

Manual for Rice Production in Africa

Manuel pratique de la production du riz en Afrique



Chief Editors: Li Hongtao Li Li

Deputy Chief Editors: Wang Xianzhong Zhang Lili

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CSK Hunan Science & Technology Press

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Preface

Rice is a highly adaptable crop widely distributed in the world. From either physiological or biological point of view, rice is an ideal crop for the entire Africa continent. Meanwhile, Africa is endowed with rich agricultural resources, sufficient rainfall and heat, land resources and human resource, which are the precondition, basis and guarantee for agricultural development. Therefore, promoting rice high-yielding cultivation technology is a significant and effective way for food security in Africa.



To promote rice in Africa, a technology of high-yielding cultivation is crucial. High-yielding rice cultivation is a systematic program, which requires coordination of various aspects including seed, fertilizer, irrigation, soil and management, etc. This manual will elaborate on the key technical points and relevant knowledge of high-yielding rice cultivation from four aspects: rice field preparation, sowing and seedling cultivation, field management and harvesting management. The technical process can be summarized as below:



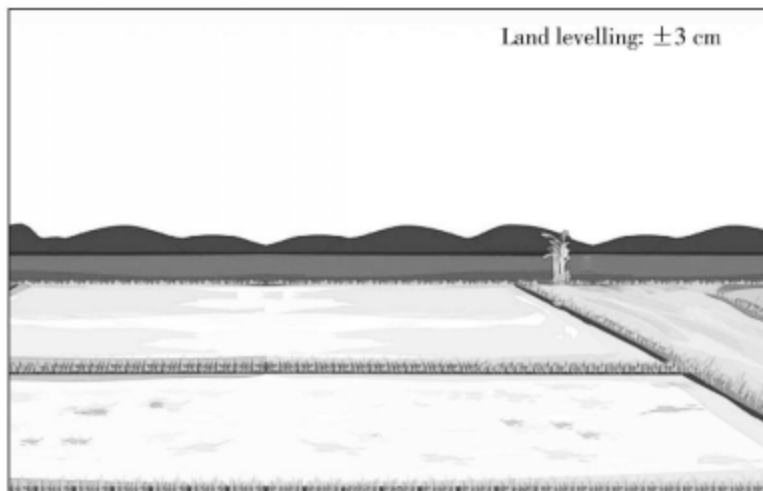
Rice field preparation	Principles of rice field preparation
Sowing and seedling cultivation	Drying, selection, soaking and sterilization of seeds; acceleration of germination; seedbed preparation; sowing; seedbed management
Field management	Seedling transplanting; fertilization; irrigation; disease and pest control
Harvesting management	Reaping; threshing; drying; cleaning; storage

Part I Rice Field Preparation

[Operating Steps and Key Technical Points]

1. Principles of rice field preparation

- Rice field should be levelled, with a height difference less than 3 cm.
- Soil should be fine-textured and topsoil should be soft to retain water and fertilizer.
- No residual weeds in the field.



2. Field preparation

• After the previous crop season, plow the field using tractors with plow or cattle in time. The plowing depth should be over 15 cm to bury weeds and crop stubble deep into the soil to facilitate degradation of organic matters and enhance soil fertility.

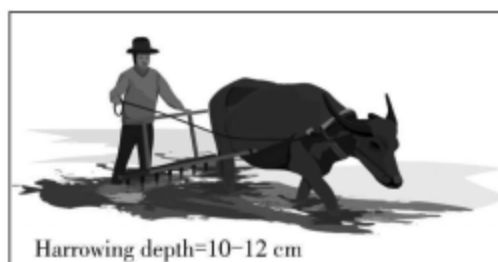
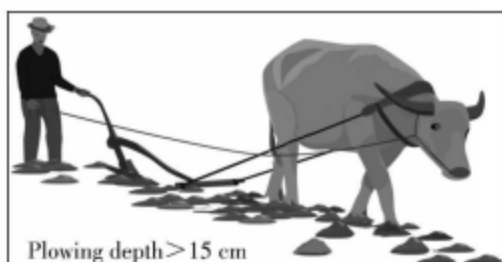
- Store water after plowing to soak the field.
- Before transplanting, plow and harrow once using a tractor with plow/harrow or cattle (with a depth of 10 – 12 cm) to level the field and make it soft enough for transplanting.

• Africa has diversified soil types. Thus the field should be prepared based on its specific soil type. The methods are as follows:

❶ In a swamp paddy, if soil is heavier-textured, plow twice and harrow twice; if the soil is soft, then plow twice and harrow once.

❷ In an arid upland, the field can be fallowed directly after rice harvesting. Plow and prepare the soil when it's dry and before rain comes. Till the soil in a saturated condition after rain comes. Plow and harrow 1 to 2 times, and then proceed to transplanting.

③ For the field utilizing green manure in the humid area, choose appropriate time to turn over the soil while taking into consideration the transplanting season as well as the yield and effect of green manure. Generally, it is most effective to turn over the soil during the most flourishing period of green manure. Dry the field properly after turnover and soak the field for 10 to 15 days. Then plow and harrow to level the field, making it ready for transplanting.

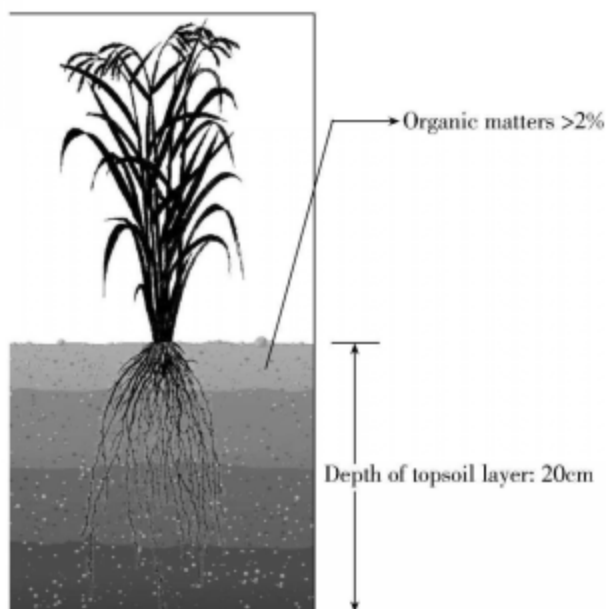


Soil type	Number of plowing	Number of harrowing
Swamp paddy	2	1
Arid upland	1	1 - 2
Field utilizing green manure in humid area	1	1

[Soil Conditions for Rice Cultivation]

- **Thick topsoil and fertile soil.** Thicker topsoil allows better water and fertilizer retention, extends the range of fertilizer and water supply, accelerates the degree of soil-ripening, and creates good condition for the growth of rice root system. Generally, the depth of topsoil layer is required to be 20 cm and contain over 2% of organic matters along with various microelements needed for the growth of rice.

- **Proper permeability to retain water and fertilizer.** Proper permeability can increase oxygen content and decrease toxic substance content in the soil. However, if soil permeability is too high, its ability to retain water and fertilizer will decrease, causing great loss of water and fertilizer. In Africa, soil's ability to retain water and fertilizer is closely related to the soil texture. Generally, permeability of soil is low if it is heavier-textured with fine particles and compact structure. Conversely, sandy soil with loose structure provides easier



passage of air and gains temperature back more quickly but can also easily lose water and fertilizer. A fine rice field should be easy to till with little clod forming and low resistance when tilled dry. When a field is tilled in a saturated or flooded condition, soil should be soft but not too wet that it becomes slushy and water and soil should be mixed evenly. That is to say, a fine rice field should have relatively firm plow pan to retain water and fertilizer while maintaining proper permeability.

- **Vigorous beneficial microbial activities.** Abundant beneficial microorganism can facilitate corrosion of plant residual and degradation speed of cellulose and increase organic matter content in the soil. At the same time, acid produced from microbial metabolism can facilitate decomposition and supply of solid nitrogen, phosphorus, potassium and other mineral nutrients in the soil, thereby enhancing the soil fertility.

Part II Seed Sowing and Seedling Cultivation

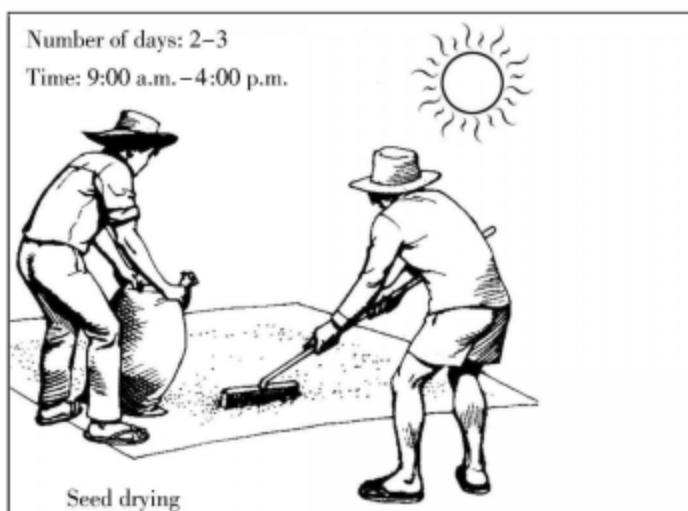
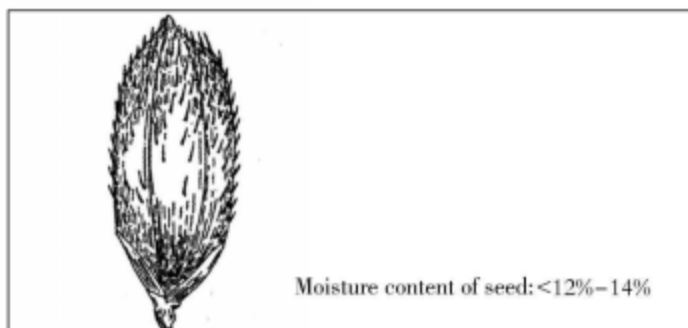
[Operating Steps and Key Technical Points]

1. Seed drying

- Dry seeds in the sun for 2 – 3 days from 9:00 a. m. to 4:00 p. m. on sunny days under high temperature. Make sure that seeds are spread out, frequently turned over and thoroughly dried with even sunlight and heat on them.

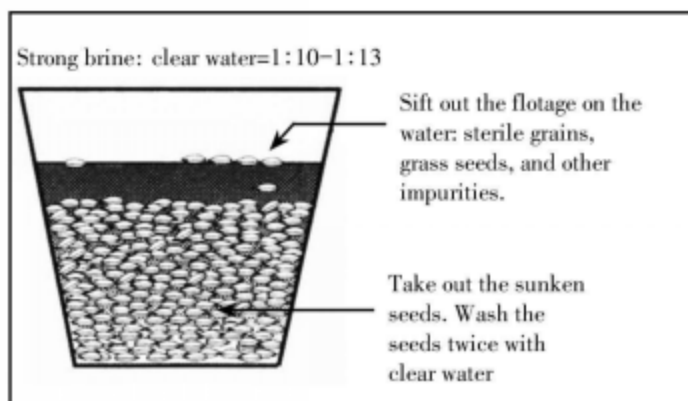
- Seed drying strengthens water permeability and breath ability of seeds. The moisture content of the seeds should be controlled under 12% – 14% so as to increase the germination rate and potential.

- As in some area of Africa, the outside temperature can be very high, direct contact with concrete ground should be avoided so as not to burn the seeds.



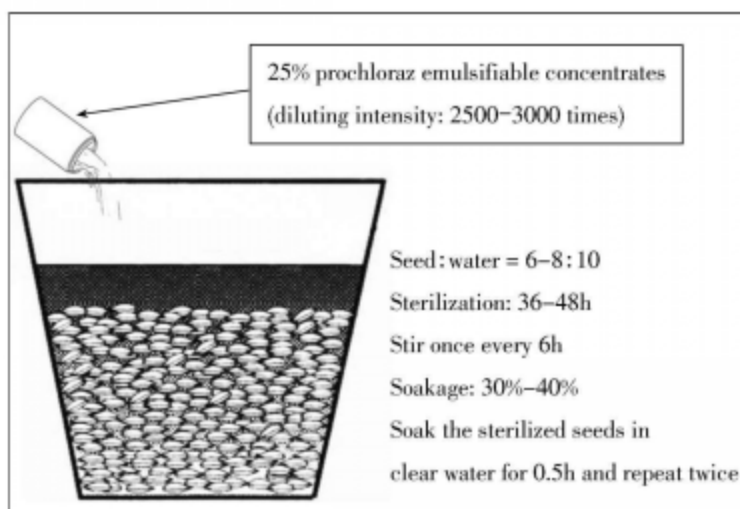
2. Seed selection

- Prepare strong brine by melting salt in boiling water, and then mix strong brine with clear water at a ratio of 1:10 to 1:13 in other containers.
- Put seeds in brine and sift out the flotage after full stirring. Take out the sunken seeds and wash twice with clean water.



3. Seed soaking and sterilization

- Soak 6 to 8 kg seeds with 10 kg of clean water for 2 to 3 days indoor under room temperature. When the white belly and embryo of seeds become clearly visible, which means moisture content has reached 30% to 40% of the total seed weight, then we can say the seeds are saturated.
- Better to carry out seed soaking and sterilization at the same time. Soak seeds in the diluent (diluted 2500 to 3000 times) of prochloraz emulsifiable concentrates (25%) for 36 to 48 hours and stir once every 6 hours to ensure even sterilization of seeds.
- Soak disinfected seeds in clear water for 2 hours and repeat the process twice before proceeding to germination.

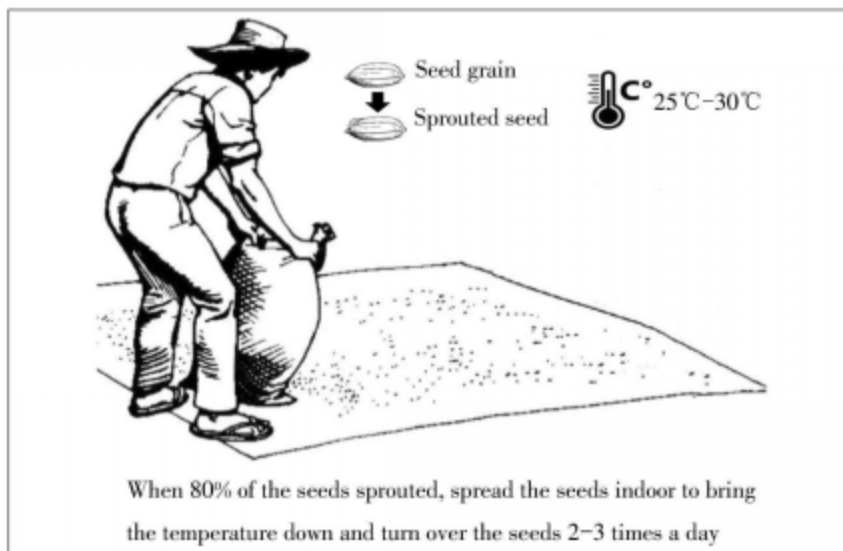
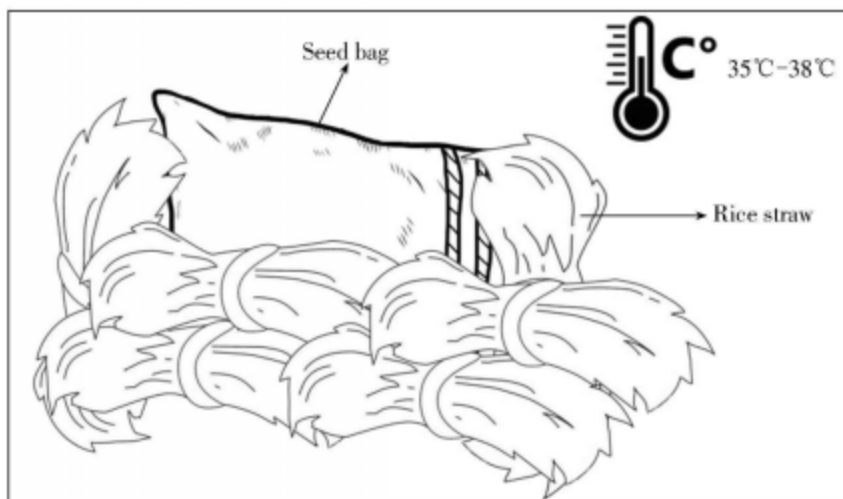


4. Acceleration of germination

- Pack the sterilized seeds with gunnysacks or breathable woven bags and seal the bags with straw for insulation. Keep the temperature at 35°C to 38°C. Turn over the sealed seeds if the temperature is too high and sprinkle warm water to keep the seed bags warm if temperature is too low.

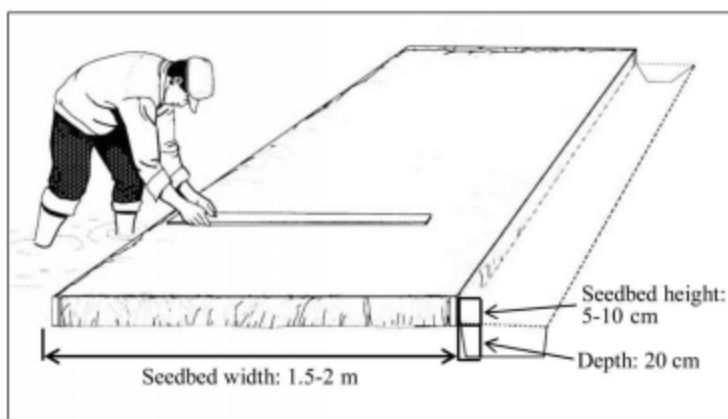
- When 80% of the seeds sprouted, spread the seeds indoor to cool the temperature down to 25°C to 30°C and turn over the seeds 2 to 3 times a day to prevent overheating of the seed sprouts. Since the temperature in certain areas of Africa can be very high, it is suggested to soak seeds in running water during daytime and spread them out during night time for 2 – 3 days.

- Acceleration of Germination is completed when the sprouts grow to half of the seed length and the roots grow to the same length of the seeds.



5. Seedbed preparation

- Choose a soft, fertile and levelled field with less weeds and wind, good light and convenient irrigation.
- Build a 5 – 10 cm high and 1.5 – 2 m wide seedbed. Make sure that the seedbed is levelled and the soil is soft and loose in the upper part and firm in the lower part.
- Build 20 cm deep drainage channels between seedbeds.



6. Sowing

- Sow the germinated seeds evenly on the seedbed (1 – 2 kg of seeds per 20 m² of the seedbed).
 - Press the seeds into the soil once after sowing, leaving only the sprouts out of the soil.
- Cover the seedbed with 0.5 cm of fine and moist soil and then plastic mulch. Seal and secure the edge of the mulch with soil.



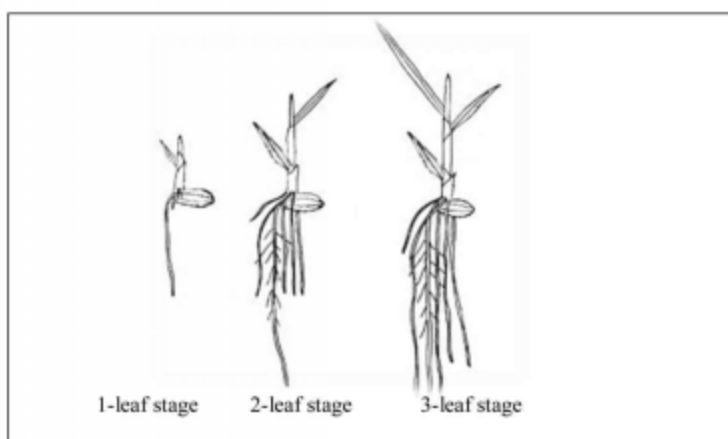
7. Seedbed management

- Seedbed temperature management

keep the bed warm when the first leaf comes out after sowing. Keep the greenhouse temperature at 28°C – 30°C. The optimum temperature is 25°C – 28°C. Keep the temperature at 25°C during 2-leaf stage and 20°C – 22°C at 3-leaf stage. The temperature should always be no less than 10°C.

- Seedbed ventilation

Remove the plastic mulch when the seedlings turn green in the morning or at night when the temperature difference is small inside and outside of the greenhouse, so that the seedlings can get used to new environment sooner. As the leaf stage grows, the time of ventilation should be extended accordingly. Especially at 2.5-leaf stage, temperature should be kept under 25°C and ventilate if the temperature exceeds 25°C to prevent early heading. Enhance ventilation gradually from 3-leaf age till the temperature is consistent inside and outside of the greenhouse. Then remove the plastic mulch and the seedlings are ready to be transplanted.



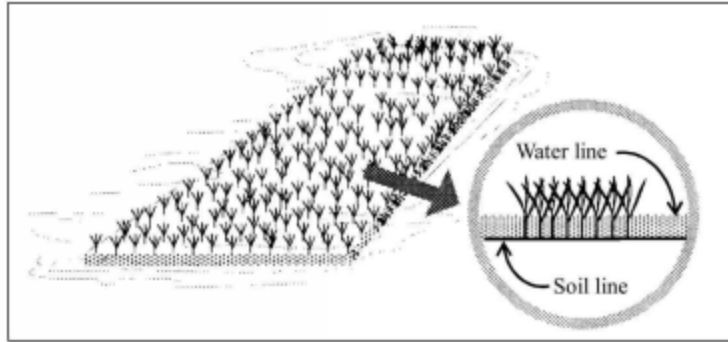
- Seedbed moisture management

① Water the seedbed before sowing to fully saturate soil.

② Watering should be limited before 2-leaf stage (normally don't need to water) to ensure sufficient oxygen and allow seed roots grow deeper into the soil so as to dwarf the first leaf sheath. After 2-leaf stage, water once a day in light of moisture condition. Insufficient moisture will cause leaf rolling and while too much moisture will cause excessive leaf growth and maldevelopment of the root system.

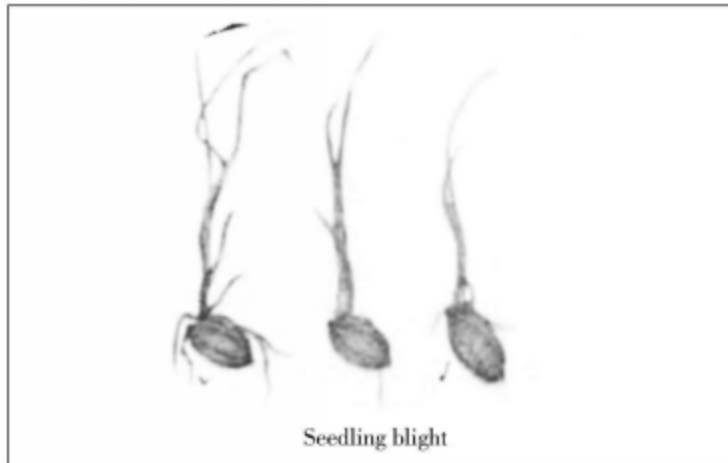
③ Water seedbed to 2 – 3cm from the surface after 2-leaf stage to allow the shift from absorbing nutrition of endosperm to that from photosynthesis.

④ Water seedbed to 5cm after 3-leaf stage to control weeds. Weed the seedbed otherwise the weeds will compete with seedlings for sunlight, water and nutrition.

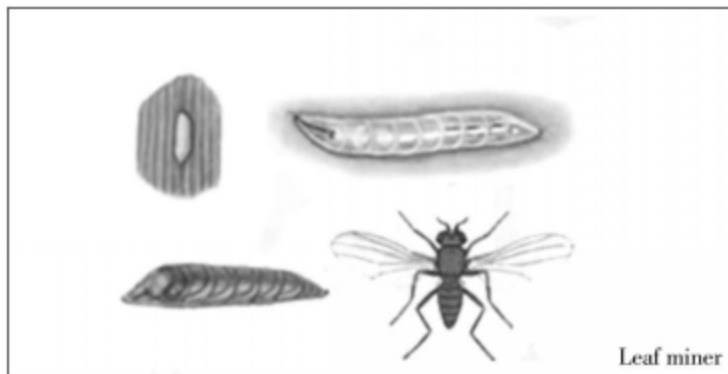


- Prevention and control of pests and diseases

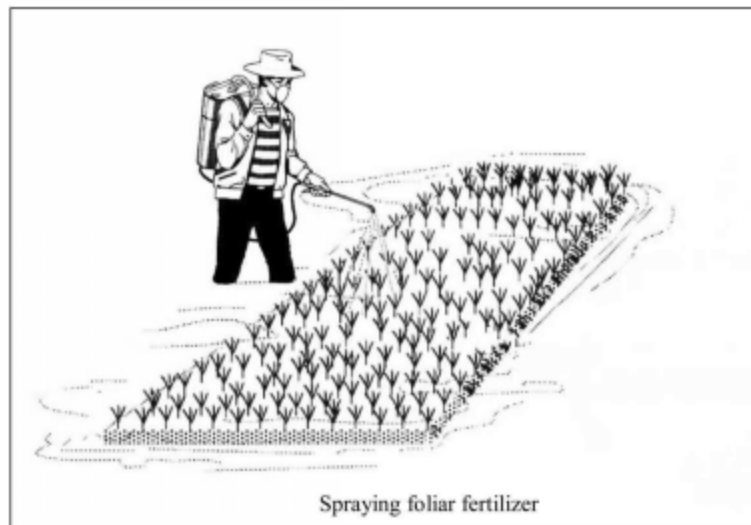
① Prevention of seedling blight: spray broad-spectrum biological pesticide (15mL/m², mixed with 2.5 – 3 L water). If pH value of the seedbed soil increases, spray diluent (diluted 500 times) of 95% sulfuric acid to balance pH value to the standard value (5.0 –6.0).



② Prevention of leaf miner: one day before transplanting, spray diluent (diluted 800 times) of 225 – 300 g of 10% Imidacloprid Wettable Powder (an effective heterocyclic insecticides with low toxicity) per hectare on leaf surface.



- **Topdressing:** In later stage of seedling growth, spray diluent (diluted 100 times) of urea (1.5 – 2g) and potassium sulphate (0.25g) per square meter. Two days before transplanting, spray 1.5 – 2g of diammonium phosphate (DAP) per square meter and fully water the seedbed once after dressing fertilizer. One day before transplanting, spray 3kg of rooting powder (concentration: 10 – 15ppm) per square meter.

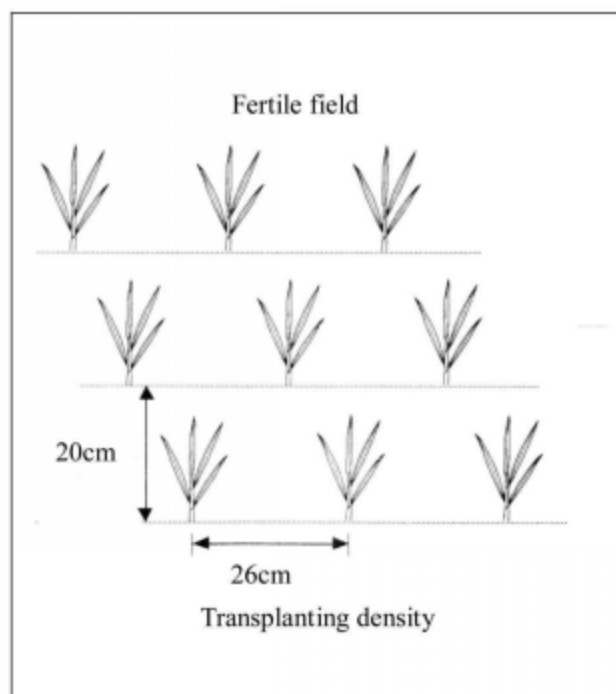


Part III Field Management

[Operating Steps and Key Technical Points]

1. Transplanting seedling

• Transplanting density (number of seedlings per square meter) should be determined based on various factors such as soil fertility, climate conditions, cultivation competency, and etc. For relatively fertile field with good fertilizer supply and climate condition, the proper density is around 125 seedlings/m². Whereas for less fertile field with poor fertilizer supply and weather condition, density could be increased accordingly to 140 seedlings per m².



• There are three common transplanting methods: manual transplanting, mechanical transplanting and seedling broadcasting. Their respective procedures and technical points are as follows:

❶ **Manual transplanting** Adjust the water layer of the field to about 1 cm the day before the transplanting. The seedlings should be transplanted straight, steady, shallow and evenly into the soil as soon as it's picked up from the seedbed. Depth of manual transplanting should be 2 – 3 cm. Check and make up for omitted spots within three days after transplanting.