GROWERTALKS

Pest Management

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What Impacts the Effectiveness of Translaminar Pesticides?

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There are a number of different pesticide types—in this case, insecticides and miticides—used to suppress insect and mite pest populations in greenhouses and nurseries, including contact, stomach poison, systemic and translaminar.

Translaminar pesticides are widely used against an assortment of pests, including spider mites, leafminers and thrips because the active ingredient is distributed into plant tissues where these pests feed. (The translaminar pesticides commercially available are listed in Table 1.) Translaminar or “local systemic” activity refers to absorption by one side of the leaf surface so that the active ingredient is available to insect and mite pests feeding on the other or untreated leaf surface. The active ingredient penetrates leaf tissues and forms a reservoir of active ingredient within the leaf that can persist for up to 14 days, although persistence is dependent on the specific translaminar pesticide.

A multitude of factors associated with plants may influence the activity of translaminar pesticides, including leaf structure (surface), leaf age and development stage of plant growth. Translaminar pesticides may enter the plant leaf after application, with penetration occurring primarily through the leaf cuticle. The mechanism involved in penetration and movement into leaves via the leaf cuticle is by diffusion, which involves the movement of compounds from a region of higher concentration to one with a lower concentration. The distance by which translaminar pesticides diffuse across the leaf may be affected by the leaf cuticle.

Pictured: Leaves covered with insecticide spray solution. The leaf cuticle can prevent the movement of translaminar pesticides into leaf tissues

The leaf cuticle functions as a barrier that can inhibit absorption, penetration and transport of foliar-applied pesticides into the leaf. The leaf cuticle is very lipophilic [an affinity for dissolving in lipids (fats)], which can impact penetration into the leaf. The permeability of the leaf cuticle is an important factor that can influence penetration and subsequently movement through leaf tissues, and varies depending on the presence of cuticular waxes on the leaf surface. Leaf cuticle permeability can differ among plant species and cultivars, therefore, reduced penetration and movement through the leaf tissues may indirectly impact suppression of pests with translaminar pesticides.

However, any variations affiliated with penetration through the leaf cuticle may be due to differences in cuticular waxes and leaf cuticle thickness, which is primarily a function of plant species. For instance, leaf cuticle thickness may impede penetration by inhibiting the diffusion process and ability of translaminar pesticides to enter the leaf and move into areas where pests are feeding. In addition, leaf cuticle thickness may differ between the top and bottom of the leaf surface. Moreover, surface or embedded layers of waxes may hamper penetration of translaminar pesticides, as well as leaf pubescence or the presence of trichomes (hairs), which adhere to spray droplets and can inhibit penetration through the leaf cuticle.

Environmental factors—including temperature, sunlight and relative humidity—can also affect cuticle thickness or leaf rigidity. Both ambient and leaf temperature, in fact, can affect penetration through the leaf cuticle and thus impact efficacy. For example, studies have shown that cooler environmental conditions lead to reduced efficacy of translaminar pesticides compared to warmer temperatures. The proposed mechanism responsible for this difference is that higher temperatures change or alter cuticular waxes (long-chain alcohols, fatty acids and hydrocarbons), thus increasing permeability and transport across the leaf cuticle.

Plant growth rate or age may directly impact the effectiveness of translaminar pesticides. Applications to plants producing vigorous leaf growth may result in greater efficacy against pests compared to plants not actively growing or flowering, which may be affiliated with increased leaf rigidity and/or a thicker cuticle (older or senescing leaves). Furthermore, the cuticle of new or young leaves may be thinner and thus more permeable than mature or older (thicker) leaf cuticles.

However, in some cases, thicker cuticles are more permeable than thinner cuticles, which could enhance translaminar movement, thus resulting in increased efficacy against the target pest. The uptake of compounds may occur more efficiently through the lower leaf surface than the upper leaf surface, whereas in other cases, it’s the opposite. In addition, absorption through the leaves may be influenced by the wax content on leaf surfaces and presence of stomates on the underside of leaves.

Plant type may influence the activity of translaminar pesticides. For example, translaminar activity of imidacloprid (Marathon) against the green peach aphid (*Myzus persicae*) on cabbage (*Brassica oleracea*) leaves was better than acetamiprid (TriStar), whereas acetamiprid was more active on melon aphid (*Aphis gossypii*) feeding on cotton (*Gossypium spp*.) leaves than imidacloprid. In addition, reports have indicated that plant type may impact the efficacy of pymetrozine (Endeavor) because the rate of penetration and subsequent translocation may vary in different plants.

The activity of translaminar pesticides may be affected by surfactants that enhance penetration through the cuticle and into leaf tissues by reducing the surface tension of spray droplets on the leaf cuticle, thus increasing the total surface area covered. However, increased surface area covered and penetration depends on the type of surfactant and concentration applied. Horticultural and mineral oils reportedly increase the activity of certain translaminar pesticides (e.g., abamectin or Avid) by improving penetration through the cuticle layer and permitting compounds to remain in solution longer, which reduces evaporation from leaf surfaces and allows more time for the pesticide to penetrate the leaf cuticle.

The physical characteristics of pesticides impact the ability of certain pesticides to have translaminar properties. For example, the primary reason why pyrethroid-based insecticides (e.g., bifenthrin, cyfluthrin, lambda-cyhalothrin, fluvalinate and fenpropathrin) have minimal translaminar activity is due to their high lipid solubility in leaf waxes. Their lipid solubility is much greater than their water solubility so that they only remain in the cuticle and do not move inward and subsequently distribute themselves into the vascular tissues.

In conclusion, this article was developed to help greenhouse and nursery producers understand the factors that may influence the activity of translaminar pesticides, such as the leaf cuticle, which is associated with thickness and waxiness of the leaves of certain plant types. Therefore, the information presented in this article should be helpful in maximizing the effectiveness of translaminar pesticides. **GT**

> Table 1. Common and trade names of pesticides (insecticides and miticides) with translaminar activity labeled for use in greenhouses and/or nurseries.
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> Common Name (Active Ingredient) — Trade Name
> Abamectin — Avid
> Acephate — Orthene
> Acetamiprid — TriStar
> Chlorfenapyr — Pylon
> Cyantraniliprole — Mainspring
> Cyromazine — Citation
> Dinotefuran — Safari
> Etoxazole — TetraSan
> Flonicamid — Aria
> Imidacloprid — Marathon
> Novaluron — Pedestal
> Pymetrozine — Endeavor
> Pyridalyl — Overture
> Pyrifluquinazon — Rycar
> Pyriproxyfen — Distance/Fulcrum
> Spinosad — Conserve
> Spiromesifen — Judo
> Spirotetramat — Kontos
> Thiamethoxam — Flagship

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