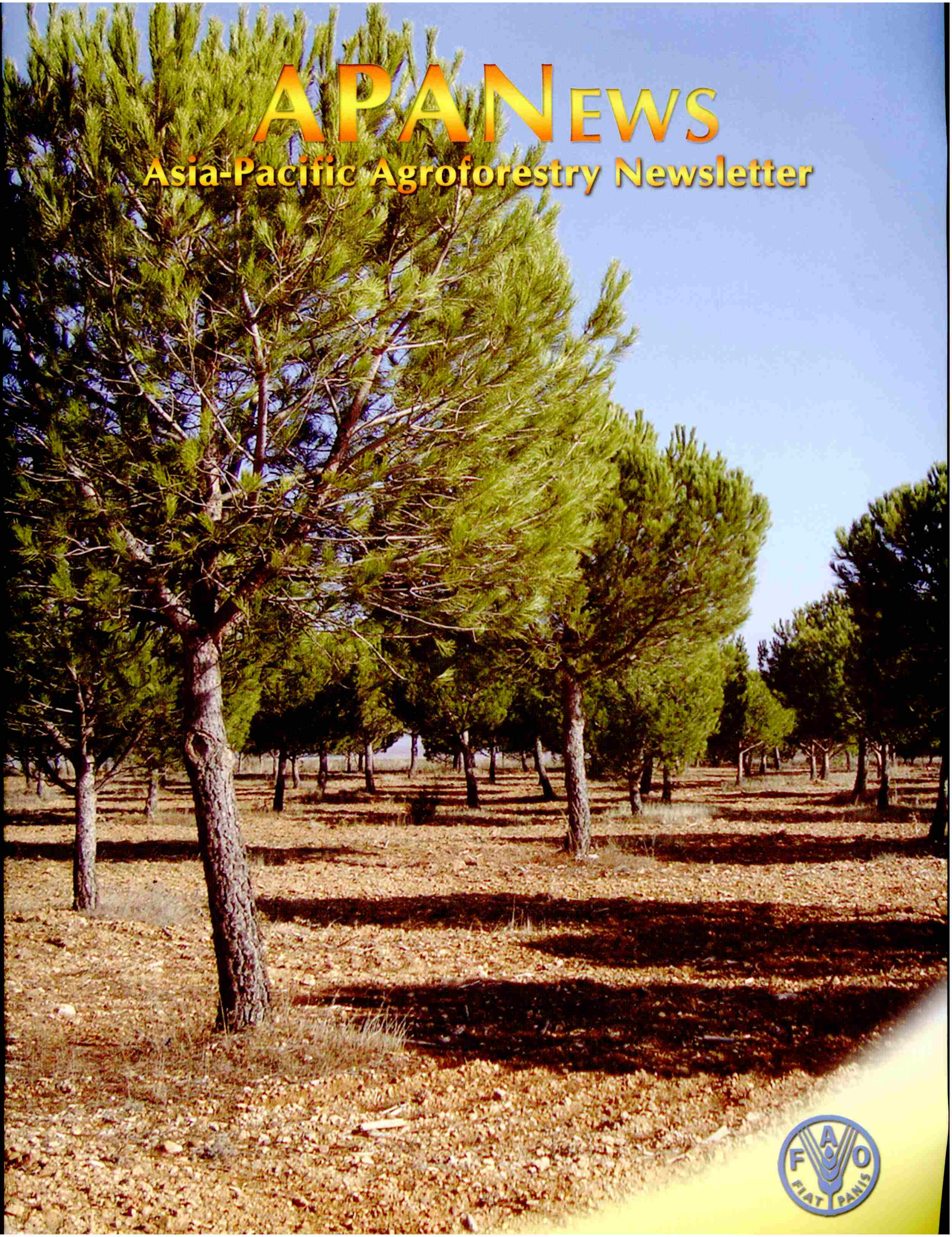
APANEWS

Asia-Pacific Agroforestry Newsletter



Featuring the capabilities...

Continued from 3

of western winds from Lao PDR and central Viet Nam.

Propagation

The treated seeds of *Cynodon dactylon* Pers. are sown directly in barren lands or fallowed areas. When planted in fallowed areas, the seeds are treated by fire prior to the onset of the rainy season. The seeds are then sown while hot to prevent insect attack. The cuttings, meanwhile, are prepared and maintained in the nursery or home gardens before the planting season.

Cynodon dactylon Pers. can be easily planted during the spring and summer seasons in Viet Nam through stems, seeds or cuttings. The grass can cover 60-80 percent of the coastal areas. Cattle can graze on *Cynodon dactylon* Pers. for 6-8 months.

Cynodon dactylon Pers. is one of the economically and ecologically valued grasses in Viet Nam. Further research is needed to explore the grass's capabilities of preventing soil erosion in agroforestry systems. •

The author can be contacted at the Viet Nam's Forestry Network Department of Agriculture and Rural Development, No. 256 – Le Duan Road, Dong Ha City, Quang Tri Province, Viet Nam.

References: (1) Ha, H. Q., and Nguyen, N. T., 1989. Economic grasses in Eakao Forest-Park, Buon Ma Thuot City, Forestry Engineer Thesis in Tay Nguyen University, Dak Lak Province, Viet Nam; (2) Ho, P. H., Volume 1, 1970., Volume 2, 1972. South Viet Nam's Vegetation, Lua Thieng Publisher, Sai Gon, Viet Nam; (3) Ly, T. D. et al. 1993. 1900 Used plant species in Viet Nam, P. 334, National Centre for Natural Science and Technology, Institute of Biological Resources and Ecology, Ha Noi, Viet Nam; (4) Trung, T. V., 1998. Tropical Forest Ecosystems in Viet Nam, Scientific and Technical Publisher, Ha Noi, Viet Nam; (5) Sy, H. M. 1974. Wildgrass in South Viet Nam, PP. 44-45, Institute of Agricultural Research, Sai Gon, Viet Nam; (6) Victor W. Sidel et al., 1997. A Barefoot Doctor's Manual, The Revolutionary Health Committee of Hunan Province, Routle & Kegan Paul, London, U.K.

Pine nut (*Pinus pinea* L.) production, an alternative for temperate areas

Verónica Loewe M. (vloewe@infor.cl), Claudia Delard R. (cdelard@infor.cl) and Alejandro Venegas G.

Stone pine originated in Mediterranean Europe with a distribution of approximately 600 000 ha. The species is mostly concentrated in Spain (476 000 ha), Portugal (70 000 ha), Turkey (40 000 ha), Italy (40 000 ha), Tunisia (15 000 ha), France (13 515 ha), Morocco (3 000 ha) and Israel (2 000 ha).

Stone pine reaches 20-25 m high with an umbrella-shaped crown. The species grows in a wide range of soils and climates, is resistant to wind, and used to control erosion in coastal areas. It can resist saline winds and adverse conditions. The species forms good forests for fungi production. When planted in areas with an annual rainfall of more than 400 mm, stone pine attains a relatively high fruit yield.

Stone pine is famous for its fruits, called pine nuts. Pine nuts are consumed directly or processed as ice cream, cakes and other forms of desserts. It is also used as seasoning and raw material in pesto sauce. Pine nuts are the highest valued dried fruits in the international market because of its high protein content (30%), dietetic fiber, vitamins and minerals, high unsaturated fatty acids content (93%), as well as its low carbohydrate content (7%). Pine nuts are, therefore, good sources of bioactive compounds which could be added to other processed food.

Unfortunately, world production of pine nuts is lower than demand. It is estimated that world production is only 30 000 tons (6 000 tons of white pine nuts). Spain is the major producer of pine nuts, contributing to 45 percent of total production.

Challenges to production

In Europe, stone pine has been attacked by the insect *Leptoglossus occidentalis*. Infestation severely reduces pine nut production. It is estimated that this problem will continue progressively in the coming years.

The species was introduced in Chile more than 100 years ago mainly to stabilize coastal dunes which was proven effective. In this country, the consumption of pine nuts is limited to immigrants from Italy, Spain and Arab countries. Several European producers have expressed their interest to cultivate stone pine for the production of pine nuts in over 10 million ha in Chile, where the potential area is over 1.3 million ha. This species is being considered to complement crops planted in small- and medium-sized farms to provide added annual income.

Grafting techniques

In Europe, non-grafted trees bear fruits at 15-18 years. In Chile, fruit production starts at around eight years old. To homogenize fruit quality, increase fruit production, and improve orchard management and harvest, different types of grafting techniques were explored.

In October and November 2010, grafts were done in three different zones: Constitución, Curicó and Valdivia. In Constitución, grafts were executed on a three-year-old *Pinus radiata* plantation to form a clonal orchard and initiate fruit production. *Pinus radiata* in this area is mainly considered a forest species. In Curicó and Valdivia, trials were done in two nurseries (Viverosur and Bopar) to obtain clones that would be used to establish clonal seed orchards.

Scion collection was done between 4 October and 18 November 2010 between the regions Metropolitan and Araucanía, specifically in the localities of Pirque, Cáhuil, Toconey, Mulchén, and Antiquina.

In Viverosur, rootstocks were obtained from three-year-old *Pinus radiata* seedlings and two-year-old *Pinus pinea* seedlings. In Bopar, four types of rootstocks were obtained from one- to four-year-old *Pinus pinea, P. radiata, P. ponderosa* and *P. contorta,* located in both bed layers and greenhouses.

The percentage of graft survival was higher in *Pinus radiata* rootstocks which were obtained from Viverosur and in *P. ponderosa* rootstocks which were obtained from Bopar (Table 1). The number of successful grafts (35.2%) in the natural environment was found superior as compared to those grown in the greenhouse environment (Table 2).

In the Bopar nursery, cleft (apical shoot on basal tissue) and side grafts obtained good results. Basal cleft graft worked well on *Pinus radiata* rootstocks at an average of

Continued on page 6

Table 1. Survival of *Pinus pinea* grafts in nurseries.

Nursery	Rootstock	Clone	Month of grafting (2010)	Total grafts (N°)	Final evaluation: Days since grafting	Alive grafts (N°)	Average success rate (%)
Viverosur	*P. radiata*	C1-C2-C3-C4-C5	October	541	101 a 102	187	34.5
		C6-C7-C8-C9-C10					
		C11-C12-C13-C14-P1					
	P. pinea	EC1-EC2-EC3-EC4	October	210	114	0	0
Bopar	*P. contorta*	C20-C21-C22-C23-	November	813	66 a 67	35	4.3
		C25-C26-C27					
	P. ponderosa	A1-A2-M1-M2-M3	October and November	838	70 a 87	128	15.3
		T1					
	P. radiata	M1-M4-C25	November	173	66	21	12.1
		C28-30					
	P. pinea	A1-A3-T1-M1	October	1 132	60 a 88	110	9.7
		M2-M3-M4-M5	November				
		C25-EC1-EC3	November				
Total				3 497	Total	481	

Table 2. Survival of grafts from three-year-old *Pinus radiata* rootstocks.

Clone	Grafting date (2010)	Total grafts (N°)	Final evaluation: Evaluation date (2011)	Days since grafting	Alive grafts (N°)	Average success rate (%)
C2-C3-C5-C6-C7						
C8-C9-C29-C30-P1	October	315	January	109	111	35.2

Fig. 1 Stone pine orchard.

Fig. 2 Stone pine cones.

Fig. 3 Nuts sourced from stone pine cones.

Fig. 4 White pine nuts.

Pine nut production...

Continued from 5

41 percent graft survival. However, basal cleft graft was not found successful in stone pine rootstocks, probably due to their limited development.

The Whip & Tongue technique, used in Viverosur, achieved 34.6 percent graft survival, which is similar to the results obtained by Abellanas *et al.*, (2000) who obtained 35 percent graft survival using the traditional cleft technique. In this study, however, the use of cleft grafts obtained lower success rates (7.1%) (Table 3).

Fig. 5 Packed pine nuts.

Fig. 6 Sweets from pine nuts.

Grafts done in the *Pinus radiata* plantation reached 35.2 percent success rate. The double scion cleft graft (apical bud on last year's tissue) achieved 100 percent success rate, but considering only one repetition (Table 4.)

Gallardo and Gallardo de Prado (1981) studied the behavior of stone pine grafts on rootstocks of the same species in a population of more than 46 000 trees. Results showed that basal cleft graft obtained 52.5 percent success rate. In this study, the use of basal clef graft obtained 41 percent in the Bopar nursery, while 45 percent success rate was obtained in Constitución.

Table 3. Grafts survival in nursery according to rootstock and graft type.

Nursery	Rootstock	Graft type	Total grafts (N°)	Alive grafts (N°)	Success rate (%)
Viverosur	*Pinus radiata*	Whip and tongue	541	187	34.6
Bopar	*Pinus ponderosa*	Cleft (apical bud on apical bud)	838	128	15.3
	Pinus pinea	Cleft (apical bud on apical bud)	969	23	2.4
		Side	135	81	60
		Cleft (apical bud on basal tissue)	28	6	21.4
		Total	1 132	110	9.7
	Pinus radiata	Cleft (apical bud on apical bud)	162	11	6.8
		Cleft (apical bud on basal tissue)	11	10	90.9
		Total	173	21	12.1
	Pinus contorta	Cleft (apical bud on apical bud)	813	35	4.3
Total alive grafts			3 497	481	13.7

Table 4. Graft survival in plantations according to graft and scion type.

Rootstock	Graft type	Scion type*	Total grafts N°	Alive grafts (N°)	Success rate (%)
Pinus radiata (3-year-old plantation)	Cleft (apical bud on apical bud)	Same diameter	169	73	43.2
		Lateral scion	117	27	23.1
		Double scion	7	2	28.6
	Cleft (apical bud on last year tissue)	Single scion	19	8	42.1
		Double scion	1	1	100
	Side	Masculine flower scion	2	0	0
Total alive grafts			315	111	35.2

* Scion type: "Same diameter apical" refers to scions with the same diameter as the rootstock when grafted. "Lateral scion" refers to scions with thinner diameter than rootstocks, which are laterally grafted. "Double scion" refers to two scions that were grafted.

Conclusions

In general, graft survival in the three sites reached an average of 26.5 percent success rate, although results obtained in Constitución presented better results (35.2 percent). The same results were found by De la Parra (1980) who grafted stone pine on *P. halepensis* and obtained an average of 78 percent success rate. Castaño and Oliet (2004) indicated that the technique must be precise, clean cuts must be made, and the tape must be perfectly adjusted to protect the graft union.

The study also found that the knowledge, skills, and training of personnel who undertake the grafting techniques are relevant and may heavily influence the rate of survival.

The use of grafted stone pine plants not only increases fruit production but also promotes the plantation of stone pine in relatively poor, eroded areas with relative low water availability as a source of livelihood.•

The authors can be contacted at the Chilean Forest Institute, INFOR (www.infor.cl).

References: (1) Abellanas, B.; Butler, I; Monteagudo, F. 2000. Estudio de la Rentabilidad Económica de una Parcela de Injertos de Pino Piñonero a los 9 Años de su Instalación. Primer Simposio del Pino Piñonero (Pinus pinea). Valladolid (España). Pp. 101-110; (2) Castaños, J. Y.; Oliet, J. 2004. Puesta en valor de los recursos forestales Mediterráneos. El injerto de pino piñonero (Pinus pinea L.). Manuales de restauración forestal Nº 9. 248 p.; (3) Gallardo M. J.; Gallardo de Prado, J. 1981. Cinco estudios sobre injertos en pino piñonero. ICONA, Madrid. Ecología. Nº 5. Pp.: 197-209; (4) Parra, J.L. 1980. Creación de huertos semilleros de pino carrasco e injertos de pino piñonero sobre carrasco, en la provincia de Murcia. Boletín de la Estación Central de Ecología 9(18): 15-23.

Fig. 7 Cleft graft (scion substitution).

Fig. 8 Side graft (under lateral bark).

Fig. 9 (Clockwise) Cleft graft on (a) (b) last year's tissue and (c) on basal tissue.