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# Using a Self-Cutting Chopper Prototype in Mechanized Landscape Conservation Measures

*For fully mechanised bush and shrub removal in valuable open landscapes, a prototype bush chopper was developed, which can cut, chip and load plant material in one operation.*
*Experiences from field tests show that the chopper's conception works basically.*

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## Keywords

Open landscapes, landscape conservation measures, self-cutting chopper, spiral chipper

Removal of bushy and woody vegetation is one key issue in landscape conservation and biotope protection of open landscapes. Particularly in neglected areas or in those under extensive cultivation conditions pioneer species of shrubs and arboreal vegetation overgrow the open landscape biotopes and a degradation of these is the consequence [1, 2, 3]. Currently, burning, mechanical mulching, manual removal of bushy vegetation and grazing are the most frequent methods to maintain the treelessness and the conditions of open landscape biotopes. However, because of technological weaknesses or high costs the applicability of these techniques is limited [2, 4, 5, 6, 7].

### Fully- Mechanised Landscape Conservation Methods

Within a joint venture project, a fully- mechanised landscape conservation concept is developed at the Section of Agricultural Engineering of the Georg- August- University of Göttingen. The concept shall enlarge the possibilities of present landscape conservation management practices and aims at the efficient mechanical clearing of bushy and arboreal vegetation from open landscapes in compliance with the special demands of these biotopes. It is based on an innovative self- cutting spiral chipper, which cuts the woody vegetation near to the ground, chips it to homogeneous wood chips and loads the chips for removal. All these steps are done in one single operation by only one machine [8].

### Prototype of the Landscape Conservation Chopper

The tested prototype of the landscape conservation chopper is a completely newly developed machine concept (*Fig. 1*). Its design is based on operational experiences with a modified bush chopper [9], which was primarily developed for fire- free land preparation in tropical land management systems [10].

The landscape conservation chopper is mounted to the three- point hitch of a conventional agricultural tractor and requires a power supply of approx. 110 kW.

Covering the tractor's width, the shrubs are sawed off by six horizontal saw blades near to the ground and are turned over to a horizontal position by a bow. Tangly or diagonal lying stems in front of the machine are cut by a hydraulic hedge shears to divide them into two flows of material. Each is transported by two supply drums to a chipping unit consisting of a conical rotor drum in horizontal position equipped with a sharp-edged chipping spiral. In the chipping process the spiral cuts into the material and thereby produces homogeneous wood chips. By the pitch of the conical spiral the chipping unit feeds itself automatically. The produced wood chips can be loaded by a spout to a container for removal.

### Practical Experiences

In the vicinity of Göttingen, the landscape conservation chopper was tested on neglected grassland covered with partially heavy bushy and arboreal vegetation. The predominant plant species were blackthorn, whitethorn, cornel, dogrose, ash and birch. The stem base diameter of the bushes and trees reached from 1 to 20 cm and the heights from 1 up to 6 m. As a rule, all dimensions in these ranges were unequally distributed over the area.

The main conclusion of these tests is that the principle of this prototype is suitable for application in landscape conservation measures. Bushy and arboreal vegetation can be cut, chipped and loaded with one machine and the produced material can be removed from the area. Thus, it is possible to clear bush encroachments from areas in one single operation.

In spite of the successful application, problems caused by the chopper's design were detected, which could only be solved by redesign of the machines construction.

*Visibility and Manoeuvrability*
Due to the choppers weight of approx. three tons and a length of 2.3 m, it is difficult for the operator to manoeuvre on narrow or hil-

ly terrain. Because of the high machine frame and the centrally placed spout on the chopper, the visibility to the working area is restricted. The use of a special surveillance camera could decrease the restriction, but nevertheless control of the working process is delicate and demands some experience of the operator.

*Cutting*
Trees and bushes of diameters up to 12 cm could be cut by the saw blades without any difficulty. Above this diameter the spur gear unit of the saw blades, which is installed under them, strikes the stumps during cutting. This involves lifting of the machine in a range of a few centimetres. Vertical forces to the saw blades are the consequence, resulting in heavy mechanical stress.

Due to an inexistent automatic adjustment of the working height and the above mentioned restricted view to the working area, cutting the stems near to the ground is highly demanding to the operator.

*Material Feeding*
A continuous constant feeding of the plant material from the supply drums to the chipping units without accumulation or obstruction is indispensable for a trouble- free chopping process. Diagonally lying stems in front of the supply drums often obstructed the flow of material causing accumulations. Either these had to be removed manually or a sudden advance of the aggregate material induces an overload of the machine's chopping units. To avoid obstruction of the chipping unit, the hydraulically driven supply drums had to be stopped, interrupting the working process.

During the machine's testing, different types of conveying tools for the supply drums have been tested. The tendency of winding up branches and twigs around the drums could not completely be avoided. Particularly in bushy vegetation, manual removal of jammed and wound up material from the supply drums was frequently required.

Basically, dividing the material into two flows turned out to be unfavourable for the feeding. The hydraulic hedge shears cut the material without any problem, but this process produced short stem and branch pieces which contributed substantially to the obstruction of the feeding drums. Furthermore, the voluminous and intractable plant material had to be directed to two relatively small supply drums, affecting adversely the feeding process.

*Changing Torque Directions*
The two chipping drums, the six saw blades and the oil pump for the hydraulic hedge shears are powered by the power take-off

*Fig. 1: Young growth chopping of ash in an overgrown scattered orchad meadow with the new prototype of the landscape conservation chopper*

(p.t.o.) of the tractor. For this reason the power transmission has a ramified structure. During the chopping process the components are loaded alternately. Particularly, high mechanical loads occur between the saw blades and the chipping unit's power transmission so that the gear units are damaged. A friction clutch between these components could decrease the damaging loads but the basic problem of the changing torque directions, also between the two chipping units, could not completely be solved in this machine's design.

*Loading of Chopped Material*
The capacity of the spout was sufficient. Merely, the spout geometry has to be revised to achieve a concentrated material flow. This is necessary to load the material without any losses to a container.

To ensure a good manoeuvrability and unloading in a short time a bucket added to the front loader of the tractor is used to collect the chipped material.

*Chipped Material*
Even though the machine has not undergone any optimisation related to the particle size distribution, the wood chips are quite uniform. The chopped material from the field tests could be classified by sieve analyses according to European Standard prCEN/ TS 14961 as particle size range P 63. But it has to be noted that the overall quality of the produced wood chips was lower than wood chips from e.g. forest trunk wood because of higher ash content and a coarser structure due to branches and twigs in the raw material.

Due to the relative good quality of the material the utilization was realised willingly by a local customer.

**Conclusion and Outlook**

The application of this prototype of a landscape conservation chopper showed that it is possible to cut, chip and load young bushy and arboreal vegetation in one single operation. Grown up woody plants on areas of open landscape biotopes can be removed mechanically and a utilization of the produced wood chip material can be realised.

However, the extensive tests also revealed basic deficiencies of the machine's design, which could only be solved partially in this prototype. Hence, a new prototype is being developed, comprising the experiences with the former machine. This new prototype will be tested under field conditions in 2007.

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