Vitis 25, 169—177 (1986)

Centro di Studio per il Miglioramento Genetico della Vite, CNR, Torino, Italia
Istituto di Chimica Agraria dell'Università di Torino, Italia

Control of sucker growth on *Vitis vinifera* cv. Merlot with NAA derivatives[1]

by

I. Eynard, G. Gay, R. Vallania, P. Occelli, R. Botta[2]), M. Dolci and A. Martini[3])

Impiego di esteri del NAA per la spollonatura della vite cv. Merlot

Riassunto: Alcuni esteri noti o di nuova sintesi dell'acido naftalenacetico furono messi a confronto con il sale sodico del medesimo acido. Fra gli esteri oltre all'etilico apparvero promettenti l'E4, l'E5 e l'E9 mentre l'E3 presentò problemi di solubilità. L'effetto spollonante si mantiene nell'anno seguente il trattamento, al terzo anno l'efficacia si riduce.

Key words: auxin, shoot, bud, growth, yield, must quality, economy

Introduction

From the beginning of viticulture to about 50 years ago, the grapevine training systems had usually been either very low (gobelet, head-pruned vines) or very high with vines growing on arbors or sloping top trellis. Only a part of the vineyards were trained on medium height (1—2 m) vertical trellis.

With the low systems the suckers were not a problem because of the very short trunks, with the higher systems the vine could develop enough abundant leafage on the top.

In the 70's and 80's the general trend all over the world is towards medium-high support for vines with trunks 50—80 to 180 cm high.

In these conditions the control of shoots on trunks is a problem, because the manual removal requires 20 man hours/ha or more. In order to reduce this labour cost, two alternative methods were undertaken. The first one was the mechanical removal with specific devices created since 1978 (Elia 1979, 1980; Lacombe and Faucon 1978).

The second approach to the problem was the chemical control; many products have been tried but only dipyridylic herbicides (diquat and paraquat) are widely applied. Specific mechanical devices were prepared in order to spread the chemical only on the trunk, avoiding drift damages to the fruiting and renewal canes (Ducasse and Sylvestre 1984; Paoletti 1984; Collard and Panigai 1985; Sylvestre 1985).

1-Naphthaleneacetic acid (NAA) proved to be effective in controlling unwanted sprout growth on several fruit crops (Boswell and McCarty 1974; Larue *et al.* 1974; Phillips and Tucker 1974; Raese 1975; Boswell *et al.* 1976 a and b; Dozier and Hollingsworth 1976; Couvillon *et al.* 1977; Elfving and Forshey 1977; Miller 1977; Nauer and

[1]) Centro di Studio per il Miglioramento Genetico della Vite CNR, Pubblicazione n. 151.

[2]) Centro di Studio per il Miglioramento Genetico della Vite, CNR, Via P. Giuria 15, 10126 Torino, Italia.

[3]) Istituto di Chimica Agraria dell'Università, Via P. Giuria 15, 10126 Torino, Italia.

BOSWELL 1977; ANTOGNOZZI 1978 a and b; BOSWELL *et al.* 1979; NAUER *et al.* 1979; MILLER and WARE 1980; HARRE 1982; AUSTIN 1983) and on grapevines (CARGNELLO and LAVEZZI 1980; MORRIS and CAWTHON 1981; AHMEDULLAH and WOLFE 1982).

The most positive NAA result in comparison with dipyridylics was the carry-over effectiveness in the subsequent years (one or two according to the concentration), but these trials were not conclusive. Some deleterious effects such as emission of aerial roots from the trunk and reduction of growth and yield, were found on young vines (CARGNELLO and LAVEZZI 1980).

At the high rates necessary for sucker control, solubility of NAA becomes a problem. In previous experiments NAA was applied as acid, but more often as sodium salt or ethyl ester by spray or by brush in water, or in a mixture of latex paint: water (1 : 1 or 1 : 2 ratio), or added with EHPP, or in a more complex formulation (Tre-Hold Sprout Inhibitor A-112) in asphaltic base.

Methods

In 1983, 1984 and 1985, trials on grapevines were conducted in Chieri (Torino) on Merlot comparing six NAA esters; three of them were synthesized for the first time by the researchers of the Agricultural Chemical Institute of Turin University.

E1 = Ethyl 1-naphthylacetate
E2 = Butyl 1-naphthylacetate
E3 = 2-Ethoxyethyl 1-naphthylacetate
E4 = 2-(2-Ethoxyethoxy)ethyl 1-naphthylacetate
E5 = 2-[2-(2-Ethoxyethoxy)ethoxy]ethyl 1-naphthylacetate
E9 = Isopropyl 1-naphthylacetate

In 1983, the NAA sodic salt and E1, E2, E3, E4 treatments were applied on May 2 (22—24 °C) when the shoots on the trunks were between bud burst and the 3-leaf stage. NAA (4—8 %) was considered, but in water with acetone was impossible to apply because the acid did not remain suspended. All the other NAA derivatives (in water solution with Tween 20 at 0.1 %) were applied with a hand sprayer to run off on buds and new shoots.

The effects on suckers and on the shoots of spurs and fruiting canes were monitored during the following months (May 9, 17, 30; June 14). The same and following years' yield, must pH, acidity, soluble solids and pruning weight were recorded. The treatments were not repeated on the same plants. The number of shoots which had sprouted on each vine were counted in May 1984 and 1985.

In 1984, a wide range of concentrations (1, 2, 4, 8 %) was tested for E1, E3 and E4 (E2 was repeated only at 8 %). For the first time, E5 (1, 2, 4, 8 % rates) was tested, always water-soluted with Tween 20 (0.1 %).

These treatments were applied on May 24 when the more developed shoots were 20 cm long. The temperature at application was lower than in the first year (11—13 °C) despite the clear day. The sucker control was visually evaluated 1 week later on a scale of 0 (no control) to 10 (complete control).

In 1985, the E1, E3, E4 treatments were repeated on other similar plants at 2—8 % concentrations (in water with 0.1 % Tween 20), comparing them with test untreated or treated only with 0.1 or 0.5 surfactant (Tween 20). Another synthesized product (E9) was tried at 8 % + Tween 20 (0.1 %).

All experiments were randomized as complete-block designs with single-tree plots and four replications. The significance of results was tested by Duncan's multiple range test.

Table 1

Effects of 1983 treatments

Effetti dei trattamenti 1983

Treatments		Number of suckers/plant			Pruning weight g/plant		Yield kg/plant		Cluster weight g		Soluble solids Refract. %	Acidity meq/1	pH
		1983 31/5	1984 31/5	1985 27/5	1983 15/3/84	1984 15/3/85	1983 7/10	1984 2/10	1983 7/10	1984 3/10	1983 8/10	1983 8/10	1983 8/10
Check		19.0 a	14.1 a	16.0 a	672 abc	512 ab	5.400 abc	3.925 a	200 a	119 ab	22.2 ab	119 ab	3.15 a
NAA Na salt	4 %	1.2 bc	0.2 c	6.4 b	399 c	297 b	4.212 c	3.587 a	220 a	108 b	22.1 ab	114 b	3.25 c
	8 %	0.9 bc	0.0 c	1.5 c	504 bc	445 b	4.775 bc	3.662 a	187 a	136 ab	23.0 a	120 ab	3.23 bc
E1	8 %	2.4 b	5.8 ab	12.9 a	903 a	888 a	7.547 a	4.237 a	220 a	157 ab	21.6 ab	119 ab	3.20 abc
E2	8 %	1.8 bc	1.0 bc	5.3	197	350	3.612 c	3.512 a	161 a	178 a	20.7 b	117 ab	3.18 ab
E3	8 %	0.1 c	0.1 c	4.8 bc	777 ab	525 ab	7.375 ab	4.675 a	210 a	160 ab	20.8 b	126 a	3.19 abc
E4	8 %	0.2 bc	0.0 c	5.2 bc	550 bc	487 ab	4.650 bc	3.225 a	158 a	105 b	22.3 ab	117 ab	3.22 bc

Means within columns separated by Duncan's multiple range test, 5 % level.

In order to ascertain the reason of lack of suckering in the year following treatment, in 1985 shoots at various stages of growth on cuttings were treated in the laboratory with a water solution of E4 2 % + surfactant. The damage to shoots was progressive and after the shoots died, sections of the bud complex were obtained.

Field results and discussion

1983 Trial

The sucker elimination in the spring of treatment was good with E1, E2, E3, E4 at 8 % and also with NAA sodic salt (Table 1). The response was quicker with E3 and E4 than with E1 and E2.

No shoot regrowth on the trunk occurred during the same year on vines which had been sprayed. There was no visible evidence of effects on the foliage of the upper part of the vine except where accidentally reached by the sprays. In this case the shoots were obviously injured like the suckers.

Table 2

Effects of 1984 treatments

Effetti dei trattamenti 1984

Treatment	Sucker control 1) 31/5/84	Yield g/vine 7/10/84	Cluster wt g 7/10/84	Pruning wt g/vine 15/3/85	Sucker number 25/5/85	Yield g/vine 3/10/85	Cluster wt g 3/10/85
Check	2.0 g	3950 ab	105.0 abc	1075 ab	11.9 a	5875 abc	180.2 b
E1 1 %	8.6 cd	3650 ab	141.5 a	730 bcd	3.5 bcd	5175 abc	203.0 ab
E1 2 %	9.8 ab	4562 ab	98.2 abc	795 bcd	3.9 bcd	5987 abc	183.0 b
E1 4 %	9.7 abc	1975 ab	78.7 bc	542 cd	0.2 e	5650 abc	287.7 a
E1 8 %	10.0 a	2512 ab	75.5 bc	295 d	0.4 e	3287 c	243.4 ab
E2 8 %	9.1 abcd	3375 ab	89.7 bc	577 cd	0.1 e	4882 abc	244.6 ab
E3 1 %	2.2 g	4112 ab	99.7 abc	754 bcd	9.4 abc	5112 abc	202.8 ab
E3 2 %	3.4 f	4250 ab	105.5 abc	977 bc	8.5 abc	5287 abc	189.9 b
E3 4 %	4.0 f	4850 a	119.2 ab	690 bcd	8.0 abc	4012 bc	151.4 b
E3 8 %	5.7 e	4925 a	117.7 ab	1160 ab	7.6 abc	6500 abc	189.4 b
E4 1 %	9.0 abcd	2725 ab	97.0 abc	800 bcd	6.8 abc	5912 abc	188.8 b
E4 2 %	9.1 abcd	3350 ab	121.7 ab	1212 ab	5.5 abc	7300 ab	202.1 ab
E4 4 %	9.7 abc	3425 ab	108.2 abc	945 bc	3.7 bcd	5950 abc	214.8 ab
E4 8 %	9.6 abc	4275 ab	120.0 ab	952 bc	3.4 cd	6900 abc	212.4 ab
E5 1 %	8.1 d	2087 ab	77.7 bc	550 cd	10.0 ab	3712 bc	190.9 ab
E5 2 %	8.4 d	1737 b	60.5 c	1535 a	4.7 abc	8850 a	209.4 ab
E5 4 %	8.6 cd	3950 ab	113.5 ab	942 bc	4.7 abc	5525 abc	195.0 ab
E5 8 %	9.9 ab	3275 ab	108.5 abc	727 bcd	0.6 de	4137 bc	229.9 ab

1) 10 point scale: 0 = no effect, 10 = complete control.

In the following spring the residual sucker control was excellent for the NAA derivatives apart from E1 which had a less persistant efficiency. The inhibitory effect of E1 began to dissipate; the number and vigour of suckers were reduced only in 1984, and in the following year the growth was almost the same in both untreated and treated vines.

With E2, E3 and E4 in 1985 the sucker development was a third of the check; it was minimal on trunks treated with NAA sodic salt 8 % 25 months before.

Pruning weight, yield, cluster weight, must composition (soluble solids, acidity, pH) were not significantly affected by any treatments.

1984 Trial

All the chemicals already tested in 1983, if applied at the same rate (8 %), gave good results except E3 because of poor solubility of pure ester (Table 2). The sprout die-back and inhibitory effect was satisfactory also with lower concentrations of E1 (till 2 %) and E4 (till 1 %). The sucker control was excellent on trunks sprayed with E5 at 8 %, slightly decreasing at lower rates.

Pruning weights of vines treated with NAA derivatives were not significantly reduced (except by high rates of E1 and E2), and some of the plants best chemically desuckered yielded as the check.

In 1985 the persistance of the inhibitory effect, evidenced by low sucker number, was good with E4 (4—8 %), excellent with E1 (4—8 %), E2 (8 %) and E5 (8 %). The number of unwanted sprouts increased with lowering of the E1, E4, E5 rates.

At the 1985 vintage, the only significant difference from the check was the low number of clusters in the E1 highest rate (8 %) treated vines (12.5 clusters/vine compared with 30.0 clusters of the check).

Table 3

Effects of 1985 treatments

Effetti dei trattamenti 1985

Treatment		Sucker control [1]) 4/6/85	Yield g/vine 3/10/85	Cluster wt g 3/10/85	Soluble solids Refract. % 3/10/85	Acidity meq/1 3/10/85
Check		0 f	5912 a	164 a	23.2 a	82.3 a
Tween 20	0.1 %	0 f	5862 a	164 a	21.7 a	90.1 a
Tween 20	0.5 %	0 f	5225 a	174 a	22.8 a	79.9 a
E1	2 %	7.7 bc	4712 a	161 a	21.5 a	86.3 a
E1	8 %	9.2 a	4812 a	187 a	22.0 a	86.3 a
E3	2 %	1.7 e	6337 a	189 a	21.7 a	83.3 a
E3	8 %	3.6 d	4187 a	147 a	22.9 a	77.5 a
E4	2 %	7.1 c	5762 a	186 a	22.3 a	82.0 a
E4	8 %	9.9 a	3460 a	139 a	22.5 a	82.6 a
E9	8 %	9.1 ab	6750 a	196 a	21.8 a	88.4 a

[1]) 10 point scale: 0 = no effect, 10 = complete control.

1985 Trial

The chemical tested for the first time, E9 at 8 %, resulted in growth suppression and die-back of suckers similar to that induced by E1 and E4 at the same rate (Table 3).

The good results of E1 and E4, at 8 %, were confirmed but the same compounds at 2 % were slightly less effective than the previous year, probably because the shoots were more developed at time of treatment. E3 for the second time showed solubility problems, which reduced its effectiveness.

Discussion

The few erratic data of the 1984 trial can probably be explained by the fact that some parts of fruiting canes were accidentally reached by treatments due to the lower training system of vines than used in the first year.

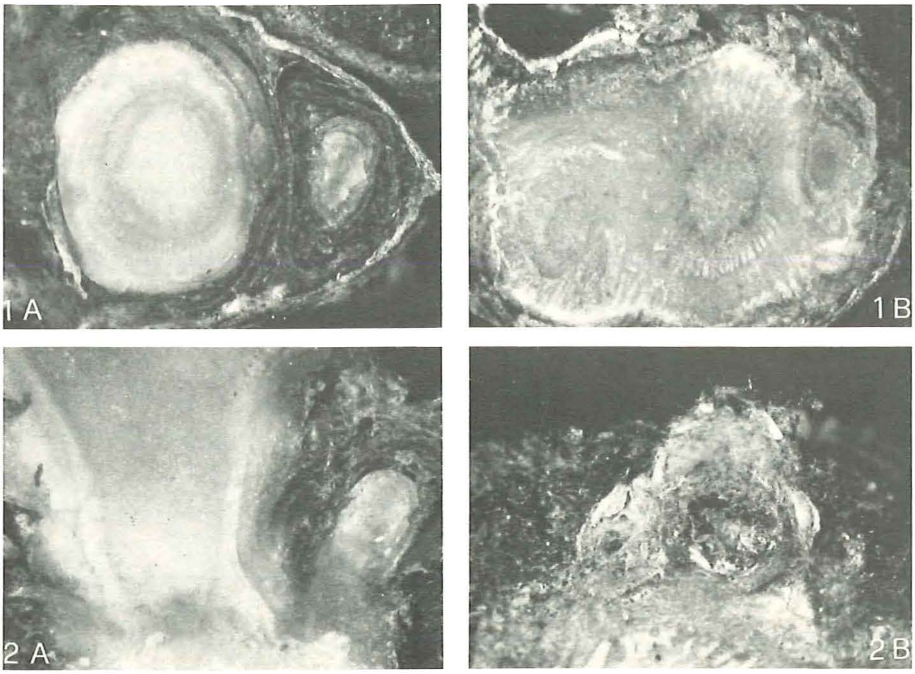

Fig. 1: 11 d after spraying, a basal section of the treated shoot (B) shows dark vessels but the lateral buds seem less affected (A, control).

Fig. 2: Afterwards, the difference from check (A) becomes deeper: necrosis reaches lateral buds also (28 d after E4 treatment, B).

Fig. 1: A 11 d dal trattamento, alla base del germoglio irrorato (B, A é il test) si nota l'imbrunimento dei vasi, mentre le gemme laterali sembrano ancora quasi indenni.

Fig. 2: In seguito le differenze dal testimone (A) si accentuano e la necrosi interessa anche le gemme secondarie (B, 28 d dopo il trattamento con E4).

In order to avoid this problem, in 1985 the fruiting canes were isolated with a plastic film at spraying. Among the chemicals tested, only E1 8 % seems to present some risks of damage to the plant growth.

Laboratory trial results and discussion

The investigation was carried out in order to ascertain if the buds were killed directly or (as seems more probable) as a consequence of translocation from the more absorbent tissues of the treated shoots.

Less growth inhibition effect has previously been observed on orange trees in 'leaves off' than in 'leaves on' conditions (NAUER *et al.* 1978).

Generally on fruit crops little or no NAA translocation from the treatment site has been mentioned, but on newly grafted citrus and fig plants a translocation has been noticed (NAUER and BOSWELL 1977, 1978; NAUER *et al.* 1979); the Na salt formulation translocated basipetally farther than the ethyl ester one (NAUER et al. 1978).

In the 1985 experiment on the shoots of cuttings, the drying process was slow and it was possible to follow the progressive response beginning from the top of the shoot.

Visual symptoms ranged from mild to severe epinasty accompanied by leaf necrosis, ending with stem necrosis and total shoot die-back.

The process was not always complete; this result can be related to low rate of treatment or to absence of growing shoots above the treated area (ELFVING and FORSHEY 1977; FOURNIOUX and BESSIS 1984). Indeed, the importance of other growth controlling substances from growing points interfering with applied ones, was hypothesized (LAKSO and CARPENTER 1978).

In the first period when the shoot was dried the lateral buds appeared uninjured. The bud complex in *Vitis vinifera*, especially the dormant ones on the trunk, is usually well coated. In this first phase, only the vessels of killed shoots were darkened (Fig. 1). Afterwards some lateral buds also appeared damaged (Fig. 2).

Conclusions

Some of the newly synthesized compounds (E4, E5) seem very promising in order to achieve a good control of suckering, avoiding manual removal for 2 years. Subsequently some new shoots sprout, which can be an advantage in allowing a return pruning if required.

In the 3 years of trial, all of these compounds at applied rates, did not show harmful effects on vigour or yield of grapevine (some doubts can persist for E2) probably because the translocation is slow and limited to the buds near the treated sprouts.

Summary

Six NAA esters (three known, three newly synthesized) were tested for the grapevine sucker control. Good results were achieved by E4, E5, E9 (8 % concentration) but E3 presented solubility problems. Suckering was reduced also in the second year, without repeating the treatment.

Literature cited

AHMEDULLAH, M.; WOLFE, W. H.; 1982: Control of sucker growth on *Vitis vinifera* L. cultivar Sauvignon blanc with naphthaleneacetic acid. Amer. J. Enol. Viticult. **33**, 198—200.

ANTOGNOZZI, E.; 1978 a: Effetti dell'estere etilico del NAA nel controllo dei succhioni in piante potate di melo, pero, susino e pesco. Ann. Fac. Agrar. Univ. Perugia **32**, 753—760.

— — ; 1978 b: Il controllo chimico dei succhioni con l'estere etilico del NAA in piante potate di pero cv. Buon Cristiano Williams. Ann. Fac. Agrar. Univ. Perugia **32**, 763—769.

AUSTIN, E. M.; 1983: Naphthaleneacetic acid and fruiting of rabbiteye blueberry 'Tifblue'. J. Amer. Soc. Hort. Sci. **108**, 314—317.

BOSWELL, S. B.; BERGH, B. O.; WHITSELL, R. H.; 1976 a: Control of sprouts on topworked avocado stumps with NAA formulations. HortSci. **11**, 113—114.

— — ; — —; — —; KUMAMOTO, J.; 1979: Reduction of rootstock sprouts on young grafted avocados with NAA. HortSci. **14**, 57—59.

— — ; MCCARTY, C.D.; 1974: Basal sprouting of fig trees controlled with NAA. Calif. Agricult. **28** (4), 14—15.

— — ; — —; EDE, L.L.; CHESSON, J. H.; 1976 b: Effect of a single application of naphthaleneacetic acid on yield and shoot growth of young lemon trees. HortSci. **11**, 222.

CARGNELLO, G.; LAVEZZI, A.; 1980: Ricerche sull'applicazione di sostanze chimiche in funzione „spollonante". Riv. Viticolt. Enol. (Conegliano) **33**, 336—347.

COLLARD, F. G.; PANIGAI, L.; 1985: Causerie technique sur les techniques et matériels d'épamprage de la vigne. Progr. Agric. Vitic. **102**, 21—22.

COUVILLON, G. A.; BASS, S.; JOSLIN, B. W.; ODOM, R. E.; ROBERSON, J. E.; SHEPPARD, D.; TANNER, R.; 1977: NAA-induced sprout control and gummosis in peach. HortSci. **12**, 123—124.

DOZIER, W. A.; HOLLINGSWORTH, M. H., JR.; 1976: Sprout control of apple nursery stock with NAA. HortSci. **11**, 392—393.

DUCASSE, M.; SYLVESTRE, J. G.; 1984: L'épamprage chimique de la vigne. Vignes Vins (328), 33.

ELFVING, D. C.; FORSHEY, C. G.; 1977: Effects of naphthaleneacetic acid on shoot growth of apple trees. J. Amer. Soc. Hort. Sci. **102**, 418—423.

ELIA, P.; 1979: Tecniche di meccanizzazione della viticoltura e macchine per vigneto. Quad. Vitic. Enol. Univ. Torino **3**, 215—263.

— — ; 1980: Spollonatura meccanica in vigneti collinari con un prototipo idoneo ad operare su ceppi contorti. Atti Convegno Nazionale sulla Meccanizzazione della Viticoltura Collinare, Torino, 77—90.

FOURNIOUX, J. C.; BESSIS, R.; 1984: Physiologie de la croissance chez la vigne: Influences foliaires. Vitis **23**, 231—241.

HARRE, A. J.; 1982: NAA — the growth regulator with a new future. Orchardist of New Zealand (Alexandra) **55** (5), 162.

LACOMBE, R.; FAUCON, L.; 1978: L'ingéniosité en viticulture. Progr. Agric. Vitic. **95**, 337—341.

LAKSO, A. N.; CARPENTER, S. G.; 1978: Control of regrowth in mechanically-hedged apple trees with NAA and daminozide. HortSci. **13**, 55—56.

LARUE, J. H.; SIBBERT, G. S.; BAILEY, M. S.; FITCH, L. B.; YEAGER, J. T.; GERDTS, M.; 1974: NAA sprout inhibition shown in olives, pomegranates, prunes, plums and walnuts. Calif. Agricult. **28** (9), 18—19.

MILLER, S. S.; 1977: Control of rootsuckers on apple trees with growth regulators. HortSci. **12**, 577—578.

— — ; WARE, G. O.; 1980: Naphthaleneacetic acid as a sprout inhibitor on pruning cuts and scaffold limbs in 'Delicious' apple trees. HortSci. **15**, 745—747.

MORRIS, J. R.; CAWTHON, D. L.; 1981: Control of trunk shoots on 'Concord' grapevines (*Vitis labrusca* L.) with naphthaleneacetic acid. HortSci. **16**, 321—322.

NAUER, E. M.; BOSWELL, S. B.; 1977: Effect of NAA on shoot growth of topworked fig trees. HortSci. **12**, 250—251.

— — ; — —; 1978: NAA sprays suppress sprouting of newly budded citrus nursery trees. HortSci. **13**, 166—167.

— — ; — —; HOLMES, R. C.; 1978: Translocation of NAA in 'Washington' navel orange. HortSci. **13**, 48—49.

— — ; — —; — —; 1979: Persistence of NAA-induced growth inhibition in sweet orange seedlings. HortSci. **14**, 525—526.

PAOLETTI, A.; 1984: Spollonatura chimica della vite. Notiziario Ortoflorofrutticoltura **10**, 237.

PHILLIPS, R. L.; TUCKER, D. P. H.; 1974: Chemical inhibition of sprouting of pruned lemon trees. HortSci. **9**, 199—201.RAESE, J. T.; 1975: Sprout control of apple and pear trees with NAA. HortSci. **10**, 396—398.

SYLVESTRE, J. G.; 1985: L'épamprage chimique de la vigne. Progr. Agric. Vitic. **102**, 92.

Eingegangen am 3. 3. 1986

Prof. I. EYNARD
C.N.R. — Centro Studi
Miglioramento Genetico Vite
Via Pietro Giuria 15
10126 Torino
Italia