by planting fork
d) Insufficient puddling
e) Old seedlings

Good idea:

f) Palm-leaflet rope for marking

2. PP notes

---

a) Deep planting depth

Kunthai (2008/07/21)

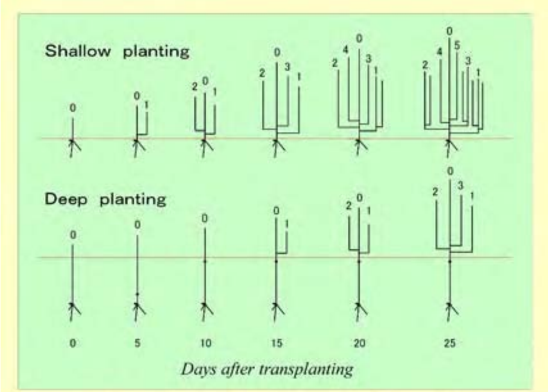


Fig. td. Tiller development affected with planting depth

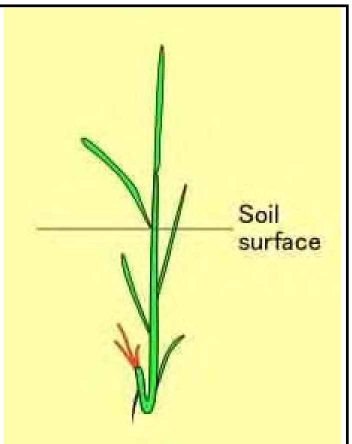
b) Too many number of seedlings per hill

Number of seedlings per hill was 7-12 at the beginning (about 100^2).
No instruction to them by the MAFFS-K staff? Great fault.

Kunthai (2008/07/21)

c) Folded stem by planting fork

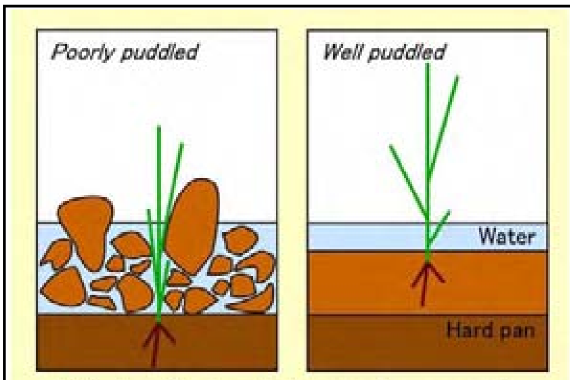
Growing point is located at the base of the stem (close to the roots). Can you imagine how the new leaves develop?



d) Insufficient puddling

Well puddled by feet

Kunthai (2008/07/21) puddling



Difficulty of shallow planting due to poor puddling

Puddling-2

e) Old seedlings

Watch etiolated stem and disease occurrence.

Kunthai (2008/07/21)

Blast and some fungus diseases developed

Kunthai (2008/07/21)

disease

f) Palm-leaflet rope at Kalintin

(Watch better puddling, too)

Kalintin
(2008/07/08)

Video show
(failed)

(Watch shallow and deep planting depths at Kalintin and Kunthai, respectively)

Video

The end

I will collect a homework at the beginning of training session next week.

end

【Appendix A4-7】

Pre-lesson exercise
2008/07/23

Name: ______________________________

Q. How many bags of fertilizers do you need in a half-hectare field area, when the recommended rate of fertilizer nutrients is at 106-60-60 kg/ha of N-P_2O_5-K_2O?

Note that (1) available fertilizers are urea (46% N) and a high-analysis compound fertilizer (15-15-15), and the weight of fertilizers is 50 kg a bag.

Ans.:

【Appendix A4-7】

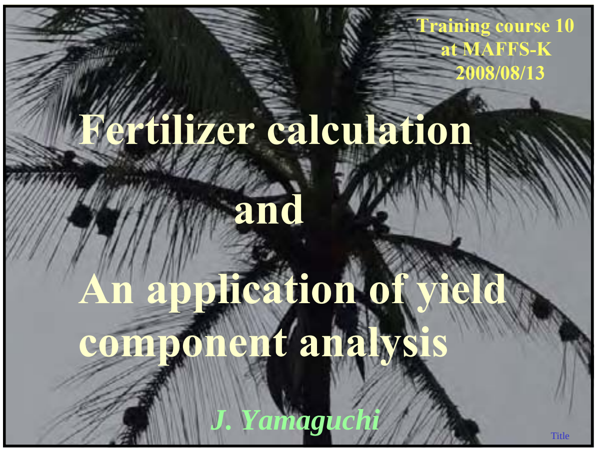
Homework
2008/07/23

Name: ______________________________

Q. The total acreage of the PP in 2008 is basically 0.5 ha, and it is equally split into two sub-plots: with and without fertilizer. How much fertilizer do you apply to a fertilized plot of the main field? Compound fertilizer (17-17-17) has been already supplied and urea will be delivered later. The recommended fertilizer rate per hectare is two bags of compound fertilizer as a basal application and one bag each of compound fertilizer and urea as a top dressing.

Calculate the application rate (the weight per unit field area, kg/ha) of nutrients (ingredients) in total, too.

Ans.:



Today's topics

Refreshers

1. **Fertilizer calculation for the PP**
2. **An application of yield components (from Radio Kolentin)**

Notes

1. **Pot culture**
2. **Modification of growth monitoring**

Sub titles

Homework on 23/07/2008

Q. The total acreage of the PP in 2008 is basically 0.5 ha (a), and it is equally split into two sub-plots: with and without fertilizer.

a) Rosinor, Kunthai, Robennah, Kalintin, Sabuya

Q1. How much fertilizers do you apply to a fertilized plot of the main field?

HW 7/23

Compound fertilizer (17-17-17) has been already supplied and urea will be delivered later.

The recommended fertilizer rate per hectare is:

a) two bags of the compound fertilizer as a basal application, and,
b) one bag each of the compound fertilizer and urea as a top dressing.

HW 2

Q2. Calculate the application rate (the weight per unit field area, kg/ha) of nutrients (ingredients) in total.

HW3

Refresher item

* Difference between the rate and quantity

The rate is:

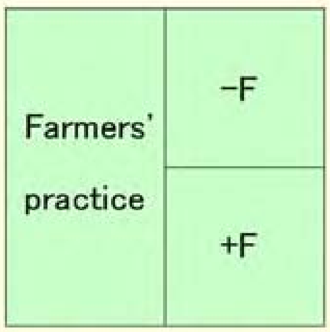
The quantity per unit length, area, volume, weight, time, etc.

e.g., kg/ha, km/h, Le3,000/d, etc.

The rate is different from a fraction and percentage.

Rate?

1



Basic layout of the PP in 2008

Q1. How much fertilizer (bags or kg) is to +F plot?

The total acreage is 1 ha.

Hint 1: What is the acreage of +F plot?

Hint 1

Q2. The application rate of ingredients (nutrients)?

Answer should be:

N, P_2O_5, and K_2O

= X, Y and Z kg/ha

Hint 2

Best answer will be given (explained)

by whom ?

How

Ans. to Q1:

Number of bags/+F plot

	17-17-17	Urea
Basal	1/2	-
Top dressing	1/4	1/4

or

kg of fertilizer/+F plot

	17-17-17	Urea
Basal	25	-
Top dressing	12.5	12.5

Note: +F plot area = 0.25 ha = ¼ ha

Ans 1

Ans. to Q2:

	Fertillizer	Nutrient rate (kg/ha)		
		N	P_2O_5	K_2O
Basal	17-17-17	17	17	17
Top dressing	17-17-17	8.5	8.5	8.5
	Urea	23	0	0
Total		48.5	25.5	25.5

Ans 2

Topic 2. YC application

A bumper crop with minimum rice seed:
one (1) bushel of seed rice produces 100 bushels at harvest.
(Voice of a farmer in Radio Kolentin)

Is it realistic or unrealistic?

You are now able to answer it through logical approach of the yield component concept.

1 to 100?

2

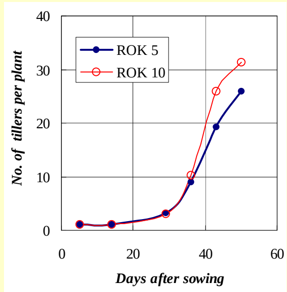
YC approach;

1) How many panicles per plant are feasible (or are expected) from a seed?

2) How many grains per panicle are feasible (or are expected)?

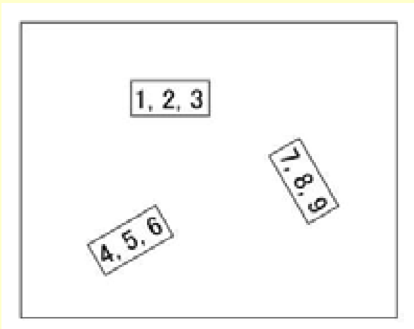
YC approach

Is the pot culture an ideal condition?



Pot culture

Modification of growth monitoring



Please refer to the handout.

Gr. Mmonit.

Fin

fin


Training course 12
at MAFFS-K,
17/09/2008
Several Faults Found in Farming Practices in the Pilot Project Sites
Photos taken by T.KIMIJIMA


Robat, 8 Sep. 2008
1. Wrong selection of nursery site. Too much gravel make soil surface dry easily, which decreases the germination rate.


Robat, 8 Sep. 2008
1. Wrong selection of nursery site. Many seed rice failed to germinate.


Robat, 8 Sep. 2008
2. Careless handling of uprooted seedlings. Roots are exposed to air and sunlight for long time until the seedlings are transplanted.

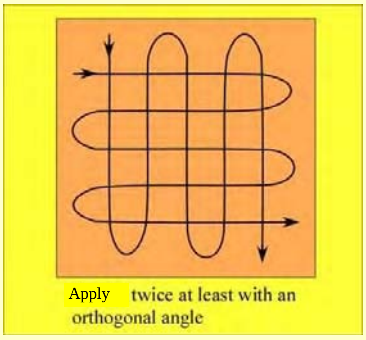

Macoth, 12 Sep. 2008
2. Careless handling of uprooted seedlings. How long will the seedlings be kept under this condition?


Macoth, 8 Sep. 2008
2. Careless handling of uprooted seedlings. Roots of the uprooted seedlings should be given water.

Uniform application of fertilizer 1

- If small amount of fertilizer remains, mix it with dry coarse sand thoroughly. The coarse sand is available at the side of stream.
- Apply sand with fertilizer in the same way as apply fertilizer only.

Uniform application of fertilizer 1



2

3. Too sparse planting density

will decrease in yield, as tillers cannot compensate.

What are the causes?

- Fail to refill the missing hills?
- Insufficient number of seedlings as a result of planting too many seedlings per hill, or as a result of lower germination rate, or any other reason?
- Crab damage?

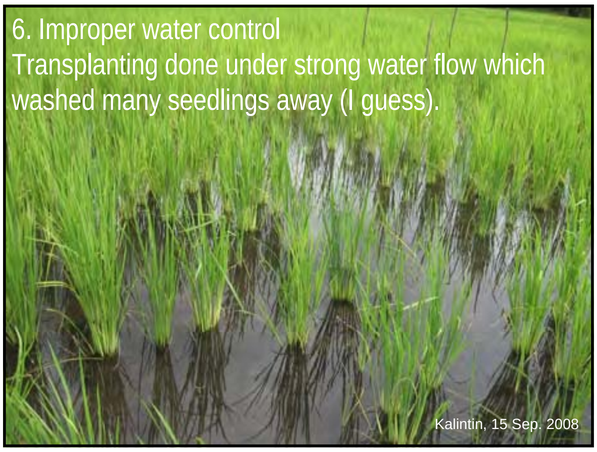

4. Too many missing hills
Stunted growth of rice plants found in the area where stagnant water remains
Macoth, 12 Sep. 2008


Macoth, 12 Sep. 2008
4. Too many missing hills
Transplanted rice at adjacent field.

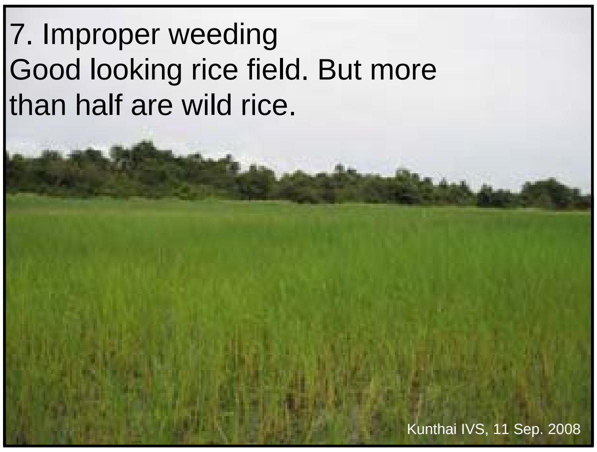

Kunthai IVS, 11 Sep. 2008
5. Untimely transplanting
Good looking rice growth from one edge (transplanted 21/07/08).


5. Untimely transplanting
Completely different story at the other end (transplanted 10/08/08).
Kunthai IVS, 11 Sep. 2008


6. Improper water control
Too many water inlets (water is continuously flowing).
Kalintin, 1 Sep. 2008


6. Improper water control
Transplanting done under strong water flow which washed many seedlings away (I guess).
Kalintin, 15 Sep. 2008


Kalintin, 15 Sep. 2008
7. Improper weeding
Two months have passed since
transplanting. Weeding yet done.


7. Improper weeding
Good looking rice field. But more
than half are wild rice.
Kunthai IVS, 11 Sep. 2008


Thanks for your
attention!

Proposed cost components for rice production per ha

1.Clarification of the following issues through the cost analys
 1)Production cost per ha
 2)Marginal benefit per ha
 3)Justification of technical package point of view from economic aspect
2.The sales price (farm gate price) of rice will adopted the in December and August.
3.Farme gate price estimates divided two types such as husk rice and milled rice
4.Yield is decided by the PP result

Summary of cost components for rice production per ha

Items	Technical Package for Mangrove Swamp			
	Quantities (kg)	Unit price (kg/Le)	Total (Le)	Remarks
I. Gross income				
1. Seed rice				
2. Milled rice				
3. Parboild rice				
II. Expenditures (1+2)				
1. Flow expenses(1.1+1.2)				
1.1 Direct inputs (materials)				
Seed (local)				
Fertilizers				
1.2 Direct labor cost				
Brushing/Land clearing				
Ploughing/Harrowing				
Nursery/Transplanting				
Weeding				
Harvesting				
Transportation				
Threshing/Winnowing				
2. Fixed expenses (2.1+2.2+2.3+2.4)				
2.1 Farm tools				
Planting folk				
Sacks				
Brushing knife				
Cutlass				
Axe				
Large hoe(ploughing)				
Medium hoe(ploughing)				
Small hoe (weeding)				
Mattock				
Shovel				
Harvesting knife				
Basket				
sub-total				
2.2 Land rental				
2.3 Milling cost				
2.4 Repair				
III. Estimate Benefit (I-II) (Estimate benefit of before labor cost)				

Number of labor and labor cost per acre (summary)

Upland: Kunthai and Robennah

Operation	Labor	Input person		Working day		Working hour/per day		Payment(Le/person/day)		Total labor cost (Le)		Remarks
		Kunthai	Robennah	Kunthai	Robennah	Kunthai	Robennah	Kunthai	Robennah	Kunthai	Robennah	
1. Land preparation	Family	7	2	2	2	5	6	0	0	0	0	Seed preparation,
	Employee	30	28	2	2	5	8	7,000	6,000	420,000	336,000	Brushing, felling, burning, clearing
2. Planting	Family	5	10	1	1	5	6	0	0	0	0	Sowing
	Employee	20	**40**	1	1	5	6	7,000	5,000	140,000	200,000	Sowing, seed harrowing
3. Fertilizer	Family	0	0	0	0	0	0	0	0	0	0	No operation
	Employee	0	0	0	0	0	0	0	0	0	0	
4. Weeding	Family	0	10	0	1	0	8	0	0	0	0	
	Employee	25	**30**	1	1	9	8	7,000	6,000	175,000	180,000	
5. Additional works	Family	0	0	0	0	0	0	0	0	0	0	Replanting, others
	Employee	0	0	0	0	0	0	0	0	0	0	
6. Protection/control	Family	5	5	20	1	3	8	0	0	0	0	Bird scaring
	Employee	4	15	7	3	9	8	0	6,000	0	270,000	Fencing, trapping
7. Harvesting	Family	5	10	1	1	5	8	0	0	0		
	Employee	30	**50**	1	1	9	8	7,000	6,000	210,000	300,000	Cutting, threshing, winnowing
8. Transportation	Family	0	0	0	0	0	0	0	0	0	0	Transportation works included
	Employee	0	0	0	0	0	0	0	0	0	0	harvesting operation
9. Rice mill	Family	2	4	1	2	6	9	0	0	0		
	Employee	0	0	0	0	0	0	0	0	0	0	
10. Sales/marketing	Family	0	0	0	0	0	0	0	0	0		The strong dependancy to the trader
	Employee	0	0	0	0	0	0	0	0	0	0	
Total	Family	24	41	25	8	24	45	0	0	0	0	
	Employee	109	**163**	12	8	37	38	0	0	945,000	1,286,000	
										US$315.00	US$428.67	

Number of labor and labor cost per acre (summary)

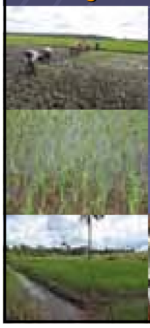
Lowland: Robat(Associated magrove swamp), Rosinor(Mangrove swamp), Macoth(Mangrove swamp), Kalintin(Boliland), Sabuya(IVS

Operation	Labor	Total inputs person					Working day					Working hour/per day					Payment(Le/person/day)					Total labor cost (Le)					Remarks
		Robat	Rosinor	Macoth	Kalintir	Sabuya	Robat	Rosinor	Macoth	Kalintir	Sabuya	Robat	Rosinor	Macoth	Kalintir	Sabuya	Robat	Rosinor	Macoth	Kalintir	Sabuya	Robat	Rosinor	Macoth	Kalintin	Sabuya	
1. Nursery preparation	Family	2	5	3	10	8	2	2	1	2	1	2	4	5	7	4	0	0	0	0	0	0	0	0	0	0	Seed and nursery preparation
	Employee	12	5	6	10	10	1	2	1	0	3	9	4	5	7	4	5,000	5,000	4,000	5,000	5,000	60,000	50,000	24,000	0	150,000	Brushing, plowing nursery field
2. Land preparation	Family	1	3	3	10	0	10	3	2	2	0	2	4	5	7	0	0	0	0	0	0	0	0	0	0	0	
	Employee	25	**45**	12	**30**	20	1	**3**	2	2	2	**11**	4	5	7	4	5,000	5,000	7,000	5,000	5,000	125,000	**675,000**	168,000	300,000	200,000	Plowing, paddling for main field
3. Seeding	Family	1	10	3	10	8	1	2	1	2	3	6	4	5	7	4	0	0	0	0	0	0	0	0	0	0	Uprooting
	Employee	8	0	10	15	0	1	0	1	2	0	6	0	5	7	0	2,500	0	7,000	5,000	0	20,000	0	70,000	150,000	0	
4.Transplanting	Family	1	1	3	10	8	1	1	1	2	**5**	6	6	8	7	5.5	0	0	0	0	0	0	0	0	0	0	
	Employee	15	20	10	**30**	3	1	1	1	2	**5**	6	6	8	7	5.5	5,000	5,000	4,000	5,000	5,000	75,000	100,000	40,000	300,000	75,000	
5. Additional works	Family	2	1	3	5	5	3	8	3	5	5	3	4	5	7	7	0	0	0	0	0	0	0	0	0	0	Re-planting
	Employee	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
6.Weeding	Family	1	0	0	0	0	5	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Employee	8	0	0	0	0	5	0	0	0	0	3	0	0	0	0	2,000	0	0	0	0	80,000	0	0	0	0	
7.Protection/control	Family	1	5	3	10	3	10	20	14	7	20	3	1	1	3	3	0	0	0	0	0	0	0	0	0	0	Bird scaring
	Employee	0	0	0	**30**	0	0	0	0	7	0	0	0	0	7	0	0	0	0	3,000	0	0	0	0	630,000	0	Fencing, trapping
8.Harvesting	Family	5	5	3	10	8	1	1	1	1	1	4	5	5	7	4	0	0	0	0	0	0	0	0	0	0	
	Employee	12	20	15	**30**	5	1	1	1	1	1	4	5	5	7	4	5,000	5,000	4,000	5,000	5,000	60,000	100,000	60,000	150,000	25,000	Cutting, threshing, winnowing
9.Transportation	Family	5	10	0	0	8	1	1	0	0	1	11	5	0	0	4	0	0	0	0	0	0	0	0	0	0	
	Employee	5	0	0	**20**	0	1	0	0	1	0	11	0	0	3	0	5,000	0	0	3,000	0	25,000	0	0	60,000	0	
10.Drying	Family	5	10	0	10	8	3	1	0	1	3	7	5	0	7	4	0	0	0	0	0	0	0	0	0	0	Drying for storage, dryingfor milling
	Employee	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
11.Rice mill	Family	2	3	4	3	3	1	1	3	1	1	7	5	9	7	7	0	0	0	0	0	0	0	0	0	0	
	Employee	1	0	0	0	0	1	0	0	0	0	7	0	0	0	0	10,000	0	0	0	0	10,000	0	0	0	0	
12.Sales/marketing	Family	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Sale & distributed of rice dependen on the trader
	Employee	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total	Family	20	43	25	**68**	51	30	39	26	22	37	44	38	43	52	38.5						0	0	0	0	0	
	Employee	78	90	53	**165**	38	7	7	6	15	11	54	19	28	45	17.5						455,000	**925,000**	362,000	**1,590,000**	450,000	
																						US$152	US$308	US$121	US$530	US$150	

Ministry of Agriculture, Forestry and Food Security
The Republic of Sierra Leone

Japan International Cooperation Agency
Japan

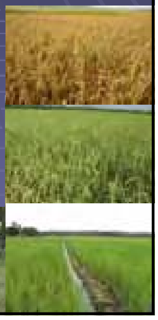
The Agricultural Development Project in Kambia

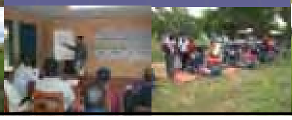


Agricultural Technical Support Guidelines
(Final Report)

5th Steering Committee Meeting

12 January, 2009





Project Purpose and Outputs

[Project Purpose]
To strengthen the technical support system for farmers with farmers' participation in the Kambia District

[Expected Outputs]
- Improvement of agricultural support system at MAFFS-K
- Formulation of agricultural technical package to improve productivity for model farmers
- Preparation of agricultural technical support guideline

Contents of the Guidelines

- Part I: Main Report
- Part II: Agricultural Technical Packages
- Part III: Agricultural Technical Manuals
- Part IV: Annexes

Part I Main Report

- Chapter 1 Introduction
- Chapter 2 Background Information
- Chapter 3 Formulation of Agricultural Technical Packages
- Chapter 4 Dissemination Plan of the Agricultural Technical Packages
- Chapter 5 Recommendations

Part II Agricultural Technical Packages

- Chapter 1 Introduction
- Chapter 2 Technical Package on Rice Production
  - Rice cultivation
  - Cost benefit
  - Post harvest handling
- Chapter 3 Technical Package on Vegetable Production
  - Vegetable cultivation
  - Cost benefit

Part III Agricultural Technical Manuals

- Chapter 1 Introduction
- Chapter 2 Rice Production Manual
- Chapter 3 Post Harvest Handling Manual
- Chapter 4 Vegetable Cultivation Manual

1

Part IV Annexes

- Annex 1 Pilot Project for Rice Production
- Annex 2 Pilot Trial for Vegetable Production
- Annex 3 Results of Field Surveys
- Annex 4 Training of Extension Workers
- Annex 5 Radio Extension Programs
- Annex 6 Project Documents

Technical Package for Rice Cultivation

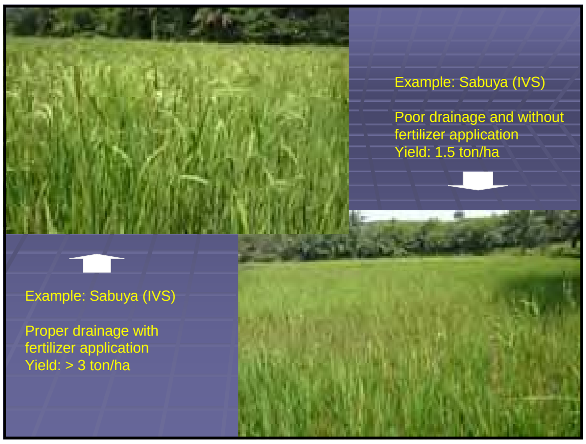
- Key techniques introduced
  - Timely farming based on well-planned cropping calendar,
  - Rational seed rate,
  - Proper land preparation,
  - Proper water control such as bund making,
  - Efficient fertilizer application, and
  - Appropriate transplanting methods for the transplanting system in lowlands

Integrated approach will improve grain yield under the low-input condition.

Technical Manuals for Rice

- Timely farming practice based on well-planned cropping calendar
  - Decide the farming scale this year
  - Secure seed rice (variety, growth duration, 1,000 grain weight, etc. are necessary basic information)
  - Plan the cropping calendar (ex. mangrove swamp)
    1. Determine transplanting date (to be low tide period)
    2. Determine sowing date in the nursery (four weeks before transplanting)
    3. Determine nursery site (dry land, exposed area) and secure the area
    4. Early implementation of first digging to wash salts

Robat, ROK 14, Harvest on 22/12/08, > 4 t/ha realized with fertilizer application (N:P_2O_5:K_2O = 48.5:25.5:25.5 kg/ha).



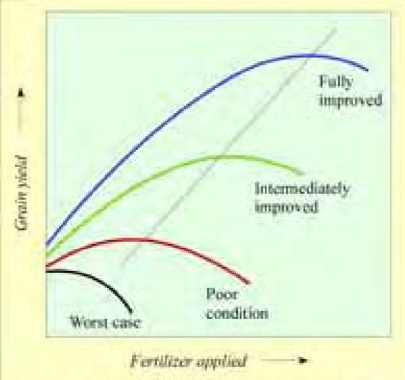


Fig. if. Interaction between cultural condition and grain yield under ordinary environmental condition

Low fertilizer response at the PP sites indicate that crop management practiced was still poor.

Issues on fertilizer application

- Split application (basal and 1 top dressing at panicle initiation stage) of fertilizer increased grain yield by 0.5 to 1.0 ton/ha.
- Under the present economic situation and farming environment, incremental benefit by yield increase hardly cover the fertilizer cost.
- Heavy rainfall and uncontrolled water conditions also negatively affect the efficiency of fertilizer application.

Dissemination Plan of Technical Package

- Basic strategy
  - Practical extension at farmers' field
  - Extended promotion of TP
  - Efficient operation
  - Close monitoring and evaluation

Dissemination Plan of Technical Package

- Framework of the plan
  - Objective: to increase rice yield in the Kambia district
  - Implementation period: three (3) years
  - Target farmers: all farmers in the Kambia district

Dissemination Plan of Technical Package

- Implementation plan
  - Preparation phase (1st year)
    - Establishment of Office
    - Recruitment of staff and training
    - Selection of farmers' group (56 groups in total)
    - Training of farmers and FEWs
    - Formulation of monitoring plan
  - Dissemination phase (2nd and 3rd year)
    - TP trial, demonstration and training
    - Dissemination through radio
    - Monitoring and evaluation

Dissemination Plan of Technical Package

- Institutional plan
  - Office to be established under the district council
  - Office to be autonomous and financially independent
  - Close collaboration with MAFFS-K
  - Formation of Technical Package Dissemination Team
  - One managing director, two experts, two coordinators, seven facilitators, and two support staff.

Recommendations

- Dissemination of the technical package to the whole Kambia district (on-farm trial and demonstration, use of radio)
- Further improvement of the technical package through basic research and on-farm trial (effective fertilizer application, water control, etc.)
- More capacity building of extension workers (training)
- Standardization of measuring unit (volumetric weight)
- Securing pure seed (provision of quality seed)

Thanks for your attention!

Tenki!
Mo-mo!
Wonuwali!
Wali mo-mo!
Arigatou!

Training course 16 at MAFFS-K
2008/10/22
(modified after presentation)

Appendix A4-11 Plant Nutrients and Fertilizer Application

1. Essential elements for plant growth

Table 1

Essential elements of higher plants and animals

Element	Plant	Animal
Macro	C, H, O, N, P, S K, Ca, Mg	C, H, O, N, P, S K, Ca, Mg Na, Cl
Micro	Fe, Mn, Cu, Zn Mo B, Cl, (Ni ?)	Fe, Mn, Cu, Zn Mo I, Co, Se, Cr, As, *etc.*

Benificial elements for plants:
Si, Na, Al, Co, Ni, Se

Definition of element essentiality

1. **Necessity**: When an element lacks, plants show abnormal growth and are not able to fulfill an entire life cycle.

2. **Non-substitution**: A deficiency symptom is specific to an element and the element does not substitutable with other elements.

3. **Direct contribution**: Recovery of affected growth is due to a direct effect of the addition of an element. It is not a result of an indect effect like removal of toxic substances or amendment of soil condition.

4. **Unique function**: An element is a constituent of materials that are inevitable to plant growth, or it is deeply involved in physiological or biochemical reactions.

5. **Universality**: The above-mentioned ability (or role) is not confined to a specific species.

Essentiality should be ((1+2+3) or 4) and 5

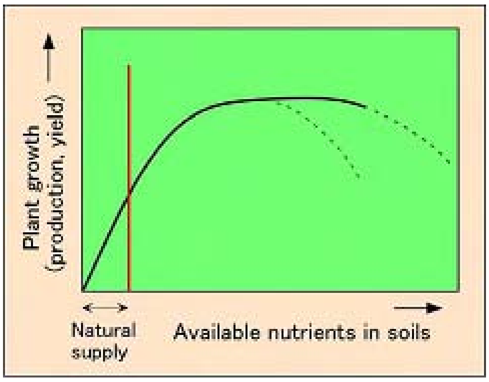


Fig. 1

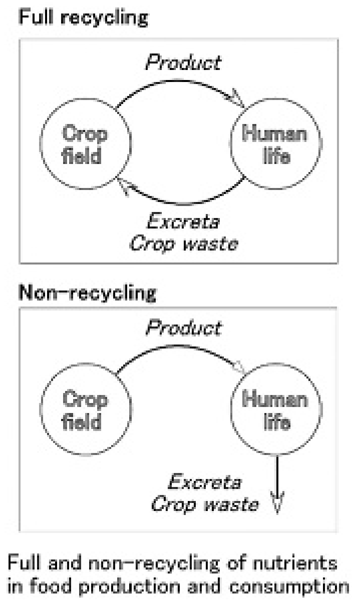
Table 2

Major physiological functions of the essential elements

Oxygen (O)	1. Key element in respiratory metabolism 2. Constituent of water and carbon dioxide 3. Dominant element of various plant structural matters
Hydrogen (H)	1. Involvement in all physiological metabolisms like water 2. Dominant element of organic matters like oxygen (Produced from water decomposition in chlorophyll)
Carbon (C)	1. CO_2 assimilation through photosynthesis 2. Core element of organic compounds like oxygen 3. End product of respiratory metabolism
Nitrogen (N)	1. Constituent of proteins that are dominant in protoplasm 2. Constituent of chlorophyll, enzymes, hormones, nucleic acids, etc.
Phosphorus (P)	1. Intermediate products of photosynthesis, respiration, carbon metabolism, etc. 2. Energy transmission as a form of ATP and ADP 3. Constituent of nucleic acid and enzymes
Potassium (K)	1. Water control through turgor pressure in cells 2. Involvement in absorption and reduction of nitrate and in protein synthesis 3. Stimulation of disease and insect resistance
Calcium (Ca)	1. Involvement in synthesis and strengthening of membrane by combining with pectic acid 2. Neutralization of toxic substances like organic acids
Magnesium (Mg)	1. Constituent of chlorophyll 2. Involvement in absorption and internal movement of phosphorus 3. Activation and constituent of enzymes
Sulfur (S)	1. Constituent of proteins, amino acids, vitamins, etc. 2. Involvement in oxidation and reduction reaction 3. Formation and constituent of specific compounds
Iron (Fe)	1. Involvement in chlorophyll synthesis 2. Antagonistic reaction with cupper, manganese, etc. 3. Involvement in oxidation and reduction reaction as Fe-enzymes
Manganese (Mn)	1. Chlorophyll synthesis and involvement in photosynthesis and vitamin C 2. Activation of oxidation-reduction enzymes
Boron (B)	1. Involvement in water, carbohydrate and nitrogen metabolisms 2. Involvement in Ca uptake and translocation, formation of membrane, and maintenance of translocation tissues 3. Activation of various enzymes
Zinc (Zn)	1. Constituent and activation of enzymes, and catalysis of oxidation and reduction reaction 2. Involvement in tryptophan synthesis 3. Antagonistic reaction with iron and manganese
Molybdenum (Mo)	1. Constituent of oxidation-reduction enzymes 2. Involvement in nitrogen fixation in root nodules and in nitrate reduction 3. Involvement of vitamin C synthesis
Cupper (Cu)	1. Constituent of Cu enzymes involved in oxidation and reduction 2. Indirect involvement in chlorophyll synthesis 3. Mutual reaction with Fe, Zn, Mn and Mo
Chloride (Cl)	1. Involvement in light reaction in photosynthesis 2. Involvement in synthesis of starch, cellulose and lignin

2. Why do we apply fertilizers?

a) Natural vegetation thrives without artificial fertilizers (see slides).
b) Natural supply of nutrients varies greatly depending on climate, soils and anthropological activities (Fig. 1).



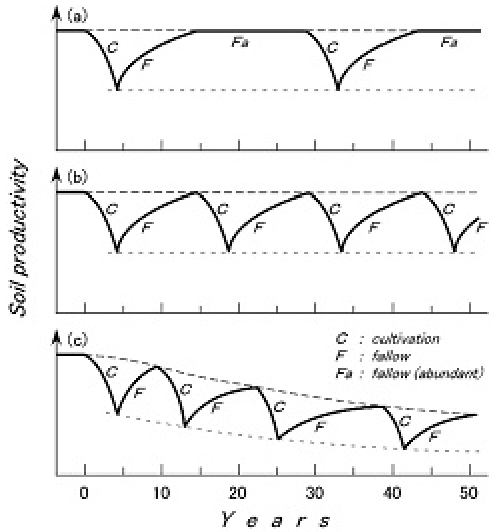


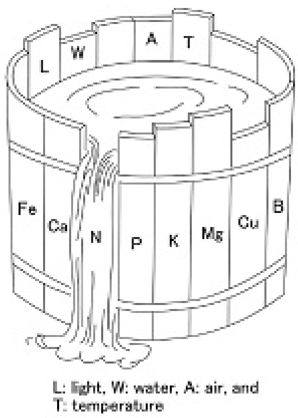
Fig. 2 Fig. 3

Adult person excretes all nutrients taken. When excreta are fully recycled, the potential productivity would be maintained at the original level at least (Fig. 2). Yet, the present life style does not allow to do so. Hence, human being induces soil degradation.

Human being has created two agricultural systems to maintain production level constant or even raise it.
1) Slash-and- burn shifting agriculture (Fig. 3)
2) Application of fertilizers: either of organic matters or chemicals

3. The three principles of fertilizer application:

1) The minimum law
2) The law of diminishing return (Fig. 5)
3) Identical nutrient requirement for production regardless of yield level



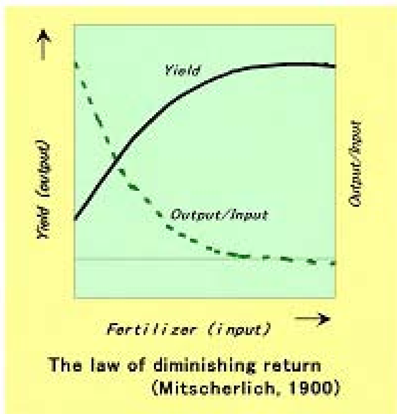


Fig. 4 Donebek's element barrel
(The minimum law)

Fig. 5

Quantity of water (crop production) is determined with the lowest height of board (minimum nutrient).

4. Critical level of nutrients

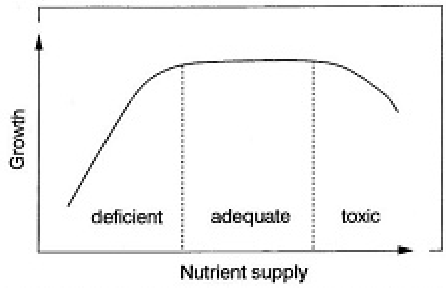


Fig. 12.1 Relationship between nutrient supply and growth.

Fig. 6

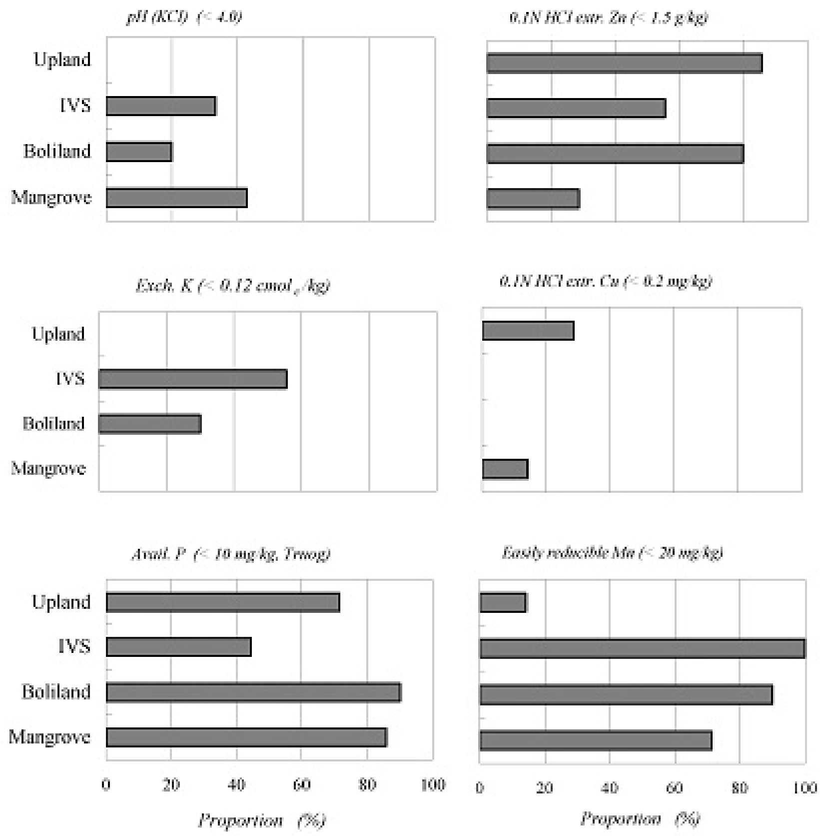


Fig. nd Proportion of soils of which nutrient concentration is lower than the critival level.

Genral soil nutrient status in Kambia

1. Many nutrients were widely low, being even below the critical deficiency level in several soils. For instance, the majority of soils lack phosphorus, zinc, manganese, etc.
2. General nutrient status was better in uplands th an in inland valley swamps (IVSs) and bolilands, although soil fertility in the latter two varied greatly.
3. No single, common nutrient responsible for low rice yield was identified: i.e., nutrient status was site-specific.

Today's topics

1. Techniques introduced to eggplant, pepper and watermelon

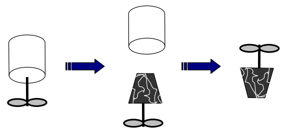
2. Presentation of watermelon disease

Seed drilling in the nursery bed

To prevent from uneven growth and difficulty of uprooting, seeds were drilled in the nursery bed followed by inter-row cutting by knife before transplanting to stimulate new root growth.

Raising plug seedlings

To raise healthy seedlings, plug seedlings were raised by plastic cups. 1 or 2 seeds for each cup were sown. Seedlings were watered substantially before transplanting. Soil blocks were taken out from the cup by 2 fingers pinching stems when transplanted.

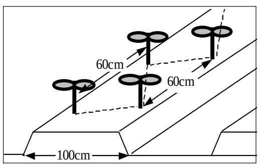


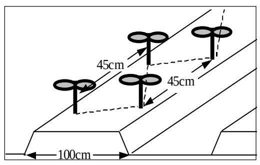
Fertilizer application in liquid form

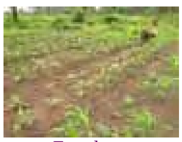
Prior to transplanting, liquid form of NPK compound in the concentration of 200g/20L water was infused in each planting hole to hasten the plant growth. Hot water is preferable.

Basal application $N:P_2O_5:K_2O$=4:4:4kg/10a was done after a week.

Transplanting in row

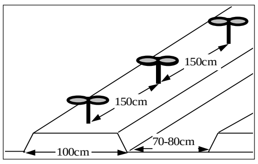


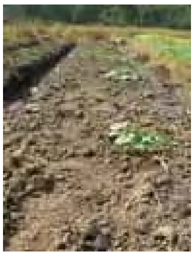



Eggplant


Pepper

Transplanting in row

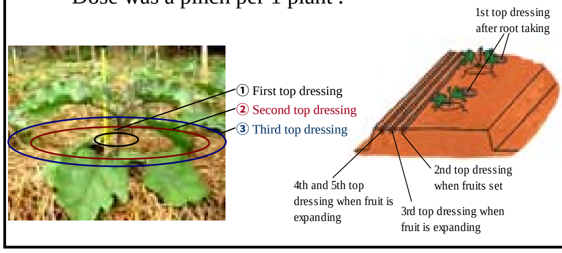




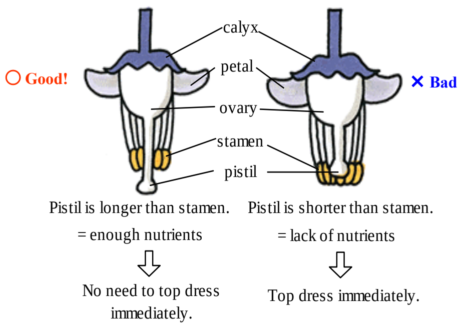
Watermelon

Method of top dressing

To minimize the dose of fertilizer, top dressing was done after root taking for several times. Application was done to different spot each time. Dose was a pinch per 1 plant .

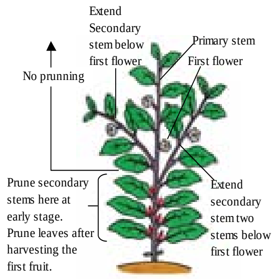


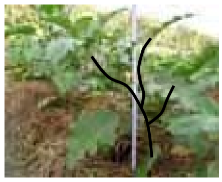
Method of nutrient diagnosis



Prunning eggplant

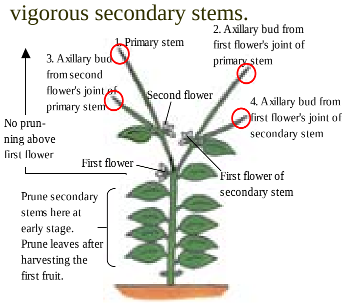
To produce high quality fruits and to manage easily, stems were pruned except primary stem and 2 of the vigorous secondary stems.

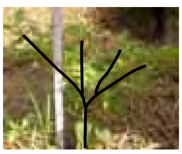




Prunning pepper

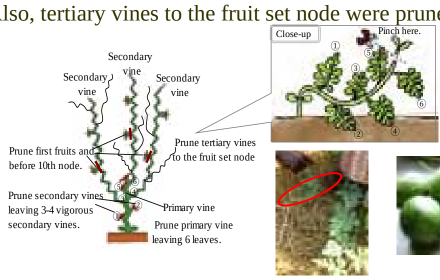
To produce high quality fruits and to manage easily, stems were pruned except primary stem and 3 of the vigorous secondary stems.





Prunning watermelon

To produce high quality fruits and to manage easily, primary vine leaving 6 leaves were pruned at first. Then secondary vines leaving 3-4 of vigorous secondary vines were pruned. Also, tertiary vines to the fruit set node were pruned.



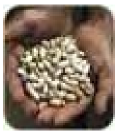
2

Pest control by neem

To prevent from pest by low input, neem was utilized as local resources.


Neem tree


Neem leaves


Neem seeds


Neem kernel

Neem tree is organic insecticide which contains high element to avoid hundreds of pests.

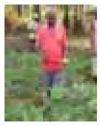
Making neem water

Seed Extract (3L)

i) Prepare 150g of dried neem seeds.
ii) Smash seeds into paste.
iii) Add 3L water into the paste.
iv) Keep in the shade more than 24 hours.
v) Filtrate extract to fine gauze.
vi) Add small amount of mashed soap as spreading agent.
vii) Spray or brush to back and surface of leaves or to fruits at evening hours once a week.
iix) Neem powder is preferable in rainy season.

Leaf Extract (3L)

i) Prepare 1.5kg of dried neem leaves and 0.5kg of dried pepper.
ii) Add 3L water.
iii) Follow the same process as seed extract.


Spraying neem water

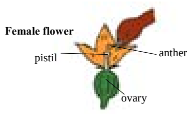

Applying neem powder

Hand pollination

To ensure pollination, pollen of male flower was applied to tip of pistil. This is necessary on rainy season whereas not in dry season. It is better to finish in morning time.


Male flower


Female flower



Today's topics

1. Techniques introduced to eggplant, pepper and watermelon
2. Presentation of watermelon disease

Damage of watermelon disease

In the trial, disease which completely damaged the fruit pulp inside whereas no scar on the fruit surface emerged just before the harvest period.

Views on watermelon disease

As a result, it is highly assumed as a damage of common name tephtrid fruit fly, scientific name *Bactrocera invadens*.

There is no formal report which detected in Sierra Leone, however, it is highly distributed in tropical Africa especially in lowland and rainy season.

In MAFFS-K, experiment to catch male fly by pheromone (Methyl Eugenol) is ongoing now.

Although, some reports can be found for mango and citrus damage, no knowledge is known for watermelon.

2008/12/03

JPT

Post-harvest losses

1. Characteristic of rice production in Cambia

   a) Single cropping

   b) Harvesting period: start from the end of rainy season (upland rice) toward the dry season

   c) Manual harvesting by harvesting knife

   d) Manual threshing by beating

2. Summary of the results of the post harvest practices of rice in pilot project village survey in 2007

Table 1. Indicator for harvesting time of rice in each Pilot Project village

Pilot project village	Color of grain	Color of leaf	Grain dryness
1 Macoth		100	
2 Rosinor	70	30	
3 Kunthai	90	10	
4 Robat	100		
5 Robennah	70	30	
6 Kalington	85	15	
7 Sabuya	80	20	

Table 2 Position to be cut for harvesting rice (right figure)

Pilot project	w	x	y	z
1 Macoth	X	X		
2 Rosinor	X	X		
3 Kunthai		X		
4 Robat		X		
5 Robennah		X		
6 Kalington		X		
7 Sabuya		X		

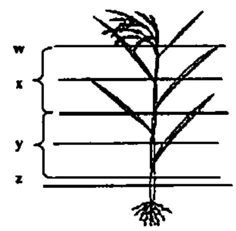


Table 3 Place for putting rice sheaves before threshing

Pilot project village	In the rice field	Outside of the rice field	At their home
1 Macoth	30	20	50
2 Rosinor	30		70
3 Kunthai	100		
4 Robat	100		
5 Robennah	60	40	
6 Kalington	85	15	
7 Sabuya	50	50	

Table 4 Place for threshing

Pilot project village	In the rice field	Outside of the rice field	At their home
1 Macoth	30	20	50
2 Rosinor	30		70
3 Kunthai	100		
4 Robat	50	30	20
5 Robennah	60	40	
6 Kalington	75	25	
7 Sabuya	50	50	

Table 5 Number of day for drying sheaves before threshing

Pilot project	Days
1 Macoth	7
2 Rosinor	2
3 Kunthai	21
4 Robat	60
5 Robennah	3
6 Kalington	2
7 Sabuya	5

Table 6 Estimated rice losses at each stage of the post-harvest practices (%)

Works	Macoth	Rosinor	Kunthai	Robat	Robennah	Kalingtin	Sabuya
1. Harvesting	41	33	36	60	74	47	53
2. Drying of sheaves before threshing)	10	16	27	14	7	29	21
3. Threshing	30	31	24	9	7	14	9
4. Winnowing after threshing	19	20	13	17	13	10	17
Total	100	100	100	100	100	100	100

3. Post-harvest losses

Table 7 Reported Losses of Rice within the Postharvest System

Region and Country	Total Percent Weight Loss	Remarks
West Africa	6-24	Drying 1-2; on-farm storage 2-10; parboiling 1-2; milling 2-10
Sierra Leone	10	
Uganda	11	
Rwanda	9	
Sudan	17	Central storage
Egypt	2.5	
Bangladesh	7	
India	6	Unspecified storage
	3 - 5.5	Improved traditional storage
Indonesia	6-17	Drying 2; storage 2-5
Malaysia	17 - 25	Central storage 6; threshing 5-13; Drying 2; on-farm storage 5;
	c.13	handling 6
Nepal	4-22	On-farm 3-4; on-farm storage 15; central storage 1-3
Pakistan	7	Unspecified storage 5
	2-6	Unspecified storage 2
	5-10	Unspecified storage 5-10
Philippines	9 - 34	Drying 1-5; unspecified storage 2-6; threshing 2-6
Sri Lanka	13 - 40	Drying 1-5; central storage 6.5; threshing 2-6
	6 - 18	Drying 1-3; on-farm storage 2-6; milling 2-6; parboiling 1-3
Thailand	8-14	On-farm storage 1.5-3.5; central storage 1.5-3.5
Belize	20 - 30	On-farm storage
Bolivia	16	On-farm 2; drying 5; unspecified storage 7
Brazil	1 - 30	Unspecified storage 1-3U
Dominican Republic	6.5	On-farm storage 3; central storage 0.3

Postharvest food losses in developing countries, National Academy of Science, Washington (1978)

Table 8 Comparison of total recorded project losses

Operation	Sri Lanka	Thailand	Myanmar	Indonesia	Bangladesh	Nepal	AVG
Cutting	0.86	10.1	2.1	0.8	2.3	1.9	3.0
Field drying (including bundling)	0.5	1.2	0.4		0.7	1.9	0.9
Transport		1.2	0.4	-	0.5	0.5	0.7
Stacking, pre-threshing	2.8	1.4					2.1
Threshing (including cleaning)	0.5	0.9	0.4	-	1.4	2.2	1.1
Drying	-	-	-	2.9	2.3	1.6	2.3
Parboiling					1.9	-	1.9
Storage	7.5	-	-	3.2	0.9	6.3	4.5
Milling	-	-	-	4.4	3.8	4.4	4.2
Average total losses	12	14.6		12.2	13.2	16	13.6

Source: Calverley, 1994.

Table 9 Rice losses occur at all stages of the post-harvest chain

Harvesting	Handling	Threshing	Drying	Storage	Milling	Total
1 - 3	2 - 7	2 - 6	1 - 5	2 - 6	2 - 10	10 - 37

Source: Rice in human nutrition (1993) FAO

Table 10 Grain losses at different harvesting times based on crop maturity date.

Harvesting time, week(s)	-1	Maturity date (0)	1	2	3	4
Loss, %	0.77	3.35	5.63	8.64	40.7	60.46

Source: Almera, 1997

Table 11 Average losses related to condition of ripeness of three rice varieties when harvested by traditional hand cutting method, Philippines.

Variety	3 days before normal stage, %	Normal stage for traditional, %	3 days after normal stage, %	5 days after normal stage, %
IR8	13	17	23	29
Peta	3	7	11	15
Raminad	3.5	6	8	9

Source: NAPHIRE, 1997.

Table 12 Percentage grain losses resulting from dates of cutting of two varieties of rice.

Cutting date	Grain loss, %			
	Before reaping		During reaping	
	IR-36	IR-38	IR-36	IR-38
5 days before maturity	0.05	0.23	0.39	0.35
5 days after maturity	0.16	0.23	0.49	0.58
At maturity	0.16	0.54	0.42	0.42

Source: Calpatura, 1978.

Table 13 Average cutting losses related to condition of ripeness of rice.

Harvesting system	3 days before normal stage (%)	Normal stage for traditional (%)	3 days after normal stage (%)	5 days after normal stage (%)
Traditional hand cut	6	8.7	10.5	12
Reaper-binder	1	3.1	1.2	5.8
Combine harvester	2	3.1	1.2	5.8

Source: Hilangalantileke

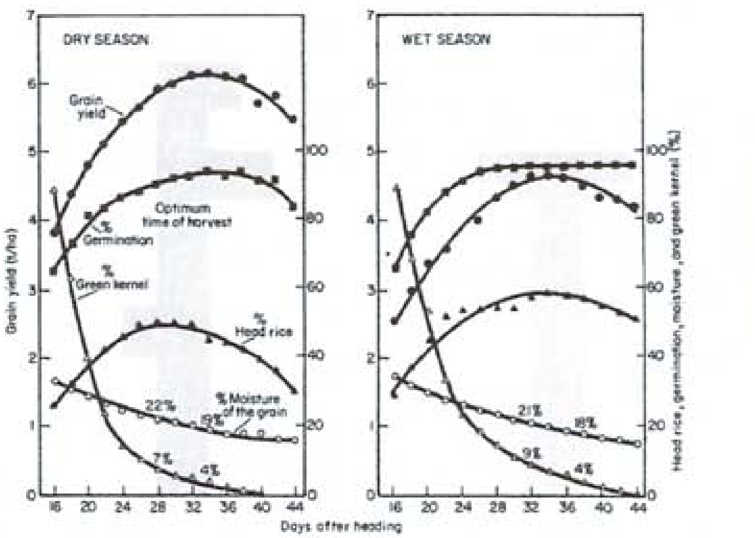


Figure 1 Optimum time of harvest on the basis of maximum grain yield and high percentages of head rice and germination as indicated by percent moisture of the grain at harvest and percent green kernels. IRRI, 1968 dry season and wet season. (Adapted from Nangju and De Datta 1970)

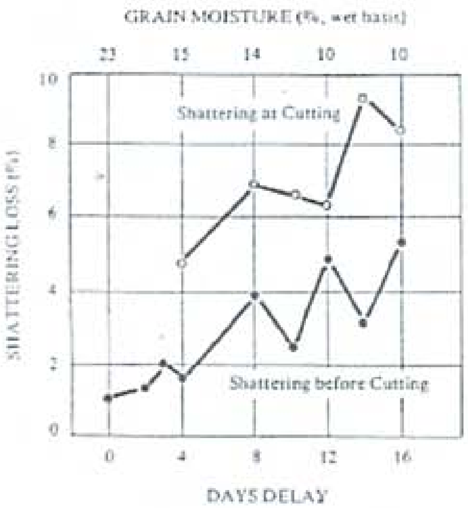


Fig. 2 Effect of delay in harvesting on shattering loss by plants in the field and at cutting time. Variety D52-37. (from Wanders 1974)

Photo 1 Rice terrace in Hyogo, Japan

Photo 2 One of rice drying methods in Hyogo Japan

Training on Vegetable Production

10th, Dec. 2008
Junnosuke Harada, JICA Expert

1. Raising seedlings (Nursery)

Raising seedlings is the most important process in vegetable production.

Advantages of raising seedlings are considered to be as follows,

1) Small plants can be effectively managed in the nursery while it is difficult for them to grow in open field due to unfavorable climatic condition and early pest attack.
2) Pests and diseases can be controlled effectively in small area of nurse
3) Seeds can be saved by reducing mortality and disease damage after germination
5) Help to replace early damaged seedlings in the main field.
6) Healthy seedlings can be selected for transplanting.
7) Early weed competition in the main field is reduced.

Disadvantages of raising seedlings can be,

1) Require high labor and skills i.e fertilizer application, thinning, protection and transplanting etc.
2) Problem of getting equipments like, coffee cups etc.

1.1 Preparation of nursery soil.

1) Prepare soil free from contamination. Note that very rich compost mixed with chemical fertilizer might render rapid elongation in seedlings. Paddy soil or virgin soil is supposed to be less contaminated.
2) Use well decomposed compost.
3) Apply fertilizer as shown in the table below and mix well with the soil.

Recommended amount of fertilizer to be applied to nursery soil

Ingredient (g/1m^3 of soil)	Fertilizer (g/m^3 of soil)	
NPK compound	NPK compound (15,15,15)	866～1,800

Note: Used 4 buckets of top soil from uncontaminated field mixed with 3 to 4 hand grips of NPK compound (15,15,15) as nursery soil.

1.2 Sowing methods

(1) Broadcasting

Inconvenient for management of seedlings and waste of seeds

(2) Drilling

Convenient for management, easy to estimate number of seedlings in nursery and easy for thinning if necessary

1.3 Sowing procedure:

Plow well and worked in prepared nursery soil in nursery beds (1m×2m) size.

(1) Make sowing ditches keeping 15 to 25cm between them using your finger or stick.

(2) Sow seeds in the ditches and cover them with the same soil

Note: Heavy soil like clay soil is not to be used for covering, fine soil containing sand and organic matter is recommended to be used

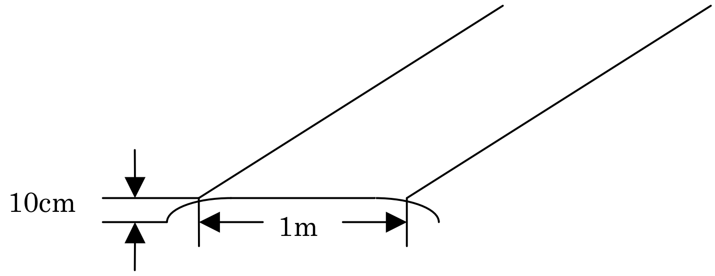
(3) Put rice straw or any sorts of light and dry leaves on the seed bed after sowing to keep soil wet

(4) After germination, remove the cover immediately

(5) If shade is set up on the nursery, it should be removed after germination when it does not rain

(6) Thinning is to be done to avoid dense population and eliminate abnormal and tiny seedlings

In case of nursery set up on a bed, the soil might be contaminated with disease. It is recommended to bring the soil from paddy field or virgin area which should be much less contaminated with diseases. Recommended amount of fertilizer is applied and mixed well with soil at least 15cm deep. Then seeds are sown in the procedure as mentioned above.



Flat bed nursery

1.4 Raising seedlings using planting pots

In Sierra Leone, repeatable use of planting pot adequate for vegetable seedlings is not available. Coffee cups are suggested to be used.

Advantages of using planting pots:

1) Seedlings can be planted completely with soil block without any damage of their root during transplanting.

2) Seeds can be saved

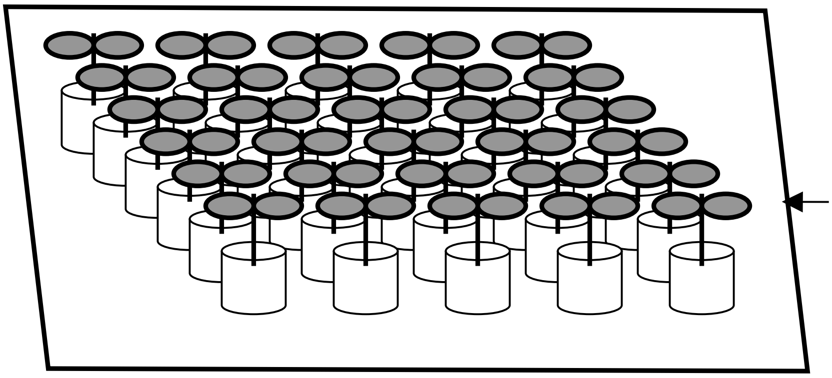
3) Seedlings can be managed intensively

4) Easy to move the seedlings if necessary

Utilization of plastic coffee cups

Cucurbit crops like cucumber, watermelon and other gourd plants are very sensitive for transplanting. Direct sowing has been commonly conducted in Sierra Leone to avoid transplanting shock, which may be beyond the recovery level. Considering the importance of intensive management at the seedling stage, raising seedlings is recommended for careful management on watering and fertilizer application, intensive control of pest and disease as well as maintenance of plant vigor in the small area of nursery.

Small size of plastic coffee cups can be substituted as planting pots for raising vegetable seedlings by making nail head size of hole on the bottom for drain. Colored cups are more suitable for root development because of the growth habit of plants.



Caution:

Watering must be carefully done because of its characteristics that soil in the pots easily gets dried up as compared with nursery on the ground soil.

Seedlings must be transplanted at proper stage since the volume of pot is limited for root development.

2.5 Status of shading in the nursery:

Weather condition	Status of shade	Phenomenon of
Sunny, High temp.	Shaded	Seedlings get elongated.
	Non-shaded	Seedlings may get wilted, but **it can be amended by watering.**
Rainy, High temp	Shaded	Seedlings get elongated and feeble in humid condition under the shade. **Shading material should be thinly covered.**
	Non-shaded	It facilitates disease occurrence

1.6 Thinning:

This is the reduction of seedlings in the nursery especially those nursed in seed bed. This facilitates maximum space and nutrient utilization by seedlings.

2 Ridging

After the field is plowed, ridges are to be made at the standard interval depending on the planting crops as mentioned below. It depends on what and when to be planted whether making high or low ridge. Root tuber vegetables require rather high ridge than fruit and leaf vegetables. In rainy season, higher ridges are suitable because of its characteristics of quick drainage. On the contrary in dry season, lower ridges are better for plants to uptake water from the soil because of easy access to ground water for the plant root.

Spacing

vegetables	Spacing between rows (cm)	Spacing between plants (cm)
Carrot	25-45	10-12
Cabbage	60	40
Onion	30	10
Cowpea	45	25
Cucumber	90	45
Watermelon	180	150
Pumpkin	180	90
Eggplant	90	60
Pepper	90	45
Okra	90	36
Sweet potato	90	30
Yam	60-90	45
Taro	90	45-60
Ginger	60	30

3 Transplanting

Transplanting is the most crucial task for seedlings. It must be very careful to handle this work adeptly to mitigate transplanting shock as much as possible. Prior to transplanting, field must be well prepared to welcome the seedlings.

In Sierra Leone, temperature is always rather high all year round. Transplanting should be done in the evening which is cooler than daytime. Procedures of transplanting are explained as follows.

1) Hardening of seedlings in nursery is important to mitigate transplanting shock by reducing watering starting from 2 to 3 days before transplanting
2) Cutting interrow space by knife to stimulate new root growth 3 days before transplanting.
3) Water is given sufficiently to seedlings 1 hour before transplanting to facilitate easy uprooting with a ball soil around.
4) Field must be well prepared to be rather good condition than nursery. Field soil should be well moistened than nursery soil.
5) Seedlings should be planted in the adequate depth which is 1 to 2cm deeper than previous level in nursery
6) If seedlings are elongated, adjust the level by slanting seedlings

7) Seedlings should be transplanted in the evening to avoid transplanting shock from sunlight
8) Transplanting of seedlings should be suspended when it is windy and rainy to avoid wilting and disease infection
9) If weather condition is severe like in rainy season, younger seedlings should be transplanted because of its quick recovery from transplanting shock

4. Crop management

4.1 Fertilizer application

Fertilizer application is to supply plant nutrient that is not sufficiently contained in the soil. Fertilizer is dispensable for vegetable production because of much more sensitive and weak in absorption of nutrients from soil than other extensive crops like cereal crops. Fertilizer should be applied to the field at least one or two days before transplanting or sowing.

Determination of fertilizer dose

Absorption of total nutrient by vegetable crops

Vegetables	Total nutrient absorption (kg/ha)			No. of plants in 1ha	Amount of NPK (15:15:15) t o be applied on K base kg/ha	Amount of NPK (15:15:15) t o be applied on K base g/pl at
	N	P_2O_5	K_2O			
Cucumber	15.8	9.0	31.9	24,000	212.6	8.9
Eggplant	21.0	4.5	34.1	18,000	227.3	12.6
Pepper	19.7	6.4	32.8	24,000	218.7	9.1
Cowpea	13.1	5.6	12.4	90,000	82.7	0.9
Cabbage	17.6	5.3	13.7	39,750	91.3	2.3
Onion	6.8	3.8	9.8	300,000	65.3	0.2
Carrot	11.6	5.6	13.5	180,000	90.0	0.5
Sweet potato	16.1	4.1	29.3	36,000	195.3	5.4

Practice:

In case of cucumber for example,

Total absorption of three major elements for cucumber

N :15.8kg/ha, P_2O_5 :9.0 kg/ha, K_2O :31.9 kg/ha

These amounts are pure in major elements. These should be converted into the amount of fertilizer to be applied by multiplying by percentage composition of the fertilizer used. In case that 15:15;15 is used, 31.9kg of K is to be converted by multiplying by 100/15, which is equal to 212.6kg.

Top dressing

Fertilizer is applied around the plants in the amount of NPK 6kg/10a at maximum if necessary

It is a usual practice to use a hand palm grip quantity of fertilizer for any plant stand being worked in the soil around the root area of the vegetable plant.

Method of fertilizer application

1) Ridge application

This is practiced for most of vegetables especially direct sown vegetable crops like onion, carrot and ets. Fertilizer is applied along the ridges to be in uniform for all the plants.

2) Spot or ring application (around each plant stand).

This is adequate for transplanted vegetable crops Fertilizer is applied around the plants.

4.2 Pinching

This is to encourage the growth of bigger and quality fruits.

Pepper and eggplant

Full vegetative growth after transplanting, select the best 3 to 4 vigorous primary branches and remove the rest of other branches using your fingers. All the shoots are left as they grow after three to four stems are determined. Probably the first flower shall be removed if the plants are weak in the growth.

Watermelon

(1) Select the best 4 vigorous branches two each side making them grow the same direction.

(2) Remove all the fruits below the 10th leaf on each branches selected.

(3) Pinch any secondary branches noticed below the fruit set position. The first fruit on each branch must be beyond the 10th leaf.

19/11/2008

Subject 1. Relationship between Production, Area and Grain Yield

(for an example of rice, but applicable to any crops)

1. Definition of variables

   a) Production [P]: the quantity of products (grain weight) regardless of harvested area, e.g., ton, kg, g, etc.

   b) Area [A]: harvested (or planted, cropped) acreage, e.g., ha, m^2, acre, etc.

   c) Grain yield [Y]: grain weight per unit field area, e.g., ton/ha, kg/ha, g/m^2, etc.

2. Relationship between 3 variables

Production = Grain yield x Area, P = Y x A

or

Grain yield = Production / Area, Y = P / A

Note that this is an equation with 3 variables, so that any variable cannot be calculated unless two other variables are measured.

Subject 2. Grain Weight Correction with Moisture

Net grain weight (applicable to any variable like grain yield, production, etc.) is affected with the moisture amount (note). The higher the moisture amount the larger the apparent grain weight (production), even though the dry matter production is the same. So, any country defines own standardized (official) moisture amount to all crops. For rice, the standard moisture amount is 14% in Sierra Leone (SL).

Note) Grain weight that we commonly measure is an apparent one, which is composed of dry matter and moisture (water). The dry matter can be measured only when we have a temperature-controlled dryer or oven.

Exercise 1: Calculate the grain yield adjusted to 14% moisture (the standard in SL), when the grain yield is 1.40 ton/ha at 17.0% moisture. Note that 17.0% is often the moisture amount of grains equilibrated to air humidity during rainy season.

Exercise 2: Calculate the grain yield adjusted to 14% moisture, when the grain yield is 1.40 ton/ha at 12.0% moisture. Note that 12.0% is often the moisture amount of grains equilibrated to air humidity during dry season or exposed under strong sunshine for a long period.

An extra training session will be open on these subjects in December 2008.
Name (in block letter): ___________________________

Answers to the Exercise

Question: Calculate the grain yield at 14.0%.

Exercise 1: When grain yield is 1.40 ton/ha at 17.0%,

Ans.:

Exercise 2: When grain yield is 1.40 ton/ha at 12.0%,

Ans.:

Submit the answer at the next task force meeting.

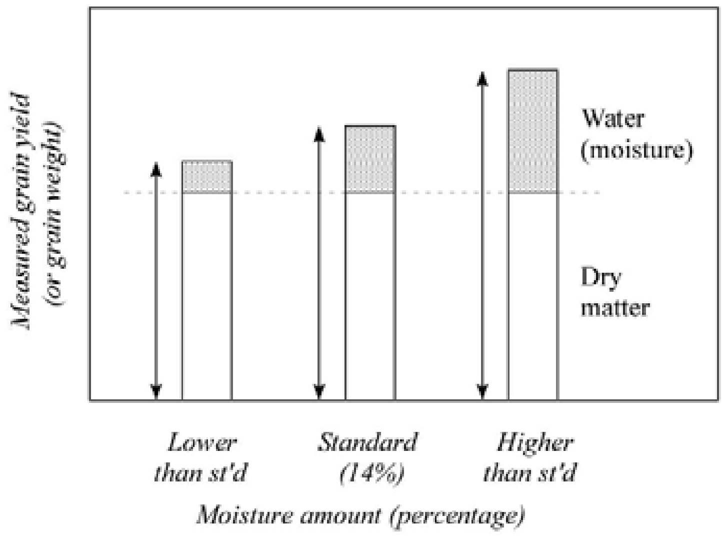
Training course 20
19/12/2008

Grain Yield (Production) Correction with Moisture

1. Basic calculation (a premise) of a fractional equation

   a = bc, b = a/c, c = a/b

2. Concept of the moisture adjustment (See the text on 19/11/2008)



3. How to adjust the moisture of grain yield

3-1. Definition

GY measured (GYm) = DM + W

where DM is dry matter and W the moisture (water) amount.

3-2. When the moisture amount is 14.0%, the DM is 86.0% of the GY: i.e.,
DM/GY = 0.86 => GY = DM / 0.86 (1)

Note that DM is unknown in eq. 1.

3-3. Based on the given condition: grain yield is 1.40 ton/ha at 17.0% [Exercise 1],

DM / (DM + W) = (1- 17.0/100) => DM/GYm = 0.83
DM / 1.40 = 0.83 => DM = 1.40 x 0.83 = 1.162 (2)

Substitute the solution [answer] for DM in eq. 1
the grain yield at 14.0% = DM / 0.86 = 1.162 / 0.86 = (1.351163) = 1.35 ton/ha

or simply, the grain yield at 14.0% = (1.40 x 0.83) / 0.86 = 1.35 ton/ha

3-4. Similarly, when the grain yield is 1.40 ton/ha at 12.0% [Exercise 2],
DM / 1.40 = 0.88 => DM = 1.40 x 0.88 = 1.232
the grain yield at 14.0% = DM / 0.86 = 1.232 / 0.86 = 1.43 ton/ha

or simply, the grain yield at 14.0% = (1.40 x 0.88) / 0.86 = 1.43 ton/ha

Training course 20
17/12/2008

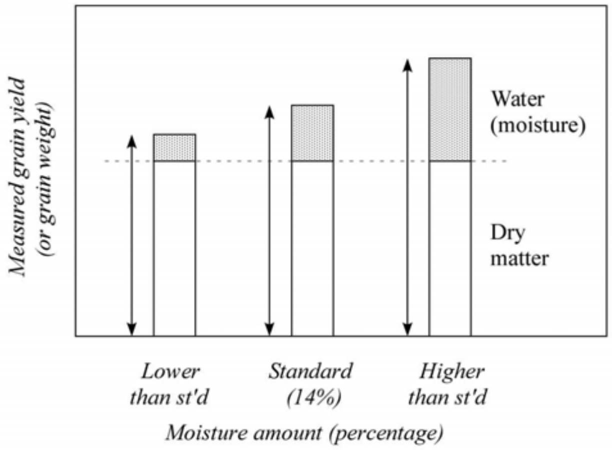
Grain Yield (Production) Correction with Moisture

1. Basic calculation (a premise) of a fractional equation

$$a = bc, \quad b = a/c, \quad c = a/b \qquad (1)$$
$$a \times b = c \times d \quad \text{or} \quad ab = cd \qquad (2)$$

Note that the equation (2) can be modified as a = cd / b, c = ab / d, etc.

2. Concept of the moisture adjustment (See the text on 19/11/2008)



Note that the dry matter (weight) itself remains the same regardless of moisture percentages.

3. Calculation procedure

Definition

$$\text{Grain Yield measured (GYm)} = DM + W \qquad (3)$$

where DM is dry matter (weight) and W the moisture (water) amount (weight).

Exercise 1: GY at 14% when GYm is 1.40 ton/ha at 17.0%,

pDM14 : Dry matter percentage at 14% moisture = (100-14) = 86% or 0.86
pDM17 : Dry matter percentage at 17% moisture = (100-17) = 83% or 0.83
DM14 : Dry matter (weight) at 14% moisture = GY14 x pDM14 = GY14 x 0.86
DM17 : Dry matter (weight) at 17% moisture = GY17 x pDM17 = 1.40 x 0.83
GY14 : GY at 14% moisture
GY17 : GY at 17% moisture

(DM17) = (DM14)
1.40 x 0.83 = GY14 x 0.86 -> GY14 = (1.40 x 0.83) / 0.86= (1.351163) = 1.35 ton/ha
(a) (b) (c) (d) (c = ab / d)

Exercise 2: GY at 14% when GYm is 1.40 ton/ha at 12.0%,

1.40 x 0.88 = GY14 x 0.86 -> GY14 = (1.40 x 0.88) / 0.86= 1.43 ton/ha

Important notice: bear in mind always the effective number of digits.