content in leaves decreases day by day, and as a result the rate of carbon assimilation also decreases in direct proportion to the decrease in nitrogen content. As the rood activity and the root-emerging ability have already been weakened at the full heading stage, the amount of nitrogen to be applied should be equal to or more than that in the "top-dressing at the late spikelet initiation stage".

(2) Intermittent Irrigation Techniques for Healthy Roots.

The second requisite is to promote the healthiness of roots. There is a close relationship between the root activity and the rate of carbon assimilation, and with a decrease in the root activity the rate of carbon assimilation decreases. An instance is illustrated in Fig. 37.

The figure shows the results of an experiment in which a paddy field with an abnormal reductive soil condition induced by applying 5 Kg. of strach per m^2 and another paddy field with an axidising soil condition caused by intermittent irrigation were set up, and a comparative investigation was made regarding the rate of carbon assimilation under different light intensities in natural conditions.

According to the figure, little or no difference is found in the rate of carbon assimilation between the two treatments under weak light intensities, while the difference becomes larger with an increase in the light intensity; in other words, the rate of carbon assimilation in the oxidizing treatment increases with an increase in the light intensity, whereas that in the reducing treatment becomes saturated at about 0.8 $cal/cm^2/min$ of the light intensity and does not increase at all under light intensities higher than that. The examination of the causes of the difference revealed that in the reducing treatment the water content in the leaf-blades decreased markedly under high light intensities on account of the decline in the ability of water absorption due to poor root activity.

Now, the most effective way to make the roots healthy is to supply them with air, which is almost freely available. To aerate soil in ordinary paddy fields, there is no other way than to lower the water level by draining water from the field. Furthermore, for aerating soil from the time just before the reduction division stage during and after which rice plants require water most, there is no other method than intermittent irrigation.

The necessity of intermittent irrigation varies with the field conditions, because this method is not necessary for a field with high water permeability, and in such a field the root activity does not decrease at all even if the field has been under completely flooded conditions. It is necessary, therefore, to determine the length of the flooding period and the draining period according to the conditions of each field, which are different from each other in water-holding capacity, in difficulty in making soil reductive and in convenience of practices. In fields where soil is liable to become reductive and root-rot is liable to occur, a method of flooding for 1 day and draining for 3 days (1-day flooding and 3 day draining) or that of flooding for 2 days and draining for 5 days (2 day flooding and 5 day draining) can commonly be used. It is important not to flood the field for a period longer than 5 days by repeating flooding and draining practices within the limit of not drying the soil excessively. Especially, in fields where root-rot is liable to occur, it is desirable to extend the draining period a little longer. In any case, if symptoms of rolled leaves are observed even slightly on a clear day, it will be necessary to irrigate the field at once by shortening the draining period.

2.2. Saving of manpower by mechanization.

Adaptability trials on each individual technique have been conducted according to four divisions of working processes in mechanized rice cultivation, i.e. 1) Plowing and puddling, 2) Transplanting, 3) Harvesting and 4) Drying.

2.2.1. Establishment of techniques for plowing and puddling suitable for soil condition.

The dry condition of Nile Delta soil shows exceptional hardness, on the other hand, when containing water, the soil clods collapse easily and become heavy and sticky. It is peculiar also in that the plow sole is not entirely constituted and the plow level stratum is extremely deep.

Accordingly within a day or so after irrigation the soil becomes swollen and soft, even the subsoil, which makes plowing and puddling very difficulty.

It is therefore necessary to clarify paddy field preparation techniques for the practical work of transplanting.

2.2.1.(1) Establishment of Plowing Method to Cope With Soil Hardness.

After harvesting winter crops such as wheat and Egyptian Birsim the upper layer of soil exhibits an extremely high soil hardness.

The soil hardness near the surface varies considerably with the type of crop grown prior to plowing and the period since the last irrigation. Harvesting of the winter crop usually occurs 30 to 45 days after the last irrigation. At this time the soil moisture has reduced to less than 20% and therefore the most suitable method of plowing is chisel plowing. Rotary plowing requires a machine of considerably greater horse power. Plowing for rice cultivation usually occurs between the end of May and the middle of June at which time the average 15 cm depth soil hardness becomes nearly 20 kg/cm^2 by penetrometer, requiring horse power of 70 and 50 by rotary and chisel plowing respectively. The results of crush ratio against the several methods of plowing adapted are shown in Table 8. The cole size recorded on the 30th is smaller than that of the 45th day for all plowing methods as the soil hardness increases.

Furthermore the crush ratio improved with both methods as the plowing frequency increased. Chisel plowing was found to have a larger clod size distribution than rotary plowing. However clods of 10 cm diameter existing after chisel plowing had completely collapsed within one hour of irrigation.

Generally, the soil structure is easy to collapse by water absorption due to a high degree of base saturation. Therefore the degree of crush ratio applicable to the differing methods in rice cultivation does not have any influence on transplanting work. Chisel plowing is therefore the most suitable method for the soil condition encountered.

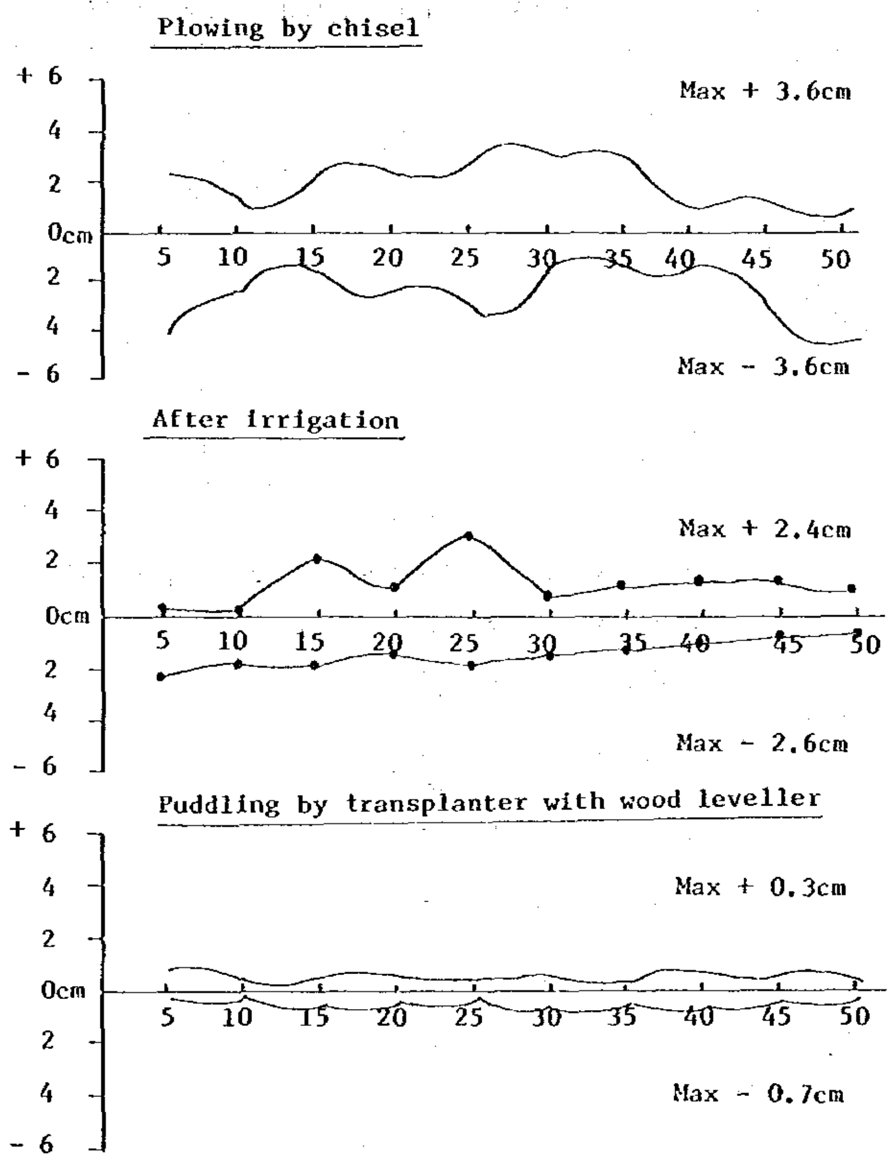


Table 8 Variation of Levelling Condition by Transplanter with Wood Leveller

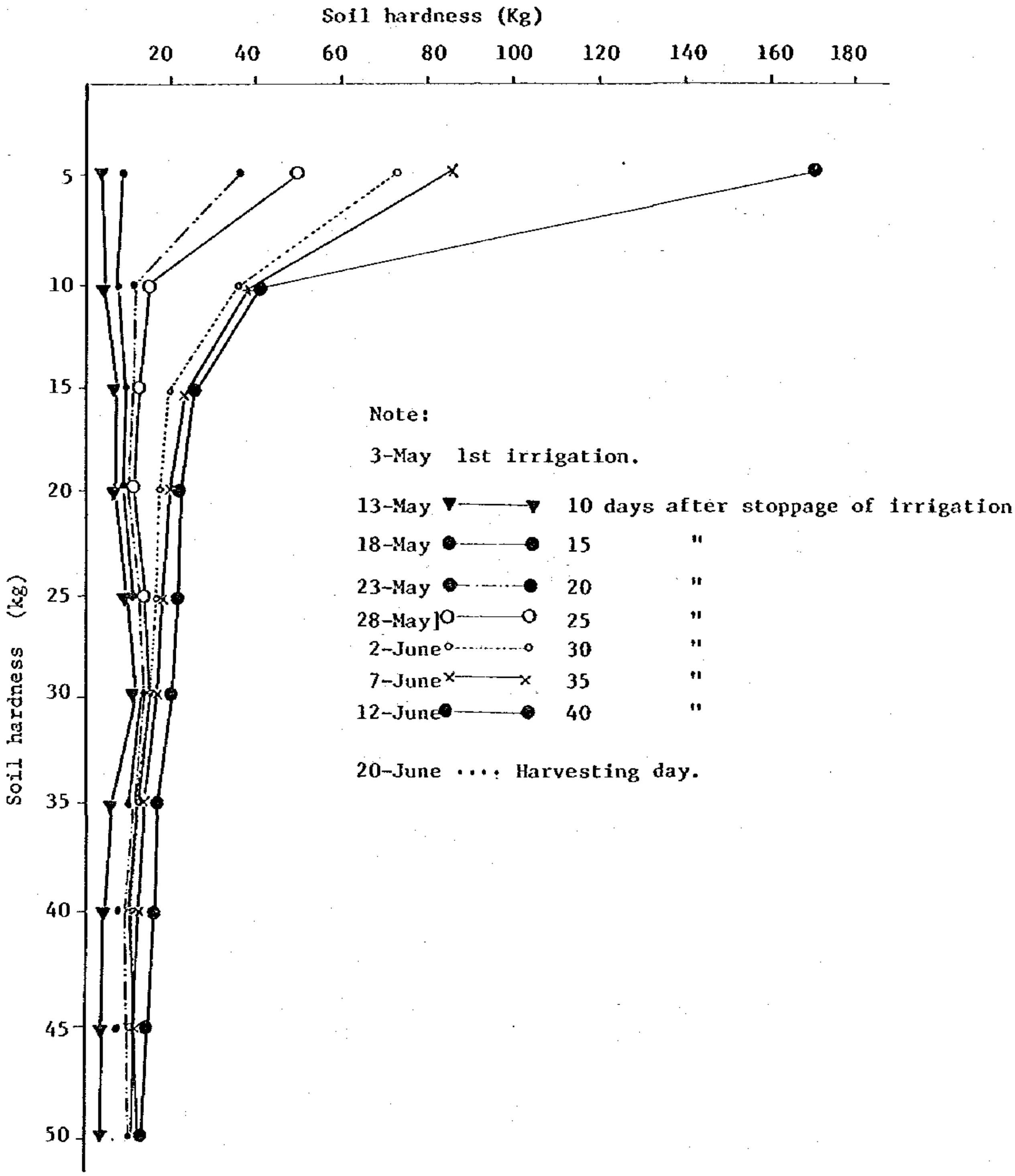


Fig. 39 Vertical Distribution of Soil Hardness after last Irrigation of Wheat Field

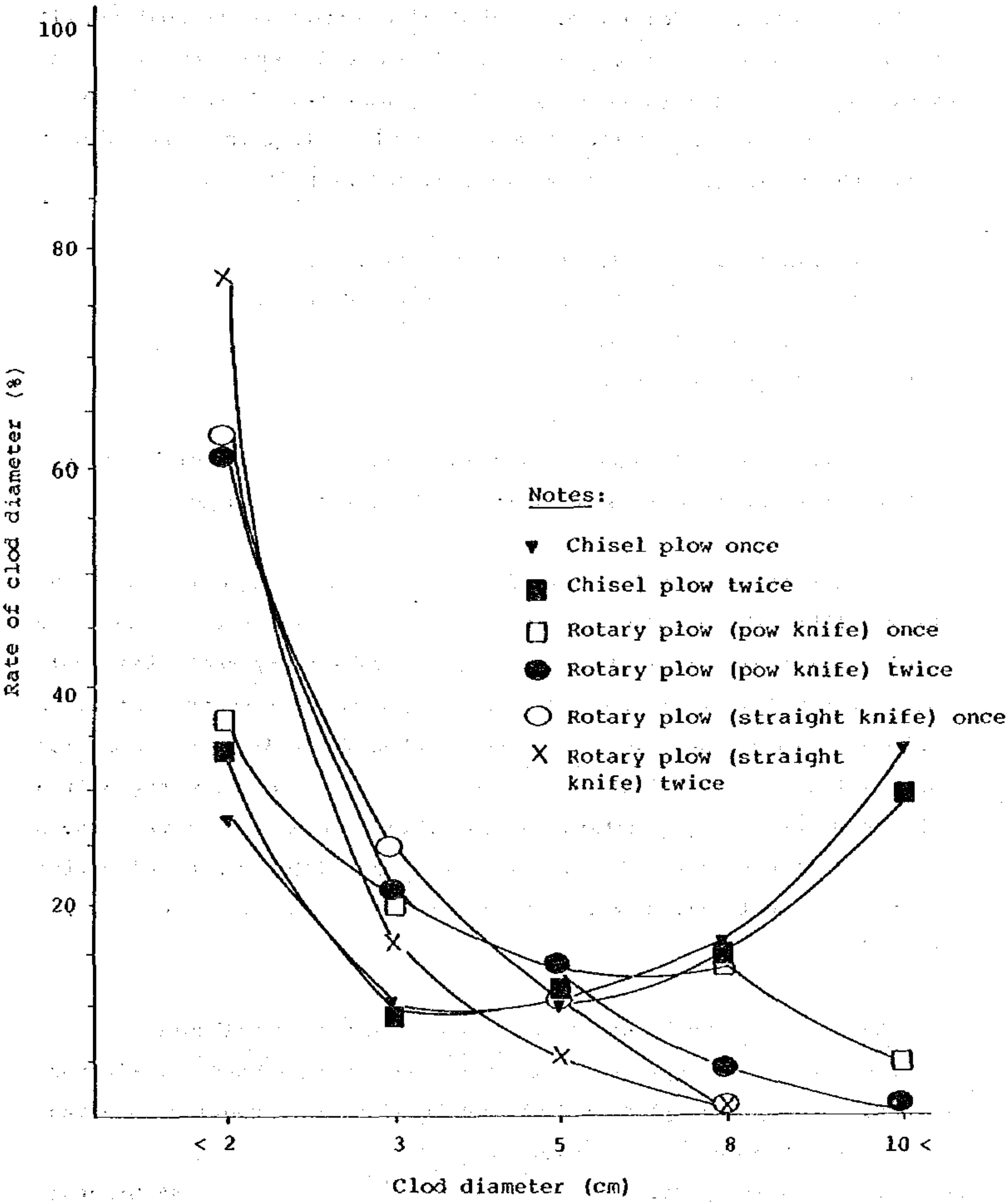


Fig. 40 Relationship between Plowing Systems and Variation of Clod Diameter after stoppage of Irrigation for 30 days

2.2.1.(2) Establishing of Puddling and Levelling Techniques

Due to the easy collapse of clod size following irrigation, it is very necessary to employ a puddling and levelling board to achieve the necessary accuracy for transplanting. The three trial methods for soil levelling were conducted as follows; and Table 8 shows the variation in soil levels produced by puddling.

i) Puddling by transplanter with wood leveller;
ii) Puddling by transplanter leveller fixed in front of the planting device;
iii) P.T.O. rotary puddler.

It became evident from the trials conducted that there was very little difference in accuracy between the three techniques.

Further experimental study of the techniques mentioned above as i) and ii), showed that a very high working efficiency could be achieved and also that there is a high probability that this could be maintained in practice. From surveys made of farmers' fields in the Nile Delta, the range of levels taken following the rice crop harvesting, was found to be $\pm$ 2.4 cm. These findings emphasized the need for rotary puddlers for levelling purposes. It was proven that by stirring the soil by P.T.O. rotary puddler was an effective method of controlling the growth of the perennial weed, Cyprus Rotundus.

The times to puddle and level one feddan are as follows:

i)	Puddling by transplanter with wood leveller:	1 Hour 7 Minutes
ii)	Puddling by transplanter leveller fixed in front of planting device :	2 Hours 30 Minutes
iii)	P.T.O. rotary puddler :	- 45 Minutes

The cone plumb penetration (so-called "cone index") necessary for mechanical transplanting is between 8 and 12 cm.

Figure 41 shows the relationship between the three puddling techniques, cone index, and the number of days after puddling. In the case of rotary puddling, the cone index, one day after puddling, was found to be more than 11 cm and reduced to 10 cm only after three days. However, the cone index recorded for puddling by transplanter with wood leveller fixed in front of the planting device, was found to be less than 10 cm after one day.

In conclusion, the techniques of (i) puddling by transplanter; and (ii) simultaneously levelling and transplanting by transplanter leveller fixed in front of the planting device, were found to be most suited to the conditions of the Nile Delta. However, rotary puddling is also recommended for fields having a high weed growth.

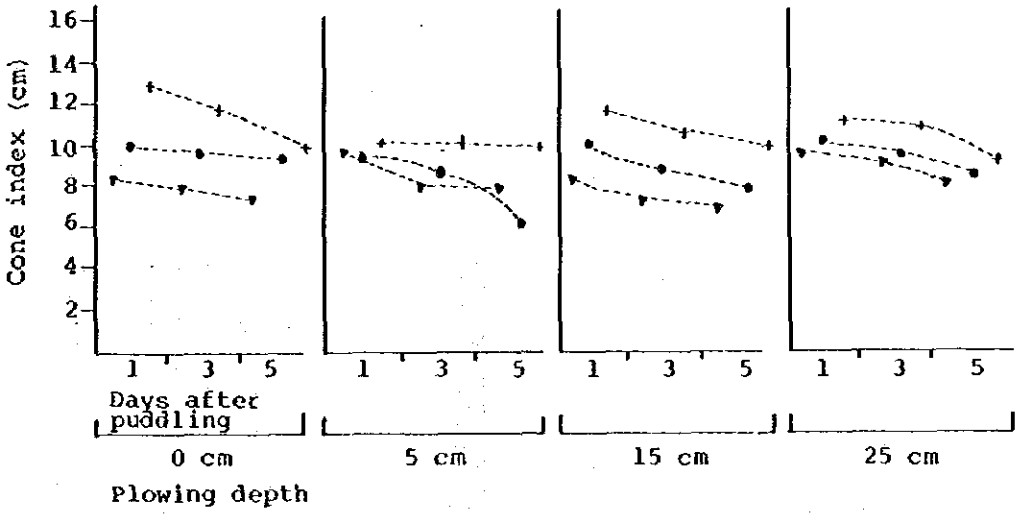
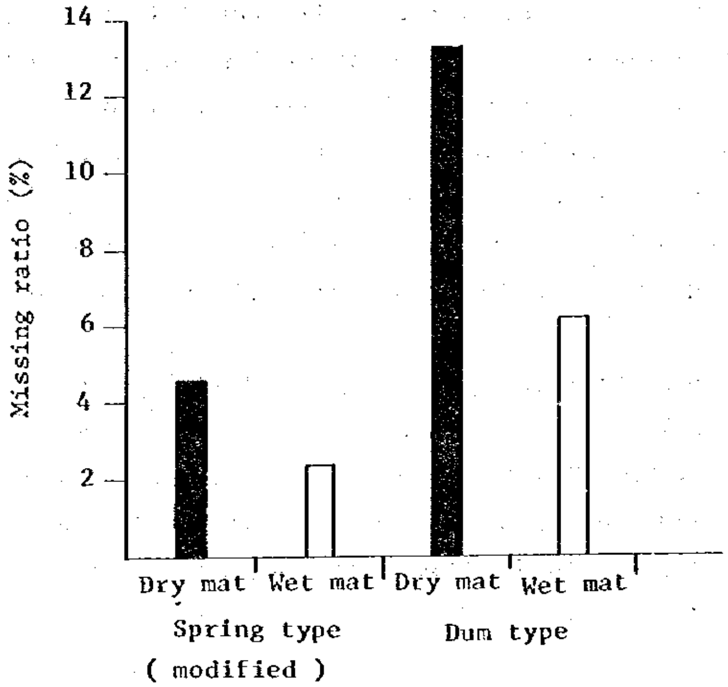


Fig. 41 Relationship between plowing depth and cone index by three types of puddling methods

Notes: ▾ --- Puddling by transplanter with simultaneous levelling and transplanting
• --- Puddling by transplanter
+--- Puddling by rotary



The relation of missing ratio between spring and cum type

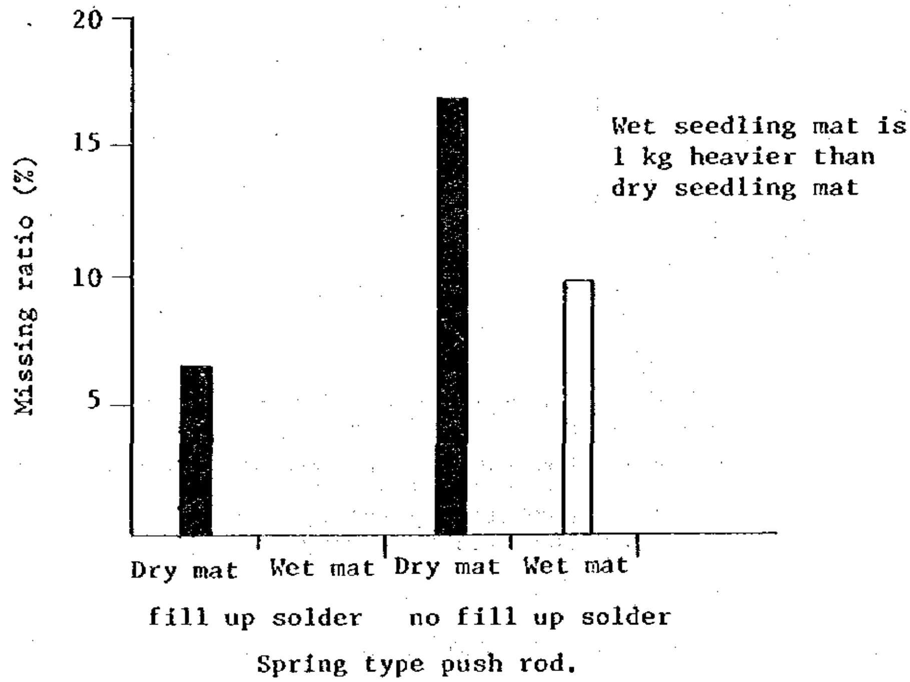
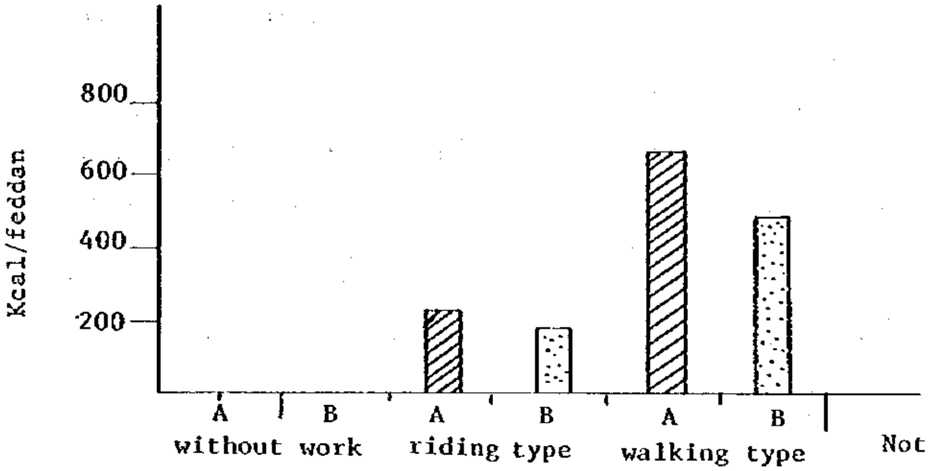


Table 9 The relation of missing ratio between fill up solder and no fill up solder to push rod



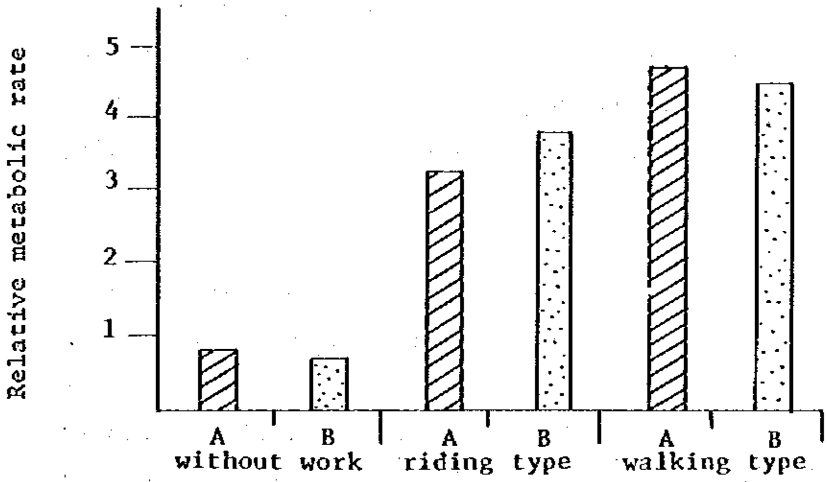
Notes:

A---Age 24, Height 168cm, Weight 76kg

B---Age 18, Height 152cm, Weight 53kg

Riding Type---6 row front mounted transplanter

Walking Type--4 row walking type transplanter



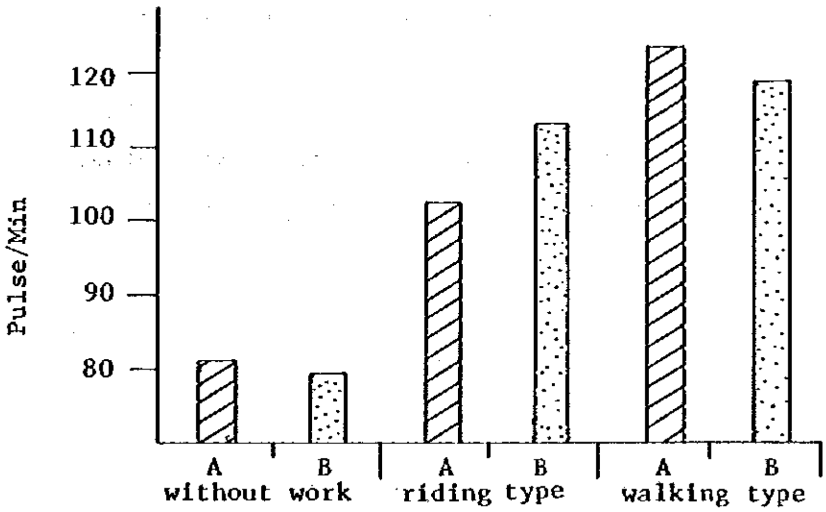


Table 10 The consumption of Operators' energy by use of Different types of Rice Transplanters (Kcal)/Feddan

2.2.2. Establishment of Technique for Rational Mechanized Transplanting

The Nile Delta soil has a heavy stickness due to the high content of silt and clay, making it difficult to perform mechanical transplanting.

2.2.2.(1) Modification of transplanter's finger to suit soil conditions

As the Nile Delta soil consists of clay and silt, after the absorption of irrigation water, it becomes extremely sticky. The stickness reduces the transplanting accuracy because the seedling picked up by the transplanting finger in the soil are not easily released from it causing a high missing ratio. In order to decrease this missing ratio, a push rod mechanism on the planting fingers was introduced.

Table 9 indicates the considerable improvement achieved in the missing ratio by using a spring type push rod compared with the culm type one. Furthermore it was confirmed that a wet seedling mat, one kg heavier, could be transplanted with a lesser missing ratio than that of a dry mat, by using the spring type push rod. The Table shows that by soldering up the gap in the push rod device, the missing ratio can be reduced to almost zero.

It can be concluded, therefore, that the most suitable transplanting finger push rod for the moderate soil wetness condition of the Nile Delta, is the spring type one filled up with solder.

2.2.2(2) Suitable working methods for Walking and Riding types of Transplanters

It takes three days to obtain the cone index to make mechanical transplanting possible after mechanical puddling by rotary, due to the extremely fine particles of soil of the Nile Delta. Moreover, as the paddy fields lack the form of a plow pan, the irrigation water tends to percolate to the lower layer of the soil with a time lapse, making it difficult to walk in the fields. Accordingly the operators prefer the riding type of transplanter compared with the walking type which causes more fatigue.

As a result of studies to determine the most suitable working time for the walking type of transplanter, it was clearly found to be that of three to four days after mechanical puddling. However, due to the increased fatigue of the operators when using the walking type of transplanting, it was found that two days after puddling was not suitable. Table 10 records the comparison of the energy consumption of the operators per feddan, when using both the walking and riding types of transplanters.

According to these results, it was clearly evident that the energy consumption of the operators was twice as much as using the walking transplanter as that consumed when using the riding type.

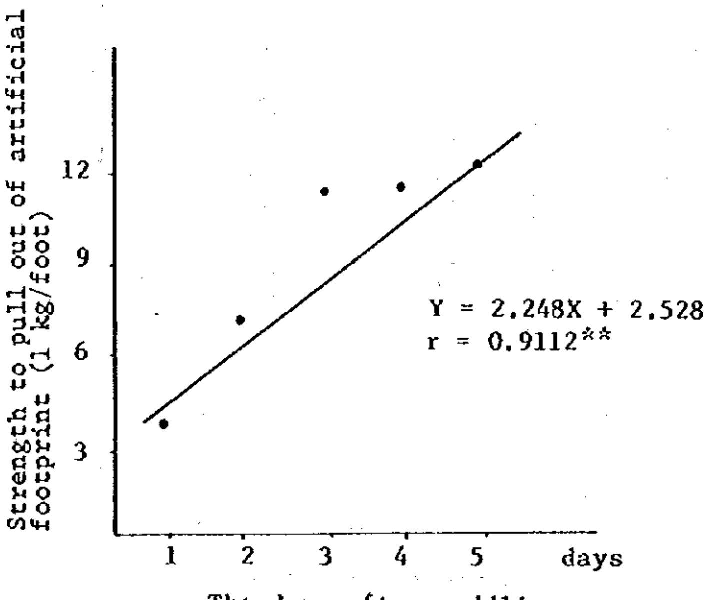


Fig. 42 Relation between pull out kg/foot and days after puddling

A trial was conducted to show the relationship between transplanting accuracy for a walking/riding type of transplanter and plowing depth. The missing ratio is almost the same for plowing depths of 0, 5, 15 and 25 cm, but at a plowing depth of 0 to 5 cm there seems to be less contact with the ground surface of the floating device because the planting device mechanism of the transplanter is designed for moderate depth for stability.
On the other hand, as shown in Fig. 43, deep plowing may increase the slippage ratio and it may interfere and cause trouble. At a plowing depth of 15cm the slippage ratio is 20% and it may increase at greater depths. A moderate depth of around 15-20 cm is therefore required for mechanical transplanting.
It can be said that the floating ratio is the same as the missing ratio for all transplanters. The 1st. day after puddling the worked soil would not hold the seedlings easily after being picked by the planting fingers. This would indicate that a wait of 3 days is required after mechanical puddling for the riding type of transplanter and a 2-day wait for the walking type if the 5% missing ratio is accepted.

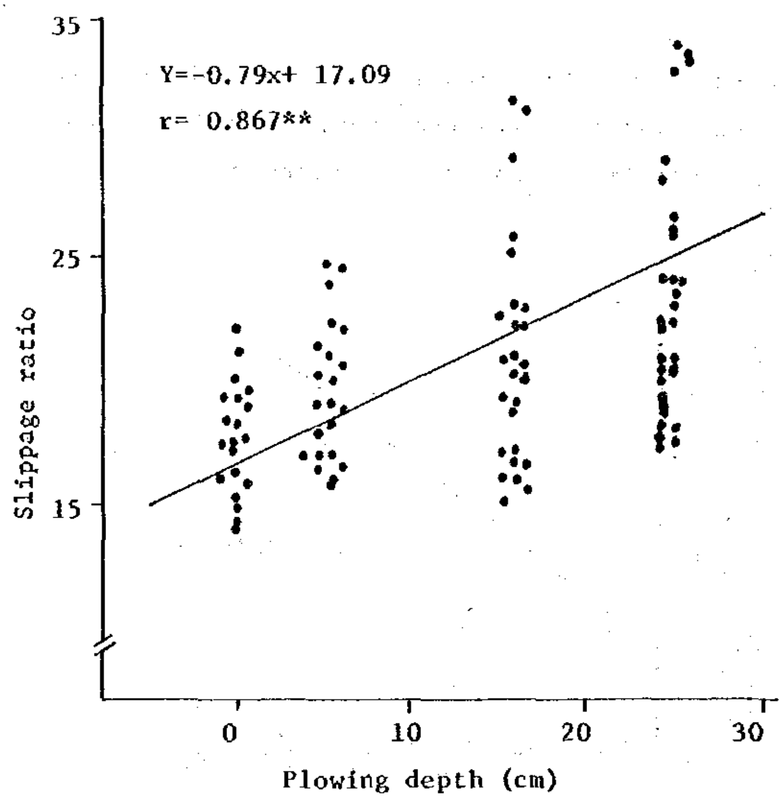


Fig. 43 The relationships between plowing depth and slippage ratio.

2.2.2.(3) Comparison Study for Effective Field Efficiency of Different Types of Rice Transplanters

In the Nile Delta, Japanese made transplanters of 4 row walking type, 6 row riding type and 8 row riding type are introduced at present. Effective field efficiency trials for these transplanters under local conditions were conducted.

1) Machinery used:
4 row walking type transplanter, 6 row riding type transplanter, 8 row riding type transplanter, 6 row and 8 row riding type transplanters are front transplanting type.

The effective field efficiency trial results of 4 row walking type, 6 row and 8 row transplanters are indicated in Fig. 43.

According to it, actual transplanting time for the machine with more transplanting rows is shorter, showing the same tendency as theoretical field efficiency. As for effective field efficiency, assuming the efficiency of 4 row walking type to be 1, 6 row riding type showed 1.01, 8 row riding type showed 1.28. Regarding seedling feeding time in total working hours, the 4 row walking type accounted for 21.3%, 6 row riding type, 32.3% and 8 row riding type accounted for 45.5%. Seedling feeding time occupies more percentage as the number of transplanting rows of the transplanter is not linked with effective field efficiency in multiple proportions.

These figures will not change greatly in normal operation. The effective field efficiency of the 4 row walking type transplanter does not differ so much as compared with 6 row and 8 row riding type transplanters, and its advantage over 2 other machines is evident in view of the price of machinery and machinery cost per transplanting area.

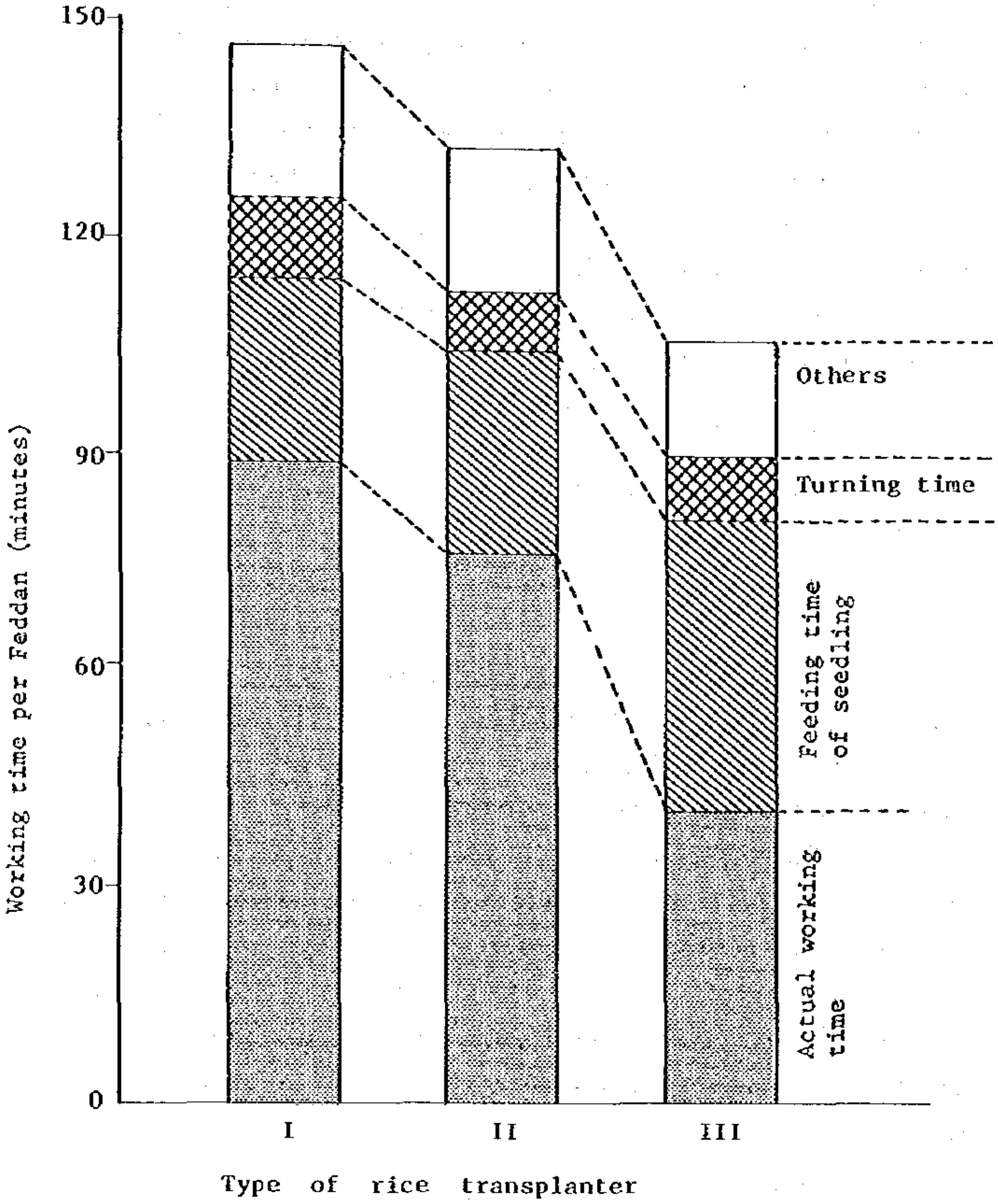


Fig. 44 Comparison of Working Hours and its Components for Different Types of Rice Transplanters

Note: I = 4 row walking type rice transplanter
II = 6 row riding type rice transplanter
III = 8 row riding type rice transplanter

However, the 4 row walking type posed a problem of excessive fatigue for operators under the local condition of soil stickness. Therefore net needs further studies in the future, including field depth and transplanting time after puddling.

2.2.2(4) Transplanting Accuracy

Experimental machinery and methodology are the same as in section (1); and Table 11 (1) indicates the planting finger adjustment for each machine; number of seedlings transplanted per hill; and the vacant hill rate.

Part (1) Planting Finger Adjustment for each Machine (Sowing Q'ty, 200gr per box)

Type of Transplanter	Transplanting finger adjustment (mm)		No. of plant/hill	S.D	Ratio of vacant hill (%)
	Horizontally	Vertical			
6 row riding	10	10	3.80	1.94	6.6
"	10	14	4.20	2.84	3.3
"	10	14	4.22	2.61	5.0
"	14	14	6.27	3.45	5.0
8 row riding	14	14	6.74	3.14	2.5
4 row walking	10	14	4.48	2.67	7.5

Part (2) Planting Accuracy and its details (Sowing Q'ty, 350 gr per box, planting adjustment, 14 x 14)

	Plant No. grand total/50 Nos. hill	No. of planted seedling	No. of sharply bent seedlings	No. of cut seedlings	No. of floated seedlings	Ratio of vacant hill(%)
	568	510	35	17	6	0
Ratio (%)	100	90	6	3	1	0

Table 11: Relationship between Planting Accuracy and Adjustment of Transplanting Finger (No. of Hills checked - 100)

According to these findings, the enlargement of the adjustment of the planting finger and the number of plantings per hill, are closely related for the same standard seedling box. Moreover, an increase in the number of plantings and a decline in the vacant hill rate were noticed.

The occurrence of vacant hills is supposedly caused by the sowing accuracy, but the rate recorded was from 2.5 to 5 percent, which should not be problematic. Fig. 45 shows the distribution of the number of plantings per hill.

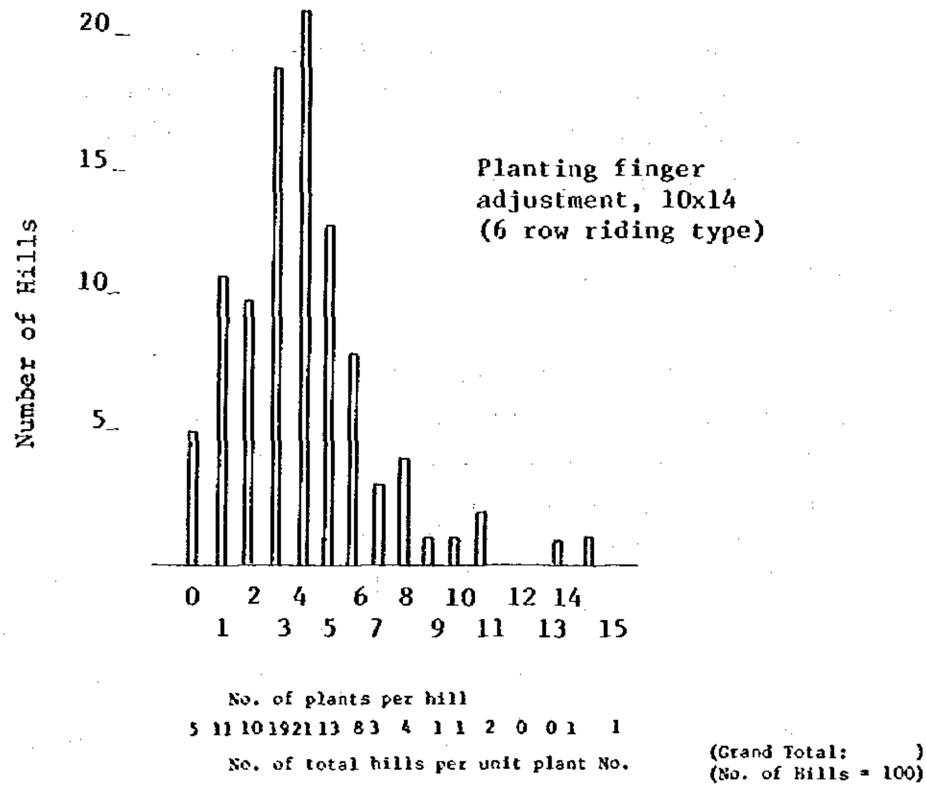


Fig. 45 Distribution number of Plants per Hill

According to it, the planting number per hill of 2-8 seedlings, within allowable limits, accounted for 60% with a vacant hill ratio of 5%. The figure includes two cases where the planting number of 14 and 15 per hill was used and the showing from these tests, although not uniform, was taken into consideration. Over dense sowing frequently resulted in broken or cut seedlings. To prevent such defective sowing, the planting accuracy of the sowing quantity of 350 g per box, was investigated. The results are mentioned in the Table.

The Table also indicated that broken or cut seedlings accounted for 10% of the total number of plantings, although there were few of these found in the case of the normal sowing quantity of about 200g. The investigation results include many cases of broken seedlings, due to their spindly growth, accounted for 6% of the above ten percent value.

Although vacant hills do not appear as a result of over-dense sowing, spindly growth does, and from this the broken or cut seedling phenomenon presumably originates.
When using transplanters, remember that the capacity of the planting fingers has been mechanically adjusted, and considered to be stable. Therefore, planting accuracy largerly depends on the conditions of the seed box, particularly to the sowing quantity therein. For this reason, before commencing planting work and throughout the entire task of planting, meticulous care should be taken to ensure that the correct sowing quantity is contained in the seeding box in order to produce uniform sowing.

Table 12. Relation between seedling density per nursery tray and the transplanter performance of Japanese transplanter, Model ; YP-6000 & YP-8000.

Adjustment index of transplanter	Size of seedling block per finger adjustment	Transplanting density (hills/M²)	Needed Number of nursery tray/Feddah	Seedling density per nursery tray (280x580x30mm)							
				*175gr(**335cc)		200gr(390cc)		250gr(493cc)		300gr(572cc)	
				Population		Population		Population		Population	
				/hill	/M²	/hill	/M²	/hill	/M²	/hill	/M²
"60"	10 x 10		64	2.9	68.2	3.3	77.6	4.2	98.7	5.0	117.5
Interhillar	10 x 14	23.5	89	4.1	96.4	4.7	110.5	5.8	136.3	7.0	164.5
distance; 18cm	14 x 14		124	5.7	134.0	6.5	152.8	8.2	195.7	9.8	230.3
"70"	10 x 10		71	2.9	75.4	3.3	85.8	4.2	109.2	5.0	130.0
Interhillar	10 x 14	26.0	100	4.1	106.6	4.7	122.2	5.8	150.8	7.0	182.0
distance; 16cm	14 x 14		136	5.7	145.6	6.5	169.0	8.2	213.2	9.8	254.8
"80"	10 x 10		82	2.9	87.0	3.3	99.0	4.2	126.0	5.0	150.0
Interhillar	10 x 14	30.0	114	4.1	123.0	4.7	141.0	5.8	174.0	7.0	210.0
distance; 14cm	14 x 14		159	5.7	168.0	6.5	195.0	8.2	246.0	9.8	294.0

(1983, RMP Kallin Center
By; S, Sugawara, Nour Saleh, Essam Ghazy, Mahmou Hamad & Mohamad Yusef)

Note
Note; (1) Variety: Giza 172,1000 grain weight = 25.86 gr at 14% moisture content.
(2) Germination ratio = 70%
(3) * in dry wieght
(4) ** Volume of pregerminated seeds
(5) Depth of mechanically transplanted field: 30 cm, three days after puddling
(6) Slip ratio of transplanter: 20%
(7) Nursery loss ratio: 05%

Adequate adjustment of the planting finger is necessary based on the relationship between the seedling quantity and finger adjustment scale as mentioned in Table 12.

2.2.3. Establishment of Technique for Mechanized Harvesting

The harvesting method of traditional rice cultivation is drying on the ground after harvesting by hand; bundling; collecting and transporting by an animal; threshing with the trample-down method by a tractor; and selecting grains and straws by machines and manpower. These practices cause heavy work for the farmers and the harvesting loss comes to 23% of the total yield.

Additionally, there is the problem of lowering of quality due to threshing and polishing being done directly on the ground so the grains become mixed with small stones, soil clods and other things.

2.2.3.(1) Determination of Optimum Harvesting Time

The most important factor in the determination of harvesting time is influenced by the high working efficiency of mechanized harvesting because if any delay to the suitable time for harvest occurs, the increase of grain losses due to over ripening and plant lodging is rapidly accellerated. The Nile Delta climatic condition shows a remarkably high amount of radiation and a big difference in temperature between day and night at the time of the ripening period. As a result of follow-up observations on the variation of both the 1000 grains and the ripening ratio, it was found that they are based on the determination of a suitable harvesting period. As shown in Fig. 46, it has been established that both settle down after 45 days of heading. Translucency is already 95% and the moisture content of the grain shows around 20-25%, with a plant lodging degree of around 45. Mechanized harvesting methods would have no impact on harvesting accuracy.

Therefore, at the time of possible early harvesting, it was confirmed that either drying method was necessary for improving the quality of rice grains.

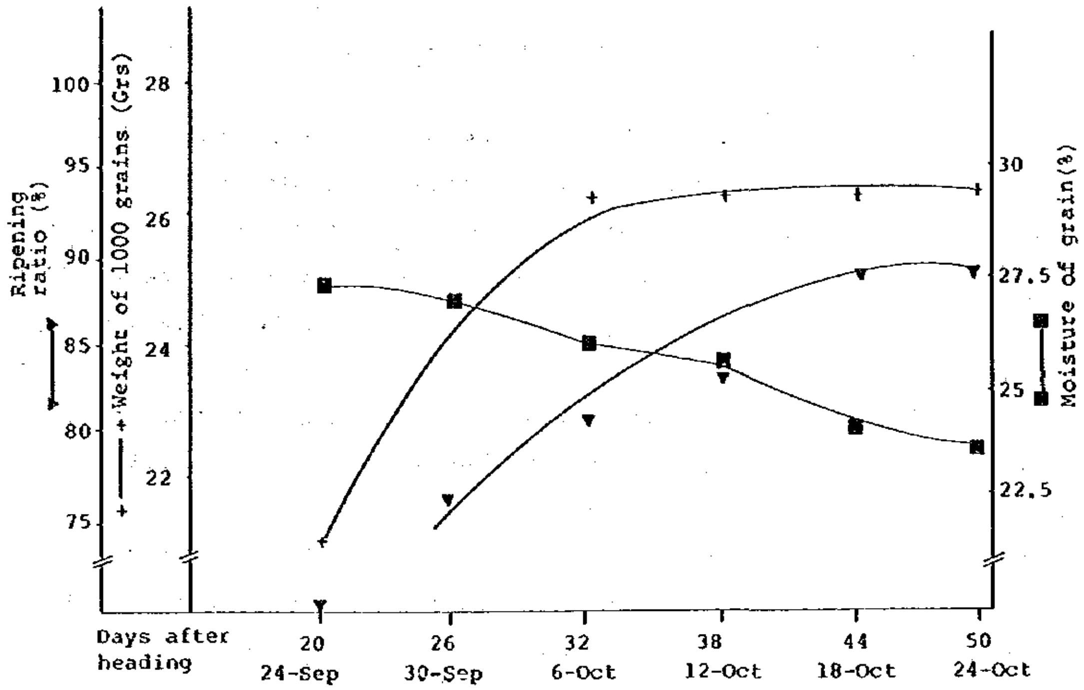


Fig. 46 The suitable time of harvest for variation of grain moisture, weight of 1000 grains and ripening ratio

Notes: Mechanical Section & trial field

2.2.3.(2) Establishment of harvesting and threshing methods

Various kinds of machinery were adapted such as binders, reapers, harvesters and the auto head threashing type combine.

(a) The Auto Head Threshing Type Combine

The auto head threshing type combine appeared to be the most efficient of the above. The binder was designed to harvest the short culm variety. According to harvest tests done with the Giza-172 long culm variety with a plant height of around 120cm the binder was found to be unsuitable due to the complete lodging of this variety. After reaping it is not easy to transfer a bundle of straw to the outlet due to the long culm of the variety. Table 13, however, shows the greater success with the short culm variety with less the 1% grain loss from head loss. The bundle type of bunder with a cutting bar of 0.6 cm takes around 7 hours per feddan. Under the drying conditions of the Nile Delta during harvest the bundle of straw is quite dry. Even the straw put on the ground dries satisfactorily so bundles of straw for drying are unnecessary in this area.

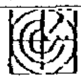
(b) The Reaper Harvesting Machine

The reaper harvesting machine did not deal with the long culm variety such as Giza-172 on the lodging condition.

If the non-lodging condition is around 45° as shown in Table 13, the test shows a working efficiency of 88%, 1.3 hours per feddan with less than 0.4% head loss because mowing is possible from any direction at the lodging degree of 45°. The reason for this high efficiency is that the machine has a cutting bar with a width of 1.2m making it highly operable and capable of a small, sharp turn.

In conclusion, the reaper's performance is very high and the combination of reaper and self-propelled automatic is very promising.

Table 13 Performance Test for Reaper

	Standing direction / Item	1	2	3	4
					
Testing condition	Variation of moisture content 1st day	16.1%	16.1%	16.1%	16.1%
	" 2nd day	14.9%	14.9%	14.9%	14.9%
	" 3rd day	14.7%	14.7%	14.7%	14.7%
	Harvesting time sec/10 m	12.8	12.5	12.5	13.3
	Harvesting speed m/s	0.78	0.80	0.60	0.75
	Plant lodging deg	44.4°	44.4°	44.4°	44.4°
	Decleaning deg	45.6°	45.6°	45.6°	45.6°
	Hardness kg/cm^2	5.6	5.6	5.6	5.6
	Cutting height cm	9.9	9.7	8.9	10.4
Performance	Straw weight (50% moisture) $kg/10\ m^2$	8.24	8.60	7.52	8.12
	Grain weight (14% moisture) $kg/10\ m^2$	4.764	4.971	4.439	4.692
	Losses weight by head $grs/10\ m^2$	14.8	7.2	5.6	18.5
	Percentage of head loss	0.30%	0.14%	0.12%	0.39%

Note: Variety - Giza-172

(c) Harvester (Ear head feeding unit is mounted on auto crawler)

On the subject of mechanical harvesting at a suitable time, a grain moisture of around 22-25% is very high. The natural dryness 10 days after reaping is suitable for threshing by the harvester.
The dried paddy straw was collected 10 days after reaping at predetermined places and was threshed by the mowing harvester. The rate of work for the long-culm variety Giza-172 was 4 hours and 47 minutes. In this system the paddy straw was not bundled owing to being mowed by the reaper and only the top of the panicle was fed into the threshing drum. The Giza-172 long-culm variety is in the range of a maximum of 65cm at the panicle position (length of culm 125cm).
The working rate tends to be greatly influenced by the irregular top of the feeding position. The irregular top of the panicle will be the same in the short culm variety after reaping as that which occurs during the collection of paddy straw for transfer. The operator has therefore to tidy the straw well when feeding it to the threshing drum. The working accuracy is clearly confirmed as being improved by the thresher. The result of the processing capacity is 510kg of paddy per hour.
It is worth noticing that on the average with short, long-culm varieties the grain loss of No. 3 chaff loss was 0.24% and unthreshed loss was 0.94% both of which are very small.
As stated above, the tops of the panicles were not trued up and unthreshed grains were left due to lack of practice. An improvement in skill will therefore result in a decrease in loss.
In conclusion, as a result of the studies on the rate of work and operation accuracy of the harvester as a combination system with the reaper, it required 4 hours and 47 minutes per feddan for the long-culm variety and the short-culm should be less. But skilled labour would greatly improve the work and operation accuracy and increase the quantity fed.
It is therefore considered that this system is a very promising one for mechanized harvesting in the studies of medium and small scale farmers.

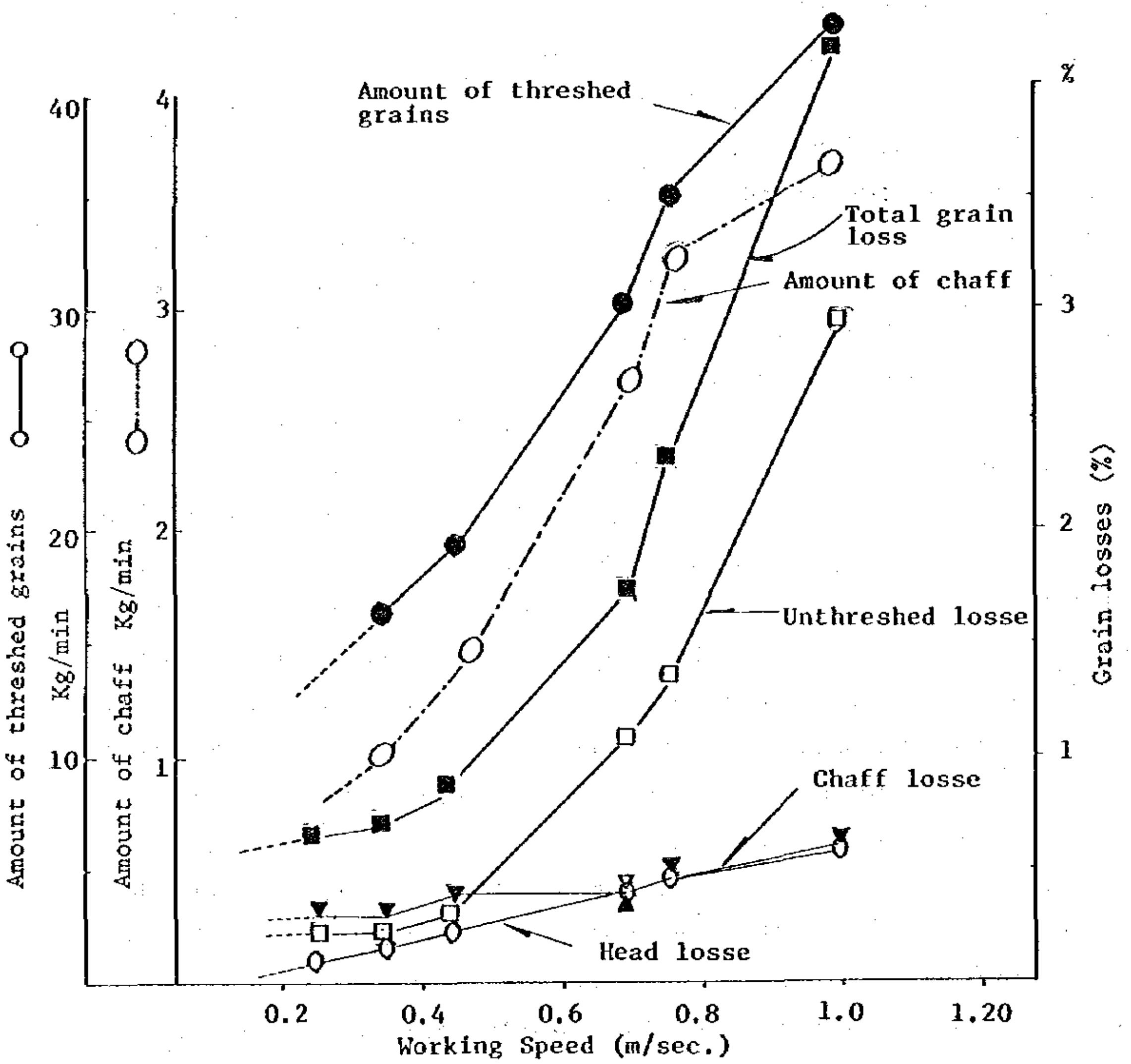


Fig. 47 The Relationship between Working Speed and Grain Losses

Note: Variety - Giza-173

Moisture content -
: Grain has 16.8%; and
: Straw has 51.8%.

(d) Combine (Ear-head feeding type of combine)

A performance test was conducted with this machine and a high rate of work as well as high operation efficiency was confirmed for the short culm variety.
The traditional variety of Egypt is the long culm variety Giza-172 and its long length of 120 cm makes it lodge easily.
It was pointed out that this machine is easily clogged by straws.
Therefore a suitable harvesting method was studied for the Giza-172. The period selected for the experiment was before plant lodging in order to study the rate of work and operation accuracy. The grain losses caused by the ear type combine were influenced by this mechanism, especially under lodging paddy plant conditions. The performance test for the ear type combine was carried out under several different field conditions. Fig. 46 shows the difference between the harvesting speed and losses. According to this Figure the losses increase with accelleration of work speed, this Figure shows the losses increasing greatly. The losses are closely related to the lodging condition and moisture content in the paddy plant after the heading. In order to keep the loss within 5%, the working speed of the combine could be adjusted around 0.4m/s under the 44.4^{o} stand angle for the long culm variety.
The occurrence of grain losses was also influenced by the reaping direction against the lodging direction. Especially a high ratio of grain losses were caused by low declining and low standing angles under the circumstances of work direction against lodging direction.
The occurrence of a high ratio for grain losses means that the shattering was caused by the picking up finger because the panicle position was located ahead of the hill position. Therefore the panicles were faced to a beating action by picking up to the hill position. The high rate of grain losses mentioned above were almost all caused by head losses. On the other hand the working direction was the same as the lodging direction. The grain losses were shown to be almost half the ratio compared to dry paddy plant conditions. It can be said that the grain loss with this type of

combine is almost the same as the head loss. The height limit of panicle distribution for the long culm variety (Giza-172) seems to be longer than that of the short culm variety (Giza-173).

A range of panicle position of around 60cm to 120cm plant height was observed for Giza-172. In order to avoid unthreshed losses for the lower panicle height, the feeding unit of the combine must be adjusted to the deepest position. Generally speaking the chaff quantity and trash are more in the short culm variety and the harvesting speed should be slower. This variety is an easily shattering type. When the harvesting speed is 0.4 m/s the percentage of head loss is 4.31% compared with a total grain loss of 5% without clogging as shown in Fig. 47. At a harvesting speed of 0.7 m/s the head loss is only 0.37% compared with a total grain loss of 1.5%.
Finally, harvesting this variety (Giza-172), by a head feeding type of combine is recommended to be done before lodging starts. If it is possible to harvest the immature grain, the harvesting speed can be accelerated and head loss would be less. The immature grain has a high moisture content therefore post harvesting must be considered (See grain drying). The most suitable harvesting speed for Giza-172 would be around 0.4 m/s (1440 km/hour) taking 4.7 hours per feddan with a 61% field efficiency. The Giza-173 variety has a very short culm and is easily harvested using the head feeding type combine. The harvesting speed is faster than that of Giza-172 and the most suitable speed is 0.7 m/s (2520 km/hour). The working rate is very high, 3.12 hours/feddan with a 63% field efficiency. In conclusion, performance tests and verification trials were conducted for both Giza-172 (long culm) and Giza-173 (short culm) using a head feeding type combine. In order to obtain maximum harvesting efficiency, the short culm variety, (Anti-lodging and non-shattering) should be recommended and introduced for mechanized harvesting.

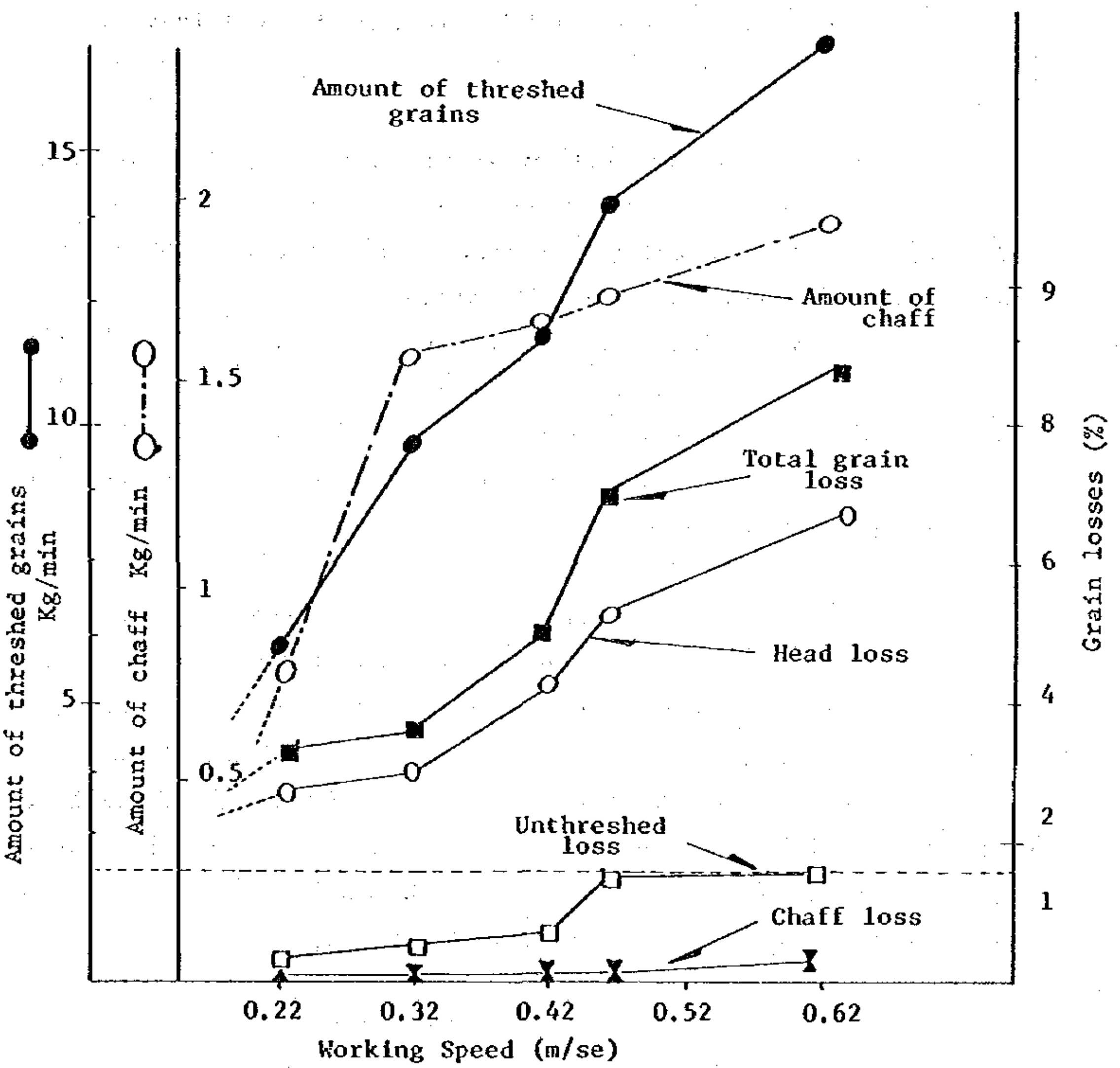


Fig. 48 The Relationship between Working Speed and Grain Losses

Note: Variety - Giza-172
Moisture content
: Grain has 16.3%; and
: Straw has 55.55%

2.2.3.(3) A Study on the possibility of mechanization of preceeding crop in order to avoid delay in the rice cultivating season

A delay in the harvest of wheat defers the rice planting period and this is one of the major reasons for a decrease in the paddy yields. Wheat, being a winter crop, occupies 40% of the fields later required for rice cultivation.
Any delay in harvesting the wheat, due to manual methods being employed, defers the time for rice transplanting. An experiment was therefore conducted on harvesting wheat using a mechanized combine and reaper to enable paddy transplanting to take place in the most suitable season.

Fig. 49 shows the suitable time for harvesting wheat in the Nile Delta. The ripening ratio and 1,000 grain weight radically increased in the first week of May becoming gradually stable by the middle of May. According to observations the moisture of the grain was 15-16% just after 30 days from the last irrigation. The experiment carried out using the reaper harvester concerned the cutting height, head grain loss, working rate and working efficiency. The details are as follows:

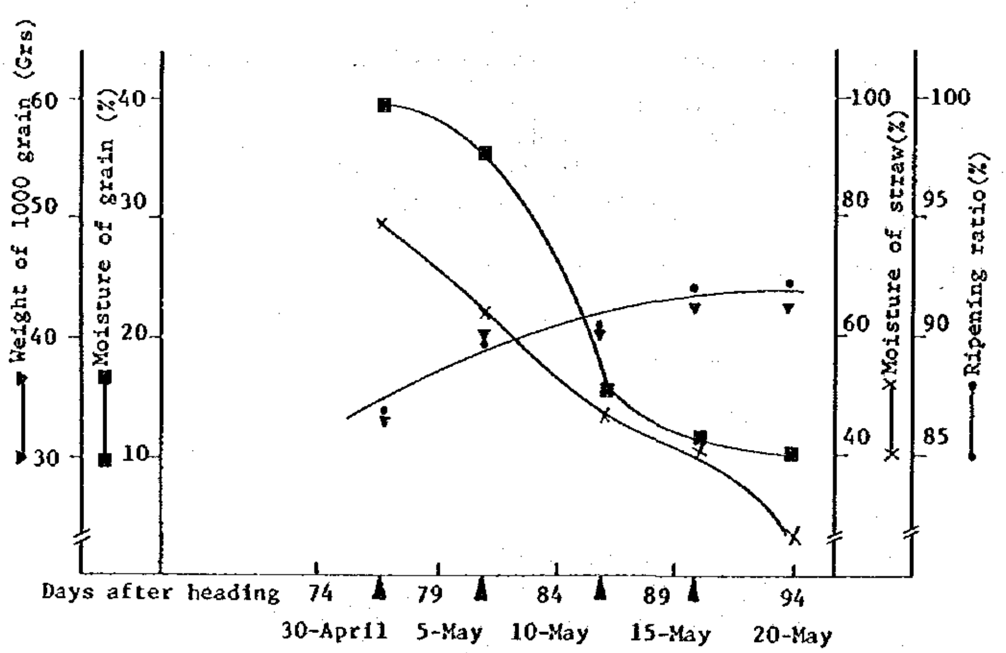


Fig. 49 The relationships between heading days, ripening ratio, and moisture of grain

A lodging degree of 45^{o} for reaping, either direction from mowing direction caused no high head grain loss, around 0.88%, with a cutting height of 9.5 cm. But if the plant lodging degree is around 30^{o}, mowing is possible from any direction, except opposite and right directions, with no increase in grain loss. The cutting height is slightly increased to around 55.6 cm since the wheat straw has as high a value in Egypt as the grain for animal fodder. Possibly mowing should be carried out to prevent any straw loss.

The investigation of the mowing performance of the reaper showed a high efficiency in the working rate of 1.3 hours per feddan and a working efficiency of the same as the rice harvesting of 88%.

When using the combine that has been used for harvesting rice for harvesting wheat there is a clogging problem in the No. 2 chaff return augur due to the difference between rice and wheat at the 1,000 grains weight. Each section should therefore be adjusted for wheat harvesting. First of all, the additional angle of the riddle and selection ratio are in an inverse proportion. Optimum adjustment values were therefore studied in advance. According to these the least broken ratio and unthreshed ratio were 25^{o} for the angle of riddle and No. 3 for the discharge level angle. The test conducted on the rate of work and working efficiency was based on the above adjustment.

The test was carried out using a head threshing type combine and showed the following performance results. Losses of each part of wheat tend to increase as the reaping speed increases but the amount of losses fitter according to the kinds of losses. Unthreshed grain loss is the highest being more than 50% of the total grain loss because the range of the panicle proportion is irregularly shown. An 85cm plant height shows 10% and 15 cm plant height shared less than 40% of the total. So even though the depth of the panicle head is controlled manually, due to the short culm, the top of the panicle cannot be caught up by the threshing drum. Therefore more than 50% of the total grain loss is from unthreshed grain. A suitable dryness occurs during the middle of May in the dry weather. The quantity of chaff is not increased and clogging does not occur. A suitable reaping speed for combine harvesting should be higher than that for rice, around 0.80 m/s without clogging. The operation rate is 1.9 hours per feddan with a working efficiency of 78.9%.

Table 14 PERFORMANCE TEST FOR COMBINE IN WHEAT FIELD

Testing condition	Time for 10m sec sec	20.16	13.00	12
	Harvesting speed(m/s)	0.49	0.72	0.83
	Sinkage of machine cm	105	0	0
	Cutting height cm	14.0	14.5	18.2
Performance	Harvested Straw weight kg/10m2	10.5	11.9	13.0
	Harvested Grain weight kg/10m2	4.70	5.75	7.25
	Chair weight gr/10m2	300	350	364
	Unthreshed loss pr/ 10m2	22.2	28.2	55
	Chaff loss gr/10m2	9.4	12.7	15.7
	Head loss gr/10m2	2.7	3.5	6.0
	Total weight of grain /10m2	4.77	5.80	7.30
	Unthreshed loss %	0.46	0.49	0.74
	Chaff loss %	0.19	0.22	0.21
	Head loss %	0.06	0.06	0.08
	Total loss %	0.71	0.77	1.04

Variety / Giza 155.
Moisture contents (chaff) / 15 %
" " (grains)/ 13 %

Standing angle / 50
Plant height / 105cm
Area / 4200 m^2

2.2.4. Establishment of technique for Grain Drying suitable for Climatic Conditions

As a result of comparison studies on various kinds of drying methods for the ear head threshing type of combine, it has been established that utilization of the solar grain dryer is the most suitable from a view point of the location in the Nile Delta, its highly practical use and low cost.

After harvesting it takes a week to reduce the grain moisture content of 22% to 14% by drying it on the ground where considerable loss takes place from sparrows and other causes.

The circulation type of dryer is suitable for large scale farming because of its high drying capacity. The performance efficiency of this dryer is 7 hours per 5.5 tons of paddy grains so it is both labour saving and extremely efficient but it is also very expensive unless shared by other farmers.

2.2.4.(1) Choice of solar grain dryer for economical reasons and climatic conditions

The existing rice harvesting in the Nile Delta is done by man-power using sickles. Mechanized harvesting methods were conducted in a limited area using reapers and combine harvesters. Generally, in this area, the farmers harvest the rice plants with a grain moisture content of below 20% and if the harvested grain has a low moisture content it would only be necessary to let it dry under natural conditions. In the case of Giza-172 however, the rice plants become completely lodged before harvesting because of heavy grains and over elongation of the rice plants. Under this condition of lodging the harvesting grain loss becomes higher than of a standing condition. It is considered that the total losses, including the head loss of the combine is around 15-25%. So it is necessary to harvest, using a combine, at a suitable period when the rice plant is standing and the moisture content of the grain is 20-25%. So the fresh paddy harvested by a combine must be dried artificially by a Solar grain dryer.
There is no rain in the Nile Delta during the rice harvesting season so there is abundant solar energy to dry the fresh paddy. The solar radiation is probably 500-600 Kcal/m^2/hour during harvesting from September to October.

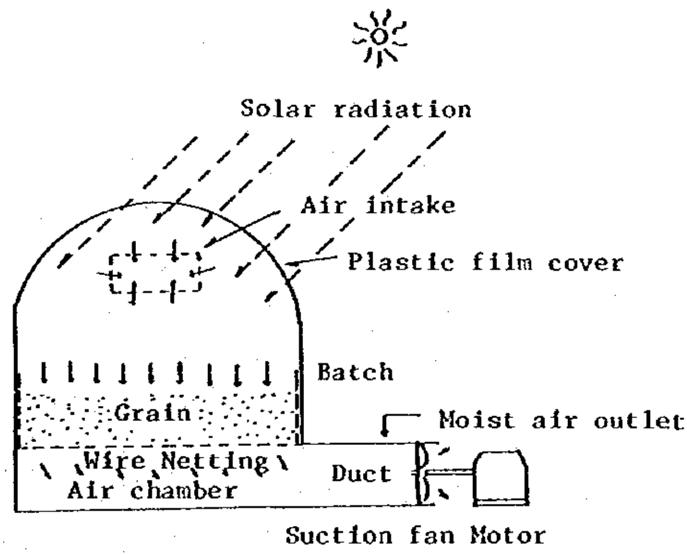


Fig. 50 Principle of Vinyl-house type Solar Grain Dryer

The solar grain drying method and technique is as follows. The greenhouse type solar grain dryer illustrated in Fig. 48 has many advantages, namely simple structure, easy construction and maintenance and low cost compared to other grain dryers. Fig. 49 shows the experiment carried out using a solar grain dryer on 3 loads of fresh paddy of 1 ton, 1.9 tons and 3.7 tons with a moisture content of 19%. The average drying rate of the paddy was reduced by 1.2% per hour, by 0.82% per hour and by 0.46% per hour for each of the loads respectively. It clearly demonstrated that the deep stack loading of 3.7 tons did not have a high drying rate.

The relationship between solar radiation and hot air temperature is shown in Fig. 51. According to this a close positive correlation is shown between increasing hot air temperatures and solar radiation Kcal.

The figure shows a figure of 300 Kcal with an increase of 2C^{o} increasing to 400 and 500 Kcal when the temperature rises by 3 to 4 C^{o}.

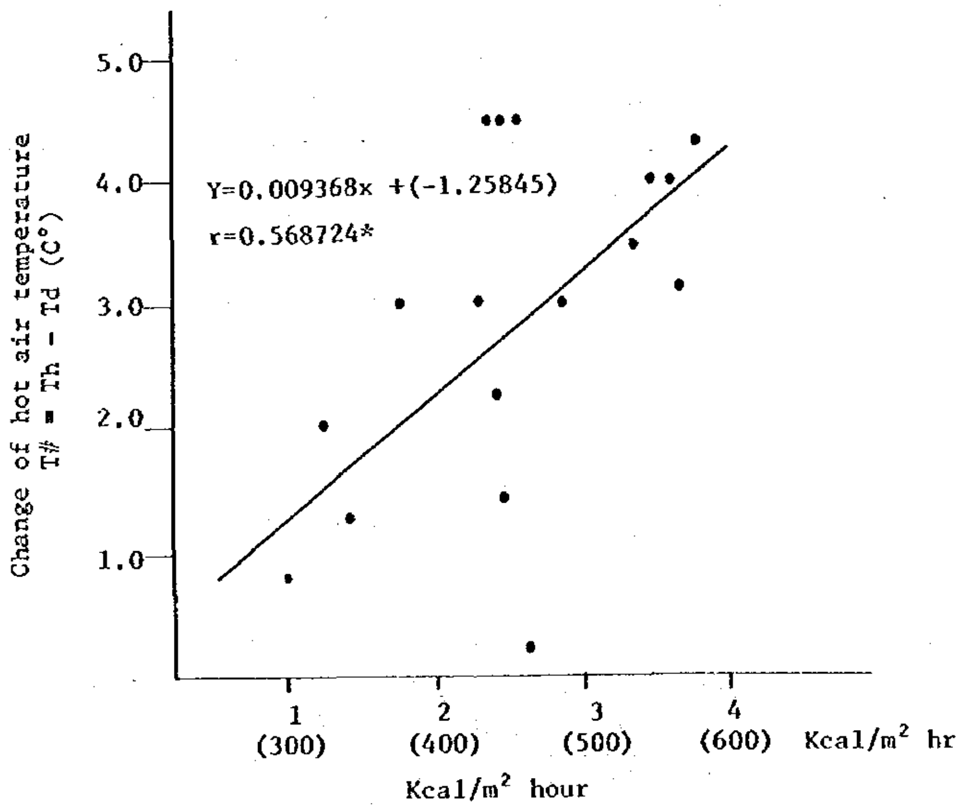


Fig. 51 The Relationship between Kcal/m^2 hour and hot air Temperature in green house

Notes: T# = Th - Td (C°)
Td = Out side temperature (C°)
Th = Hot Air temperature in green house (under the black net) (C°)

The relationship between hot air temperature and a decrease in the drying rate is shown in Fig. 52. According to this figure a positive correlation is shown of 0.885% per hour at an average hot air temperature of 24C^{o}.

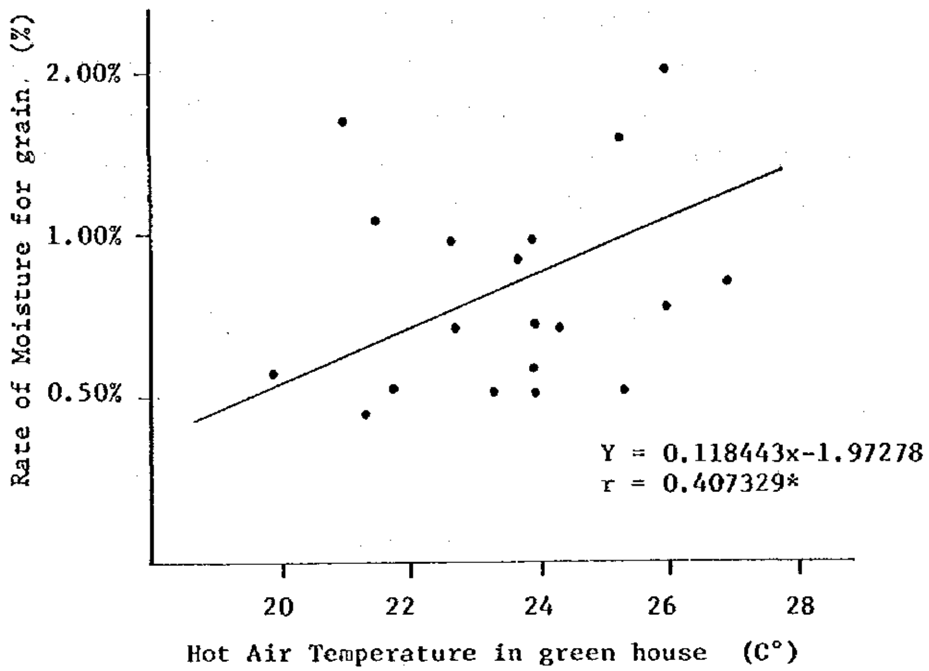


Fig. 52 The Relation between Rate of grain moisture and Hot Air Temperature in green house

It is therefore obvious that a 3 ton load of fresh paddy with a moisture content of 20% will take 8 hours to dry up to 14%. The crack ratio for every loading capacity, upper, middle and bottom layers did not show any crack and the drying time was also not influenced by these layers. The conclusion drawn from this trial was that to increase the drying rate the material for the solar energy absorber should be continually studied in order to increase the hot air temperature and that a verification trial should be carried out increasing the drying capacity by extending the drying floor.

Th verification trial for ways of natural drying was conducted. The moisture content of the paddy grain was about 19.10% after being reaped by a reaper and the drying ratio was about 0.47% per day. It took about 10 days to dry the grain to 14% using natural drying. Besides natural drying, the fresh paddy harvested by a combine must be dried artificially in a circulation type dryer which has a large drying capacity (509 tons/one path) and a drying ratio of 0.80%/ hour which is controlled by the hot air temperature inside the dryer. This dryer is suitable for holding large quantities of fresh paddy. The air can be heated by using kerosine fuel but the drying cost appears to be higher then either solar drying or natural drying.

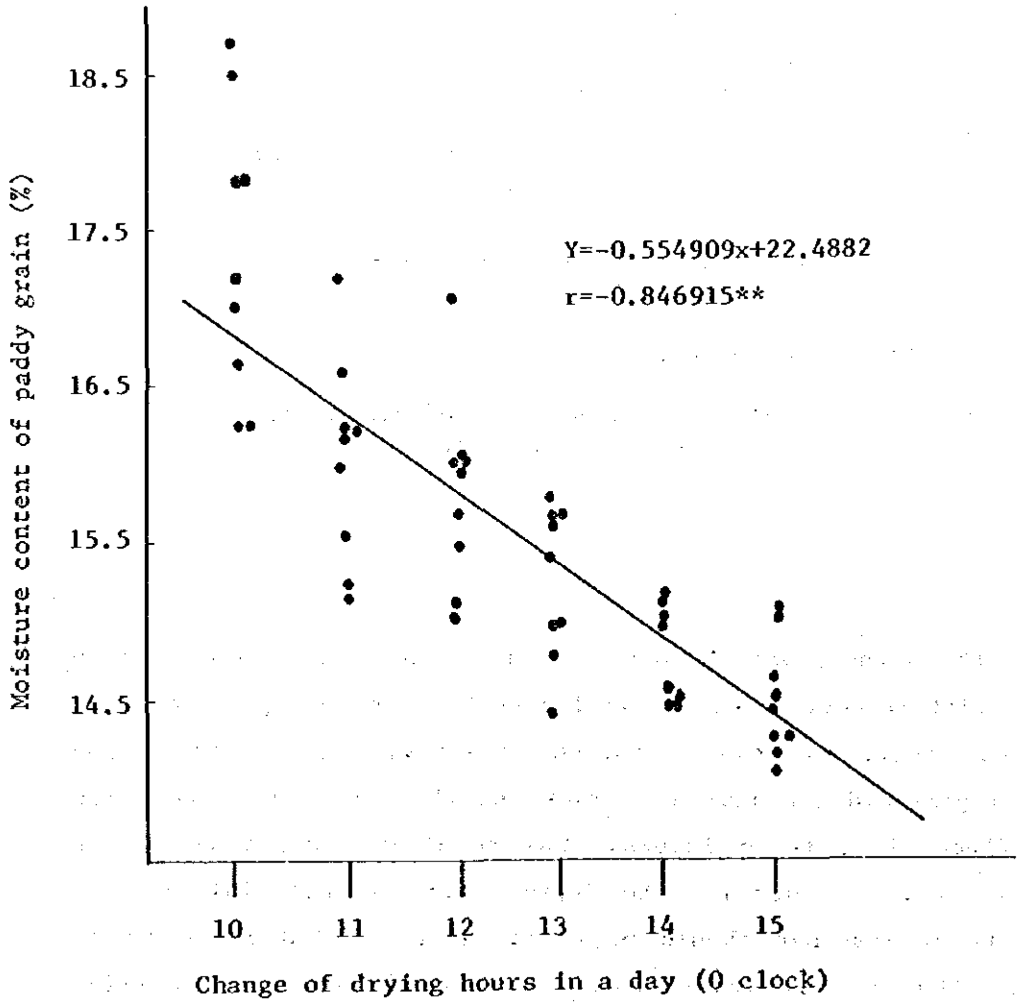


Fig. 53 Relations between the change of drying hours in a day and moisture content of paddy grain for 1000/kg.

II. ECONOMIC ANALYSIS FOR MECHANIZED RICE CULTIVATION SYSTEM

Comparison of cost and price and cost and revenue between traditional and mechanized rice cultivation systems are given in Fig. 54 and Fig. 55.

The mechanized rice cultivation system implies a comparatively higher machinery cost of 180.20 LE. per feddan (124.34 LE. in the traditional system), while it is benefited by lower labour cost of 66.26 LE. per feddan (170.45 LE. in the traditional system). That is to say, the total cultivation costs of both systems is almost the same.

After adding other direct costs, land rent and capital interest, the secondary costs of the mechanized rice cultivation and the traditional systems are 428.73 LE. and 419.21 LE. respectively.

Meanwhile, the experiments of the mechanized rice cultivation system showed an average paddy yield of 4.5 metric tons per feddan, whilst the average for the traditional system is 2.5 tons. Gross and net revenues of the mechanized rice cultivation system are 1,005.00 LE. and 576.27 LE. and those of the traditional system are 475.00 LE. and 55.79 LE. respectively.

Hence, the secondary cost per paddy rice metric ton in the case of the mechanized rice cultivation system is as low as 95.3 LE. and that of the traditonal system is 167.7 LE., evidencing clear "cost down effect" of the mechanized rice cultivation has an economical advantage over the traditional rice cultivation system if the paddy yield is 2.6 metric ton per feddan (the equilibrium) or more.

Efficiently mechanized working systems of plowing, puddling, transplanting, harvesting and grain drying, suitable for the conditions of the Nile Delta Region, have been established, and the advantage of mechanization has been made clear from the viewpoints of both yield increase and cost reduction effects.

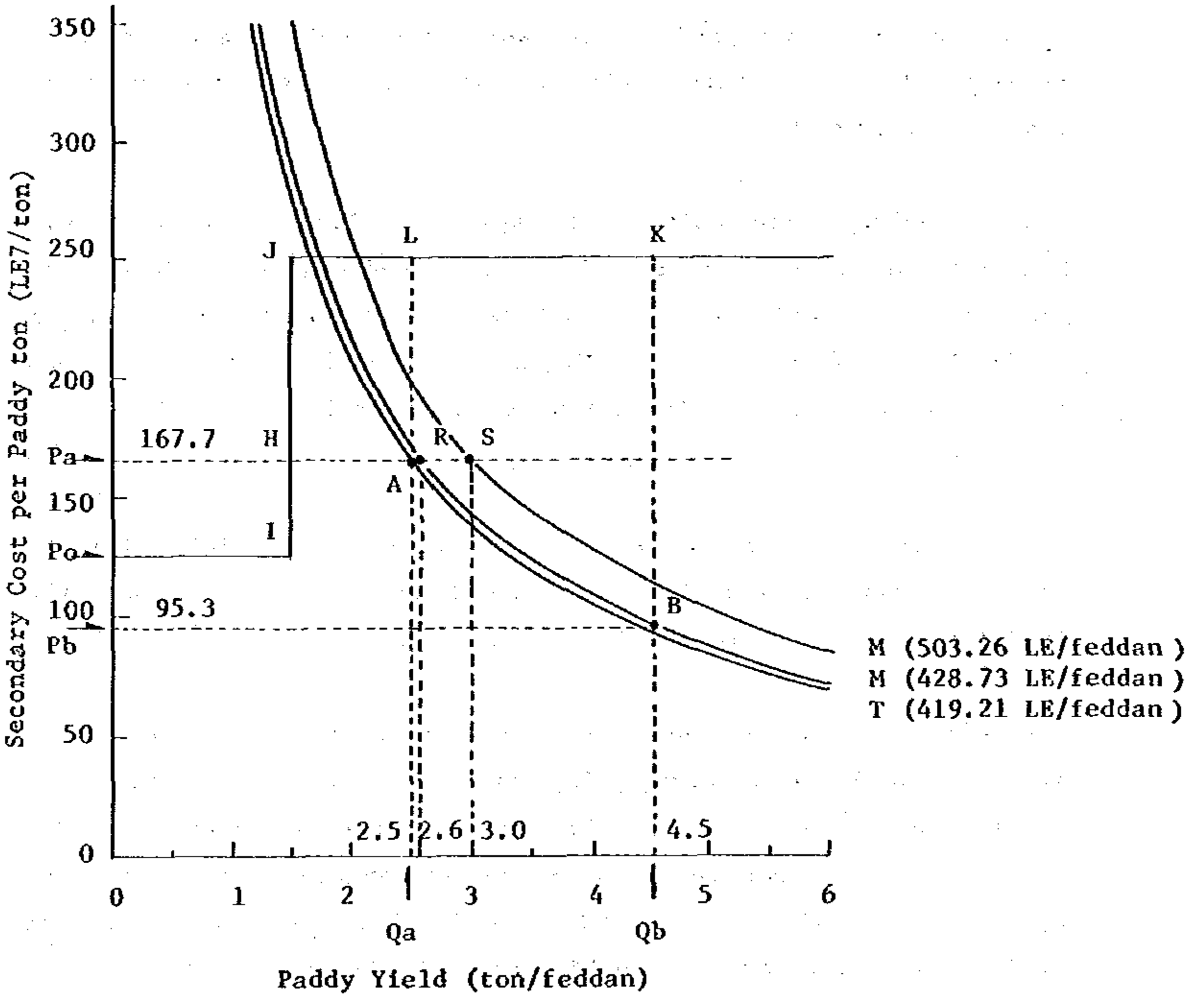


Fig. 54: Comparison of cost and price of paddy rice between the traditional system and mechanized system in rice cultivation

Note: T --- Traditional system

M --- Mechanized system depends on rental machinery

M'--- Mechanized system depends on joint holding machinery

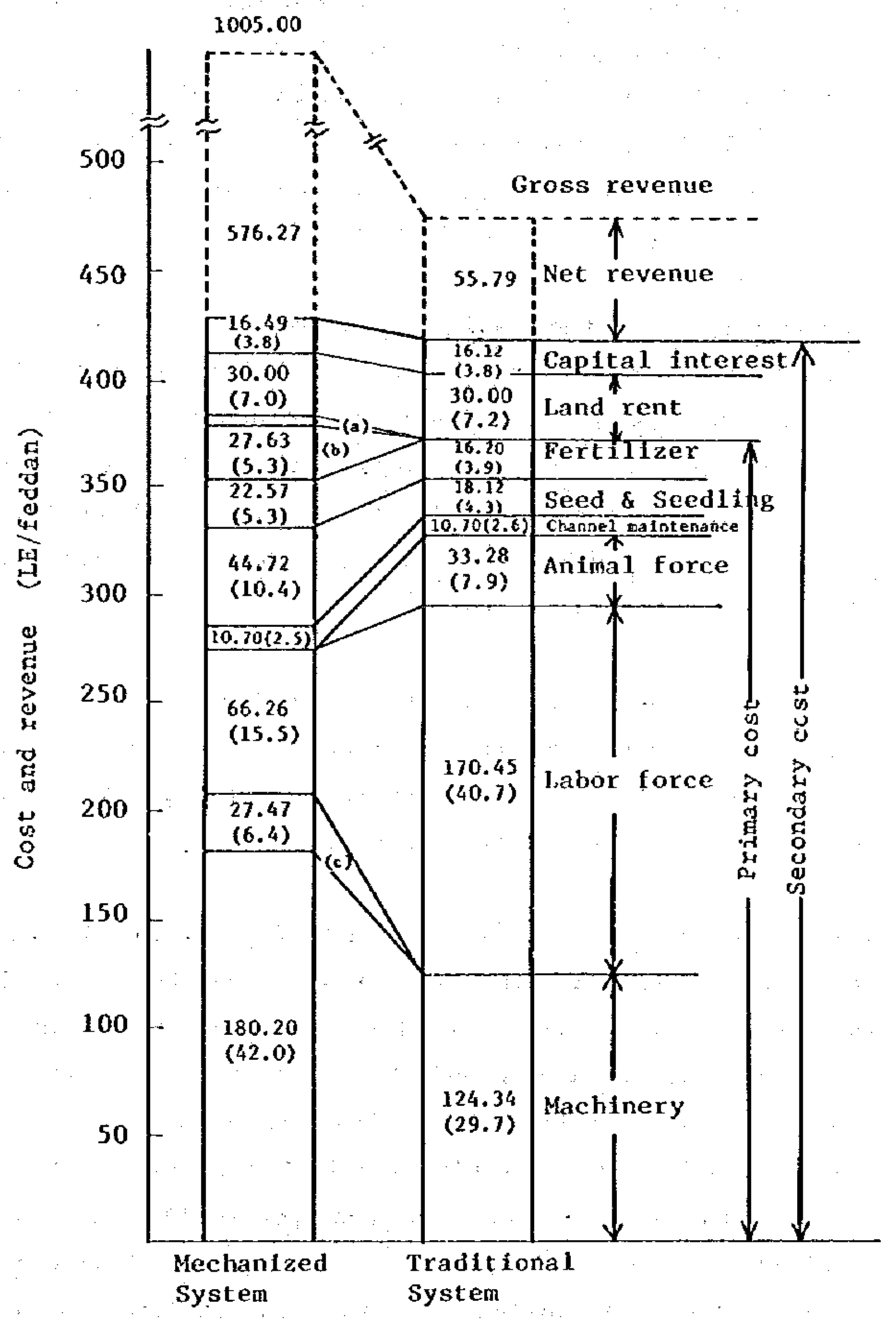


Fig. 55 Comparison of cost and revenue of paddy rice between the traditional system and mechanized system in rice cultivation

Note: (a) --- Fuel, Electric
(b) --- Herbicides
(c) --- Facility (solar grain dryer)

III. ESTABLISHMENT OF STANDARD MECHANIZED RICE CULTIVATION SYSTEM

In making a standard mechanized rice cultivation system adaptable for middle and small farmers in the Nile Delta, the Rice Mechanization Center has continuously examined the present farming system, productivity of land and labor, etc. According to the results of said examination, including all the trial results, a standard mechanized rice cultivation system has been established to adapt rationally, and effectively for all the operations of rice cultivation in this region.

The adaptability of the said standard mechanized rice cultivation system has been proved by the effect of reduction of labor and increased yield as well as the economic advantage after verification trials. However, the mechanized rice cultivation system, adapted for different individual regional conditions, is also considered. Therefore, further studies are required to modify the said system.

The comparison of cultivation practices in both the standard rice cultivation system and the traditional rice cultivation system shown in Table 15, also utilized machinery shown in Table 16, and working hours shown in Fig. 56.

The largest character of the standard mechanized rice cultivation system is not only reduction of working hours by utilizing machinery but also increasing the yield effect caused by optimum cultivation season and dense planting by using a rice transplanter and rational intensive cultivation practices according to growth stage. Results which mentioned all of it, have shown a paddy yield of 2.5 ton per feddan for the traditional rice cultivation system and 4.5 ton per feddan for the standard rice cultivation system. In additional, the results show a remarkable reduction in working hours as shown in Fig. 56.

Working Items	Standard Mechanized Rice Cultivation System	Traditional Rice Cultivation System
Raising of Seedling	1. Raising of seedling by seedling by seedling box 2. Settlement of obstacle factors for healthy seedling (1) pH value adjustment of bed soil (2) Zinc application (3) Optimum sowing Quantity, 200g/box (4) Nursery duration, 20 days 3. Young and healthy seedling, leaf age, 2.5, plant height, 15 cm 100 seedling box/Feddan	1. Raising of seedling by lowland rice nursery 2. Nursery duration, 40 days, around 6.0 leaf age seedling transplanting. 3. Sowing Quantity, 60 kg/350 m^2 for 1 feddan paddy field
Plowing and Puddling	1. Plowing optimum depth, 15 cm 2. Buring weeds and whole layer placement of fertilizer by PTO driven puddling rotary	1. Deep plowing, around 25 cm 2. Surface levelling only by animal-driven wooden leveller, deep field condition
Fertilizer Application	1. Rational split application of Nitrogen fertilizer, 50% as basal, 20% in the rooting stage, 20% at 18 to 20 days before heading and 10% at the full heading stage	1. No basal fertilizer application and top-dressing at the neck-node differentiation stage
Transplanting	1. By rice transplanter, dense, shallow and uniform transplanting, 4-6 plant/hill, 24 hill/m2 2. Possible to produce tillers from lower node by young healthy seedling	1. Random transplanting manually, 20 to 25 Nos. plant/hill, around 16 hills/m2 2. Impossible to produce tillers from lower node due to aging seedling utilization
Weeding	1. Rational herbicides application after puddling and transplanting	1. Hand weeding and herbicides application sometimes carried out
Water Management	1. Rational water management according to the growth stage 2. Mid-summer drainage to prevent inter-node elongation and lodging from 43 to 20 days before heading	1. Successive irrigation
Harvesting and Drying	1. Harvesting by head feeding combine, within short time 2. Minimized grain losses 3. High quality paddy without any admixtures such as small stones and soil clod	1. Manual reaping, thresing by wheel tractor on the ground, from reaping to storing. As so many operations required the working hours are increased accordingly. 2. The high rate of grain losses has been confirmed for these operations 3. Admixture materials are contained in paddy due to threshing on the ground by wheel tractor

Table 15 Comparison Table of Rice Cultivation Practices Using the Traditional and the Standard Mechanized Rice Cultivation Systems

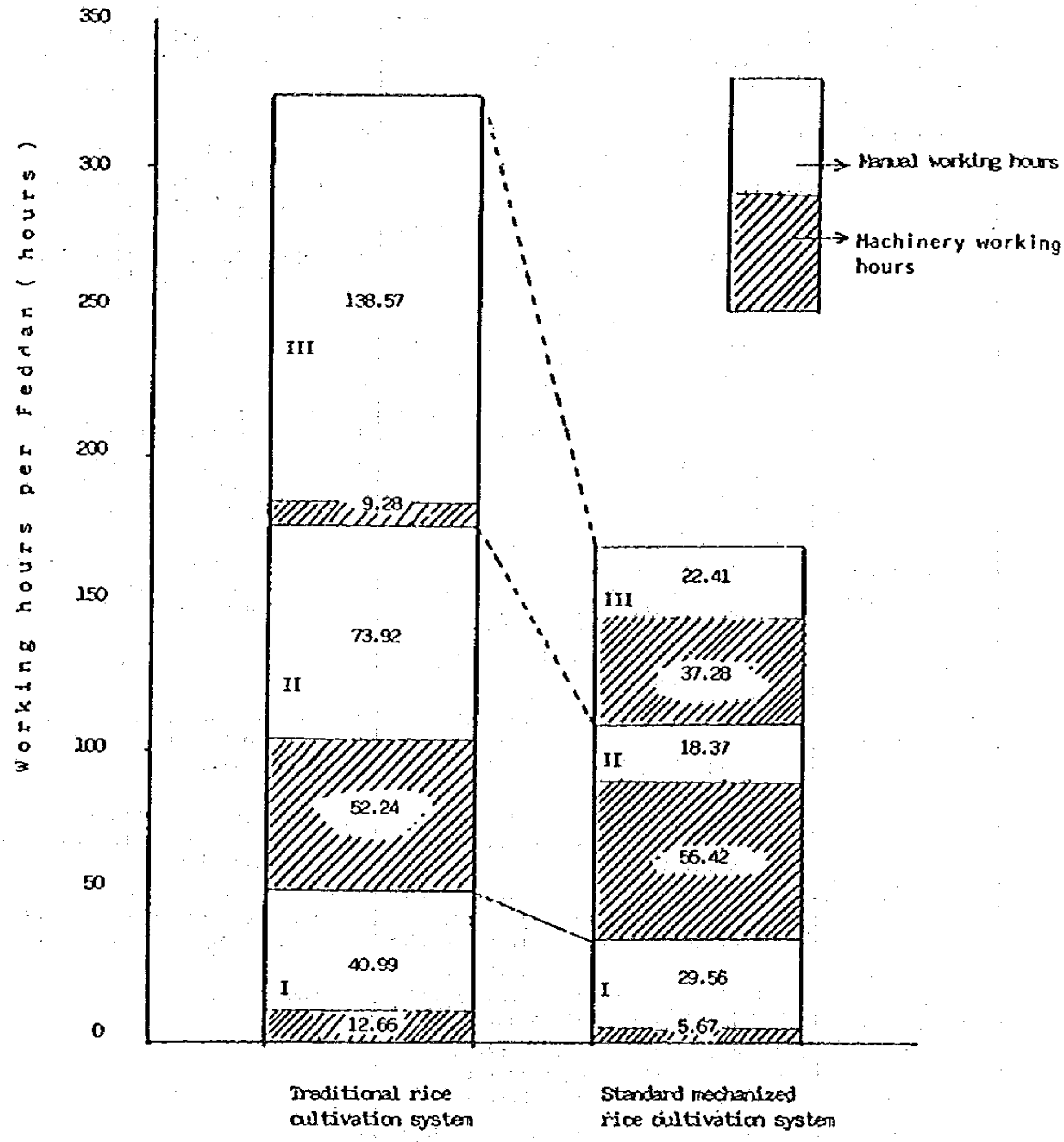


Fig. 56 Comparison between the Working Hours of the Traditional and Standard Mechanized Rice Cultivation Systems

Notes: I = Raising of seedling up to transplanting of seedling

II = Plowing, puddling, irrigation, transplanting, fertilizer application, etc. up to just before harvesting

III = Harvesting (reaping up to storing of paddy)

Total Working Hours:

Traditional Rice Cultivation System:
327.77 hours (manual, 253.49 + machinery, 74.18)

Standard Mechanized Rice Cultivation System:
168.71 hours (manual, 70.34 + machinery, 98.37)

Standard mechanized rice cultivation system

Serial Nos.	Name of machinery		Specification	Nos.	Method of utilization
1.	Wheel tractor (4 wheel driven type)		50 PSclass	1	Rental
2.	Tractor Attachment	Chisel plow (9 tines)	1.75 m width	1	"
3	Tractor Attachment	PTO driven puddling rotary	3.6 m width	1	"
4.	Tractor Attachment	Trailer	4.5 ton cap,	1	"
5.	Power sprayer (Irrigation for seedling)		600 liter tank cap,	1	"
6.	Irrigation pump		Centrifugal type 5.5 to 6 Ø	1	"
7.	Riding type rice transplanter		8 row	1	"
8.	Head feeding type combine		Cutting bar width, 1.3 m	1	"
9.	Solar grain dryer		Floor age, 25 m^2 to 50 m^2	1	Joint operation

Traditional rice cultivation system

Serial Nos.	Name of machinery		Specification	Nos.	Method of utilization
1.	Wheel tractor		50 ps class	1	Rental
2.	Tractor attachment	Chisel plow (9 tines)	1.75 m width	1	"
3.	Tractor attachment	Rear bucket leveller		1	"
4.	Irrigation pump		Centrifugal type, 5.5 to 6.0 Ø	1	"
5.	Winnower		Electric motor attached,	1	"

Table 16 Introduction of Machinery for Rice Cultivation (Traditional Rice Cultivation System and Standard Mechanized Rice Cultivation Systems)

The mechanized harvesting system showed the highest reduction rate in working hours. These reduced hours have the effect of breaking the peak of working as well as being on time to take advantage of the optimum cultivation season for successive crops. Considering a comparison both the traditional and standard mechanized cultivation systems, or can be characterized by increasing the paddy yield (high yield), reduction of working hours (saving working hours), high capital investment and intensive cultivation methods for the standard mechanized rice cultivation. The traditional method calls for a lower capital investment, lower level of paddy yield and longer labour working hours. In addition the reduced working hours by mechanization produced a state of readiness for the optimal seasonal cultivation, not only for paddy rice but also for the pre-crops and post-crops of paddy rice. A good understanding of all the operational techniques for the standard mechanized rice cultivation system is a major premise to obtain successful results.

	Kind of Work	RAISING OF SEEDLING										
		Collection of Bed Soil	Sieving and Fill-Up Soil	Plowing and Levelling for Greening Bed Preparation	Seed Selection	Seed Disinfection	Soaking of Seed	Hastening of Germination	Irrigation for Seedling Box	Sowing	Covering Soil	Pile up of Seedling Box for emergence of Seedling
CULTIVATION PRACTICES	Technical Comment	Collected Soil from good wheat field	Bed soil, sieved by 5 mm mesh; Covering soil, by 3 mm mesh	1.5 m x 17 m for 100 Nos. of Seedling Box. Irrigation and drainage canal should be close by	Salt solution	Benlate T, dilution 20 x 10 min	Irrigation Canal	Germination (Bud) Height, around 1 mm	ZSO₄ mix, 5 g mixed with 100 liters of soaking water. Tachigaren mix, 1 cc mixed with 1 liter soaking water	Sowing Q'ty per box, 180 g (Dry Weight)	Covering soil height, around 0.5 cm	2 boxes crossways, pile height up to 25 boxes
	Optimum Working Season	26/Apr - 18/May	26/Apr - 18/May	26/Apr - 18/May	26/Apr - 18/May	26/Apr - 18/May	26/Apr - 18/May	30/Apr - 22/May	2/May - 24/May	2/May - 24/May	2/May - 24/May	2/May - 24/May
WORKING PRACTICES	Possible Working Days	23	23	23	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5
	Name of Machinery and Equipment Utilized	Wheel tractor with trailer	5 mm sieve 3 mm sieve	Wheel tractor with chisel plow					Water pump with diesel engine			
	No. of Persons Working	3	2	2	1	1	1	1	1	2	2	2
	Actual Working Hours Per Feddan: Machinery Work	0.71		0.03					0.57			
	Actual Working Hours Per Feddan: Man Power Hours	1.43	5.71	2.83	1.43	0.71	0.71	0.71	5.14		1.43	1.43
	Actual Working Hours Per Feddan: Total	2.14	5.71	2.86	1.43	0.71	0.71	0.71	5.71		1.43	1.43
	Required Amount of Machinery	1		1					1			
	Required Quantity of Material per Feddan	500 kg of unsieved soil	Sieved soil: 230 kg by 5 mm mesh; 100 kg by 3 mm mesh, 1 kg of newspaper		Table Salt, around 3 kg/paddy for seed, 40 kg.	Benlate T, 200 g		Vinyl film, 1.4 m x 4 m	Vinyl film, 1.4 m x 10 m ZSO₄, 5 g Sulphuric Acid, 2.5 liters Tachigaren, 100 cc	20 kg Dry Weight		Vinyl film, 1.4 m x 20 m
	Technical and Other Important Points		Newspapers must be holed by nail to save soaking time	Greening bed must be arranged with good levelling	Specific Gravity, 1.3				Avoid over soaking	Uniform sowing	Avoid thick covering	Before 1st week of May, covered by vinyl film, Temperature, under 3° C

Chart 1 - Page 1: Standard Techniques for Mechanized Rice Cultivation

RAISING OF SEEDLING						PADDY FIELD						
Transfer of Seedling Box to Greening Bed	Irrigation by Sprayer	Greening Bed Management, Top-Dressing	Pest Control Before Transplanting	Transportation of Seedling Box for Transplanting	Fertilizer Transportation and Application (Basal)	Plowing	Irrigation	Puddling and Levelling	Transplanting	Herbicide Application: 1st Application	Herbicide Application: 2nd Application	Herbicide Application: 3rd Application
Coleoptile Height around 3 cm	Maintain just enough moisture, Remove thick covering soil and Coleoptile should have appeared	Avoid over irrigation and stagnant water in Greening bed	If necessary	The condition of healthy seedlings: Leaf age, 2.5 Dry matter weight, 1g/100 Plant height, around 15 cm		Longthwise and Sideways each once, Plowing Depth 15 cm	By water Pump	Longthwise once	// Water Management Method: No. of Plants: 4-6/hill; No. of Hills: 24-26/m2 Planting Depth: around 2-3 cm	Name of Herbicide: Ronstar Application time: just after puddling Q'ty/Feddan: 1.5 liters	Name of Herbicide: Saturn or Machete Application time: Around 7 days after transplanting Q'ty/Feddan: 1.5 liter or 12 kg granule	If necessary 15 days after transplanting
5/May - 24/May	5/May - 27/May	8/May - 15/June	21/May - 14/June	22/May - 15/June	15/May - 12/June	15/May - 12/June	19/May - 12/June	19/May - 12/June	22/May - 15 June	19/May - 12/June	29/May - 22/June	6/June - 30 June
20	23	39	25	12.5	29	29	12	12	12.5	25	25	25
	Power Sprayer	Water Pump		Wheel Tractor with Trailer	Wheel Tractor with Trailer	Wheel Tractor with Chisel	Water Pump	Wheel Tractor PTO rotary Puddling	8 row riding type transplanter			
2	2	1.		2	2	1	1	1	3	1	1	1
	1.43	2.22		0.71	0.71	3.03	7.78	1.14	2.76			
1.43	1.43	4.45		0.71	5.71				5.51	1.43	1.43	1.43
1.43	2.86	6.67		1.42	6.42	3.03	7.78	1.14	8.27	1.43	1.43	(1.43)
	1	1		1	1	1	1	1	1			
				No. of Seedlings: around 100 box/feddan	Super Phosphate, 168 kg; Potassium Sulphate, 25.2 kg. Ammonium Sulphate, 125 kg		Around 840 m3		No. of Seedlings: around 100/ Seedling Box	Ronstar 1.5 liters	Saturn 1.5 - 2.0 liters or 12 kg Machete granule	Basagran 1.5 liters
	Prevent over irrigation and stagnant water in the greening bed	Irrigation water must be drained out after absorbed enough by seedling box soil, Top-Dressing: 5 g/box of Nitrogen, 4 - 5 days before transplanting	In case of appearance of Blast and rice leaf pest control must be done	Prevent sharp bends and breakdown	Uniform application required	Avoid deep plowing		Drive with slow speed	Adjustment of machinery must be done correctly. Working speed: around 0.5 m/sec.	Water should be kept around a depth of 6 cm	According to plant and weed condition, application time can be adjusted either earlier or later	According to the occurrence of weed, herbicide can be changed

Chart 1 - Page 2: Standard Techniques for Mechanized Rice Cultivation

PADDY FIELD											
	Top-Dressing			Pest Control							
Weed Control Manually	1st Application	2nd Application	3rd Application	Insect	Disease	Water Management	Mid-Summer Drainage	Harvesting	Transportation Paddy	Paddy Drying	Transportation Straw
If necessary	Application Time: 7 days after transplanting	Application Time: 18-20 days before heading	Application Time: Head Sprouting period	If necessary for Blast		2 hours every 4-5 days	42 - 35 days before heading time. Duration: around 2 weeks	By head Feeding type combine		By Solar Grain	After Dried up Straw
1/Aug-31/Aug	28/May-21/June	10/Aug-4/Sep	6/Sep-27/Sep			22/May-15Oct	23Jul-12/Aug	13/Oct-10/Nov	13/Oct-10/Nov	13/Oct-13/Nov	18/Oct-15/Nov
31	25	26	22			72	20	29	29	32	29
				Power Sprayer		Water Pump		Head Feeding Type Combine	Wheel Tractor with Trailer	Soral Grain Dryer	Wheel Tractor with trailer
	1	1	1			1		2	2	3	3
						40		2.99	2.86	25	6.43
	1.43	1.43	1.43					2.99	2.86	3.70	12.86
	1.43	1.43	1.43			40		5.98	5.72	3.70	19.29
						1		1	1	1	1
	Urea: 21.9 kg	Urea: 21.9 kg	Urea: 11 kg			Around 518k M^3		Bag for combine Around 150 Estimated Yield 4.5 t per Feddan			
		Application must be controlled in order to avoid elongation of internode				Rooting and Heading Time must be controlled with deep water, irrigation water can be stopped around 17-20 days after Heading	In order to avoid Lodging (due to elongation of internode), Mid-summer drainage must be carried out	Around 40 days after Heading Time		Operation time, from 8 am - 4 pm	

REMARKS

* Possible working days have been influenced by irrigation water supply schedule, such as 4 days supply of irrigation water and 4 days stoppage. Therefore, work requiring a supply of irrigation water could only be carried out 50% of the available time.

** Transplanting work by rice transplanter must be carried out 3 days after puddling work by PTO driven rotary puddler in order to avoid conditions too soft for the rice transplanter.

*** Leaf age Count System:
Coleoptile = 0
Imperfect Leaf = 0

In order to keep up the effect of Benlate T, and its adherence, the seed should be dried up after disinfection by Benlate T.

Water Management Method:
- Deep Flooding, 5-7 cm
  a. After Puddling Before Transplanting
  b. After Transplanting, up to 3 days
- Drain Out Water
  a. Before transplanting
- Shallow Flooding (2-3 cm)
  a. From 4 days after Transplanting up to Mid-Summer Drainage

Field Surface should not appear with shallow flooding

Chart 1 - Page 3: Standard Techniques for Mechanized Rice Cultivation

Chart 2: The Results of Training for Mechanized Rice Cultivation

Title of Training Course		Training schedule												Name of Governorate and Number of trainees placed										Total	No. of Training Courses	No. of days per course
		4	5	6	7	8	9	10	11	12	1	2	3	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)			
Rice Mechanization Basic Course	1982													148										148	10	6
																					Sub total			148	10	
Rice Mechanization Basic Cours	1983													268										268	15	12
Advanced Machinery Course														13										13	1	6
Advanced Cultivation Course														12										12	1	12
																					Sub total			293	17	
Rice Mechanization Basic Course	1984														10	13	9	8	1	1	1			43	3	16
																					Sub total			43	3	
Rice Mechanization Basic Course	1985															8								8	1	12
Rice Mechanization Advanced Course																9	8	7	1	1				26	2	12
Agricultural Machinery Practical Training of University Students																						196		196	12	6
Joint Training Program with Sakha Agricultural Station																								30	1	6
																					Sub total			260	16	
Agricultural Machinery: Practical Training of University Students	1986																							96*	7	5
Total														441	27	21	16	9	2	1	1	292	30	840	53	

Note: (1) = Kafr El-Sheikh (2) = Sharkia (3) = Bihira (4) = Kalubia
(5) = Gharbia (6) = Cairo (7) = El-Menia (8) = Beniswif
(9) = University students (10) = Joint training with Sakh Station
* = As of 28th July 1986

Details:

Rice mechanization basic course	29 courses,	467 trainees
Rice mechanization advanced course	2 course,	26 trainees
Advanced machinery course	1 course,	13 trainees
Advanced rice cultivation course	1 course,	12 trainees
Executive engineer training course with Sakh	1 course,	30 trainees
Practical training for University Students	19 courses,	292 trainees

RMC, Mechanization Division, July 1986

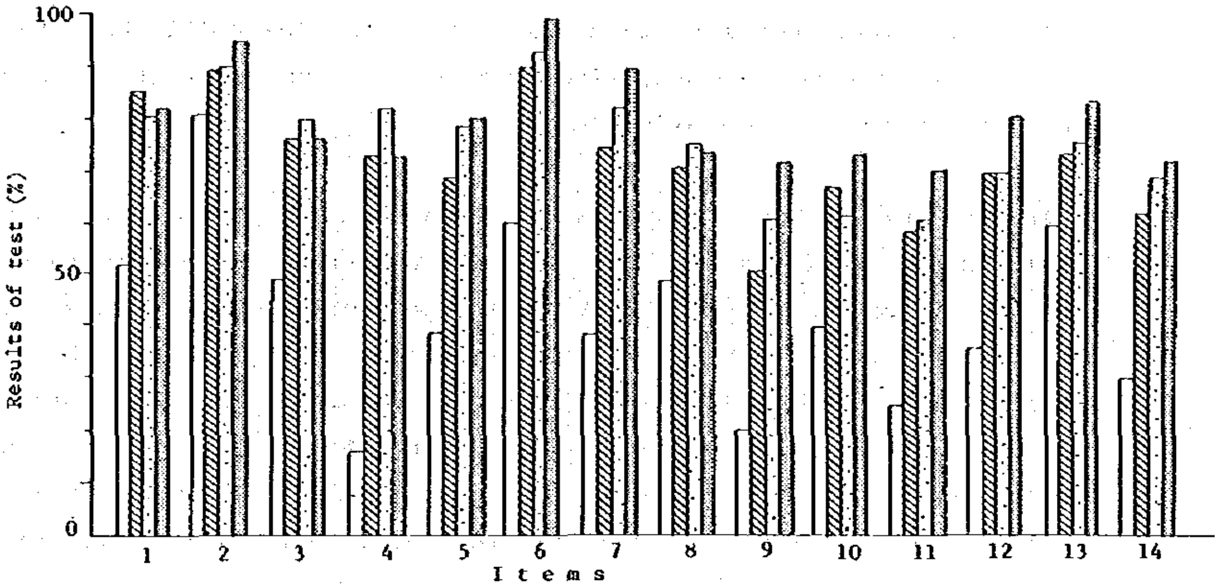


Fig. 57 The results of tests for non-trained staff: once, twice and three times trained.

Note:

Items

1 = Raising of seedling
2 = Paddy field preparation
3 = Working schedule
4 = Working capacity of rice transplanter
5 = Adjustment of rice transplanter
6 = Cropping season for paddy plant
7 = Maintenance and repairing of machinery

Items

8 = Herbicides
9 = Basal fertilizer application
10 = Top-dressing and mid-summer drainage
11 = Harvesting time and drain out irrigation water
12 = Harvesting by combine
13 = Storing of machinery
14 = Economic points for mechanized rice cultivation

Non-trained staff	Once trained staff	Twice trained staff	Three times trained staff
X = 42.94	X = 73.11	X = 76.00	X = 80.41
SD = 17.59	SD = 11.52	SD = 10.20	SD = 9.48
n = 14	n = 14	n = 14	n = 14

IV. TRAINING ACTIVITY FOR MECHANIZED RICE CULTIVATION

Training programmes for the mechanization of rice cultivation have been carried out continuously since October 1982 up until the present time, at the Rice Mechanization Center.

The results of these activities are shown in Fig. 55, which gives in detail the types of courses, their titles, schedules, durations and the number of trainees, etc. Instructors conducting the courses and demonstrating the principles of mechanized rice transplanting prior to March 1984, were from the Staffs of the Governorate of Kafr El-Sheikh and the Agricultural Cooperative. Although the First Phase of the Project was carried out at the Kallin Center, which at that time had no available accommodation facilities for trainees, these alternate arrangements were followed.

Accommodation facilities for trainees became available with the completion of the new Meet El Dyba Rice Mechanization Center in 1984 and the aims and objectives of the Second Phase of the Project were carried out there. Trainees were enrolled from the Governorates where rice cultivation was prominent and university students were attracted by the comprehensive studies offered in this field in Egypt.

1. Training Materails and Detai;s of Training

Details of training and teaching materials are summarized in Table 17.

Training lectures (basic courses for rice mechanization) and general practices are in the ration of 1:1. The raising of seedlings by seedling box takes up a great part of the curriculum, in view of local circumstances. Text books, manuals, pamphlets and other training materials are revised, supplemented and up-dated on a regular basis to incorporate verifying results of experiments, advice on mechanization problems and guidance activities. Films and slides are also used aiming at the prospect of audiovisual training in the future.

Table 17 Training Contents and Materials Required

Years and months	Training contents	Training Materials Required	Remarks
1982 October to 1983 April	Raising of seedling by seedling box for mechanized rice transplanting and rice transplanter performance.	* Raising of seedling by seedling box. * Rice transplanter	Training duration, 1 week.
1983 December to 1984 March	Raising of seedling for mechanized rice transplanting and rice transplanter Paddy cultivation practices Working performance and cost for mechanized rice transplanting.	# Raising of seedling and mechanized transplanting. # Paddy rice culture physiology and fertilizer application techniques. * Diseases and insect pest control for raising of seedling by seedling box. # Performance of rice transplanter	Training duartion, 12 days. Slides and Films have been used for training since Dec. 1983
1984 September to 1985 February	Mechanized rice cultivation (From raising of seedling up to mechanized harvesting)	# Raising of seedling for mechanized transplanting (Revised edition) # Paddy culture physiology and fertilizer application techniques (Revised edition)	Training duration, 12 days and 16 days.
1986 January ～	Mechanized rice cultivation (From raising of seedling up to mechanized harvesting)	# The field practices of mechanized rice cultivation # Manual of self feeding type combine harvester (Safe handling and maintenance)(Revised edition) # Manual of rice transplanter (Safe handling and maintenance) (Revised edition)	Training duration, 12 days and 1 week (for University students, practice training)

Note : * Pamphlet, written in Arabic
Text book

2. Results of Questionnaires from Trainees

In order to assess the degree of effective training activity, all the trainees were requested to complete both the pre and post-training Questionnaires. Such factors as technical points, training durations, training materials, and lectures, etc., were covered in the Questionnaires.

The effects of training were clearly recognized. It is believed that the trainees benefited from the programmes and that their level and scope of knowledge were increased.

As mechanized rice transplanting has only been in practice since 1983, it has been said that the principle of it has not taken root as satisfactorily as it might have in local districts other than the Governorate of Kafr El-Sheikh. Taking these circumstances into consideration, and in view of the absolute necessity to settle the technicalies for the basis of mechanized rice transplanting, the raising of seedlings by seedling box should be the main subject of training.

A complete arrangement for heating equipment for the winter season was among other requests. Trainees are satisfied with meals and accommodation. Sports supplies and equipment have been made available and activities have been arranged. However, measures should be taken for heating the recreational areas during the winter months. Air conditioning/heating units are greatly desired to serve the dual purpose of coping with high temperatures in the summer and cold/windy/damp conditions in the winter season. As power breakdowns are frequent, emergency back-up equipment would be most advantageous.

There were no problems of discipline encountered in connection with training life.

Training results are clearly recognizable through observations of the Demonstration Site for mechanized rice transplanting at Kafr El-Sheikh, under the supervision of personnel who have completed training at the Rice Mechanization Center. For the settlement of further technicalities concerning the principles of mechanization, an improvement of basic training, and the inclusion of refresher training programmes, as well as on-the-job training (OJT) are considered important aspects to any subsequant verifying experiments envisaged for the Rice Mechanization center.

V. ADVICE AND GUIDANCE ON THE DEMONSTRATION OF ACTIVITIES OF MECHANIZED RICE FARMING

In 1984, the demonstrations on mechanized rice cultivation, based on the results achieved by the verifying trials, had to be cancelled because of a shortage of irrigation water. The actual demonstration activities were conducted in 1985, using 40 feddans of the experimental farm attached to the Rice Mechanization Center. The Egyptian Counterpart personnel assumed their duties under the guidance and advice of the Japanese Experts.

The anticipated paddy yield of 4 tons per feddan was achieved and the good results of the mechanized rice farming system envidaged by the Project, were actually confirmed. In comparison to the existing paddy yield of 2.5 tons per feddan, the achievement of such a significant increase in yield, should be evaluated as the fulfillment of the main objective of the Project.

During the rice cultivation period, the Center had many visitors who came to observe the demonstration activties, and the Egyptian Counterparts took care of them.

The Egyptian Government formulated a Five Year Food Production Increase Plan as one of the measures of improving its agricultural and social situation, and gave priority to mechanized rice cultivation as an important political measure. In response to this policy, the Ministry of Agriculture in Egypt, inaugurated this Project in 1982 to establish mechanized rice cultivation technology for suitable local agricultural conditions in Egypt. However, the Ministry of Agriculture as well as the major rice cultivating Governorates in the Nile Delta area, expressed their strong intention of spreading partial technology tentatively during 1983, as they could not wait for the completion of the mechanized rice cultivation technical system as covered under the scope of the Project.

Under these circumstances, the Ministry of Agriculture, and the Governorates of Dhkalia and Kafr El-Sheikh (whose combined share of the total of one million feddans under rice cultivation in Egypt amounts to 50%) purchased Japanese-made rice transplanters and started to give demonstrations to the farmers. Concurrently, they strongly requested the Project to render whatever advice and guidance they were able to offer. However, the Project considered it somewhat premature to spread techniques as its activities had just started. nevertheless, the Porject could not ignore demonstrations of the system promoted uindependently by the Egyptian side, so in April 1983, was compelled to begin providing advice and guidance on the demonstrations scheduled to take place in the Kafr El-Sheikh Governorate.

All the necessary data, such as experimental results, the highest level of technical know-how at that time, as well as the regional characteristics and conditions, etc.,were collected in order that the Project's Advice and Guidance Group could prepare a comprehensive study prior to launching into this exercise.

The Advice and Guidance Groups, consitiong of two Agronomists and a Mechanical Engineer, were dispatched to eight districts where planned demonstrations were given. The plan of operation and relevant explanations were meticulously worked out in advance by the Team before conducting demonstrations to groups of officers and famers. All aspects from the raising of the seedling up to transplanting, were covered. The demonstration of mechanized rice transplanting conducted in 1983 for the Organization under the Central Agricultural Co-operation of the Governorate of Kafr El-Sheikh (KFS), dealt with such aspects as the relevenat size of plot and the steps involved in the entire schedule from the raising of the seedling to the mechanized transplanting procedure.

The Advice and Guidance Groups covered the 55 demonstration places in 8 districts daily to provide expertise, after which, informal meetings were held to discuss various matters, seek solutions to problems and to promote mutual understanding between groups.

The first demonstration on mechanized rice transplanting was carried out under good conditions, but the following items should be given urgent consideration as a countermeasure toward more successful achievement in the future:

1) Improve more techniques for raising of seedling;
2) Introduce the use of chemicals for seedling disease;
3) Introduce machinery spare parts;
4) More intensive study of transplanting techniques;
5) Improve more operationsl techniques of machinery;
6) Improve more weeding techniques, including herbicides;
7) Improve techniques for the application of fertilizer;
8) Control plowing depth correctly.

VI SEMINAR AND LECTURES

1. RMC Seminar

The RMC Seminar was conducted monthly by the Japanese Experts and Counterpart Personnel in order to publicize the results of the verifying trials carried out in the Project. This Seminar discharged an important role in the exchange of technical views on mechanized rice cultivation and its related subjects with the Researchers of the National Rice Research Institute, Professor of the Tanta University and Extension Officers. The results of the Seminar are as follows:

Subject	Lecturers	Date of Seminar
1) Weed Control in the Egyptian Paddy Field	Dr. M. TAKABAYASHI	2 September 1984
2) Studies on the Light-Curves of Carbon Assimilation of the Rice Plant	Dr. T. TANAKA	28 October 1984
3) The Economic Advantage of Rice Mechanization in Small and Middle-Sized Farms	Mr. S. HARADA Mr. A.G.E. BALY Mr. M.E. AHMED	25 November 1984
4) Raising of Seedling and Rice Transplanting	Mr. S. SUGAWARA Mr. N. EL FATEHY	6 January 1985
5) Mechanized Harvesting	Mr. Y. KIMURA Mr. G. ESSAM Mr. M. ASAR	27 January 1985

Subject	Lecturers	Date of Seminar
6) Nitrogen Transformation and its effects on Paddy Plant and Seasonal Change	Mr. S. EL NOUR	27 March 1985
7) Framework of the Rice Mechanization System for Middle and Small Scale Farmers	Mr. S. KIMURA	7 April 1985
8) Paddy Weed Control	Mr. N. EL FATEHY Mr. MOHAMED THMAN Mr. I. ABDEL RAHMAN	30 June 1985
9) Problems encountered in Traditional Rice Cultivation Techniques and the Technical Improvements Offered in Mechanized Transplanting	Mr. T. NUMBA Mr. S. EL TANGA	15 July 1985
10) Results of Trials and Survey conducted by the Agronomy Division, 1984	Mr. S. EL TANGA	23 September 1985
11) Actual Practice of Rice Cultivation in Egypt	Mr. HAMDY EMARA	7 October 1985
12) Solar Grain Drying	Mr. J. SATOH Mr. Y. KIMURA Mr. M. KALEH Mr. M. MOUSTAFA Mr. S. LOOKA	12 December 1985

2. Special Lecture

Dr. Takayuki TANAKA, the Team Leader of the Japanese Experts, gave a special lecture for the Counterpart Personnel of the Rice Mechanization Center, on the following subjects;

1. Actual Practices of High-Yielding Rice Cultivation Through "Ideal Plants"; and

2. Dry Matter Production on the Basis of Maximizing Yield in the Rice Plant Community.

VII ANNUAL REPORT ON PROJECT ACTIVITIES AND TRAINING MATERIALS

The Project has prepared an Annual Report which covers its activities and achievements to-date and icludes an inventory of training materials and aids. Amongst the training materials is a 15m/m film and relevant pamphlet produced to introduce the activities and objectives of the Project. In making the 16 m/m film, a film crew was dispatched twice to the Rice Mechanization Center in order to shoot on-the-spot photographs of the actual activities in progress both in the interior and the exterior of the Center.

As covered in the Report, the following is a list of the documentation and information material now available at the Center:

1. Annual Report, 1982-83;
2. Preliminary Report on Research Highlights in 1983;
3. Results of the Trials and Survey conducted by the Agronomy Division;
4. General Information on the Rice Mechanization Center;
5. Theory and Practice of Fertilizer Techniques;
6. Annual Report, 1984-85;
7. The Fielf Practice of Mechanized Rice Cultivation;
8. Rice Transplanter Manual (Safe Handling and Maintenance);
9. Manual of Self-Feeding Type Combine Harvester (Safe Handling and Maintenance).

VIII GRANT AID

The construction of the Rice Mechanization Center, which includes a main building, auditorium, cafeteria, lodgings, resthouse, storehouse, workshop and water tank, was started in january 1982 and completed in March 1983.

The total cost of five million two hundred thousand US Dollars (US$ 5,200,000) was paid by the Government of Japan.

IX MODEL INFRASTRUCTURE

1. Kallin Experimental Field

Improvements to the experimental field at Kallin were made in 1983 and totalled Forty-Five Thousand US Dollars (US$ 45,000). This amount covered the construction of farm roads, irrigation and drainage canals, diversion facilities and other related items.

2. Meet El Dyba Experimental Field

Improvements to the experimental field at Meet El Dyba were made in 1984 and 1985 respectively and totalled Two Hundred and Eighty Thousand US Dollars (US$ 280,000). This total constitutes the costs involved for the construction of irrigation and drainage canals, the installation of water pumps, and under--drainage system and other related requirements.

X PILOT INFRASTRUCTURE

Improvements were made to the Meet El Dyba Experimental field in 1983 at a total cost of Two Hundred and Eight-Five Thousand US Dollars (US$ 285,000). This total includes the costs involved for the construction of farm roads, irrigation and drainage canals, substructures, ridges, levelling and other related equipments.

XI OPERATIONAL BUDGET ALLOCATION FROM THE GOVERNMENT OF EGYPT

In the first year, 1981/82, the operational budget although allocated, was delayed due to formalities of the Record of Discussions of the Project between both Governments.

The following year, however, the operational budget was accurately allocated to the Project. From the year 1982 to 1986, the total funding was US Dollars (US$) for the Project.

A sufficient budget allocation, taking into account the inflationary factor, will also be a prerequisite for the Project in the future.

XII ASSIGNMENT OF JAPANESE EXPERTS

Seven (7) long-term experts were assigned to the Project in accordance with the field of expertise described in the Record of Discussions. The total assignment period of these experts was two hundred and forty-three man/months (243 m/m) representing 73.3% of the full assignemt of three hundred man/months (300 m/m).

With respect to short-term experts, twenty-eight (28) were assigned for a total period of fifty-four man/months (54 m/m). The majority of the long and short-term experts were satisfactorily assigned.

XIII TRAINING OF EGYPTIAN PERSONNEL IN JAPAN

Twenty-five (25) Counterparts were trained in Japan with a total of one hundred and eleven man/months (111 m/m) as of 1986. The classification of this training was as follows: six (6) attended group training programmes; five (5) followed training in specialized fields; and nine (9) undertook specially arranged observational tours.

The field of training covered planned courses in: (a) Agricultural Machinery; (b) Agricultural Extension; (c) Economic Analysis; (d) Diseases and Insect Pests in Rice Plants; and (e) Rice Cultivation; as well as other related studies.

XIV PROVISION OF EQUIPMENT AND MACHINERY

The total amount of the grant for equipment and machinery was One Million Six-Hundred Ninety-Three US Dollars (US$ 1,693,000) as of 1986. The expenditure was mainly used for the purchase of tractors, nursing seedling facilities, transplanters, combine harvesters, reapers, movable harvesters, vehicles and related devices required to implement the activities and meet the objectives of the Project. Most of the equipmwnt and machinery is in sound condition having been utilized properly.

LIST OF JAPANESE EXPERTS

1. LONG TERM EXPERTS

Field of Expertise	Name of Expert	Duration of Assignment
(1) Team Leader	Dr. Toyoo TOMITA	1982 4. 6 - 1984 4.5
	Dr. Takayuki TANAKA	1984 4. 3 - 1986 8.17
(2) Coordinator	Mr. Takeshi NARUSE	1982 2. 9 - 1985 2.8
	Mr. Kimio MIURA	1985 5. 9 - 1986 8.17
(3) Rice Cultivation	Mr. Teruhisa NAMBA	1982 2. 9 - 1986 8.17
(4) Agricultural Machinery	Mr. Yasuhiro KIMURA	1981 12. 8 - 1986 8.17
	Mr. Seikichi SUGAWARA	1983 3. 4 - 1986 8.17

2. SHORT TERM EXPERTS

(1) Team Leader	Dr. Toyoo TOMITA	1981 12. 8 - 1982 3.7
(2) Coordinator	Mr. Kunihiro MASUMI	1985 2.21 - 1985 5.20
(3) Agricultural Machinery	Mr. Tomizo KATO	1984 1.6 - 1984 2.5
	Mr. Shoichi KIMURA	1985 2.12 - 1985 4.11
	Mr. Junichi SATO	1985 11.26 - 1985 12.18
(4) Economic Analysis	Dr. Tadao HATANO	1983 10.21 - 1983 12.20
	Mr. Setsuyo HARADA	1984 9.15 - 1984 12.13
	Dr. Hisataro HORIUCHI	1986 1.21 - 1986 4.15
(5) Soil Fertility	Dr. Kaoru SEINO	1983 10.21 - 1983 11.20
(6) Weed Control	Dr. Minoru TAKABAYASHI	1984 7. 7 - 1984 9.6

(7) Land Consolidation	Mr. Yasuo MATSUBARA	1982 3.10 - 1982 6.1
	Mr. Mitsuharu KURAKAZU	1982 10. 7 - 1983 6.30
		1985 1.28 - 1985 5.11
	Mr. Yasukazu HIROSE	1982 12. 7 - 1983 6.22
	Mr. Kouichi INOUE	1984 8.17 - 1984 9.15
		1984 12.15 - 1985 2.2
	Mr. Masaru SHIBATA	1984 8.17 - 1984 9.15
	Mr. Shinichi HOSONO	1985 12.3 - 1986 4.13
(8) Training Materials	Mr. Tetsuya WATANABE	1985 3.3 - 1985 3.17
		1985 6.11 - 1985 7.7
		1985 10. 1 - 1985 10.25
	Mr. Kuniyasu SAGARA	1985 6.11 - 1985 7.7
		1985 10. 1 - 1985 10.25
	Mr. Kasuchige FUJISAKI	1985 6.11 - 1985 7.7
		1985 10. 1 - 1985 10.25
	Mr. Tomizo KATO	1986 1.21 - 1986 3. 2

LIST OF PARTICIPANTS IN COUNTERPART TRAINING IN JAPAN

Fiscal Year	Name	Training Programmes	Duration
1981	Dr. Hossary	Study Tour	1981.10.17 - 1981.10.24
1982	Mr. Osama K.	Study Tour	1982. 4.25 - 1982. 5.18
	Mr. A. Mageid	Study Tour	1982.10.16 - 1982.11.15
	Mr. El Tanga	Rice Cultivation	1983. 2.26 - 1983.12.14
	Dr. A. F. Sahrigi	Study Tour	1983. 2. 6 - 1983. 2.17
1983	Dr. Zakaria El H.	Study Tour	1983.10.16 - 1983.10.29
	Mr. Doma	Study Tour	1983. 5.10 - 1983. 5.29
	Mr. Hamdy M. E.	Mechanized Rice Cultivation	1984. 3.29 - 1984.10.31
	Mr. Nour Saler	Mechanized Rice Cultivation	1984. 3. 1 - 1984.10.31
	Mr. Moustafa S. A.	Mechanized Rice Cultivation	1984. 2.23 - 1984.11.30
1984	Mr. El Sombaty	Study Tour	1984. 7. 9 - 1984. 7.25
	Mr. A. M. Ahtiyal	Weed Control	1984. 6.28 - 1984. 8.31
	Mr. M. Bideer	Agricutural Machinery	1984. 6.14 - 1984.12.22
	Mr. Samir	Rice Cultivation	1985. 3. 7 - 1985.10.11
	Mr. Osama K.	Study Tour	1984.11.22 - 1984.12.13
1985	Mr. A. E. Fattah	Rice Disease & Insect Pest	1985. 6. 2 - 1985.12. 9
	Mr. A. E. Gawad	Weed Control	1985. 6. 6 - 1985. 8. 5
	Mr. M. Yusef M.	Agriculture Extension	1985. 8.15 - 1985.12.14
	Mr. Said E. M. S.	Study Tour	1985.10.19 - 1985.11. 3
	Mr. Mustafa M.	Rice Cultivation	1986. 2. 6 - 1986.11.29
	Mr. Asar M. Asar	Mechanized Rice Cultivation	1986. 2. 6 - 1986.11.29
	Mr. Shehata S. L.	Mechanized Rice Cultivation	1986. 2. 6 - 1986.11.29
	Mr. Gawad Baly	Economic Analysis	1986. 3.30 - 1986. 6.30
	Mr. Ibrahim	Agricultural Machinery	1986. 3.15 - 1986. 7.30

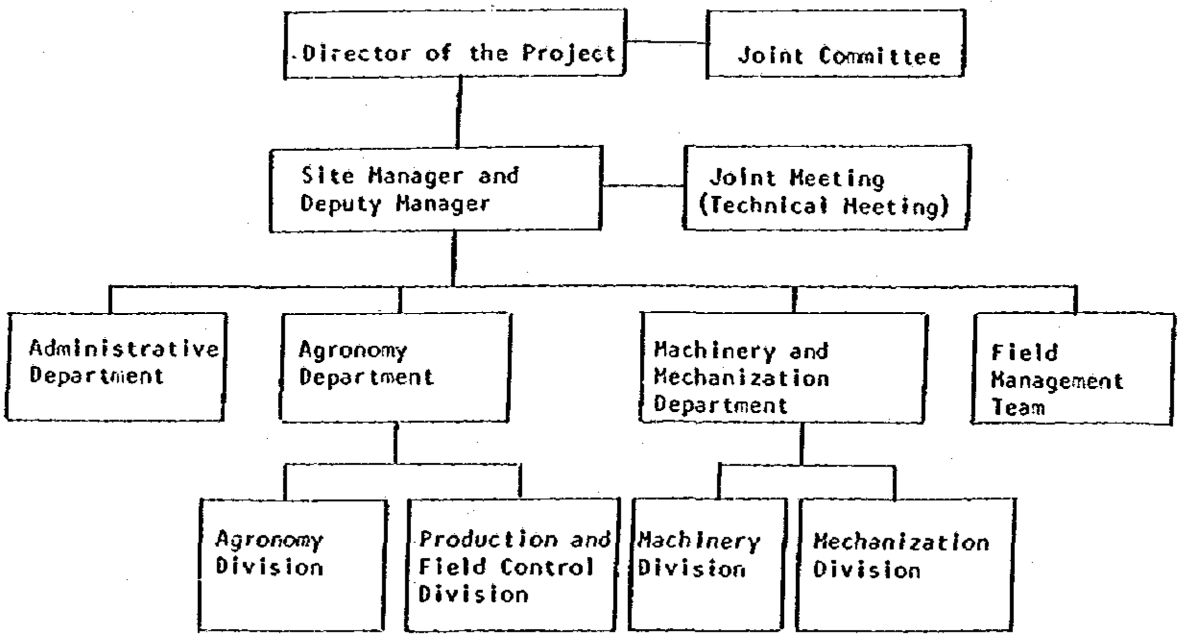


Chart 3: Operational/Organizational Chart of the Rice Mechanization Project

JICA