on the morphological characters of leaves using dried specimens and seedlings.

The distribution of Shan-type tea plants was considered from the results of measuring length and width of leaves, number of lateral veins and number of serrations, and from the results of observing colors and hairs on the surface of leaves.

Leaves of specimens collected from Tapple in Katin State were mostly about 14 cm in length and had about 10 pairs of lateral veins, and leaves from the western region in Shan State were larger than the ones from Tapple. The latter resembled to those of Assam-type in India. In the eastern and southern regions of Shan State the leaves were smaller, and in the Northern and Southern Shan State the most of the tea plants had small leaves as in China-type.

The number of lateral veins and serrations of leaves as well as leaf-width are not widely different from each other. The leaves with larger length was likely to have generally more lateral veins, more serrations and wider leaves.

The seedlings from the seeds harvested in Northern Shan State, but Tapple more specimens than Namsan, showed many variation in such characters as anthocyanine content of young leaf buds and petioles, leaf length, quantity of leaf-hair, etc. The leaf-length varied from 7.5 cm to 14 cm, and the number of lateral veins varied from 7.5 to 9.5.

Some characters of China-type were mingled with them. The seedlings from Tapple in Katin State showed, however no anthocyanine in young leaves and buds, and they have, 15-20 cm length, with about 10 paires of lateral veins. They seems to have characteristic of Shan-type, and there are few variations in leaf characters.

From these results, the center of distribution of Shan-type tea plants is thought to recognize in Tapple in Katin State, and the one of distribution of China-type tea plants in the eastern region in Burma, and so the one of distribution of Assam-type tea plants in the western region. In the south region, Shan-type are mingled with China-type.

Advice for Eastern Nigeria Swamp Rice Cultivation*

Sin-iti YAMAMOTO  
(Rice Specialist, Yamanasi Prefectural Office)

1. Introduction

I (Rice Agronomist, Sin-iti YAMAMOTO) came to Enugu, Eastern Nigeria in July, 1962, under the Japanese Government Technical Assistance Scheme. For about eleven months I observed Eastern Nigeria rice culture, and made some surveys and trials.

Now I should like to advise for improvement of Eastern Nigeria swamp rice culture as follows.

2. Agro-Climatic Condition for Rice Growing in Eastern Nigeria

1. Air Temperature

During the day the air temperature is suitable but at night the air temperature is too high for rice growing.

Optimum air temperature

Day, 77°F~95°F  Night, less than 72°F

2. Humidity

Suitable (70%~100%)

3. Precipitation

The total rainfall is suitable but sometimes heavy storms and falls leach out nutrients and beat down crops. For about five months of the year there is too little rainfall, so soils baked and scorched.

4. Sun Radiation

* Received for publication, October 29, 1965
Table 1. Soil

<table>
<thead>
<tr>
<th>Date</th>
<th>Place</th>
<th>P.H.</th>
<th>P.O₅ (per lb)</th>
<th>Mn (P.M.)</th>
<th>FeO₂</th>
<th>FeO</th>
<th>K₂O</th>
<th>Ammoniacal N</th>
<th>N of nitrate (per lb)</th>
<th>Cl (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>27.12.62</td>
<td>Adani Farm Settlement Swamp</td>
<td>3.8</td>
<td>0.0</td>
<td>lacking</td>
<td>very small</td>
<td>very small</td>
<td>lacking</td>
<td>contain</td>
<td>0.02</td>
<td>—</td>
</tr>
<tr>
<td>8. 1.63</td>
<td>Abakaliki, Min. of Agric. Nursery</td>
<td>4.5</td>
<td>0.0</td>
<td>-do</td>
<td>-do</td>
<td>-do</td>
<td>-do</td>
<td>contain</td>
<td>0.01</td>
<td>—</td>
</tr>
<tr>
<td>8. 3.63</td>
<td>Ekpet, Abakaliki Swamp</td>
<td>4.2</td>
<td>0.1</td>
<td>&gt;/</td>
<td>&gt;/</td>
<td>&gt;/</td>
<td>slightly lacking</td>
<td>0.02</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>7. 6.63</td>
<td>Norcap, Abakaliki Swamp</td>
<td>4.2</td>
<td>0.0</td>
<td>small</td>
<td>&gt;/</td>
<td>very rich</td>
<td>-do</td>
<td></td>
<td>0.04</td>
<td>—</td>
</tr>
<tr>
<td>14. 6.63</td>
<td>Akokwa, Orlu Swamp</td>
<td>3.8</td>
<td>0.0</td>
<td>very small</td>
<td>&gt;/</td>
<td>very rich</td>
<td>contain</td>
<td>0.02</td>
<td>0.003</td>
<td></td>
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<tr>
<td>14. 6.63</td>
<td>Ika-uku, Chief Imo, Orlu Swamp</td>
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<td>0.0</td>
<td>lacking</td>
<td>lacking</td>
<td>slightly lacking</td>
<td>-do</td>
<td></td>
<td>0.03</td>
<td>0.02</td>
</tr>
<tr>
<td>20. 6.63</td>
<td>Itu Leper Colony Swamp No. 2</td>
<td>3.8</td>
<td>0.0</td>
<td>rich</td>
<td>very small</td>
<td>lacking</td>
<td>rich</td>
<td>0.08</td>
<td>0.004</td>
<td></td>
</tr>
<tr>
<td>22. 6.63</td>
<td>Oron, Swamp</td>
<td>4.4</td>
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<td>very small</td>
<td>-do</td>
<td>-do</td>
<td>contain</td>
<td>0.32</td>
<td>0.03</td>
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<tr>
<td>22. 6.63</td>
<td>Oron, Nursery</td>
<td>3.8</td>
<td>—</td>
<td>-do</td>
<td>&gt;/</td>
<td>slightly lacking</td>
<td>-do</td>
<td></td>
<td>0.04</td>
<td>—</td>
</tr>
</tbody>
</table>

Enough.

5. Evaporation
Too much.

3. Soil

The Eastern Nigeria soil area is too bad for rice cultivation.

1. P.H.
Good soil P.H. for rice growing is 5.5 ~ 6.5. Almost all of this country’s soil P.H. is less than 5.5 (See Table 1.)

2. Organic Matter
This country's soil very low in organic matter content and so is very poor for rice cultivation. (See Table 1.)

3. Percolation
Everywhere in this country the soil is porous through which water percolates readily.

4. Erosion
The soil is not cohesive and is eroded in heavy rainfalls.

4. Water

Water temperature is suitable for rice growing.

Water quality is not so good. About half of the places visited, it is lacking in SiO₂ and K₂O (See Table 2).

5. Variety

Oryza sativa Japonica varieties are noted for high yield and high response to fertilizer but handicapped by susceptibility to tropical plant disease. B. G. 79 (Oryza sativa Indica) is a good variety, still better varieties must be bred which are very suitable for each area.

Note. Japanese rice seeds were presented on the 6th of June, 1963, by the Japanese Government to the Eastern Nigeria Government as follows:

<table>
<thead>
<tr>
<th>Variety Name:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Norin No. 1</td>
<td>(Swamp Rice)</td>
</tr>
<tr>
<td>Norin No. 41</td>
<td></td>
</tr>
<tr>
<td>Rikuto Norin No. 9</td>
<td>(Upland Rice)</td>
</tr>
<tr>
<td>Hatakoganemochi</td>
<td></td>
</tr>
</tbody>
</table>

6. Cultivation

1. Preparation of seed
For very thin sowing and transplanting about 6 lbs. seeds will be sufficient for one acre of paddy field.

The seed grains are freed from hulled paddies which are susceptible to infection of
<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Place</th>
<th>Air Temp. (OF)</th>
<th>Water Temp. (OF)</th>
<th>P. H.</th>
<th>K$_2$O (P.P.M.)</th>
<th>SiO$_2$ (grains per gals)</th>
<th>CaCO$_3$ (grains per gals)</th>
<th>Cl (P.P.M.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.12.62</td>
<td>0 : 40</td>
<td>Igbiriam Swamp</td>
<td>84</td>
<td>79</td>
<td>5.2</td>
<td>0.25</td>
<td>1.82</td>
<td>1.40</td>
<td>12</td>
</tr>
<tr>
<td>27.12.62</td>
<td>12 : 00</td>
<td>Adani Swamp</td>
<td>91</td>
<td>79</td>
<td>5.8</td>
<td>1.00</td>
<td>1.40</td>
<td>0.56</td>
<td>—</td>
</tr>
<tr>
<td>4. 1.63</td>
<td>10 : 00</td>
<td>Degema Swamp</td>
<td>88</td>
<td>84</td>
<td>6.2</td>
<td>6.00</td>
<td>1.12</td>
<td>4.76</td>
<td>175</td>
</tr>
<tr>
<td>26. 1.63</td>
<td>1 : 00</td>
<td>Ikkom, Cross River</td>
<td>84</td>
<td>82</td>
<td>5.7</td>
<td>0.70</td>
<td>1.96</td>
<td>1.40</td>
<td>12</td>
</tr>
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<td>26. 1.63</td>
<td>1 : 00</td>
<td>Ikkom, Tributary of Cross River</td>
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<td>79</td>
<td>7.2</td>
<td>0.80</td>
<td>1.96</td>
<td>1.40</td>
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<td>Iboko, Rice Scheme</td>
<td>95</td>
<td>93</td>
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<td>7.60</td>
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<td>2.80</td>
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<td>1 : 30</td>
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<td>—</td>
<td>6.2</td>
<td>1.4</td>
<td>1.40</td>
<td>3.64</td>
<td>—</td>
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<tr>
<td>24. 2.63</td>
<td>4 : 20</td>
<td>Afikpo, Cross River</td>
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<td>85</td>
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<td>1.68</td>
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<td>4 : 45</td>
<td>Abina, Abakaliki Water Supply Pond</td>
<td>93</td>
<td>91</td>
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<td>8. 3.63</td>
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<td>88</td>
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<td>4.8</td>
<td>1.9</td>
<td>1.12</td>
<td>2.24</td>
<td>—</td>
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<td>20. 3.63</td>
<td>2 : 20</td>
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<td>5.3</td>
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<td>1.40</td>
<td>—</td>
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<tr>
<td>20. 3.63</td>
<td>4 : 15</td>
<td>Ogoja, Aiya River</td>
<td>92</td>
<td>90</td>
<td>7.0</td>
<td>6.00</td>
<td>2.24</td>
<td>3.92</td>
<td>—</td>
</tr>
<tr>
<td>25. 3.63</td>
<td>4 : 00</td>
<td>Obubra Ferry, Cross River</td>
<td>—</td>
<td>—</td>
<td>6.5</td>
<td>2.10</td>
<td>1.68</td>
<td>1.40</td>
<td>—</td>
</tr>
<tr>
<td>28. 3.63</td>
<td>8 : 30</td>
<td>Yakurr, Obubra, Fish Pond</td>
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<td>—</td>
<td>5.6</td>
<td>5.50</td>
<td>1.68</td>
<td>1.68</td>
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</tr>
<tr>
<td>8. 4.63</td>
<td>11 : 30</td>
<td>Enugu, Water Supply Pond</td>
<td>—</td>
<td>—</td>
<td>7.2</td>
<td>0.85</td>
<td>1.26</td>
<td>0.98</td>
<td>—</td>
</tr>
<tr>
<td>15. 4.63</td>
<td>4 : 00</td>
<td>Itu, Cross River</td>
<td>89</td>
<td>88</td>
<td>6.6</td>
<td>1.20</td>
<td>1.34</td>
<td>1.26</td>
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</tr>
<tr>
<td>17. 4.63</td>
<td>1 : 50</td>
<td>Nekede, Farm, River</td>
<td>88</td>
<td>81</td>
<td>6.2</td>
<td>0.85</td>
<td>0.92</td>
<td>0.45</td>
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<tr>
<td>17. 4.63</td>
<td>4 : 50</td>
<td>Ojji River, beside of P. M. Power Station</td>
<td>90</td>
<td>83</td>
<td>5.3</td>
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<td>1.29</td>
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<tr>
<td>27. 4.63</td>
<td>9 : 00</td>
<td>Eungu, Rainfall</td>
<td>—</td>
<td>—</td>
<td>6.6</td>
<td>1.70</td>
<td>0.00</td>
<td>1.12</td>
<td>—</td>
</tr>
<tr>
<td>24. 5.63</td>
<td>11 : 00</td>
<td>Iboko, Rice Scheme</td>
<td>—</td>
<td>—</td>
<td>6.4</td>
<td>4.00</td>
<td>0.48</td>
<td>1.30</td>
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</tr>
<tr>
<td>28. 5.63</td>
<td>3 : 30</td>
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<td>92</td>
<td>82</td>
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<td>2.71</td>
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<td>6 : 55</td>
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<td>71</td>
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<td>1.01</td>
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<tr>
<td>30. 5.63</td>
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<td>Obudu Cattle Ranch Rainfall</td>
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<td>65</td>
<td>5.4</td>
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<td>0.00</td>
<td>7.2</td>
<td>—</td>
</tr>
<tr>
<td>7. 6.63</td>
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<td>NORCAP, Abakaliki Swamp</td>
<td>—</td>
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<td>0.90</td>
<td>1.68</td>
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<td>10 : 15</td>
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<td>76</td>
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<td>4.20</td>
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<td>1.12</td>
<td>—</td>
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<tr>
<td>15. 6.63</td>
<td>8 : 50</td>
<td>Ihiteowerri, Orulu, River</td>
<td>82</td>
<td>81</td>
<td>5.3</td>
<td>0.25</td>
<td>1.26</td>
<td>0.56</td>
<td>—</td>
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<tr>
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<td>10 : 45</td>
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<td>4.9</td>
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<td>0.62</td>
<td>0.56</td>
<td>—</td>
</tr>
<tr>
<td>22. 6.63</td>
<td>9 : 20</td>
<td>Oron, Cross River</td>
<td>79</td>
<td>—</td>
<td>6.2</td>
<td>1.40</td>
<td>1.04</td>
<td>1.12</td>
<td>0.00</td>
</tr>
<tr>
<td>22. 6.63</td>
<td>9 : 20</td>
<td>Oron, Tributary of Cross River</td>
<td>79</td>
<td>81</td>
<td>6.3</td>
<td>5.50</td>
<td>0.98</td>
<td>0.91</td>
<td>0.00</td>
</tr>
<tr>
<td>29. 6.63</td>
<td>4 : 30</td>
<td>Eungu, Rainfall</td>
<td>84</td>
<td>81</td>
<td>6.3</td>
<td>0.35</td>
<td>0.22</td>
<td>0.92</td>
<td>0.25</td>
</tr>
</tbody>
</table>
rotting diseases on the seed bed.

Before soaking the seed grains they should be fanned and sieved to remove immature grains, preferably by "salt water selection".

The seeds are immersed in an aqueous solution of salt or ammonium sulphate of the following specific gravities: for non-glutinous, awnless varieties 1.10; for the glutinous varieties 1.08. The specific gravity of a freshly laid hen's egg is between 1.08 and 1.09. Hence the test for proper concentration of the solution for seeds in the solution, the sunken heavy grains are used for seeding.

The selected grains are washed with fresh water and allowed to soak in fresh water for saturation.

The grains usually contain 13 to 15 per cent moisture; at 50°F they may reach saturation at 23 per cent by weight, and at 82°F at 26 per cent requiring 10 to 14 days at 50-59°F, at higher temperature 2 to 3 days may be sufficient.

Disinfect the seeds with a solution of "Us-pulun", "Mercuron" or other mercuric germicides: soaked grains are immersed in a 0.1 per cent solution for 6 hours at 64°F or longer if the temperature is lower.

Another way is to immerse the soaked grains in a dilute solution of formalin (commercial form aldehyde solution diluted 1 : 50) for 30 minutes. The treated grains are heaped on the floor, covered with wet straw mats and allowed to stand for 3 hours; they are rinsed thoroughly with fresh water after the treatments.

For seed rot disease (Achlya sp. and Pythium sp.) seeds are immersed in a 0.5% solution of copper sulphate for 24 hours. Avoid metal containers when mercuric germicides are handled. Do not use your hands to scrub, this would damage the awns of grains because awns are very precious to preserve the grain from various germs and diseases and they permit the grains to adsorb oxygen and sun rays.

In order to stimulate the growth of roots it is necessary to immerse the seeds in fresh water for some time before sowing. In Japan the seeds are left in water for a week or 10 days but in tropical countries it does not necessarily require such a long time. It all depends upon how ready they are to sow in beds. During the period of immersion, when a tub is used, pour in fresh water twice a day and try to have the seeds, which sank to the bottom of the tub, come up by pouring the fresh water from a certain height, say 1 or 1.5 feet. The strong force of the water in the centre of the tub will make the seeds change their position upside down. Be sure to take out water of the same quantity of a fresh water before you add, to prevent overflowing.

Take out a certain quantity of grain and examine them by holding them in a bright light. If they are transparent throughout without any cloud, they are ready to sow in the beds.

After draining the water, keep the grains in a cool place to get them dry enough.

The seeds are soaked in hot water overnight, or baled soaked seeds are laid on a hot manure kept to start germination and kept in a warm place. At 86°F, germination may be complete within 24 hours. The length of the plumule should not be more than one than one third inch, but the radicle may develop much longer.

2. Nursery

The first ploughing must be done in March or after harvested rice, that depth is about 5 inches. The second ploughing and harrowing in May. Before this compost must be supplied about 3 ounces per 1 square foot.

One or two days before sowing a rectangular raised seed bed must be prepared. The width of the bed should be about 3 feet. Remove big stones and tree roots, soften and level the surface. About three quarter fertilizer must be given as the basic dressing, when seedlings grow up the additional one quarter fertilizer is top dressed.

The sowing period is from the middle of May to the end of June. Before sowing the seeds should be soaked for about 1 or 2 days
until a few seeds begin to germinate. Just before sowing, half a gallon of water is sprayed per 1 square foot. The seed rate is 15–20 grains per 10 square inches. After sowing, cover seed with one third of an inch of soft soil, chaff, rice straw or palm leaves etc. This forms protection from birds, control weeds and provides shade from the strong sun radiation, consequently reducing soil temperature and protecting the surface soil from drying. When the seed bed is dry, some water should be sprayed or irrigated. The seed bed should be sprayed two or three times with copper fungicide for disease control, and with D.D.T. insecticides for insect control.

3. Paddy Field

The modern practice in the paddy field is to divide a large field into a number of small level areas which are separated by contour soil walls. The water is led in from a channel and is drained from a central channel. The paddy fields of Eastern Nigeria are mostly in swamps which do not have divisional walls, and channels. The surface of each paddy field is not level, hence the quantity of water for a crop can not be controlled.

(A) Unit

For the use of a big machine, the unit of one paddy field must be more than half an acre rectangle. But, whatever the area and size of the field section level.

(B) Preparation of paddy field

Before the rainy season starts, the first ploughing should be done carefully over turn the soil completely in order to plough under green manure and weeds. After this, supply compost 3 tons per acre. After one or two rains, the second ploughing and harrowing should be done to the depth of 5 to 7 inches, and the clods be broken. The surface of the paddy field should be levelled. The paddy field is irrigated about 1 inch depth, the bunds (the soil wall which surrounded each paddy field for retaining the water) should be made or repaired with the soil from both sides of the bund. This is very important work in irrigating sloping fields. After this, just before transplanting, puddling should be done. After a little irrigation, to the surface of the paddy field to crush the clods and mix fertilizers into the soil. The purpose of puddling, is to soften the soil, and to level the surface of the paddy field.

(C) Fertilizer

It needs 39 lbs. N, 16 lbs. P₂O₅, and 24 lbs. K₂O, to produce 1 ton unhulled rice.

About 60% of fertilizer N should be supplied at the time of puddling, about 20% at the tillering period, and about 20% at the very-young-head forming period.

Usually, fertilizer P₂O₅ and K₂O is supplied as the basic fertilizer.

(D) Transplanting

The best time to transplant seedling:

The seedling has 6~8 leaves, its height about 7~9 inches. This seedling is about 4~6 weeks old after sowing. It is half the success of the rice cultivation to get good seedlings. Seedlings that are lifted and transplanted in the evening are better than those which are lifted and transplanted in the morning. Before lifting seedling, supply water to the nursery, thus the seed bed soil is soft and it is easy to lift seedlings. The lifted seedlings should be carefully handled, so that the root is not damaged, wash the root, take away the dust and weeds. Cut off about one third of the length. After lifting seedlings, they should be kept in cool place under shade or in cool running water.

Straight-line-transplanting:

Space rows should be from 10 to 15 inches. Space between hills (plants) should be from 8 to 12 inches. This spacing will not only facilitate the work of weeding, inter-row-cultivating, supplying additional fertilizer, but also it is easy to control diseases and pests. In this operation, strings or rulers are used which are marked at definite intervals. When strings are used they are marked at the reguard spaces 2, are stretched along the bunds on both sides and
then cross string is stretched across the surface of paddy field. The transplanters walk along the cross strings and transplant the seedlings at the marked spots, along the strip. The transplanting operation is usually done by stepping backwards, but sometimes it is done by walking forward. In the former, care should be taken not to walk on the spots to be planted. Transplanting efficiency differs according to the skill of transplanters. Therefore, when several planters are transplanting along the same cross string, the overall efficiency of the operation of transplanting may be reduced by this defect. The up and down string method of transplanting is in practice, whereby up and down strings are stretched at intervals of six rows with the transplanters between the two strings, transplanting six hills in succession as they advance. The number of seedlings in a hill is normally 2 to 3, although it varies according to the rice variety and according to fertilization. Seedlings should be planted as shallow as possible since deep planting tends to delay the rooting of the seedlings.

The way to plant seedlings into paddy field:
Hold the seedlings between thumb and fore-finger and push it into the soil while you dig a hole with the middle finger. Be careful not to damage the stems or the roots. This way is better than using a transplanting stick. Plant very shallow, about 1 inch deep and spread the roots evenly. Try to dig a small hole when planting seedling making way for the tender roots by the fore and middle fingers and push them into the soil. It is advisable to transplant in shallow not very deep. When you use the third finger all-together, it is liable to damage the roots, thus stimulating growing unnecessary roots. Be careful not to step on the ground where the seedlings are to be planted. Planted in this way the plants should yield large grains uniform in size and giving more weight after polishing, the percentage of wasteful bran is by far lower than in smaller sized grains. Water is kept somewhat deeper for several days after the transplanting to maintain an even temperature at night and to control weeds and stabilise seedlings during the early stage. Seedlings usually take root in about a week after transplanting.

(E) Weeding and Inter Row Cultivation
The first weeding and inter row cultivation is done one week after transplanting, by hand rotary weeder or free hand. Before the young ear formation stage, weeding and inter row cultivation is done again. 2-4-D (Herbicide weedkiller) is useful. Conditions, such as better irrigation and drainage, and relative large-sized farming are favourable. 2-4-D is applied just after the stage of maximum number of tillers. The paddy field is drained, so the weeds appear above the surface of the water which allows 2-4-D to stick directly to the weeds as it is sprayed all over the field at the ratio of 6 ounces per acre, dissolved in 12~20 gallons water. The nozzle of the sprayer is held 12~20 inches above the soil surface, taking care to sprinkle the solution as much as possible on the weeds, rather than rice plants. This operation is carried out on windless days. The paddy field is irrigated one or two days after the spraying operation has been completed. If the irrigation is delayed, the chemical effect on the weeds is reduced and damage to the rice plants is increased.

(F) Mulch
Mulching is very useful for weed control, reducing the temperature of soil and water, and to protect the surface soil from drying.

(G) Harvest
The best time for harvesting is when most of the hulls have turned yellow and the stalks and the leaves have lost their green colouring, about 5~7 weeks after earing time.

(H) Selection and Storage of Rice Seeds
The best time to prepare rice seed is about 1 week before the usual harvesting time, when about 1 inch of heads of strong ears containing grains, turn yellow. For seed rice, while threshing, great care
should be taken not to damage the grains. It is most desirable to collect only the well ripened paddy as seed grains from the upper ears of plants with “Semba”, the tooth-shaped small hand thresher made of pieces of metal arranged in rows. Store the rice seeds in clean cotton cloth or jute bags. Do not put them in cement paper bags or in empty kerosene cans, etc., because the chemicals contained therein will make the rice seeds deteriorate and render them inactive. Caustic soda, especially, affects the seeds and makes them lose their power to germinate.

7. Irrigation

Eastern Nigeria has about 70 inches of precipitation annually (almost all of the rain is in the rainy season which is the rice cultivation season), but this country can be troubled at any time by shortage of water, because there are no water control systems. The paddy field which is well irrigated and has no fertilizer at all, will produce about half the yield of the paddy field which is well supplied with fertilizer.

The depth of water is usually kept at about 4–6 inches. It is most necessary to have adequate water when preparing for transplanting or during the young ear formation stage. After this, the paddy fields are gradually drained until they are completely drained about 3 weeks after the rice plants have developed ears.

It is very difficult to make a good water control system for the individual farmer. So, this work should be done by the Government or by big farmer’s corporation.

8. Soil Improvement

This country’s soil is too poor for rice cultivation. Accordingly, increasing the soil productivity should be done as follows:

(1) Earth brought from Another Place
    Carry good soil which includes much organic matter, and mix into the paddy field.

(2) Compost
    Supply 4 tons compost per acre every year.

To make compost, farmers must keep plenty of livestock (cows, horses, pigs, sheep, goats, rabbits, poultry, ducks, geese, etc.) and cut down and gather plenty of wild grass. Stable manure (cattle dropping) and compost must be kept in the compost shed.

(3) P.H.

The best condition of soil P.H. for rice cultivation is 5.5–6.5. So if the paddy field soil P.H. is less than 5.5, supply lime and correct the P.H. to more than 5.5.

(4) Fallow

Do successioned cropping every 3 or 4 years, let the paddy field lie fallow, and cultivate green crops or cover crops. Then the soil nutrients will be increased and soil will be well conserved.

(5) Drainage

A paddy field which is too swampy must be drained by an open ditch or under canal.

9. Machinery

For the small scale farmer, these Japanese style farm machines for rice cultivation will be useful:

(1) Walking Power Tiller (field tiller, hand tractor, Japanese small tractor)
    Weight: 200–500 lbs.
    Engine: 5–10 horse power petrol or diesel engine.
    Many attachments as follows:
    - Ploughs, wheels (paddy ploughing wheels, paddy puddling wheels, rubber tyres), cultivators (one-gang cultivator, ridger, ditcher), mower, levelling rake, trailer.
(2) Hand Rotary Weeder.
(3) Sickle.
    Grass cutter, ordinary sickle, notched serrated-type sickle.
(4) Hand Reaping Machine.
(5) Manpower Pedal Thresher.
(6) “Semba” (Hand Thresher).
    The tooth-shaped small hand thresher made of pieces of metal arranged in rows.
(7) “Tomi” (Hand rice cleaning machine).
10. Prevention from Salt Damage for Mangrove Swamp Rice

(1) At first:
(A) Irrigate with pure water, which will reduce the density of salt concentration.
(B) Supply plenty fertilizer, especially nitrogen.
(C) Improvement drainage.
(2) Basic Countermeasure:
(A) Make banks on seashore to prevent invasion of sea water.
(B) Synthetic adjust the irrigation and drainage system.
(C) After (B), irrigate about 25 inch depth pure water divided into 2~3 applications.
(D) Supply 13 cwt. lime per acre, (replacement of the soil bases Na. and Mg. by Ca.)
(E) If one can't do these countermeasures, it is better to give up these paddy fields, and make a new paddy field where there are better conditions.

11. Control of Plant Transpiration and Water Evaporation

This country has high air temperature and heavy sun radiation all year round, so control of transpiration and evaporation is a very important problem. Especially, just after sowing and transplanting, it is necessary to keep good soil moisture and to prevent the seedling wilting. For this purpose, there is a good material called O.E.D. green.

What is O.E.D. green:
The main ingredient of O.E.D. green is oxyethlene Docosanol, C_{22}H_{45}O (CH_2CH_2O)_n H, Japanese Government Patent No. 247110. It is properly used in the form of suspension (solvent), it covers all the surface of plants with its adhesive thin film, and by suppressing transpiration from the plants, prevents their wilting or dying.

When this O.E.D. green suspension is applied to the surface of soil, it also interrupts evaporation of water and consequently raises soil temperature and protects the surface of soil from drying.

Note: O.E.D. green were presented from me to Ministry of Agriculture, Enugu.

12. Proposals for Carrying Out Further Experimental Investigation

(1) Sowing Season Test.
(2) Transplanting Space Test.
(3) Fertilizer Test.
(N, P_2O_5, K_2O)
(4) Survey of Transpiration, Evaporation and Percoration at full time of paddy field.
(5) Diseases and Pest Control Test.
(6) Weed Control Test.
(7) Irrigation Method.
(8) Mechanization of Rice Culture.
(9) Soil Improvement Test.
(10) Readjustment of Arable Land Test.
(11) Climate Observation.

Of course, these observations must include; sunshine record, sun radiation (cal. per square inch per min.), evaporation, percoration, soil moisture, water and soil temperature, precipitation. It must be continued in many places and for ever.

13. Conclusion

I have been in this country since the end of July 1962, alone, and with very little equipment. When I arrived, rice transplanting had almost finished; my duty term is only one year,
so I couldn't sow seed myself and harvest the
crop.

I suppose for the improvement of Eastern
Nigeria rice culture, these two points are most
important:
(1) Soil Improvement.
(2) Water Control.

Moreover, for the improvement of rice
culture, many rice specialists should be invited
including specialists in agronomy, breeding,
control of disease and pests, soil, fertilizer,
meteorology, civil engineering, machinery, etc.,
with sufficient organization, equipment, number
of men, rice culture experiments should be
continued for at least five years. After that,
some good results may be achieved.

(和 文 摘 要)
ナイジェリア東部州の水稲作に対する勧告
山 本 信 一
（山梨県庁稲作専門技師）

筆者は、1962年7月から1カ年に、現地試験観察で西アフリカのナイジェリア連邦東部州にあって、同国の稲作
を指導した。その結果、土壌改良と用水管理が最も重要であるとし、上記英文の稲作改良勧告書を作成しました。

ハマオモトに関する研究

（1）分布、立地条件について*

三木末武・長東一喜
（玉川大学農学部）

花は両3日もつ。1花軸上では普通20数個の花が花
期2週間に及ぶ。顕る大型で観賞植物として海浜では
特に目を纏き、天然記念物の指定を受けている。この
ための教唆か、わが国にはその栽培に乏しく、その分
布および分布上の研究は別として、園芸学的研究対象
としては意外等閑に付されてきた点がある。

C. asisticumの変種常緑多年草のハマオモトは、
わが国では普通海岸から完万大島、宮崎（慶福花として
指定保存）、高知、和歌山、三重（県花として指定）、
静岡、伊豆七島、北見は千葉県房総の東岸仁右衛門島
（地図では波太島）や神奈川県三浦半島の西岸北緯
35°13′の天神島までである。中でも波太島は黒潮と親
潮の落ち合う南寄りであり、同時にそれらの地は本種
の原産とみなされる。

ハマオモトの名は、海浜産とオモトに似ているから
で、古名ハマヤ（浜木綿）の名の出所に関する種々異
説中、業に因んだその白い葉柄に基づくといわれるの
が真に近いようである。理由は葉柄を短くと帯褐色白色