

A GUIDE TO USING DRAUGHT ANIMALS IN COTTON PRODUCTION

A MANUAL FOR THE TRAINING OF TRAINERS



LPP

CPP
CROP PROTECTION PROGRAMME

ACKNOWLEDGEMENTS

This manual results from a collaborative effort based on the work of and contributions from the following institutions and individuals:

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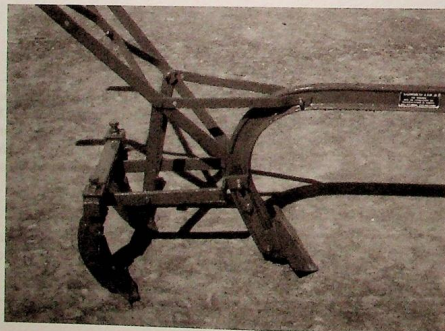
Introduction

Cotton provides an important source of income for many households in Uganda. Yields however are often very low, commonly below 200 kg per acre. Farmers comment that weeds, pests, adverse weather conditions and declining soil fertility are reasons for this poor level of production. Also the crop is labour intensive. In Teso, where there are few tractors, some 85% of cotton land is prepared by ox plough with the remainder cultivated by hand hoe. More than half the area planted to cotton is currently weeded at least four times. Weeding with hoes involves all family members including school children. Nearly three-quarters of farmers hire some labourers to assist with weeding.

How can farmers harvest higher cotton yields by using resources that are available to them and without increased expenditure on labour? This manual outlines how ox-drawn tools can be used profitably in cotton production to achieve timely planting and effective weed control. Based on experiences of cotton growers in Kumi, Soroti and Pallisa districts the manual describes a number of options for using oxen for:

- land preparation
- planting
- weed control

The objective of the manual is to provide extension workers with information on the advantages, costs and skills of animal draught operations so that they can assist farmers to try these practices for themselves in their cotton crops.



SAIMCO SAARI Weeder

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Land preparation

Thorough and timely land preparation is the key to ensuring that cotton is established into a weed-free seedbed and grows vigorously. Farmers should plan to begin ploughing as soon as rains soften the soil in early May so that cotton can be planted by late May or the first week of June.

- Good land preparation can be used to control weeds and to reduce the amount of weeding that is needed in the crop.



There are two options for land preparation using an animal drawn plough:

Conventional tillage: A weed-free seed bed is prepared by ploughing at least twice. Weedy land which has been under fallow or used for a crop in the short rains is ploughed in April or in early May when the first rains fall. A second ploughing is undertaken before planting at least two weeks after the initial ploughing. This is to allow time for weeds to emerge so that they can be killed by the second ploughing.

Reduced tillage planting using herbicides: To do this requires the purchase of a herbicide containing the chemical glyphosate. This is sold under various names including Roundup. Information in this manual refers to the use of Roundup. When farmers buy other products containing glyphosate (e.g. Kalachi, Mamba and Touchdown) they will need to read the label to find out the dosage to be applied. Products containing glyphosate are broad-spectrum herbicides, which kill most weeds including the perennial grasses and sedges. The herbicide enters the leaves and travels down inside the growing weed to kill the roots. This is an effective way of killing problem weeds including couch and spear grass. The herbicide works best when weeds are growing vigorously. Stubborn, well-established weeds may need to be sprayed twice. When Roundup is sprayed onto weeds before planting the number of ploughings can be reduced. On-farm trials have shown that on herbicide treated fields the area covered by weeds at time of first weeding is about one third of that on un-sprayed fields that were ploughed twice. The amount of labour needed for first weeding is also less where herbicide has been used during tillage.

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Reduced tillage planting

- **Option A for land that has been fallow or is very weedy following a crop in the previous season:** Plough at the onset of the rains when the soil is moist. Allow weeds to emerge and grow for at least 10 to 15 days. The day before planting spray Roundup to kill weed re-growth. For one tank full of a 15 litre knapsack sprayer use 175 ml of liquid Roundup. Increase the amount of Roundup to 350ml for each knapsack when the field is infested by speargrass or use one and a half sachets (150 g) of powdered Roundup Max. Each tank full should be sprayed on one quarter of an acre. Cotton can then be planted immediately and will emerge on a weed-free field. Roundup liquid formulation can also be applied by using the Micron ULVA+ spinning disc sprayer. For the ULVA+ mix 500 ml of Roundup in 4.5 litres of water and add to the 5 litre spray tank. This should be applied on 2,500 square metres (Two tanks will cover 1.25 acres).
- **Option B for land that has been cropped in the previous season but has few weeds:** Land that was under a crop the previous season and is still soft need not be ploughed before planting cotton. Roundup should be used to kill weeds that have grown up since the previous season. For one tank full of a 15 litre knapsack sprayer use 175 ml of liquid Roundup or one sachet (100 g) of Roundup Max. Spray onto one quarter of an acre. The field can then be planted without ploughing by opening planting furrows with a plough as described in the section on line marking and planting.

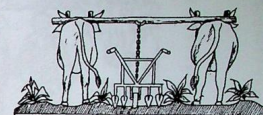
Advantages and disadvantages of reduced or zero tillage with herbicide:

Advantages	Disadvantages
Land preparation requires less labour and is cheaper	Herbicide must be purchased each year
Cotton can be planted after ploughing only once. (Option A)	Herbicide not widely available in stores
Allows timely planting. Land can be sprayed and cotton planted the next day without ploughing. (Option B)	A knapsack sprayer with a nozzle suitable for herbicides is needed
Cotton emerges and seedlings grow in a weed-free field, and less weeding is needed	
Problem perennial weeds including couch and spear grass are controlled	
Weeds killed by Roundup can be left as a mulch on the soil surface to conserve moisture and prevent erosion	

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STEP 3

- From 5 weeks after crop emergence the weeder can be used to weed between the crop rows a second time. Repeat steps 1 and 2.
- The weeder width and depth should be set so that the tines do not till too deep and damage crop roots.



Advantages and disadvantages of weeding with an ox-drawn weeder or weeder attachment on the plough:

Advantages	Disadvantages
Inter-row weeding can be done quickly with only one pass per row	Draught animals needed although they can be hired (if trained to weed)
Weeding can be undertaken until the crop becomes too tall for animals	Only removes inter-row weeds
Tillage depth is adjustable so that crop roots do not get damaged	Weeds within the crop row must be removed by hand or with a hoe
	Taller weeds have to be pulled by hand

Average weeding costs

In 2005 farmers in Kumi and Soroti estimated that it cost on average 18,100 Shillings per acre for labour to use an ox-drawn weeder for the first weeding in cotton. This included the cost of hand-weeding in the crop rows. The cost of undertaking the first weeding using traditional hand hoeing was 32,800 Shillings per acre.

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Weeding with a plough



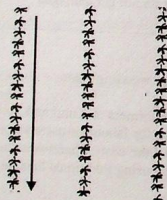
STEP 1 – From 2 to 3 weeks after crop emergence the plough with the mouldboard removed can be used to weed between cotton rows. The cotton plants must be big enough to ensure that they are not buried by the soil thrown up by the plough.



Use the correct yoke length – twice the crop row spacing.

Pass 1 – Between the two crop rows with the plough share uprooting weeds

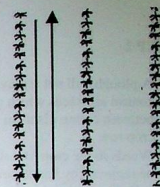
- Do not till too close to the crop row to avoid damaging the cotton plants.



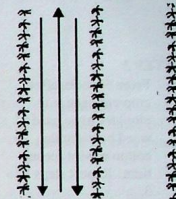
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Pass 2 – Return between the two crop rows with the share uprooting the weeds and throwing soil towards the next crop row.

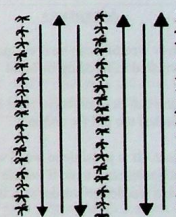
This may be sufficient but, if not, make a third pass (see below).



Pass 3 – A third pass may be needed close to the second pass to make sure all the weeds between the crop rows are uprooted.



Pass 4 etc. - Continue between all rows



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STEP 2

- A plough will not remove or control all weeds which grow between cotton plants in the crop row
- Weeds in the crop row should be removed by hand hoeing or pulled up by hand



STEP 3

- From 5 weeks after crop emergence the plough can be used to weed between the cotton rows a second time. Repeat steps 1 to 3.

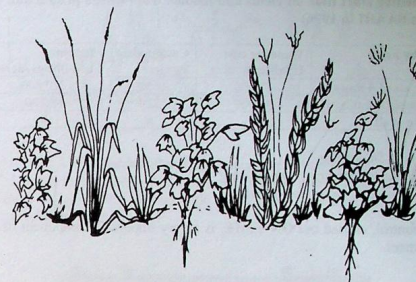


Advantages and disadvantages of weeding with a plough:

Advantages	Disadvantages
Inter-row weeding can be done quickly compared to weeding by hand	Draught animals needed but can be hired (if trained to weed)
Weeding can be undertaken until the crop becomes too tall for animals	Two or three passes are needed for each row compared to one with a weeder
Low cost - It is possible to weed with draught animals even if you do not have a weeder or weeder attachment	Only removes inter-row weeds
Suitable for weeds taller than 15 cm	Weeds within the row must be removed by hand or with a hoe

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Weed Control in Cotton



Weeds are a major cause of low yields of cotton. They are particularly damaging in the first 2 to 4 weeks after cotton seedlings have emerged because during this period the crop grows slowly while weeds grow very fast. Weeds cost farmers money in a number of ways:

- Weeds take up and use fertiliser which has been applied for the benefit of the cotton crop
- It costs just as much to apply insecticides to stunted, weed infested cotton as it does to spray well weeded cotton fields but profits will be less
- Weed infested cotton will produce low yields

When should farmers weed?

Weeding must be carried out from two weeks after plant emergence up to 10 weeks to ensure the growth and development of strong cotton plants. Keeping the crop free of weeds during this period will also ensure that fertiliser or manure is available to the crop and is not taken from the soil by weeds. Weeding also results in a rough soil surface that can trap rainfall.

Any delay in weeding young cotton can result in lower yields at harvest. Delaying the start of the first weeding by only two additional weeks can result in 30% to 65% reductions in potential yield. The actual amount of seed cotton lost as a result of late weeding will depend on how well rainfall is distributed. Yields will be lower when weeding is delayed in seasons when rainfall is poor.

If there is a shortage of labour early in the season farmers should concentrate efforts at two weeks after crop emergence by maintaining a weed-free area of approximately 30 cm wide either side of the crop row. Weeds left should be removed as soon as

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labour is available. However, when trained oxen or cattle and a weeder or a plough are available weeding can be undertaken on time with less labour.

Effects of weeding start time on yields and income from cotton production (based on data from SAARI in 1996)

Weeding by hand	Weeding cost US\$ /acre	Cotton yield kg /acre	Income US\$ /acre
Start early; weed 4 times	80,000	552	220,800
Start late; weed 4 times	80,000	224	89,600
No weeding at all	0	0	0

Cotton price is U Sh. 400/kg

Early weeding started 30 days from planting

Late weeding started 45 days from planting

Good weed control, carried out **ON TIME**, is a very important component of cotton crop management.

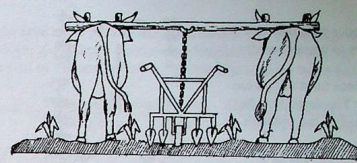
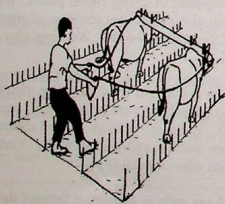
Using an animal-drawn weeder

See front cover for illustration of weeder in use.

Animal-drawn weeders can be bought from some agricultural equipment suppliers. A lower cost alternative is to buy an attachment which converts a plough into a weeder. The mouldboard and share are removed and the weeder assembly, comprising a set of 3 tines, is bolted on. These are available from SAIMMCO Ltd in Soroti and cost about 80,000 US\$.

Training

Draught oxen need training before they can be used for weeding. They have to learn to walk carefully in the spaces between the rows without damaging the plants. This training can be done by making the animals practise walking down rows marked out with wooden pegs (2 to 3 hours per day for a week). The animals need to be muzzled to prevent them from eating the crop. More information is available in a manual from SAARI.

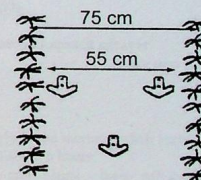


STEP 1 - From 2 to 3 weeks after crop emergence cotton plants are big enough to allow the weeder to be used to weed between the crop rows. The weeder width and depth should be set so that the tines do not till too deep and damage crop roots. (Adjust the depth as for a plough.)



Use the correct yoke length - twice the crop row spacing.

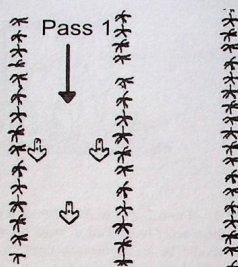
- Set width across the tines to suit the crop row



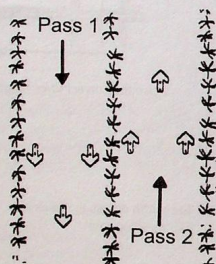
Width of weeding set for 75 cm row

Pass 1 - Weeder goes between the two crop rows to uproot weeds.

- The tines must not go too deep. The depth may be adjusted as for a plough.



Pass 2 - Move to the next crop row and repeat, then continue for the whole field.



STEP 2

- A weeder will not remove or control weeds which grow between cotton plants in the crop row
- Weeds in the crop row should be removed by hand hoeing or uprooting by hand



Tillage costs

The farmer can save up to 30% of the usual cost of two ploughings when Roundup is used after a single ploughing. Used on unploughed land, the savings will be as much as 80% of the cost of the conventional practice of ploughing twice before planting.

Tillage and herbicide costs - Shillings per acre				
	1 st ploughing	Herbicide + application	2 nd ploughing	Total cost
Conventional tillage	30,000	-	30,000	60,000
Reduced tillage	30,000	16,000	-	46,000
Zero tillage	-	16,000	-	16,000



Hydraulic nozzle lever-operated knapsack sprayer

See also back cover

Herbicide application:

- Only apply to vigorously growing weeds
- Do **not** apply immediately after rain or early in the morning when leaves are wet, and do **not** apply when rain is likely within about 6 hours
- Do **not** spray on to cotton or any other crop plants - these will be killed by Roundup.
- Use a herbicide nozzle on the sprayer. This produces a flat pattern of spray with the higher rate of liquid discharged. This is necessary for herbicides but not for insecticides. If no herbicide nozzle is available then the farmer must move very slowly when spraying weeds (about half the speed he would use for insecticide applications) and ensure all the liquid in the spray tank is used on one quarter acre.
- Thoroughly clean out the sprayer after using Roundup, as residues could 'burn' your cotton crop next time you use the sprayer for insecticides.

IMPORTANT SAFETY INFORMATION FOR USE OF ROUNDUP



- **BEFORE SPRAYING ALWAYS READ THE INSTRUCTIONS ON THE LABEL OR GET SOMEONE TO DO THIS FOR YOU.**
- Never handle herbicide concentrate without covering arms and hands with rubber gloves or thick plastic bags
- Never smoke or eat while spraying
- Never use empty containers for water or anything else - always destroy
- Always store herbicide safely
- Never let herbicide enter water courses
- Always wash hands and clothes after spraying

Planting

To produce high yields it is important to space cotton plants so that they can make maximum use of available soil moisture and plant foods. Research has shown that spacing varies for different areas of the country.

- For Teso, plant cotton 30 cm apart in the crop row and place rows 75 cm apart
- In Kasese in western Uganda, plant cotton 45 cm apart and place rows 90 cm apart.

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Line Marking with Oxen

Fertiliser at Planting

Uganda soils are often low in phosphate. Use of MAP fertiliser (50 kg /acre) or DAP fertiliser (50 kg /acre) at planting can help to promote good cotton root development. Basal fertiliser can be broadcast before the planting furrows are made. A better response may result by spreading the fertiliser along the planting furrow. When this method is used cotton seed should be dropped on the side of the furrow - above and to one side of the fertiliser. It is important not to place the seed directly in contact with the fertiliser, particularly on sandy soils as this can cause seedlings to "burn" so that poor crop stands result. After sowing cover the seed with soil by either harrowing with a tree branch or by kicking soil over the seed with feet.

Gap Filling and Thinning

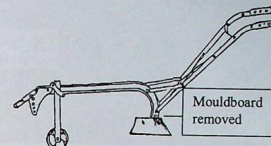
Germination should be checked about 5 to 7 days after planting. If there are areas without seedlings, replant these immediately using a hoe to provide a uniform crop cover with no gaps in the field. Three weeks after planting the seedlings should be thinned. Excess seedlings should be removed to leave only 2 per planting hole. Excess plant density will reduce yield and make pest control difficult.

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In both cases place 3-5 seeds per hole. When "fuzzy" non-delinted seed is used it is not practical to space cotton seed accurately. The correct within row spacing will be achieved by thinning out excess plants after emergence.

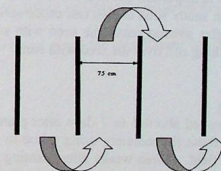
Line marking and planting using oxen

Planting lines can be made by using a plough. First remove the mouldboard from the plough.



Alternatively planting lines can be opened with the front tine on an ox-drawn weeder. In this case remove the two rear tines first. For Teso use a 150 cm yoke (distance between the 2 oxen) to produce 75 cm rows with a plough (mouldboard removed) or weeder (2 rear tines removed).

Begin by cutting a furrow (as straight a possible) on the edge of the field/garden. Turn the oxen around and ensure that one ox follows the cut furrow/mark. The next furrow/mark will then be automatically made at a distance of 75 cm from the first to provide the required row width. Continue in the same manner across the field/garden.



Marking planting furrows - Right hand ox walks in the previous furrow (see photo below)

Cotton seed should be dropped into the furrows by hand and covered by kicking a shallow depth of soil over the seed by feet or by harrowing with a tree branch.

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Fertiliser top dressing: Apply 50 kg /acre urea during second weeding so the action of the plough or weeder incorporates the fertiliser into the soil.

Insect Pest control

As the cotton grows, different pests become important. In the early stages, cotton aphids move into the crop, feeding on the nitrogen-rich new young leaves. A small bug, the Lygus bug attacks the youngest leaves and the young fruit buds. When the buds, flowers and bolls appear a number of different caterpillars (bollworms) feed on them. Cotton stainers pierce the bolls allowing fungus to discolour the lint. There are specific control measures available for each of these major pest groups. Profitable pest control depends on the farmer making regular inspections of his crop to see if the number of insects are increasing to levels that justify spraying of insecticide. Instructions on how to scout and to decide when and what to spray are given in: "Integrated control of PESTS, WEEDS and DISEASES in UGANDAN COTTON: An illustrated manual for use in small-holder cotton" available from your ginnery.

For further information contact:

Serere Agricultural and Animal Research Institute
PO Soroti
E-mail: director@narosaari.org

For details of how to train draught oxen see:

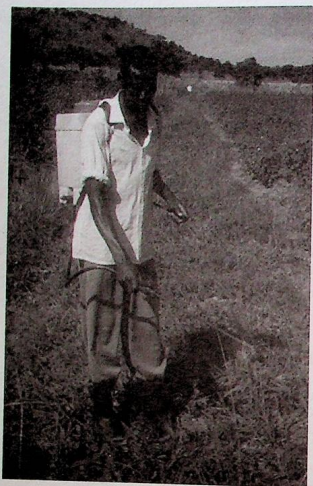
Training for Animal Traction
Available from SAARI, Soroti or VSF (Veterinarios Sin Fronteras), Soroti

The ox-drawn weeder and a weeder attachment for the plough are available in Uganda from:

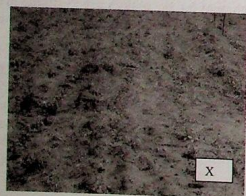
SAIMCO Limited
PO Box 280
Soroti

E-mail: sm@infocom.co.ug

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Applying Roundup to a weedy area before planting



Cotton at 20 days after planting
X - Field sprayed with Roundup before planting and after one ploughing; Y - field ploughed twice before planting