Netting Applications for Agricultural Bird Control

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Abstract: Bird control in agriculture is an age-old problem. Techniques range from various types of lethal control to hazing and exclusion. Netting is used effectively in several forms of agricultural bird control. In grapes and blueberries, netting is applied by the row or in an overhead canopy fashion. Netting is also used in aquaculture to eliminate damage from wading birds. No one debates the effectiveness of net, however, the application and retrieval has been so problematic as to make the process not worth pursuing. In recent years, significant advances have been made in the field of mechanized net application and retrieval. These advances combined with innovative applications in aquaculture and other industries bring the use of netting for agricultural bird control to a new level of effectiveness.

Key Words: NetMaster™, bird netting, vineyards, blueberries, aquaculture, exclusion, bird control, European starlings, robins, house finches, cedar waxwings, egrets, herons

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INTRODUCTION

To the uninitiated, birds seem to be everything but crop marauders or killers of anything other than unwanted "bugs." Regarded for centuries as worthy of study and even worship, birds have seldom been spoken or written about in the same context as "pests." The reality with agricultural pest birds is far different than the perception most people have of birds in general.

Pest birds cause a number of problems in agriculture. Crop damage in grapes and blueberries ranges from missing fruit to bird-caused berry imperfections, which increases susceptibility to insect damage or disease. Aquacultural damage takes a similar pattern, ranging from fish kill to injury that results in higher disease rates. In both industries the culprit comes from the sky.

VINEYARD BIRD CONTROL

In the grape industry, specifically wine grapes and premium table grape varietals, bird damage is too costly to ignore. Much time is spent discussing and developing techniques for bird control (Taber and Martin 1998). The average vineyard manager spends most of his time coordinating a myriad of operations and bird control is often overlooked. Vineyard economics in the late 1980s and all through the 1990s forced grape growers to re-examine the issue of bird control. Unacceptable losses of multiple acres in a few days added up to almost unbelievable costs. Premium varietal winegrapes range from approximately $1,000 per ton to as high as $3,500 per ton. With an average yield of 3-5 tons per acre, growers face potential losses of $3000 to $17,500 per acre to birds. These kinds of numbers are a shock to a growing industry. This shock demands a solution.

Problem Birds

No less than 25 species feed on wine grapes in the Almaden vineyard at Paicines, California (Boudreau 1972). The culprits in the grape industry are all too common throughout all growing regions. European starlings (*Sturnus vulgaris*), robins (*Turdus migratorius*), and house finches (*Carpodacus mexicanus*) account for the majority of damage. Other birds that also cause damage are cedar waxwings (*Bombycilla cedrorum*), Bullock's orioles (*Icterus bullockii*), mourning doves (*Zenaidura macroura*), California quail (*Lophortyx californicus*), bobwhite quail (*Colinus virginianus*), and turkeys (*Meleagris gallopavo*).

Starlings, robins, and house finches are what growers focus on. Each bird has its own feeding characteristic, with robins and house finches being similar in methodology, but not damage.

Starlings occur in very large numbers throughout North America. Jewett (1942) first recorded the starling in California from a specimen taken at Tulelake, Siskiyou County, on January 10, 1942. Since this date, California's starling population has increased into the millions (Palmer 1972).

Most of the grapes grown in the U.S. are produced in California. Smaller acreage of vineyards can be found on the East Coast in upstate New York and Long Island as well as in states such as Kansas, New Mexico, Arizona, and Colorado. California, because of habitat and climate, supports a tremendous population of resident starlings. This resident population, combined with migratory birds, can decimate a crop and cause huge financial losses in a short period of time.

Starlings are canopy feeders, meaning they drop down through the top of the vine canopy and feed on clusters of grapes. Being a flocking bird, they are easy to identify because they are usually present in large numbers. Starlings take the entire grape from the cluster, sometimes stripping the cluster completely. This is a common characteristic they share with robins and turkeys. This characteristic allows savvy vineyard managers to identify their problem birds without actually

seeing the birds, but by carefully examining the damage to the crop.

Robins can occur in large numbers during migration, but usually only a few are seen. Because of their solitary nature, they are not as easy to notice as flocking birds and seldom get the credit for being the agricultural pests they are. Robins are ground-based feeders. They will fly into a vineyard, land on the ground between the rows, and begin working their way along from vine to vine, taking whole grapes one at a time. Because of their low visibility, it is very difficult to determine how many robins may be in a vineyard eating grapes at any given point in time.

House finches usually travel in small groups of 5 to 20 birds. Like robins, they are ground-based feeders. House finches cannot take whole grapes, but instead, peck at the berries leaving a characteristic "V"-shaped hole in the grape. They move from cluster to cluster, seeming to randomly damage as much fruit as possible. Because of the way they feed, finch damage usually leads to insect damage and disease in the remaining berries or remnants of berries left in the grape cluster. As with robins, it is difficult to determine how many house finches may be in a vineyard. However, they can be more vocal and usually more active than robins and therefore easier to spot.

Solutions

In the effort to rid vineyards of these pest birds, the short-term solutions of the day seemed obvious— kill the birds. It didn't take long to discover the myriad of problems associated with this approach. What seemed simple and obvious was not. Animal damage control specialists know that lethal control isn't always the best option. Very few vineyard managers are animal damage control specialists.

The search for a solution began. Lethal control was a legal option with starlings and house finches, but not robins, in most cases. For some species, trapping was effective. Hazing was another workable solution. However, it became apparent that some birds existed in such numbers at certain times of the day or year that no matter how many were scared or killed it still wasn't enough to stop the damage. Netting became a viable solution. Practical application and removal of netting was an entirely different matter.

Netting

The simple reason for using netting is that it is a physical barrier, which prevents birds from eating grapes. Several techniques exist that make net exclusion possible in a vineyard. Over-the-row netting allows one to apply netting to the row of vines, taking advantage of the fact that grapevines make an excellent support structure for netting. The complicating factors in this approach include application and removal; tendril growth is another factor, as well as care and management of vines through the netting.

Net Application by Hand

Application and retrieval initially was done by hand. While there are very many trellis choices for growers, it is standard that most vines are 5 to 7 feet tall and 2 to 4 feet wide when the canopy is mature and fruit ready for harvest. This creates an obvious problem of reach, or lack of reach, when it comes to placing netting over the top of the row by hand. This problem was initially addressed by using poles to lift and place the netting properly. While effective, this approach is too time-consuming. Growers manufactured several tractor attachments that would support, somewhat precariously, a full roll of net over the row of vines, allowing netting to be rolled out as the tractor was driven between the rows. This approach was far more effective time-wise, but very dangerous because of the heavy rolls of netting and uneven surfaces often present in vineyards. In addition, retrieval of the netting was a failure because it was so difficult to get netting wound back up tightly. Pre-harvest removal and off-season storage of used material usually resulted in more damage to the net than it received while in place protecting the crop.

Mechanical Application of Netting

Because the use of netting was economically driven in the first place, the demand arose for a commercially available tractor attachment that would apply and retrieve netting. In 1997 Wildlife Control Technology, Inc. provided that piece of equipment. Wildlife Control Technology, Inc. in cooperation with Andros Engineering designed and built the NetMaster™. This piece of equipment is three-point-hitch-mounted and uses tractor auxiliary hydraulics to apply netting fed from a spool to grapevines.

To begin the application process, a spool of netting is placed on the drive axle of the NetMaster™ and netting is pulled off, lifted, and fed through a directional sweep. As the net comes off the spool and through the sweep it is distributed high over the grapevines, making it easy for a person walking along the vines to grab the edge of the net and pull it to the ground. One spool can carry from 1,250 to 2,500 feet of 14-foot, 17-foot, or 20-foot-wide netting, depending on the strand thickness of the product.

This application process, combined with a relatively small tractor attachment in the form of the NetMaster™, has revolutionized crop protection. At a rate of 2-4 acres per hour, vineyards are now netted faster than ever. In addition, the netting is retrieved and stored quickly and efficiently on the same spools used for application. The key to this system is the way the equipment lifts and rewinds the netting onto the spools. The retrieval process is essentially the reverse of the application process, with the netting being lifted off the vines and hydraulically rewound onto the same spool used in application. This system allows growers to choose what width and length of netting that will best work for them and custom apply it according to their own management practices.

Other Methods of Vineyard Netting

Not all vines need to be netted using the over the row approach. Vertically trellised vines allow the grower to attach netting strips 2-4-feet in width to a top and bottom wire on either side of the "fruiting zone." This is the area on the grapevine where the fruit hangs. By attaching the net strips on both sides of the vines, you can sandwich the grapes between two strips of netting. This approach works very well in smaller vineyards where the use of a NetMaster™ is not economically possible.

Some vineyards have chosen an overhead canopy approach. By attaching pieces or panels of netting together and supporting them, it is possible to create a bird-proof overhead canopy. The biggest advantage is that vines can be monitored, pruned and managed under the net canopy. Overhead canopies are detailed later in this discussion.

In every case, vineyard netting must be removed prior to harvest. Given the nature of the damage, the financial impact and the difficulty surrounding the solution of exclusion, today's grape grower is better equipped than at any time in the past to deal with bird damage by using netting as the primary bird control technique.

BLUEBERRY BIRD CONTROL

Blueberries are grown throughout North America. The prerequisite for blueberries is acidic soil conditions. Once thought to be a primarily cold climate crop, blueberries are now being grown in diverse climates with adjustments being made by plant variety. Hybridization has created a lucrative nationwide industry and demand for premium blueberries.

Problem Birds

The problem birds in blueberries are the same as grapes with one notable exception: cedar waxwings are a major problem throughout the continent, but especially in the eastern and southeastern regions of North America.

Cedar waxwings are extremely efficient feeders, working as a group to effectively wipe out any fruit-bearing crop they find desirable. Because their digestive system works so quickly, cedar waxwings are capable of consuming very large quantities of berries in a day. Cedar waxwings are a light-colored bird, smaller than a robin or starling. They do not occur in flocks numbering in the thousands like starlings can, but it is not uncommon to see 40 or 50 in a group. Cedar waxwings are not as recognizable except for the high-pitched call they frequently make.

Cedar waxwings are very persistent and site oriented. Once they feed in an area, they will return to that area very consistently until nothing remains to be fed on. They are also very skilled in climbing and hovering while feeding. It is not uncommon to see cedar waxwings hanging upside down or hovering like a humming bird while stripping a cluster of berries. This persistence and adaptability, coupled with their migratory nature and therefore need for "fuel," makes them very difficult to control with conventional techniques such as distress calls or other noisemaking devices.

Other birds that commonly damage blueberries are mockingbirds (*Mimus polyglottos*) and western kingbirds (*Tyrannus verticalis*). These birds can be problematic but do not generally do the kind of damage that robins, starlings, house finches, and cedar waxwings do.

Netting

There are two basic approaches to netting blueberries: an overhead canopy system which covers the entire field; or a post and wire supported system, in which each row or pair of rows is covered with bird netting.

Overhead Net Systems

Overhead canopy systems begin with posts and wires to support the net. The post lengths may vary, but as a rule 10-foot to 12-foot posts of wood or metal are used. The spacing of these posts should be approximately every 25 feet. Posts are placed around the perimeter as well as through the interior of the field. Once the posts are in place, cables can be run in both directions perpendicular to each other, intersecting all posts and covering the field. It is also a good idea to put a "cap" on the posts. A plastic cap is available for metal "T" posts. This cap is designed to allow the netting to slide freely over the top of the post, cables, and any attachments used to hold the cable, without snagging.

The support cables, which can range in construction from solid strand wire to 3/16-inch diameter cable, serve two purposes; they are an attachment point for the net, and they elevate the net above the bush so that people and equipment may work under the overhead net canopy. Cables may be attached and terminated at the posts, but in larger fields (over 100 feet in length or width) they should be run through an attachment point, such as an eyebolt or D-ring, on the posts and down to a ground anchor. An earth anchor or pipe in concrete can be used as a solid anchor for the cables. A large overhead net system will put a lot of stress on the cable supports and posts. It is important to use an anchoring system that will properly secure the cable and support the weight of the net. As a general guideline, cables running the long length of the field should be attached to a ground anchor and cables running the short width of the field can rest on top them and be terminated at the perimeter posts.

Once the cables are in place, the netting can be lifted and slid into place. The most common and effective mesh size of netting to use is ¾ inch. This netting is available in 14-foot, 17-foot, and 20-foot widths.

Net installation usually requires 3 or 4 people to slide the net into position and begin to attach it to the cable support system. If one large piece of net is used, two people can begin pulling the net up and over the cables using lengths of rope. The other two people feed the net from the ground, or from an elevated support such as a forklift, with a rug pole and keep it free of any

obstructions or tangles. In this way the netting is systematically guided across the cable support system and field without putting too much weight or stress on any part of the net.

If sections of net are to be used, it is best to start with the first section, partially resting on the cables above the berries, and at a comfortable working height. The next panel can be attached to the first, the net pulled out over the system, and the following panel attached, until all panels are attached to each other and pulled into place over the cable support system. Net panels may be attached to each other using light gauge cable and lacing the two pieces together. They may also be attached by slightly overlapping the panels and hog-ringing them together. Pulling net can be a lot of work if done in windy conditions or if the "netting crew" gets in too much of a hurry. Netting a blueberry field is a mind-over-matter process rather than a brute force effort.

Temporary attachments such as plastic ties or twine may be used to hold the net to the cable support system. All of these attachment devices need to be carefully removed prior to post season net storage. Nothing damages netting more quickly than pulling as hard as you can on it while it's still attached to the support system. The attachments must be placed frequently enough to hold the net in place during weather events. Generally, one point of attachment every 1 to 3 feet should hold, depending on how windy the area is. Prior to net removal, the plastic ties or twine can be quickly cut off with a pair of side cutters.

If a heavy duty-netting product is used and the climate allows it (no snow and ice), a grower may elect to leave the netting in place permanently. If net is to be permanently attached, a more secure attachment device, such as metal hog rings, should be used to hold the net in place. Expect to have yearly repairs due to wind-caused abrasion and foreign objects becoming caught in the net. Most blueberry growers do not have this luxury and are forced to install and remove netting on a yearly basis.

The overhead net canopy is perfect for both U-pick and mechanically harvested berries as long as the system is high enough to accommodate the equipment required. Net should also be draped down the sides of the system and anchored to a cable run at ground level. This will hold the net along the perimeter and act as a tie-down for the side curtain of netting. The side netting prevents birds from flying underneath the net canopy and feeding, which they will do if it is not in place.

An overhead net system allows the grower to operate without any of the access problems normally associated with net. In addition, the canopy is bird-proof and relatively easy to maintain.

Netting Blueberries by the Row

Netting over each row is done several ways. One method involves the use of metal or wood stakes (7-foot or 8-foot), driven in the ground down both sides of a row or rows of blueberries. By spacing the stakes every 25 feet or so, parallel from each other on either side of the row, and running solid strand wire through the tops of the stakes and down the length of the row, an over-the-row support system is created. It is easy to then maneuver the netting, usually 14-17 feet in width, into place over the wire support system and the blueberries. While this technique does not allow unrestricted access to the plant, it is possible to spray, prune, and sample fruit with this system.

Another over-the-row-technique is to construct a "T" out of metal posts, similar to a grape trellis. Solid-strand wires are then run between the posts (spaced again every 25 feet) to act as a support for the netting. These three support wires are run at the top and two outside edges of the "T." When the net is placed over the posts and berry bushes, the wire will hold it above and away from the branches so that the net will not come into contact with the fruit.

It is important when netting blueberries by the row that the net is held and supported away from the canopy of the berry bush. Unlike grapevines where the fruit is somewhat hidden, blueberry plants carry the fruit on the exterior of the leaf canopy. If the netting is resting on this canopy, it will damage the fruit. In addition, birds can simply stand on the net and peck at the berries through the mesh openings.

This row-by-row system is extremely effective, requires less netting than an overhead canopy system, and is easier to maintain. It is not a permanent application and will require the netting to be installed and removed seasonally. The NetMaster™ machine described in the grape section also works well for this application. The net must be removed before mechanically harvesting the crop. For hand harvesting, the netting can simply be lifted up, berries picked, and netting returned to its original position.

Whether a blueberry grower chooses an over-the-row system or an overhead canopy, bird damage is no longer the threat it has been for years, thanks to these innovations in the use of netting.

NETTING FOR BIRD CONTROL IN AQUACULTURE

Bird damage in aquaculture is well documented over the last few years (Parkhurst 1994). In this discussion, we will only cover the use of netting. Pyrotechnics, sound systems, hazing using lasers at night roosts, and many other techniques are used with some success for several bird species that eat fish. However, no simple solution has existed for wading birds until recently.

Wading birds such as common egrets (*Casmerodius albus*) black-crowned night herons (*Nycticorax nyctiorax*), green herons (*Butorides virescens*), and great blue herons (*Ardea herodias*) have been costing fish farmers thousands of dollars a year. By feeding both day and night, this combination of birds has defeated the most determined hazing efforts money can buy. California goldfish farmer Mack Galbreath developed a netting

technique for wading birds that has allowed him to discontinue all other bird control techniques.

Perimeter Netting for Wading Birds

Wading birds, as the name implies, are limited to fishing in water no deeper than they can wade in. Having said this, shortly after net installation excluded them from shoreline access, I observed resident snowy egrets (*Leucophoyx thula*) fishing by hovering over water too deep for them to wade, a classic example of species adaptation to an effective exclusion technique. Fishable water, approximately 12-20 inches deep, is always available near the shoreline of ponds. Most fish rearing ponds are no more than 24-48 inches deep for several reasons. Temperature control, water clarity, weed control, and refuge from predators all have a part in determining optimum pond depth. In addition, fish harvesting (seining) is done mostly by hand, so the pond must be entirely accessible while wearing hip or chest waders. Most ponds slope steeply to maximum depth, leaving a target area of 4 to 6 feet from the bank for wading birds to fish in.

Overhead net systems are effective, given the pond is small enough to net. Pond netting is well documented (Martin et al. 1998), but most fish farming operations have a limited operating budget that does not allow the techniques used in other industries to be applied here. Another drawback to overhead netting of fish rearing ponds is access. Ponds have to be fed, seined, cleaned, and chemically treated to provide the best growing environment. Some of these tasks are difficult if not impossible when the pond is covered entirely from the top and sides.

Wading birds do more damage in many regions than diving birds such as common mergansers (*Mergus merganser*) or double-crested cormorants (*Phalacrocorax auritus*), because they feed both day and night and may occur in larger numbers. Mergansers and cormorants are generally migratory in nature while wading birds such as egrets and herons will quickly become resident if the food source will support them.

The perimeter netting system developed by Mr. Galbreath starts with 1¼-inch mesh extruded polypropylene netting that is 12 feet in width. This net is attached 1-2 feet from the water's edge and secured to a perimeter solid-strand cable that is anchored at shoreline. Metal "T" posts are then driven into the pond bottom approximately 5 feet from the bank along all four of the pond edges. These posts are spaced 25 feet from each other. Solid strand wire is strung between the posts, at the top and at water level. The "T" posts are sticking out of the water approximately 4 feet. The net is pulled from the bank up and over the support wire and posts, and allowed to hang straight down to just above water level. At water level, a single wire is run between the posts for net attachment, if necessary.

This angled "L" of netting excludes all bird access from the shore as well as 5 feet out into the pond. In addition, the free-hanging edge of the net does not allow small herons and egrets to use it as a support to hang on and feed, which they will do with a more rigid structure.

The biggest advantages offered by this system are ease of installation, reduced labor cost, and minimum requirement of materials. By using this system in all of his ponds, Mr. Galbreath has reduced his total bird damage from wading birds and diving birds by over 90% (pers. comm.). Prior to installation of perimeter netting, annual losses of 25% to 30% were common. These losses occurred in spite of full-time bird hazers in pickups using pyrotechnics and lethal control as allowed with depredation permits. The cost for this hazing program averaged $45,000 per year, not including the dollar value of fish lost in spite of the program. Over 5 years (1995-1999), fish losses for the entire operation were approximately $400,000 per year.

This estimate is derived by evaluating the harvest weight of fish from rearing ponds over the course of their growing season. As an example, Mr. Galbreath stated that it was standard practice to put 500 lbs. of fish into a pond with an anticipated harvest of at least 500 lbs. but preferably 600-700 lbs. depending on the final weight of fish grown. Instead, it was typical to harvest 250-300 lbs. of fish from these ponds because of bird losses. In one case in 1999, 500 lbs. of fish were placed in a pond, and only 2 fish were recovered in seining operations when that pond was harvested. All of this damage took place despite the previously mentioned full-time hazing operations and depredation permits.

Mr. Galbreath's entire fish farming operation, which includes two separate locations that total 260 acres, is now covered with perimeter netting. The bird net installation, labor and materials, cost approximately $125,000; however that cost was paid back completely in the first year because of the drastic reduction in bird damage. In addition, the system will last at least 5 years, with only partial replacement of netting required after that.

As a result of this perimeter netting approach, the aquaculture industry now has an easy-to-install system to deal with bird damage. Not only is this system extremely effective, it also does not interfere with day-to-day management practices.

SUMMARY

The use of netting in agriculture and aquaculture has evolved significantly across a broad range of crops and industrial opportunities. Many man-hours on the part of growers and managers as well as animal damage control professionals have resulted in new techniques, equipment and applications. These developments have transformed ideas and concepts into everyday realities that allow netting to become a practical and cost effective tool for bird control in today's market.

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LITERATURE CITED

BOUDREAU, G. W. 1972. Factors related to bird depredations in vineyards. Am. J. Enol. Vitic. 23(2):50-53.

JEWETT, S. G. 1942. The European starling in California. Condor 44:79.

MARTIN, L. R., L. M. MARTIN, and M. R. TABER. 1998. Containment basins and bird exclusion–a historical perspective. Proc. Vertebr. Pest Conf. 18:61-65.

PALMER, T. K. 1972. The house finch and starling in relation to California's agriculture. Proc. Gen. Mtg., Working Group on Granivorous Birds, The Hague, Holland, Sept. 1970.

PARKHURST, J. A. 1994. An overview of avian predation and management techniques at fish-rearing facilities. Proc. Vertebr. Pest Conf. 16:235-242.

TABER, M. R., and L. R. MARTIN. 1998. The use of netting as a bird management tool in vineyards. Proc. Vertebr. Pest Conf. 18:43-45.