DOMESTICATION OF *RICINODENDRON HEUDELOTII* (BAILL.) PIERRE EX. PAX. IN THE HUMID LOWLANDS OF CAMEROON

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Abstract

Ricinodendron heudelotti is one of the top ranking indigenous multipurpose tree species retained for improvement in the humid lowlands of West Africa. It is a common species known as Djangsang in Cameroon, producing highly oleaginous nutritious seeds. It is harvested by local populations for consumption and sale. In addition, it is an integral part of traditional farming systems and, therefore, is protected in cropping fields. There is, therefore, an urgent need for its domestication. Phenology and propagation are among the first steps of the domestication process. Therefore, to know the probable fruiting period of the species, a weekly phenological study was undertaken in three localities at each of two sites in the forest zone of Cameroon from July 1989 to July 1992. The experimental design was a 2 × 3 factorial located in a randomized complete block design with three replications. The sites (Yaounde, Sangmelima) were taken as the main treatments while years (1989, 1990, 1991), during which observations were carried out, were considered as sub-treatments. The effect of site, year and their interaction were significant respectively at 0.05, 0.01 and 0.001 level of probabilities. To overcome seed dormancy, a germination test was carried out in the laboratory using a randomized complete block design with four replicates and five treatments. The experimental unit was made up of 60 seeds. Results indicated a significant difference between treatments. Hand scarification increased the germination rate up 60 per cent, whereas the control gave a germination rate of only 3.33 per cent. Due to the dioecious nature of the species (separate male and female plants), vegetative propagation by cuttings was conducted in the open field. The experimental design was a split-plot design with three replicates. The main plot was the type of wood (basal, median and extreme) whereas the sub-plot was the position of the cutting (vertical, slanting). The experimental unit was made up of 20 cuttings. Significant difference was observed between the types of wood (P=0.05) as indicated by the median wood which showed a high sprouting potential.

Introduction

Ricinodendron heudelotii, from the family of Euphorbiaceae, is known as Djansang in Cameroon and Okwe in Nigeria. It is common in semi-deciduous forest and at the fringe of the humid forest in Cameroon (Mollet *et al.*, 1995a).

The uses of the tree are many and varied. The tree produces a highly-nutritious seed. These seeds can either be dried and crushed and then cooked with fish, chicken, vegetable and in many sauces, or eaten directly like peanuts (Anigbogu, 1996). The nut contains high quality oil (45%) and the tree could become a major producer of cooking oil, comparable to that of cotton, soya bean and peanut (Tchiegan, Kapseu & Mapongmetsem, 1995). The green leaves are used as forage for goats and sheep (Daguma, Tonye & Depommier, 1990) and their protein content is 16 per cent (Anigbogu, 1996). It has no known toxicity. The tree is appreciated for the shade it provides and as an indicator of soil fertility (Daguma, Tonye & Depommier, 1990). It is an agroforestry tree with important market value; thus a measure of nuts costs US $ 1.30 and 1.50 in Cameroon (Mapongmetsem *et. al.*, 1996). In addition, edible caterpillars (*Imbrassa ertlii, I. epimethera*) harvested on the tree are consumed or sold locally (Daguma, Kang & Okali, 1988). About five varieties have been identified in Zaire (Latham, 1996). All parts of the tree are used in traditional medicine. Despite the vast array of potentials and the fact that farmers have already identified it as one of the 'top ten' species in West Africa (Mollet *et al.*, 1995b), it has not yet been systematically integrated in the farming systems throughout the humid lowlands of West Africa. It is now up to researchers to identify its potentials in various combinations with crops to improve its productivity.

The main objectives of this paper are to (1) assess the phenological behaviour of the species with a view to determining its fruiting habit and response to change in climate (It is envisaged that such information would facilitate the development of appropriate management in integrated cropping system (agroforestry) and indicate appropriate time of germplasm collection for artificial regeneration); (2) identify appropriate and/or efficient propagation techniques which could be used to artificially multiply the species and also for subsequent management studies; (3) evaluate its field growth performance after artificial regeneration.

Experimental

Study site

The study area was the forest zone of Cameroon, mainly in Yaounde (average rainfall 1600 mm, temperature 24 °C) and Sangmelima (average rainfall 1660 mm, temperature 23.7 °C). The dry season is distinct. There are, however, variations from year to year. The vegetation is humid forest whereas the soil is, for the most part, ferralitic.

Methodology

To evaluate the fruiting pattern of the species, three locations were selected respectively at Yaounde (Akok Ndoe, Etetack and Nkolda) and Sangmelima (Nkwang, Mimbo and Gombo). The frequency of observation was once a week. July was the start point of the phenological year. Thus, July = 1, August = 2, up to December = 12. The fruiting phenology weekly observation was carried out from July 1989 to June 1992 in a randomized factorial design with three replications. The experimental unit was made up of five trees. Locations were the replications; the site was the main treatment whereas the year was the sub-treatment.

For the seed germination, two trials took place in the laboratory after preliminary investigations at the nusery (Mapongmetsem, 1994). To assess the influence of the following treatments: cold and hot water (3 min), sulphuric acid (98%) (20 min), hand scarification and control on the germination, an experiment was carried out in a randomized complete block design with four replications. The experimental unit was made up of 60 seeds. For the second germination test, seeds were soaked in sulphuric acid (98%) at different times: 20, 35, 45, 60, 75, 90 and 180 min. The different times represented the treatments among which 20 min was the control. The experimental design was a randomized complete block design with four repetitions and 60 seeds for the experimental unit.

For the initial growth performance, the germination trial enabled the collection of seedlings of the species. Seven months after establishment, five plants from each replication were excavated and then the height, the diameter of the stem and the diameter of the tap root were measured. Five of them were introduced in the homegarden for subsequent studies (assessment of the growth and identification of the period of the first flowering of the tree).

Concerning the vegetative propagation, two experiments were undertaken in the open field at the nusery of the IRA/ICRAF Project at Nkolbisson. Adult trees were cut at 1.5 m above the ground and allowed to resprout. After 12 months, shoots were collected and split into three sections (basal, median and extreme). Dimensions of the plot were 21.5 m × 10 m. The length of the cutting was 30 cm whereas the diameter varied from 2 to 4 cm and the burial depth was 10 cm. The trial was conducted in a split-plot design with three replications and the experimental unit was made up of 20 cuttings. The type of wood and the orientation of the cuttings (slant and vertical) were considered as main treatments and sub-treatments respectively. The second vegetative propagation trial was based only on the median wood which showed good potential in the open field. Data collected were mean date and range of fruiting, germination percentage, rooting percentage of cuttings, height and diameter. The statistical analyses performed were simple variance and correlation.

Results and discussion

Phenology

The difference between sites was statistically significant both for the mean date (P = 0.05) and range ($P < 0.01$) of fruiting indicating that the two sites are different. The results clearly show that substantial variation exists between the two sites. One of the suggested explanations is the dioecious nature (males and females) of the species. At Yaounde, 60 per cent of trees bear fruits whereas at Sangmelima, there were 35 per cent. Only the females bear fruits. The species give fruits very early in December at Yaounde and late in January at Sangmelima. In addition, the range of fruiting is extended at Yaounde as compared to Sangmelima (Table 1). This was due probably to the difference in climate between the two sites. Sangmelima is wetter than Yaounde (Mapongmetsem *et al.*, 1995).

TABLE 1

Effect of site on the mean date and range of fruiting of Ricinodendron heudelotii

Sites	*Mean date (months)*	*Range (months)*
Yaounde	6.15	7.11
Sangmelima	6.89	5.86
Mean	6.52	6.33
LSD at P=0.05	0.52	0.88

The effect of year is significant on mean date (P

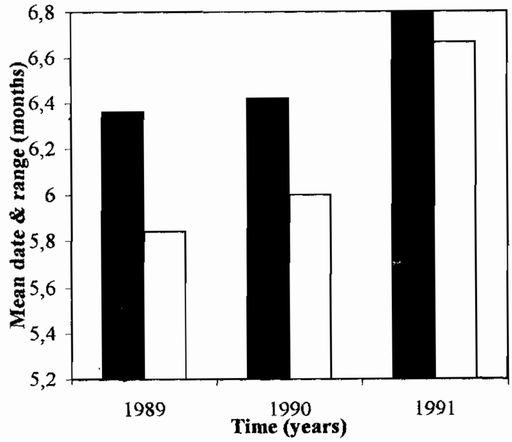

Fig. 1. Influence of year on fruiting pattern; ■ MDFR, □ RGFR

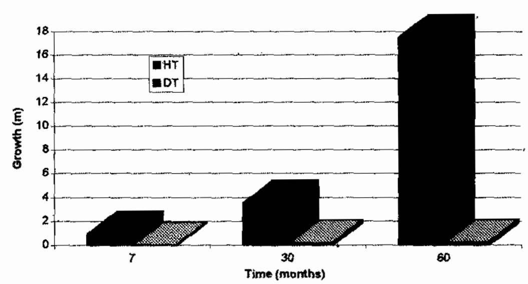

Fig. 2. Growth performance of *Ricinodendron heudelotti*

= 0.01) and duration ($P = 0.001$) of fruiting. These were due to the lateness (January) of fruiting in 1991 which induced extended fruiting (Fig. 1). The climate conditions were very harsh (Mapongmetsem *et al.*, 1995). This situation is portrayed by the year 1991 in which fruiting lasted 6.6 months compared to 1989 where it lasted 5.8 months. It can be pointed out that 1991 was the year of extended fruiting (Fig. 1). These facts suggest that climatic conditions change from year to year.

TABLE 2
Effect of the interaction year-site on the mean date of fruiting of the Ricinodendron heudelotii

Year	*Mean date (month)* *Yaounde*	*Sangemelima*
1989	5.78	6.94
1990	6.35	6.48
1991	6.33	7.27
Mean	6.15	6.90

Means between years 6.53; sites 6.52

LSD at $P = 0.05$ between years 0.24; sites 0.52

TABLE 3
Effect of treatments on the germination potential of Ricinodendron heudelotii

Treatments	*Germination (%)*
Untreated seeds	0
Hand scarification	61.6
Ordinary water	0
98 per cent sulphuric acid	3.3
Hot water	1.3
Mean	13.04
LSD at $P = 0.05$	10

The year by site interaction was also significant ($P = 0.001$) on the mean date of fruiting. The mean date ranges from 5.78 months (1989) to 6.35 months at Yaounde (1990) whereas at Sangmelima, it stretched from 6.48 months (1990) to 7.27 (1991) (Table. 2). The interaction is due to the lateness (mid-January) of the fruiting in 1991 at Sangmelima. The site by year interaction is due to the particularity of the year 1991 at Sangmelima where the fruiting was late (mid-January). This could be explained by the pedoclimatic conditions which prevail at Yaounde and at Sangmelima.

The tree bears fruits from March to December but from practical point of view, mature germplasm can be harvested from October to December in the forest zone of Cameroon and abroad. Given the place and time of the year during which seed harvesting is indicated, the domestication process can start. The success of any agroforestry system depends fundamentally on uniform establishment of the woody species within a reasonably short period of time. To organize his work, the farmer would have to select the most effecient and feasible propagation technique in order to gain in time and yield.

Seeds germination

Concerning the sexual propagation, the effect of treatments was significant ($P < 0.001$). This was due to the critical effect of the manual scarification on the achievement of maximum germination (Table 3). It enables germination up to 61.6 per cent.

Sulphuric acid is one of the best treatments to overcome seed dormancy (Duguma, Tonye & Depommier, 1990), but the results did not confirm it. This was probably due to the fact that the soaking time was not fully achieved. Based on this result, subsequent experiment was concentrated on the soaking time in sulphuric acid. The germination percentage stretched from 0 per cent (15-18 min) to 15 per cent (60 min). Despite the low germination percentage, there was a significant difference between the times ($P = 0.05$). The results remained low as compared to that obtained from hand scarification. The germination of the species irrespective of time suggests the existence of a physiological barrier constituted by the hard seed coat. There was a negative and imperfect correlation ($r = -0.24$) between soaking time and germination percentage. The absence of correlation between soaking time and germination percentage is in disagreement with the results obtained on *Leucaena leucocephala (*Duguma, Tonye & Depommier, 1990). The suggested explanation is that the seed coat of the Euphorbiaceae is tougher than that of the leguminous. Hot water kills the embryo because hot water goes inside the seed.

Growth performance

For the initial growth characteristics of the 7-month-old seedlings raised in the nusery, the height (HT) was 0.90 m and the diameter (DT) 0.0085 m. For the tap root, the growth was 0.65 m and 0.01 m for the length and the diameter respectively. In the home garden, the growth rate of the species in terms of height is very fast. This is shown in Fig. 2 where the height of the tree ranges between 3.5 m (2.5 years) and 17.5 m (5 years). It can be pointed out that the growth of the diameter is very low. It stretches from 0.175 m (2.5 years to 0.23 m (5 years). In the foregoing accounts, *Ricinodendron heudelotii* is one of the scarce fast-growing indigenous species. Meanwhile, at this stage, the species has not yet borne flowers and, consequently, the sex of the tree is still unknown.

Little progress has been made in the domestication of the tree because of its relatively long vegetation periods and its seed dormancy. Fortunately, vegetative propagation offers the opportunity to rapidly overcome these limitations.

Vegetative propagation by cuttings

As far as the vegetative propagation of the species is concerned, there far as is a significant variation between the type of wood ($P = 0.05$). This preliminary results show that the sprouting potential ranges from 4 (immature wood) to 17 per cent (semi mature wood). The results points to the suggestion that the median wood is more resistant in the open field than the two other woods. Also, it indicates that phytohormones and nutritive substances are not uniformly distributed in different parts of the same plant (Hartman & Kester, 1983). For the effect of the orientation of the cuttings, the rooting potential varied between 8.33 per cent (vertical position) and 8.11 per cent (slanting position) and did not show any significant difference between the two positions. The results agrees with the findings on *Triplochiton scleroxylon* (Leakey, 1983). More than 60 per cent of rooting in the species is reported in propagators (Shiembo, 1991).

Conclusion

The fruiting pattern of the species varies in accordance with pedoclimatic conditions of the site. *Ricinodendron heudelotii* is a dioecious species. Manual scarificaton is the best nursery technique to achieve uniform, rapid and maximum germination. *Ricinodendron heudelotii* can be classified among the fast-growing indigenous tree species. For the vegetative propagation, the semi mature wood is suitable in the open field. Grafting and layering can be envisaged in order to increase the propagation potential of the species. The present study indicates the place, the period of seed harvest and the required propagation techniques for artificial regeneration of the species.

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