Copper and Velvet Antler Production: A Clinical Trial

I H Walker, P R Wilson, S Beckett

1. Introduction

Copper supplementation as copper oxide wire particles (COWP) boluses or copper injections given to deer, or $CuSO_4$ added to fertiliser, is quite commonly practised on deer farms in Central Hawke's Bay.

In clinical practice we are constantly monitoring serum and liver copper, and pasture copper levels as part of our service to deer farmers in order to encourage optimal production from deer.

The Animal Health Diagnostic Laboratories have guidelines from which we tend to make our recommendations to farmers.

Adequate levels include:

i.	serum copper	8.0 - 18.0 umol/L
ii.	serum ferroxidase	11-32 iu/L
iii.	liver copper	>95 umol/kg

There is often much discussion as to how to interpret the laboratory results in relation to a particular farm so that the appropriate advice is given, with particular reference to farm production.

The clinical syndromes which we attribute to low copper levels are well recorded in deer, and these include poor weight gain, osteochondrosis and enzootic ataxia. There is one clinical trial in New Zealand which is indicative of copper supplementation improving velvet antler production (McHugh, 1992).

Where clinical signs of Cu deficiency are diagnosed a supplementation programme can be commenced with confidence. However, how do we interpret the marginal results?

Can we confidently recommend copper supplementation if the liver and serum copper levels are below the normal levels, and expect to see an economical production response?

Should we supplement if we don't see clinical signs?

What is the economic significance to a farming operation in terms of a productivity response if copper is supplemented?

The property where this trial occurs has a history of low to marginal copper levels over a number of years. Supplementation of copper to deer has been, at best, sporadic.

Laboratory samples taken from 2.y.o. stags from the trial farm November 1995 are listed in Table 1.

Table 1. Liver and serum copper concentrations from 2-year-old stags

Sample	Liver copper umol/kg	Serum copper nmol/L
1	30	4 5
2	59	12 1
3	41	9.6
4	33	8 2
5	41	12 4
		11 1
		12 8
		7 9
		9 3
Average	41	11 1

In March 1996 the question was asked by the farm manager as to whether he should supplement the R2 stags with copper or not, and if so, when.

This question prompted a controlled clinical trial.

2. Objectives

To investigate if copper supplementation to rising two-year-old red stags on this property gave a productive and/or economic response.

Measurements were:

- Liveweight gain over the trial period
- Velvet weight and velvet grade from the R2 stags.

The economic analysis was to be measured in dollar terms with current input prices and farmer returns for venison and velvet.

3. Farm profile

Area: 270 ha
Stock wintered: 1635 Deer - 620 breeding hinds

	- 310 MA velvetting stags - 145 R2 velvetting stags - 560 weaner hinds and stags
Deer carrying capacity:	12 s.u./ha (Some cattle traded to utilise feed surpluses).
Soil type:	Wanstead Clay Series and small area of silt loan
Stock policy:	Maintain a Red breeding herd. Breed Red replacements for a velvetting mob. Sell/slaughter surplus stock. Terminal sire to portion of hinds - all offspring slaughtered from 10 months onwards.

4. Method

An outline of the trial design is presented in Figure 1.

A total of 142 individually identified R2 red stags were divided into four randomly allocated groups. Within each group, seven stags were randomly selected for repeat blood sampling over the trial period.

The body weights were recorded on May 14, June 28, August 20, October 2 and December 18 1996. On these days, the seven selected stags from each treatment group were blood sampled and ferroxidase levels analysed. Bodyweights were recorded in the morning on each occasion within three hours of leaving the paddock.

On May 14, two of the groups of stags were treated with a 20gm CuO wire particle bullet (Copacaps 20 gm, Rhône Mèrieux), and two groups received no COWP capsule.

On August 15, one group of stags from the May treated group, and one group of stags from the May control group were administered a 20gm COWP bullet. The remaining two groups received no treatment. This effectively created a cross-over trial design.

All stags were managed as one group, and grazed on pastures to a minimum post grazing pasture cover of 1100 kg DM/ha.

Antler button casting dates were recorded for all stags by bringing them through the shed up to four times per week to draft off stags into about four velvetting groups. The velvetting groups were grazed on paddocks with similar pasture covers as far as possible.

Velvetting date was recorded for all stags.

Individual velvet sticks were identified and submitted to the Wrightson Velvet Pool for weighing and grading.

Velvet prices used for financial analyses were based on the Wrightson N.I. Velvet Pool No. 13 29/1/97.

The stags that the farmer did not select as replacement velvetters for his velvetting herd were slaughtered. All carcass weights according to the kill sheet where possible, were identified with the individual records, and at least four liver samples were taken from each treatment group and analysed for copper.

Figure 1. Trial Design

Date	Groups				Tasks
15 May 1996	N = 36 CON	N = 35 CON	N = 35 CON	N = 35 CON	Allocate stags to groups Weigh and identify Treat 2 groups with COWP Blood sample
28 June 1996	CON	CON	TREAT	TREAT	Weigh Blood sample
28 August 1996	CON/ CON	TREAT/ CON	CON/ TREAT	TREAT/ TREAT	Weigh Blood sample Treat 2 groups with COWP
2 October 1996	CON/ CON	TREAT/ CON	CON/ TREAT	TREAT/ TREAT	Weigh Blood sample Record casting date
18 Dec 1996	CON/ CON	TREAT/ CON	CON/ TREAT	TREAT/ TREAT	Weigh Blood sample Liver sample at slaughter

Record velvetting date, velvet grade, and harvest date as appropriate.

5. Results

Descriptive data and analysis are presented in Tables 2-5. All data was recorded into a database (Access, Microsoft Inc) for analysis using SAS.

Serum Ferroxidase and Liver Copper

Table 2. Serum ferroxidase levels iu/l

Treatment group		14/5/96	28/6/96	20/8/96	2/10/96	18/12/96	Liver copper umol/kg
Con/Con	Ferrox	18 43	23 71	14 57	10	12 57	98 75
	STD	8 47	8 91	6 25	7 05	6 14	
Con/Treat	Ferrox	16 71	18 29	10 14	17 0	17 0	250 8
	STD	6 23	6.16	8 11	5.35	4 6	
Treat/Con	Ferrox	17 86	26 14	21 57	13 71	15 71	194
	STD	9 12	9 64	12 67	7 91	6.51	
Treat/Treat	Ferrox	20 86	30 43	28 71	21 57	18 71	386 75
	STD	8.01	3.81	4.27	2.72	2 96	
Comparison of Treatment Means		N S	p = 0 002	p = 0 004	p = 0 037	N S	p = 0 063

Treatment with 20gm COWP gave a significant effect on serum ferroxidase levels at 6wks and 12 wks after treatment. At 18 weeks (i.e. 2/10/96) the non treatment group was significantly lower than the treatment groups. However, by the end of the trial, i.e. 18/12/96, any difference in serum ferroxidase had gone.

When the stags were slaughtered in December, there was a significant difference in the liver coppers between the treatment groups.

Treatment Group Liveweights

Table 3. Liveweight data kg

Treatment grp	Weight 1 14/5/96	Weight 2 28/6/96	Weight 3 20/8/96	Weight 4 2/10/96	Weight 5 18/12/96
Con/Con	91 03	90 06	93 22	99 47	111 72
Con/Treat	95 59	95 43	98 38	104 85	116 82
Treat/Con	98 46	98 26	101 46	108 34	122 71
Treat/Treat	97 64	96 36	100 17	106 71	119 91
Difference between 2 treatment and 2 control grps	p = 005	p = 003	p = 002	-	-
Difference between 4 treatment grps	p = 008	p = 002	p = 003	p = 003	p = 009

There was a significant difference between the treatment groups before the trial. This continued throughout the trial period.

Liveweight Gain

Table 4. Liveweight gain kg/day

Treatment grp	Weight 1 14/5/96	Weight 2 28/6/96	Weight 3 20/8/96	Weight 4 2/10/96	Weight 5 18/12/96
Con/Con		-0 017	0 057	0 145	0 158
Con/Treat		-0 003	0 056	0 146	0 146
Treat/Con		-0 004	0 060	0 160	0 184
Treat/Treat		-0 03	0 069	0.148	0 165

There was no significant difference in liveweight gain between the treatment and control groups over the period between Weight 1 and Weight 3.

Similarly, there was no significant difference in liveweight gain between Weight 1 and Weight 5 between the treatment and control groups (p = .346).

Velvet Growth

Table 5.

	CON/ CON	CON/ TREAT	TREAT/ CON	TREAT/ TREAT	
Days to casting from May 15 treatment	152 4		148 8		p = 0 03
Days to casting from Aug 20 treatment	55 5	50 3	53 2	51 5	N S
Days of antler growth (casting to harvest)	56.42	55 76	56 74	56 03	NS
Days to cutting from May 15 treatment	208 5		205 3		p = 0 046
Days to cutting from Aug 20 treatment	111 9	106 3	109 0	108 2	N S
Daily velvet growth kg/day	0 0185	0 0197	0 0206	0 0197	N S
Total velvet weight (both sides)	1 04	1 09	1 17	1 105	N S
Total velvet value $ (Tot wt x value)	$85 32	$95.87	$100 99	$94 64	p = 0 031

There was no significant difference between the treatment groups for;

- Days to casting from Aug 20 treatment.
- Days of antler growth between casting and harvest.
- Days to cutting from Aug 20 treatment.
- Daily velvet growth.
- Total velvet weight.

However, there was a significant difference between the treatment group and the control group from May 15 to casting date and harvest or cutting date, and a significant difference in velvet value between the treatment groups.

Simple Linear Regressions

Linear regressions were analysed between total velvet weight and the stag bodyweights at the five weighing dates. Similarly, a linear regression was established between total velvet value and the stag bodyweights at the five weighing dates.

Linear regressions

	Seta	P. Value
Total velvet weight = Weight 1	0.0083 kg	0 000005
Total velvet weight = Weight 2	0 0091 kg	0 000001
Total velvet weight = Weight 3	0 0096 kg	<0 000001
Total velvet weight = Weight 4	0 0092 kg	<0 000001
Total velvet weight = Weight 5	0.0076 kg	<0 000001
Total Velvet Value = Weight 1	0 850 $	0 000007
Total Velvet Value = Weight 2	0 925 $	0 000002
Total Velvet Value = Weight 3	0 984 $	<0.000001
Total Velvet Value = Weight 4	0.923 $	<0 000001
Total Velvet Value = Weight 5	0 756 $	<0 000001

There was a highly significant influence of bodyweight measurement at any of the dates given on velvet weight and value.

Multiple Regressions

Multiple regressions were analysed using total velvet weight and total velvet value between the treatment groups at each weighing date and the control group.

The highly significant bodyweight effect on velvet weight and velvet value was not affected by the various treatment groups.

6. Discussion

Serum ferroxidase levels were significantly increased six weeks after administration of 20gm COWP, and this persisted until at least 12 weeks after treatment. The COWP treatment also reduced the range of ferroxidase as indicated by the smaller standard deviation. The copper administration successfully increased the liver copper levels.

The control/control group had a significantly lower serum ferroxidase on 2nd Oct. The mean serum level was 10 iu/L with a s.d. of 7.05 iu/L indicating that a lot more than 50% of the individuals in this group had low serum ferroxidase when velvet was effectively growing, yet in the final analysis, there was no effect on weight of velvet, attributable to the effect of copper level.

The mean weights of treatment groups at the beginning of the trial were not equal, and this persisted throughout the trial. This confounded the statistical analyses but regression analysis was used to distinguish weight effects from copper effects.

The liveweight gains were negative for the first six weeks even though we estimated that they were getting adequate pasture. Quite clearly, the LWG considerably increased in the spring, even though the copper supplementation appeared to have no effect.

The May copper treatment had a positive influence on the antler casting date. The mean casting date of the Treat/Treat group was actually six days ahead of the Control/Control group. This may have been a bodyweight effect. The total value of velvet is influenced quite significantly by the price received for each respective grade i.e. C, D or E. However, the results indicate a tendency towards improved velvet grade from the copper treatment, but this also may have been related to liveweight differences.

The linear regression model with bodyweight and velvet weight is further evidence to support selection of stags for velvet weight on bodyweight. In fact, it confirms in our opinion, that you can cull the poorer bodyweight stags and will be unlucky to lose many potentially good velvet producers.

The final multiple regression confirms that bodyweight on its own has a greater effect on velvet weight than copper supplementation. Thus there can be two possible conclusions from this result. Either the copper levels on this farm have increased in the six months between the original levels of Nov 1995 to the beginning of the trial, or alternatively, the animal health laboratory normal values are very conservative.

Improved nutrition in 1996 compared with 1995 may have altered copper uptake and metabolism to improve the copper status.

Conclusions

We can conclude for the period of this trial in 1996 that copper supplementation gave no productive or economic response in terms of liveweight changes or velvet production.

This data has significance because it suggests that if copper does influence antler production, the effects are below the range observed here, despite levels here being below "reference" ranges. This brings into question the accuracy or appropriateness of current reference ranges as they apply to velvet antler growth.

From the farmer's perspective, this is a good result, as for 1997, he has not supplemented his R2 stags with copper.

Acknowledgements

* Ian Spiers Memorial Trust for funding of project.
* Rhone Merieux for supply of Copacaps.
* Keith Burden, farm manager for co-operation and accuracy in gathering information.
* Wrightson Deer Velvet Pools - Manager - Mr Phillip Irwin for weighing and grading of velvet.

References

McHugh P (1992) Investigation of poor velvet production *Proceedings of a Deer Course for Veterinarians* No 9, Deer Branch NZVA. P R Wilson (Ed). Pp149-54