ALNUS ACUMINATA WITH PASTURE*

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*(Translation from spanish N. Price

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INTRODUCTION

The deliberate combination of "Jaul" (Alnus acuminata) with pasture (mainly Pennisetum clandestinum , but also with P. purpureum and Axonopus scoparius) has been practiced traditionally from at least 1950 (3) in what is called, locally, the high altitude zone of Costa Rica, (see fig.1). There have been a number of publications refering to the potential ,of this combination ,for timber production with figures of around $10M^3$/ha/year being quoted (1,2,3,6,10). However, very little has been written concerning the ecological effects arising from the inclusion of A. acuminata in pastures. CATIE presently has a number of permanent plots, the first being established in March of 1979 (2), in which measurements of growth rates of this species are being made in combinations containing different pasture species. In the future it es hoped that the investigation will be extended to include measurement of forage production under conditions of shade and no shade, and also with a study of nitrogen fixation by Frankl alni which live symbiotically in the roots of "Jaul."

LITERATURE REVIEW

In a description of this system, Combe (2) notes the following: "Naturally regenerated A. acuminata seedlings, which are easily found on disturbed soil, open beds, road embankments and especially along the embankments of streams, are used as planting stock."

"In the case of A. acuminata, the production of firewood and lumber represent a direct input of substantial importance to small farms. It is a pioneer indigenous species of rapid growth. Its' wood often being used for small carpentry jobs, and up to a certain point as a substitute for Pine (which is not native to Costa Rica). The physical characteristics of the wood of A, acuminata also permits its' use in the manufacture of pulp and wood chips."

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** Taken from Combe, J. Alnus acuminata with grazing and mowing pasture: Las Nubes de Coronado, Costa Rica, in De las Salas, G., ed., Proceedings of the Workshop on Agro-forestry Systems in Latin America, Turrialba, Costa Rica, UNU-CATIE, 1979. p.201.

At present, according to quality, the 'tucas labradas' (round wood) of A. acuminata command a price of ℓ 363/M^3 at the lumber yard, a price slightly less than for "Ciprés" (Cupressus lusitanica), which is produced in the same region. In this agroforestry system, rotations of 15-20 years are common for the forestry component, which can produce a final commercial volume of more than 200 M^3/ha of round wood, at the same time as providing a supply of firewood for home consumption on the farm.

"Thanks to the symbiosis of A. acuminata with Actinomyces alni, (syn. Franki alni) the root system of the tree has the potential to fix atmospheric nitrogen in quantities sufficient for the development of the plant. Research (7) on this has demonstrated that 6-5 month old "Jaul" seedlings with this symbiosis contain an average of 60.5 mg (more than 2%) of nitrogen, as compared to 0.17 mg without this association a 355 fold difference. Another study (9) has shown that the average content of nitrogen in the leaves of A. acuminata from trees in a plantation that did not receive fertilizers varied between 3.66% to 2.40%, the latter value being derived from dried leaves obtained from the litter layer (ie. non-nitrogenous compounds having been leached). The fixation of atmospheric nitrogen as well as the possibility of up-take of nitrogen originating from fertilizers applied to the pasture could very well lead to an appreciable indirect benefit in the recycling of this element via the litter of A.acuminata."

"Among the other positive effects that can be mentioned are the supply of organic matter, the control of soil moisture and the colonization and stabilization of steep, eroded slopes or areas susceptible to erosion if not covered quickly by protective vegetation."

From the beginning the same farmers have indicated to us some of the apparent disadvantages such as:

- the reduction in productivity of forage under excessive shade of A. acuminata or of other competitive effects;
- the reduction in the productivity of forage due to drip impact, originating in the upper branches."

"For lack of recommendations on the silviculture and with out information on the possible production of available nutrients by A. acuminata for the pasture, the farmers continue to apply fertilizers and manage their pastures in the same way, with or with out the presence of A. acuminata."

It is also worthwhile reviewing the data coming from Colombia, which refers to A. jorullensis, which we believe to be in reality A. acuminata. The Colombian research has concentrated in the region of Caldas, between 2000 and 3250 m.a.s.l. (annual min. temperature:11.2 & -1°C, respectively; annual max. temperature:24.7 & 22.0°C, respectively; annual rainfall: 1836 & 1241 mm, respectively) (8). All reports from this area make note of the demand for high humidity by A. jorullensis, not only in the soil but also in the atmosphere. Further, these authors mention that it is frequently found in association with "kikuyo" (P. clandestinum). The root system of the tree is described by Muñoz(5) as superficial and he observed that the nodules of the Actinomyces (Franki) were concentrated in the upper 5 cm of the soil profile. Venegas (10) reports that P. clandestinum that grew a) in full sun, b) under 2-5 year old A. jorullensis, c) under 12 year old A. jorullensis, showed protein contents of 10%, 15% and 20%. He also claimed that there was a 33% increase in the weight gain of calves (density 2-3/ha) in pastures containing three year old A. jorullensis (800-1000/ha) as compared to calves from pastures exposed to full sun. It is almost certain that this result reflects the fact that during the dry season (July and August) the production of forage under shade is much greater than in the open sun.

Volume Tables for A. acuminata have been prepared by Alvarez (1) and Meneses (4). The former calculated a local table applicable to stands in combination with pasture for the zone around San Isidro de Coronado, in Costa Rica. He found an average volume increment of 11 M^3/ha/year for three pastures which contained A. acuminata in densities of 204,35 and 94 trees/ha (ages 10,11 and 20 years, respectively).

DATA SUMMARY FROM PERMANENT OBSERVATION PLOTS

Table 1: General information from two farms which have forest pastures

	FINCA YORUSTY	FINCA RASGO NUÑEZ
Location:	Las Nubes de Coronado	San Rafael de Coronado
Elevation:	1700 m.a.s.l.	1450 m.a.s.l.
Species:	*Alnus acuminata* *Pennisetum clandestinum*	*A. acuminata* *P. purpureum*
Age:	15-18 years	9 years
Provenance:	Local	Local
Initial spacing:	9.1 X 13.5 M	7 X 9 M
Area:	Each rotational paddock is approximately 0.5 ha	Total area planted is approximately 4 ha.
Rotation:	Aprox. 75 cows/day every 30 days (equivalent to a density of 5 cows/ha)	Hay (not grazed)
Fertilization:	200 lbs./pasture twice a year.*	
Production:	30 bottles**/cow/day	Forage used for horses

* Normally Nutran (33% N) Data from 1980

** One bottle contains approx. 1.5 lbs of milk.

Table 2: Characteristics of A. acuminata in two farms with forest pastures.

	FINCA YORUSTY	FINCA RASGO NUÑEZ
Density (ha) 1981	46	159
Height (m) 1979	22.1	10 (estimate)
Height (m) 1981	22.8	12.5
Diameter (cm) 1979	44.6	17.0
Diameter (cm) 1981	45.5	24.7
Basal area (m^2/ha) (G) 1981	7.59	8.03
Growth (G) (m^2/ha/year)1979-1981	0.138	2.18*
Commercial volume(V)** (m^3/ha) 1981	69	-
Volume* increment (m^3/ha/yr) Mar. 1979- April 1981	1.7	-
Value (£/ha)*** 1981	21,528.00	-
Value of annual increment (£/ha/yr.) Mar. 1979- Apr. 1981	529	-

* Calculated for the same trees, 1979 & 1981

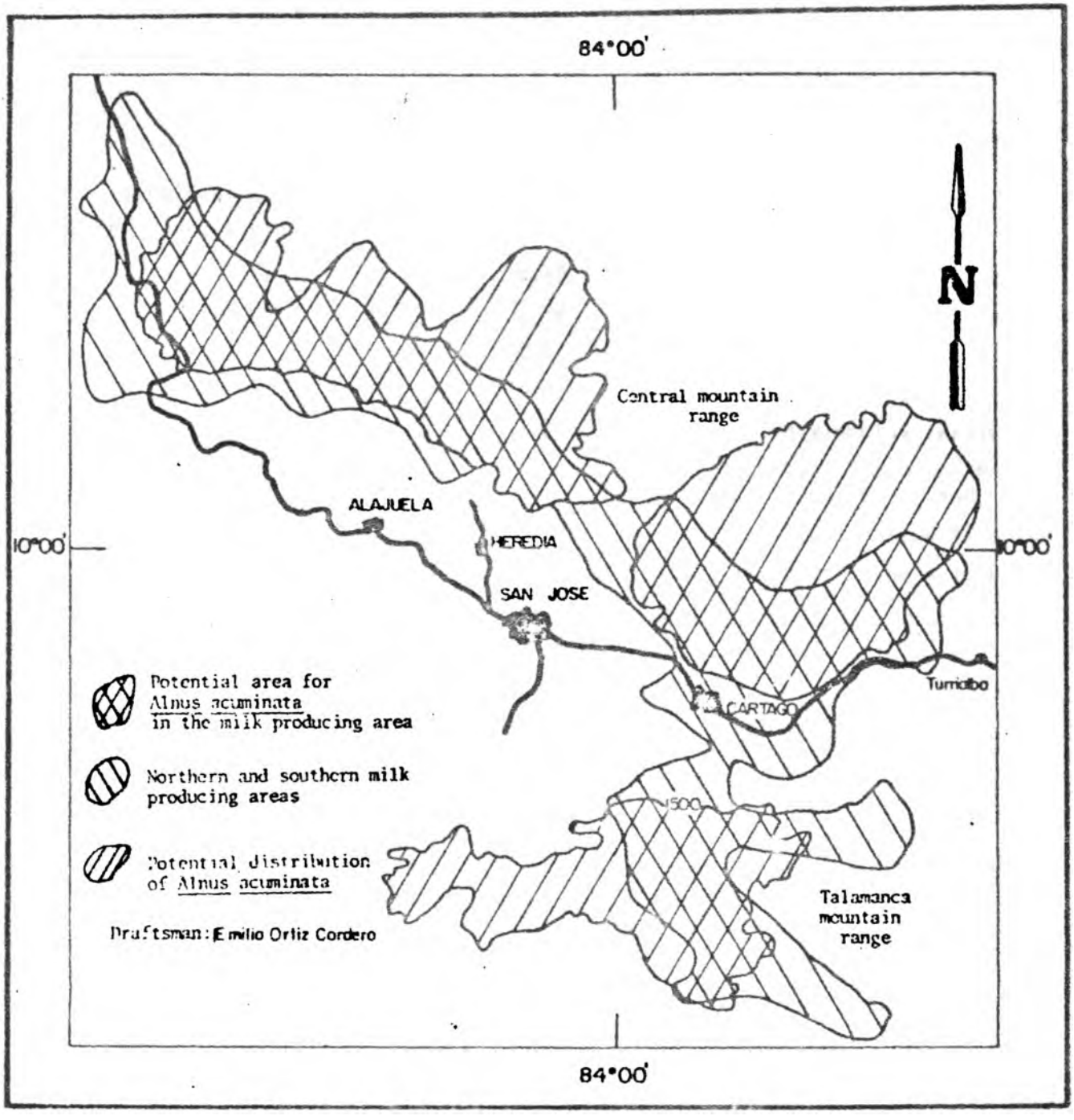
**Commercial Form Factor= 0.403; derived from measurements on 25 trees by Alvarez (1).

*** $1m^3$= 312 "pulgadas ticas"; 1 pulgada tica of A. acuminata is worth £1.00(1980 value)

CONCLUSIONS

In order to improve the economic returns of this system and to promote its transfer to analogous zones the following aspects need to be investigated:

1. Determination of the total area dedicated to this association and possible correlation with climatic factors, particularly rainfall and cloudiness.
2. The influence of A. acuminata over the nitrogen content of the soil, the improvement of its physical characteristics.
3. The productivity of pasture with and without the presence of A. acuminata.
4. The adaptation of management techniques for pastures taking into consideration the inclusion of A. acuminata.
5. The formulation of silvicultural recommendations for the management of shade trees (particularly thinning and pruning regines).



Scale: 1:500,000

Figure 1: Potential distribution of Alnus acuminata in the northern and southern regions of Costa Rica.

Estimated area: 60,000 has.

Elevation: 1200 - 2400 m.s.n.m.

Source: Peterson, A. Regiones agrícolas de Costa Rica. Turrialba, Costa Rica, IICA. 1965.

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