EFFECTS OF VARIOUS RATES OF FUSILADE SUPER AS A RIPENER ON THE SUGARCANE VARIETY N14

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Abstract

Fusilade Super at rates of 300 ml/ha, 400 ml/ha and 600 ml/ha were applied to the sugarcane variety N14 in 5 ripener experiments. The objective of the experiments was to establish whether the reported poor responses of N14 to Fusilade Super could be improved by applying higher rates than the 330 ml/ha used for ripening other sugarcane varieties. The data indicate that of the rates tested, the optimum rate of applying Fusilade Super to N14 is about 400 ml/ha. Comment is made on the effects of topping height and the interval between varying and harvesting on the reponses to Fusilade Super.

Introduction

Data from the earliest experiments in which Fusilade Super was tested as a ripener indicated that responses of the sugarcane variety N14 were poor (Anon,[1 2]). Poor growing conditions, mainly due to a lack of soil moisture, are often cited as the reason for the poor responses of N14 to Fusilade Super. Results reported by Rostron *et al*[3] suggested that the responses to N14 to Fusilade Super could be improved by applying higher rates than the 330 ml/ha (41g ai/ha) recommended for other varieties. Because Fusilade Super may have severe effects on cane growth, it was necessary to demonstrate whether greater responses in terms of cane quality would provide equally good responses in terms of mass of recoverable sugar. Statistically significant improvements in cane quality in response to Fusilade Super are often associated with small responses in terms of mass of estimated recoverable sugar. This is due to a decrease in stalk mass partly negating the improvement in cane quality. In anticipation of high variability of growth in the commercial fields in which the experiments were sited, an attempt was made to measure the effects of Fusilade Super on stalk growth other than those that would be demonstrated from the standard sampling technique, which involves breaking each stalk at the natural breaking point and therefore does not consider the top of the stalk in detail.

Method

Details of the experiments are shown in Table 1. The experiments were of an incomplete latin square design with the exception of experiment 5, which had a randomised block design. Gross plot sizes either 54 m^2 or 72 m^2 and treatments were replicated 5 or 6 times.

The experiments were sited in commercial fields on the farm Mhlati (Transvaal Suiker Beperk) near Malelane. Husbandry at the sites was no different from the standard practice. The ripener, Fusilade Super (fluazifopbutyl 125 g ai/1), was applied by hand-operated knapsack sprayer with an overhead boom fitted with two TK 1,0 floodjet nozzles. The spray mixtures were delivered ar rates of between 50 1/ha and 70/1/ha.

At the time of spraying (in experiments 1, 2 and 3) and at intervals thereafter, 4 cane stalks were taken from 4 predetermined points in the net rows of each plot. The trash was removed from the stalks and untreated cane was topped at the natural breaking point. In the case of cane treated with Fusilade Super the breaking point was sometimes at one of the necrotic rings on the upper internodes. The stalks were then weighed. The stalks in experiments 4 and 5 were fed through a disintegrater and sub samples were analysed for juice quality and fibre content in the Central Board laboratory at Malelane. In experiments 1, 2 and 3 the sample of 16 stalks was arranged according to length and the stalks were numbered after being weighed. Stalks numbered 3, 4, 9, 10, 13 and 14 were selected as a sub sample and were shredded for analysis for juice quality and fibre content. In experiments 4 and 5 a composite sample for each treatment consisting of 3 stalks per plot was taken at the time of spraying. To simulate what could happen in commercial practice, no attempt was made to recover tops which broke off when samples were loaded and transported to the mill.

At the time of spraying in experiments 3, 4 and 5 the uppermost leaf with a visible dewlap on each of several stalks was marked with paint. Five marked stalks were harvested at various intervals in each plot and sectioned as shown in Table 2. Each section was weigned and analysed separately for juice quality and fibre content. The point at which the sheath of the marked leaf was attached to the stalk was within 10 mm to 30 mm of the apical meristem. Starting with the first internode below this point of attachment, the internodes were numbered. The two internodes which were formed above this point of attachment were designated with letters A and B respectively. Top sections of stalks were bound with string to prevent them from breaking off during transportation so that an assessment of the effects of Fusilade Super on the whole stalk could be made.

Table 1
Details of experiments

Exp. No.	Crop	Rates of Fusilade Super applied (ml/ha)	Date applied	Age of cane at spraying (months)	Quality at spraying		Stalk mass (g) at spraying	No. of green leaves at spraying
					Purity %	Ers %		
1	R	300, 600,	2 June 1986	10	82	9,4	1 611	9-12
2	R	300, 600,	13 June 1986	9,7	74	6,1	1 454	10-12
3	R	300, 600,	16 October1986	10	85	11,1	1 052	10
4	P	300, 400, 600	5 May 1987	9,4	73	9,1*	1 005	8-9
5	R	300, 400, 600	6 October 1987	9,5	88	13,4*	1 104	9-10

* Suc %

Table 2
Details of sectioning

Experiment 3			Experiment 4			Experiment 5		
Segment	Internodes included	Interval spray to sample	Segment	Internodes included	Interval spray to sample	Segment	Internodes included	Interval spray to sample
Top	A, B, 1	9 weeks	Top	A, B, 1	10 weeks	Individual internode	B to 8	8 weeks
Six internodes	2 to 7		Individual internodes	2 to 13		Base	9 to 12	

Results

Detailed results are presented in Tables 3 to 10. Summaries of these results are reflected in Figures 1, 2 and 3.

Table 3
Cane quality, mass of stalks and recoverable sucrose for two rates of Fusilade Super at various intervals in Experiment 1

Treatments	ers % cane				stalk mass (g/stalk)				ers (g/stalk)			
	0[a]	3,5	5	8	0	3,5	5	8	0	3,5	5	8
Control	9,4	10,0	9,8	10,3	1 583	1 891	1 807	1 804	148,8	189,1	177,1	185,8
Fus 300 ml/ha	9,4	11,0*	10,5	10,9	1 650	1 828	1 776	1 754	155,1	201,1	186,5	191,2
Fus 600 ml/ha	9,5	10,7	10,3	11,8**	1 600	1 896	1 906	1 742	152,0	202,9	196,3*	205,6
Mean	9,4	10,6	10,2	11,0	1 611	1 872	1 830	1 767	151,9	198,0	186,3	193,9
C.V. %	11,9	7,6	6,1	5,3	13,4	10,1	6,6	5,8	20,0	13,3	8,9	8,9
LSD (P = 0,05)	1,4	1,0	0,8	0,7	262	233	152	129	37	33	21	22
LSD (P = 0,01)	1,9	1,4	1,1	1,0	361	321	209	178	51	45	28	30

a = Weeks after applying treatments

Table 4
Cane quality, mass of stalks and recoverable sucrose from two rates of Fusilade Super at spraying and at various intervals after spraying in Experiment 2

Treatments	ers % cane				stalk mass (g/stalk)				ers (g/stalk)			
	0[a]	3	6	10	0	3	6	10	0	3	6	10
Control	5,6	6,9	8,8	8,3	1 450	1 735	1 654	1 592	81,2	119,7	145,5	132,1
Fus 300 ml/ha	6,5	8,2	9,6	9,3	1 525	1 990*	1 646	1 575	99,1	163,2*	158,0	146,5
Fus 600 ml/ha	6,2	7,9	9,2	9,7*	1 388	1 756	1 589	1 533	86,1	138,7	146,2	148,7
Mean	6,1	7,7	9,2	9,1	1 454	1 827	1 630	1 567	88,8	140,5	149,9	142,4
C.V. %	15,1	14,2	9,6	10,7	11,7	9,2	6,7	8,7	21,9	18,4	14,7	10,9
LSD (P = 0,05)	1,1	1,4	1,1	1,2	213	203	135	169	24,3	31,4	26,8	19,1
LSD (P = 0,01)	1,6	1,9	1,5	1,7	294	280	186	234	33,5	43,4	37,0	26,4

a = Weeks after applying treatments

Table 5
Cane quality, mass of stalks and recoverable sucrose from two rates of Fusilade Super at spraying and at various intervals after spraying in Experiment 3

Treatments	ers % cane				stalk mass (g/stalk)				ers (g/stalk)			
	0[a]	3	6	9	0	3	6	9	0	3	6	9
Control	11,3	11,2	11,3	11,5	1 052	969	1 094	1 057	118,9	108,5	123,6	121,6
Fus 300 ml/ha	11,1	11,7	12,4*	12,8	1 063	1 011	1 031	1 089	117,9	118,3	127,8	139,4*
Fus 600 ml/ha	11,0	12,0	13,1**	13,7**	1 012	990	1 052	1 016	114,6	118,8	137,8*	139,1*
Mean	11,1	11,6	12,3	12,7	1 052	990	1 059	1 054	117,1	115,2	129,7	133,4
C.V. %	5,0	6,7	7,7	8,0	5,8	6,9	6,8	7,5	7,4	9,6	8,1	10,8
LSD (P = 0,05)	0,69	0,98	1,1	1,2	74,7	83,8	88,2	97,7	10,8	13,6	12,7	17,6
LSD (P = 0,01)	0,95	1,4	1,6	1,7	103,2	115,7	121,7	134,8	14,9	18,8	17,6	24,3
S.E.D. ±	0,32	0,5	0,5	0,6	35,1	39,3	41,4	45,8	5,1	6,4	6,0	8,2

a = Weeks after applying treatments

Table 6
Effects of two rates of Fusilade Super on stalk sections in Experiment 3

Treatments	Tops (internodes A, B and 1)				Internodes 2 to 7			
	Pol % cane	Ers % cane	Mass (g/section)	Ers (g/section)	Pol % cane	Ers % cane	Mass (g/section)	Ers (g/section)
Control	0,92	−3,57	114	−4,1	10,9	8,0	269	21,6
Fus 300 ml/ha	2,37	−2,40	114	−2,8	12,8**	10,3**	292	30,1*
Fus 600 ml/ha	3,30	−1,20	104	−1,5	13,7**	11,4**	294	33,5**
Mean	2,20	−2,39	111	−2,8	12,5	9.9	285	28,3
C.V. %					6,7	10,0	10,0	16,9
LSD (P = 0,05)					1,1	1,3	38,9	6,2
LSD (P = 0,01)					1,5	1,8	55,3	8,8
S.E.D. ±					0,48	0,57	17,5	2,8

Table 7
Cane quality, mass of stalks and recoverable sucrose from 3 rates of Fusilade Super on N14 and N17 at spraying and intervals after spraying in Experiment 4

		Pol % cane	Stalk mass (g/stalk)	Pol (g/stalk)
At spraying	N17	9,3	872	81,2
(5 May 1987)	N14	9,1	1 005	91,7

Treatments	Ers % cane				Stalk mass (g/stalk)				Ers (g/stalk)			
	6[a]		9[a]		6[a]		9[a]		6[a]		9[a]	
	N17	N14	N17	N14	N17	N14	N17	N14	N17	N14	N17	N14
Control	10,9	10,6	11,7	10,9	969	1 028	982	1 033	105,6	108,9	114,9	112,6
Fus 300 ml/ha	12,7**	11,2	12,3	11,3	950	1 000	913	1 050	120,7*	112,0	112,3	118,6
Fus 400 ml/ha	12,0	11,0	12,7*	11,3	950	1 000	938	1 025	114,0	110,0	119,1	115,8
Fus 600 ml/ha	13,0**	11,3	12,9**	11,5	888*	1 025	963	1 088	115,4	115,8	124,2	125,1
Mean	12,2	11,0	12,4	11,3	939	1 013	949	1 049	113,9	111,7	117,6	118,0
C.V. %	9,0		8,6		9,0		11,5		12,8		14,7	
L.S.D. (P = 0,05)	0,9		0,91		80,3		105,1		13,0		15,6	
L.S.D. (P = 0,01)	1,3		1,2		107,5		141,0		17,4		20,8	
SED ±	0,46		0,45		39,7		51,9		6,4		7,6	

a = weeks after applying treatments

Cane quality (see Figure 1)

Five to six weeks after spraying differences in responses to the 300 ml/ha and 600 ml/ha were generally small. After a longer interval (8 to 10 weeks after spraying) the quality of cane treated with 600 ml/ha was substantially better than that sprayed with 300 ml/ha in experiments 1 and 3. The results from experiment 5 were the exception to this trend, as quality from applying 600 ml/ha was superior to that from 300 ml/ha seven weeks after spraying while, nine weeks after spraying differences between these two rates had decreased and were small.

In experiment 4 the responses of N14 to Fusilade Super were poor and no appreciable differences were evident from applying the various rates. In experiment 5 the substantial responses to 600 ml/ha was nearly equalled by that from applying 400 ml/ha. The responses of N17 in experiment 4 were greater than those from N14, with no clear evidence of their being improved by rates above 300 ml/ha.

Stalk mass (see Figure 2)

The results show that on average the negative effects of 600 ml/ha on stalk mass, within 6 weeks of spraying N14, were no greater than those from 300 ml/ha. Only in experiment 5 was there evidence that stalk mass accumulation was more severely impaired by 600 ml/ha than was evident from 300 ml/ha. The more rapid gain in mass of stalks treated with Fusilade Super relative to untreated stalks, from 6 weeks after spraying, in experiments 3 and 4 is surprising.

Sugar yields (mass ers) (see Figure 3)

In experiments 1 and 5 the responses to 600 ml/ha were substantially greater than those from applying 300 ml/ha in terms of estimated sugar yields per stalk. The difference, evident 5 weeks after spraying in experiment 1, continued to increase up to 8 weeks after spraying. Unlike the sustained difference in response observed in experiment 1, the substantially greater response from 600 ml/ha 7 weeks after spraying in experiment 5 was not evident 2 weeks later (9 weeks after spraying). The data from experiment 3 also provide some evidence that, 6 weeks after spraying, response to 600 ml/ha may be substantially greater than that from 300 ml/ha.

Stalks treated with 300 ml/ha in experiment 3 gained recoverable sugar more rapidly than stalks treated with 600 ml/ha between 6 and 9 weeks after spraying. The responses to 400 ml/ha 7 weeks after spraying in experiment 5 were similar to those from applying 600 ml/ha.

Table 8

The effects of two rates of Fusilade Super on stalk sections in Experiment 4 (10 weeks after spraying)

Internodes	Ers % cane						Stalk mass (g)					
	Control		Fus 300 ml/ha		Fus 600 ml/ha		Control		Fus 300 ml/ha		Fus 600 ml/ha	
	Segment	Cumulative	Segment	Cumulative	Segment	Cumulative	Segment	Cumulative	Segment	Cumulative	Segment	Cumulative
Top + 1	1,0	9,2	2,2	11,0	–	10,1*	68	799	51	874	21	843
2	1,9*	9,9*	5,6*	11,5*	–	10,3*	37	731	32	823	29	822
3	4,3	10,4	5,6*	11,8*	–	10,7*	45	694	43	791	44	793
4	6,2	10,8	9,1	12,1	7,5	11,3	63	649	63	748	62	749
5	7,7	11,3	10,1	12,4	8,2	11,7	70	586	77	685	71	687
6	8,9	11,8	11,1	12,7	9,5	12,1	71	516	82	608	78	616
7	10,3	12,2	11,7	13,0	10,4	12,4	69	445	81	526	78	539
8	11,3	12,6	12,7	13,2	11,5	12,8	68	376	78	445	78	460
9-13	12,8	12,8	13,3	13,3	13,0	13,0	308	308	367	367	382	382

Internodes	Mass ers (g)					
	Control		Fus 300 ml/ha		Fus 600 ml/ha	
	Segment	Cumulative	Segment	Cumulative	Segment	Cumulative
Top + 1	0,7	73,4	1,1	96,0	–	84,7*
2	0,7*	72,7	1,8*	94,8*	–	84,7*
3	2,0	72,0	2,4*	93,1*	–	84,7*
4	3,9	70,0	5,7	90,6	4,6	84,7
5	5,4	66,1	7,7	85,0	5,8	80,1
6	6,3	60,7	9,1	77,2	7,4	74,3
7	7,1	54,4	9,5	68,1	8,2	66,9
8	7,7	47,3	9,9	58,6	9,0	58,7
9-13	39,6	39,6	48,8	48,8	49,7	49,7

* Interpolated data

Table 9

Cane Quality, mass of stalks and recoverable sucrose from three rates of Fusilade Super at spraying and at various intervals after spraying in Experiment 5

Treatments	Pol % cane	Stalk mass (g/stalk)	Pol (g/stalk)
Control	13,6	1 139	154,9
Fus 300 ml/ha	13,9	1 139	158,3
Fus 400 ml/ha	12,9	1 069	137,9
Fus 600 ml/ha	13,3	1 069	142,2
Mean	13,4	1 104	147,9

Treatments	ers % cane		Stalk mass (g/stalk)		ers (g/stalk)	
	7[a]	9	7	9	7	9
Control	11,8	11,9	1 181	1 276	139,4	151,8
Fus 300 ml/ha	12,8*	14,2**	1 200	1 172	153,6	166,4
Fus 400 ml/ha	14,5*	14,3**	1 163	1 135*	168,6*	162,3
Fus 600 ml/ha	14,8**	14,5**	1 169	1 099**	173,0**	159,4
Mean	13,5	13,7	1 178	1 171	159,0	160,0
C.V. %	5,6	8,5	8,2	8,7	10,6	12,0
L.S.D. (P = 0,05)	1,0	1,4	132,9	125,9	23,3	23,6
L.S.D. (P = 0,01)	1,45	1,99	186,2	173,8	32,6	32,5
SED ±	0,48	0,68	6,1	59,1	10,7	11,1

a = weeks after applying treatments

Sectioning data

Data from experiment 3 (Table 6) confirm that 600 ml/ha had a slightly greater effect on the growth of the upper section of the stalk than did 300 ml/ha. The top section of the untreated stalk would not have contributed to the total mass of recoverable sugar, and topping between internodes 1 and 2 would have given the highest sugar yields of untreated cane. This would therefore remove the section of stalk containing most of the additional growth in the time between spraying and sampling. The data for the six internodes immediately below the top show that differences in responses, in term of cane quality, were substantial (ns) between the 300 ml/ha and 600 ml/ha rates, and that the difference in response in terms of mass of recoverable sugar per stalk section was 16%. In experiment 5 (see Table 10) topping untreated cane between internodes 1 and 2, and not topping Fusilade Super treated cane would have yielded the most sugar for the respective treatments. The mass difference between Fusilade Super treated cane and the entire untreated stalk would have been 139 g (= 42 + 49 + 40 + 42 −7−27). This difference would be substantially less if the untreated stalks were topped between internodes 1 and 2. The difference would then be 15 g (= 42 −27) which reflects the effect of Fusilade Super on the mass of internode 2. These data indicate that Fusilade Super increased sucrose yields by 27,2 g (= 176,9 − 149,7) per stalk. The results from sectioning in experiment 4 (Table 8) show that the uppermost section of the untreated stalk would have contributed to the total mass of recoverable sugar. As in experiment 5, the data in experiment 4 show that the growth of the top section of the stalk, including internode 2, may also be affected by Fusilade Super. The mass differences of the whole untreated stalk and stalks treated with 300 ml/ha and 600 ml/ha would have been 22 g (= 68 + 37 − 51 − 32) and 55 g (= 68 + 37 − 21 − 29) per stalk respectively. The adverse effects of Fusilade Super on stalk mass on this occasion would therefore have caused a loss in terms of sugar yields.

Discussion

There is evidence that the responses of N14 to Fusilade Super may be improved by applying a higher rate than the 300–330 ml/ha which is recommended for other varieties. The substantial gain in sugar yields from applying 600 ml/ha was equalled by that from 400 ml/ha in experiment 5. This confirms earlier data from Rostron[3] that no further yield increases are likely to be realised from applying more than about 400 ml Fusilade Super/ha on N14.

Associated with the effects of applying higher rates of Fusilade Super is an increase in the number of stalks which develop distinct necrotic rings, and a substantial reduction in fresh leaf mass compared with applying 300 ml/ha (unpublished data). The necrotic rings which are characteristic symptoms of treatment with Fusilade Super appear to form on the internodes, which are elongating at the time of and after its application. Usually these rings form on only two internodes; but if stalk elongation is rapid following application they may develop on more than two internodes. If treated and untreated stalks were topped at the height which would result in the maximum mass of estimated recoverable sugar per stalk, then under certain conditions no mass reduction due to Fusilade Super would be apparent. Under such conditions responses to Fusilade Super should be little affected by its effect on total stalk mass. In situations where the entire stalk of untreated cane contributes to the total mass of recoverable sugar, the negtive effect of Fusilade Super, on stalk mass, particularly from higher rates, may partly negate improvements in cane quality. The data in experiment 3 suggest that similar responses may be achieved from applying 300 ml/ha and 600 ml/ha by varying the interval between spraying and harvesting. Accepting the evidence that responses to 400 ml/ha are similar to those from applying 600 ml/ha, then cane treated with 400 ml/ha would be harvested three weeks earlier (about 6 weeks after spraying) than cane treated with 300 ml/ha (harvested about 9 weeks after spraying). If these data are confirmed and the conditions leading to such responses are sufficiently well identified, the constraints pertaining to the use of Fusilade Super as a ripener may become less rigid.

The data also confirm that a shorter interval between spraying and harvesting (5 to 7 weeks) should be scheduled where growth after spraying is rapid, as it was in experiment 5, the longer time to develop responses in experiment 1 being associated with less rapid growth. An investigation of the relationship between accumulated insolation and the optimum response time, may be useful in providing more specific advice concerning the most suitable time interval before harvesting cane treated with Fusilade Super.

The gain in sugar yields from harvesting cane 5 to 7 weeks after being sprayed with 300 ml/ha and 600 ml/ha was, on average, 6% and 10% rspectively. This increased to 9% and 11% at 9 weeks after spraying in cane treated with 300 ml/ha and 600 ml/ha respectively.

Acknowledgements

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Table 10

Effects of Fusilade Super on stalk sections in Experiment 5 (8 weeks after spraying)

Internodes	Ers % cane				Stalk mass (g/section)				Ers (g/section)			
	Control		Fus 400 ml/ha		Control		Fus 400 ml/ha		Control		Fus 400 ml/ha	
	Segment	Cumulative	Segment	Cumulative	Segment	Cumulative	Segment	Cumulative	Segment	Cumulative	Segment	Cumulative
B	−2,7	11,5	–	–	42	1 280	–	–	−1,1	147,4	–	–
A	−1,95	12,0	–	–	49	1 238	–	–	−1,0	148,5	–	–
1	−0,7	12,6	–	–	40	1 189	7	1 208	−0,3	149,5	–	–
2	2,4	13,0	–	–	42	1 149	27	1 201	1,0	149,7	–	–
3	6,2	13,4	9,7	15,1	51	1 107	55	1 174	3,1	148,7	5,3	176,9
4	8,5	13,8	11,9	15,3	52	1 056	55	1 119	4,4	145,6	6,6	171,6
5	10,4	14,1	13,0	15,5	48	1 004	52	1 063	5,0	141,2	6,7	165,0
6	11,7	14,2	13,8	15,6	43	956	44	1 012	5,0	136,1	6,0	158,3
7	12,6	14,4	14,6	15,7	42	913	40	968	5,2	131,1	5,8	152,2
8	12,8	14,4	14,9	15,8	50	871	54	928	6,5	125,9	8,1	146,4
9–12	14,6	14,6	15,8	15,8	821	821	874	874	119,4	119,4	138,3	138,3

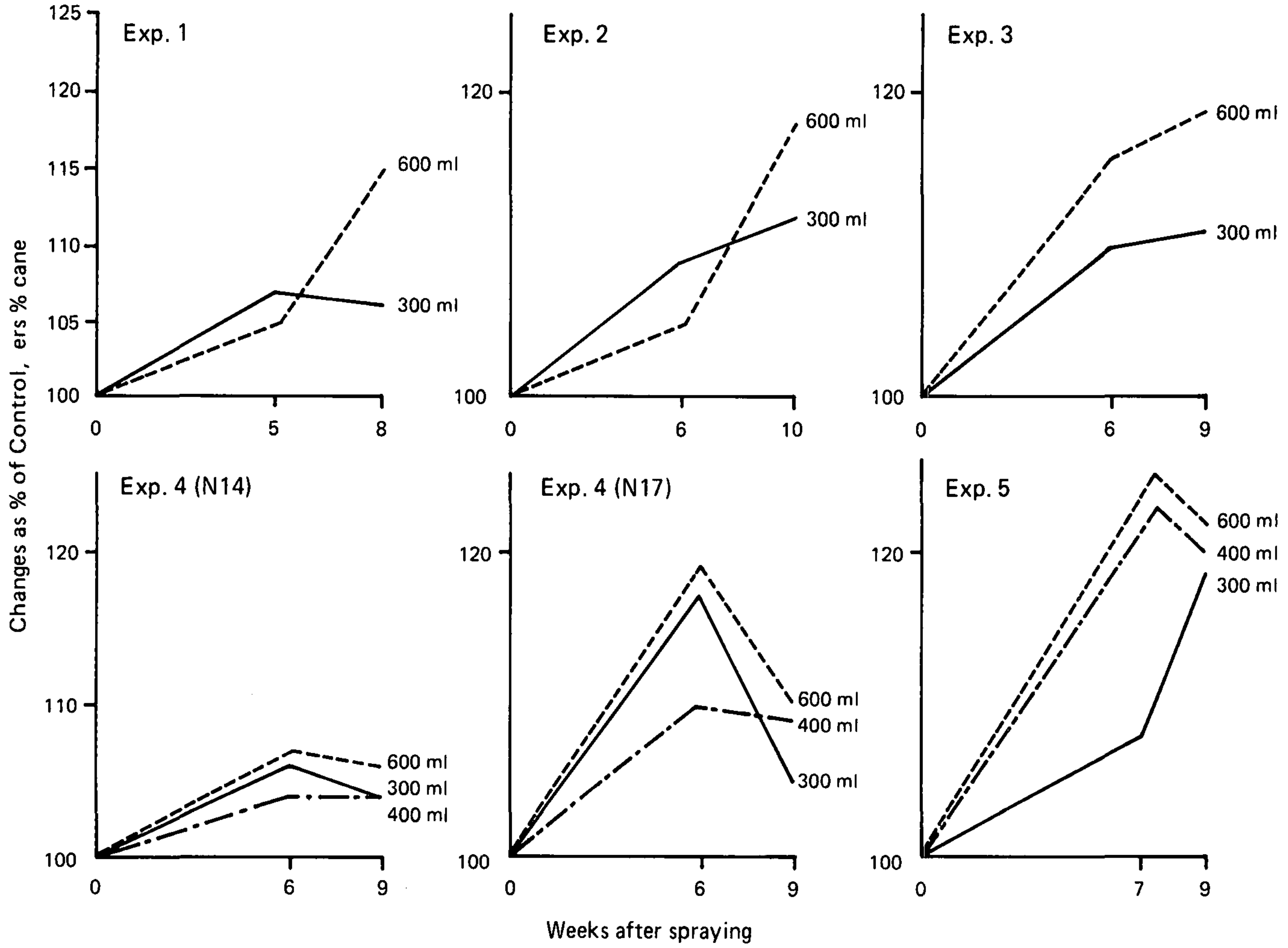

FIGURE 1 Effects of various rates of Fusilade Super on cane quality.

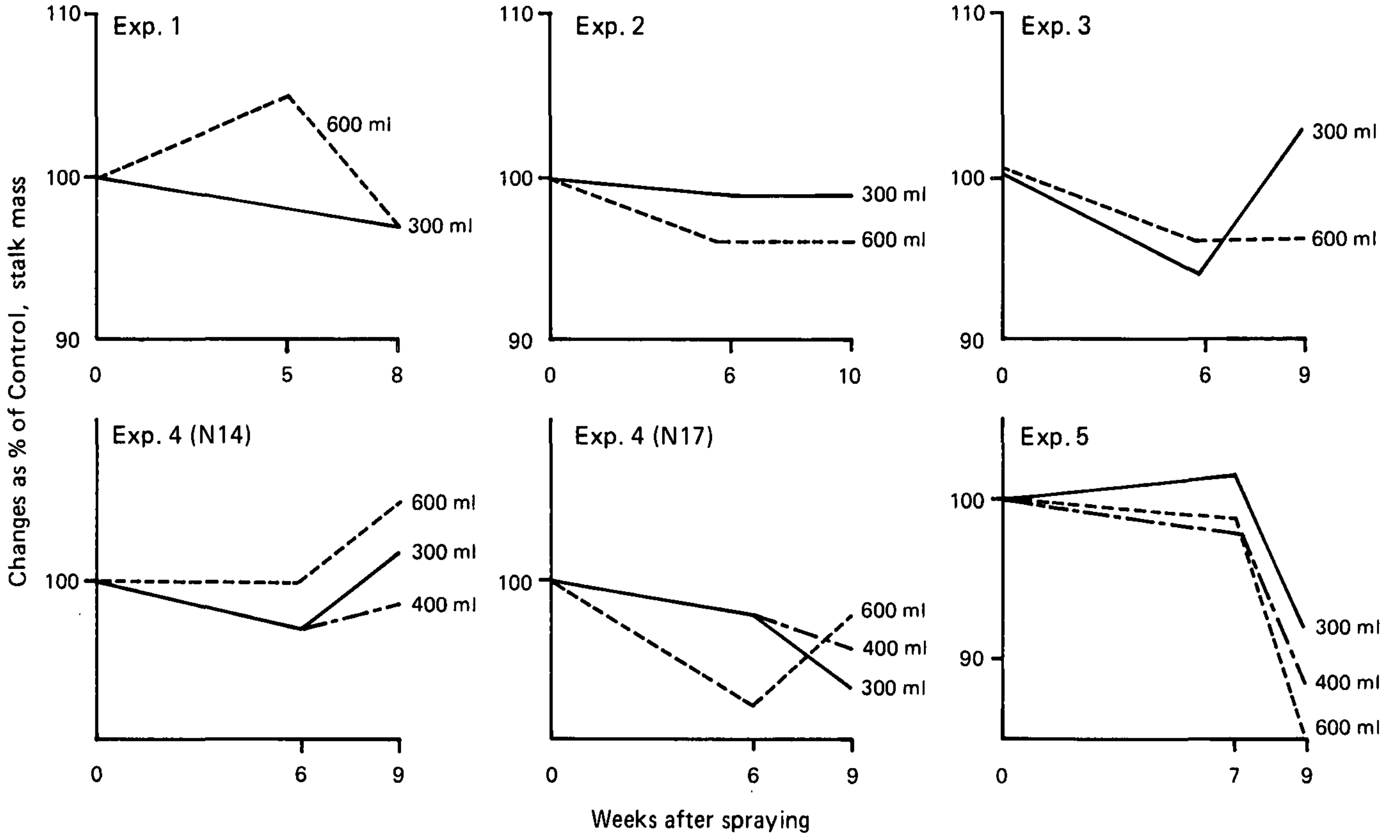

Figure 2. Effects of Fusilade Super at various rates on stalk mass.

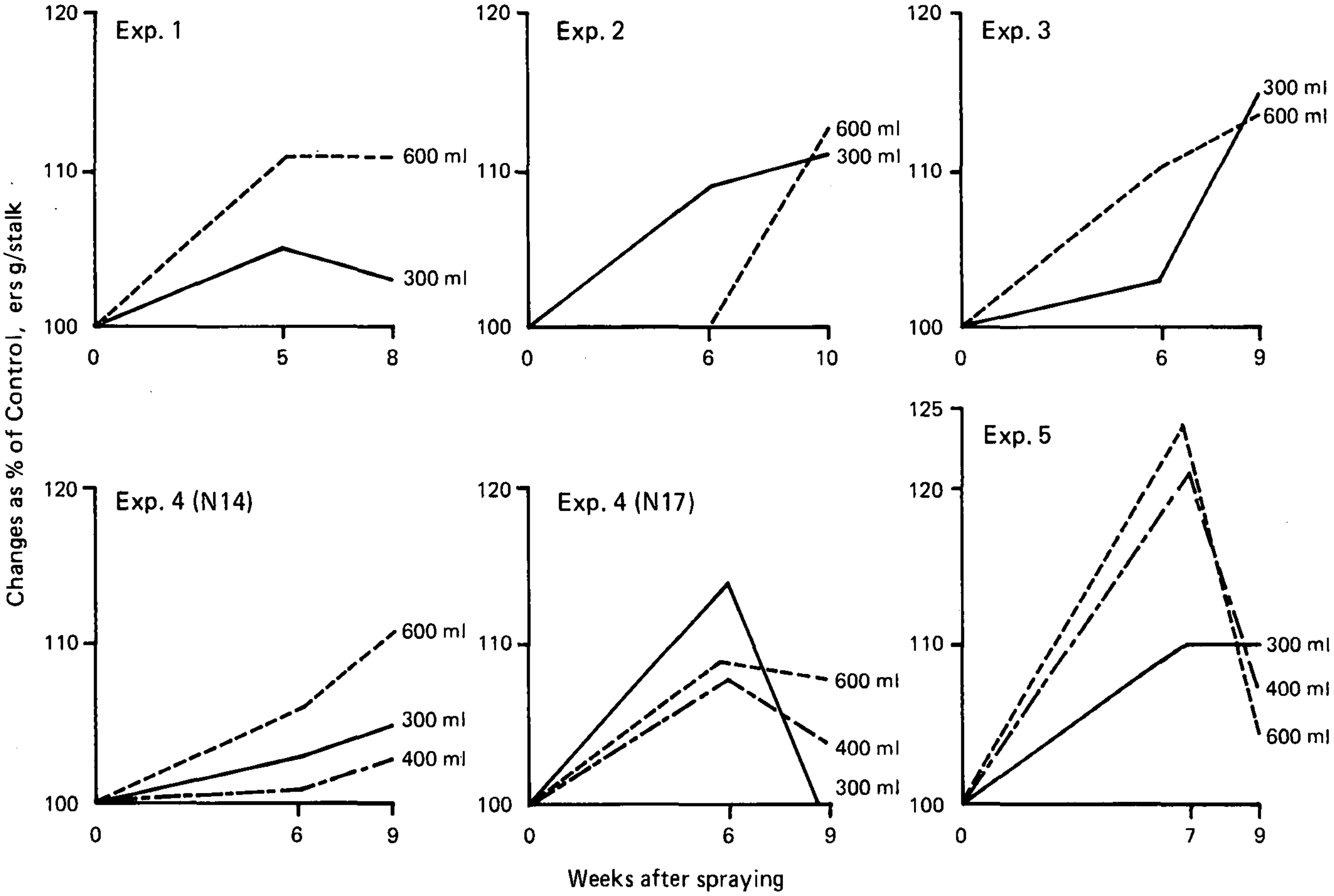

FIGURE 3 Responses in estimated recoverable sugar to rates of Fusilade Super.