CHAPTER 1

INTRODUCTION

Bananas are an important commodity crop around the world. According to cytogenetic and classification studies of collected *Musa* germplasm, they are believed to have originated in Southeast Asia and are considered one of the earliest cultivated fruits (Molina, 1998). Today, bananas are the second largest produced fruit crop in the world after citrus and recognized as the fourth most important food crop in terms of gross value, after rice, wheat, and maize (Sundararaju, 1998). Bananas are considered to be one of the most important sources of energy in the diet of people living in the tropical humid region and grown in more than 120 countries. Some advantages include: their non-seasonal fruiting; their provision of farmers with a regular source of food and continual income throughout the year; their quick maturation (often in less than a year); their potential, with good maintenance, to remain productive for 20 years or more; their high productivity, at 40-50 tons of fruit per hectare per year; and their wide geographical adaptation with proper cultivar selection (Molina 1998). In the poorest countries of Africa, Latin America and Asia, almost 90% of production is consumed in the production area (Aurore, 2009). The fruit is not the only important part of the plant. Banana leaves are used in cultural and religious ceremonies as well as for wrapping and packaging food. Banana flowers are cooked and added to dishes. Banana pseudostems can be dried for rope, eaten as a vegetable, or used in animal feed as a source of fiber.

Although the majority of bananas are grown for fruit, the use of bananas and their pseudostems in animal feed has long been used throughout the tropics. In Northern Thailand, an area that considers bananas as a "part of life" (Tongdee, 2010), stalks are commonly used as a pig feed. These stalks are sometimes fed raw, but often cooked and served with other, more nutritious types of feed (such as grains, fruit and vegetables) to provide a more balanced diet for the animals. This is more affordable than traditional feed for the average farmer and can be grown on his own land. In one study researching the chemical composition of banana, *Musa cavendishi* stalks were found to contain 9.8% dry matter (DM), 8.8% crude protein, 31.7% crude fiber, 35.2% cellulose, and 9.2% lignin in dry matter (Viswanathan, 1989). One barrier to using bananas as pig feed is that large numbers of stalks are needed if raising animals for even a small commercial business. One adult pig can eat 20 stalks in six months (Tongdee, 2010). Using the stalk before the plant fruits enables farmers to harvest more frequently, but reduces time for the production of sword suckers to replace the removed stalk. In addition, more recently, the new innovation of fermenting sliced banana stalks has created additional demand for bananas.

Upland Holistic Development Project (UHDP), Heifer Thailand, as well as numerous other NGOs and institutions working with farmers in Northern Thailand, are promoting fermented banana stalks as an alternative feed source for pigs and other animals. Chopped banana stalks are combined with molasses and salt and allowed to ferment before feeding it to the pigs. Fermentation substantially increases the number of various digestible bacteria in the presence of lactic acid, which is produced in the fermentation process. One study showed that the process of fermentation increased

the enzyme activity to 1.83 IU/mL/min after 72 hours (Shafique, 2004). Fermentation increases digestibility, making the stalks significantly more nutritious and also enabling farmers to save on wood fuel previously used for cooking banana stalks. The fermented banana stalks can also be mixed with other locally grown feed to further increase nutritional content. In addition to pigs, UHDP has been experimenting with using the fermented banana stalks as feed for other animals, such as chickens, ducks and even cattle (Tongdee, 2010).

In Thailand, farmers primarily cultivate the 'Kluai Nam Wa' cultivar, producing 1,095,475 tons per year or 82.3% of total banana production in 1998 (Wattanachaiyingcharoen, 1998). 'Kluai Nam Wa' grows faster than many other varieties, produces more suckers in a shorter amount of time, and farmers can consume all parts of the plant – stalk, fruit, and blossom; however, even this fast-growing variety has not been able to meet the increasing demand for more bananas. Farmers are in need of affordable planting material. Therefore, simple, low-technology methods to produce high quality planting material are crucial to the development of local agriculture in Northern Thailand.

At present, there is not an adequate supply of banana planting material in Northern Thailand. "In the last 20 years, demand from farmers and development organizations for quality planting material has increased" (Lefranc, 2008). Currently, large corporations or universities are doing most of the plant production through tissue culture. This is expensive for farmers, and they are more likely to plant diseased material or non-resistant material from suckers off their own stock. A

survey carried out by FAO showed that "traditional suckers are being used as planting material by more than 92% of the growers across the world while approximately only 8% have access to tissue culture based planting material" (Singh, 2011). Farmers would greatly benefit from a more affordable and widely available option for obtaining planting stock. Inexpensive multiplication techniques are needed which can be easily implemented by farmers.

In the past, there has been some research on rapid banana multiplication, using low input, inexpensive, macroproduction techniques, but these have been conducted primarily in Africa and South America. At present, these techniques are not yet being widely used or promoted throughout the world. It is unclear whether this is due to lack of success from those replicating the techniques or from the lack of adequate education, promotion and training. Very little of this research has been reported in the available literature, which means there is great opportunity to study what techniques are most effective in Southeast Asia. Additionally, any resulting information will be beneficial to local farmers of northern Thailand, as it will enable them to propagate their own bananas, without significant financial burden, for human consumption or livestock feed production, providing them with a more sustainable lifestyle.

The objective of this research is to determine the most effective propagation methods of *Musa* (ABB) cv. 'Kluai Nam Wa' in Chiang Mai Province, Thailand. Additionally, the effects of the factors of time and location on the growth of banana plantlets will be explored.