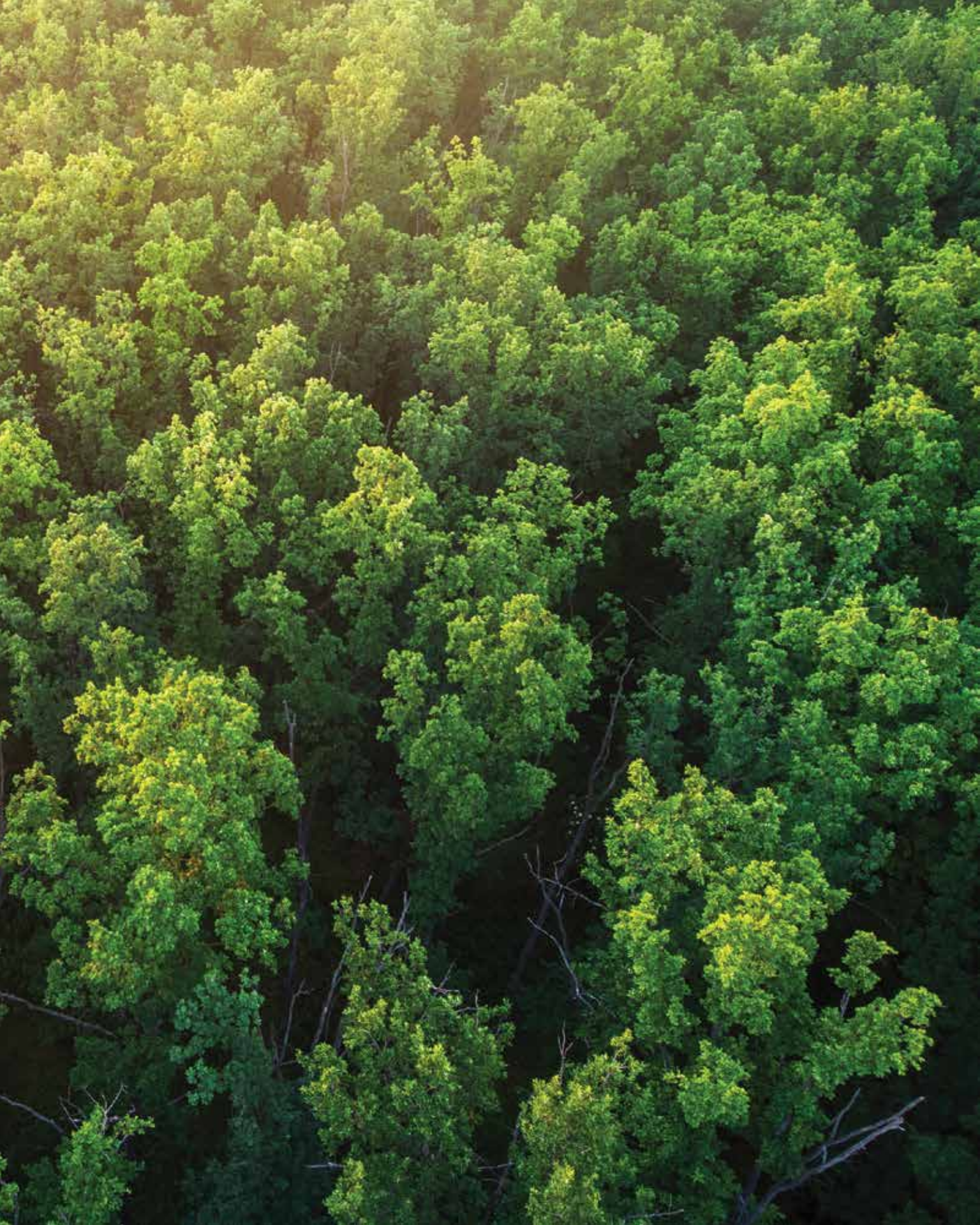
Introduction

section 1



1.1 WHAT IS FORAY AND WHY IS IT IMPORTANT?

Foray biorational insecticide technology is based on the gram-positive, rod-shaped bacterium *Bacillus thuringiensis* spp. *kurstaki* Strain ABTS-351, commonly known as Bt or Btk. The vegetative cells of Bt contain spores which enable it to survive in an adverse environment and reproduce in a favorable environment. During spore formation, the bacterium also produces unique crystalline proteins called delta-endotoxins. Together, the endotoxins and spores are toxic to many tree defoliating lepidopteran larvae.

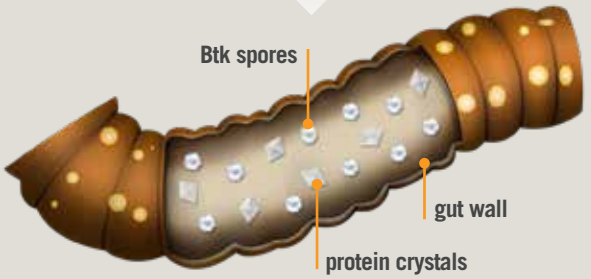
Foray was developed in response to the growing concern among the scientific community, policy makers, and the public in the 1960s and 70s regarding the use of synthetic chemicals in pest control. As it is derived from a ubiquitous, soil-borne bacterium, Btk is "friendly" to human beings, birds, fish, and other animal species because its activity is limited entirely to susceptible caterpillars.

The inert ingredients in Foray, which include various carriers, suspension agents, and stabilizers, are classified by the US Environmental Protection Agency (EPA) as inert ingredients of minimal toxicological concern to non-target organisms and

Figure 1.2

How Foray Works

Target pests ingest Btk protein crystals (protoxins) when feeding on treated leaves. Feeding stops within minutes as crystals are solublized in the gut and immediately begin damaging gut walls.



Btk spores germinate and pass through the compromised gut wall, causing blood poisoning.

Larvae perish in 1 to 3 days from a combination of sepsis and starvation.

the environment (List 4), and are Generally Recognized as Safe (GRAS).

This combination of efficacy and target specificity is what makes Foray biorational insecticide so important for forest health professionals around the world. In today's climate of sustainability and stakeholder awareness, forest program managers need highly effective tools that are safe and proven. Just as Btk exhibits a powerful insecticidal activity specific to caterpillar pests, Foray does not exhibit any of the hazards often associated with broad-spectrum chemical insecticides.

Several Foray formulations are available for control of forest defoliators. They are:

- **Foray 48B** 48 CLU*/gal (12.7 CLU/L)
- **Foray XG** 48 CLU/gal (12.7 CLU/L)
- **Foray 76B** 76 CLU/gal (20 CLU/L)

*Cabbage Looper Units: the standard measure of potency for Btk

Each of these products offers unique characteristics to address the diversified requirements of local pest control programs and aerial or ground applications.

1.2 HOW DOES FORAY WORK?

Btk is active only on the larval (caterpillar) stages of Lepidoptera, and must be ingested by the caterpillar to be effective. Activation of Btk toxic proteins takes place in the insect's mid-gut where the caterpillar's unique, alkaline pH and enzymes break the crystal down into smaller active toxins. (See **Figure 1.2**)

These activated toxins then bind to the cell membrane lining the gut, generating pores that lead to cellular swelling and lysis (disintegration of the cell wall). The effect of this process on the insect host is a complete cessation of feeding

(usually within an hour), lysis of gut lining cells through the action of active toxins, perforation of the intestinal wall, septicemia (blood poisoning), and ultimately death of the larvae.

Different subspecies of Btk have different protein crystals composed of specific toxin combinations. For example, Foray Btk contains four crystal-shaped toxin subtypes - CryIA(a), CryIA(b), CryIA(c), and CryIIA.

Sustainability

Foray is based on the ubiquitous, naturally-occurring soil-borne bacterium, *Bacillus thuringiensis* spp. *kurstaki* Strain ABTS-351 (Btk). While highly effective against various species of Lepidoptera, Btk has little to no impact on non-target species and the surrounding environment.

Each toxin aligns with a specific receptor site on the insect gut for binding (and subsequent gut wall disruption) to occur.

An insect must have the receptor sites for the specific Bt toxins to bind to in order to be susceptible to the insecticide. This unique 'lock and key' feature is what differentiates Bt from other types of bacteria and modes of action.