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An investigation of the efficacy of a polyvalent mastitis vaccine using different vaccination regimens under field conditions in the United Kingdom (2015)

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J. Dairy Sci. 2015;98:1706-20.

1. Introduction

Clinical and subclinical mastitis remain a major cause of financial loss to the dairy industry and a significant challenge to the dairy producer, with a large number of herds still experiencing unacceptable levels of disease. Vaccination can play a useful role in mastitis control programs, although there is a relative dearth of large, well-controlled field efficacy studies. However, despite development of several vaccines in the 1980s, based on the J5 *Escherichia coli* mutant, such vaccines to date, although demonstrating an ability to reduce the severity of clinical signs and duration of infection, have failed to demonstrate a reduction in the rate of intramammary infections (IMI).

Investigation of the use of J5 coliform vaccines has also demonstrated a positive effect on production in that vaccinated cows have been shown to recover milk yield after a clinical case more quickly than unvaccinated cows.

2. New mastitis vaccines

Although mastitis vaccines have been available in many jurisdictions, in the European Union is relatively recently, with a polyvalent mastitis vaccine directed against both enterobacterial and staphylococcal species (STARTVAC®; Hipra UK&Ireland Ltd., Nottingham, UK). Registration studies demonstrated a reduction in IMI with coliformand *Staphylococcus spp.* and a decrease in severity of clinical signs of disease when using the product. However, these registration studies were based primarily in southern Europe and were conducted under very different climatic and management conditions to those seen in northern Europe and the United Kingdom. A significant constraint to the use of mastitis vaccines has been the relatively onerous vaccination regimens that are necessary to achieve the desired level of efficacy. These often necessitate vaccination both before and after calving. This has led to the development of more practical, farmer-friendly

Farm	Herd Size	Yield[a]	BMSCC[b]	CMI[c]
B	190	8,843	254	36
C	568	9,280	238	111
F	218	9,918	288	67
H	231	9,012	193	114
P	286	8,917	356	40
R	205	8,758	349	149
T	581	10,654	260	41

Figure 1. Study, from 7 farms in the southwestern United Kingdom. **a:** 305 d (Litres) **b:** $x10^3$/mL (Bulk tank Somatic Cell Count) **c:** clinical mastitis cases/100 cows/year (Clinical Mastitis Incidence)

Diagnosis	Overall n	%
E. coli	160	20.54
S. uberis	155	19.90
S. aureus	19	2.44
Enterococcus spp	18	2.31
S. dysgalactiae	16	2.05
Yeast spp	14	1.80
Bacillus spp	11	1.41
T. pyogenes	11	1.41
Enterobacter spp	6	0.77
Klebsiella spp	5	0.64
Serratia spp	5	0.64
Lactococcus spp	4	0.51
Pseudomonas spp	4	0.51
Proteus spp	3	0.39
Aerococcus spp	2	0.26
Acinetobacter spp	2	0.26
Aspergillus spp	2	0.26
Micrococcus spp	2	0.26
Streptococcus spp	2	0.26
Prototheca spp	2	0.26
Candida spp	1	0.13
Citerobacter spp	1	0.13
Gemella spp	1	0.13
Pasteurella spp	1	0.13
Staphylococcus spp	1	0.13
Unspeciated Gram-ve	1	0.13

Figure 2. Bacterial results of all samples collected..

approaches to vaccination when J5 core antigen vaccines have been deployed in the field, such as a rolling schedule of vaccination of all cows in the herd on a quarterly basis. Other attempts at improving efficacy have also been made by increasing the number of vaccinations and by **vaccinating earlier in the lactation cycle, in part to reduce the effect of IMI acquired during the dry period.**

3. The study

The aim of the study outlined here was to investigate the efficacy of a multivalent mastitis vaccine in the control of bovine mastitis under UK field conditions using both the label regimen and a schedule of quarterly vaccination.

3,130 cows were recruited between September 2010 and January 2012 to develop this study, from 7 farms in the southwestern United Kingdom, (Figures 1 and 2) and were randomly allocated, within farm, to 1 of 3 groups. The first group received the vaccine (STARTVAC®) following the label regimen, the second group was vaccinated every 90 d following an initial

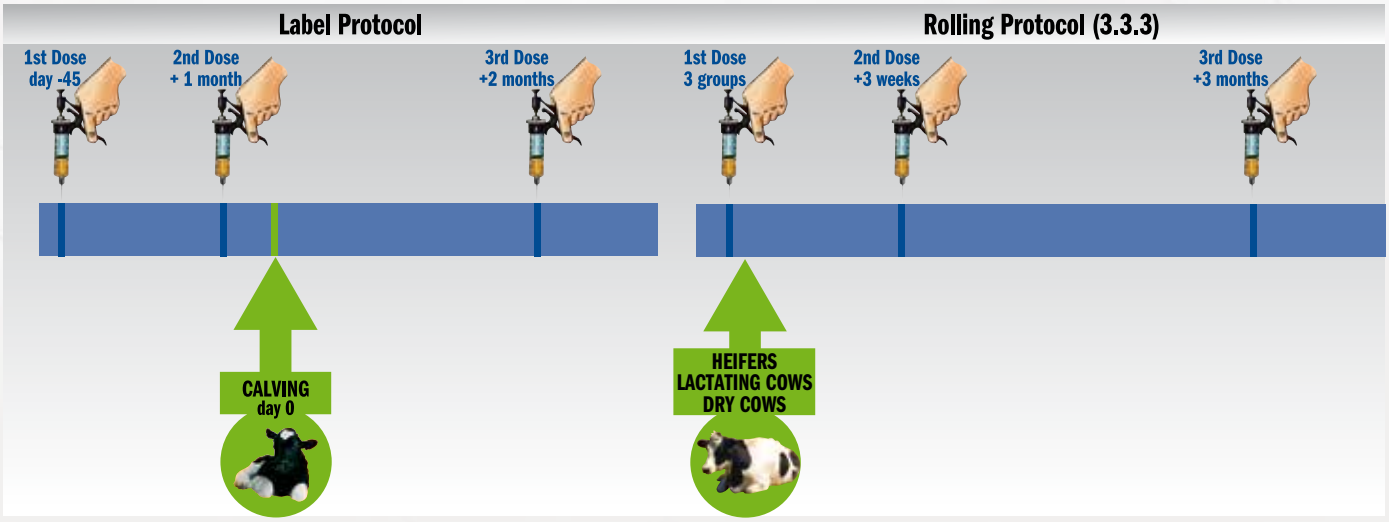

Figure 3. Vaccination protocols used.

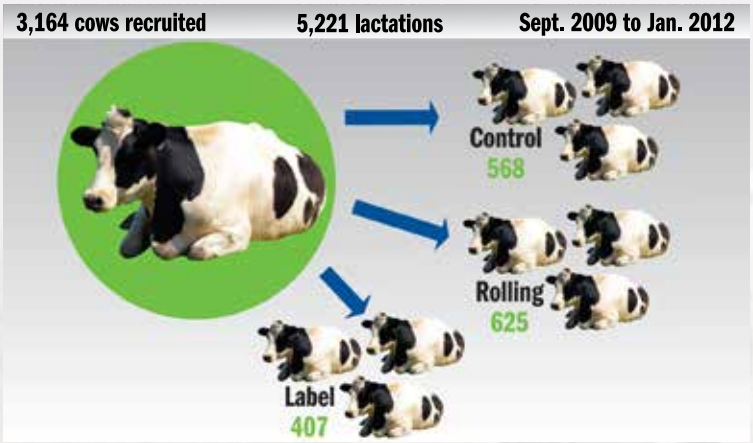

Figure 4. Study groups distribution.

vaccination course, and the third group was left unvaccinated to act as controls (Figures 3 and 4). Vaccine efficacy was assessed in the first 120 d of lactation. No strict criteria were applied pertaining to bulk milk SCC or clinical mastitis incidence. All cows and heifers approaching their first calving were eligible for recruitment to the study, contingent on being in good health, having 4 functional quarters, teats free of significant teat lesions, and an estimated calving date to allow vaccination at predicted times before calving. Data were available for analysis from 1,696 lactations in 1,549 cows.

In total, 779 cases of clinical mastitis occurred in the 3 study groups, and we detected no significant difference in the incidence or prevalence of clinical or subclinical mastitis between any of the 3 groups. Mastitis vaccination following the label regimen was associated with a significant reduction in the severity of clinical cases (Figure 5). **Cows in this group were at significantly decreased odds of developing clinical mastitis**

presenting with more than just milk changes [odds ratio: 0.58; 95% confidence interval (CI): 0.35–0.98]. Similarly, each additional vaccination resulted in a cow being at decreased odds of developing clinical mastitis presenting with more than just milk changes (odds ratio: 0.87; 95% CI: 0.77–0.98) (Figure 6). When we extended our analysis of the **effect of vaccination on culling** to encompass the first 305 d of lactation, this revealed a significant difference in the total number of cows culled between the treatment groups, with 26.2, 18.3, and 24.2% of cows being culled in the unvaccinated, label, and rolling groups, respectively (Figure 7). **Analysis of milk production data demonstrated that, on average, cows on the label regimen produced a higher volume of milk (231 L; 95% CI:104.1–357.4)** (Figure 8) **and more milk solids (12.36 kg; 95% CI:3.12–21.60)** (Figure 9) **than unvaccinated cows in the first 120 d of lactation.**

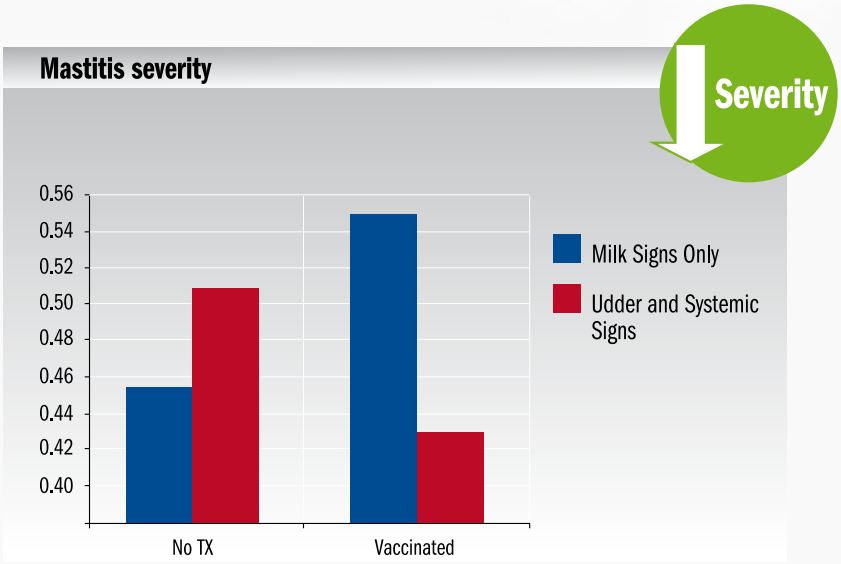

Figure 5. Mastitis severity.

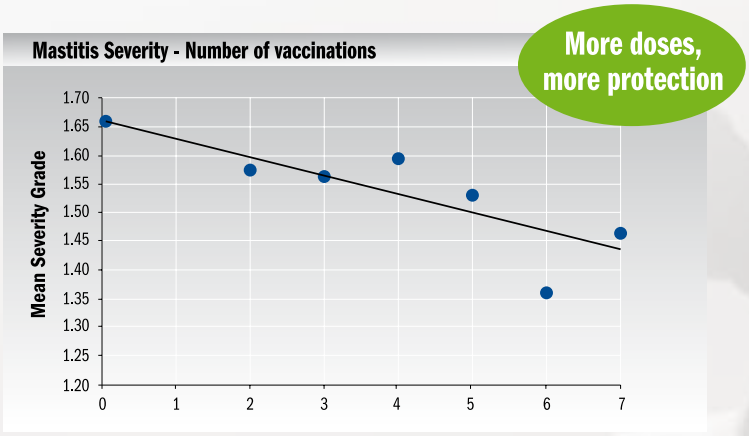

Figure 6. Mastitis severity in relation with the number of vaccinations.

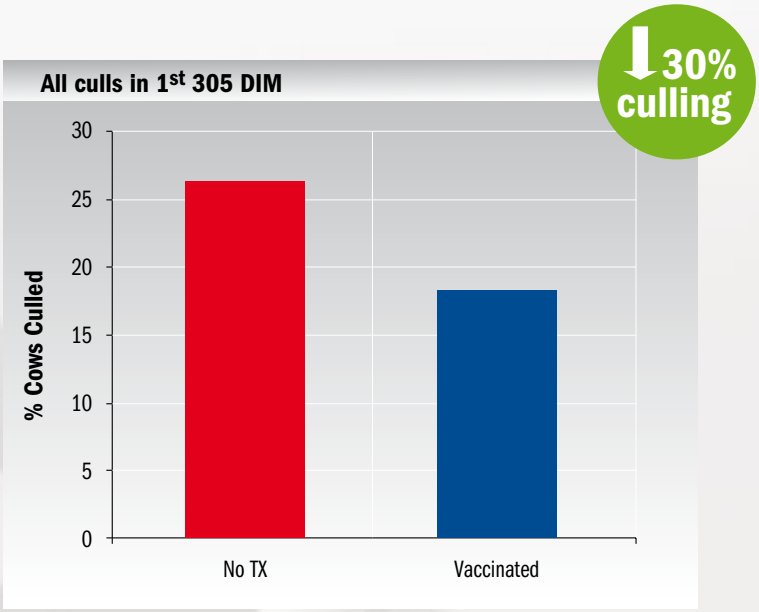

Figure 7. Culling rate.

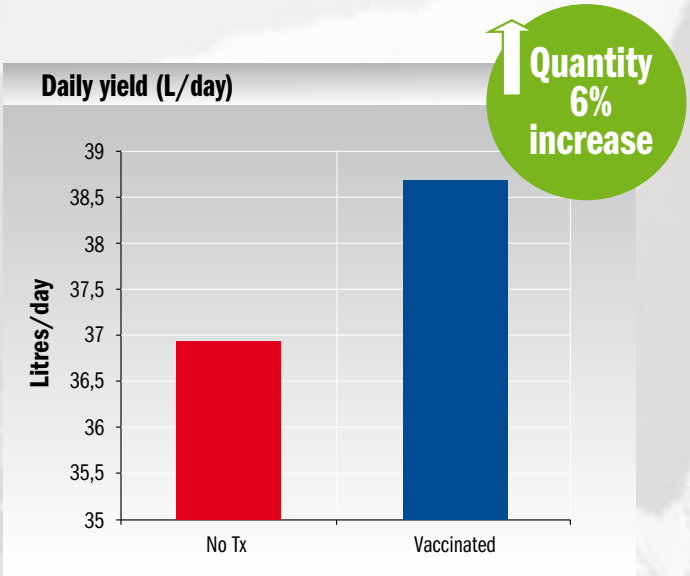

Figure 8. Daily milk yield.

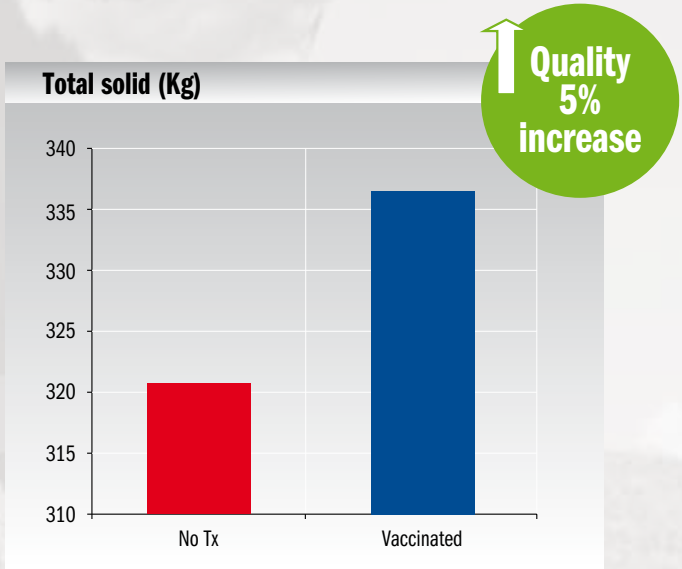

Figure 9. Milk solids.

4. Conclusions

In conclusion, vaccinated cows were significantly less likely to experience severe clinical mastitis and produced significantly more milk and milk solids than unvaccinated herdmates, offering a **return on investment of approximately 2.57:1 under UK conditions based on increased milk yield alone.**

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