Broussonetia papyrifera in Ghana: Its Invasiveness, Impact and Control attempts

Paul P. Bosu and Mary M. Apetorgbor
Biology and Forest Health Division Forestry Research Institute of Ghana

Introduction

Broussonetia papyrifera (Paper mulberry) is a woody perennial of the family Moraceae, and is native to Japan and Taiwan. It thrives well in a wide range of habitats including humid tropics, subtropics and temperate environments. It is believed to have been introduced into Asia, Europe, and the Pacific Island countries in ancient times. *Broussonetia* is cultivated for a variety of purposes; as shade tree, in home gardens for soil stabilization, glue from the sap, and more popularly production of traditional 'tapa' cloth from the bark. Paper mulberry has also been introduced into the United States and known to occur from Illinois to Massachusetts, southward Florida, and westward to Texas. In Africa it is known to occur in at least two countries - Ghana and Uganda.

Paper mulberry was introduced into Ghana in 1969 by the Forestry Research Institute of Ghana (FORIG). The reason for its deliberate introduction was to evaluate its potential for pulp and paper production. However, the plant has now become invasive of alarming proportion. It is perhaps the most serious non-indigenous woody invasive plant in the closed forest zone of Ghana and the second most important plant invasive after *Chromolaena odorata*. It is known locally as 'York', the name of the Technical Officer who worked on the plots during the experimental trials of the 1970s.

Distribution and Impact

In Ghana, paper mulberry is highly concentrated in the two forest reserves, namely Pra-Anum and Afram Headwaters Forest Reserves. It is in these forest reserves that the initial experimental trial were carried out. The two reserves are located within the Moist Semi-Deciduous (MSDF) and Dry Semi-Deciduous Forest (DSDF) zones, respectively. These two forest types are types among the most floristically diverse and economically important of all the forest types in Ghana. The high concentration of paper mulberry in these two reserves and nearby reserves or forests were facilitated by extensive deforestation and bushfires. From these two centers, the plant is spreading

extensively. Dense stands of *Broussonetia* can be seen conspicuously in farms and along roads in and around Pra-Anum and Afram Headwaters forest reserves. The species is spreading to other areas up to perhaps 100 km from these point of introduction

Invasiveness and Impact

In the Pacific Islands paper mulberry is not invasive because only male clones were introduced. Thus, no seeds are produced and propagation is by vegetative means, using root shoot suckers. In Ghana and other places where both fertile male and female plants were introduced the invasive potential of the plant increases significantly. In Ghana, the tree fruits twice in a year and the fruits are dispersed over long distances by fruit eating birds and bats (Agyeman 2000). The seeds rarely germinate in dense canopy forests (Agyeman 2000), however, in large canopy gaps, roadsides, and abandoned farmlands regeneration is very prolific. The rapid spread of paper mulberry in Ghana has been facilitated by the high rate of deforestation in recent times.

Another characteristic that promotes the invasiveness of *B. papyrifera* is its ability to resprout from roots. Trees form a dense mat of roots which shoot up randomly at short intervals when growing conditions are right. Together with its high growth rates paper mulberry competitively prevents the regeneration of most indigenous species.

Management Attempts

In 2006 the Forestry Commission of Ghana acquired funds from the African Development Bank to carry out on-farm research activities in community forest plantations. The project was to be carried out in five degraded forest reserves, under the Community Forest Management Project (CFMP). Afram Headwaters Forest Reserve was among the five reserves selected. With *Broussonetia* as a major limiting factor to tree regeneration its control was considered on the Project.

FORIG was tasked by the Forestry Commission to evaluate management strategies for *Broussonetia*. Consequently, the following objectives were set for investigations, a) impact of the species on livelihoods of rural communities, b) evaluation of various control methods, c) evaluation of agroforestry techniques to suppress regeneration, and

d) studies of the physical and mechanical properties of the as wood. In this article we provide a synopsis of the various control methods used under item b.

Experimental Evaluation of Various control methods

Broussonettia papyrifera (Yorke) was classified as either pole-size tree or shrub. Several control strategies were designed to test their impact on the pole-size trees as well as the shrubs.

Trials on Shrubs

A *Nauclea diderrichii* plantation with dense growth of *Broussonetia* was selected for the trial. Four experimental treatments were randomly applied to sixteen 5m x 5m size plots in the plantation. These were i) Manual removal, ii) Direct herbicide application, iii) Cut-and-squirt (I), and iv) Cut-and-spray (II). Prior to application of control treatments the per cent cover of *B. papyrifera* was estimated in each plot. The herbicides used were a systemic triclopyr-based tree killer (I) and a glyphosate weedicide (II). Per cent *B. papyrifera* cover was then assessed after week one, three and ten. Manual removal (uprooting) and Cut-and-squirt I effectively killed or suppressed regeneration and reduced post-treatment cover of *Broussonetia* (Table 1).

Table 1. *Broussonetia papyrifera* stand (%) in plots before and after application of experimental treatments

Treatment	**% Cover by Broussonetia/ Plot**	
	Initial cover	**After 10 weeks**
Manual removal	75	4
Herbicide	22	18
Cut-and-Squirt I	42	2
Cut-and-Spary II	55	50

Trials on Pole-size trees

Twenty-two pole-size trees were selected along a major highway for the trial. This highway runs through the middle of the Afram Headwaters F.R. The trees were paired by size (diameter and height) and proximity. One tree of each pair was randomly

selected as the treatment tree and other as the control tree. Treatment trees were first girdled at breast height with a cutlass to a length of about 30-45cm, all around the bole. The girdled portions were then squirted with Triclopyr using the manufacturer's recommendation. Control trees were girdled but not treated with the chemical. Trees were evaluated for per cent defoliation and mortality at weeks one, three and 10. The treated trees experienced an average of 40% defoliation after the first week, and an average of 81% defoliation by the third week. By the 10^{th} week all eleventh treated trees had died. None of the control trees died though average defoliation of up to 38% was observed by the third week.

Table 2. Mean of *Broussonetia papyrifera* pole-size trees following application of experimental treatment.

Treatment	**Mean % Defoliation**	
	Week 1	**Week 3**
Girdle + Squirt	40	81
Girdle only (Control)	7	38

Conclusion

Manual removal of shrubs (uprooting) and cut-and-squirt with triploclor were effective at controlling shrubs. Girdle and squirt with triploclor was also effective at killing pole-size trees. The other treatments did were not as effective or were only effective for a short time. Other control strategies are currently being experimented. Further studies planned including a) nation-wide assessment of the distribution of the species, b) studies of the ecological impact of control on the forest ecosystem, c) environmental impact of chemical control, and d) public education and integrated control approach that includes all major stakeholders.

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