

WILLOW (*SALIX BABYLONICA*) FODDER TREE FOR THE TEMPERATE: AN EXPERIENCE FROM BHUTAN

K. Wangdi and W. Roder

RNR Research Centre, Jakar, Ministry of Agriculture, P.O. Jakar, Bhutan

1. INTRODUCTION

Livestock production plays an important role in the traditional Bhutanese farming system. Fodder production from natural grasslands and fallow vegetation is distinctly seasonal. Tree fodders are important for ruminant nutrition contributing about 20% of the total feed requirement (Roder, 1992). They are especially valuable during the dry winter season, when fodder from other sources become limited both in quantity and quality. Furthermore under adverse conditions such as poor soil conditions and drought stress. Tree fodders are generally superior to herbaceous species. Elevation and other climatic factors dictate the type of fodder species available but the main fodder trees comprise of the genus *Ficus*, *Bambusa*, *Bauhinia*, *Quercus* and *Salix* (Roder, 1992).

Different species of *Salix* are grown all over the World for fodder, fuel, construction and environmental preservation because of their wide adaptability. They can grow in poor and exposed soils (Roberston, 1984) and can tolerate heavy metals like Cadmium and Zinc in the soils (Pertu, 1993 and Nielson, 1994).

In Bhutan, the most popular species of salix is *Salix babylonica* but is not known when it was first introduced into the country. Early European visitors to Bhutan make reference to the abundance of willow trees in Paro and Thimphu valleys. Today it is found widespread throughout the country at elevations ranging from 800-3000m. and it is by far the most important tree fodder species at elevations above 2500m (Roder, 1981).

2. BIOMASS PRODUCTION

A lot of studies on biomass production have been carried out in the UK, New Zealand, Scandinavian countries and Canada for willow species other than *S. babylonica*. They reported an annual production of 14 t/ha (Beale, 1997), 1-9.9 t/ha (Douglas, 1996), 9-10 t/ha (Hytonen, 1994), and 8-11 t/ha (Roberston, 1984). The yield from existing stands of *S. babylonica* in Bhutan has been estimated at 3.8 - 7.0 t dry matter ha⁻¹ (Roder, 1992; Gymatsho, 1986).

The variation in the biomass production may be an inherent genetic trait of the different willows that have been studied. However, production from the willows of the same species seem to be influenced initially by the addition of fertilizer (NPK) and from the cutting management in the long run. Fertilization with NPK is found to enhance the rate at which annual maximum biomass is reached but the ultimate annual maximum biomass achieved is the same with or without fertilization (Kopp et al, 1993). From the cutting regimes, it is reported that dry matter harvested 2 years after planting was about twice the total biomass harvested twice at the end of each growing season, clearly suggesting a 2 years cycle to be more productive than a one year cycle (Labrecque et al., 1993).

When compared to other fodder viz. *Chamaecytisus palmensis* (tagasaste), *Medicago* sp. and *Populus* sp., the production from *Salix* sp. was higher after 2-3 seasons of cutting (Radcliffe, 1983).

3. WILLOW AS A WINTERFED UNDER BHUTANESE CONDITION

Willow is the only fodder tree species of importance available at elevation > 2500m. It is a fodder of excellent quality with milk production potentials equal to white clover. Yet its potential as a fodder is presently not realized because the leaves drop towards the end of the growing season. The dry matter yield of willow trees aged 5-10 years continues to increase through the season, but started to decline in October.

Attempts should be made to feed willow during September - November. Willow should be used to complement white clover/grass production systems. By feeding willow at the end of the growing season, white clover/grass plots could be saved to be used as standing hay during December and January.

4. FARMERS' ASSESSMENT IN BHUTAN

Following an initial survey carried out in 1981 in Bumbthang district in Central Bhutan (elevation 2600-3000m) *S.babylonica* was clearly the preferred fodder tree species (Roder, 1982). Farmers surveyed had an average of 17.5 plants and increased the numbers by 24% during the year of the survey (Roder 1981). Similarly, in eastern Bhutan, farmers indicated their preference for this species (Wangdi, 1992). No other tree fodder species are presently planted by farmers in temperate areas.

Salix babylonica is a multipurpose tree. Farmer value it as a source of fodder but give almost equal importance to value for fuels, and fencing (Table 1). Although farmers appreciate the high quality fodder it provides, they would prefer to have species that can provide fodder during the dry winter season. Fluctuations in quality and quantity of *S.babylonica* fodder is quite similar to the seasonal pattern of natural grasslands and its leaves fall in November. Farmers interviewed cited competition for soil moisture and nutrients as an other main constraint towards wider use of *S.babylonica*.

Table 1. Main Motive for Planting *S.babylonica*^a

Uses	Respondents (%)
Fodder	80
Fencing	77
Fuel	77
Erosion control	3
For sale (branches for planting)	6

^a Data from Willow survey 1996, n = 35 farmers

5. FODDER QUALITY

Willow leaves generally contain high protein, low crude fibre and high acid detergent fibre (Nasi, 1984). Various studies have confirmed that *S.babylonica* leaves have high nutritional quality comparable to common forages, such as lucerne (*Medicago sativa*) and that they can be fed to ruminants without any adverse side effects.

Leaves harvested in April, May, September, October and November had crude protein contents of 25, 22, 17, 16 and 11% and crude fibre contents of 12, 16, 15, 15 and 22%, respectively (Roder, 1981). This indicates that CP contents of the *Salix* found in Bhutan are higher than that of some other willows found in Canada which was only 13-20% at the peak of the growth season (Roberston, 1984). In *S.*

babylonica, the minimum CP at the end of the season is still higher than the critical level of dietary CP required for acceptability for voluntary intake. Voluntary intake and animal performance was high with sheep and cattle (Table 2).

Lactating cows fed with willow only, maintained the milk yield at levels similar to the period before willow feeding. Yields dropped when willow feeding was discontinued during the end of November (Figure 2).

When comparing dry matter disappearance in rumen, *S.babylonica* was far superior to other tree leaves commonly used as feed. Dry matter disappearance for *S. babylonica*, *Robinia pseudoacacia* and *Litsea polyantha* leaves, and mixed hay was 78, 44, 31% after 24 hours of incubation, and 85, 65, 54 and 56% after 48 hours of incubation, respectively (Bajracharya, 1990).

Fig.1. Effect of harvesting date on the dry matter production and fig.2. Milk yield at weekly intervals during willow feeding from Oct 10 onward (not shown)

Table 2. Intake and Live Weight Gain of Two Types of Ruminant Animals

Animal type	Voluntary intake (g DM/W ^{0.75})	Live weight gain (g/day)	Reference
Bull	78	330	Roder, 1985
Sheep	85	64	Bajracharya, 1990

6. RESEARCH NEEDS

Fodder quantity and quality is the main constraint towards increased livestock production in all parts of Bhutan. The present fodder development activities are highly dependent on white clover and phosphate inputs. In efforts to develop alternative systems the potential of *S.babylonica* should be further investigated, especially:

- production potential under limiting soil fertility, especially, Phosphorus availability
- advantage over white clover/grass mixtures in accumulating fodder biomass over the entire growing season
- optimizing yield and fodder quality towards the end of the growing season
- complementary properties with white clover based grasslands
- harvesting systems that optimize labour inputs

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