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RECENT RESEARCH ON CONTROLLING BIRD DAMAGE TO BLUEBERRIES

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Bird damage to small fruit and berry crops is a nationwide problem that results in millions of dollars of lost income annually (Besser 1985, Avery et al. 1992). In recent years, growers of blueberries, cherries, and other small fruit crops have experienced increasing difficulties managing bird damage to their crops. This is at least partly because methiocarb is no longer available for use as a bird repellent (Tobin and Dolbeer 1987). Although methiocarb appears to pose no lethal threat to target or nontarget species (Dolbeer et al. 1994), the previous registrations for its use on fruit crops lapsed when the manufacturer opted not to fulfill additional data requirements for the U.S. Environmental Protection Agency (Tobin and Dolbeer 1987, Avery et al. 1993a).

With the loss of methiocarb as a bird repellent, there has been an increasing need for alternative approaches that will safely and effectively deter avian depredators. Here, I will focus on 3 areas of research that we have recently explored. The first involves possible exploitation of an inherent physiological digestive constraint shared by many fruit-eating bird species. The second centers on the potential bird deterrent properties of an insecticide currently registered for use in blueberries. The third concerns recent field tests of a bird-aversive compound that is commonly used as an additive in human foods.

Altering Fruit Sugar Composition

One possible component of an integrated avian depredation management strategy is the altering of characteristics of

cultivated fruits and berries to reduce their attractiveness to birds. Fruit size can be a determinant of the food selection behavior of avian frugivores (e.g., Martin 1985), and given a choice birds tend to prefer smaller fruit which are more efficiently handled than are larger fruit (Avery et al. 1993b).

Chemical composition of fruits also affects attractiveness to birds. In particular, it is known that European starlings, American robins, and other major fruit depredating species prefer the simple hexose sugars, fructose and glucose, to sucrose (Martínez del Rio et al. 1988, Brugger and Nelms 1991, Brugger et al. 1993). The preference for hexose sugars and the avoidance of sucrose by these species is related to an enzyme deficiency that prevents the birds from digesting sucrose (Martínez del Rio and Stevens 1989, Martínez del Rio 1990).

It has been proposed that increasing the sucrose content of cultivated blueberries, strawberries, and other small fruit can reduce the value of these fruit as a food source for depredating birds (Brugger et al. 1993). Support for the feasibility of this approach has been obtained in recent plant physiological research conducted at the University of Florida (Darnell et al. 1994).

In recent feeding trials involving cedar waxwings and European starlings, we corroborated and extended earlier findings (Avery et al. 1995). We showed that both species can learn to associate visual cues, such as color and location, with sucrose and to reduce consumption of artificial fruit paired with the appropriate cue. In starlings, the avoidance response is rapid and persists even after the sucrose is removed.

Because starlings, robins, and other frugivorous species lack the intestinal enzyme necessary for hydrolysis and digestion of sucrose (Martínez del Rio and Stevens 1989), sucrose ingestion by these birds results in an osmotic imbalance that is distressful or even fatal (Schuler 1983, Martínez del Rio et al. 1988). This motivates birds that experience intestinal distress to avoid sucrose thereafter. On the other hand, cedar waxwings are able to digest sucrose, but they do it inefficiently, probably because of rapid gut passage rate (Martínez del Rio et al. 1989). The less efficient digestion of sucrose keeps their blood glucose level low, and consequently birds that consume sucrose remain hungry. Thus, in choice tests, waxwings learn to prefer hexose sugars over sucrose (Martínez del Rio et al. 1989), but their response is slower and not as emphatic as that of the starlings. Cedar waxwings may attempt to compensate for their inefficient digestion by increasing their intake of high-sucrose fruit, but their rate of intake is limited and they are unable to maintain positive energy balance eating sucrose fruit.

An accelerated program of varietal improvement, either through traditional plant breeding or using molecular genetic approaches, will enable high sucrose cultivars to be produced and evaluated. It will then be possible to incorporate this facet of bird depredation management into integrated strategies to reduce growers' losses.

Imidan Repellency

Phosmet is the active ingredient in Imidan(R), an insecticide registered for use on a variety of crops, including blueberries. There have been unsubstantiated reports that birds in the field are repelled by phosmet-treated food, but experiments to evaluate this had not been performed. Thus, we conducted 2-cup feeding trials with captive cedar waxwings, European starlings, and American robins to assess their responses to food adulterated with phosmet. Each bird received one cup of untreated fruit mash and one cup of fruit mash treated with a pre-determined level of phosmet. We measured consumption after 3 hours on each of 5 days.

Responses to phosmet-treated food were consistent across species in that all were deterred by concentrations of 100 pm or greater, and all reacted with indifference to the 10 ppm level. The allowable phosmet residues on fruit at harvest range from 5 to 10 ppm, although concentrations on fruit soon after application may be 20-60 ppm or more (Crites, W., unpublished). Thus, when applied to fruit, phosmet may have an initial repellent effect that could be exploited in the management of birds that cause millions of dollars worth of damage annually to crops such as grapes, cherries, and blueberries. This possibility needs to be further evaluated, particularly given the current lack of alternative repellent materials for bird damage control.

Methyl Anthranilate Field Trials

Methyl anthranilate (MA) is a fruit-flavored food additive approved for human consumption by the U.S. Food and Drug Administration that is offensive to birds (Kare 1961, Mason et al. 1991). Although MA has proven effective as a feeding deterrent in a variety of situations (e.g., Cummings et al. 1991, Mason et al. 1991), investigations of its effectiveness as a bird repellent on fruit crops have produced mixed results. Some (Askham 1992) have reported successful reductions in bird damage to blueberries and cherries, while others (e.g., Avery 1992, Cummings et al. 1995) have found MA treatments to be ineffective.

In 1994, with the support and cooperation of the North American Blueberry Council, we evaluated the bird repellency of ReJeX-iT AG-36 (PMC Specialties, Cincinnati, OH) methyl anthranilate (MA) formulation at 2 sites near Salem, OR and 1

site each near Mt. Vernon and Lynden, WA and Fenville, MI. At each location, a 1-ac test plot was sprayed 3 times, each application consisting of 15 gal of ReJeX-iT AG-36 in 60 gal of water which yielded a single application of approximately 20 pounds of MA/ac. Each plot was sprayed initially 7 days prior to the first picking and then immediately after the first and second picking. Thus, total application for the season on each study plot was 45 gal of ReJeX-iT AG-36, or approximately 60 pounds of MA.

We recorded yields from each sprayed plot and from nearby 1-ac control plots that were similar in age, variety, and yield history. In addition, we marked 50 branches of 20 berries each in the sprayed and control plots and we recounted the fruit 1, 3, 7, 14, and 21 days after the initial application.

At only 1 of the 5 sites did the yield from the treated plot exceed that of the control plot. Furthermore, numbers of berries lost to birds from the marked branches in the sprayed plots exceeded numbers lost to birds on the control plots.

Analyses of MA residues from berries collected at each site indicated a mean of 77 ppm MA on fruit immediately after spraying, with degradation to 20 ppm, 4 ppm, and 2 ppm after 1, 3, and 6 days postspray, respectively. Thus, it appears that the airblast application technique and the high volatility of the MA combined to produce MA concentrations on the fruit that were too low to be effective against bird depredators.

Future Plans

Regardless of the control technique used, it will be most effective if implemented before birds become established at the site. Furthermore, combinations of methods will generally produce better results than will techniques applied individually. Netting, properly installed and maintained, is probably the only sure way to eliminate bird damage. Nonetheless, we are continuing to test and evaluate new nonlethal approaches, chemical and nonchemical, that can be incorporated into effective programs to manage bird damage in blueberries and other small fruit crops. In the immediate future, our plans include investigating the feasibility of bringing methiocarb back as a bird repellent in fruit crops, as well as continued research into the interactions between fruit sugars and fruit-depredating bird species.

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