GUM TREES and GUM ARABIC
Field Manual
GUM TREE and GUM ARABIC
Field Manual

Agro - Silvo Pastoralism

0 to 5 yrs

6 to 11 yrs

12 to 17 yrs

18 to 23 yrs

Crops

Use of wood

Text and synopsis:
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Preface

One of the main problems in several African countries producing gum arabic and gum resins, is the lack of knowledge for the sustainable use of this important commodities and the need of providing enhanced value to the product, improving its quality according to the requirements of marketing and exporting sectors.

Most of the stakeholders face problems related to the production, appropriate techniques for the collection of the product, quality control and classification for export purpose.

The Food and Agriculture Organisation (FAO), considered in 1997 that a manual on gum arabic could be an important tool for the development of programmes of training in the African gum producing countries and started its elaboration in collaboration with the Association for International Development of Natural Gums (AIDGUM).

The draft manual was presented at the meeting of the Network for Natural Gums and Resins in Africa (NGARA) held in Nairobi (29th-31st May 2000). Several countries provided comments to improve the manual, which covers general aspects of natural regeneration, systems of plantation, production, management of natural stands and plantations, tapping and natural exudation techniques, storage and packing of the product, quality control, grading and marketing.

The revised manual was again improved by a larger group of producing countries in January 2003 on the occasion of an Orientation Seminar held in Nairobi to launch the activities of NGARA and the Acacia Operation project in the region. The document was considered as a general manual, useful for the programme of training in the African producing countries.

The manual will be used by extension agents and forest technicians for training programmes for producers, collectors and other stakeholders. The manual is the first in a series to be produced. Additional manuals will be produced focussing on specific aspects after a programme on training needs has been elaborated covering both gums and resins.
GUM TREES and GUM ARABIC

Acacia senegal

HARD GUM ARABIC

tapping

Acacia seyal

FRIABLE GUM ARABIC
FORCED EXUDATION (TAPPING)

or

NATURAL EXUDATION

(A. laeta)

A. senegal

A. seyal

Acacia seyal

NATURAL EXUDATION

GUM TREES and GUM ARABIC - Field Manual

1.2
Forced node (tapped)

Natural node

A. seyal

A. senegal

(A. laeta)

Tapping techniques are under investigation for A. seyal (to be cont.)

Natural node

FRIABLE GUM ARABIC
SUPPLEMENTARY NOTES:

1- It is vital to know how to recognise the leaves, flowers, seeds and spines of the various gum trees, since the friable gum of *A. seyal* must always be collected and sold separately.

2- There is no harvesting from *A. laeta*, since the *Alimentarius Codex* no longer considers this as gum arabic.

3- The natural exudation of *A. senegal* produces nodes of a smaller size than with tapping. The yield is reduced by up to 5 fold. This explains the presence of only one gum recipient or koro instead of three on sheet 1ter.

4- To date there are no recognised tapping techniques to increase production of gum from *A. seyal*.

5- Despite this, the yield is substantial and increases with careful sylo-pastoral management of *A. seyal* forests.

6- In practice the pruning of trees to make forage available to animals creates wounds facilitating exudation.

7- Sheets 1bis and 1ter can be enlarged by photocopying to create an information poster. In such case:

8- Begin by showing the botanical figures, and ask the audience to name the trees bearing the leaves, flowers, seeds and spines, thus identifying the common (or local) names.

9- Continue by locating the various *Acacia* species in sequences of landscapes depending on soil type, from top to bottom: stony, sandy then clay, near watercourses.

10- End by linking the various *Acacias* with the gum they produce, the various yields and the risks.

11- For example, tapping is, on occasion, prohibited by the Forestry Code; seek information from the Water and Forestry department of the country.

12- It should also be noted that tapping requires special tools that will not cause undue damage to the trees, but that despite their use, tapped trees will perish earlier (live a shorter time) than naturally harvested trees.

13- Note also that *A. senegal* prefers raised rather sandy soils, but can also grow in small depressions provided the soil is well-drained.

14- *A. seyal* adapts to many types of soil, primarily clay, so is better equipped to withstand drought than *Acacia senegal* which is the first to disappear after a period of several dry years.

PERSONAL NOTES:
HARVESTING AND PROCESSING ACACIA SEEDS

By natural methods:

If the rains were heavy, feed the pods in February

... otherwise, feed them from January

By artificial methods:

If the rains were heavy, harvest the pods in January ...

otherwise, harvest them in December

Drying
Natural regeneration:

Acacia senegal → Formation pruning

Acacia seyal → Natural falling

Artificial regeneration:

Selection of best gum trees

Gum arabic harvested, from best gum producers

Period of harvesting

December → January

GUM TREES and GUM ARABIC - Field Manual 2.2
Rub the pods

Sort or winnow the seed

3 ml per Kg

OIL seed of Neem

NURSERIES

Store in a sack, of either paper or breathable woven fabric

Afforestation of bare land

Gum tree groves, wooded fallow land

Reforestation, regeneration of forests

NATURAL REGENERATION

ARTIFICIAL REGENERATION

GUM TREES and GUM ARABIC - Field Manual 2.3
SUPPLEMENTARY NOTES:

1- There are at least two ways of restoring or planting an acacia wood or orchard:
   - the most simple is to use natural solutions, that is sylvo-pastoralism of acacia (integrating livestock in the forestry cycle), or even agro-sylvo-pastoralism (combining, according to a precise timetable, agricultural crops, livestock and trees; this is sometimes described as sequential agroforestry).
   - the more modern method and also sometimes the most difficult and costly way, is to create nurseries, raising the plants in sacks, before planting them out after very careful preparation of the soil.

2- These two regeneration methods impose excellent knowledge of the phenology of acacias, both to ensure ingestion of the pods when they are truly ripe, or for harvesting them carefully by hand, then cleaning and sorting them.

3- Natural regeneration is based on the appetite of ruminants for Acacia pods, and the natural processing the seeds undergo, not being crushed by the animal's teeth but emerging whole from the digestive system in the manure.

4- When harvesting seed, the best gum trees can be selected (those identified as good gum producers) and their seed harvested as a priority. To maintain a large gene pool, no seed is collected from trees less than 100 m apart. The pods and the seeds are stored in sacks made from synthetic or natural (jute) woven fabric.

5- After being dried in the shade, the Acacia pods are opened by rubbing between the hands, then the seeds are winnowed prior to storage. Since the seed is highly vulnerable to weevils, it is advisable to treat it with an insecticide, such as oil of Neem, at a rate of 3 ml of oil (the contents of a lemonade or beer bottle cap) per kg of seed.

6- Sacks containing the seed must be labelled with the species (senegal or seyal), the precise location where they were harvested and the date.

7- Experience shows that depending on the rainfall in the year, Acacia pods mature earlier or later. If there is a lot of rain, the seeds only mature in January, and otherwise in December.

8- Acacia seyal has approximately 20 000 seeds per kg (seeds/kg)

9- Acacia senegal has 15 000 seeds/kg

PERSONAL NOTES:
THE ACACIA NURSERY

A well drained site, a hut, a fence, a well ....

a plant

acacia planting
ORDER OF TASKS

1, 2, 3, ......, 9

Width: 1 m

Polythene tubes
10 x 20 cm
In black PVC

Firm earth down well

Depth: 0.2 m

2 seeds per pot, covered by their own thickness with sand

Water cold, seeds of one year boiling, seeds over 1 year old

24 hours soaking, Eliminate seeds that float

GUM TREES and GUM ARABIC - Field Manual 3.2
10
SHELTER, to protect young plantlets from the sun
Secco, millet stems
Shaded for a max.
2 weeks

11
Watering
Upkeep
5 x 15 litres per bench, mornings
5 x 15 litres per bench, evenings
After 5 to 6 weeks

12
Cutting off protruding roots of plants, by moving the pots

3 x 15 litres per bench, mornings
3 x 15 litres per bench, evenings
After 11 to 12 weeks
SUPPLEMENTARY NOTES:

N° 1 to 5 - LOCATION AND PREPARATION OF THE NURSERY
- Away from the area (main bed) of the flood zone or wadi
- Away from routes used by herds and from drinking points
- Near water table (less than three metres), water available
- Near village (caretaking and watering)
- Side shading (Neem, ... plant if necessary)
- Presence of good land (arable soil) since earth extracted from “benches” will be used to fill the sacks, pierced at the bottom (drainage)
- A “bench” is about 1000 pots (14 lines x 71 rows), diameter 7 cm (width of flat surface 10 cm), height 20 cm

N° 6 to 9 - PREPARATION AND POSITIONING OF SOWINGS
- Seeds of the year soaked for 24 hours in cold water
- Seeds older than one year covered with boiling water and left to soak and cool for 24 hours
- This treatment:
  I - sorts out dead seeds, these float to the surface and should be removed
  II - thanks to the humidity, ends the dormant period for good seeds
- In each pre-filled pot, place 2 acacia seeds of the chosen variety, cover with a layer of sand equal to the thickness of the seed
- Label each bench with the date of sowing, the species of acacia and possibly, the origin of the seeds used
- A nursery record incorporates this data and notes the dates the seed germinated (start – end) and other important dates (weedkilling or treatment against insect attack)

N° 10 to 12 - RAISING THE PLANTS
- Very soon after sowing, a shelter of millet stem secco must be erected. This must be removed two weeks after germination of the acacias. Retain only one seedling per pot. Any second seedlings should be transplanted into empty pots.
- After about 5 to 6 weeks, the pots must be moved and the roots protruding outside the bottom of the sack cut off.
- Watering on a morning and evening should be reduced by 5 litres per week & per bench, that is, from 150 to 90 litres in 12 weeks.
- On leaving the nursery, a plant should be at least 15 cm tall, and grown in some 12 weeks to be ready for planting out when the rainy season is well established.

PERSONAL NOTES:

GUM TREES and GUM ARABIC - Field Manual 3.4
ESTABLISHING A GUM TREE GROVE

Natural

Manure contract

Millet + direct sowing of Acacia 5m x 5m

Traditional millet

Artificial

Acacia Planting 5m x 5m

Harvesting + replanting

GUM TREES and GUM ARABIC - Field Manual 4.1
The following year, the plot is cultivated, but preserving the acacias.

Herds roam the fallow plot.

The millet sown grows around the acacias.

1. Digging holes
2. Filling in
3. 15 cm
After 3 to 5 years cultivation, the gum tree grove is established.

Preparation of the plants

Planting

Compacting

GUM TREES and GUM ARABIC - Field Manual 4.3
SUPPLEMENTARY NOTES:

- In both cases, that of natural or artificial acacia groves, it is more economic to cultivate millet, for example between the young acacia shoots or plants, to ensure satisfactory cleaning of the ground and so avoid the risk of bush fires.
- As soon as enough young trees have been produced, by natural sowings linked to the empty pasture, or after planting, the grazing animals must be excluded from the plot for three to five successive cultivation years, to ensure the trees grow as rapidly as possible. Then it becomes possible to start pruning the trees, shaping them and so preparing them for the gum harvest (above all A. senegal), since their tops will be beyond the reach of the grazing animals.

PLANTING:
- The planting holes must be prepared from the time of the first rains. They should be 40 cm x 40 cm x 40 cm (opening x depth). The ideal alignment of holes is 5 metres x 5 metres, in a herringbone pattern, maximising land use by roots and of airspace for the tops to the trees (460 trees per hectare).
- For successful staking out in a herringbone pattern, first stake out a straight base line along one side of the plot, making sure there is a space of 5 metres between each pickaxe blow (which marks the ground at the centre of the planting hole of 40cm x 40cm x 40cm).
- Then a wooden template (usable by a single operator) or a rope with 3 knots (three operators, one for each knot are essential), of 5 metres x 5 metres allows fixing the position of the subsequent rows of holes.

- Before placing a plant in the earth, it must be prepared by cutting the base of the pot, then removing the plant totally from the pot by splitting the latter from top to bottom, ensuring at the same time, the cutting of off small roots beginning to encircle themselves around the edge of the sheath. If this step is omitted, the roots will continue to wind around themselves forming a bundle. This will have a substantial adverse effect on the shape, growth and stability of the young tree. Finally, compact the earth firmly around the plant, leaving close to it the sheath (control).

PERSONAL NOTES:
MANAGEMENT OF THE GUM TREE GROVE

0 to 5 years

Food crops

6 to 11 years

Use of wood

12 to 17 years

18 to 23 years

GUM TREES and GUM ARABIC - Field Manual
The construction of a shelter fence is recommended, using acacia branches that are not suitable for use as firewood. The pods will be left on the plot.
SUPPLEMENTARY NOTES:

- Management of gum tree groves implies a full evolutionary cycle, from the natural or artificial establishment of young Acacia shoots, to the use of old trees as wood for fuel and for protective fences, the last products from the grove. There are also the indirect effects of the gum tree grove in terms of soil fertility, since it will have operated as a wooded fallow area for a period of at least 20 years.

- Wooded fallow allows resting and enriching the soils. The acacia roots draw up nutrients from the subsoil, washed down by the rains during periods of cultivation; these elements are used by the tree to form branches, leaves and pods, then fall back to earth where they are incorporated in the surface layers.

- After around 15 to 20 years the gum trees can be felled and the area made available for agriculture for several years. The first two years are highly productive, then the gum trees can gradually be reintroduced either naturally (agro-pastoralism), or artificially (planting) to reconstitute a wood on the depleted soil.

- During the period of reconstitution, which may extend over three to four years, the young gum tree grove can be cultivated, thus ensuring upkeep of the plantation. To protect the plot from grazing animals when using the mature trees, the spiny acacia branches must be woven together around the field, forming a fence or zeriba.

- It can be seen this cyclical management of the gum tree grove produces:
  - Several cereal harvests (from 0 to 5 years)
  - A small gum harvest (from 6 to 11 years)
  - An abundant gum harvest (from 12 to 17 years)
  - A reducing harvest (quantity and quality), with more coloured gums (from 18 to 23 years)
  - Wood fuel and protective wood fence
  - Rich soil, ready for new harvests
  - Good pasture for 20 of the 23 – 25 year full cycle (revolution).

PERSONAL NOTES:
1- PRUNE, 2- TAP, 3- HARVEST

Secatuers for pruning

Sonke for tapping

Container for collecting gum to avoid it dropping on the ground

* As of today, there are no recognised techniques for tapping Acacia seyal
A. seyal and A. senegal, **NATURAL EXUDATION**

Pruning: - Tidy, healthy tree
- Ease of access
- Easier harvesting

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**Acacia senegal, FORCED EXUDATION**

Pruning: - Tidy, healthy tree
- Easier tapping
Harvesting:
- Tool with handle
- Clean cloth sack

Tapping: one incision per branch > 5 cm diam.

Harvest every 10 days (that is 6 to 8 times)

Wait 2 to 4 weeks

Tear off

Remove
SUPPLEMENTARY NOTES:

THE TOOLS:

- **pruning:**

  - West Africa: Remove and cut by pushing
  - East Africa: Remove by pushing, then cut by pulling on the tool

- **tapping:**

   - Clean cloth sack and gum collector

- **collecting:**

   - The gum trees are pruned to prepare them for the harvesting of gum arabic, and to make forage (branches and pods) available to animals. This operation occurs just before tapping and allows evaluating whether the leaves are ready to fall (October / November). The gum harvest begins a month later.

   - Tapping, if applicable, begins when the leaves fall, indicating lack of water and the start of gum formation. The first nodes form after 3 to 4 weeks, then every 10 days, until all the ground water is used up, or the rains return. The nodes are harvested at regular intervals, at least every 10 days, and at most every two weeks.

PERSONAL NOTES:
QUALITY CONTROL OF GUM ARABICS

Pure
Clean
Polymerised

by the PRODUCER

**Trackability**: labelling and marking of sacks with at least the **name** of the producer and **place** of harvesting or collecting.

by the TRADER

**Sorting**: of impurities and rejection of gums in blocks, non-polymerised.

**Trackability**: re-packaging with constitution of batches numbered by **Producer**.

by the EXPORTER

**Sampling**: - Colour - Moisture content - Viscosity - Polarimetric deviation

**Trackability**: documentation of batches, sorting or re-packaging.

by the IMPORTER

**Re-sampling**: - Chemical analysis - Bacteriological analysis

**Trackability**: continued documentation of batches on the basis of local data.
**BY THE PRODUCER**

**Pure:**
no blending

**Clean:**

*Acacia senegal*

*Acacia seyal*

**Polymerised:**

Drying:
1 week at least

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**Labelling or marking of new sacks in woven fabric**

- Product & COUNTRY
- Botanical name
- Regional name
- Name of producer
- Place or area of production
- Date of packaging and net weight

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**BY THE TRADER**

The regional trader plays a key role in quality control.

He can and **must reject** all non conform gum arabic, that is:
- blended
- dirty
- badly dried

**Systematic manual SORTING**

Rejection of blended or block gums

Elimination of impurities: stones, wood
BY THE USER OR IMPORTER

Continuing the analyses in the Laboratory

- on samples prior to delivery:

Quality control of gum arabic for export

- on samples following receipt of the batches delivered:

verification of the quality of gum arabics entering stocks in order to decide the proportions in which they should be assembled to prepare the product required by the customer or end user.

BY THE EXPORTER

Systematic mechanical SORTING

Elimination of residual impurities: stones, wood and nodes of other varieties of Acacia

The exporter is the final link in the quality control chain.
He must check his batches of gum arabic to ensure reliability of exports, and market only Pure, Clean and Polymerised gums.

Mini-Laboratory for QC*

- Colour: comparative colorimeter
- Humidity: infrared scales
- Viscosity: Brookfield machine
- Polarimetric deviation: polarimeter
- Concentration: refractometer
- Acidity: pH meter
+ thermometers, scales to 0.1 g
mechanical stirrer + beakers

Electricity essential * & technical training to acquire
SUPPLEMENTARY NOTES:

*Analysis equipment and methods:*

For correct sampling of a batch of gum, the latter should be sampled from a set of typical nodes. An appropriate result is obtained for example, by sampling 200 grams of gum arabic for every 2 tonnes of a load.

**Example:** an exporter receives a delivery by truck, of 10 tonnes of gum arabic in sacks of approximately 100 kilograms.
- The twentieth, the fortieth, the sixtieth, the eightieth and the hundredth and final sack are set on one side. These sacks are then opened and 200 grams of gum arabic sampled from each.
- The kilogram of gum arabic obtained (5 x 200 g) should be coarsely crushed before mixing, with clean, dry hands (washed with soap and then dried). This provides a uniform sample, representative of 10 tonnes of the gum arabic delivered, stored in a sealed labelled glass jar (variety, origin, date, etc.).

Most analyses are conducted after dissolving the gum arabic in water. Prepare a “master” solution, 25% concentration, by dissolving 250 grams of gum arabic in 750 grams (or 75 cl) of water at room temperature using a mechanical stirrer.

Filter the solution through fine white fabric to eliminate particles, (sand, bark, etc.) larger than 0.2 millimetres. This solution can be used to make the following measurements:
- **VISCOSITY** (Brookfield machine)
- **COLOUR** (Comparative Colorimeter)
- **pH** (pH meter)

The **HUMIDITY** is measured using an infrared scale, with 10 grams of gum arabic lightly crushed, taken from the sample in the glass jar referred to above.

The **POLARIMETRIC DEVIATION** is obtained from the master solution, diluted to 4 – 5% dry extract (value measured with the refractometer) and filtered through fine filter paper. A test tube of the solution is then placed in the polarimeter.

**PERSONAL NOTES:**
PACKAGING THE GUM ARABIC

Use of the gum:
- sodas, drinks
- pharmacy, dietary
- sugars, industry

Drying

Sorting and packaging

Harvesting

Transport, processing or export
Harvesting

Drying: 1 week

Acacia senegal, forced exudation

Collecting

Drying: 1 week

Acacia senegal, natural exudation

Collecting

Drying: 1 week

Acacia seyal

Pure:
No blending

Acacia senegal

Clean:

Acacia seyal

Polymerised:

Drying:
1 week at least

GUM TREES and GUM ARABIC - Field Manual 8.2
Gum arabic from CHAD

*Acacia senegal*

"KITIR"

W. XYZ

Dourbali

06.03.2000

50 kg net

Gum arabic from CHAD

*Acacia seyal*

"TALHA"

A. BCD

Am Timan

10.04.2000

50 kg net

New sacks:

Woven fabric:

Jute fibre or polypropylene

Labels:

- Product & COUNTRY
- Botanical name of species and type harvested
- Regional name
- Name of producer
- Place or area of production
- Date of packaging
- Net weight in kg
Gum arabic is a foodstuff. In March 1999 it was classified thus by JECFA, a joint group of experts from the WHO and the FAO, two United Nations bodies responsible respectively for health and food. The result of this classification in the ALIMENTARY CODEX is that only hard gums collected or tapped from Acacia senegal and friable gums collected from Acacia seyal can be labelled as “GUM ARABIC”.

GUM ARABIC

Hard gum from *A. senegal*

Friable gum from *A. seyal*

As a foodstuff and more generally, gum arabic must be harvested in accordance with 3 rules:

- **Pure**: no blending of products of different types or from different tree species.
- **Clean**: no contact with the ground under the tree (use of the gum collecting tool), transport in a new or clean fabric sack, no contact with the floor or other products in the building where the gum is stored for drying (gum placed on an impermeable sheet). Gum arabic dissolves in water, absorbs odours (pleasant and unpleasant). When transporting by road, protect the gum by using an impermeable clean sheet.
- **Polymerised or dried**: when harvested or collected the gum is still viscous inside the node. It must be placed in a dry, well-aired location, but protected from dust and light for at least one week. The gum hardens so it can be bagged, without the formation of compact blocks. Traders will reject gums that have formed solid blocks.

Gum arabic is bagged up in new sacks of natural (jute) or artificial (polypropylene) fibre, permeable to the air, allowing the gum arabic to “breathe”.

Each sack of gum must be labelled or marked with the **Name of the product** (gum arabic), the **Country**, the **Botanical Species**, the **Regional Name**, the name of the **Producer** the **Place of Harvesting**, the **Date** of bagging and the **net Weight**.

**PERSONAL NOTES:**
USE OF OLD GUM TREE GROVES

Felling, use

Fence, zeriba

Wood fuel
Natural Regeneration \((Acacia\ senegal\ or\ seyal)\):

Artificial Regeneration \((Acacia\ senegal)\):
Young gum tree grove, planting
SUPPLEMENTARY NOTES:

In this sheet we will recall the phases for using the wood from gum tree groves and for their reconstitution. We must examine the basic cycle of gum tree grove development in more detail.

Acacias form a very special botanical genus, with two main characteristics:

- A capacity to reconstitute soils, both by the abundance of their vegetable biomass, and to a lesser extent, a feature common to all members of the mimosa subfamily (leguminous family) to fix atmospheric nitrogen in the soil.
- Their edibleness by animals, constituting almost all the available browsing plants in the Sahel zone, thus constituting a vital resource for the large herds, primarily of cattle found in this region.

Gum trees are still closely linked with pastoralism, supplying forage (leaves, pods and young branches), while relying on animals for the regeneration of the gum tree groves, since the passage of seeds through the digestive tract of the ruminants provides a natural processing facilitating their subsequent germination. Since the seeds are heavy and thus hard to disseminate, the animals also play a role by dispersing the seeds as they travel to browse.

Preferring to colonise soils free of competing vegetation, that is following bush fires (*Acacia seyal*), or cultivation, the gum trees and especially *Acacia senegal*, are closely linked to itinerant agriculture, depending on the pattern of leaving fallow zones, where they play a key role in the wooded phase of such systems.

For this reason natural regeneration is always displayed first in this manual since it requires fewer inputs and energy than the planting option. On occasion assistance is necessary, and natural regeneration may have to be replaced by planting. This option has been adopted in some countries that have decided to intensify gum production, and almost always calls for heavy subsidising and hence the durability of such schemes may be difficult to ensure.

PERSONAL NOTES:
BIBLIOGRAPHY

Since this Manual is for use in the field, it does not cover all the questions that may be posed by readers. The following references provide more detailed responses. They are part of the documentation used in preparation of this manual.

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**FAO**

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**CCI**

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**ISRA**

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**GTZ**

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**RIAT**

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**AFVP**

Projet gommier, Ministère de l'Environnement – TCHAD - Pourquoi tailler les gommiers ?
- Comment saigner les gommiers ?