DOI:10.26524/jms.2014.19

Rcbd of blue tick adaptation to dipping during winter season: a case of mashona cows in mukore village, masvingo, zimbabwe.

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ABSTRACT: Ticks cause great economic losses to livestock in the world and have adverse effect on livestock host in several ways and parasitize a wide range of vertebrate hosts, and transmit a wider variety of pathogenic agents than any other group of arthropods. A complex of problems related to ticks and tick-borne diseases of cattle created a demand for methods to control ticks and reduce losses of cattle. In this paper, dipping is the only control method used to eradicate cattle ticks in the area of Mukore and only Mashona cows are examined. However, Randomized Complete Block Design (RCBD), an experimental method, confirms that Blue Ticks are resistant to dipping in this area. Four different parts of a cow (blocks) are of interest in this research during the experiment. The results show that the most affected area is the udder followed by the belly, tail and lastly the ear. Tickbuster (EC) cattle Dip is the chemical used in the plunge dipping tank. A supplementary method such as spraying the cows on critical areas after dipping should be adopted rather than relying on dipping only.

Keywords*:* Blue Ticks; Dipping; Randomized Complete Block Design; Mashona cows.

1. INTRODUCTION

Controlling and eradicating cattle ticks is extremely important for the viability of the cattle industry in Masvingo. Ticks increase in number over the hot, wet months in summer, and this is when they cause most damage to cattle. Adult ticks cause greater damage to cattle than the immature stages, and are also more frequent in summer. Cattle ticks are the most external parasites of cattle which can cause fever in cattle and if little attention is given, cattle may die. For the past years, the livestock industry has been experiencing huge costs in production and control costs due to cattle ticks. It is suggested that tick infestations by about 30 adult ticks can cause anaemia or death due to blood loss. The death of cattle through tick diseases has a negative impact on the economy as far as dairy industry is concerned. Intensive tick control keeps the tick numbers low so that damage and tick-borne diseases are not a problem to cattle. The most common traditional method of treating ticks on cattle has been, and still is, dipping. When cattle are dipped they jump through a bath containing a solution which kills the cattle tick. More than 500 cattle dip yards were built in Masvingo area under the government controlled program. Currently, tick buster dip Emulsifiable Concentrate (EC) is used for cattle dipping in Mukore village under Masvingo District. There are different types of cattle ticks which are feeding on cattle blood in Mukore Village, namely Brown ear tick, Blue tick, Bont tick, Red legged and Bont legged but most dangerous tick in this area is the blue tick. Heavy infestation of ticks on cattle results in a loss of condition, failure to gain properly and severe degree of anemia. Tick biters are irritating and cause the infected animal to rub and scratch, resulting in a scabby skin condition, sometimes followed by secondary infection. Many farmers in Masvingo need to be educated about strategic tick control method rather than the intensive tick control adopted in the Mukore area because it is economical and gives the cattle the opportunity to be exposed to ticks and tick-borne disease and develop some protection against them.

According to Furman and Loomis (1984), ticks are very important and harmful blood sucking external parasites of mammals, birds and reptiles throughout the world. In his research, Snelson (1975) stated that ticks cause great economic losses to livestock in the world and have adverse effect on livestock host in several ways. Kaaya and Hassan (2000) reported that the use of entomopathogenic fungi to control ticks may reduce the frequency of chemical acaricide use and the need for treatment for tick-borne diseases. Pasture spelling, pasture burning and use of certain grasses and legumes are also practiced for inhibition or killing of ticks (Branagan, 1973; Sutherst et al., 1982; Chiera et al., 1984).

Ticks are divided into two groups namely soft bodied ticks (Argasidae) and hard bodied species (Ixodidae). Hard ticks feed for extended periods of time on their hosts, varying from several days to weeks, depending on factors such as host type, life stage and species of tick. Sonenshine (1991) noted that the outer surface of hard ticks grows to accommodate the large volume of blood ingested, which, in adult ticks, may be anywhere from 200 to 600 times their unfed body weight while Furman and Loomis (1984) stated that soft ticks have an uncanny resistance to starvation, and can survive for many years without blood meal. Seasonal dynamics exert a major influence on the dynamics of transmission of tick-born pathogen (Estrada-Pena, 2001). In Zimbabwe particularly Masvingo Province, the control of tick infestations and the transmission of tick-borne diseases remain a major challenge for the cattle industry. Tick control is vital for many countries. According to Springell (1983), in 1974 Australia alone losses an estimated US$ 62 million due to cattle tick (*Boophilus microplus*). Brazil also loses around US$ 2 billion per year due to tick-diseases (Grisi et al., 2002).

As a way of protecting livestock from ticks and tick-borne diseases, different methods such as dipping, spraying, ear tagging have been used to apply chemicals in Masvingo Province. Drummond (1983) suggested that direct application of acaricides to animals is the most popular method of controlling ticks on livestock, but as a way of protecting livestock from ticks and tick-borne diseases, different methods such as dipping, spraying, ear tagging have been adopted to apply chemicals in Mukore village. Dipping is the method where animals are immersed in a dipping tub containing solution of chemicals and is the commonly used method in Mukore village. Basically, dipping vats provide a highly effective method of treating animals with acaricides for tick control. Abdel-Shafy and Zayed (2002) concluded that Neem can be used for tick control at economic concentrations of 1.6% to 3.2%. According to a survey of cattle tick control practices in South Africa by Spickett and Fivaz (1992), they found that 35.7% of farmers using hand sprays have confirmed acaricide resistance compared with 25.8% and 23.9% of users of spray races and plunge-dips respectively.

2. RESEARCH DATA

Seven (7) Mashona cows were selected at random and were treated with dip every week for ten (10) weeks to remove ticks. The experiment has been carried out in the village of Mukore in Masvingo province during winter season (April 2013 to July 2013). Survived Blue ticks were counted after every dip on four (4) different parts of each cow's body, namely: head (ears), belly, udder and tail. Mukore area experiences warm and humid weather conditions in winter.

2.1 Research Hypothesis

H_0: Dipping has effect in eradicating Blue ticks on Mashona cows.

H_1: Dipping has no effect in eradicating Blue ticks on Mashona cows.

Decision: Reject H_0 if $F_0 > F^{0.05}_{a-1,(a-1)(b-1)}$

3. RESEARCH DESIGN

A Randomized Complete Block Design (RCBD) was used to analyze data. The model is as follows:

$$y_{ij} = \mu + \tau_i + \beta_j + \epsilon_{ij} \quad (3.1)$$

Where:
y_{ij} is the j^{th} observation of the i^{th} treatment,
μ is the overall mean,
τ_i is the effect of the i^{th} treatment,
β_j is the effect of the j^{th} block,
ϵ_{ij} is the random error term.

Table 3.1: Design layout of RCBD

	Blocks						
Treatment	**1**	**2**	**3**	**4**	**…**	**b**	$\boldsymbol{y_{i.}}$
1	y_{11}	y_{12}	y_{13}	y_{14}	…	y_{1b}	$y_{1.}$
2	y_{21}	y_{22}	y_{23}	y_{24}	…	y_{2b}	$y_{2.}$
3	y_{31}	y_{32}	y_{33}	y_{34}	…	y_{3b}	$y_{3.}$
4	y_{41}	y_{42}	y_{43}	y_{44}	…	y_{4b}	$y_{4.}$
.	.	.	.	.	…	.	.
.	.	.	.	.	…	.	.
.	.	.	.	.	…	.	.
a	y_{a1}	y_{a2}	y_{a3}	y_{a4}	…	y_{ab}	$y_{a.}$
$\boldsymbol{y_{i.}}$	$y_{.1}$	$y_{.2}$	$y_{.3}$	$y_{.4}$	…	$y_{.b}$	$\boldsymbol{y_{..}}$

Where:

$$y_{i.} = \sum_{j=1}^{b} y_{ij} \quad , \quad i = 1,2,3, \dots , a \tag{3.2}$$

$$y_{.j} = \sum_{i=1}^{a} y_{ij} \quad , \quad j = 1,2,3, \dots , b \tag{3.3}$$

$$y_{..} = \sum_{i=1}^{a} \sum_{j=1}^{b} y_{ij} \tag{3.4}$$

Table 3.2: Analysis of Variance (ANOVA) table of RCBD

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F – Value
Treatments	$SSTreatment$	$a-1$	$SSTr/(a-1)$	$MSTr/MSE$
Blocks	$SSblocks$	$b-1$	$SSBk/(b-1)$	$MSBk/MSE$
Errors	$SSError$	$(a-1)(b-1)$	$SSE/(a-1)(b-1)$	
Total	$SSTotal$	$N-1$		

Where:

$$SSTotal = \sum_{i=1}^{a} \sum_{j=1}^{b} y_{ij}^2 - \frac{y_{..}^2}{N} \tag{3.5}$$

$$SSTreatment = \frac{1}{b} \sum_{i=1}^{a} y_{i.}^2 - \frac{y_{..}^2}{N} \tag{3.6}$$

$$SSBlock = \frac{1}{a} \sum_{j=1}^{b} y_{.j}^2 - \frac{y_{..}^2}{N} \tag{3.7}$$

$$SSError = SSTotal - SSTreatment - SSBlock \tag{3.8}$$

Assumptions of the model:

$$\epsilon_{ij} \sim NID\left(0, \sigma^2\right)$$

$$\sum_{i=1}^{a} \tau_i = 0, \qquad \sum_{j=0}^{b} \beta_j = 0$$

4. RESULTS AND DISCUSSION

Table 4.1: Number of treatments and blocks and associated number of ticks

	BLOCKS					
Treatment (Dipping)	Head (ears)	Belly	Udder	Tail	$y_{i.}$	$y_{i.}$
1	12	20	31	2	65	16.25
2	4	69	63	34	170	42.5
3	15	32	66	34	147	36.75
4	2	53	68	39	162	40.5
5	36	53	112	44	245	61.25
6	21	86	126	73	306	76.5
7	14	37	65	24	140	35.0
8	5	33	80	10	128	32.0
9	31	47	38	33	149	37.25
10	23	27	23	15	88	22.0
$y_{.j}$	163	457	672	308	**1600**	
$y_{.j}$	16.3	45.7	67.2	30.8		**40.0**

Table 4.2: Analysis of Variance (ANOVA) Table

Source of Variation	SS	D. F	MS	F_0	F – Value
Treatments (Dipping)	11142	9	1238	4.69	2.25
Blocks	14186.6	3	4728.9	17.93	2.96
Errors	7123.4	27	263.8		
Total	32452	39			

ANOVA table in table 4.2 shows that both F_0 are greater than F- table values. The decision is to reject H_0 in favour of H_1 and we conclude that dipping has no effect in eradicating blue ticks on Mashona cows. Furthermore, blocking seems to play a pivotal role in identifying the most affected part of a cow since blocking is significant.

Table 4.3: Parameters and residuals of the model

Order	$\boldsymbol{\beta_j}$	$\boldsymbol{\tau_i}$	**Actual Value**	**Predicted Value**	**Residual**
1	-23.7	-23.75	12	-7.45	19.45

2	5.7	2.5	20	21.95	-1.95
3	27.2	-3.25	31	43.45	-12.45
4	-9.2	0.5	2	7.05	-5.05
5		21.25	4	18.8	-14.8
6		36.5	69	48.2	20.8
7		-5.0	63	69.7	-6.7
8		-8.0	34	33.3	0.7
9		-2.75	15	13.05	1.95
10		-18.0	32	42.45	-10.45
11			66	63.95	2.05
12			34	27.55	6.45
13			2	16.8	-14.8
14			53	46.2	6.8
15			68	6.8	61.2
16			39	31.3	7.7
17			36	37.55	-1.55
18			53	66.95	-13.95
19			112	88.45	23.55
20			44	52.05	-8.05
21			21	52.8	-31.8
22			86	82.2	3.8
23			126	103.7	22.3
24			73	67.3	5.7
25			14	11.3	2.7
26			37	40.7	-3.7
27			65	62.2	2.8
28			24	25.8	-1.8
29			5	8.3	-3.3
30			33	37.7	-4.7
31			80	59.2	20.8
32			10	22.8	-12.8
33			31	13.55	17.45
34			47	42.95	4.05
35			38	64.45	-26.45
36			33	28.05	4.95
37			23	-1.7	24.7
38			27	27.7	-0.7
39			23	49.2	-26.2
40			15	12.8	2.2

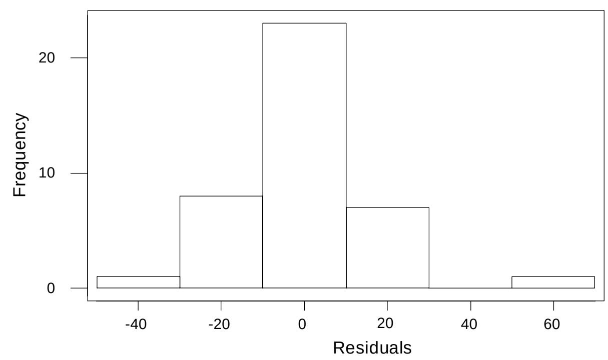

Fig 4.1: Histogram of Residuals

The histogram above is approximately a normal curve. Residuals follow a normal distribution with mean zero and a constant variance.

5. CONCLUSION

Blue ticks on Mashona cows in the village of Mukore are resistant to dipping. To eradicate them completely, a different way should be adopted rather than dipping. The most affected area on a cow is udder followed by a belly, tail and lastly an ear. More Blue ticks are expected during the rainy season and more resistance by these ticks is expected. Randomized Complete Block Design (RCBD) seems to be the perfect design to analyze the data since residual analysis proves to satisfy all model assumptions.

6. RECOMMENDATIONS

We would like to recommend farmers from Mukore village to spray their cows with the solution after dipping especially to most affected areas as mentioned above. Otherwise the blue ticks will spread so rapidly that in the near future they might be an outbreak of diseases caused by these ticks. We would also recommend the use of other designs such as factorial designs to support RCBD.

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