

APPENDIX 1

DIFFERENT PRACTICAL METHODS for UREA TREATMENT

This Appendix is aimed at the extension officer who needs to prepare a demonstration for a farmer with whom he will leave the necessary instructions and equipment so that later and under guidance, he can carry out the operation himself. The extension officer will already have made the necessary arrangements to prepare a suitable enclosure. He should also have carefully thought of all equipment needs and made sure that suitable forage is available for the demonstration, without any last minute difficulties arising.

Whether treatment will involve small quantities for an individual farmer or significant amounts on a scale for a large farm or a cooperative, the practical operations which will be involved for "urea treatment" will be as follows:

- preparation of the equipment;
- preparation and weighing of the forage to be treated;
- preparation of the urea solution;
- careful incorporation of the solution with the forage being treated;
- careful covering of the treated forage.

One of the key factors for successful urea treatment is the uniform incorporation of the solution with the mass of forage being treated. A simple watering can may be used for small amounts of forage, or a sprayer for larger amounts. The solution should be sprinkled on, layer by layer. When dealing with forage in bulk or in bunches, it should be trampled firmly with the feet so as to compact each layer within the treatment enclosure.

A - Bulk forages treated in small amounts

The example already given under § 432 will be reconsidered where 200 kg of straw in bulk are to be treated in a corridor made from bricks of banco with a volume of 2 m³.

The parameters for treatment are as follows:

5 kg of urea and 50 litres of water per 100 kg of dry straw

for which, in this example,

5 x 200/100 = 10 kg of urea

50 x 200/100 = 100 l of water

1. Preparation of the material

Only minimum quantities of materials will be purchased as recourse will be made to local and family solutions amongst the farmers:

Material to be prepared by the farmers:

- *for transport of the water:* buckets or drums carried on carts close to the treatment area,
- *for preparing the solution:* one or two used drums or half-drums and buckets or extra pot jars, also poles, branches or sticks for stirring,
- *for measuring the amounts of urea:* recipients such as empty tin cans, calabashes, which will be calibrated/graduated by the technician,
- *for applying the solution:* watering cans (from 10 to 15 l) equipped with sprinklers for spreading well the solution or, in their place, buckets, or any other receptacle such as calabashes so that sprinkling can be done by hand,
- *for covering and making the enclosure airtight:* banana leaves, coconut palms, cow dung, clay mixed with finely chopped straw, *séko* matting (*Andropogon gayanus*), bamboo fencing, plastic sheeting if this exists and is not too expensive, used fertilizer sacks sown together to make a sheet, straw to make an inclined roof from several straw layers if none of the previously mentioned items are available; and finally, a few stones, bricks, tree branches or anything heavy to cover and hold down the top of the enclosure.
- *for measuring the quantities of straw:* a few lengths of rope or strong string (at least 2 m long).

Material to be prepared by the technician:

- *for weighing and measuring:* a simple weighing scale for 30 to 40 kg, a portable balance graduated in 100 g, a measuring tape and *writing material*.

2. Preparation and weighing of the forage to be treated

The straw to be treated should be dry and not damp. Leave it ready in piles of sheaves if it is already bunched; if this is not the case, take care when withdrawing from the stack to line up the lengths of straw in bunches, not just dropping it in a heap. This will help both for the eventual weighing and treatment operations.

Collect together several bunches of straw until you have 10 kg, measured with the weighing scale (see **Photo 23**). Prepare with the farmer, the necessary length of cord for tying up the 10 kg of straw, always tying it the same way. Make a knot on the strand to measure this length. In this way and using the knotted strand, the farmer can now proceed to make up bunches of 10 kg of straw on his own, without any need to reweigh his straw.

*For group demonstrations, one could ask the farmer to prepare the straw, "weighed" by this simple technique, stacked in heaps of 50 or 100 kg (**Photo 24**). This preparatory work will assist enormously with the work which remains to be done on the day of the demonstration.*

Bunches of rice straw, resulting from hand threshing operations, are often quite uniform (200 to 300 g). Before each treatment operation, it is always useful to take out a dozen samples or so and to estimate their average weight.

3. Preparation of the solution

Weigh a quantity of 10 kg of urea with the balance. Because the farmer will not have such a balance, calibrate one of the recipients which he has and with which he is familiar, a glass for tea for example, if one is in North Africa.

One needs about 15 glasses of tea to make up 1 kg of urea. One may also calibrate larger recipients such as tin cans for conserves or condensed milk, ... or any recipient which can be readily identified by the farmer.

Pour 100 litres of water into a 200 litre (40 gallon) drum. Here again, receptacles can be graduated so that a mark indicates this precise amount. Slowly introduce the 10 kg of urea, stirring the water in the drum vigorously with a stick or paddle so as to avoid the formation of any lumps. The water will become cool as the urea dissolves. Some 10 minutes will be needed to dissolve all the 10 kg of urea.

4. Spraying and compacting the straw

The straw is sprinkled with the solution, layer by layer (**Photo 25**), until complete filling is achieved for the silo, the trench, the pit or the enclosure. Experience shows that, in order to ensure good compaction and moisture content in the straw whilst reducing to a minimum the spraying operations, it is most convenient to build straw layers which are about 20 cm deep once compacted.

According to this rule of thumb, a silo which is 1 m high will be made up of $100/20 = 5$ layers

In this example, 200 kg of straw will be treated, so each of the 5 layers will contain $200/5 = 40$ kg of straw.

- Make the first layer by placing 40 kg of straw at the bottom of the silo, the bunches to lie parallel with the edges. Trample it down well, specially at the edges (by dancing; children often like to undertake this task). Now sprinkle the straw, still continuing to trample it, with the required amount of solution which in this case is 20 litres for 40 kg of straw (50 %), which means two watering cans full of 10 litre capacity. It is very important to sprinkle the straw evenly; never over-sprinkle certain parts and forget others.
- Once the first layer has been finished, spread out another layer of 40 kg, follow the same procedure and repeat up to the top layer. If any solution remains after completing operations, don't hesitate to sprinkle it on top of the pile.

5. Ensuring an airtight enclosure and placing the cover

In order to achieve a good treatment, one must neither lose any solution by **infiltration** into the soil or along the walls, nor lose any ammonia by evaporation to the atmosphere.

The soil and the walls must therefore be sealed if they are not impermeable. This is the case of the hole or the semi-buried trench. For silos made in *banco* which are considered in this example, take care to ensure airtightness by covering the walls with a sealing material made from mud mixed with straw or manure or, even better, cement. The soil may also be lined or recovered with a layer of cement.

Once the silo, pit or hole is filled, trample down well the last layer: invite as many people as possible to "dance" on top. Now it should be covered. Various possibilities present themselves according to the availability of local materials.

The cover could be made:

- from strips of plastic sheeting,
- from old fertilizer or flour sacks which have been sewn together (**Photo 26**) in the form of strips which allow covering the silo. A set of $2 \times 4 = 8$ sacks allows one to make a sheet measuring 2 m x 4 m. Two could be

made so as to cover the silo with a double layer with overlaps which would allow the forage to be well tucked in; these can be used again the following season as long as they are well washed and cleaned each season.

- using banana leaves or mats made from sisal or *séko* (Photo 27) which should already be on the site, ready for placement. It is very important that the edges and joints be well covered.

It is also feasible to make the cover with mud mixed with manure in a similar way to sealing the walls (see above).

Once the silo has been well filled and trampled down, heavy objects should then be placed on top to keep it well compacted (bricks, stones, sacks filled with earth, etc.).

B - Bunches or bales of forage treated in large amounts with farmer groups or on a large scale farm

For the case of conventional bales, one should proceed in a manner similar to that for batch treatment.

Sprinkling the urea solution can be done by hand with a watering can, layer by layer (Photo 20) after having determined the average weight of the bales or bunches and thus that of each individual layer. The layers should be built in a criss-cross fashion to avoid any losses of the solution.

The process of spraying on the solution may be mechanised by using booms equipped with nozzles which are connected to a tanker truck with a pump (Photo 21) and a precision meter. This is the system which has been developed in Tanzania for baled maize stalks, treated at the level of cooperative farms. For the type of forage being treated, one had even arrived at undertaking a single spraying operation on top of each stack (made up of a maximum of 4 layers in this case) once it had been constructed. The first trials were crowned with success but it is still necessary to verify the repeatability of such a method for which success depends upon the capacity of the forage to retain and absorb the water. The authors do not recommend trying this method with certain forages with rigid or smooth stalks such as *Andropogon gayanus*.

Forming the airtight seal is done by the classic method with plastic sheeting in the same way as for ammonia treatment. Various solutions are

currently under study, as has been mentioned, to economise on the plastic (by covering the stack with mud).

In South East Asia (for example in Cambodia) the straw is harvested in small bunches of about 250 g. The stacks of bunches are built up with layers of 500 bunches (100 to 150 kg) following the normal traditional method for making the stack (**Photos 18 and 19**). A layer of 100 kg is generally made up of four rows of bunches which overlap each other so as not to leave any gaps between them and always placing the cut end of the straw towards the outside. The layer is then sprinkled with 50 litres of the urea solution. The operation is repeated for each layer until the stack is completely built. One should make sure that a stack like this is not made too narrow. Two layers of non-treated bunches are then placed right on top of the stack. A roof, sloping towards the sides, is then made to cover the entire stack (**Photo 28**).