NERICA RICE CROP MANAGEMENT

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Background information

The timeliness and quality of land preparation are critical to rice production. NERICA varieties are no exception. Good soil tillage practices generally enhance efficient fertilizer-use, soil porosity and aeration and then have positive impacts during germination, seedling emergence and stand establishment stages of plant growth, in addition to weed control.

Unit 1 – Land selection and preparation

Land preparation for NERICA varieties can take the form of conventional tillage operations of ploughing and harrowing using tractor or animal traction. This is applicable mostly for medium- to large-scale farmers. Smallholder farmers, particularly in the humid forest agro-ecosystems, after clearing and burning the debris, use minimum tillage operation consisting of opening up of the spot to dibble in the NERICA seeds using a hand hoe.

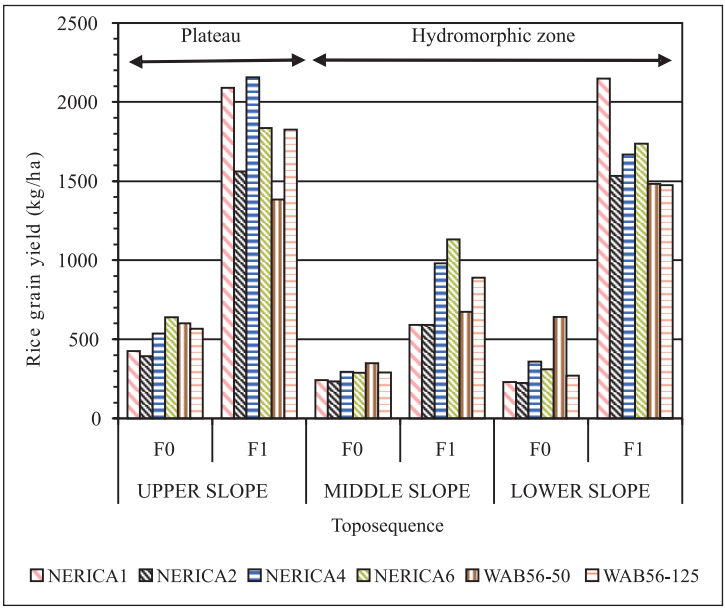
Unit 2 – Land selection: where to grow NERICA varieties?

The NERICA varieties are developed for the upland production systems. They can grow in any agro-ecosystem under upland conditions so long as there is enough moisture to sustain the crop throughout the growth period. Some of the NERICA varieties (NERICA6 for example) can be grown in the hydromorphic fringes. However, waterlogged soils are not appropriate.

NERICA varieties can grow on a variety of soils ranging from moderately drained to well drained soils. In West Africa most of the

soils in the upland rice production agro-ecology are sandy loams to sandy clays with pH ranging from 5.0 and 6.0. In the humid forest agro-ecosystem, where there are heavy losses of exchangeable bases due to excessive rainfall, the pH may range between 4.0 and 4.5.

NERICA varieties can grow at both low and relatively high altitudes. For example, NERICA4 has been shown to thrive in Ethiopia at 1,900 meters above sea level (masl) and matured within 130–140 days. NERICA1–4 have been grown at low altitude in the Wabe Shebelle river valley in Ethiopia and matured within 80–90 days.



Source: WARDA (2006) Joint Interspecific Hybridation Progress Report, p.96.

Figure 17. Grain yield (kg ha^{-1}) of NERICA lines and sativa along the toposequence with (F1) and without (F0) fertilizer application.

Unit 3 – Cropping calendar

In general, upland rice can grow in any environment with at least 15 to 20 mm of five-day rainfall during the growing cycle. During germination and early growth stages, 15 mm per five-day rainfall is sufficient. In environments where there are two distinct cropping seasons, it is important to establish the time to sow in each season based on the long term (15-year) daily rainfall pattern or actual trials on optimum sowing date.

In Uganda, East Africa, based on the long-term rainfall pattern, sowing dates of 20–25 February for the first season and August 24–28 for the second season crop were recommended for optimum NERICA production (Tuboi 2006, personal comm.)

In the monomodal rainfall savannah zone of Côte d'Ivoire, West Africa upland rice is sown in May–June while sowing in March–April (first season) and May–June (second season) is recommended in the bimodal rainfall forest zone (Becker and Diallo, 1992)

Unit 4 – Planting of NERICA varieties

Before planting NERICA varieties, it is important to conduct a germination test to establish the actual seed rates to use based on the viability of the seeds.

NERICA seed treatment prior to planting
The NERICA seeds may be treated with Apron Star 42 WS (thiamethoxam + difenoconazole + metalaxyl-m) at the rate of one sachet (10 g) per 1 kg of seed 2–3 days before planting. Other suitable seed treatments may be used according to availability and per the manufacturers' instructions.

In an environment where termites and nematodes pose serious threat to uniform emergence and crop establishment, it is recommended

to incorporate carbofuran (Furadan) at the rate of 2.5 kg a.i. per hectare into the planting rows. To ensure uniform application, Furadan should be mixed with sand at a ratio of 1 part of Furadan to 4 parts of sand.

NERICA seed pre-germination prior to planting

To ensure uniform seedling emergence and good establishment, NERICA seeds can be pre-germinated before planting.

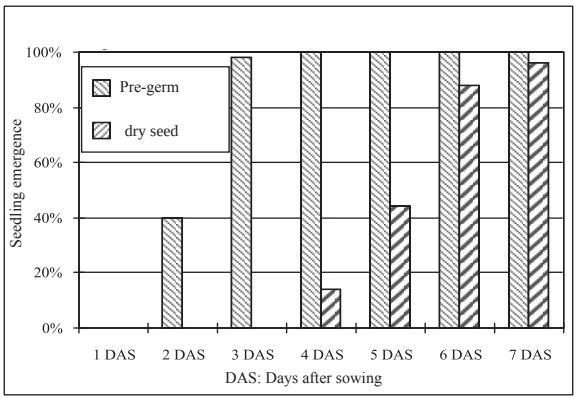


Figure 18. Seedling emergence of pre-germinated versus dry seed, in Namulonge, Uganda. (T. Tsuboi, unpublished data).

Unpublished data of T. Tsuboi in Uganda, East Africa, show that when dry NERICA seeds are sown directly, it takes five days for the seedlings to emerge. But for pre-germinated seeds (i.e. seeds soaked in water for 24 hrs and incubated for 48 hrs) it takes 2–3 days for the seedlings to emerge and the plants are uniformly established in the field (Figure 18).

NERICA seed dormancy breaking

Some NERICA varieties have showed dormancy characteristics (failure of mature seeds to germinate under favourable environmental conditions) inherited from their parent *O. glaberrima* (Guei *et al*., 2002). In this case, particularly when using newly harvested seeds, seed dormancy would need to be broken to enhance uniform seedling emergence and establishment. This can be done by soaking the seeds for 16 to 24 hrs in 6 ml of concentrated nitric acid (69% HNO_3) per litre of water for every 1 kg of newly harvested seeds. After soaking, the acid solution is drained off and the seeds are sun-dried for 3–5 days to a moisture content of 14% and stored for sowing.

Unit 5 – Plant density

Uniform crop establishment and optimum plant densities are essential to optimize yields. The use of seed dressing, pre-germinated seeds and a sowing depth of 2 to 4 cm is recommended for uniform plant establishment.

When the seeds are viable (germination rate of more than 80%), seeding rate of 50–60 kg ha^{-1} is recommended for dibble sowing and 80 kg ha^{-1} for sowing by drilling. Five to seven seeds can be sown per stand and later thinned to 2–4 seedlings at 14 to 21 days old. If germination percentage is less than 80%, the seed rates should be increased accordingly. Note that only filled grains should be used for sowing. The empty grains should first be removed by floating in water.

In Benin (West Africa), a spacing of 20 cm × 20 cm with 4 plants per stand (1×10^6 plants ha^{-1}) for sowing by dibbling is recommended for NERICA cultivation.

In Uganda (East Africa), a spacing of 30 cm × 12.5 cm or 15 cm × 15 cm is recommended for sowing by dibbling. But when sowing is by drilling, a spacing of 30 cm × 1.7–2 cm or 25 cm × 2.2–2.4 cm is recommended.

A sowing depth of 2–4 cm is recommended for NERICA lines. Deep placement of seeds at more than 4 cm resulted in poor germination and delayed seedling growth (Tsuboi, unpublished data, 2005).

Unit 6 – Weed management in NERICA rice-based cropping systems

In West Africa, between 27 and 37% of the total labor invested in rice is taken up by weeding (WARDA, 1998). In the main rice growing ecologies – mainly the rainfed ecologies and those suitable for irrigated rice – weeds are the main constraints, reducing production by up to 40% and potentially causing total crop failure if left uncontrolled (WARDA, 1998). This constraint is well perceived by rice farmers. A survey conducted in Côte d'Ivoire by WARDA revealed that every single farmer identified weeds as a major problem in rice cultivation regardless of ecology.

The commonest weed species found in the rainfed upland ecology in West Africa include *Paspalum scrobiculatum*, *Euphorbia heterophylla*, *Chromolena odorata*, *Oldenlandia herbacea*, *Tridax procumbens*, *Digitaria horizontalis, Tridax procumbens Cyperus esculentus* and *Cyperus rotundus*. In the East, Central and Southern Africa (ECSA) country of Tanzania, *Ageratum conyzoides*, *Galinsoga pariflora*, *Clotalaria incana* and *Rottboellia cochinensis* are cited among the principal weed species encountered in the upland rice ecology.

Though *O. glaberrima* has been shown to be competitive against weeds (Johnson *et al.*, 1998; Fofana and Rauber, 2000), NERICA varieties cannot thrive in an unweeded field.

Hand-weeding regimes

When should I start weeding NERICA rice fields?
When weed pressure is minimal in the field, only one weeding within 15–21 days after sowing (DAS) is sufficient for NERICA rice plants to grow well. But when weed pressure is high, a second weeding at panicle initiation stage (about 42–50 DAS) is needed. Weed a third time if necessary.

However, hand weeding can be relatively ineffective, particularly in controlling many of the perennial weeds (e.g. *Cyperus* spp.) that have underground tubers and rhizomes from which they can rapidly re-establish. Therefore, integrated management of weeds involving the use of herbicides combined with hand weeding will be the most sustainable approach to managing weeds for NERICA production.

Chemical control

What is the recommended herbicide, its application rate and timing for NERICA varieties?

Any herbicide suitable for upland rice production can be used for NERICA varieties.

Pre-emergence herbicides: applied before the weeds emerge, they provide an extended period of weed control as they are used during land preparation before NERICA rice planting. Table 16 indicates general guidelines to some herbicides used in NERICA rice production.

Post-emergence herbicides: they are applied after emergence of rice and weeds, but preferably at the early growth stages of weeds (3–5 leaves).

Various types of weeds are associated with rice; therefore, the use of a combination of herbicides that kill different types of weeds is advised.

Table 16. Selected herbicides recommended for NERICA rice production

Herbicide formulation	**Rate a.i. (kg ha^{-1})[1]**	**Time of application**	**Remarks**
propanil + bentazon	1.0–3.0	Post-emergence	Formulated mixture. Apply 14–21 days after transplanting
propanil + 2.4D	3.0	Post-emergence	Apply 14–21 days after seeding or transplanting
propanil + thioben-carb	1.5–3.0	Post-emergence	Apply 14–21 days after seeding or transplanting
oxadiazon	0.6–1.25	Pre-emergence	For direct seeded (3 days after sowing)
butachlor	1.0–2.3	Pre-emergence	Apply within the first three days of sowing

[1]*Use higher rates when the weed pressure is high.*

Use of legume fallows to control weeds in NERICA rice fields

Well-managed legume fallows provide opportunities to control weeds in the various agro-ecological zones in upland rice-based systems of West Africa. Fallow vegetation composed of legumes, including *Aeschynomene histrix, Stylosanthes guianensis, Canavalia ensiformis, Crotalaria anagyroides* and *Mucuna prurensis* have been shown to control weeds when grown in sequence with upland rice in the savannah and forest agroecologies of Côte d'Ivoire, West Africa (Becker and Johnson, 1998).