

PROTECTING CATTLE AGAINST THE *AMBLYOMMA VARIEGATUM* TICK



The Acaricide Foot-bath

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Amblyomma variegatum adults wait on the ground, hidden under vegetation or debris, for their hosts to pass by. When cattle are grazing, they « wake up » these ticks which attach between their hooves where they remain as long as the animals are upright. These observations made at CIRDES have led to the development of an efficient, rapid and economic tick control method directed against the *A. variegatum* tick: the ACARICIDE FOOT-BATH.

Control of adult *Amblyomma variegatum* ticks

Why?

The losses due to *Amblyomma variegatum* make this tick the most harmful to West African cattle. Its attachment causes severe wounds, even in local breeds of cattle which are generally less sensitive to cowdriosis (or heartwater), a disease transmitted by *A. variegatum*, and to dermatophilosis, in which skin lesions are worsened in the presence of the tick. These two diseases cause a high mortality rate in animals of exotic breed introduced into the region.

Animals that are significantly infested, such as the young Goudali bull shown in Figure 1, can suffer a weight loss which can reach 15 to 20 kg (on average, each pair of *Amblyomma variegatum* can cause a loss of 50 g of liveweight). In lactating cows, ticks also lead to reduced milk production. In the sub-humid region, infestation frequently reaches 400 to 500 ticks per animal during the rainy season. During this period, production losses are put at 5.5 to 7.5 € (or 7 to 10 US\$; or 3.8 to 5.2 £) per animal.

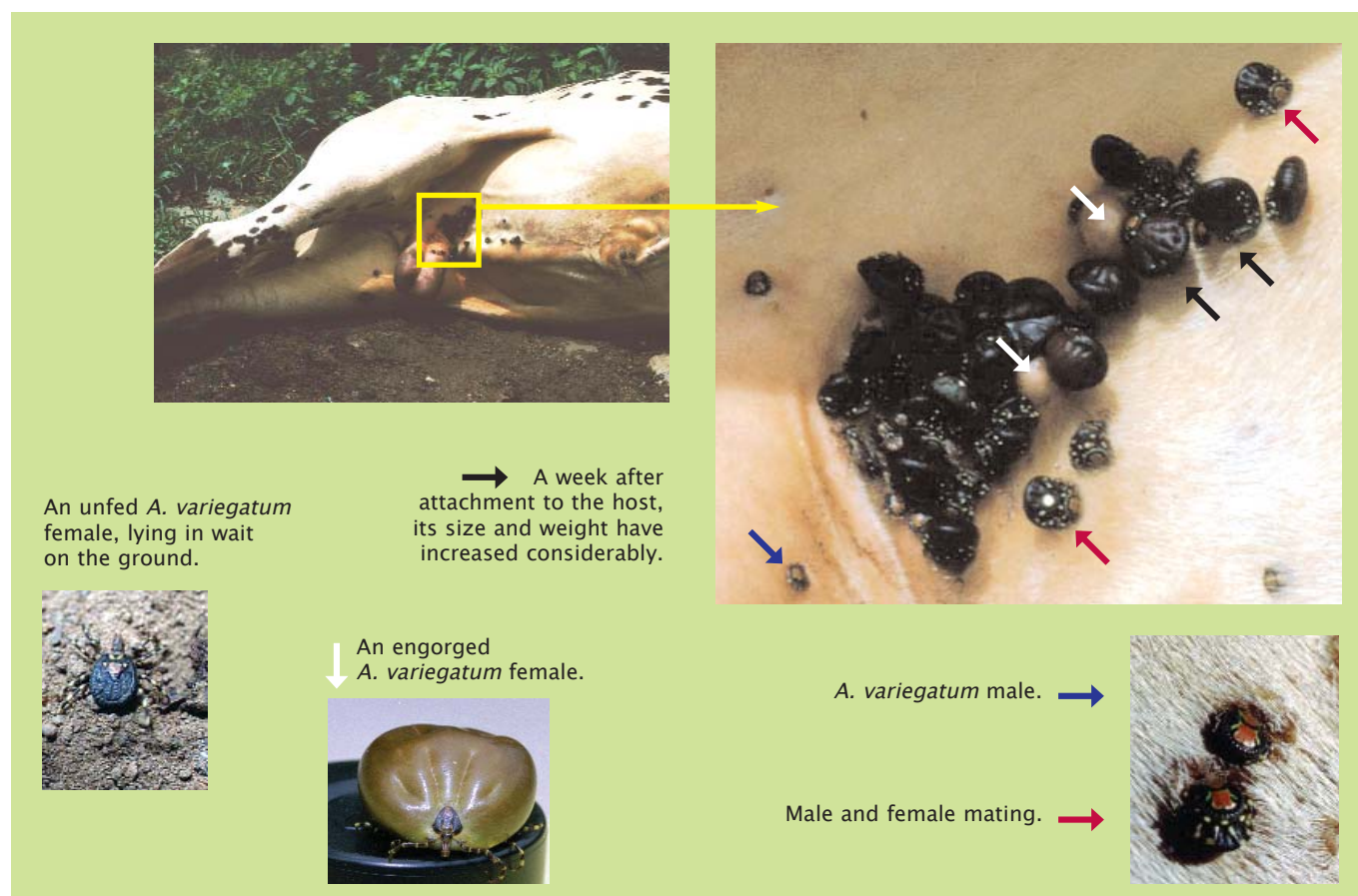


Figure 1. Morphology of *Amblyomma variegatum* adults and infestation of a Goudali bull-calf (photos F. Stachurski).

But what livestock farmers fear most are the wounds to the udder which is, as well as the chest and the inguinal area, one of the preferred attachment sites for *Amblyomma variegatum* (figure 2). When they are not quickly removed, ticks cause wounds which can destroy one or several teats (figure 3). Milk production consequently decreases, the growth of calves before weaning is reduced as well as their resistance to diseases, and their mortality rate becomes higher.

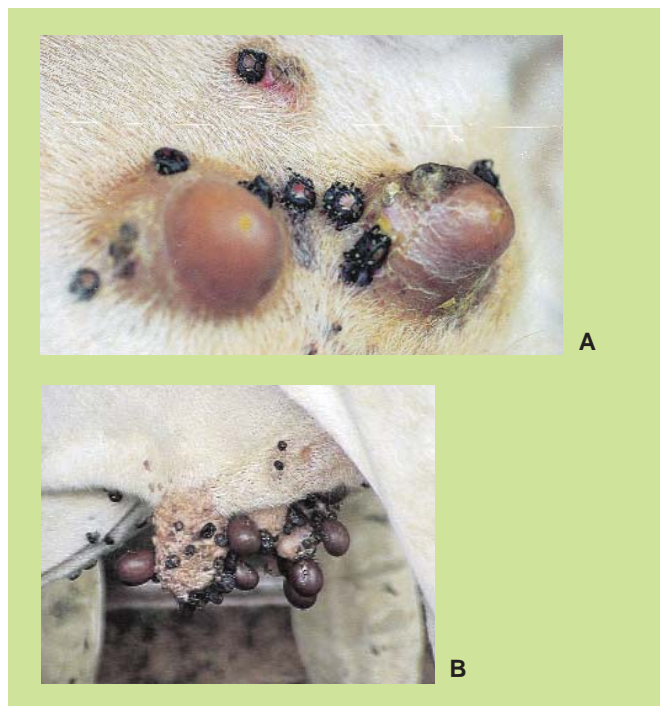


Figure 2. *A. variegatum* adults attached to the udder of a heifer (A) and of a cow (B).

(photo A: F. Stachurski; B: M. Desquesnes)

Amblyomma variegatum

- ◆ Causes wounds
- ◆ Damages teats and udder
- ◆ Increases death rate of calves before weaning
- ◆ Dramatically reduces growth and milk production

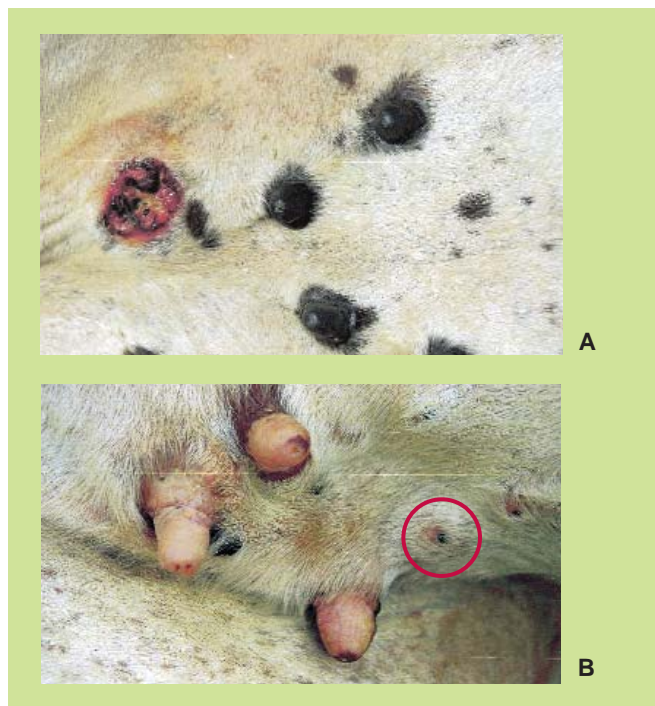


Figure 3. Wound in the groin region of a heifer (A); teat destroyed following attachment of numerous ticks (B).

(photos: F. Stachurski)

When?

A. variegatum is a three-host tick. The three stages (larvae, nymphs, and adults) of the life cycle, which lasts one year in tropical areas, are observed successively on the hosts. After engorgement, each stage must drop off from its host to metamorphose or to lay eggs on (or in) the ground (figure 4).

Larvae infest animals at the end of the rainy season, and nymphs during the first months of the dry season. These immature stages infest many different host species (ruminants of course, but also francolins, hares, cattle egrets, hedgehogs, guinea fowl, etc...). But, as they do not cause noteworthy wounds, it is uneconomical to try to eliminate them.

Adults infest their hosts essentially during the first weeks of the rainy season. They have been present in the pastures for the last three to six months but remained hidden and motionless in the most humid places (ground crevices, network of roots of shrubs or of perennial grasses). This state, called behavioural diapause, stops at the onset of the rains with the beginning of the host-seeking activity of the adults.

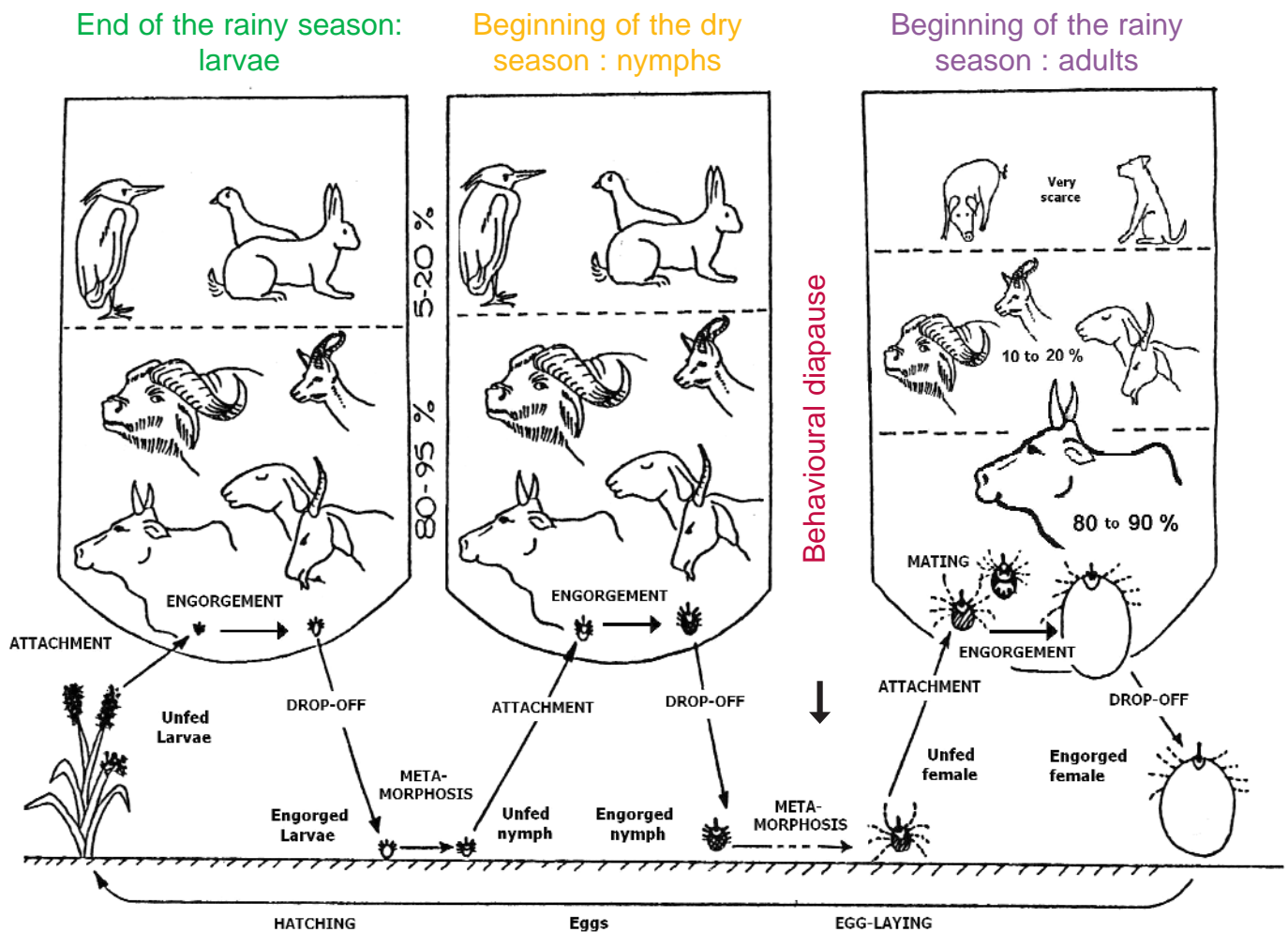
Important: in equatorial areas, the three stages may be observed simultaneously almost all the year round. Seasonal variations of infestation are less significant and biological characteristics may be different. The characteristics and principles of tick control should be adapted to suit local circumstances.

Control of *A. variegatum* adults has to be carried out during peak infestation, i.e. during the first weeks of the rainy season in tropical areas with one dry season and one rainy season: from mid-May to the end of July in the south-west of Burkina-Faso, for example.

How?

Livestock producers are used to manually removing ticks from their cattle, often during milking. This method is difficult to apply with recalcitrant animals, painful for the animals and also time-consuming. That is why herdsmen are increasingly using acaricides. Diluted in water, they are used with a knapsack sprayer (figure 5), or, as oil-based « pour on », they are put on the back of the animals (figure 6).

Spraying is not costly but is very time-consuming because each animal has to be restrained in turn to be sprayed. «Pour-on» products are easily applied but very expensive: a single dose costs about 0.75 € (or 1 US\$, or 0.5 £). These drawbacks limit the use of acaricides by traditional livestock farmers who are moreover not well-informed of the risks linked to the use of

Figure 4. Life cycle of the *A. variegatum* tick.

those products — for example the presence of chemical residues in milk and meat, or the hazard of selecting tick strains resistant to the acaricide used.

To reduce the treatment cost, some farmers increase the interval between applications of the product or use too low doses of acaricides. Others make mixtures supposed to kill ticks containing plant pesticides (for example those meant to treat cotton fields), used engine oils or other unidentified components. Such practices do not provide adequate protection against wounds caused by ticks and may be dangerous for humans and animals.



Figure 5. Acaricide application with a knapsack sprayer. (photo F. Stachurski)



Figure 6. Application of an acaricide "pour-on" formulation on the back of an animal. (photo D. Cuisance)

Chemical control methods used against adults *A. variegatum* are efficient when properly applied but they are expensive or time-consuming. To protect animals adequately, it is necessary to apply acaricide treatments every 7 to 14 days.

Tick control with the acaricide foot-bath

A new and efficient method, which is inexpensive and rapid, has been developed at CIRDES following observations on tick behaviour.

Why is the foot-bath efficient ?

Numerous tick species attach preferentially to certain areas of the animal's body. *A. variegatum* adults infest predominantly the udder (or the scrotum), the chest and the axillae. But unlike tick larvae or adults of other tick species which climb to the top of grass stalks to await contact with a host, *A. variegatum* adults remain on the ground, where they seek shelter beneath the vegetation and soil debris, until a host appears. Surveys carried out in CIRDES have shown that these ticks infest cattle in two steps.

1. When cattle are walking on pasture, they activate ticks which emerge from their hiding-places and move towards them. When they reach their hosts, the ticks attach between the hooves, on the skin of the inter-digital spaces (figure 7). They do not move from this temporary attachment site as long as the cattle are grazing or standing upright.

2. When the cattle lie down, the ticks detach from the feet and move to the predilection sites where they reattach. Cattle generally graze from 8 to 10 hours daily before returning to their night pens to lie down. Movement of the *A. variegatum* from the temporary attachment sites to the predilection sites therefore occurs mainly during the night.

Consequently, most of the ticks picked up in the pastures are still found attached to the feet of the cattle in the evening. They can then be killed by a targeted treatment performed by the regular passage of the animals through a foot-bath containing an acaricide formulation (figure 8).

Most of the *A. variegatum* picked up during the day when grazing are still found attached to the feet in the evening when the cattle return from pasture.

How to build a foot-bath

Dimensions in the construction plans described herein (figure 9) are indicative. Several years of experience have however shown that these dimensions are adapted to local cattle breeds in West Africa.

1. The foot-bath should not be installed in places where flooding could occur. It should be partly embedded in the soil so that it sticks up about 15 cm to prevent rain flowing over the ground from entering and diluting the acaricide formulation. Water should however be available within a short distance to enable the preparation of the acaricide mixture.

2. Dig a hole in the ground, using the following dimensions: length 370 cm; width at ground level 80 cm; width at the bottom of the hole 70 cm (the walls are sloped); depth 35 cm. If the foot-bath is placed in sandy soil, rocks must be put in the hole to make the soil more stable under the concrete. In this case, foundations must be about 20 to 30 cm deeper than those shown in the sketch.

3. Prepare concrete to pour the floor of the foot-bath by mixing one bag of cement, 2 wheelbarrows of sand and 4 wheelbar-

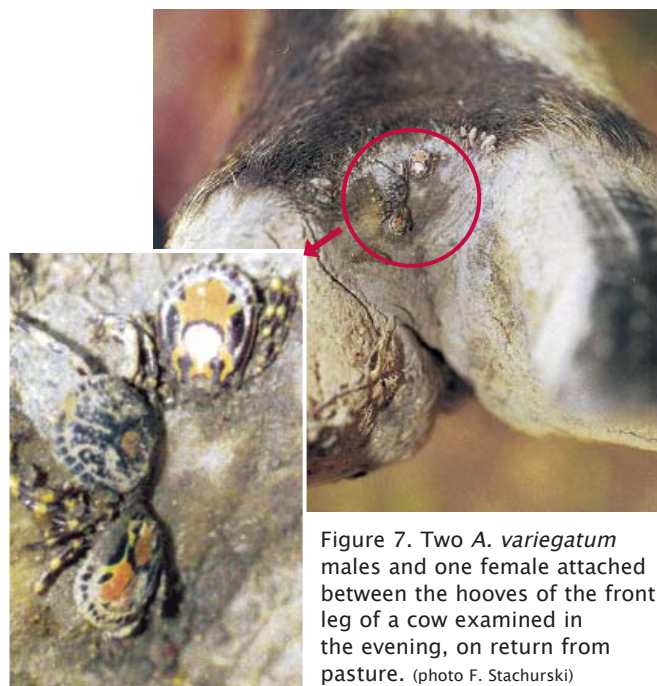


Figure 7. Two *A. variegatum* males and one female attached between the hooves of the front leg of a cow examined in the evening, on return from pasture. (photo F. Stachurski)



Figure 8. Passage of a herd through an acaricide foot-bath. (photo F. Stachurski)

rows of gravel. Seven bags of cement are necessary, 6 to prepare concrete, and one for the finishing, after drying. For this finishing, mix sand with cement only, without adding gravel. Do not use cement alone because a smooth and slippery surface can make animals skid.

4. Pour concrete for the floor of the foot-bath to a thickness of 10 cm. Let the concrete dry for one hour before levelling the surface with a trowel, then water the floor regularly during the day.

5. On the following day, place a wooden form in the hole, into which the walls of the vat will be poured. The walls are about 12 cm thick and slightly sloped, like the hole in the soil. Pour the concrete to half way up the height of the wall, and place the iron armature into the reinforced concrete. This armature is as long as the walls and measures 35 cm high and 8 cm wide. Use iron of 6 mm thickness to make the frames which are bound with wire, every 30 cm, onto the 8 mm iron rods. Drive the iron structure into the concrete and hold it in the middle of the wall. Then pour in the remaining concrete to completely cover the armature. Place armatures measuring 35 cm high and 15 cm wide at each end of the foot-bath in order to reinforce the entrance and the exit of the vat. Leave the

wooden form in place for one day until drying is complete (water concrete regularly).

6. Take out the frame, pour the two inclined slopes inside the foot-bath, and do the finishing with the mixture of cement and sand. The junction between the floor and the walls must be perfect, so that water cannot infiltrate.

7. Put U-shaped 50 mm iron rods on the outside, along the sides of the foot-bath. The holes intended for the fixation of 6 cm x 8 cm rafters have to be drilled beforehand. Attach rafters onto the U-shaped iron rods before driving these in the ground or else they risk not being at the right depth. Pour reinforced concrete around the base of each U-shaped iron rod to strengthen the whole structure. Iron rods have to be placed with the U open towards the outside of the foot-bath. Rafters are fastened to the inside of the foot-bath. Dig into the wood slightly and drive the head of the bolts in (see figure 9) so that animals do not get hurt.

8. Make inclined ramps on the outside (entrance and exit of the vat) so that animals go in and out without having to jump.

9. Finally, build the roof meant to protect the foot-bath from the rains. It is made up of two parts, each measuring half the length of the foot-bath (figure 9) and made of a wooden frame covered with corrugated iron. The roof's width must be perfectly adapted to that of the foot-bath so that there is no space left where water could enter. Place the lower side of the roof towards the direction from where rains are likely to come: they will flow out on the roof towards the outside of the foot-bath. Place handles at each end of the roofs to allow easy manipulation. To facilitate the setting up without leaving a space between the two roofs, position the handles so that they are not right opposite one another.

10. Install a waiting pen (funnel-shaped) at the entrance of the foot-bath to channel the herd.

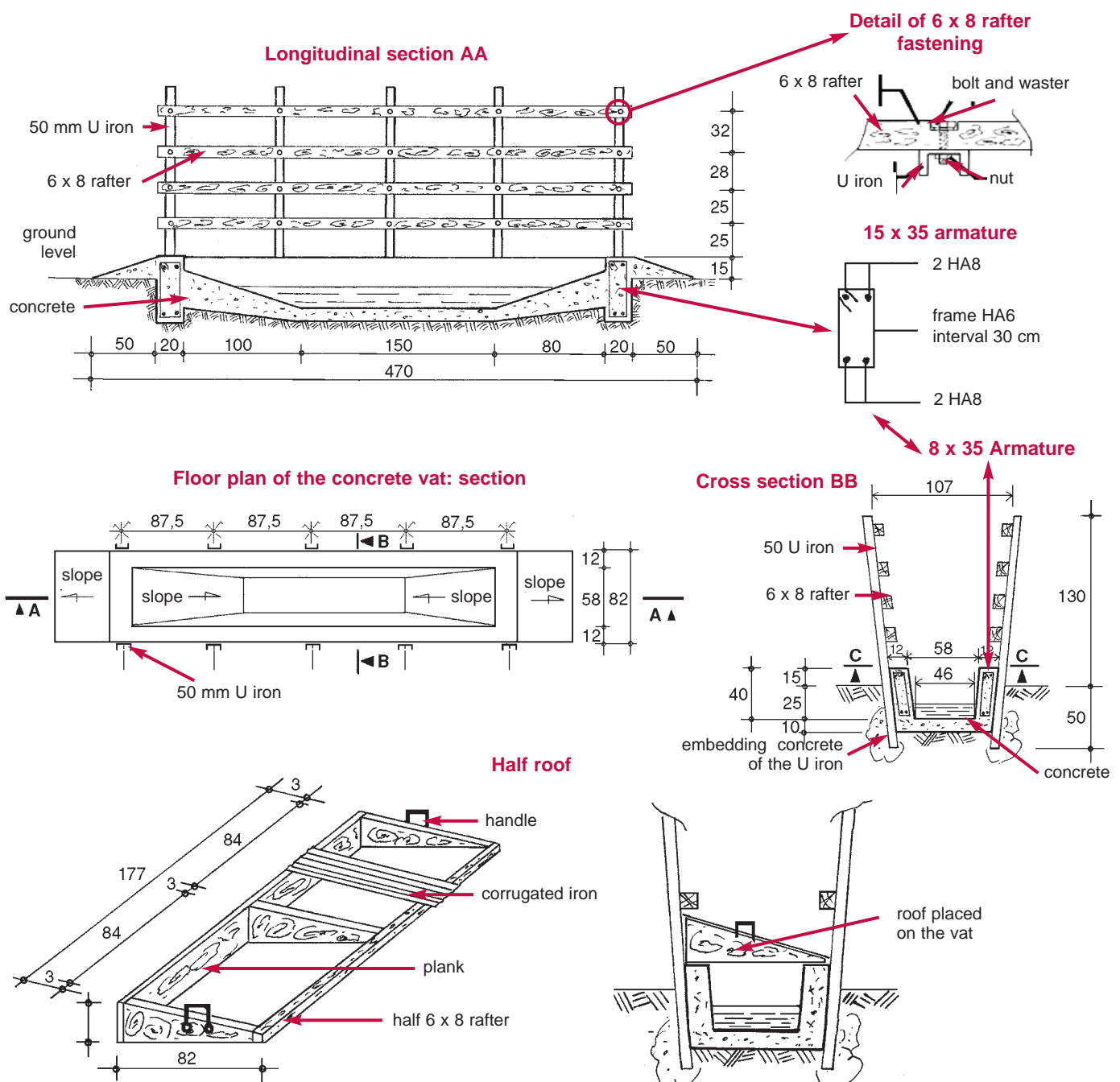


Figure 9. Construction plan of the foot-bath.

How to use it?

Gauging

If the dimensions given in figure 9 are used for the construction, the capacity of the foot-bath is about 200 litres. However, it is necessary to know the exact volume corresponding to a given depth of the acaricide mixture. To measure this, make a wooden gauge with centimetre graduations marked by engraving or burning (figure 10). Then use a 10 litre bucket to fill the foot-bath with water. After each bucketful, take note of the depth in the centre of the foot-bath, always at the same place (the depths are approximate at about half a centimetre). Draw up a table which gives the volume according to the depth.

For example:

Water volume (in litres)	Water depth (in cm)
10	3
20	5
30	6.5
40	8.5
60	10
70	11
80	12.5
90	13.5
100	15
110	16
etc.



Figure 10. Wooden gauge with graduations marked by burning: a line at each centimetre. (photo M. Konkobo)

Measure the volume until the water reaches about 25 cm deep. For more precision, empty the foot-bath and carry out the gauging a second time, and calculate the average of the two sets of measurements. The established table has to be used later to determine a volume falling between two graduations, which is essential in case of accidental dilution of the acaricide mixture by the rain. In the example cited above, between the height of 14 cm (about 93 litres) and the height of 16 cm (110 litres), there is a volume of 17 litres.

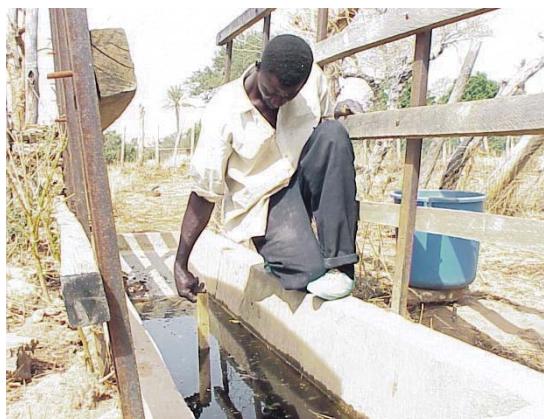


Figure 11. Measurement of the liquid depth in the middle of the foot-bath. (photo M. Konkobo)

Products used

So far, treatments using the foot-bath have only been done with pyrethroids which are less toxic and have a longer residual effect than organophosphorus compounds. The main products presently available, as well as their dilution rates, are catalogued in Table 1.

Other pyrethroids are available on the market (cypermethrin, cyfluthrin, lambda-cyhalothrin, etc...) but have not been yet used in the foot-bath. If the concentration recommended by the manufacturers and the interval between treatments are respected, those products should also be efficient in the foot-bath. As far as amitraz is concerned (TaktikND for example), it has also not yet been tested in the foot-bath. Since its residual effect is twice as weak as that of the pyrethroids, it is assumed that, when applied by foot-bath, it would not persist long enough on the feet of the animals to lead to the elimination of ticks picked up on the following days during grazing in the pastures.

Filling of the foot-bath

The foot-bath is filled with a 10 or 20 litre bucket. Take note of the number of buckets of water used to fill the tank to a depth of about 20 cm, then add the corresponding volume of the product. Be careful: the dilution depends on the product used (see Table 1).

Example: if 10 buckets of 20 litres (that is 200 litres) are required to give a depth of 19 cm in the foot-bath, then it is necessary to add 100 ml of BUTOX^(R), or 100 ml of DOMINEX^(R), or 135 ml of BAYTICOL^(R). When the level decreases, after several passages of animals, water is added again using a bucket of 20 litres and the corresponding volume of product (10 ml of BUTOX^R or DOMINEX^(R), or 13.5 ml of BAYTICOL^(R) per bucket).

Table 1. Main products available and their dilution rates.

Trade name	Active ingredient	Volume required to dilute with...		
		10 litres of water	20 litres of water	200 litres of water
Butox ^R	Deltamethrin	5 ml	10 ml	100 ml
Bayticol ^R	Flumethrin	6.7 ml	13.5 ml	135 ml
Dominex ^R	Alphacypermethrin	5 ml	10 ml	100 ml

The implementation of the treatment

To use the foot-bath efficiently, these instructions should be followed:

1. Cattle have to be treated in the evening, when they come back from pasture (figure 12). Treatment is applied at the beginning of the rainy season for about ten to twelve weeks. In the Sudan Savannah zone, such as the South-West of Burkina Faso, the treatment period extends from mid-May to the end of July. No trial or study has been carried out in the coastal areas of Ghana, Ivory Coast, Benin or Togo so that it is not known whether foot-bath tick control would be cost-effective when adult ticks are present almost all year round, or what would be the best treatment period.

2. Start the treatment when the infestation level of the animals reaches on average 20 to 30 adult *A. variegatum*.

3. Treat animals every two days in the beginning of the season (May and June), then every three days in July. This represents about 30 to 35 passages for the whole peak infestation period.

4. Limit the losses of product through splashing. To do so:

- Get the animals used to passing through the installation before filling it.
- Make low slopes which are not slippery (for example with shallow slots in the cement) both at the entrance and at the exit of the foot-bath.
- Do not overfill the bath.

5. Measure the level before and after each treatment. This indicates whether rains have entered the bath and, if this should happen, this make it possible to determine the required quantity of acaricide which has to be added. To limit this risk, do not forget to replace the roof on the foot-bath after use (figure 13).



Figure 12. Passage of a herd through a foot-bath in the evening, when returned from pasture. (photo F. Stachurski)



Figure 13. Foot-bath protected from rain by its roof.

(photo M. Konkobo)

Example: Supposing that in the evening after treatment the acaricide mixture in the bath was 17.5 cm deep. The following night, a heavy rain occurred. Two days later it was observed, before the passage of the cattle, that the bath was 20 cm deep. Using the gauging done before filling the foot-bath, it was known that this increase of 2.5 cm represented about 50 litres of water. It was then necessary to add 25 ml of DOMINEX or BUTOX or 34 ml of BAYTICOL (depending on the product used during the first filling of the bath).

6. Maintain the bath level between 15 and 20 centimetres during the first two months, adding water regularly as required (per bucket of 10 or 20 litres) as well as the product according to the dilution prescribed by the manufacturer, before the passage of animals. During the last two or three weeks of use, stop adding water and acaricide but keep letting animals pass through it as long as the level remains higher than 5 or 6 cm. At the end of the treatment, the product volume lost will be minimal.

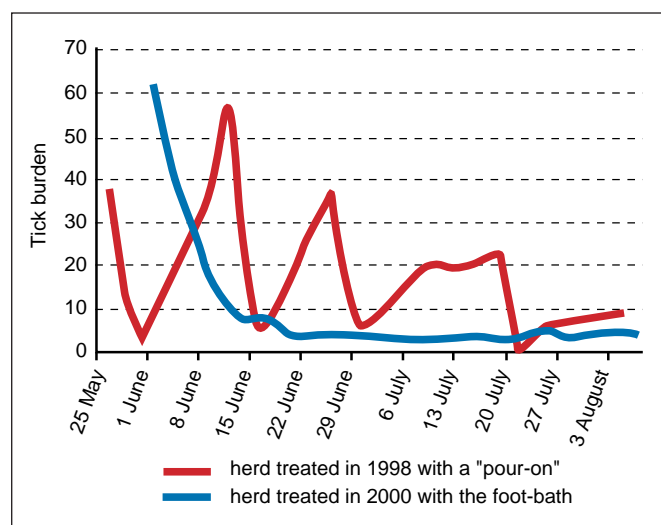
The depth of the bath may decrease between two passages because of water evaporation. If the mixture level is high enough (about 15–20 cm), it is not necessary to add water: product which is a little more concentrated is not toxic. When water is added to the bath later on, the product volume corresponding to the volume of water added has to be put in.

7. Do not let animals drink the mixture put in the foot-bath and, after their treatment, do not let them pass through rivers, creeks or ponds, or else the product will be eliminated by water. The herd must be brought back and kept in the night pen just after the treatment. Herds kept too far away from a foot-bath, or whose night pen is separated from the installation by a river, should not use that foot-bath.

Results obtained with the foot-bath

An effective treatment

Treatments applied every two or three weeks by spraying or "pour-on" quickly kill the attached ticks but keep them free from re-infestation for only a few days (4 to 10, depending on the product used, see figure 14). The regular passage through the foot-bath leads to a less rapid reduction in the infestation, but thereafter the tick burden is maintained at a very low level (figure 14). Animals are thus better protected against the wounds caused by accumulation of numerous ticks at the same feeding site.



A rapid treatment

Once animals get used to passing through the foot-bath, less than 15 minutes are necessary to treat 120 cattle. Two to three hundred animals can thus be treated each evening, after 6 pm, when they come back from pasture.

An economical treatment

Each time a cow passes through the foot-bath, about 200 to 250 ml of diluted acaricide are used. To ensure a sustained efficiency, animals have to pass through the foot-bath about 30 to 35 times during the beginning of the rainy season, which represents a volume of 6 to 8.5 litres of acaricide mixture used per animal. This is 3 to 4.4 ml of DOMINEX or of BUTOX, or 4 to 5.8 ml of BAYTICOL. The price of annual treatment is therefore about 0.25 euro (or 0.33 US\$ or 0.18 £) per cow, exclusive of the cost of the foot-bath building which should be written off over ten years and depends on the number of animals using the installation.

Figure 14.: Average number of *A. variegatum* in a herd of 90 animals treated in 1998 by pour-on and in 2000 by the foot-bath.

➔ *This technical manual is intended for decision-makers, for veterinarians and for technicians in cattle breedings. These latter should bring the main part of the message to the farmers.*

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