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Agricultural machinery – Mechanical Rice Transplanter – Methods of Test

BUREAU OF PRODUCT STANDARDS

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National Foreword

This Philippine Agricultural Engineering Standards PAES 152:2010, Agricultural machinery – Mechanical Rice Transplanter – Methods of Test was approved for adoption as Philippine National Standard by the Bureau of Product Standards upon the recommendation of the Agricultural Machinery Testing and Evaluation Center (AMTEC) and the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development of the Department of Science and Technology (PCARRD-DOST).

Foreword

The formulation of this national standard was initiated by the Agricultural Machinery Testing and Evaluation Center (AMTEC) under the project entitled "Development of Standards for Agricultural Production and Postharvest Machinery" funded by the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development - Department of Science and Technology (PCARRD - DOST).

This standard has been technically prepared in accordance with BPS Directives Part 3:2003 – Rules for the Structure and Drafting of International Standards.

The word "shall" is used to indicate mandatory requirements to conform to the standard.

The word "should" is used to indicate that among several possibilities one is recommended as particularly suitable without mentioning or excluding others.

In the preparation of this standard, the following documents/publications were considered:

Campbell, J.K. 1990. Dibble sticks, donkeys, and diesels. International Rice Research Institute. ISBN 971-104-185-5. 147-150.

Eam-o-pas, K. and Y. Goto. 1990. Comparative performance of the rice transplanters in Thailand's field conditions. Kasetsart J. (Nat.Sci. Suppl.) Vol.24:64-68.

Eam-o-pas, K., V. Munthimkarn, N. Ounkong, Y Goto and T. Yamauchi. 1988. Performance of a self-propelled riding type rice transplanter. Kasetsart J. (Nat.Sci. Suppl.) Vol.22:79-87.

Regional Network for Agricultural Machinery. 1983. Test codes and procedures for farm machinery. Technical Series No.12. Economic and Social Commission for Asia and the Pacific.

Regional Network for Agricultural Machinery. 1979. Rice Transplanter: highlights of research, design, development and evaluation from different countries. RNAM Digest 1. 43pp.

Thein, M. Mechanical rice transaplanters in Burma.

http://www.knowledgebank.irri.org

http://www.steelforge.com/alloysteels.htm

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ANNEXES

Agricultural Machinery – Mechanical Rice Transplanter – Methods of Test

1 Scope

This standard specifies the methods of test and inspection for a mechanical rice transplanter. Specifically, it shall be used to:

1.1 verify the mechanism, dimensions, materials, accessories of the mechanical rice transplanter and the list of specifications submitted by the manufacturer;

1.2 determine the performance of the equipment; and,

1.3 report the results of the tests.

2 References

The following normative documents contain provisions, which through reference in this text constitute provisions of this National Standard:

PAES 151:2010 Agricultural Machinery – Mechanical Rice Transplanter – Specifications

3 Definitions

For the purpose of this standard, the definitions given in PAES 151 and the following shall apply:

3.1
effective field capacity
function of field speed, operating width and field efficiency expressed in hectares per hour

3.2
effective working width
total width per row of transplanting arm

3.3
field efficiency
ratio between the productivity of a machine under field conditions and the theoretical maximum productivity

3.4
hills
points in the field where a seedling is transplanted

3.5
overall length
measurement between extremities of the mechanical rice transplanter along its longer side including all protruding parts

3.6
overall width
measurement between extremities of the mechanical rice transplanter along its shorter side including all protruding parts

3.7
percent damaged hill
ratio of the total number of hills with seedlings damaged by cutting, bending or crushing during transplanting to the total number of hills expressed in percentage

3.8
percent missing hill
ratio of the total number of hills without seedlings to the total number of hills expressed in percentage

3.9
planting efficiency
ratio of the number of hills with seedlings to the total number of hill expressed in percentage

3.10
rows
series of hills in a field

3.11
theoretical field capacity
function of speed of transplanter and the width of operation expressed in hectares per hour

3.12
tray angle
angle between the bottom of the seedling tray and the horizontal

4 General Conditions for Test and Inspection

4.1 Role of manufacturer/dealer

The manufacturer shall submit the operator’s manual of the mechanical rice transplanter and shall abide by the terms and conditions set forth by an official testing agency.

4.2 Role of the operator

An officially designated operator shall be skilled and shall be able to demonstrate, operate, adjust and make repairs related to the operation of the equipment.

4.3 Test site conditions

The mechanical rice transplanter shall be tested through actual transplanting of rice seedlings. The field to be used shall be puddled before the test. The field shall have an area of at least 1000 m^2. with ample space for headland turns. It shall have a rectangular dimension.

4.4 Test instruments/equipment

The suggested list of minimum test materials needed to carry out the mechanical rice transplanter test is shown in Annex A. Seedling preparation is shown in Annex E.

4.5 Termination of test for mechanical rice transplanter

If during the test, the mechanical rice transplanter encounters major component breakdown or malfunction, the test engineer shall terminate the test.

5 Test and Inspection

5.1 Verification of the manufacturer's technical data and information

This inspection is carried out to verify the mechanism, dimensions and construction material of the mechanical rice transplanter in comparison with the list of manufacturer's technical data and information. All data shall be recorded in Annex B.

5.2 Performance test

5.2.1 This is carried out to obtain actual data on overall performance of the equipment.

5.2.2 Soil data analysis

Initial data such as field area, soil type and soil hardness shall be obtained and recorded in Annex C before the test operation. Soil hardness shall be measured using a drop-type cone penetrometer.

5.2.3 Field performance test

5.2.3.1 The mechanical rice transplanter shall be tested through actual transplanting of rice seedlings.

5.2.3.2 Five (5) sampling areas shall be selected randomly in the field. Selected areas shall be in succession and shall have four (4) rows (Fig. 1).

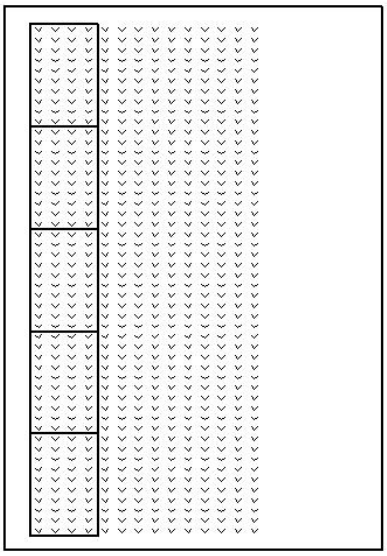

Figure 1. Sampling areas

5.2.3.3 The number of seedlings per hill shall be noted and shall be recorded.

5.2.3.4 The distances between hills and between rows shall be measured and shall be recorded in Annex C (Fig. 2).

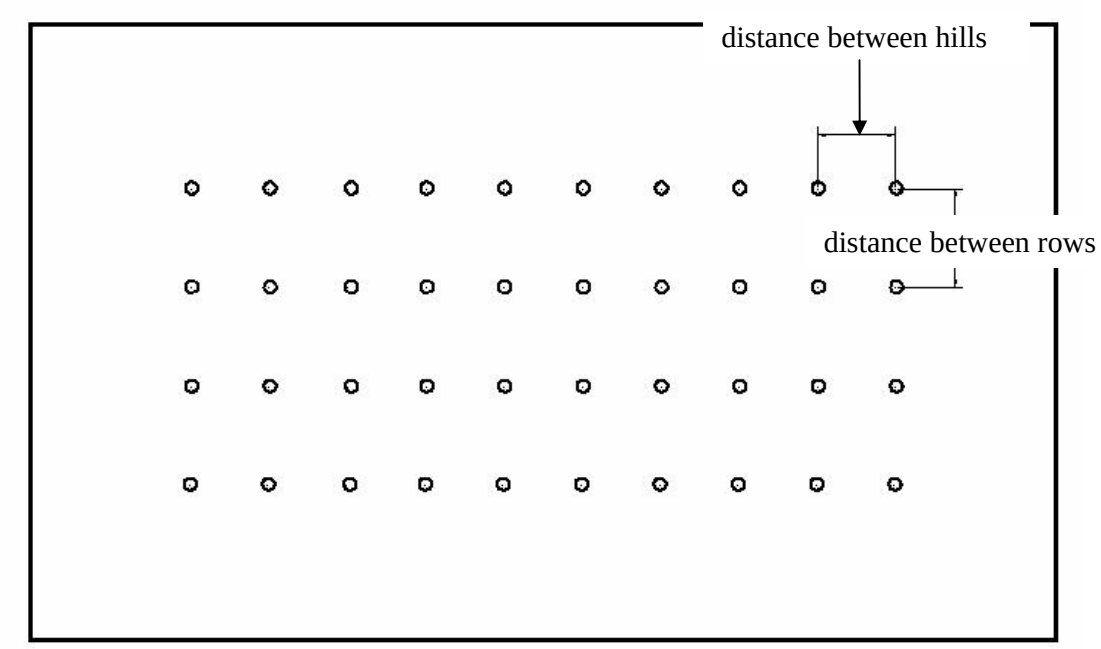

Figure 2. Distance between hills and between rows

5.2.3.5 Percent error for the distances shall be computed using the formula in Annex D.

5.2.3.6 The number of hills, missing hills, and damaged hills shall be noted and shall be recorded.

5.2.3.7 Planting efficiency, percent damaged hills and percent missing hills of the mechanical rice transplanter shall be computed using the formula in Annex D.

5.2.3.8 Test for uniformity of transplanting depth

5.2.3.8.1 The transplanting depth per hill in a row shall be noted and shall be recorded (Fig. 3).

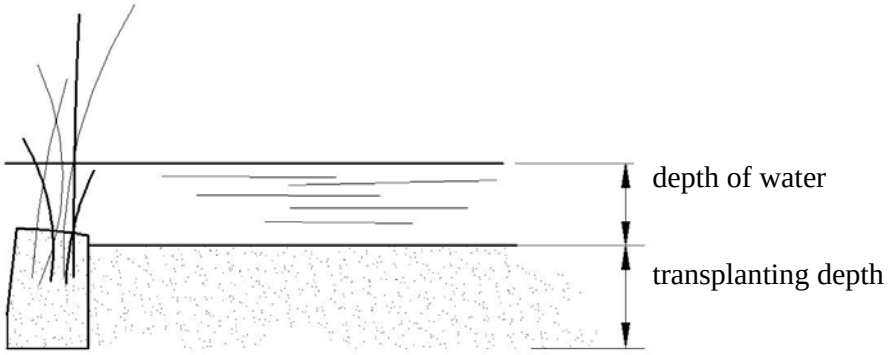

Figure 3. Transplanting depth

5.2.3.8.2 The mean depth and the percent error for the mean depth shall be computed using the formula in Annex D.

5.2.3.9 Condition of the mechanical rice transplanter shall be inspected after the test to determine possible damage or breakdown.

5.2.3.10 The total operating time of the mechanical transplanter shall be recorded. Non-productive time shall also be recorded. Total productive time shall be obtained by subtracting the non-productive time from the total operating time.

5.2.3.11 Actual and theoretical field capacity, as well as field efficiency shall be computed using the formula in Annex D.

5.2.3.12 Transplanting speed

The transplanting speed shall be obtained by recording the time required for the mechanical rice transplanter to travel a 20 m distance in the field. Non-productive time such as reloading of the seedling tray during operation shall be deducted from the total travel time. The speed of transplanting shall be computed using the formula in Annex D.

5.2.3.13 Fuel consumed (for engine driven type only)

The fuel consumed by the mechanical rice transplanter shall be obtained. This can be done by measuring the volume of fuel refilled after the test. The tank shall be filled to full capacity before and after each trial.

5.2.3.14 Power requirement

The draft requirement of the mechanical rice transplanter shall be obtained and shall be recorded in Annex C.

5.2.3.12 Welded parts shall be inspected. Loosened bolts shall be noted.

5.2.3.13 All data shall be recorded in Annex C.

5.2.3.14 Planting pattern

Before the operation, a turning zone shall be established. It shall be about one cycle of going and returning. Seedlings shall be transplanted next to the straight side of the border along the longest side of the field (Fig. 4).

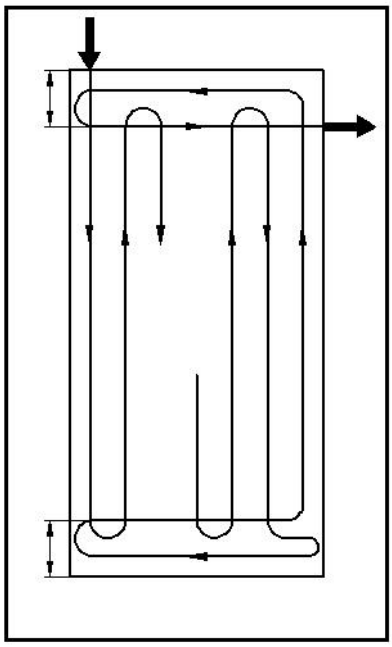

Figure 4. Planting pattern

5.3 Test trial

At least three (3) trials shall be required in conducting the test. Test data shall be gathered as required in Annex D.

6 Test Report

The test report shall include the following information in the order given:

6.1 Title

6.2 Summary

6.3 Purpose and Scope of Test

6.4 Methods of Test

6.5 Description of the Machine

Table 1 – Machine Specifications

6.6 Results and Discussions

6.7 Observations (include pictures)

Table 2 –Performance test data

6.8 Name(s), signature(s) and designation(s) of test engineer(s)

Annex A

Suggested Minimum List of Test Equipment

Items		Quantity
A.1.	timer accuracy: 0.10 s	1
A. 2	steel tape capacity: 5 m; 50 m	2
A.3	weighing scale capacity, 1000 kg	1
A.4	fuel consumption	
	graduated cylinder capacity, 1000 mL	1
A.5	soil analysis	
	soil test kit	1
	drop-type cone penetrometer	1
A.6	marking pegs	4
A.7	rice seedlings	
	root-washed rice seedlings	as needed
	soil-bearing rice seedlings	as needed
A.8	draft measurement	
	load cell	1
	dynamometer	1
A.9	protractor	1
A.10	calculations	
	scientific calculator	1

Annex B
(informative)

Specifications of Mechanical Rice Transplanter

Name of Applicant/ Distributor: _____
Address: _____
Tel No: _____

GENERAL INFORMATION
Name of Manufacturer: _____
Make: _____
Classification: _____
Serial No: _____ Brand/Model: _____
Production date of mechanical rice transplanter to be tested:
_____
Testing Agency: _____ Test Engineer: _____
Date of Test: _____ Location of Test: _____

Items to be inspected

ITEMS	Manufacturer's Specification	Verification by the Testing agency
B.1 overall dimensions		
B.1.1 overall height, mm		
B.1.2 overall length, mm		
B.1.3 overall width, mm		
B.1.4 weight, kg		
B.1.5 operating width, mm		
B.2 seedling tray		
B.2.1 width, mm		
B.2.2 length, mm		
B.2.3 tray angle, deg		
B.2.4 material		
B.2.5 number of divisions		
B.3 grasping fork		
B.3.1 width, mm		
B.3.2 length, mm		
B.3.3 material		
B.3.4 total number of grasping forks		
B.4 transplanting arm		
B.4.1 width, mm		
B.4.2 length, mm		
B.4.3 material		
B.4.4 total number of transplanting arms		
B.5 float		
B.5.1 width, mm		
B.5.2 length, mm		
B.5.3 thickness, mm		

ITEMS	Manufacturer's Specification	Verification by the Testing agency
B.5.4 material		
B.6 handle		
B.6.1 width, mm		
B.6.2 length, mm		
B.6.3 material		
B.7 paddle wheel		
B.7.1 diameter, mm		
B.7.2 number of paddles		
B.7.3 material		
B.8 engine		
B.8.1 type		
B.8.2 power output, kW		
B.9 mode of transmission system		
B.9.1 type		
B.9.2 material		

ANNEX C

Performance Test Data Sheet

Items to be measured and inspected

C.1 Test field conditions	**Remarks**
C.1.1 dimension of field, m^2	
C.1.2 soil type (clay, clay loam, sandy, etc.)	
C.1.3 soil hardness (kg/cm^2)	

C.2 Field performance											
C.2.1 Sampling Area 1											
C.2.1.1 Number of seedlings per hill											
C.2.1.2 Number of missing hills											
C.2.1.3 Number of damaged hills											
C.2.1.4 Distance between hills (mm)											**Ave.**
C.2.1.5 Distance between rows (mm)											**Ave.**
C.2.1.6 Percent error for distance between hills, %											
C.2.1.7 Percent error for distance between rows, %											
C.2.1.8 Planting efficiency, %											
C.2.1.9 Transplanting depth											
Hill no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	
Depth, mm											
C.2.1.10 Mean depth, mm											
C.2.1.11 Percent error, %											

C.2.2 Sampling Area 2											
C.2.2.1 Number of seedlings per hill											
C.2.2.2 Number of missing hills											
C.2.2.3 Number of damaged hills											
C.2.2.4 Distance between hills (mm)											**Ave.**
C.2.2.5 Distance between rows (mm)											**Ave.**
C.2.2.6 Percent error for distance between hills, %											
C.2.2.7 Percent error for distance between rows, %											
C.2.2.8 Planting efficiency, %											
C.2.2.9 Transplanting depth											
Hill no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	
Depth,											

mm										
C.2.2.10 Mean depth, mm										
C.2.2.11 Percent error, %										

C.2.3 Sampling Area 3										
C.2.3.1 Number of seedlings per hill										
C.2.3.2 Number of missing hills										
C.2.3.3 Number of damaged hills										
C.2.3.4 Distance between hills (mm)										**Ave.**
C.2.3.5 Distance between rows (mm)										**Ave.**
C.2.3.6 Percent error for distance between hills, %										
C.2.3.7 Percent error for distance between rows, %										
C.2.3.8 Planting efficiency, %										
C.2.3.9 Transplanting depth										
Hill no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Depth, mm										
C.2.3.10 Mean depth, mm										
C.2.3.11 Percent error, %										

C.2.4 Sampling Area 4										
C.2.4.1 Number of seedlings per hill										
C.2.4.2 Number of missing hills										
C.2.4.3 Number of damaged hills										
C.2.4.4 Distance between hills (mm)										**Ave.**
C.2.4.5 Distance between rows (mm)										**Ave.**
C.2.4.6 Percent error for distance between hills, %										
C.2.4.7 Percent error for distance between rows, %										
C.2.4.8 Planting efficiency, %										
C.2.4.9 Transplanting depth										
Hill no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Depth, mm										
C.2.4.10 Mean depth, mm										
C.2.4.11 Percent error, %										

C.2.5 Sampling Area 5	
C.2.5.1 Number of seedlings per hill	
C.2.5.2 Number of missing hills	

C.2.5.3 Number of damaged hills											
C.2.5.4 Distance between hills (mm)											Ave.
C.2.5.5 Distance between rows (mm)											Ave.
C.2.5.6 Percent error for distance between hills, %											
C.2.5.7 Percent error for distance between rows, %											
C.2.5.8 Planting efficiency, %											
C.2.5.9 Transplanting depth											
Hill no.	1	2	3	4	5	6	7	8	9	10	
Depth, mm											
C.2.5.10 Mean depth, mm											
C.2.5.11 Percent error, %											

C.3 Transplanting speed				
Items	Trials			Average
	1	2	3	
total operating time to finish transplanting, h				
total non-productive time, h				
total productive time, h				
Transplanting speed, kph				

C.4 Actual field capacity, ha/h				
	Trials			Average
	1	2	3	

C.5 Theoretical field capacity, ha/h				
	Trials			Average
	1	2	3	

C.6 Field Efficiency, %				
	Trials			Average
	1	2	3	

C.7 Fuel consumed, mL				
	Trials			Average
	1	2	3	

C.8 Power requirements	
C.8.1 Draft, kg	

C.9 Other observations	**Remarks**
C.9.1 accessibility of grease points *	
C.9.2 cracks on welded parts	
C.9.3 detached welded parts	
C.9.4 loosened bolts	
C.9.5 miscellaneous:	

* rating: 1 – very good
2 – good
3 – satisfactory
4 – poor
5 – very poor

ANNEX D

Formula Used During Calculation and Testing

D.1 Draft requirement for animal drawn rice transplanter

$$D - P\cos\theta$$

where:

D draft of the rice transplanter, kg

P pull, kg

θ angle between the line of pull and the horizontal

D.2 Percent damaged hills

$$H_{pd} = \frac{H_d}{H_t} \times 100$$

where:

H_{pd} percent damaged hills, %

H_d number of damaged hills in the sampling area

H_t total number of hills in the sampling area

D.3 Percent missing hills

$$H_{pm} = \frac{H_m}{H_t} \times 100$$

where:

H_{pm} percent missing hills, %

H_m number of missing hills in the sampling area

H_t total number of hills in the sampling area

D.4 Planting efficiency

$$P_e = \left(1 - \frac{H_m}{H_t}\right) \times 100$$

where:

P_e planting efficiency of the transplanter, %

H_m total number of missing hills

H_t total number of hills

D.5 Field efficiency

$$Eff = \frac{C}{C_u} \times 100$$

where:

Eff field efficiency of the transplanter, %

C actual field capacity

C_0 theoretical field capacity

D.6 Actual field capacity

$$C = \frac{A}{T}$$

where:

C actual field capacity, ha/h

A total area transplanted, ha

T total operating time required for transplanting, h

D.7 Theoretical field capacity

$$C_0 = w \times S$$

where:

C_0 theoretical field capacity, ha/h

w	operating width of the transplanter, m
S	speed of the transplanter, kph

D.8 Percent Error

$$\%\ error = \frac{|V_m - V_t|}{V_t} \times 100$$

where:

% error	percent error, %
V_m	mean value
Vt	theoretical value

D.9 Transplanting speed

$$S = \frac{D}{T_o - T_{np}}$$

where:

S	speed of the transplanter, kph
D	distance between the first and last hills, km
To	total operating time, h
T_{np}	total non-productive time, h

ANNEX E

Seedling Preparation Using Double Mulching Technique

1 Sowing is done manually using two plastic film sheets or canvass on seedbeds.

2 Preparation of plastic film

Wrap or fold the plastic film and make holes using the punching stick or common wire nail (with punching handle).

3 Preparation of seedling frames for the seedbed

Wooden or steel bars/plates/purlin (or any similar material) can be used to prepare the seedling frames. Seedling frames are fixed on the seedbed after the first mulch (plastic film) has been placed.

4 Seedbed preparation

4.1 Choose an area with good access to irrigation and drainage.

4.2 Prepare the seedbed area 2-3 days before the sowing schedule.

4.3 Plow once and harrow (puddle and level) the seedbed area.

4.4 Construct the seedbeds, 1.5m wide, 3-5 cm height and at any desired length. Keep 30cm distance between seedbeds.

4.5 Level the seedbed using wooden leveler *(paleta).*

5 Soil preparation

Prepare 1,500 kg of nutritional or garden soil for 1 ha before sowing. Dry the soil for 4-6 days to reduce moisture content to 10–20 % for easy crushing. Sieve crushed soil.

6 Seed soaking and incubation

6.1 Soak the seeds (40 kg/ha) in clean water for 6 hours. Keep the water and seeds at room temperature.

6.2 Remove the soaked seeds from the container. Drain the water and place the seeds in clean sack.

6.3 Tie the sack loose enough to allow the aeration of seeds.

6.4 Turn it every 2 hours to improve aeration. Keep it moist by sprinkling water each time you turn until seeds germinate.

6.5 Seeds are ready for sowing when they start to break and until roots have extended to 1 mm.

7 Sowing

7.1 Place the plastic film into the seedbed. Stretch the plastic film well to cover the surface.

7.2 Fix the seedling frame on top of the plastic film. Pegs can be used to hold or permanently fix the frames in place.

7.3 Place the pulverized soil inside the frame. The depth of soil bed in the frame should not exceed 2 cm and should also be uniform and leveled. Saturate the pulverized soil with water using a sprinkler or sprayer.

7.4 Spread the germinated seeds evenly using the required weight of seeds per area of the seedling frame.

7.5 Cover the broadcasted seeds with a very thin film of soil ranging from 0.3–0.5 cm. Then cover the seedbed with another plastic film (without holes) for 1-2 days depending on weather conditions. The cover will serve as protection from the rain and birds.

7.6 Remove the plastic cover when the height of the seedlings reached 1 cm.

8 Water management

8.1 Water should be leveled on the surface of the seedbed. This depth should be maintained during the single-leaf stage.

8.2 During 2-3 leaf stages, the water level should be frequently checked. During irrigation, water depth should be leveled with the surface of the frame and should be drained after 10 minutes.

8.3 Four to five days before transplanting, the water level should be half the depth of the seedbed to enhance the development of the roots.

8.4 Seedlings should be transplanted at 16-18 days of age.

9 Preparation of seedlings before transplanting

9.1 Drain the seedbed one day before transplanting.

9.2 Cut the seedling mat using sharp knife or cutter into tray size seedlings (28 cm x 116cm or 28 cm x 58 cm).

9.3 Roll each seedling mat and distribute along the paddy dikes.

Philippine Agricultural Engineering Standards

AMTEC-UPLB – PCARRD Project: "Development of Standards for Agricultural Production and Postharvest Machinery"

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