c. Herbicides

The results of herbicide experiments on the direct-sowing cultivation method on flooded fields are shown in Table 1. They suggest three promising herbicide combinations; 1) Oxadiazon just after puddling + Bentazone, 30 days after sowing, 2) Benthiocarb, 7 days after sowing + Bentazone, 30 days after sowing, and 3) Pyrazolate just after sowing + Bentazone, 30 days after sowing. However, the idea 1) was cancelled because sowing can not be done for four days after an Oxadiazon application (if the field is left for four days after puddling, the soil surface becomes too hard for sowing). Also idea 3) was cancelled for the time being until Pyrazolate becomes available on the Egyptian market. The idea 2) combination remained as the only recommendation, though the application timing was changed to 15 days after sowing instead of 7 days, since phyto-toxicity to rice plants was anticipated.

Herbicide-application in the direct-sowing cultivation method on dry fields was investigated in 1989 based on the recommendation of RRTC. From this result, clear effects were observed in the treatment with Benthiocarb 2.1 L/f + Propanil 3-4.5 L/f, applied at 15-20 days after sowing. Field conditions at the time of application must be dry, and it is recommended that it be applied about 2 days before flush water. Bentazone must be applied also, the as same as in the case of the direct-sowing cultivation method on flooded fields, that is: 30 days after sowing. The field must be drained one day before the application of Bentazone so that the soil surface is in a water-saturated condition.

Table 1-1 WEED CONTROL EXPERIMENT IN DIRECT SOWING CULTIVATION METHOD ON FLOODED FIELD R M P, 1987

No.	TREATMENT: After puddle Before seeding	Just after Sprouting /_1	After /_2 Sprouting	After 30 days	RESULT: Cyperus difformis No./m^2	Cyperus difformis W./m^2 g /3	Echinochloa spp. No./m^2	Echinochloa spp. W./m^2 g /3	Other weed W./m^2 g	Total /_3 W./m^2 g
1	- -	- -	- -	- -	706.3 a	296.7 a	0 b	0 b	21.2 a	317.9 a
2	Oxadiazon	- -	Benthiocarb	Bentazone	0 b	0 b	0 b	0 b	10.7 a	10.7 b
3	Oxadiazon	- -	- -	Bentazone	0 b	0 b	0 b	0 b	8.4 a	8.4 b
4	Benthiocarb	- -	- -	Bentazone	2 b	0.1b	0 b	0 b	5.6 a	5.7 b
5	- -	- -	Benthiocarb	Bentazone	38 b	15.1b	0 b	0 b	30.8 a	45.9 b
6	Benthiocarb	- -	Benthiocarb	Bentazone	0 b	0 b	0 b	0 b	43.8 a	43.8 b
7	- -	- -	Molinate /_4 (Ordram)	Bentazone	226 b	82.1b	0 b	0 b	4.4 a	86.5 b
8	Oxadiazone +Butachlor	- -	- -	Bentazone	141.3b	49.0b	0 b	0 b	22.5 a	71.5 b
9	MO	- -	- -	Bentazone	2.3b	0.4b	0.5b	1.2ab	95.3 a	96.9 b
10	Pyrazolate	- -	- -	Bentazone	0 b	0 b	2.8a	2.2a	1.3 a	3.5 b
11	- -	MO	- -	Bentazone	84.8b	31.3b	0.8b	0.9ab	24.5 a	56.7 b
12	- -	Pyrazolate	- -	Bentazone	198 b	70.2b	0 b	0 b	2.9 a	73.1 b
AV.					116.4	45.4	0.33	0.35	22.6	68.4
C.V					138.4%	135.4%	396.6%	370.6%	267.6%	130.20%

Note /_1 ...... 3 days after sowing

/_2 ...... 7 days after sowing

/_3 ...... Dry weight

/_4 ...... 10 days after sowing

Table 1-2 WEED CONTROL EXPERIMENT (D. S. WET CONDITION), RMC, 1987

Treament No.	Yield t/h	/_2 (t/f)	Days Heading	to Maturity	Diseases /_1 BL (1-2)	NBL	BS	BL (5)	Lodg %	Plant Height (cm)	Panicle length (cm)	No. of grains per panicle	Percentage of maturity	1000 grain weight	No. of panicle/ m^2
1	3.81	(1.60) d	87	132	-	2	-	-	0	83.4	20.6	93.9	91.8	22.4	528.3
2	8.38	(3.52)ab	87	132	-	2	-	-	21	86.2	21.9	120.1	93.9	22.2	594.0
3	8.80	(3.70)ab	87	133	-	2	-	-	49	85.2	21.3	120.7	91.9	21.7	739.8
4	0.46	(0.19)e	88	134	-		-	-	0	89.8	22.1	134.5	71.7	21.6	40.5
5	8.55	(3.59)ab	87	132	-	2	-	-	44	85.8	21.6	118.9	93.5	21.9	630.0
6	0.72	(0.30)e	88	134	-		-	-	0	89.9	22.3	159.2	84.5	21.2	44.9
7	8.57	(3.60)ab	87	133	-	2	-	-	55	85.7	21.3	120.2	94.1	21.8	581.8
8	7.21	(3.03)abc	87	133	-	2	-	-	15	85.5	20.9	98.8	93.0	22.5	733.8
9	5.48	(2.30)cd	87	132	-	2	-	-	8	90.7	21.8	179.1	86.2	21.2	557.0
10	8.95	(3.76)a	87	132	-	2	-	-	38	85.9	21.6	103.4	94.2	21.9	806.5
11	7.69	(3.23)abc	87	133	-	2	-	-	36	84.4	20.7	99.1	89.3	22.3	712.8
12	6.38	(2.68)bcd	87	133	-	2	-	-	19	84.5	20.8	95.8	89.7	21.6	650.2
AV.	6.25	(2.63)	87.2	132.8	-	-	-	-	-	86.4	21.4	120.3	89.5%	21.9	535.0
CV.	24.7%									3.9%	3.2%	21.09%	8.3%	3.6%	17.8%

Note ..... /_1 BL (1-2) = Leaf Blast in seedling, BL (5) = Leaf Blast in Heading, NBL=Neck Node Blast

/_2 Corrected for 14% of moisture contents

* Treatments are same as table 1.

Table 3 Results of Investigation (Weed amounts) - Herbicide Experiment on Direct Sowing Cultivation Method on Dry Field, R.M.C, 1989.

Treatment /_1	No. of weeds				Dry weight of weeds			
	Cyperus rotundus	Cyperus difformis	Echinochloa Spp.	Broad leaf+ other weeds	Cyperus rotundus	Echinochloa Spp.	Broad leaf	Total Weeds in 2nd sampling
A (Control)	2 a	0 a	33.5 a	11.25 a	0.7 a	4.61 a	11.36 a	74.05 a
B Saturn + Propanil (7.5L)	1 a	0 a	2.75 c	2.75 ab	0.37 a	0.11 b	0.24 b	10.81 b
C Saturn + Propanil (11L)	3.75 a	0 a	4 bc	3.5 ab	1.12 a	0.11 b	0.52 b	14.44 b
D Saturn + Propanil (7.5L)	5.75 a	0 a	12 b	5.25 ab	1.54 a	1.05 b	0.57 b	20.96 b
E Saturn + Propanil (11L)	0.25 a	0 a	6.25 bc	2.5 b	0.04 a	0.71 b	0.57 b	16.66 b
Average	2.55	0	11.7	5.05	0.75	1.32	2.65	27.38
C.V.(%)	205.6		46.28	102.85	217.19	83.00	250.55	75.08

Note ... * /_1 B and C = Chemicals are applied 2 weeks after sowing
D and E = Chemicals are applied 3 weeks after sowing
* /_2 The values followed by the same letter are not significantly different at 5% level.

Table 4 Yield and yield Components - herbicide experiment on the Direct Sowing Cultivation Method on Dry Field - RMC, 1989

Treatment /_1 Name	Days to Head	Days to Mat.	Diseases BL (5)	Diseases NBL (9)	Diseases Bs (5)	Lodge (%)	Plant Height (cm)	Panicle Length (cm)	No. of Spikelet /Panicle	No. Of Panicle /m²	Ripen. Ratio (%)	1000 Grain weight (g)	Yield (t/ha)	Yield (t/f)
A	97	135	1	1	1	0	87.5	21.9	116 a	398 a	92.9 ab	24.9 a	8.91	3.74 a
B	96	135	1	1	1	0	88.0	21.3	106 ab	382 a	93.4 ab	25.9 a	9.65	4.05 a
C	96	134	1	1	1	0	88.1	21.1	94 b	427 a	92.2 ab	25.9 a	9.42	3.96 a
D	99	135	1	1	1	0	86.5	21.8	100 ab	431 a	91.2 b	25.0 a	9.73	4.09 a
E	97	134	1	1	1	0	87.8	20.7	90 b	400 a	94.5 a	25.1 a	9.54	4.10 a
A.V.	97	135	1	1	1	0	87.6	21.3	101	408	92.8	25.3	9.45	3.97
C.V.(%)	0.86	0.52				-	1.33	3.98	10.54	13.52	1.91	3.76	8.95	

Note .... * /_1 See Table 3

* The values followed by the same letter are not significantly different at 5% level

* Yields are corrected to 14% moisture content

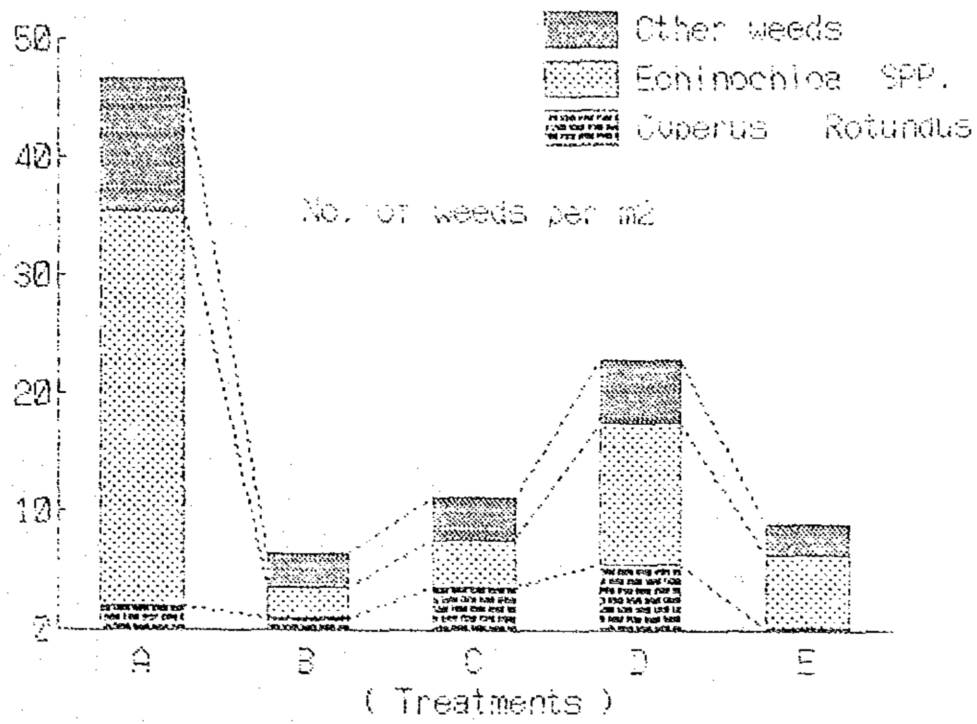


Fig. 7 Number of weeds - Herbicide Experiment in Direct Sowing Cultivation Method on Dry Field - RMC, 1989

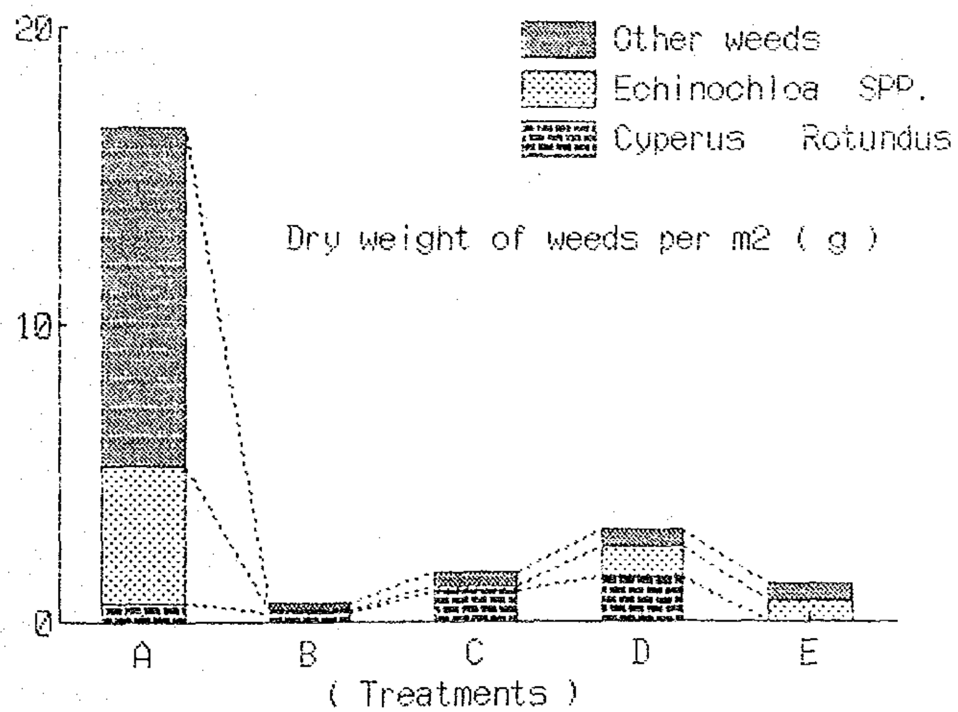


Fig. 8 Dry weight of weeds - Herbicide Experiment in Direct Sowing Cultivation Method on Dry Field - RMC, 1989

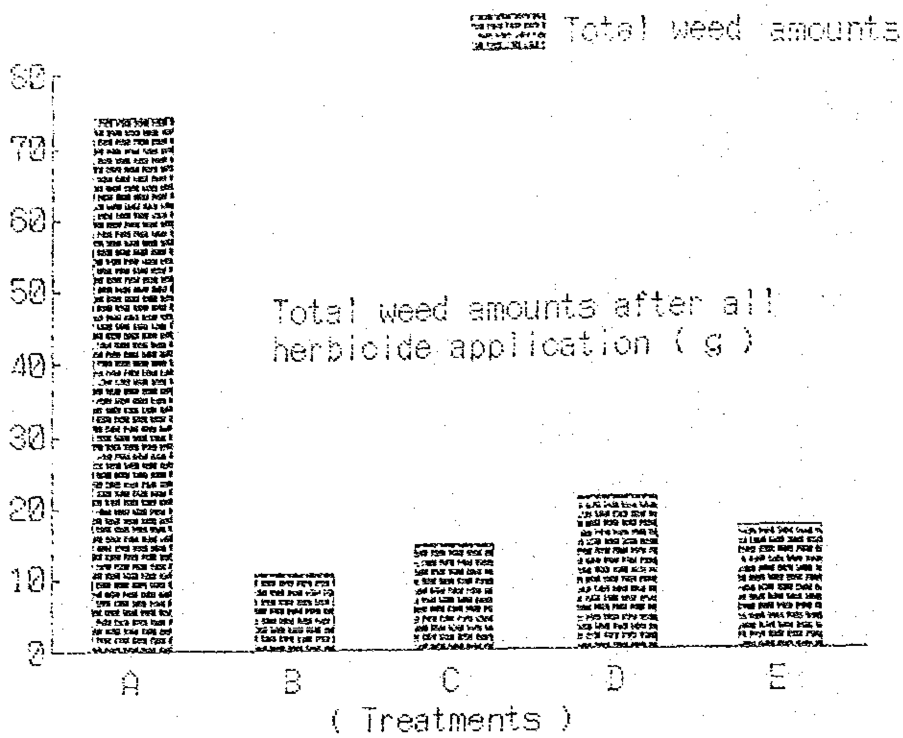


Fig. 9 Total weed amount after all herbicide applications, Herbicide Experiment in Direct-Sowing Cultivation Method on Dry Field - RMC, 1989

In any kind of herbicide application, attention must be paid to the recommended dosage as well as to uniform application, timing, desirable field-water conditions, and etc.

d. Weed control systems

It is almost impossible to eradicate all weeds from the fields by depending only on herbicides. Especially in the direct-sowing cultivation method, herbicide option is limitted. Therefore, it is better to consider the application of herbicides as a supplementary weed control system.

Some practices which are related to weed control system are as follows ;

(1) Perennial weed control in winter by using glyphosate (chemical is brushed on weed leaves with a round swipe or a similar implement).

(2) Plow up and dry up the rhizomes of perennial weeds, and bury the seeds of annual weeds at the time of land preparation

(3) Shorten the time between the last chiselling and sowing (to give the advantage to rice in growth competition with weeds)

(4) Shorten the time after the first irrigation until sprouting by shallow sowing, using vigorous seeds and other practices.

(5) Thorough land leveling (in order to facilitate easy irrigation)

(6) Water must be as deep as possible within a range of what rice plants can tolerate

(7) Deliberate dyke-formation so as to minimize horizontal water-seepage

(8) Uniform sprouts, as much as possible, to minimize "missing hills" (no-sprout patches) in order to give the advantage to rice in growth competition with weeds

(9) Perfect herbicide application (see the previous section)

(10) Hand weeding at the earliest possible opportunity.

(11) Prevent annual weeds from forming their seeds in the field (as a countermeasure to the successive year)

High efficiency and good effects should be expected through an organization of the above-mentioned preventative and eradication methods. In other words, if some of them are neglected or not completed, weeds may pevail in the fields indefinitely. Small farmers with 3-5 feddans can defeat weeds without failure only if they have enthusiasm. Consequently, the issue is not how to control weeds but how to save labor or cost (and mechanize if possible) the above-mentioned practices or systems.

Fig. 10 Weed Control System for the Direct Sowing Cultivation Method on Dry Field

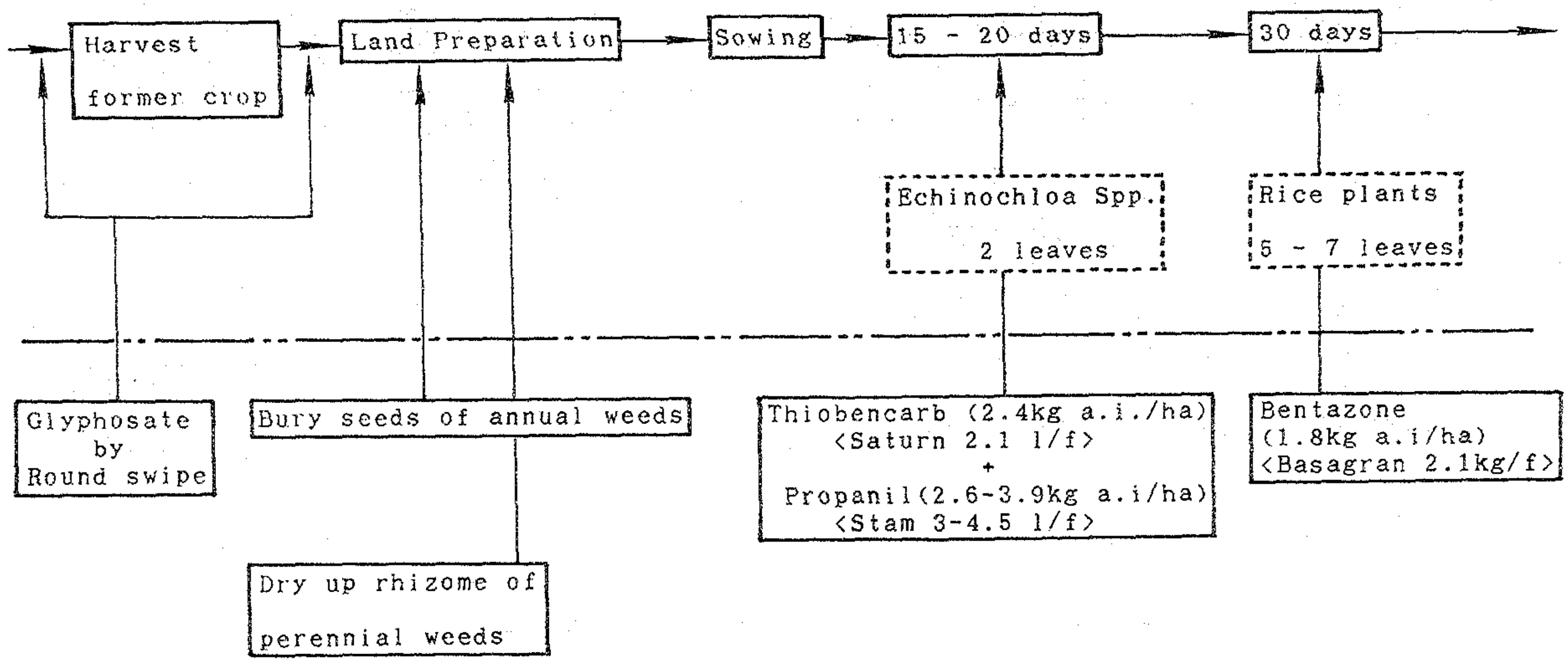
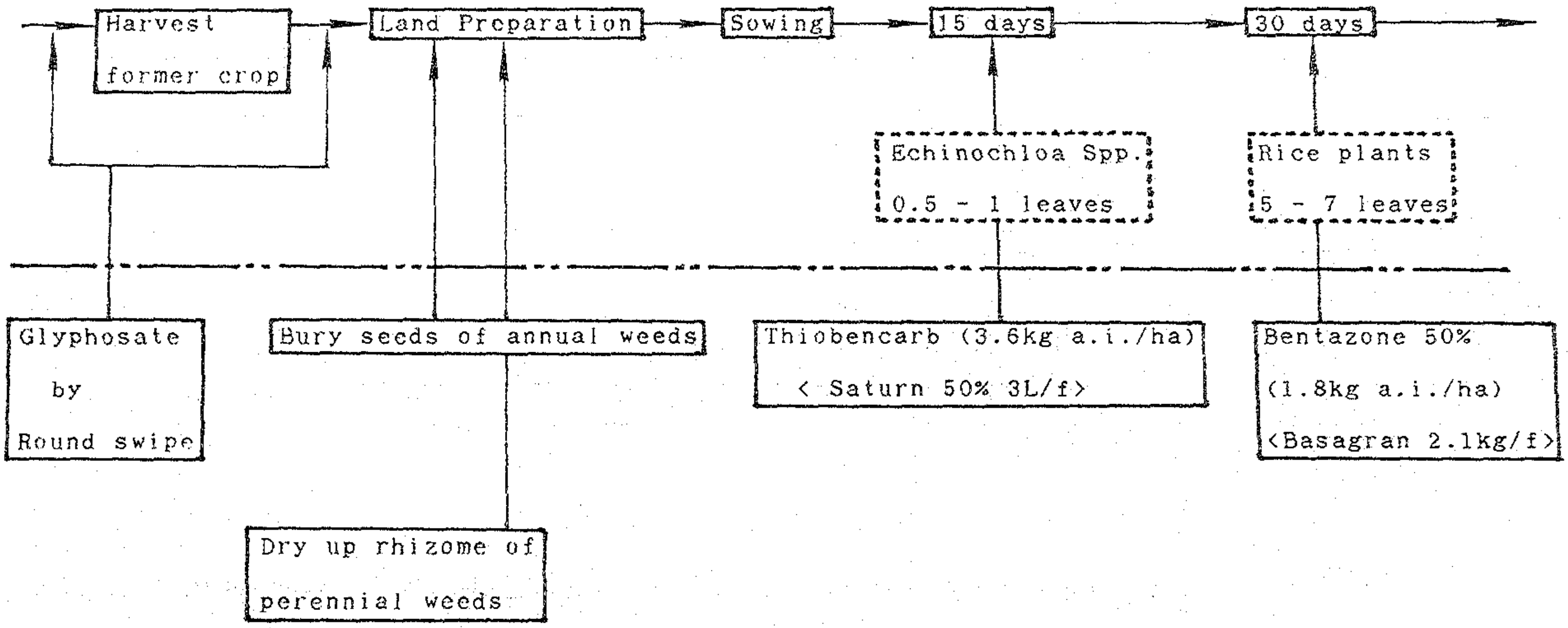


Fig.11 Weed Control System for the Direct Sowing Cultivation Method on Flooded Field



3) Fertilization

a. Mechanical fertilization

The required quantity of fertilizer and the timing of its application in the direct-sowing cultivation methods, for both on dry field and on flooded field, are shown in Table 1.

From among the farm machines used for powdery and granular herbicides,the broadcaster and lime sower were selected. For the broadcaster, four types can be found; (i) the self-propelled type, (ii) the tractor mounted type (iii) the power tiller mounted type, and (iv) the manual type. For basal fertilization, the P.T.O powered tractor mounted type can be recommended. However, for basal fertilization P_2O_5 and K_2O are powdery and must be spread comparatively less and attention should be paid to the following advice.

Basal fertilization in the direct-sowing cultivation method on dry field :

i) The basal fertilizer must be applied before making the simplified levee. Prior to fertilization, when the simple levee is constructed and the field is partitioned by it, the operation is less efficient.

ii) When P_2O_5 and K_2O are mixed and applied

For mixing, a concrete mixer can be used.

Another method of mixing the fertilizers is to spread a vinly sheet out, place the fertilizer on it and have the four corners lifted up by four workers.

iii) The canvas attachment is mounted on the broadcaster before operation.

iv) The rotational speed of P.T.O and the operating speed are maintained at 540 rpm and 8 to 10 km/hour respectively.

Basal fertilization in the direct-sowing cultivation method on flooded field :

i) Fertilizer must be applied before making the simplified levee.

ii) Ammonium, Sulphate (N) must be applied without mixing.

iii) Super phosphate (P_2O_5) and Potassium (K_2O) must be together mixed before application.

iv) For ammonium sulphate applications, the canvas attachment must be removed. For applying the mixture of Super phosphate and Potassium, the canvas attachment must be mounted and operated at 540 rmp P.T.O at 8 to 10 km/hr travelling speed.

Top-dressing fertilization :

Large farm machines, like the tractor, can not be operated at this stage of rice growth in either the direct-sowing cultivation method on flooded field or on dry field. The required quantity of urea is applied as the top-dressing. The manual broadcaster can be used for this purpose.

Table 1 shows the features of various types of fertilizer applicators.

Table 1 Kind of advantages and disadvantages of each fertilizing machine

Kind of Fertilizing Machine	Advantages	Disadvantages	Remarks
Self-propelled type Broadcaster	1) High hopper capacity, therefore, loss time is few for add fertilizer. 2) It not necessary to change the implement.	1) We can not use it in the field with young developing rice plants. 2) High price.	
Trailed type Broadcaster	1) Possible to use it with a bigger hopper than the mounted type. 2) Ground wheel drive type. So that it is possible to deliver fertilizer with interlock working speed.	1) Is apt to generate nonuniform spraying on unevenfield. 2) We can not use it in the field with young developing rice plants..	
Mounted type with PTO Drive Broardcaster	1) Possible to adjust application rate by change working speed. 2) Hard to generate uniformity of spraying on unevenfield. 3) Mounted length is shorter than the trailed type.	1) Higher price than the trailed type.	Suitable for basal.
Manual Broadcaster	1) Possible to work in the field with young developing rice plants.	1) Cannot spread powder fertilizer. 2) Small hopper capacity. 15L so loss of time for addition fertilizer is great.	Suitable for topdressing.
Limesower	1) Suitable for many types of fertilizer applications.	1) Not suitable for low volume application.	

b. Standard timing and amount of fertilization

The fields in the direct-sowing cultivation system on dry fields are obliged to be in a rather dry condition for the first 20 days, and nitrogen in the soil tends to become nitrate in form which is easily volatilized or washed out of the field. Therefore, the first nitrogen application must be done after the field is submerged (around 20 days after sowing). Further, fields of this cultivation method have more field percolation, and fertilizer may be washed out of them easier and faster than the case of puddled fields. Increased dosage of fertilizer, therefore, is essential in this method, and more frequent split applications may be effective especially when water percolates excessively or when soil is infertile (see Table 2).

The concept for top dressing during a later stage is the same in any kind of cultivation method. So, 17kg Nitrogen ingredient per feddan is standard for all the cultivation methods.

The tactics for phosphorous and potassium fertilizer are the same as for the transplanting method, and are increased or decreased according to soil fertility (see Table 1).

Table 1 Standard fertilization method in the direct-sowing cultivation method

< on flooded field >

	Basal Appli.	1st TD	2nd TD
N	12.5-17 kg/f	12.5-17 kg/f	17 kg/f
P_2O_5	25-35 kg/f		
K_2O	12-17 kg/f		

Note ..... Basal appli. before puddling, 1st TD at 20 days after sowing and 2nd TD at 20 days before heading

< on dry field >

	Basal Appli.	1st TD	2nd TD	3rd TD
N		12.5-17kg/f	12.5-17kg/f	17 kg/f
P_2O_5	25-35kg/f			
K_2O	12-17 kg/f			

Note ... Basal appli. after 1st chiselling, 1st TD at 20 days after sowing, 2nd TD at 40 days after sowing and 3rd TD at 20 days before heading

Table 2 Results of Experiment on Fertilization in The Direct Sowing Cultivation Method on Dry Field - RMC, 1989

Treatment	Days to		Diseases			Lodge (%)	Plant Height (cm)	Panicle Length (cm)	No. of Spikelet /Panicle	No. Of Panicle $/m^2$	Ripen. Ratio (%)	1000 Grain weight (g)	Yield	
Name	Head	Mat.	BL (5)	NBL (9)	Bs (5)								(t/ha)	(t/f)
A	97	141	1	1	1	0	81.3 a	21.4 b	113 a	428 a	91.9 b	25.6 bc	6.66 bc	2.80
B	96	142	1	1	1	0	85.5 a	22.4 ab	124 a	371 a	92.8 ab	25.6 bc	6.84 bc	2.87
C	96	141	1	1	1	0	81.5 a	21.5 b	116 a	416 a	93.0 ab	25.7 bc	6.19 c	2.60
D	98	141	1	1	1	0	80.6 a	21.8 ab	114 a	409 a	92.5 ab	25.1 c	6.42 c	2.70
E	95	142	1	1	1	0	85.4 a	22.7 a	124 a	464 a	94.0 a	26.0 ab	7.38 ab	3.10
F	97	141	1	1	1	0	89.7 a	22.1 ab	121 a	422 a	93.0 ab	26.0 ab	7.97 a	3.35
G	96	141	1	1	1	0	89.6 a	22.4 ab	122 a	429 a	93.7 ab	26.4 a	7.50 ab	3.15
H	97	141	1	1	1	0	89.1 a	21.9 ab	117 a	436 a	92.9 ab	26.0 ab	7.38 ab	3.10
A.V.	97	141	1	1	1	0	85.3	22.0	119	422	93.0	25.8	7.04	3.00
C.V. (%)			-	-	-	-	2.37	2.9	6.0	15.4	103	105	8.03	

Note ....* Values followed by the same letter are not significantly different at the 5% level
* Yields are corrected to 14% moisture content
* Treatments are propotion of total Nitrogen (120kg/ha) and application timing (B=basal, w=weeks after sowing and PI=Panicle Initiation Stage) as follows ;

A =1/3-B, 1/3-3w, 1/3-PI B =1/3-B, 1/3-6w,1/3-PI C =2/3-3w,1/3-PI D =2/3-B, 1/3-PI
E =1/3-B, 1/3-6w, 1/3-PI F =1/8 to B,2,3,5,6,8,9 each w and PI
G =1/16-B, 1/8-2w, 3/16-3w, 1/8-5w, 1/16-6w, 1/8-8w, 3/16-9w, 1/8-PI
H =1/8-B, 1/16-2w, 1/8-3w, 3/16-5w, 1/8-6w, 3/16-8w, 1/8-9w, 1/16-PI

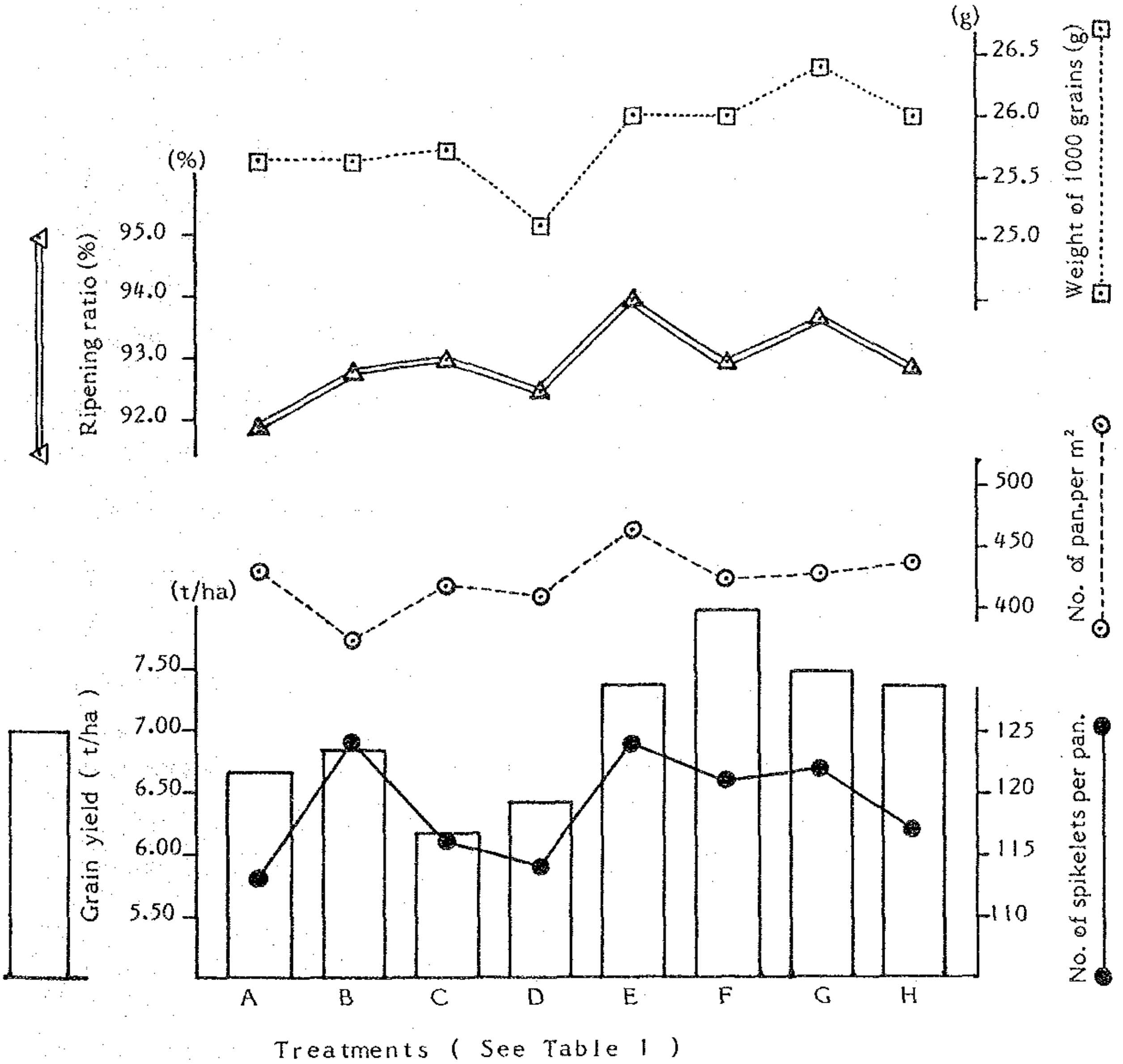


Fig.1 Experiment on Fertilization in The Direct Sowing Cultivation Method on Dry Field. - RMC, 1989

4) Diseases and Pest Control

a. Sprayer (for pest control)

The solution called "Beam", and the granular pesticide called "Fradan" are used for leaf blast disease and insects respectively. For the application of "Beam", the power sprayer mentioned in the section I-1-(2)-2) weed control can be optimally recommended.

Other types of sprayers, like the knapsack type power sprayer and the manual type sprayer, can be used too. However, with these sprayers the capacities of the chemicals tanks are not large enough for large farms.

The pesticide "Fradan" can be applied by the manual broadcaster described in the section of I-1-(1)-1)-e Seeder.

b. Diseases and the control

Several fungal diseases are known in Egypt, though none is as serious and important as "rice blast" caused by Pyricularia oryzae. "Brown spot", caused by Helminthosporium oryzae, follows it. Other diseases are less important and are negligible to deal with in this section. Blast disease, as for its magnitude, is to be discussed in the next chapter more deeply, although the control measure for it is dealt with here.

As is seen in section 2 - (1) Variety, all new varieties are highly resistant to rice blast and as long as those varieties are used, no special measure is required for rice blast.

Nevertheless, conventional varieties, such as Giza 171 or Giza 172, may still be used by the farmers. Then, some chemical applications become essential.

The prominent effects were confirmed by Tricyclazole 20% (Beam), EDDP 30% (Hinosan) and IBP 17% (Kitazin) in RRTC, while Probenazole 8% showed superb performances against leaf and neck node blast in RMC (1987-1988). Unfortunately, it is not available in the Egyptian market.

All in all, Tricyclazole 20% is the most effective against this disease. It should be applied twice, at the maximum tillering stage (against leaf blast) and at the booting stage (against neck blast).

Brown spot disease is quite popular in all the rice cultivated areas in the world. Slight infection will not reduce yield at all, but in heavy case the damage could be enormous. Appropriate measures must be taken to avoid big damage.

This disease is induced directly by Cochliobolus miyabeanus. However, this is strongly related to the nutritional condition of rice plant, and the shortage of Nitrogen, Potassium, Ferrus or Manganese may accelerate the occurence of the disease.

Accordingly, soil dressing or the use of manure or compost are effective, and split applications of nitrogenous and potassium fertilizer is recommended. Of course, seed disinfection protects from early infection of this brown spot getting a higher sprouting-ratio, and is an essential operation.

Another point to be taken into an account is water management. In order to keep the roots in a healthy condition, the rhizosphere should be kept oxidized. Once soil reduction is observed, it must be drained as soon as possible.

c. Pests and the control

The presumable harmful insests in the direct-sowing cultivation method in the Nile Delta are as follows ; stem borer (Chilo agamemnon Bles.), mole cricket (Gryllotalpa gryllotalpa), army worm (Spodoptera littoralis), rice leaf miner (Hydrellia posternalis Deem.) and stink bug (Eusacoris inconspicuus H.SC. Nezara viridula). However, more than 30 different insect species known to attack rice in Egypt have been reported by RRTC. Among all of them, stem borer may be the only insect which should be taken into account as a constant threat to rice. Some insecticide application against it should be scheduled in every season.

According to the report "Highlights of Recent Rice Research in Egypt", (Ministry of Agriculture and Land Reclamation, Arab Republic of Egypt 1987), there are four broods in a year, with the first three peaks occuring in mid May, late July, and late August, with the fourth peak occuring between late September and the first week of October. It continues, that the first and second broods are quite little, while the third stage which is responsible for the damage known as "Dead hearts" coincides with the maximum tillering stage of the rice crop. The fourth brood causes the damage known as "White heads".

Consequently, some insecticide must be applied just before the maximum tillering stage (that is, the middle of July, 60-70 days after seeding) so as to protect the rice from dead hearts. When more stem borer is apparent, then another application may be required in order to diminish "white heads".

Although RRTC recommends lindane 5% and dursban 10%, diazinon 10% and furdan 10% are also effective.

5) Harvesting

a. Harvesting by machine.

Egyptian agriculture consists of the combined rotation system of rice, wheat, soy bean, maize, and Egyptian clover. A by-product of machine-harvesting is rice straw, which can be used as animal food is sold by the farmer to get a cash income.

Two types of combine harvesters can be considered. One is the head feeding type (Japanese type), and the other is the multi-purpose combine harvester (European type). The former has less grain loss and is used especially for rice and wheat. However, considering the combined rotational farming system, the multi-purpose one can be recommended to cover the harvesting of beans and the other crops, as well as rice.

To mechanically thresh rice, beans and sun flowers, the reaper and the Egyptian-made thresher can be used. However, these machines can not be adapted to the traditional way of farming. In the traditional manual transplanting method, where large seedlings are sparsely planted in large clusters; there are cases when the reaper is unable to perform well. The table below shows the combination of the kinds of harvesting machines and the conditions of application.

Table.1 Combination of the kinds of harvesting machines and the conditions applied.

Kind of Harvester	Conditions of Application
Head Feeding type Combine	Harvesting of rice, wheat and barely
Multi Purpose Combine	Harvesting of rice, wheat and barely and soy beans
Reaper	Had the Egyptian multi-purpose thresher and transplanted rice with rice transplanter or directly sowed rice and wheat

For harvesting rice with 18 to 23% of grain moisture content and less grain loss by use of the head feeding type combine harvester, the optimum operating speed can be recommended as 0.85 km/hr to 2.10 km/hr. (Fig.1, Fig.2 and Table.2 and 3)

b). Labour Saving Effects of the Mechanical Harvest System

i) In general, the traditional harvest system consists of the following operations :

HARVESTING →	DRYING ON FIELD →	COLLECTING STRAW →	THRESHING & WINOWING →	TRANSPORTATION OF GRAIN & STRAW
(sickle)	(natural)	(hand)	(tramping by tractor & winnowing)	(trailer+tractor & hand)

Altogether, it requries more than 140 hrs/f of manual working hours and is rather labourious.

ii) If suitable machinery are introduced to the above mentioned harvesting system, both work-simplification and remarkable labour saving effects should be expected.

The results of the survey and trial show the following figures.

(Manual working hour)

i. Traditional system .... 100 (%)

ii. Reaper system 56

iii. H.F. Combine system 13

Its details was described in the following Fig. 3

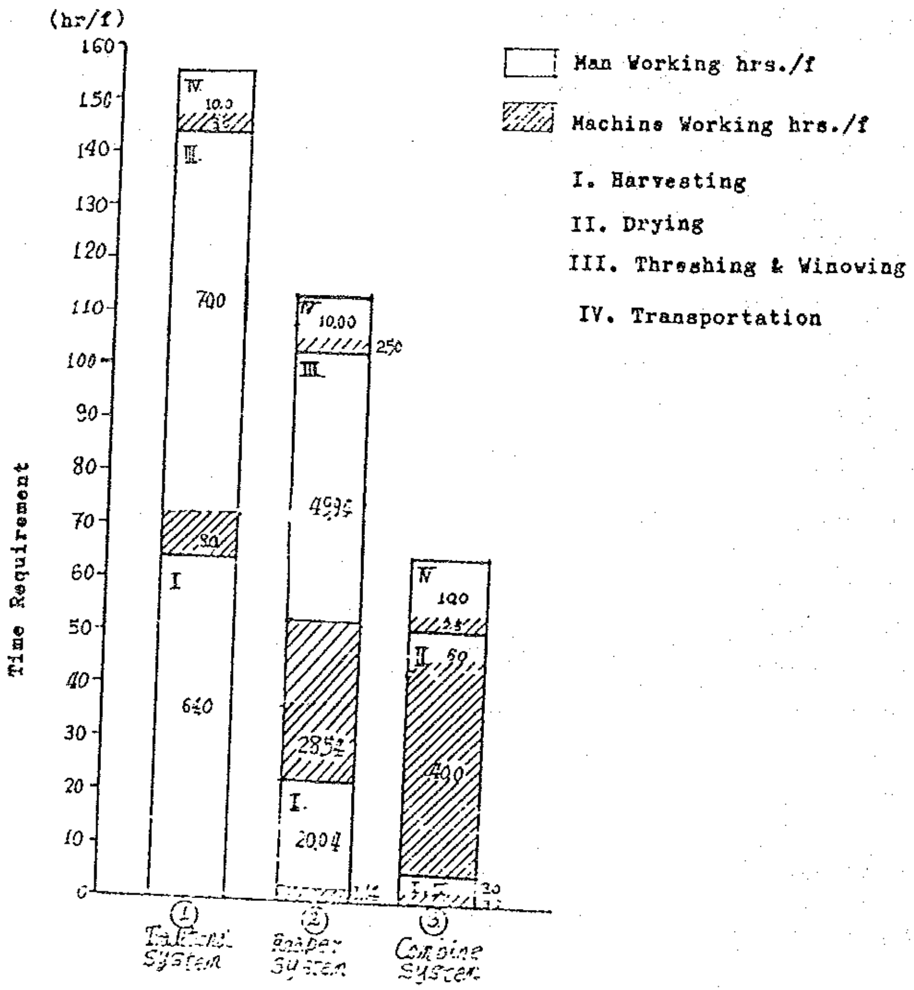


Fig-3. Tentative Comparison on Time Requirement of Harvest among Three different systems.

Remarks: ① Traditional System...... Mansura. Survey (1989)
② Reaper System........... RMC. Trial, survey, estimated
③ Combine System......... RMC. Trial (1989)

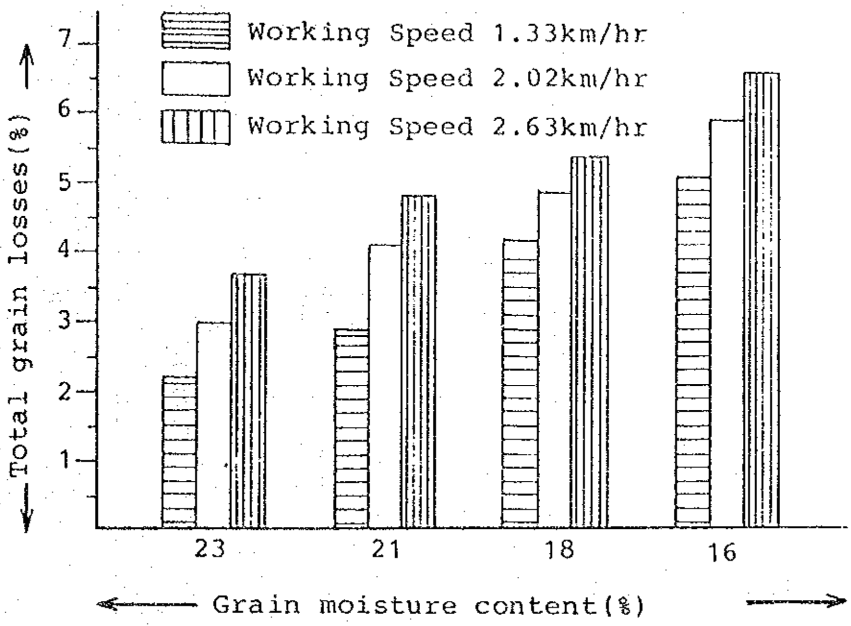


Fig.1 Relation between working speed & total grain losses under different grain moisture content.(Head Feeding type combine)

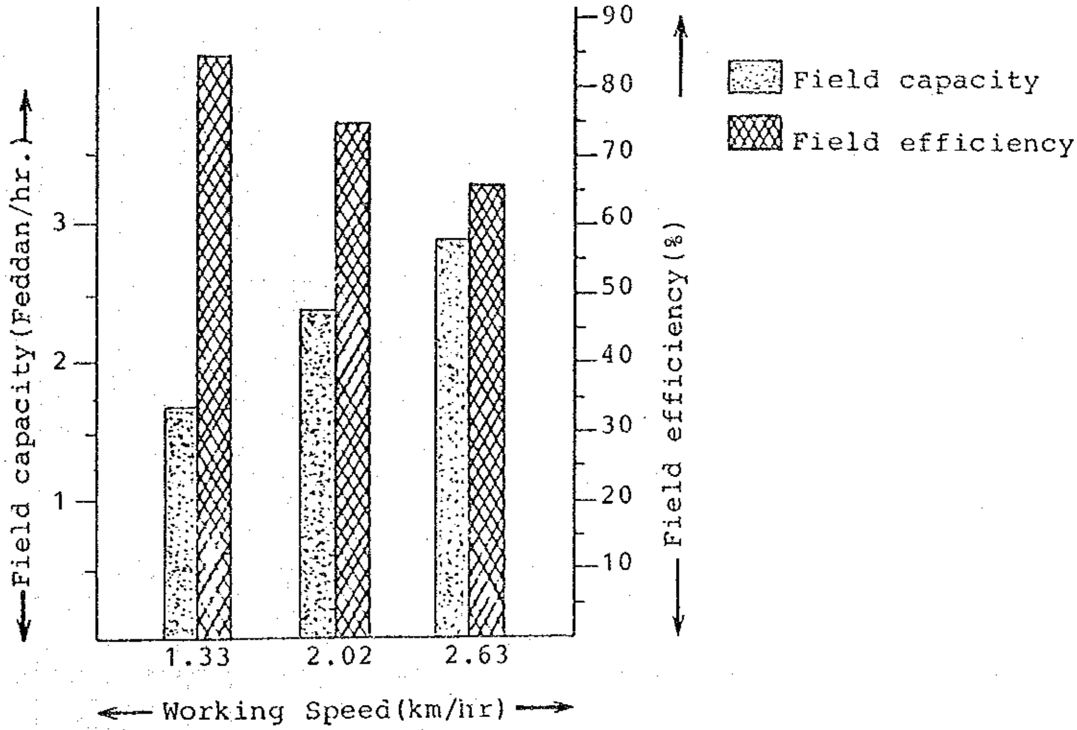


Fig. 2 Relation between working speed(km/hr) field capacity and field efficiency. (Head Feeding type combine)

Table. 2. Comparison of head feeding type combine's grain losses and multi-purpose combine's grain losses.

Rice variety : Giza-172 Grain moisture content 18%

Working speed (km/hr)	Head Feeding type Combine				Multi-Purpose Combine			
	Head losses (kg/f)	Threshing losses (kg/f)	Cleaning losses (kg/f)	Total losses (kg/f)	Head losses (kg/f)	Threshing losses (kg/f)	Cleaning losses (kg/f)	Total losses (kg/f)
0.73					17.61	35.19	18.21	71.01
0.85	20.62	24.53	6.35	51.50				
1.62	28.45	33.05	11.49	72.99				
2.25					25.00	71.41	20.13	125.53
2.27	45.99	48.71	15.00	109.70				
3.50					37.00	89.32	34.91	163.22
Total	95.06	106.29	32.84	234.19	79.61	195.92	73.25	348.78
Average	31.67	35.43	10.95	78.06	29.54	65.31	24.42	116.26
Amount of Yield	2500 kg/f				2500 kg/f			
Loss Rate (%)	1.26	1.42	0.44	3.12	1.06	2.61	0.98	4.65

1 Feddan = 42a

Table. 3. Comparison of head feeding type combine's grain losses and multi-purpose combine's grain losses

Rice variety : Giza 175.   Grain moisture content 18%

Working speed (km/hr)	Head Feeding type Combine				Multi-Purpose Combine			
	Head losses (kg/f)	Threshing losses (kg/f)	Cleaning losses (kg/f)	Total losses (kg/f)	Head losses (kg/f)	Threshing losses (kg/f)	Cleaning losses (kg/f)	Total losses (kg/f)
0.73					40.33	38.87	32.56	111.76
0.85	20.62	24.53	6.35	51.50				
1.62	28.45	33.05	11.49	72.99				
2.25					45.33	47.93	34.72	127.98
2.27	45.99	48.71	15.00	109.70				
3.50					53.25	67.46	45.50	166.21
Total	95.06	106.29	32.84	234.19	138.91	154.26	112.78	405.95
Average	31.69	35.43	10.95	78.06	46.30	51.42	37.59	135.32
Amount of Yield	3500 kg/f				3500 kg/f			
Loss Rate(%)	0.91	1.01	0.31	2.23	1.33	1.47	1.07	3.87

1 Feddan = 42a

6) Drying

The average moisture content of paddy rice during harvesting time is around 20 to 23 percent. For storing brown rice after the husking process the moisture content must be lowered to 14 to 15 percent. For this reason, drying is needed.

Two types of drying methods can be considered for this purpose. One is natural drying by the use of solar heat and wind, or spreading the rice out on the paddy ground surface. However, a big space is needed and weather conditions must be considered.

The other method is artificially forced drying by use of a rice circulation type dryer. The artificially forced drying system can be classified into the following three types: (i) "Normal": which uses air, (ii) the "rice circulation" type: which uses heated air, and (iii) the "air type": which uses solar heat. Burning kerosene oil (as the heat source) is popularly used for the "rice circulation" type dryer. This type of dryer can generally be used without considering weather conditions, and in Egypt it can easily be used. In the rice harvesting and drying season, there is less rain, therefore the possibility of using solar can be introduced, which is most suitable for Egyptian climatic conditions. By introducing this type of the performance can be improved by considering the following items:

i). To promote uniform drying, the upper layer and the lower layer of paddy rice should be completely turned for a certain period of time.

ii). To raise the temperature of heated air passing through the paddy rice layer a black colored net should be used. As a result of experiment it was found that a black colored net raised the temperature of the air which passed through the drying grain by an average of 3.2 ^{0}C. per day.

iii) For more efficient drying by use of the solar dryer, the thickness of the paddy rice layer should be 35 to 36 centimeters. For the prototype solar dryer donated by the Japanese Government, four tons will be the optimum quantity, of which the specifications are 4.6 m(length) X 3.7 m(width) X 2.2 m(height).

iv). The solar dryer should not be operated later than 3 o'clock in the afternoon, because it was observed from the experiment that the drying rate was remarkably reduced, and sometimes the moisture content increased after 3 o'clock in the afternoon.

2. Stable and High Yield Rice Cultivation Technique through Mechanization

(1) Varietal Adaptability for Mechanized Cultivation

It was stated in the previous section that there are comparatively few varietal options for rice cultivation in Egypt. Hence, varietal reaccessment for the mechanized rice cultivation system will be discussed in this section. In other words, we will discuss the important varietal characteristics of popular rices grown in Egypt in regards to their suitabilities for the mechanized rice cultivation system.

Since one of the objectives of the mechanized rice cultivation system (to achieve high and stable yield) is same as one of the objectives of the traditional cultivation method, the considerations herein are focused more on the agronomical aspects Which are related to mechanization.

Appropriate varieties for the direct sowing cultivation method and their features have been discussed in the previous chapter. However, overall varietal adaptability to the mechanized cultivation system is to be dealt with in this section, including those varieties previously discussed.

Giza 171
----

* Tall statured and lodging
* Medium-late maturity (159 days)
* High yielder (>9t/ha)
* Susceptible to blast
* Resistant to stem borer

* Short Japonica & transluscent grain
* Very high milling outturn & least breakage
* Very good cooking quality

This variety is one of the two most popular varieties in Egypt, the other being Giza 172, but, this variety inclines to lodge and this habit brings down the harvest recovery. In other words the harvest loss, including field loss before harvest, is great. Especially in a fertile field it lodges completely making mechanical harvest impossible. In addition to this negative habit, Giza 171 is quite susceptible to rice blast disease, so that the covering area of this variety may decrease gradually when a better variety with same cooking quality is launched from Rice Research and Training Center (RRTC, Herein after), ARC, Sakha.

Giza 172

* Tall statured & lodging
* Medium maturing (147 days)
* High yielder (>9t/ha)
* Highly susceptible to blast
* Resistant to stem borer
* Moderately tolerant to salinity
* Short Japonica & transluscent grain
* High milling outturn & least breakage
* Excellent cooking quality

Although this variety is shorter than Giza 171 it lodges more than the latter. It is of medium maturity with high

Table 1 Experiment on New Chemical (SERITARD) 1988, Gimmeza Satellite Field

Treatment Name	Days to Head	Days to Mat.	Diseases BL (5)	Diseases NBL (9)	Diseases Bs (5)	Lodge (%)	Plant Height (cm)	Panicle Length (cm)	No. of Spikelets /Panicle	No. Of Panicle /m^2	Ripen. Ratio (%)	1000 Grain weight (g)	Yield (t/ha)	Yield (t/f)
Seritard	100	133	1.3	2	1	0	108.1 a	22.1	98.0 a	307 a	92.0 a	27.3 a	7.8 a	3.3
Control	100	133	1.3	2	1	1.7	120.4 b	21.4	108.6 a	336 a	91.9 a	27.4 a	9.1 a	3.8
Average	100	133	1.3	2	1	0.8	114.3	21.8	103.3	322	92.0	27.4	8.5	3.6
C.V. (%)	-	-	-	-	-	-	0.96	-	9.50	25.32	1.70	1.30	12.4	-

Note ...* The Values followed by the same letter are not significantly different at 5% level

* Yields are corrected to 14% moisture content

yield, though quite susceptible to rice blast. As the taste is widely accepted - being Japonica same as Giza 171- it may keep the position of leading variety if those two problems - lodging habit and blast susceptibility - can be eradicated or soothed.

Standing on this point of view, the plant height regulator called SERITARD has been introduced and tested in R.M.C. The result is shown in Table 1.

As a result, the height of the tested variety - Giza 172 - became significantly shorter, but was followed by yield decrease. It is not clear from this experiment whether this yield decrease was caused by the application time - 45 days before heading - or not.

Probenazole 8% Granular proved to be effective against leaf blast as well as to neck node blast (See table 1,2,3 and 4 in chapter I.2.(5)), though it is not available in the Egyptian market.

The use of Giza 172 for the mechanized cultivation system is not recommended at this moment, same as Giza 171.

IR 28

* Dwarf & non-lodging
* Medium-early maturity (137 days)
* High yielder (> 10t/ha)
* Resistant to blast

* Slender & transluscent grain
* High milling outturn & less breakage

This is one of the hit varieties of IRRI, Philippines, and promises a high yield in Egypt. This has not been broken down to the blast disease so far, with least fear for the lodging, being excellent variety for the mechanized cultivation system. Besides the superior characteristics of IR 28 it has one fatal disadvantage - awful taste - which does not stimulate farmers to widen the covering area of this variety.

Giza 175

* Dwarf, but tend to lodge
* Medium-early maturity (136 days)
* High yielder (>10t/ha)
* Resistant to stem borer
* Short & transluscent grain
* High milling outturn & less breakage
* Very good cooking quality

This is a new variety, bred and released by RRTC with the original line name - Gz 1394-10-1. This variety was used in several experiments in RMC in the first year and verified its high productivity. But, unfortunately, it lodged almost completely, which obliged us to eliminate this variety from the option for the mechanized cultivation system. The reputation and popularity with the farmers remains at a low level too.

Giza 181

* Dwarf & non-lodging
* Medium maturity (142 days)
* High yielder (>10t/ha)
* Resistant to blast
* Resistant to stem borer
* Long slender & transluscent grain
* High milling outturn & less breakage
* Excellent cooking quality

This variety used to be one of the testing lines in IRTP (International Rice Testing Program) of IRRI. Although it has all the necessary characteristics for the mechanized cultivation system with high yield potentiality, it has not been well fixed as a variety. In other words, the plants diversification is still taking place in the field, which may have been brought by the segregation phenomenon. The grain length, width and thickness have wide variation, and the grain tip varies from purple to non-color. The long duration from start to end of heading and maturity is also notable. They seem to be derived from poor purification works in the seed production process.

In spite of all these disadvantages, Giza 181 still keeps its position as the best variety for the mechanized cultivation system. Therefore, when this variety is used, seed should not be produced domesticaly (especially for the farmers level), and the land preparation must be done thoroughly so as to avoid soil heterogeneity which causes uneven maturity of this variety.

Gz 1368-5-4

* Semi dwarf & non-lodging
* Medium early maturity (137 days)
* High yielder (>9t/ha)
* Highly resistant to blast
* Resistant to stem borer
* Tolerant to soil salinity
* Medium bold & transluscent grains
* High milling outturn & least breakage
* Good cooking quality

This variety, being bred at RRTC, is resistant to salinity injuries. Not only in salt-affected areas but also on normal land this variety shows tolerable features without lodging, and can be recommended for the mechanized cultivation system.

The results of the varietal trials in the direct sowing method on dry field (1987) and in the mechanized transplanting method (1988) are shown in Tab.1,2.

Table 1 VARIETY TRIAL ON THE DIRECT SOWING CULTIVATION METHOD ON DRY FIELD (R M C 1988)

Variety	Sprout Ratio (%)	Days to		Plant Height (cm)	Panicle Length (cm)	Lodg (%)	No.of Panicles per m^2	No.of Spiklet per pan	Ripening Ratio (%)	1000 Grain weight (g)	Yield	
		Head.	Mat.								(t/ha)	(t/f)
Giza 175	33	105	142	70	20.8	0	453	124	88	22.4	4.69	(1.97)
Giza 181	46	101	138	74	21.1	0	323	112	92	26.5	4.69	(1.97)
G z 1368	33	99	136	79	20.0	0	374	134	94	24.7	5.50	(2.31)
I R 28	34	104	143	85	21.9	0	339	117	87	24.6	5.10	(2.14)
Average	36.5	102	140	77.0	21.0	0	372	121.8	90.3	24.6	5.00	(2.10)

Note ....* Yields are corrected to 14% moisture content

Table 2 Results of Variety Trial (1988, R M C)

Variety Name	Days to Head	Days to Mat.	Diseases BL (5)	Diseases NBL (9)	Diseases Bs (5)	Lodge (%)	Plant Height (cm)	Panicle Length (cm)	Panicle No. /m^2	No. Of Grains per panicle	percent of mat (%)	1000 Grain weight (g)	Yield (t/ha)	Yield (t/f)
Gz 2175	93	135	1	1	1	0	94	19	162	66	74	25.9	2.9	1.2
Giza 172	98	139	2	1	2	0	112	20	182	96	88	24.9	4.3	1.8
Giza 181	88	134	1	1	2	0	88	18	353	58	81	25.5	5.0	2.1
Giza 175	88	136	1	1	1	0	81	18	366	59	86	20.1	2.9	1.2
Gz 1368	85	127	1	1	1	0	98	22	248	97	90	23.8	5.7	2.4
IR 28	93	129	1	1	2	0	91	20	352	80	91	22.6	6.2	2.6
Shinrei	83	134	1	1	1	0	78	15	372	57	93	26.3	5.5	2.3
Nipponbare	81	131	1	1	1	0	91	21	206	63	88	26.8	3.8	1.6
Average	89	133	1.1	1	1.4	0	91.6	19.1	180	72	86.4	24.5	4.5	1.9

Note ...* Yields are corrected to 14% moisture content

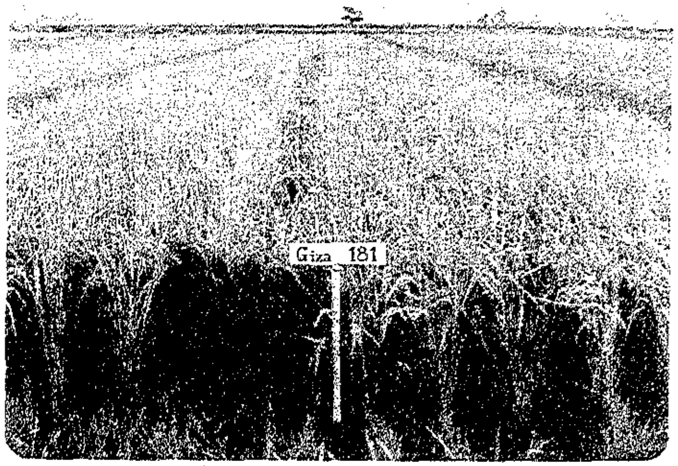
CONVENTIONAL EGYPTION VARIETIES

Picture I-2-1 Giza 171

Picture I-2-2 Giza 172

NEW EGYPTIAN VARIETIES

Picture I-2-3 Gz 1368, Recommended for salt affected regions



Picture I-2-4 Giza 181, Most promissing variety for mechanized cultivation system

(2) Improvement of Saline field conditions by the installationl of underground drainage.

1) It has been observed that the effects on the growth and yield of rice mechanically transplanted on saline or alkaline soil paddies produced by the installation of underground drainage is remarkable.

2) In this regards three different kinds of underground facilities were installed during 1986 in Block D field at RMC. Namely:

i) Corrugated pipe with rice husks (C+H)

ii) Husk only (H)

iii) Control [control] ..... (without drainage)

(see construction specification chart)

3) Brief results

Results of measurements showed the following :

i) Daily water consumption measured as the depth change of recessing level (WRD) was smallest in untreated plots (control) at 10mm/day. WRD was largest in (C+H) plots at 30mm/day; and medium in [H] plots at 20mm/day (Refer to Fig.1)

ii) In the case of two treatments with drainage facilities PH and EC measurements tended to decrease with the lapse of time after flooding (Refer to Fig.2). And also comparison of Phs and Ecs measured with water samples taken from the discharge ends of drainage pipes (or ducts), indicated higher values for C+H than H only ones. Incidentally, Ph and Ec for irrigation wate were 6.8 and 0.85 respectively.

This suggests the likelihood of effective leaching of saltstaking place as a result of improved water percolation from otherwise impervious soil by the installation of drainage devices (refer to Fig.3)

iii) Comparison of total yields clearly indicates the yield-increasing effect of drainage treatments. The yield of 4.35 ton/f was recorded for [C+H] which is 200% of control. The yield for [H] was 3.18 ton/f, 146% of control and 2.17 ton/feddan for untreated [control].

4) Summary

Measurements of physico chemical properties of soil and water, and analyses of rice growth characteristics have demonstrated that substantial yield increases were attained as a result of enhanced rice growth, which in turn was the consequence of improved soil properties due to effective leaching of saline fractions from the soil matrix through artificially installed infiltration and drainage facilities.

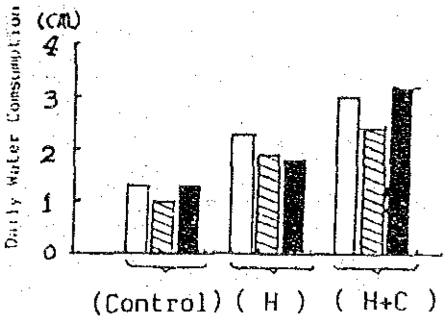


Fig. 1 Daily Water Comsumption

Notes; surveyed July22-24. Surveyed Aug. 1st Surveyrd Aug. 12

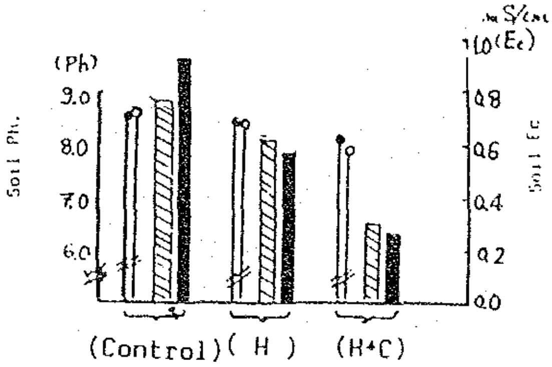


Fig. 2 Change of Ph & Ec of Soil.
(Soil layer 0 - 40

Notes: Ph before irrigation Ph after irrigation Ec before irrigation Ec afte: irrigat:

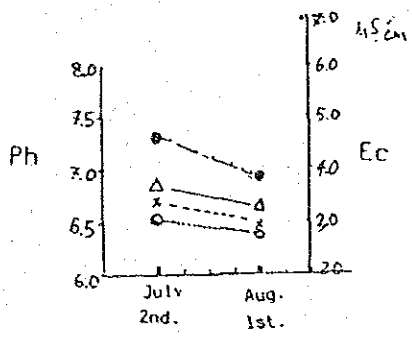
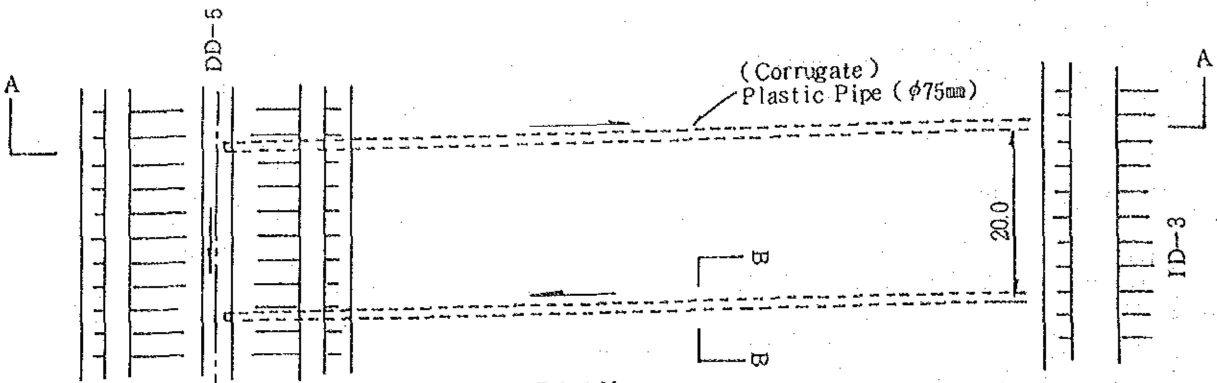


Fig. 3 Ph and Ec of Drainage Water

Notes: Ph in (H)Plot, Ph in (C+H)Plot. Ec in (H)Plot, Ec in (C+H)Plot.



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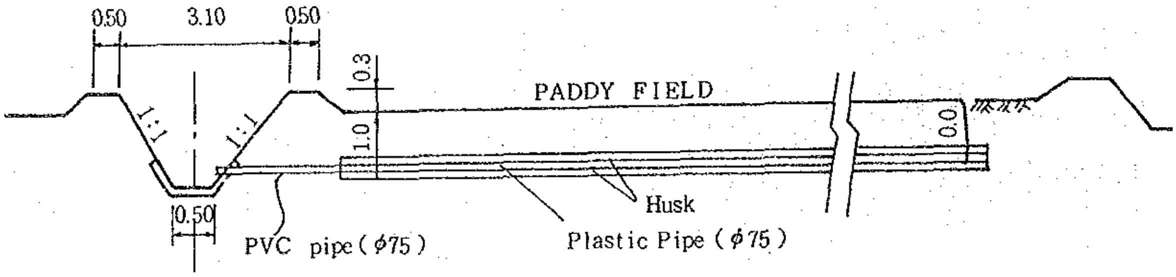
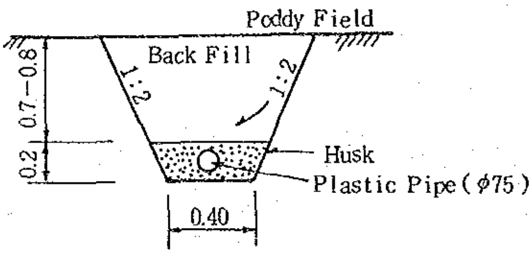


SECTION A-A



SECTION B-B

(3) Salt Injuries for Rice Plants

1) Introduction

It was clarified in the previous cooperation-term of JICA in RMPP that salt injuries for rice plants is one of the major impeding factors for the introduction of a mechanized rice cultivation system to wide salt-affected areas in the Nile Delta, and is one of the project items in the present second phase cooperation term started on 6th August 1986 (TSI). Salt injuries appear in each stage of rice plant life, affecting various aspects and finally decreasing rice production. It exists in all of the Nile Delta area in Egypt, concentrating in the lower delta near coastal regions. When we intend to mechanize transplanting, we use comparatively young seedlings for this process which are highly sensitive to the existence of salt; some plants are fatally damaged. Therefore, it is quite difficult to introduce the mechanized rice cultivation system in those areas without some effective countermeasures.

Saline soils can be defined in the next table according to Dr. P. Buringh, 1986.

Table 1 Classification of Saline, Alkali and Saline-Alkali Soils

Soil Type	ECe mmhos/cm (25^0C)	ESP (Exchangeable Sodium percentage)	PH
1. Saline	Over 4.0	$<$ 15%	$<$ 8.5
2. Saline-alkali	Over 4.0	$<$ 15%	$>$ 8.5
3. Non saline-alkali	Under 4.0	$>$ 15%	$>$ 8.5

According to the university of Arkansas, 1971, salt-affected soils are classified into three categories; Alkaline, Saline and Sodic soils.

Meanwhile, Dr. Bhumbla and I. P. Abrol suggest that salt-affected soils can be classified into only two categories: Saline soils and Sodic soils (Soils and Rice, IRRI, Saline and Sodic soils, P. 720-721).

We should like to refer to the latter in this report.

2) Salinity status in each Satellite Field

Soil and water salinity in each satellite field are shown in table 1. The table infers that there is more salt in the soil as well as in the irrigation water in Idfina and Serw which are near the Mediterranean Sea. However, this salt levels will not prevent normal rice growth as long as there is no excessive evaporation or stagnant water. On the other hand, it can be assumed that these salt levels can induce plant injuries by saline accumulation which occurs in bared spots up water or, contrarily, in deep and stagnant water spots (in the case of coarse levelling, or where water is not changed for a long time). Water logging for long periods may reduce the field soil by itself, but it seems to be accelerated by the existence of salt.

The fact that the salt level in drainage water is higher than that of irrigation water, as seen in table 1, implies that either the water is washing salt out from the fields, or that salt is accumulating by active evaporation, or the combination of those two factors.

Table 1 Soil and Water Salinity in each Satellite Field

Satellite Name	Soil (1				Water			
	PH		EC(mS/cm)		(Irrigation)		(Drainage)	
	I Layer	II Layer (2	I Layer	II Layer	PH	EC	PH	EC
Gimmeza	8.63	8.76	0.26	0.47	7.8 7.7	0.26 0.29	8.1 8.3	0.54 0.85
Misir	8.78	8.58	0.51	0.90	8.0	0.2	8.5	0.78
Idfina	8.59	8.78	1.02	1.27	7.7 7.4	0.5 1.8	8.4	2.6
Saft Khalid	8.78	8.83	0.39	0.66	7.8	0.3	8.3	1.4
Serw	8.29	8.51	2.00	1.98	7.3 8.1	1.6 1.8	8.2	2.7

(1 ....Dr. M. Morooka, Apr. 1987

(2 .... I Layer = 0 - 20cm

II Layer =20 - 40cm

While, our experiment show the severe damage to young seedlings in saline soil (Fig. 1)

3) Countermeasures for salt injuries

Countermeasures for salt injuries could be classified into four categories as followings ;

(a) Lowering soil salinity

(b) Enclosure of soil salinity

(c) Tolerating measures to soil salinity

(d) Others

The possible and practical methods of each category are to be given below.

a. Lowering soil salinity

(i) In the off-season

Re-arrangement of the field drainage system by excavating and cleaning drainage canals may lower the level of underground water and promote quicker drainage from the field. An underground drainage system may be more preferable (see previous section). Washing salt out of the field positively by means of irrigation and drainage in the off-season (which won't affect the winter crop) may be helpful. Cultivation of some forrage (e.g. *Echinochloa stagmiema*) can be recommended because frequent irrigations for this forrage may bring down the level of field salinity.

In Sodic soil with an abundance of ESP the application of gypsum is effective, since sodium could be changed to soluble sodium sulphate which can be precipitated and easily leached out from the field by successive irrigation.

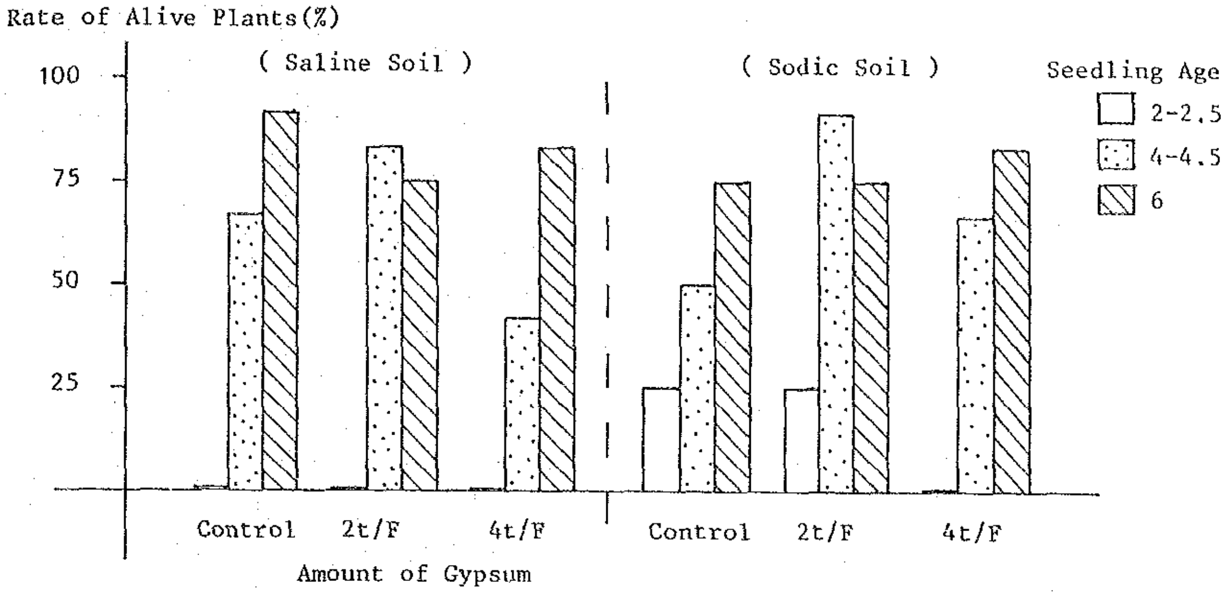


Fig.1 Survival Ratio of Seedling (Soil Salinity Exp. No. 1,) RMC, 1987

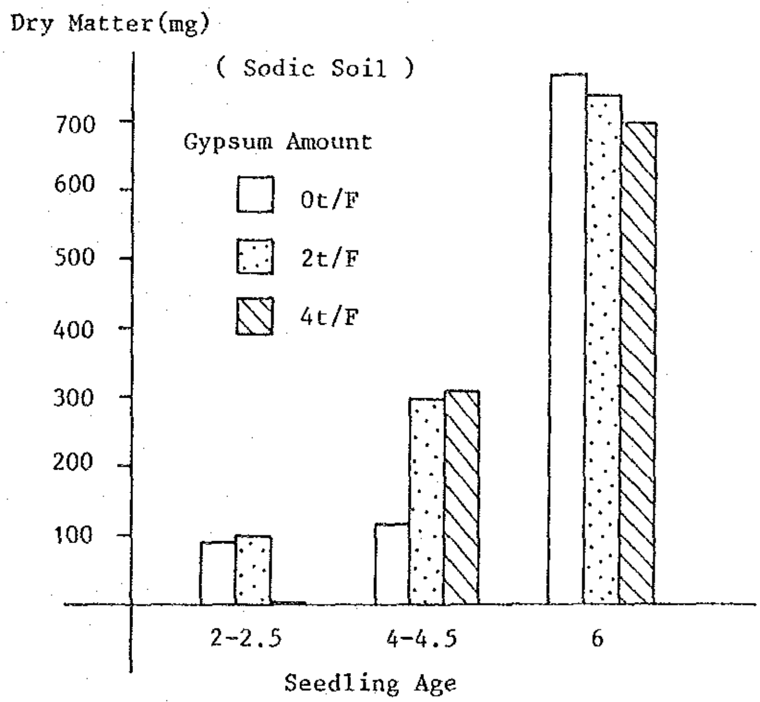
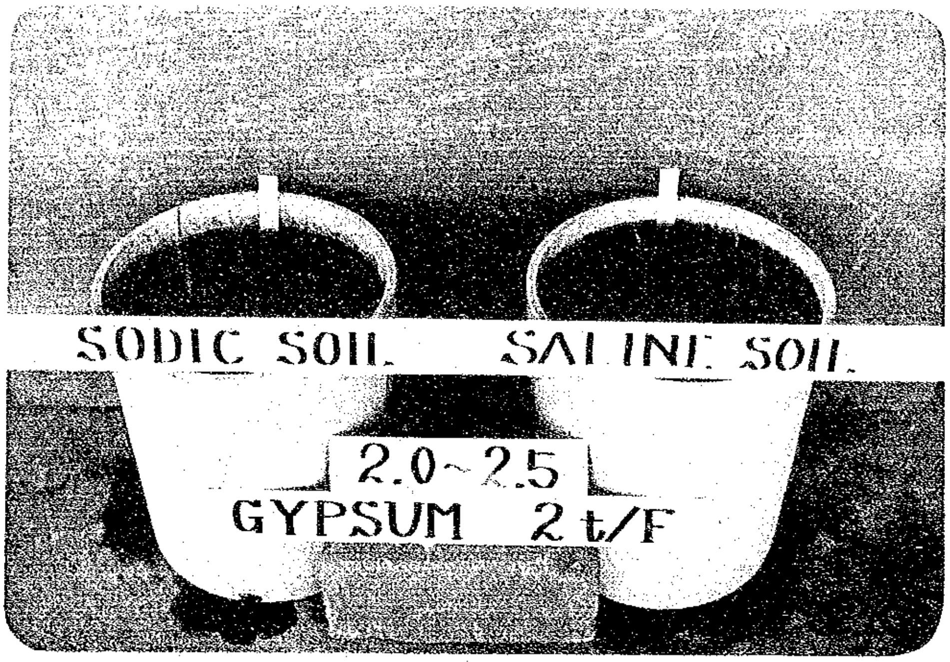
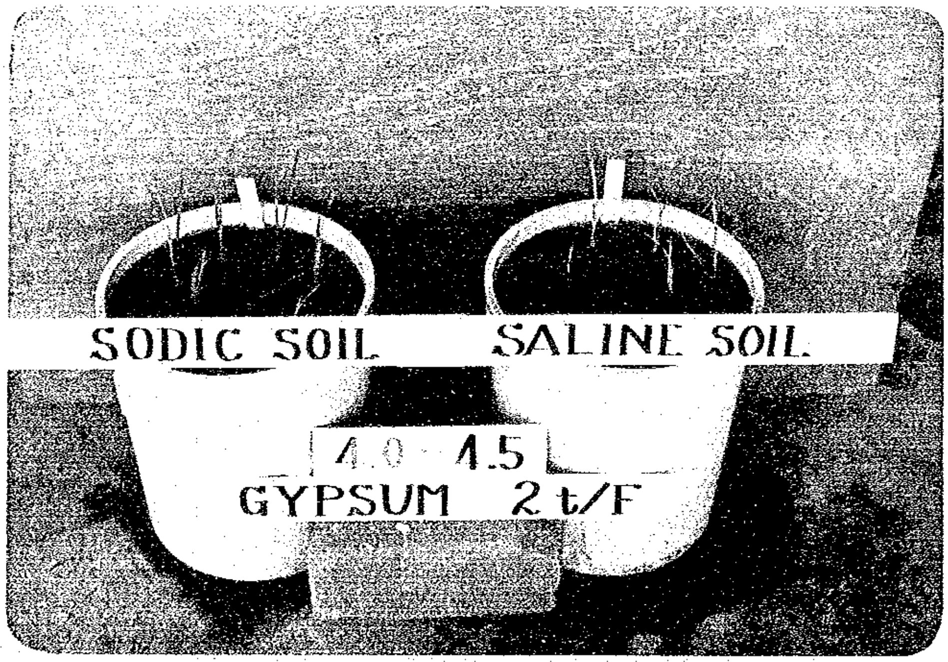


Fig.2 Dry Matter of Plant one month after transplanting (Soil Salinity Exp. No. 2), RMC, 1987



Picture I-4-1 Young seedings response to sodic and saline soils



Picture I-4-2 Intermediate seedings response to sodic and saline soils

(ii) During cultivation

Water must be changed as frequently as possible during the main cultivation season. Since nutrient absorption is disturbed, additional fertilizer may be needed.

b. Enclosure of soil salinity

Even though the salinity level is not high enough to wither plants, salt injuries tend to appear in both high places and low places which are frequently found in unevenly graded (levelled) paddies. Careful land leveling can solve this problem most of the time.

Salt damages roots in all stages of rice life, and it causes the secondary problem of nutritional disorders. The reason why there are many brown spot diseases (often caused by oxygen deficiency) in salt-affected areas can be explained by these nutritional disorders. Accordingly, some soil improvement methods should be employed in order to diminish oxygen reduction in the soil indirectly caused by salinity.

c. Tolerating measures to soil salinity

Salinity-tolerance differs according to varieties, and one variety (Gz 1368) is found to show a high tolerance to salt. This variety is to be recommended for salt-affected area.

In a mechanized transplanting system young and small seedlings with three leaves are used. As pointed out in a previous chapter, a rice plant in this stage is very sensitive to salt and comparatively bigger seedlings were studied for this mechanized transplanting system. These so called "intermediate" seedlings with 4 to 5 leaves have been observed to have more salinity-tolerance (discussed in the next section).

Besides, there is a report (Iwaki report) which says that a higher application of nitrogen can raise the "saline-critical-concentration-point" for plant growth and minimize salt injuries. Another hypothesis is that more doses of potassium fertilizer may minimize the occurence of brown spot disease. This fact has been confirmed in satellite field as is shown in Fig. 1 and Tab. 1.

d. Others

It would be better to use good irrigation water with less salt. Municipal drainage water should be used as little as possible for irrigation. Field drainage water must not be used again; in other words, water which has irrigated one plot should not be re-used to irrigate other plots.

Table 1 Experiment on Fertilizer Application in the Salt-affected Soil - 1988, Serw S. F.

Treatment	Days to		Diseases			Lodge (%)	Plant Height (cm)	Panicle Length (cm)	No. of Spikelets /Panicle	No. Of Panicle $/m^2$	Ripen. Ratio (%)	1000 Grain weight (g)	Yield	
Name	Head	Mat.	BL (5)	NBL (9)	Bs (5)								(t/ha)	(t/f)
1.Control	102	137	1	1	1	0	100	22.1	118 a	451 b	83.1 a	22.3 a	7.92 b	3.33
2. 1 N	101	136	1	1	1	0	102	23.3	126 a	521 a	76.9 b	22.0 ab	8.54 ab	3.59
3. 2 N	101	137	1	1	1	0	101	22.4	127 a	490 ab	81.6 ab	21.3 bc	8.70 ab	3.65
4. 1N+2K	102	137	1	1	1	0	102	22.4	127 a	536 a	80.7 ab	21.0 c	9.22 a	3.87
Average	102	137	1	1	1	0	101	22.6	124.3	500	80.6	21.7	8.59	--
C.V.(%)	-	-	-	-	-	-	-	-	7.26	5.86	3.66	1.77	7.14	--

Note ...* Values followed by the same letter are not significantly different at the 5% level

* Yields are corrected to 14% moisture content

* Treatment ... Control ; N = 50 kg/ha , P_2O_5 = 80 kg/ha and K_2O = 40kg/ha
1N ; N = 100 kg/ha , P_2O_5 = 80 kg/ha and K_2O = 40kg/ha
2N ; N = 200 kg/ha , P_2O_5 = 80 kg/ha and K_2O = 40kg/ha
1N+2K ; N = 100 kg/ha , P_2O_5 = 80 kg/ha and K_2O = 80kg/ha

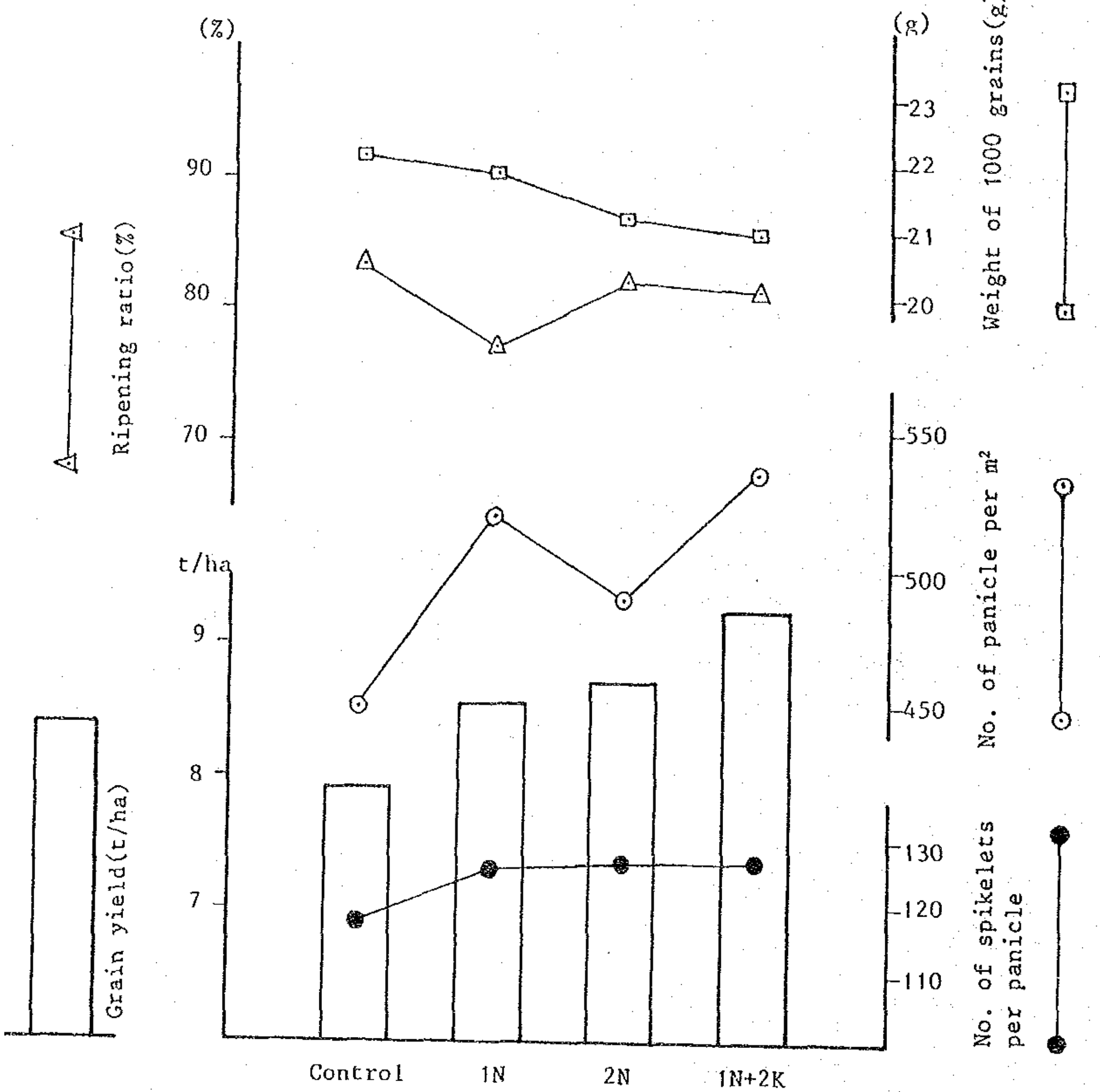


Fig. 1 Experiment on Fertilizer Application in the Salt-affected Soil -- 1988, Serw Satellite Field

(4) Intermediate Seedlings

1) Introduction

After establishing the mechanized rice transplanting system by using young seedlings in RMC, the necessity of studying the system with intermediate-age seedlings (int. seedling, hereinafter) was pointed out by next reasons; viz. a) Transplanted young seedlings, which are short in height, will be submerged in deep places of the paddy where the land levelling is coarse. b) Young seedlings with 2.0 to 2.5 leaf-age are in their most sensitive stage to soil salinity. c) The duration of appropriate transplanting time for young seedlings is too short that operational schedule become comparatively tight.

On the other hand, there are several disadvantages when using int. seedlings in the system compared with young seedlings: mainly, the operation to prepare the seedlings. Accordingly, the aim of this section is to clarify what are int. seedlings, the points to raise int. seedlings, the advantages and disadvantages of them, and finally, to discuss the feasibility and utilization of the system with int. seedlings in the Nile Delta area.

2) Features of Intermediate Seedlings

a. What are intermediate seedlings ?

We should remember the concept of young seedlings and matured seedlings again before defining int. seedlings. The concept of matured seedlings differs from region to region. It is about 4 to 5 leaf-age (excluding incomplete leaf, hereinafter) in colder regions, and 5.5 to 6.5 leaf-age in warmer regions in Japan. 6 to 7 leaf-age seedlings (matured ones) are to be used conventionally in Egypt. RRTC is promoting the use of younger seedlings (25 to 35 days old) which may coincide roughly with the ones in the warmer regions in Japan.

Young seedlings are defined as being of 2.2 leaf-age in Japan, and 2.0 to 2.5 leaf-age in RMC, Egypt. These young seedlings have been devised exclusively for mechanized transplantation in Japan only about 20 years ago. Another type of young seedlings are commonly used in the Philippines, which is called "Dapag".

Int. seedlings are also thought out for mechanized transplantation, using the same size of seedling tray as that used for young seedlings. Int. seedlings signify intermediate ones between young seedlings and matured seedlings, being 3.0 to 5.0 in leaf-age, or more often 3.5 to 4.5. Seed amount per tray ranges from 100g to 150g, comparatively wider than young seedlings of 200g. There are other ways to raise int. seedlings in paper pots or in the special tray to raise broadcastable seedlings.

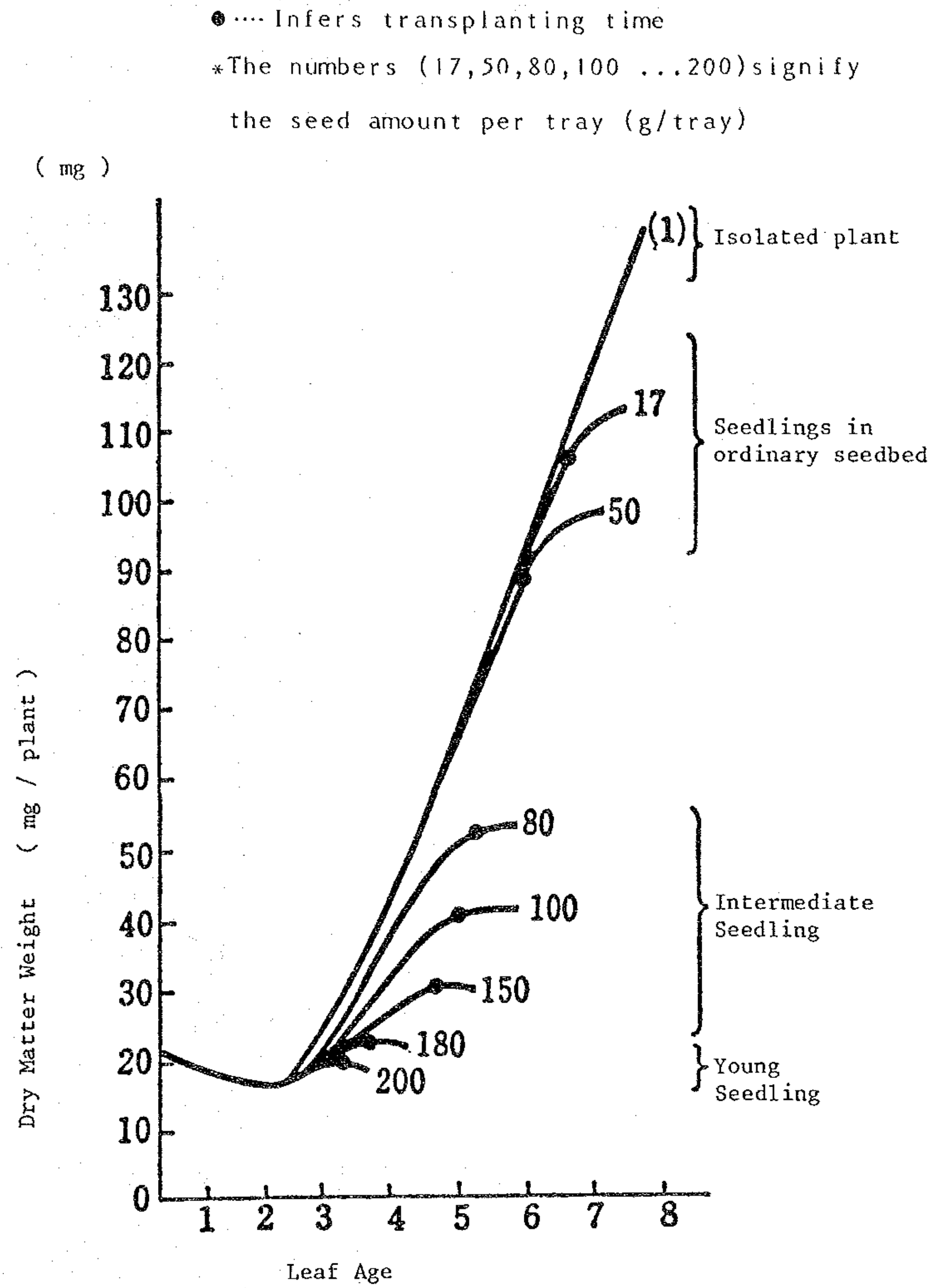


Fig.1 Transitory Relationship between Seed Amount per Tray and Dry Matter Weight of seedling

Fig.2 Ideal Seedlings of the young and intermediate seedlings

b. Physiological differences with young seedlings

Fig. 1 shows the fluctuations of leaf ageing (or age limit) and the increase of plant dry matter weight (or limit) brought about by the different seed amount per tray (K,Hoshikawa). This figure infers that the more the seed amount, the less dry weight the plant reaches. Compared to the isolated plant at the moment of transplant, int. seedlings are more degenerated than young seedlings. It can be said that maximum leaf-age and dry matter weight that the plant can reach are decided by the seed amount per tray. It is said that fertilization in the tray should be applied little by little in order to obtain ideal int. seedlings by avoiding over growths of under foliages from an early stage.

The morphological differences of int. seedlings with young seedlings are as follows:

(a). Seedling height is about 13 cm in young seedlings, while 17-18 cm in int. seedlings.

(b). Incomplete and first leaves of int. seedlings are shorter in length, but wider, than the ones of young seedlings.

(c). The upper leaves are longer toward the third or fourth leaves, and darkest in color in the fourth leaves.

(d). Crown roots come out from the first node, and seminal roots are still alive with brown color. The tip of branched roots are active and white.

(e). The plant base is thicker than the one of young seedlings.

(f). The fluctuations of plant height and age in individual plants are bigger than the ones of young seedlings.

c. Several points for raising int. seedlings

The method of raising int. seedlings is fundamentally the same as the one for young seedlings. The different points are as follows;

(a) Seed amount per tray is 100-150g

(b) Fertilization in tray as well as in seedbed

(c) Longer period in seed bed

In case of young seedlings it becomes suitable to be transplanted before they are strongly influenced by seedbed fertility. When fertile soil is used as bed soil in the tray tolerable yield can be expected even without fertilization in seedbed (usually it is given 2 days before transplanting). That is to say, they depend for their nutrients on the seed endosperm, which is gradually consumed until around 2.8 leaf stage, so that there remains endosperm in seed at transplanting time with 2.0-2.5 leaf stage. To be more precise, photosynthesis starts after the emergence of the first leaf, dry matter increases sharply and plants start absorbing soil nutrients after around 1.5 leaf stage. This stage is the so-called weaning period.

On the other hand, since the target leaf age of int. seedlings is around 3.5-4.5, the fertility of bed soil extremely influences the quality of the seedlings. In spite of less seed amount to young seedlings with 100-150g/tray, it remains the same that seedlings are excessively dense in the tray and they compete with each other for nutrients in the soil as well as for sun light at above the soil surface. This is the reason why top dressing is required even for fertile bed soil. Furthermore, the amount of their roots that pass through the holes of the tray to the seedbed increase tremendously, making seedbed fertility influential. As a conclusion, fertilization in the bed soil of the tray as well as seedbed are essential in order to obtain ideal int. seedlings.

So far, it has been recommended to apply 2g(in ingredient) of N, P_2O_5 and K_2O each to one seedling tray and $10g/m^2$ each for the seedbed, though, split application is needed for nitrogen in the tray. Further study is important to decide the best fertilization method for them.

Although seed amounts depend on the target leaf age at the time of transplanting, uniform sowing is quite necessary since the density becomes thinner than that of young seedlings. When the target leaf age is 4.5, 100g/tray will be suitable, and 150g/tray, when it is 3.5 leaf age.

The period for raising int. seedlings will be extended around 7 to 10 days more than that of young seedlings.

d. Some technical points for transplanting int. seedlings

(a) Plant density

The vegetative stage of int. seedlings after transplanting is shorter than the one of young seedlings. However, the durations of productive tillering stage are almost the same, as are the other stages, because tillerings start when leaf age is around four to five, which coincides with transplanting time of int. seedlings (actually, the plants from int. seedlings have 2-3 leaves more than the ones from young seedlings and in many cases, the growing period of int. seedlings, from sowing to maturity, is longer than that of young seedlings.

Tab.1, which is the result of the experiment on plant density of int. seedlings-RMC- 1987, shows clearly the tendency of increasing yield according to the increase of the density.

(b) Number of plants per hill

In order to transplant the maximum number of seedlings per unit area (which is 5-6 seedlings per hill), without increasing seed amount per tray, the transplanter should be adjusted to transplant shortest among the row and the planting finger of it should be adjusted to get maximum seedling-mat-area. 12cm is minimum distance for inter-plants to which the transplanter can be adjusted, and moreover, more plant density may induce disease occurrences or lodging. All in all, this distance can be considered as the minimum that we could reach. The other way to transplant a higher number of plants per unit area is to maximize the seedling-mat-area which one planting finger of the transplanter tears off.

(c) Management of paddy field

Fundamentally, there is no big difference in the management of a paddy field with young seedlings. However, more care is to be taken in case of int. seedlings so that the panicle number can be maximized.

3) Land where Intermediate Seedlings take advantage

a. Paddy field with coarse levelling or big inclination

From the viewpoint of field condition, int. seedlings are more advantageous than young ones in a coarser leveled plot. In other words, if int. seedlings are used the land need not be leveled so deliberately as it must be in the case of young seedlings. The reason is clear. Because taller int. seedlings are not submerged as much as shorter young seedlings in fields where the range of water depth is big. Especially when we make a bigger size paddy field to increase machinery efficiency we are obliged to make an incline from water inlet to water exit. Eventually, taller int. seedlings become more advantageous.

b. Land with high salinity

It was verified in the pot experiment conducted in 1987 that young seedlings are more sensitive to soil salinity than int. seedlings. We have included the series of studies on int. seedlings in the Tentative Schedule of Implementation of this project term because we anticipated the potential of int. seedlings to salinity tolerance. "Salt Injuries for Rice Plants, Sept.1988, RMPP" was submitted to clarify the mechanism, the reason of salinity damage, countermeasures for it, and etc.

In this report the importance of establishing countermeasures to soil salinity has been dealt with in the previous section.

The seedling of 2-3 leaf age is most sensitive to salt injuries, and the severity diminishes by the advance of leaf age. This is the very reason why int. seedlings are advantageous in high salinity places.

4) Disadvantages of Intermediate Seedlings

a. Higher costs for materials is needed

60 to 70 % more seedling trays are necessary than for young seedlings, therefore concerned materials such as seedling trays, bed soil, fertilizer, chemicals and etc, must be increased.

b. Increase of seedbed area

To put it simply: the place to raise the seedlings must also be increased 60 to 70 %. If the seedbed area increases, irrigation water must also be increased accordingly.

c. Longer period in seedbed

15 to 30 days, according to the air temperature or sowing date, is required to raise young seedlings with 2.0 to 2.5 leaf age. While, int. seedlings take 20 to 45 days to have 3.5 to 4.5 leaves. Consequently, the circumstances of rhizosphere - especially soil fertility - becomes highly influential which makes high intensive care, such as top-dressing, necessary.

d. More labor is required

The operations such as bed soil preparation, seedling tray preparation, sowing, seedbed management and etc. require more labor.

e. Increase of probability of missing hills

For less seed amount per tray, more uniform sowing is the must, or else it becomes one of the reasons for missing hills.

5) Consideration

It was for the countermeasure of soil salinity that the necessity to study int. seedlings has been pointed out. To be more precise, we anticipated that the sensitivity of young seedlings to soil salinity would be a bottleneck when we would eventually introduce the mechanized rice transplanting system to salt-affected regions. As was our anticipation the experiment showed the superiority of int. seedlings to young ones in mortality rate after transplanting, dry weight increase and etc. in saline soil.

On the other hand, the inherent disadvantages of int. seedlings are not less, as was discussed previously. Especially, int. seedlings are disadvantageous to young ones in the cost of raising seedlings, laborious operation and difficulties in elaborating ideal seedlings. Considering all of these factors, the future work must be focused on the definition of the areas or farmers for which this int. seedling system can be recommended.

As long as we comprehend entirely both the advantages and the disadvantages of int. seedlings, we should not miss the right way.

Table 1 YIELD TABLE (DENSITY & FERTILIZER EXP. WITH INTERMEDIATE SEEDLING) R M P, 1987

Treatment I /1	Treatment II /2				Average /3		
	60 Kg	90 Kg	120 Kg	150 Kg	t/ha	(t/f)	
30 x 12 cm	10.2	9.92	10.07	9.91	9.98	(4.19)	a
30 x 14cm	9.34	9.30	9.35	9.53	9.43	(3.96)	a
30 x 16cm	8.80	9.69	9.12	8.99	9.15	(3.84)	a
Average	9.39 a	9.71 a	9.51 a	9.48 a	9.52	(4.00)	

Note........ /1 Planting Density

/2 Nitrogen Amount per ha.

/3 Values with same letter are not significantly different at the 5% level

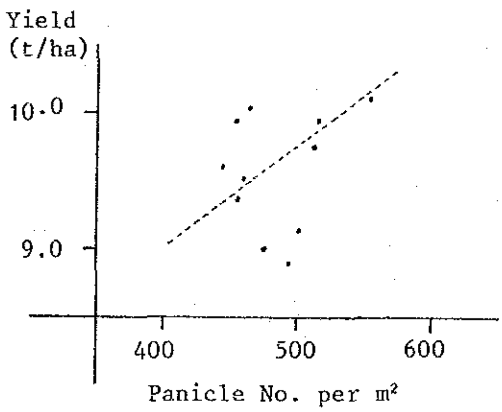


Fig.1 Panicle Number per m² and Yield - Intermediate Seedling Exp.
- RMC, 1987

(5) Rice Blast Disease

1) Mechanization and rice blast

The outbreak of rice blast disease in the Nile Delta in 1984 alerted all the concerned persons to presumable dreadful diffusion of this disease in the future. Several measures for it were taken into effect quickly. Among them was the prohibition of Reiho (Giza 173) variety to use, since it was a most pityful victim of the disease.

A misfortune was, however, for the mechanized rice cultivation system. Because this system used to go with the variety - Reiho - in many cases.

Eventually, the mechanized rice cultivation system, not Reiho, was accused for the indirect cause of rice blast disease by many scientists as well as farmers.

This prejudice to the mechanized rice cultivation system was enough for the farmers to distance themselves from this system.

Amid the context, the study of rice blast was picked up as one of the investigation items in the Rice Mechanization Center.

2) Race distribution of rice blast fungus, _Pyricularia oryzae_ in the Nile Delta

A study on pathogenic races of the disease in the Nile Delta was carried out by O. Horino et al. - short term expert from JICA to the project - in 1987. According to the report, it was found that blast fungus races virulent to each Japanese differential variety, except Toride 1 (Pi-z^t) and BL- 1 (Pi-b), are commonly distributed in the Nile Delta. Consequently, the introduction of Pi-z^t or Pi-b varieties into Egyptian varieties and the introduction of these 2 genes to Egyptian rices by breeding works are quite useful and generally recommended in order to control rice blast in future by the use of vertical resistance of rice. The report concludes that horizontal resistance should also be considered in any genetic and pathological approach, since horizontal resistance may reduce damage from the break down of vertical resistance.

The result of the investigation is shown in Table 3 .

3) Control measures

A preliminary experiment was carried on to see the effects of several chemicals in 1987. Among the tested chemicals three new chemicals, such as Isoprothiolane 12% (Fuji 1), Probenazole 8% (Oryzemate) and Futhalide 2.5% + Neo-asozin 0.4% (Rabcide Neo-aso) , were included with the domestic three chemicals, such as Tricyclazole 20% (Beam), EDDP 30% (Hinosan) and IBP 17% (Kitazin).

All chemicals used had an obvious effect on leaf blast, as is seen in Tab. 4, while no clear effect was observed against panicle blast except with probenazole 8% and Tricylazole 20%.

In the following season -1988-, two prominent chemicals (probenazole 8% and tricyclazole 20%) were compared in a further experiment. And here again, those two chemicals did not disappoint our expectation. Clear effects were observed against neck blast in the treatment with these two chemicals (see Tab. 1).

All in all, as long as a user doesn't miscalculate the timing and the dose of these two chemicals (Probenazole 8% and Tricyclazole 20%), rice blast can be checked efficiently. Moreover, the varieties that the mechanized rice cultivation system favor are still tolerant to this disease, and do not require any special measure so far.

Table 1 The Results of Blast Occurences and Plant Toxicity-Chemical Experiment on Rice Blast-R M C, 1988

No.	Treatments: Application at Seedling tray	Leaf blast	Neck blast	Plant toxicity 2 weeks after transplanting /_1	Leaf Blast at 2nd, Aug. No. of lesion/ NO. of plant	Neck Blast 3 weeks after heading /_2
1.	Probenazole	----	Probenazole	1.30 a	0 / 638	2.5 b
2.	Probenazole	----	Trycyclazole	1.28 a	0 / 695	5.2 b
3.	----	Probenazole	----	1.35 a	0 / 612	3.5 b
4.	----	Trycyclazole	Trycyclazole	1.25 a	0 / 668	4.0 b
5.	Control			1.18 a	3 / 599	16.5 a
	Average			1.27	---	6.4
	C . V .			15.03	---	59.77

Note .... /_1 .... Score is 1 (no planting injuty) to 5 (severrly injured)

/_2 .... No. of lesions per $10m^2$

/_3 .... Values followed by the same letter are not significantly different at the 5% level.

Table 2. The Yield and The Yield Components - Chemical Control Experiment on Rice Blast - R M C, 1988

Treatment	Days to		Lodg	Plant Height	Panicle length	Nos. of panicle	Nos. of sp./panicle	Ripening ratio	1000 grain	yield /_2	
/_1	Head	Mat.	(%)	(cm)	(cm)	/m2		(%)	weight (g)	t/ha	t/f
(1)	108	150	37 a	124 ab	23.9 a	324 ab	141 a	90 b	26.5 a	7.2 a	3.0
(2)	108	150	65 a	122 b	24.5 a	328 ab	129 a	91 ab	27.1 a	8.3 a	3.5
(3)	107	150	36 a	121 b	23.8 a	292 b	123 a	94 a	26.3 a	7.5 a	3.2
(4)	108	150	38 a	125 a	23.6 a	317 ab	137 a	89 b	26.8 a	7.8 a	3.3
(5)	108	150	43 a	122 b	23.9 a	351 a	126 a	91 ab	26.9 a	7.8 a	3.3
Aveage	108	150	44	123	24	322	131	91	26.7	7.7	3.2
C.V. (%)	-	-	40.3	1.4	2.6	8.19	13.0	7.8	5.3	22.66	3.2

Note ..... /_1 = Refer to Table 1

/_2 = Grain yield adjusted 14% moisture content.

/_3 = Values followed by the same letter are not significantly different at the 5% level.

Table 3 Pathogenic races of blast fungus, Pyricularia oryzae identified in Egypt, in 1987

Governorate	Number of isolate	Pathogenic races								
		001	003	007	017	077	103	107	177	203
Kafr EL Sheikh	9	4*				1		2		2
Dakhalia	21	3	1	1	1	1	5	4	3	2
Gharbia	9			3	1			2	2	1
Beheira	3				1				1	1
Total	42	7	1	4	3	2	5	8	6	6

* Figure in the table shows the number of each isolate identified in each Governorate.

* Dr. O. Horino et al.

Table 4 Protective effect of the some chemicals against rice blast in the paddy field*
(R M C, 1987)

Treatment	Block	Number of Leaf blast	Number of Neck blast	Degree of damage by panicle blast**
1. Control	1	18	30	50.5
	2	18	43	61.1
	3	12	59	77.2
	Average	16.0 a	44.0 a	62.9 ab
2. Tricyclazole 20% W.P. 1000 T	1	5	26	35.3
	2	4	47	59.2
	3	4	27	38.5
	Average	4.3 bc	33.3 ab	43.3 bc
3. Isoprothiolane 12% Granule 3 kg/10a	1	1	41	66.7
	2	16	30	65.0
	3	3	21	49.2
	Average	7.3 bc	31.7 ab	57.0 ab
4. EDDP 30% E.C., 1000 T	1	6	45	63.7
	2	11	29	46.9
	3	10	32	46.7
	Average	9.0 b	35.3 ab	52.4 ab
5. IBP 17% Granule 3 kg/10a	1	8	41	74.2
	2	8	43	73.4
	3	6	32	53.5
	Average	7.3 bc	38.7 ab	67.0 a
6. Futhalide 2.5% + Neo-asozin 0.4% Powder DL 3 kg/10a	1	2	52	70.3
	2	3	38	51.0
	3	1	59	68.5
	Average	2.0 c	49.7 a	63.9 ab
7. Probenazole 8% Granule 3 kg/10a	1	4	16	20.9
	2	5	17	29.1
	3	6	26	34.4
	Average	5.[illegible] bc	19.7 b	28.1 c
Total average		7.2	36.0	54.1
CV		40.06%	29.35%	21.08%

* Degree of damage by panicle blast was calculated the total damage of neck blast and rachis blast
** The figure indicates the number of leaf blast lesion and neck blast per 10 hills, respectively

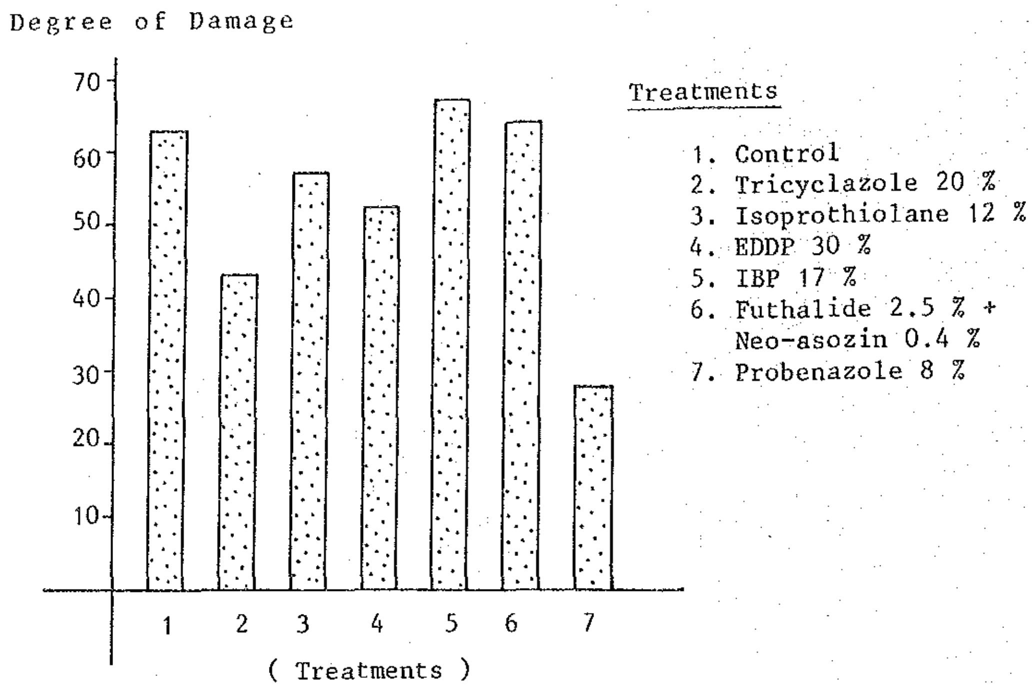


Fig.1 Difference of Chemical Effects against Neck Blast -RMC,1987-

* Degree of damage is the total figure of neck blast and rachis branch blast lesions per 10 plants.

(6) High yielding technic through the mechanized rice cultivation system

1) Accomplishment in the previous phase

One of the main targets and the accomplishments of the previous project term up to Aug. 1986, was the establishment of a stable and high yielding technique through the mechanized rice cultivation system. Especially, agronomy groups have concentrated on the method of raising seedlings in seedling trays, the number of seedlings per hill, planting density and etc. because the transplanting operation depended on a mechanical means - the transplanter. Rational water management, rational fertilization, and etc. were also studied for the early growth period (up to 43 days before heading), the middle growth period (43 to 20 days before heading) and the late growth period (after then).

As a result, the mechanized rice cultivation system was verified as a high yielding (and also economical) cultivation method, and was systematized. This system is quite significant and the post-experiments have confirmed its practicability.

However, it may need minimum modification in such cases as: when new varieties are released, sudden occurrences of pests or diseases, increase of soil salt concentration, etc.

2) Potential productivity

On the other hand, the maximum yield potentiality in the Nile Delta is quite interesting since the climatic limiting factor seems not to exist, producing no natural hazard at all.

With ideal temperature fluctuation, there is abundant solar energy, as much as 700 cal/cm^2/day in June and July when rice needs it most. Limiting factor of yield rarely exists in soil condition if ideal cultivation practice is materialized. In conclusion it can be said that cultivation practices are culprits for low yield in most cases. 5.5t/f (13t/ha) has been marked in the Yield Maximization Experiment in 1987, and the limiting factor in this case seems to have been the soil fertility. The location of RMC has been chosen for the infertility of the land. So, higher yield could be obtained in other areas if with ideal cultivation practices are followed.

From the view point of soil chemistry, there exist comparatively low organic matter(being 1.50 to 2.50 %) and low total nitrogen (being 900 - 1500 ppm): (Highlights of Recent Rice Research in Egypt, 1987, Rice Research and Training Center). Further, as was discussed in the previous section, the coastal Nile Delta is affected, more or less by salt.

In sum, soil is the limiting factor under satisfactory cultivation practices in the Nile Delta so far, and still it can be improved by manure application or crop rotation systems.

3) Feasibility of the direct sowing method

Even the direct sowing method proved to be of high productivity, up to 5t/f , in the experiments in 1987 and 1989. No new and special technique was applied through the experiments.

4) The reasons of low yield in the mechanized cultivation method

All things mentioned above indicate high yield through the mechanized cultivation method. Yet , not all plots in RMC nor in the five satellite fields can achieve 5.5t/f - expected potential yield. Why ? The presumable reasons are as follows :

< Transplanting method >

i). Missing hills (the reasons for missing hills are : a. coarse land preparation, b. rough transplanting, c. no adjustment of the transplanter, d. bad seedlings, etc.)

ii). Weeds (the main cause of abundant weeds are : a. missing hills , b. late application of herbicides, etc.)

Consequently, the deliberate operation (land preparation, raising seedling, transplanting, water management, etc,) to eliminate MISSING HILLS will guarantee the achievement of the target.

< Direct sowing >

i). Uneven seedling stand (the reasons are: a. unequal sowing b. coarse leveling or puddling).

ii). Inadequate water management.

iii). Weeds (this is accelerated by the reasons a. and b. : early hand weeding is also effective).

5) Conclusion

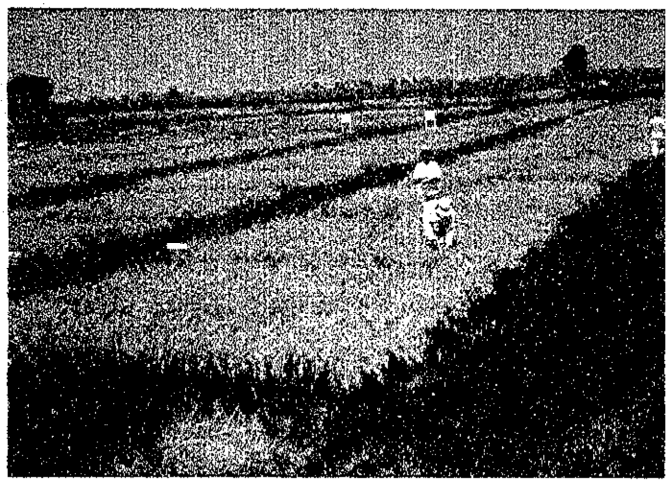
All in all, the knack of high yield (4 - 5t/f) through mechanization can be said to be a continous enthusiasm to maintain deliberate operation. As long as one is following the system respectfully, high yield can be obtained naturally (except in salt-affected areas which require special treatments).

EXPERIMENTAL ACTIVITIES IN RMC

Picture I-3-1 Scene of experimental field

Picture I-3-2 Scene of experimental field

EXPERIMENTAL ACTIVITIES IN RMC



Picture I-3-3 Sample harvesting for yield

Picture I-3-4 Sample threshing for yield

II Economic Study on Mechanized Rice Farming

1. Mechanized Transplanting Rice Farming

According to the study on the requirements for extending mechanized rice farming in the Arab Republic of Egypt which was done by Mr. Kawakami Japanese expert et al (1987), profitability of the mechanized rice transplanting farming system is higher than that of any other rice farming system when there exists a yield increase effect.

It is not affected substantially by increase of wage rates or rental fees of machinery within actual range. But if yield increase effect does not exist, the profitability of the mechanized rice farming is almost the same as that of the manual transplanting method under current conditions.

It is computed that the marginal level of yield to keep the profitability of mechanized transplanting rice farming at an acceptable level is 2.98 tons, that is, about 3.0 tons per feddan.

The first economic requirement for the general adaption of the technology is that, under current conditions, the mechanized transplanting rice farming system must give a yield over 3.0 tons per feddan constantly. And, secondly, the rental fees of the transplanter should not exceed 25 L.E. per feddan (see Fig.1). Also, the rental fees of the rice combine harvester should not exceed 70 L.E. per feddan (see Fig.2).

2. Mechanized Direct Sowing Rice Farming

In order to clear the economic effect of the mechanized direct sowing rice cultivation system, the farming survey and production cost comparison of rice cultivation system was done by Mr. Umemoto et al (1990).

On the farming survey, the current situation of agricultural labor land utilization, water conditions, machine and animal holding, rice cultivation methods were grasped. Its conclusion can be summarized as follows.

① Most farmholds have 2.7 members of family labour in a family. But since the operations in spring (sowing, transplanting) and in autumn (harvesting, threshing, separating) require more labor than the family alone, it is necessary to hire casual labor.

② According to the survey data of monthly labor hours (per feddan) of main crops (rice, cotton, brseem, maize, wheat), there are steep labor peaks in June, September and October. The reason for this is the seasonal concentration of labor- intensive operations like spotting and transplanting rice, hand control of cotton worm, harvesting and threshing seed of berseem, harvesting and threshing wheat (June), harvesting and threshing rice and picking cotton (September, October).

③ Therefore, the development of labor-saving cultivation systems in labor peak seasons will result in the evenness of labor utilization in the whole of farming.

④ From the survey of crop rotation in each farm field, two basic crop rotation patterns are noticed. One is the two year cycle pattern (cotton or maize-berseem-rice-berseem), and the other is the three year cycle (rice-berseem-maize-berseem-cotton-wheat-rice).

⑤ Considering the possibilities for other crops to be cultivated in the same field just prior to the rice cultivation season it should be pointed out that berseem is preferable if the "direct-sowing" method is used for the rice, and if the wheat is former crop, the "transplanting method" is desirable from the view point of maturity season of rice.

The reason for this is that "direct-sowing" of rice must be done one month earlier than "transplanting"; therefore the previous crop must have been harvested one month earlier if direct-sowing is to be used. Berseem has a shorter growing season than wheat and can be harvested earlier. Direct-sowing restricts the choice of prior crop cultivation.

The production costs of the following five cultivation systems, (traditional transplanting, mechanized transplanting, traditional direct-sowing on flooded field, mechanized direct-sowing on flooded field and mechanized direct-sowing on dry field) were compared, and calculated as to the advantages of extending the two mechanized direct- sowing rice cultivation systems.

The main conclusions can be summarized as follows,

1) Comparing the total cost per feddan of each cultivation system, the mechanized transplanting system was the most expensive, and the traditional direct-sowing system was the cheapest.

2) From the comparison of operation cost to each direct-sowing system, it was pointed out that the operation cost in autumn (harvesting, threshing, separating) accounts for more than fifty percent of the total cost in the case of the traditional direct-sowing system. This means that this operation is the target of further cost reductions.

3) On flooded fields :

The yield of rice in the "mechanized direct-sowing system" was treated as a variable. This variable was then calculated at the yield of the "traditional direct-sowing system". If the "mechanized direct-sowing system" attains a yield of 2.56 tons per feddan its production-cost per ton is exactly equal to the production-cost per ton of the "traditional direct-sowing system", therefore, if the "mechanized direct-sowing system" attains more than 2.56 tons of yield per feddan it is more economical (on the long term, and generally speaking) than the "traditional direct-sowing system".

On the short term (speaking from a net revenue or profitability standpoint) the advantage of the "mechanized direct-sowing system" over the "traditional direct-sowing system"is reached earlier: at 2.3 tons of yield per feddan. This relation is shown in fig.3.

4) On flooded fields

If the "mechanized direct-sowing system" attains a yield of 2.91 tons per feddan its production-cost per ton is exactly equal to the production-cost per ton of the "mechanized transplanting system".

Therefore if the "mechanized direct-sowing system" attains more than 2.91 tons of yield per feddan it is more economical (on the long term, and generally speaking) than the "mechanized transplanting system". On the short term (speaking from a net revenue of profitability standpoint) the advantage of the "mechanized direct-sowing system" over the "mechanized transplanting system" is reached much later: at 3.35 tons of yield per feddan.

This equilibrium yield is higher than the level in comparison with the "traditional direct-sowing system". Because the production-cost per ton of the "mechanized transplanting system" is lower and net revenue is higher than the "traditional direct-sowing system". To equate with the "mechanized transplanting system" the "mechanized direct-sowing system" needs a much higher yield.

5) Comparison of systems showing "equilibrium" yield is found in Table 1.

6) From the aspect of net revenue, the "mechanized transplanting system" probably has more merit than the "mechanized direct-sowing system". But the "mechanized transplanting system" requires more labor than the "mechanized direct-sowing system".

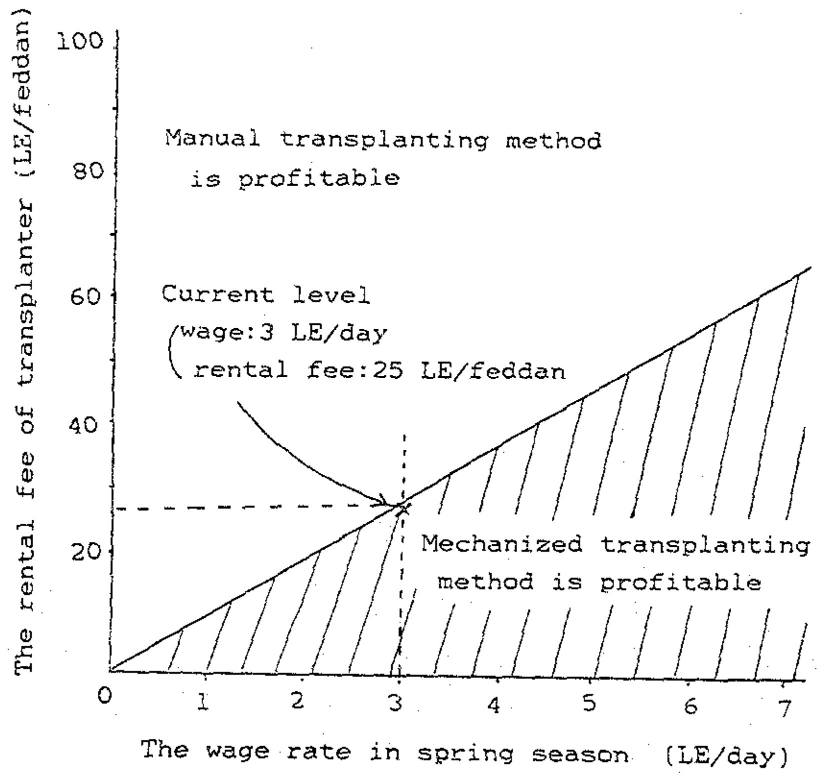


Fig 1 Relation between the rental fee of transplanter and the wage rate in spring

(Per yield of Mechanized transplanting method was supposed 3 tons.
If it were 4.5tons,Mechanized method is profitable for every condition)

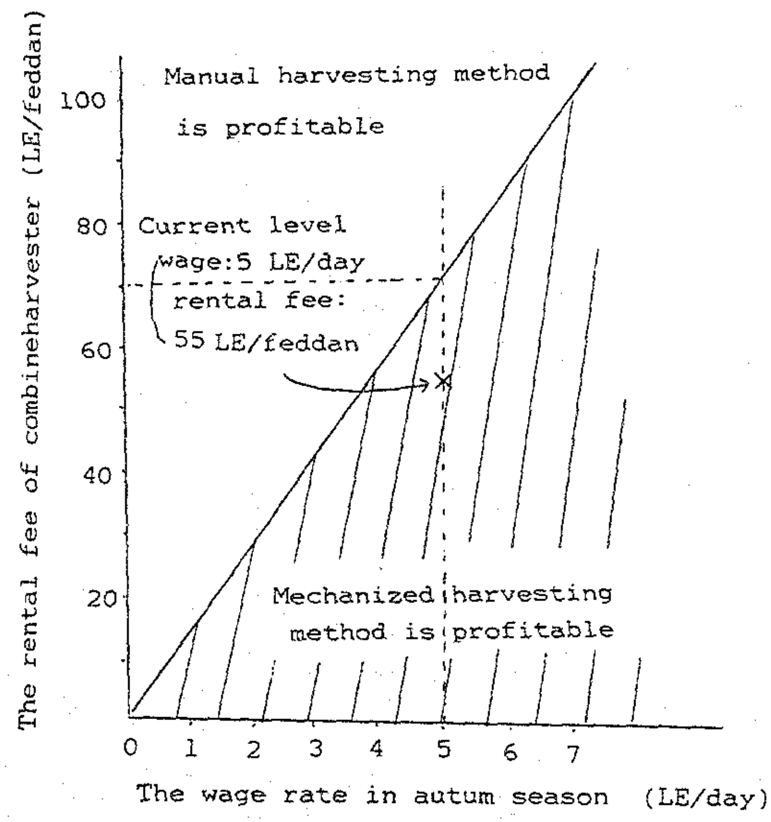


Fig 2 Relation between the rental fee of combine and the wage rate in autumn

(Per yield of Mechanized harvesting method was supposed 3 tons.
But in case of 4.5 tons Mechanized method is profitable for every condition)

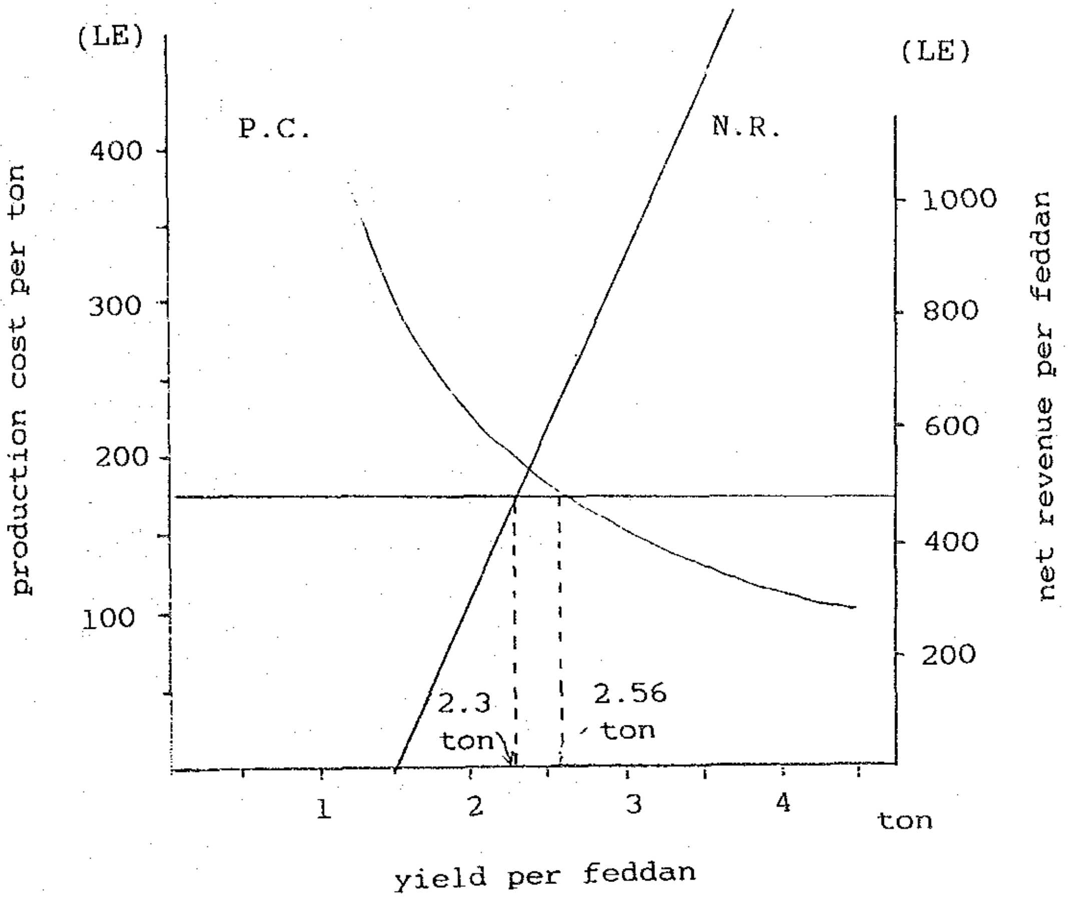


Fig.3 Comparative advantage of mechanized direct-sowing system on flooded field compared to traditional direct-sowing system

Table 1 Equilibrium yield on comparison of rice cultivation system

	from the standpoint of production-cost per ton (economical yield)		from the standpoint of net revenue per feddan (profitable yield)	
	traditional direct sowing system	mechanized transplanting system	traditional direct sowing system	mechanized transplanting system
mechanized direct sowing system on flooded field	2.56 ton	2.91 ton	2.3 ton	3.35 ton
mechanized direct sowing system on dry field	2.91 ton	3.3 ton	2.4 ton	3.45 ton

notes: if mechanized direct-sowing system can attain this level of yield, it can be said that its system is more economical or profitable than the system correspond to it.

III. Establishment of the Mechanized Rice Farming System (Standard Mechanical Direct-Sowing Rice Cultivation System)

1. Introduction

For the purpose of increasing the productivity of both land and labour in rice cultivation in Kafr El-Sheikh Gov. and similar neighbouring regions in the Nile Delta, the following two mechanical systems have been tentatively established, based upon the various results of the verification of experiments, system trials and economic analyses, etc.

(A) Tentative mechanical rice cultivation system in flooded fields. (Hereinafter refer to "flooded - M.D. system")

(B) Tentative mechanical rice cultivation system in dry fields (Hereinafter refer to "dry- M.D. system")

In this regard, it can be said that these systems were prepared as a guideline to Agricultural Extension Officers, from the view-point of accelarating their extension work to farmers in the field of practical mechanized direct-sowing cultivation.

However, further studies are needed to modify or improve these tentative systems to be more adaptable to different local areas and are also needed to improve the small machinery concerned.

It should be pointed out that "tentative" as used in this report means "temporary" or not yet finished.

2. Premises to Practice

(1) Targeted Regions;

Aimed at Kafr El-Sheikh Gov.and similar neighbouring regions where traditional direct-sowing cultivation has been increasing a lot recently.

(2) Farming type :

Farm scale : small and medium; individual farms using crop rotation.

In oreder to use the mechanized rice cultivation method effectively an area not smaller than 50 feddan in total must be available. This total area can be comprized of a number of small independent farms which join together for the purpose of mechanization under existing conditions.

(Notes)

1) Crop rotational pattern is as follows:

Summer crops: paddy rice, cotton, maize.

Winter crops: wheat, barely. Egyptian clover, others.

2) It is also one of premises to use the field after previous winter crop of Egyptian clover.

(3) Labour holdings:

Main operator	1 person (labour unit:1)	family labor
Assistant operator	1 person (labour unit ;0.6- 0.8)	

(4) Field conditions

① Soil fertility : medium or more fertile.

② Irrigation water: Favourable conditions of irrigation and drainage.

③ Farm road ; main farm road ... 5m in width.
branch farm road ..3m in width.
So as not to be inconvenient for tractor operation.

(5) Farm machinery utilization method

The necessary types and quantity of farm machinery for the tentative machanical direct-sowing rice cultivation system are listed in Tables, related to their utilization method or pattern to be required.

Refer to Table 1-A, 1-B, and 1-C

Table - 1 - A. Flooded - M.D.S. System.

No	Name of Machinery	Specification	*Nos.	Methods of utilization	Remarks
1	Wheel Tractor	50 ~ 120 P.S	1	Rental	Suitable P.S must be selected
2	Chisel Plow	1.50m. wide (7 tines)	1	"	
3	Scraper	3.0m. wide	1	"	
4	Rotary-Puddler	3.6m wide	1	"	
5	Trailer	4 Full-trailer 4 tons.	1	"	
6	Irrigation Pump	Centrifugal type (6ϕ)	(3)	Private owning or Joint-use.	
7	Manual Broadcaster	6.0m.wide broad-Casting.(Hopper 16L)	(2)	"	
8	Power Sprayer with Multi-Nozzle	7.1m. wide spray, (Engine 6 P.S)	(2)	"	for Herbicide & Insecticide
9	Head feeding Combine	Cutter bar width 1.3m (4rows)	1	Rental	
10	Solar Grain Dryer	Floor Area $16m^2$ ~ $32m^2$	(5)	Joint use	3 units of S.G.D ($32 m^2$) 5 units of S.G.D ($16m^2$)

(Notes) Numerical values of * marked Nos. were set for 50 feddan base which gathered small farm.

Table-1-B. Dry - M.D.S. System.

No	Name of Machinery	Specification	* NOS.	Method of Utilization	Remarkes
1.	Wheel Tractor	50 ~ 120 P.S	1	Rental	Suitable P.S must be Selected
2.	Chisel Plow	1.50m. wide (7 tines)	1		
3.	Disc Harrow	2.92m. wide (Tandem-2way)	1	"	
4	Scraper	2.93m. wide	1	"	
5	Heavy duty wooden Press-leveller	4.20m. wide	1	Rental or Joint-use	
6	Grain Drill Seeder	(20 rows)	1	Rental	
7	Boom Sprayer	13.7m wide (Tank Cap.600L)	1	"	
8	Trailer	Full-trailer 4 tons	1	"	
	Irrigation pump	centrifugal type (6Ø)	(3)	Private owing or joint-use	
10	Manual Broadcaster	6.0m wide broad-casting.(Hopper15L)	(2)	"	
11	Power Sprayer with Multi-Nozzle	7.1m wide spray (Engine 6 p.s)	(2)	"	for Herbicide & Insectcide
12	Head feeding type Combine	Cutter-bar width 1.3m (4 rows)	1	Rental	
13	Solar Grain Dryer	Floor Area $16m^2$ ~ $32m^2$	(5)	Joint use	3 units of S.G.D ($32m^2$), or 5 units of S.G.D ($16\ m^2$)

(Notes) Numerical value of * marked NOS. were set for 50 feddan base which gathered small farms.

Table - 1 - C. Flooded - Traditional D.S.System

NO	Name of Machinery	Specification	NOS. *	Methods of Utilization	Remarks
1	Wheel Tractor	-	1	Rental	For No.2, No.3, No.4 and also for threshing (tramping
2	Chisel plow	-	1	"	
3	Scraper	-	1	"	If the surface of field is even it can be omitted.
4	Trailer	-	1	"	for transportation of Grain after winnowing.
5	Irrigation Pump	centrifucal (6Ø)	1	Joint-use	
6	Wooden Puddler	3~4.m.wide	1	Private owing,or private rental	
7	Winnower	Engine 3PS.	1	private owing,or private rental	

(Notes) 1) Numerical Value of * marked NOS. were set for one small ferm base, basaing upon Dr. Ito's survey note.

2) * - marked items (NO.3) can be omitted if the field surface is uniformally even - levelled.

3. Tentative mechanical direct-sowing rice cultivation: Details are illustrated in the following three tables.

(1) Tentative mechanical direct-sowing rice cultivation system on flooded field (refer to Table 2)

(2) Tentative mechanical direct- sowing rice cultivation system on dry field. (refer to Table 3)

(3) Reference : Traditional direct-sowing rice cultivation system on flooded field. (refer to Table 4)

Table - 2. Flooded - M.D.S. System (varity: Giza. 181)

No	1)Kinds of Work	2)Kinds of Implument (TractorP.S)	3)Daily capacity of Implu-ment(f/day)	4) Working periods (date-Date	5)Available work day No. 1)Day No. (day)	2)Rate of Availa-ble Day (%)	3)Availa-ble work Day No. (day)	6) No. of opera-tion	7) Estimated Area-coverage of Implument (f)	* * Agronomical Standerd etc.
1.	Tillage	Chisel plow	10.2	April.16 April.30	16	70	11.2	2	57.1	Plowing depth: 15cm.
* 2.	Levelling	Scraper	19.8	April.25 - May 6	13	70	9.1	1	180.1	if neccessary
3.	Pretreat-ment of seed	Manual(Selection of seed disinfection. Soaking)	-	April.25 - May 6	15	(50)	(7.5)	1		(a) Seed selection by salt water specific gravity:1.10-1.13 (b) disinfection:1 day treatment by Benlate.T(300 gr.)(c) Soaking (2 days) & pregerminating (1 day)
4.	Irriga-tion	Manual & Pump (5∅)	for Puddling (2.0)	April.26 - May 2	18	(50)	(8.5)	1	14.1	
5.		- ditto -	for usual (6.3)	After Sowing						a)First 20 days after sowing - keep water for 7-10 days after sowing b)Dry up field for 2 days for rooting, c) Irrigation and drainege must be done d)After 20 days - follow to Transplanting system
6.	Puddling & level-ling	P.T.O droven Rotary Puddler	(6.7)	April.28 - May 12	16	(50)	(8.5)	1	53.4	Too much puddling is not recommended
7.	Sowing	Manual broad-caster	3.5	May. 1 - May.15	15	(50)	(7.5)	1	22.5	a)Seed rate;30-70 kg/f,b.Sowing when soil gelatinous, c. Targent of plant-density is 200 - 250 sedlings/m²
8.	Basal Fertilizer	Manual	5.4	Before Puddling	15	80	12.0	1		Urea 30-40 kg/f, Super phosphate 75-105 kg, Potassium sulphate 25-35 kg/f. More dosage is requried in infertile soil
9.	Top-dress No.1	Manual broad-caster	4.0	May . 20 - June 4	15	60	9.5	1	36.0	20 days after sowing. Urea 30 - 40 kg/f
10.	No.2	-ditto-	4.0	20 days before Heading	15	60	9.0	1	36.0	a)75 days aftrer sowing. (20 days before heading) Urea 30 - 40 kg/f
11.	Herbicide No.1	Power Sprayer with multi nozzle	3.6	May . 16 - May 31	15	50	(7.5)	1	27.5	15 days after sowing, Saturn EC 3 L/f should be applied.
12.	Herbicide No.2	-ditto-	3.6	June. 1 -June 15	15	50	(7.5)	1	27.5	30 days after sowing,Basagarn WP(2.1 kg/f)should be applied Water must be drained one day before application (spray)
13. *	Hand Weeding	Manual	0.14	Suitable date	(30)	(80)	24.0	1	3.4	if neccessary
14. *	Pest Control	Power Sprayer with multi-nozzle	3.6	(about 50 days after sowing	25	50	12.5	(1)	45.0	Furdan (10kg/f) should be sprayed if the adult Stem-borer is seen at 50 days after sowing.
15.	Harves-ting	H.F type Combine (4 rows)	2.7	Sept. 20 - Oct.15	26	80	20.8	1	56.2	
16.	Drying	Solar Grain Dryer	0.5	Sept. 20 - Oct.17	28	80	22.4	1	11.2	Adding to manual loading(3hr. man/f) & its unloading (3 hr. man /f).
17.	Transpo-rtation	Trailer	3.2	Sept. 20 - Oct.16	27	80	21.6	1	69.1	Adding to manual 10.0hr.man/f for straw & paddy grain Transportation.

(Remarks) 1) * Marked items (No. 2,13 & 14) can be omited if the condition is favourable such as uniform levelled field (No. 2), less weed (No. 13) & no Stem-borrer

2)** Marked Agronomical standerd were arranged, based upon trial results in Agronomy Div.

Table - 3 Dry - M.D.S. System

(varity: Giza, 181)

No	1)Kinds of Work	2)Kinds of Implement	3)Daily capacity of Implement(f/day)	4) Working periods (date-Date)	5)Available work day No. 1)Day No. (day)	2)Rate of Available Day (%)	3)Available work Day No. (day)	6) No. of operation	7) Estimated Area-coverage of implument (f)	** Agronomical Stand rd etc.
1.	Tillege	Chisel plow	10.2	April,15 April,30	16	70	11.2	2	57.1	Plowing depth: 15cm.
2.	Harrowing	Disc Harrow	19.3	April,21 - May 7	16	70	11.2	1	221.8	
*3.	*Levelling	Scraper	19.8	April,26 - May 10	15	70	11.2	1	120.8	If ne cessary
4.	Harrowing Levelling Pressing	Heavy duty wooden press leveller	24.3	April,28 - May 12	15	70	11.2	1	272.2	
5.	Pretreatment of seed	Manual				80		1		a) Seed selection by salt water(specific gravity:1.10-1.13) b) disinfection:1 day treatment by Benlate.T(300 gr.) c) Soaking if ne cessary d) dry seed is possible to use
6.	Sowing	Grain ( ) Drill Seeder	17.0	May 1 - May15	15	70	11.2	1	190.4	a)Seed rate; 40-80 kg/f,b)-Targent of plant-density is 200 - 250 seedlings/m² c) Seed ing depth should be 1 - 3 cm.
7.	Irrigation	Pump for usual (6 ф, inch)	6.3	After Sowing						Irrigation should be just after sowing .
8.	Basal fertilizer	Manual	5.4	Apr. 12 - May13	28	80	22.4	1	121.0	After Chisel plowing, Super phosphate 75-105 kg/f and Potassium sulphate 25-35 kg/f
9.	Top-dress No.1	Manual broadcaster	4.0	May . 20 - June 4	15	60	9.5	1	36.0	a)20 days after sowing.Urea 30 - 40 kg/f, b) More dosage is required in infertile soil or excess leakage of water on the field.
10.	No.2	-ditto-		May . 31 June 14						40 days aftrer sowing, Urea 30-40 kg/f. -ditto-
11.	No.3		4.0	20 days before heading	15	60	9.5	1	36.0	20 days before heading. Urea 40 kg/f
12.	Herbicide No.1	Boom Sprayer	14.7	May . 16 - May 30	15	(50)	(7.5)	1	110.3	15-20 days after sowing, application of mixed herbicide (Satur n EC and Propanil · 3-4.5 L/f),field must be dried enough for tractor operation
13.	Herbicide No.2	Power Sprayer with Multi Nozzle (Engine 6 P.S)	3.6	June. 1 -June 15	15	(50)	(7.5)	1	27.5	30 days after sowing,Basagarn WP(2.1 kg/f) water must be drained one day before application
14.	Hand Weeding	Manual	0.14	Suitable time	(20)	80	(16.5)	1	2.3	
15. *	Hand Weeding	Manual	0.14	Suitable time	(20)	80	(16.5)	1	2.3	If necessary
16. *	Pest Control	Power Sprayer with multi-nozzle	3.6	(about 60 days after sowing	25	50	12.5	1	45.0	Furdan (10kg/f) should be sprayed if the adult Stem-borer is seen at 50 days after sowing.
17.	Harvesting	H.P Combine (4 rows)	2.7	Sept. 20 - Oct.15	26	80	20.8	1	56.2	
18.	Drying	Solar Grain Dryer	0.5	Sept. 20 - Oct.23	28	80	22.4	1	11.2	Adding to manual loading(3hr. man/f) & its unloading (3 hr. man /f).
19.	Transportation	Trailer	3.2	Sept. 26 - Oct.22	27	80	21.6	1	69.1	Adding to manual 10.0 hr.man /f. for straw & paddy grain transportation.

(Remarks) 1) * Marked items (No. 3,15 & 16) can be omitted if the condition is favourable such as uniform levelled field (No. 3), less weed (No. 15) & no Stem-borrer (No.16)

2)** Marked Agronomical standerd were arranged, based upon trial results in Agronomy Div.

Table-4. Traditional Direct Seeding System (Wet)

No.	① Operation	② Date	③ Duration of Operation	④ Kinds of Power	⑤ Kinds of Implement	⑥ Description of Operation Contents
1	Tillage	May-15	April-26 May-15 (20 days)	Tractor	Chisel ploy	2 Times, 0.5 day per 1 feddan, Driver: 1,
2	Seed Preparation. 1).Selection 2).Soaking	May-10 Start	April-28 May-15 (26 days)	Manual	Tools	After seed-sieving, soaking by using Jute-bags.
3	Irrigation	May-12	May-1 May-24 (25 days)	Engine	Engine Pump	Irrigation at 2 days-intervals.
4	Puddling	May-13	May-2 May-25 (24 days)	Animal	Wooden-Puddler	Once , 2 hrs / f by 2 man.
5	Seeding	May-13	May-2 May-25 (24 days)	Manual	Tools	2 hrs/f by 1 man Seed rate: 70 kg/f, Dry up field for rooting.
6	Weed control 1) Herbicide	May-20	May-10...May-31	Manual	Tools	SATURN 1 hr/f by 1 man
	2) Hand Weeding	June-13	Jun-11...Jul-4	Manual	Hand	7 days/f by 1 man (only picking up)
7	Fertilizer 1) No.1	June-7	May-28...Jun-20	Manual	Tools	Ammonium Sulphate: 100 kg/f, 3 hrs/f ,by 1 man
	2) No.2	June-21	Jun-11...Jul-4	ditto	ditto	Urea, 60 kg/f, 2 hrs/f by 1 man
8	Harvest	Oct-11	Oct-25 Oct-30 (26 days)	Manual	Sickle	1 day/f by 8 man, including bundling operation
9	Threshing	Oct.14	Oct.28 Nov.3 (26 days)	Tractor Manual	Tractor & Winnower	Tramping by Tractor, Selection by Winower. 1 day/f by 10 man, Driver 1. Transportation of grains by Trailer(Tractor): 40 LE/f

Remarks: Dakkalia Gov.
Mansura District
Giza-171, (2.2 ton)

4. Labour Saving Effects :

Of these two mechanical systems, the remarkable labour-saving effects are realized as a whole, compared to the traditional one respectively. (refer to Fig-1)

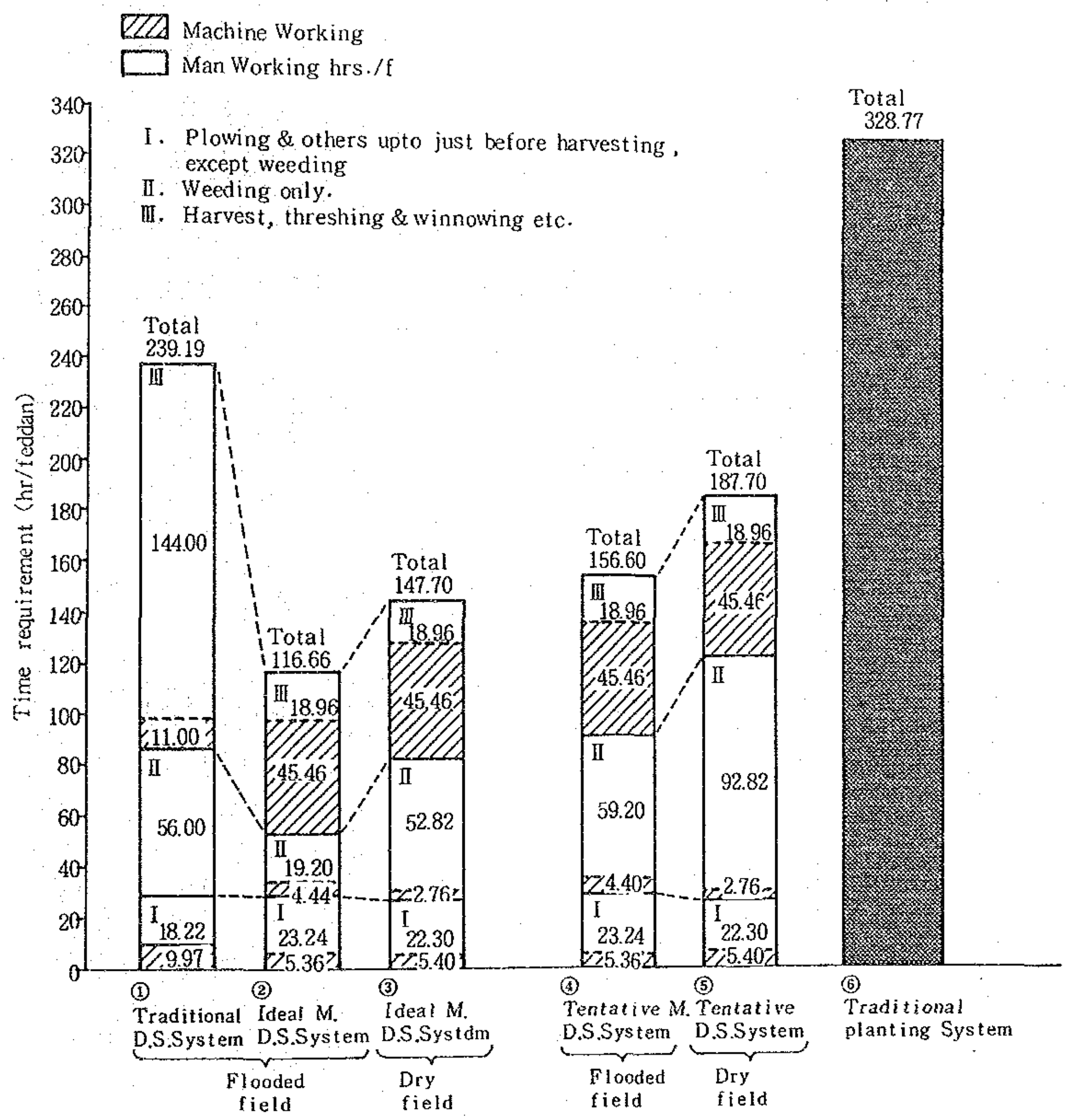


Fig. 1 Comparison of Time-requirement of work tentatively

Remarks:
① Traditional direct sowing system on flooded field (1989.Mansura,survey)
② Ideal mechanical direct sowing system on flooded field (1989.RMC, calculated) ②=④ - 40 hrs/f.
③ Ideal mechanical direct sowing system on dry field (1989.RMC,calculated) ③=⑤ - 40 hrs/f.
④ Tentative mechanical direct sowing system on flooded field (1989.RMC,System Trial)
⑤ Tentative mechanical direct sowing system on dry field (1989.RMC,System-Trial)
⑥ Traditional planting system (1985-'86.Kfs,survey)

On this point, it should be noticed that:

1) Harvesting, threshing and winnowing : these operations are so simplified by the utilization of combine that a remarkable reduction of working-time (hrs/f) can be expected easily.

2)a. Weed control: a series of weeding work requires much more working-time, depending upon the amount of weed growth in the field concerned. On the other hand, uniform and effective mechanical spraying of herbicides can be expected easily.

2)b. If the farmers field is not so weedy, * marked hand weeding operations in the tentative mechanical direct-sowing rice cultivation system (on both of flooded fields and dry fields) can be omitted or neglected so that a considerable reduction of manual working hours will be realized. Under such conditions, the flooded M.D.S. system is more efficient in labour saving effects than the standard mechanical transplanting rice cultivation system which has been already established.

2)c. Moreover, the following fact should also be attension. In general, weeding operations in the traditional direct sowing rice cultivation system (which are being practiced by many farmers)is being done roughly, and they seem not to put to much importance on the weeding operation.

5. Miscelleneous technical information :

(1) Increasing yield :

The results of system trials proved the big possibility of increasing yield, even though the yield level in the

The noticeable and important factor for increasing yield are summarized in the following 5 points respectively, comparing the traditional yield level by traditional system. Namely:

1) Optimal operation time and accurate work by machinery utilization in general.

2) Effective weed control.

3) Uniform plant density.

4) Good management work such as optimal (fertilization, irrigation practice etc.).

5) Reduction of grain loses by combine.

(2) Practical guidance

In the regards to increase yield on Dry-M.D.System, The following points are also noticeable in practice. Especially.

1) Under both of the good land preparation (Smaller soil clods well-levelled) and other recommended practices such as irrigation, seed treatment, sowing-depth and good mechanical sowing operation etc.).

2) And then, if the effective spray of herbicides are given on time (namely, excellent chemical weed control), the highest yielding can be achieved respectively under the recommended field - management under fertile soil conditions.

3) If there is a poor establishment of seedlings and also poor weed control, lower yield can be expected.

4) More-labour saving effect can be expected on weeding on crop-rotated fields with fertile soil using recommended irrigation practices.

5) As a referrence, two kinds of trial results were cited; Table 5: daily capacity of implement: and Fig.2 Relationship between the land preparation system, soil-clod diameter and the germination-ratio under the different crops used in the rotation-fields.

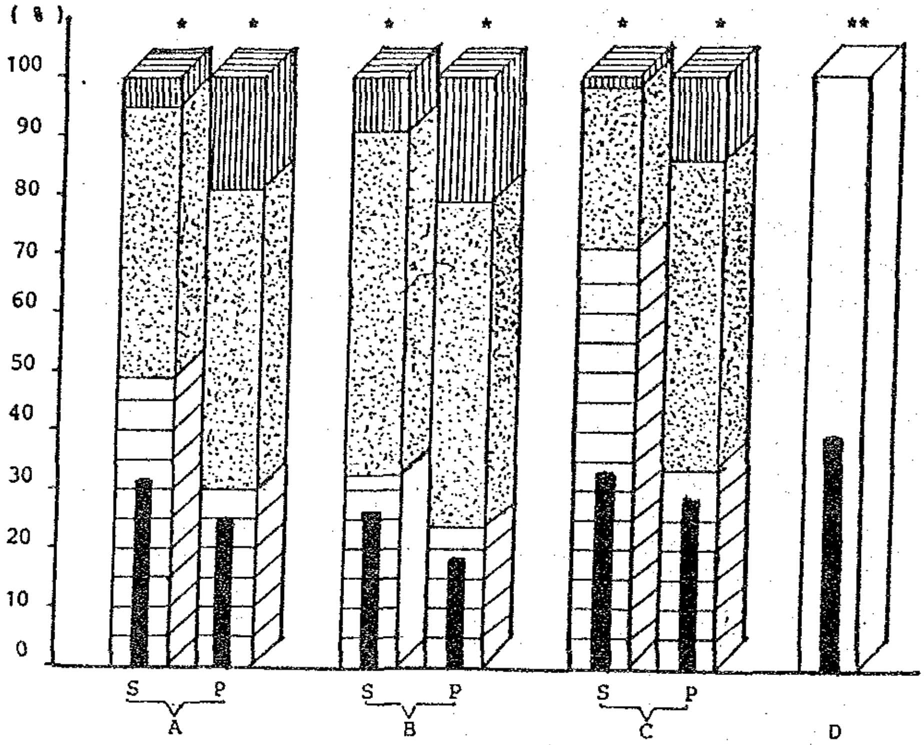


Fig. 2 Relation between land preparation system,clod diameter and germenation ratio.

Remarks:

- Germination ratio
- Clod diameter <= 2 cm
- Clod diameter from 2 to 6 cm
- Clod diameter > 6 cm

A :Simple system : Chisel(2)...Roller...W.Leveller.
B :Standard system: Chisel(2)...D.Harrow...Roller.
C :Special system :{Chisel(2)...D.Harrow...Scraper ...Roller.
D :Traditional system:{Chisel(2)...D.Harrow...Irrigation ...W.Puddler.
P :Rice → Clover → Rice
S :Soya bean → Clover → Rice
**:Sowing in wet condition
* :Sowing in dry condition

Table-5. Daily Capacity of Impl ment

No.	Items		Field Capacity					Daily Capacity			
			Theoretical Field Capacity			Field Efficiency	Effective Field Capacity	Net Work hrs Work hrs/day	Net Work rate	Net Work hrs.	Daily Capacity
			Working Width	Speed of Travel	Field Capacity						
	Name of Implument	Unit	m	Km/hr	ha/hr	%	ha/hr	hr	%	hr	ha/day
		Item No.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	Tractor (PH 85) Chisel plow 7 tins		1.32	6.05	0.798	95.9	0.765	8	70	5.6	4.29
2	Tractor (PH 85) Chisel plow 7 tins		1.56	5.00	0.781	69.0	0.539	8	70	5.6	3.02
3	Tractor (PH 85) Disk Harrow(4 Branchs)		2.92	7.34	2.14	69.5	1.49	8	70	5.6	8.34
4	Tractor (PH 120) Scraper (10 feet)		2.93	9.58	2.81	52.9	1.48	8	70	5.6	8.31
5	Tractor (PH 100) Roller (Singl)		2.41	4.50	1.30	79.6	1.04	8	70	5.6	5.80
6	Tractor (PH 85) Wooden leveller		3.88	5.87	2.28	80.2	1.83	8	70	5.6	10.22
7	Tractor (PH 24) Wooden puddler		3.31	4.32	1.43	76.0	1.09	8	70	5.6	6.09
8	Tractor (PH 75) Grain drill (TYE)		2.90	6.12	1.78	45.00	0.80	8	70	5.6	4.48
9	Tractor (PH 75) Boom Sprayer(600Liter)		13.70	2.16	2.96	37.00	1.10	8	70	5.6	6.16
10	Sprayer (PH 6)		7.1	1.08	0.767	35.00	0.27	8	70	5.6	1.51
11	H.F.Combine		1.20	2.9	0.35	78.5	0.30	8	70	5.6	1.68
12	Walking type Reaper		1.20	2.88	0.35	88.24	0.28	8	70	5.6	1.57

IV. Advice and Guidance on Training for the Operation and Maintenance of Agricultural Machinery

1. Training in Mechanized Rice Cultivation Technology and its Machinery Operation

(1). Introduction: Background

1). Since the establishment of RMPP in the fiscal year of 1981, then "Training & Mechanization Division" has successfully completed a total of fifty-six courses (a total of 877 accepted trainees) for these six years (1981-1988). Refer to Appendix-3

2). At the beginning period of the 2nd phase of RMPP (1986-1987), the "Training Department" with seven staff members was newly established at RMC for the purpose of reinforcing the training activities. Based on this, it seemed that the Egyptian Government wanted to make RMC the central mechanization training-center for the Nile Delta.

3). Under these circumstances, the "Training Department" of RMC has completed drawing up a master plan on the reinforcement of training through prominent guidance by both the General Director of AMRI and the Site Manager of RMC. Refer to Appendix-1.

Key points of this master plan can be summerized in the following three items:

i). For the coming two years (1988-1989), it should reach the following level:

* A total of 76 courses to be set.
* A total of 1,992 trainees to be accepted
* A total of 8,072 man days of training.

ii). A lot of emphasis in the training curriculum is concentrated on mechanical rice transplanting cultivation technology, including its related subjects.

Moreover, diversification in the training pattern should be performed with a sufficient level of training material such as text-books.

iii). Through implementing this master plan, it is expected that the technical achievement of RMC can be extended into many local spots in the Nile Delta region.

4). However, it was getting difficult to ensure the necessary training budget because of severe financial restriction in funding by the Egyptian National Government.
To counterbalance this deficiency the RMC could get a special training budget from JICA.