CONTROLLING BRACKEN WITHOUT HERBICIDES: ALTERNATIVE METHODS TO ENSURE PLANTATION SUCCESS

Gwénaëlle Gibaud*[1], Quentin Girard[1], Jérôme Piat[1], Claudine Richter[1], Catherine Collet[2], Mathieu Dassot[2], Léon Wehrlen[2] and Jean-Yves Fraysse[3].
[1] ONF, Research and Development Department, 77300 Fontainebleau, France.
Tel: 33-344-207-266, Email: gwenaelle.gibaud@onf.fr
[2] INRA, UMR1092, LERFoB, 54280 Champenoux, France.
[3] FCBA, 71 route d'Arcachon, Pierroton, 33610 Cestas, France.

Introduction

Common bracken (*Pteridium aquilinum*) is a herbaceous perennial plant, deciduous in winter, which can account for failures of natural and artificial tree regeneration. It is an adaptable plant which grows in many contexts and on large areas (Gama A. et al., 2006). The large fronds arise upwards from an underground rhizome, and can grow to three meters tall (Dumas, 2002). It is a strong impediment to successful natural and artificial tree regeneration. Indeed, rhizomes hinder planting and curb root development of seedlings. During summer, common bracken shades the seedlings and makes a high competition for water and minerals (Gaudio, 2010). Then, during autumn, it falls on seedlings and lays those ones down. That's why foresters have to control common bracken growth to ensure the success of tree regenerations.

From the 1970's to 2010, herbicides were used in forest to limit the number of manual cleanings. Asulam, a selective herbicide used to kill bracken and docks, was mainly employed in French forests. However, it was not approved by the European Commission Implementing Regulation in 2011. That's why alternative methods to control bracken are currently being tested.

This study presents the first results of the experimental network ALTER (alternatives methods to herbicides) set up across different regions in France. The objective of this network is to test and evaluate several alternative methods to herbicide products for site preparation before planting.

Materials and methods

The experimental network ALTER began in 2009. Two new tools mounted on mini-excavators were tested:

- a deep scarifier (DS) (Scarificateur Réversible®, Grenier-Franco) that removes the vegetation, extracts the root systems (included bracken rhizomes) and fractures the soil structure down to 40 to 60 cm deep;
- a multifunction sub-soiler (MS) (Sous-soleur multifonction®, Grenier-Franco) that decompress the soil down to 60 cm (favourable for compacted soils), without reversing the soil horizons and creates an additional 20 cm mound (favourable for water-logged soil). This tool was used after the extraction of bracken rhizomes with a deep scarifier.

These new methods were compared to:

- control (C), without site preparation (except crushing of vegetation with a forestry mulcher);
- no competing vegetation (NV) where the ground is maintained as bare as possible with herbicide treatments repeatedly spread;
- usual methods (UM). These methods were different in each experimental site: herbicide treatment before planting (UM-H) or ploughing (with a mouldboard plough (UM-M), a disc plough (UM-D) or a stubble plough (UM-S)).

From 2010 to 2012, four experimental sites were set up across different regions in France, in forest blocks with high and dense common bracken. The different site preparation methods were implemented. Then, in

each site, one deciduous (oak) and one conifer (pine) species were planted, in separated plots (no mixture of species).

Table 1. Description of the experimental sites

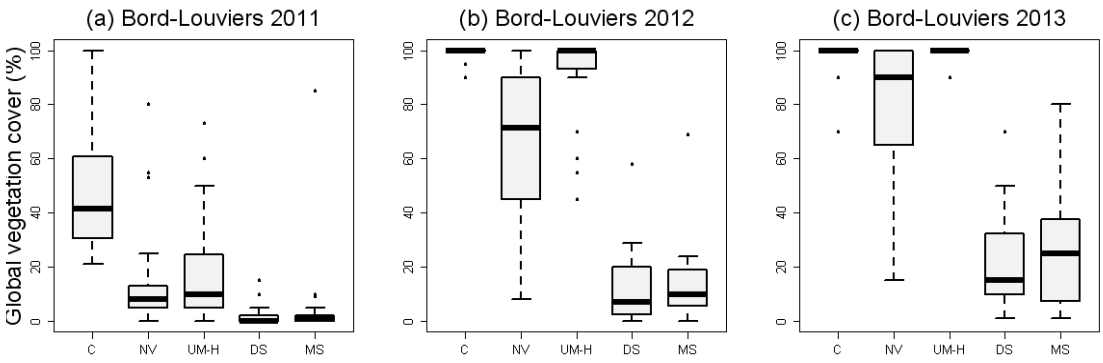
Forest	Usual method tested	Deciduous species	Conifer species
Bord-Louviers	Herbicide treatment (Asulam) before planting	Quercus petraea	Pinus nigra subsp. laricio
Escource	Mouldboard plough	Quercus robur	Pinus pinaster
Haguenau	Disc plough	Quercus petraea	Pinus sylvestris
Villecartier	Stubble plough	Quercus petraea	Pinus sylvestris

Results and discussion

In 2013, the seedlings were one, two or three years old according to the planting date. In two experimental sites, the mortality rate was very high after the first year because of unusual severe cold in February 2012 in Escource and Haguenau and poor quality oak seedlings in Escource. That's why new seedlings had to be planted again during the following winter (oaks in Escource and Haguenau and pines in Escource).

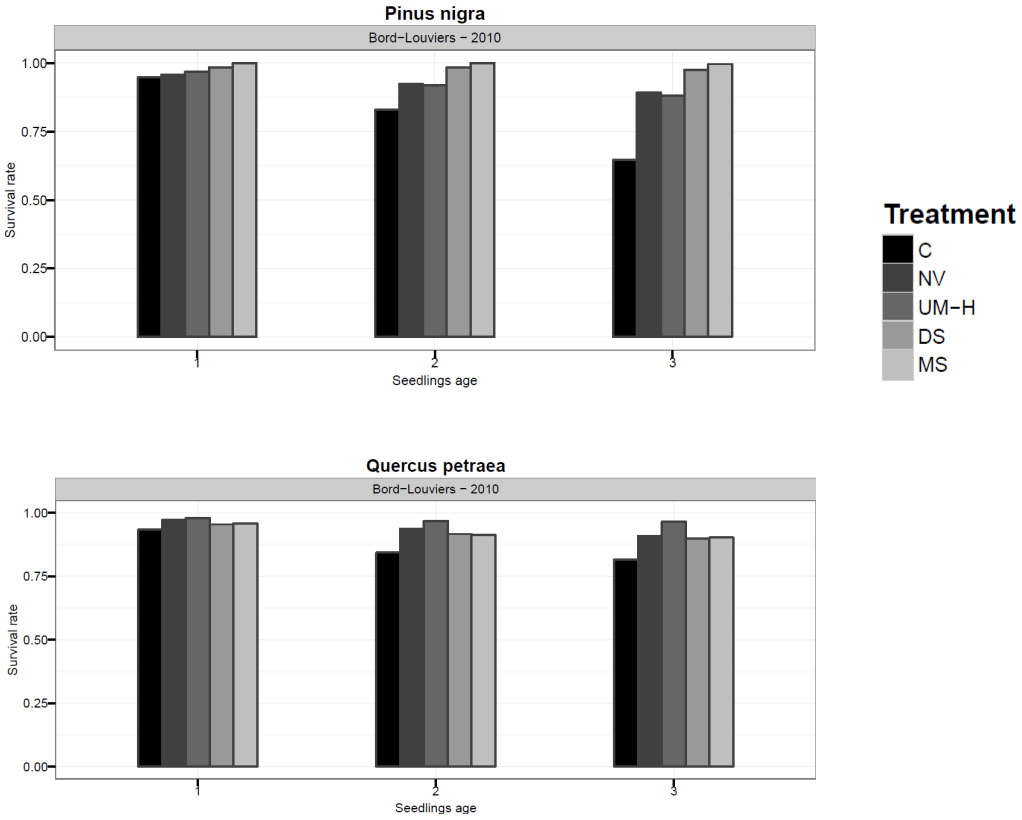
In the older experimental site (Bord-Louviers), the new methods (DS and MS) provided an efficient control of bracken. The global vegetation cover remained very low for these site preparation methods; three years after planting, vegetation covered around 20% of the soil for DS and MS against 100% for control and usual method. In the three other sites of the experimental network, global vegetation cover in DS and MS plots were lower than in C and UM plots two years after the site preparation.

Figure 1. Global vegetation cover during 3 years after planting in Bord-Louviers experimental site.



In Bord-Louviers, three years after preparation and planting, these low global vegetation cover in DS and MS induced higher pine seedlings survival rate (98 and 100%) than in control (65%) and usual methods plots. For oak seedlings, the control survival rate was the lowest (82%) while the other treatments, including DS and MS, have a survival rate from 90 to 97%.

Figure 2. Survival rate during 3 years after planting in Bord-Louviers experimental site.



In DS and MS plots, the height growth was better than in control plots: +49% and +66% for pine seedlings and +20% and +32% for oak seedlings in Bord-Louviers experimental site three years after planting. These plants were also higher than those of UM-H. NV plots were intermediate but this method can not be used in usual forest management.

Concerning basal diameter growth, tendency was the same. Pine seedlings in DS and MS were respectively bigger +86% and +121% than in control plots (+37% and +44% for oak seedlings). For both oak and pine, seedlings of the new methods had a better diameter growth than those of the UM-H plots, but lower than those of NV plots. These results concerning survival rates, high growth and diameter growth three years after planting in Bord-Louviers, were similar than results obtained in the three other experimental sites of ALTER network for seedlings one or two years after planting.

These encouraging results may be confirmed by next measures. Then, we'll also have to compare the global implementation costs of these methods from site preparation to seedlings freeing from common bracken. Indeed, DS and MS methods require a higher implementation cost before planting but plantation is faster and plots need few or even no bracken cleaning operations, whereas usual methods needs expensive cleaning operations each year after planting to ensure seedlings survival. This is the objective of another experimental project (PILOTE) which started in 2013.

References

Auzuret X. et al, 2014. RDV techniques. 43:22-32.
Dumas Y., 2002. Revue Forestière Française. 54;4:357-374.
Gama A. et al., 2006. Éditions QUAE. 319 p.
Gaudio N., 2010. Thesis - Université d'Orléans. 194 p.