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EVALUATING A POP-UP SCARECROW COUPLED WITH A PROPANE EXPLODER FOR REDUCING BLACKBIRD DAMAGE TO RIPENING SUNFLOWER

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ABSTRACT: A combination Purivox[®] Double-John carousel propane exploder and CO₂ pop-up scarecrow operated in synchrony was evaluated in five ripening sunflower fields in 1981 and 1982, respectively, near Devils Lake and Westhope, North Dakota. In each field, this treatment was evaluated in an alternating off-on sequence of 5-day intervals for a period of 20 days. In 1981, devices were deployed at one unit per 8 to 10 acres and in 1982 at one unit per 4 to 6 acres. The degree of effectiveness for reducing bird damage in three of five fields that met selection criteria ranged from 71 to 87% with a mean of 78%. During the first 10-day cycle, damage on these three fields was reduced 70, 89 and 95% or a mean of 84%, while in the second cycle damage was reduced an average of 59%. In the remaining two fields in which blackbirds were well established, damage was only reduced 8 and 31% during the entire test period. This was attributed to well-established feeding patterns in the fields by large flocks of blackbirds from a nearby roost. The cost to operate one unit on 6 acres of sunflower was \$14 per acre if prorated over a 10-year period (the expected unit life). Bird damage must be 18% or higher before a grower could expect a return on money invested with this device. The cost-benefit ratio in this study was 1:2.3 because damage exceeded the 18% level. Although the cost-benefits of the combination scare device indicated that for most growers in North Dakota the cost of control would exceed the dollars saved, it would be most useful in about 1.2% of the fields which annually get more than 18% damage.

INTRODUCTION

Several types of exploders have been used effectively to reduce crop damage by blackbirds and starlings (Cardinell 1937, Zajanc 1962, DeGrazio 1964, Stickley et al. 1972) and to deter them from urban roosting areas (Mott 1980). Other acoustical devices such as alarms, pyrotechnics, and distress calls have been used with varying degrees of success (Neff and Meanley 1957). Visual devices such as scarecrows, raptor-shaped kites, balloons, and flashing or revolving lights, and barriers such as netting or grid wires have also been used.

Improvements of some of these methods have been achieved. Pearson et al. (1967) used recorded starling distress calls, and Mott (1980) used pyrotechnics to move blackbirds and starlings from urban roosts considered to be a nuisance or health hazard. Scarecrows have been used successfully to alleviate bird damage to ripening fruits (Cardinell 1937) and waterfowl damage to swathed grains (Stephen 1959, USDI 1978).

Shooting and gas-operated exploders are often recommended as methods for protecting agricultural crops and as supplements to reinforce visual scare devices, particularly scarecrows (Zajanc 1962, DeGrazio 1964, Mitchell and Linehan 1967, DeHaven 1971, Stewart and Baumgartner 1973, Knittle and Guarino 1976, Besser 1978). The relative effectiveness of these methods is based mostly on testimonials. Attempts to use scare-devices alone seem to indicate, however, that birds acclimate to their presence, in some cases rather quickly. Logically, if two or more different devices are used in combination, the effect of each device could be enhanced. If the acclimation time is lengthened to as much as 9 days, this period could cover the length of the most critical time of blackbird damage to ripening sunflower (Cummings 1981, 1982).

Very few studies have been effectively designed to evaluate the actual crop protection afforded by mechanical devices. DeGrazio (1964) showed that blackbird damage in a ripening corn field protected by carbide exploders was only 1% compared to 43% on an unprotected field. Stickley et al. (1972) tested two exploders in each of six Ohio corn fields ranging from 5 to 17 acres and reported an 81% damage reduction by blackbirds during a 6-day test period. Potvin and Bergeron (1981) reported that two non-synchronized exploders reduced blackbird damage in ripening field corn by 73%, two synchronized exploders producing consecutive detonations reduced damage by 66%, and a single exploder provided no protection. The area protected by each pair of exploders was about 25 acres.

Tests conducted with scarecrows are also limited. Boag and Lewis (1980) used scarecrows to reduce the number of ducks using polluted ponds. A combination of scarecrows and pyrotechnics was found effective for protecting ripening rice fields from blackbirds in Arkansas (Neff 1949, Neff and Meanley 1957). Hothem et al. (1981) showed that raptor-mimicking kites attached to helium-filled balloons reduced damage to vineyard grapes primarily by robins (*Turdus migratorius*), starlings (*Sturnus vulgaris*), and house finches (*Carpodacus mexicanus*) by 41%.

The purpose of this study was to determine the effectiveness of a mechanical, gas-operated, pop-up scarecrow (SC) coupled in synchrony with a Purivox[®] Double-John (DJ) propane exploder. Data were needed

*The use of tradenames does not imply government endorsement.

to estimate the maximum acreage that could be protected and the cost-benefits of using these devices in ripening sunflower fields.

METHODS

This study was conducted in the vicinity of Westhope, North Dakota, in 1981 and near Devils Lake, North Dakota, in 1982. Five fields ranging in size from 4 to 48 acres were selected in areas of historical bird damage (Table 1). These fields were located on flightlines of blackbirds emanating from major roosts and were near staging or loafing areas. For three of the five fields, Rosenau (RO), Riggins (RI), and Pelican (PE), the SC-DJ test began when 10% of the sunflower heads in the field had reached the end of the anthesis stage of sunflower growth (when the first ray petals on a head begin to wither and drop, Siddiqui 1975), and when at least 2,000 blackbirds were observed feeding in the field. The remaining two fields, Lee-West (LW) and Lee-East (LE) were selected after blackbirds had become well established and fields had substantial bird damage.

Table 1. Sunflower fields used for combination pop-up scarecrow and exploder study near Upham and Devils Lake, North Dakota 1981 and 1982.

Field	Acreage	Start of test (date)	Days after the end of anthesis	Exploder- scarecrow (units/field)
Rosenau(RO)	33	08/25/81	2	4
Lee-East(LE)	43	09/13/81	18	5
Lee-West(LW)	48	09/14/81	19	5
Riggins(RI)	4	08/16/82	0	1
Pelican(PE)	30	08/31/82	5	5

The test design followed was similar to one used by Hothem et al. (1981) to test the effectiveness of raptor-kite balloons for reducing bird damage to ripening wine grapes in California. In each of the five fields, alternating sequences of 5-day periods were used during a 15 or 20-day test. In the treated period the scare devices were operated and during the control period they were deactivated. SC-DJs were deployed at one unit per 8 to 10 acres in 1981 and one unit per 4 to 6 acres in 1982. A coin toss determined whether the first period was a control or treated.

Damage survey plots were established in each field just before the end of the anthesis stage of sunflower growth. Each field was surveyed for bird damage before the test periods began and every 5 days during the 20-day test. All damage assessments were conducted after 1100 hours when bird activity was minimal to reduce any disturbance by observers. Damage in each field was measured on heads in 80 stratified random 5-ft linear plots in 1981 and 50 stratified random 3-ft linear plots in 1982. Plots were marked with small pieces of colored flagging so that the same heads were assessed in each assessment. The template method (Otis 1981) was used to measure total area (CM²) of damage on each sunflower head. Head and undeveloped center diameters were measured with a flexible steel tape (cm) and data from each head converted to total available area of seed. Amount of cm² damage was converted to pounds lost per acre for data analysis.

During 1981, each field was observed every day for a 30-minute period between sunrise and 1100 hours. In 1982, observations were changed to every 2 days for a 10-minute period between sunrise and 1100 hours because analysis showed little variation in bird numbers on consecutive days. The number of blackbirds (by species) observed entering a field during each period was recorded. Bird activity was converted to bird use per minute per acre (birds/min/a) for comparative purposes. The starting time for bird observations was alternated among fields to reduce time bias. Blackbird reactions to the SC-DJ were also documented.

Each SC-DJ was composed of the following components (Figure 1) and operated in the following manner:

1. Each SC consisted of the upper torso of a life size, inflatable plastic scarecrow (Burpee Seed Co., Clinton, Iowa) injected with polyurethane foam to ensure rigidity and to eliminate deflation from punctures.
2. Each SC was mounted on the arm of a CO₂-operated pop-up device designed and constructed to our specifications by the American Target Co., Denver, Colorado.
3. The camouflage-painted DJ exploders were mounted facing opposite directions about 3 ft apart on each end of a center-pivoting horizontal bar.

4. Each SC-DJ was mounted on its own adjustable tripod and elevated to just above sunflower-head height. This procedure minimized muffling of DJ discharges and allowed the SC to be partially hidden from view when not in the upright position. This was to retain the element of surprise and preclude or minimize conditioning responses by birds.

5. The SC-DJ operating sequence was set on a 10-minute cycle with an adjustable valve on the propane bottle. Each SC was set to pop-up from 15 to 30 seconds before two consecutive explosions from the DJ (0.8 seconds apart).

6. Synchrony between the SC pop-up and DJ discharges was achieved by a simple button-trigger mechanism which was activated by the DJ trigger, i.e., as the exploder gas chamber filled with propane, it raised a bar which depressed the button-trigger. As this trigger was depressed, CO₂ was released into a valve which caused the pop-up arm to spring upward putting the SC into the upright position. After the DJ discharged, the button-trigger was released allowing the pop-up arm to fall slowly to the horizontal position.

7. Each SC-DJ was fitted with a photo-cell timer which turned it off at sunset and on again near sunrise.

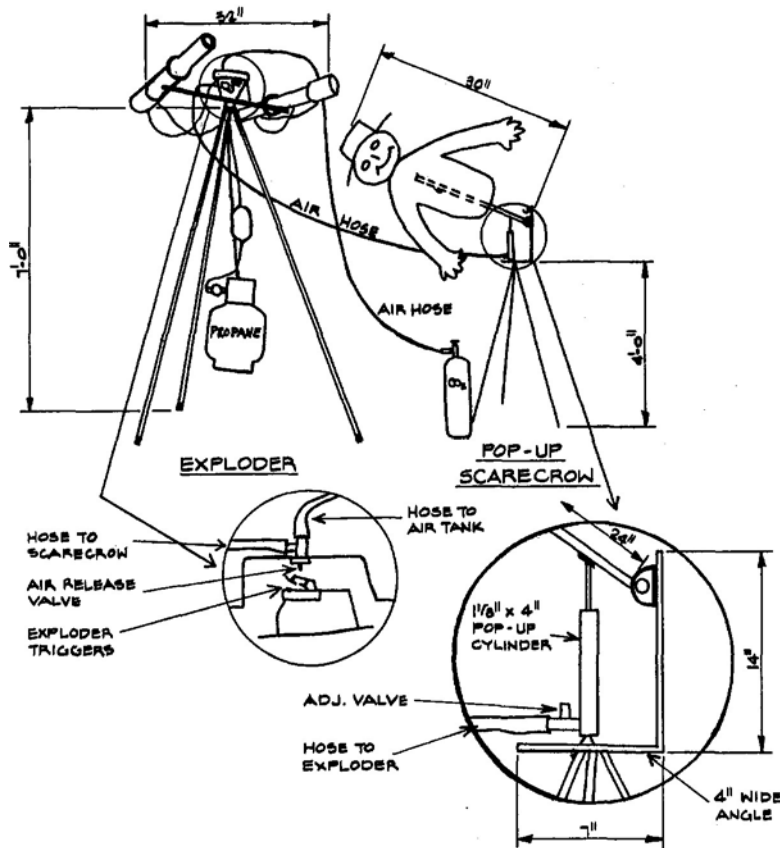


Figure 1. Pop-up scarecrow and Double-John exploder unit.

RESULTS AND DISCUSSION

The effectiveness of the SC-DJ in reducing damage varied from one test field to another and between treated periods (Table 2). The degree of effectiveness in fields PE, RI, and R0 during the test period ranged from 71 to 87% with a mean of 78%. During the first 10-day cycle, average damage reduction was 84% (SE = 7) (Table 2). During the second cycle on the same fields, damage was only reduced an average of 59% (SE = 13) (Table 2). The low level of damage sustained during the second control period suggests that there may have been a carryover effect. That, is, once birds were frightened from the fields during the treated period, they did not return in numbers observed during the first control period. The birds that did return to the test field might have habituated to the SC-DJs which may explain the reduced differences in damage between cycles.

Table 2. Blackbird damage to sunflower in three test fields over four 5-day test periods.

Test period	Sunflower damage by test period (lbs/a) test fields						Mean damage reduction (%)
	Rosenau (RO)		Riggins (RI)		Pelican (PE)		
	C ^{1/}	T ^{2/}	C	T	C	T	
1st 5 days	19		283		60		
2nd 5 days		1		32		18	84
3rd 5 days	9		25		25		
4th 5 days		6		7		7	59
	28	7	308	39	85	25	
Damage reduction(%)	75		87		71		78

^{1/} C = SC-DJ inactive

^{2/} T = SC-DJ active

In field RO as many as 46,000 blackbirds were observed in the field. Of the total damage incurred during the entire test period (35 lbs/a), 54% occurred in the initial control period (increasing at about the same rate as pretest losses), 3% in the first treated period, 26% in the second control period, and 17% in the second (last) treated period. RO was 33 acres (880 yds by 300 yds) with four SC-DJs (one per 8.25 acres) placed on the long axis down the center of field and about 160 to 200 yds apart starting 115 yds from the west end. Blackbirds tended to enter the field from the northwest from a woodlot located 75 yds from the field edge. Pretest damage was mainly confined to the north edge of the field nearest this woodlot. Once the SC-DJs were activated all birds immediately vacated the field. Although flocks initially made repeated attempts to re-enter, they were repulsed by the SC-DJs and moved on down the flightline after the first day of operation. However, there were a few small flocks remaining near the field on subsequent days and from time to time they entered the field, but landed some distance from the devices, usually near edges or corners.

Large flocks (more than 1,000 birds) did not return to field RO during either treated period. However, the amount of damage recorded in the second treated period (6 lbs/a) was only slightly less than the preceding control period (9 lbs/a), although observations showed about 25 times more bird use in this control period. Also, the average number of birds/minute/a entering the field during the last treated period was half of the average of the first treated period.

Bird observations in field PE showed that more than 1,700 blackbirds (95% red-winged blackbirds (*Agelaius phoeniceus*) and 5% yellow-headed blackbirds (*Xanthocephalus xanthocephalus*) visited the field during each or three 10-minute counts conducted prior to the activation of the scare-devices. During the first treatment period, almost the same number of birds (1,400) were observed in three 10-minute counts. In field RI bird pressure during the control period averaged 57 birds/min/a. Yellowheads and redwings accounted for 55% of the birds observed. Bird activity during the period was 5 birds/min/a. During the final treated period bird observations showed that bird numbers in the test field were 1 bird/min/ac; however, during three 10-minute counts, 2,200 blackbirds (66% yellowheads, 33% redwings, and 1% unknown) were observed in habitats adjacent to the field.

The remaining two test fields, LW (48 acres) and LE (43 acres), were 0.25 mi apart, of the same maturity, similar in pretest losses (840 and 1007 lb/a, respectively) and had nearly equal pretest bird pressure, up to 30,000 blackbirds (Table 3). The test lasted 15 days in these two fields and was terminated because of harvest. In fields damage was only reduced an average of 20%. Poor protection in both fields was attributed to SC-DJs inability to break a well-established feeding pattern. Five SC-DJs were used in each field, one in the middle of the field and one in the approximate middle of each quadrant. When the SC-DJs were activated in field LW during the first treated period, blackbirds showed an immediate response by departing the field in flocks ranging in size from 150 to 3,000 birds. Several flocks moved to the northeast toward a roost while others moved to field LE. Remaining flocks of birds in the field would only mill about and settle back into the field after a discharge of the SC-DJs. This was attributed to the birds having a well-established feeding pattern in each field and because the fields were located next to a major blackbird roosting site, allowing for constant bird pressure on each field and habituation to the SC-DJs. Birds arrived in field LW and LE on flightlines from a roost on each morning, but most continued moving with the flightline as SC-DJs began to activate at or shortly after sunrise. However, birds would return to this field throughout the day, showing no great aversion to the SC-DJs.

Table 3. Blackbird damage to sunflower in two test fields over three 5-day test periods.

Field	Pretest damage (lbs/a)	Sunflower damage			Treatment means	Damage reduction (%)
		1st 5 days	2nd 5 days	3rd 5 days		
		<u>I</u> ^{1/}	<u>C</u> ^{2/}	<u>I</u>	<u>I</u>	<u>C</u>
Lee-West(LW)	840	64	64	53	59	64
		<u>C</u>	<u>T</u>	<u>C</u>		
Lee-East(LE)	1007	176	78	52	78	114
Overall mean (%)						20

1/ T = SC-DJ active

2/ C = SC-DJ inactive

The cost of placing a SC-DJ unit in operation is shown in Table 4. The double exploder was priced at \$360 in both 1981 and 1982. Including rental of the CO₂ tank, all costs amounted to \$139 per acre (833/6 acres). If this figure is prorated over a 10-year period (the exploder has a life expectancy of 10 years, pers. comm. J. Marley, Margo Horticultural Supply Limited), the cost is \$14 per acre. The total amount of damage on control fields was 421 lbs/a and 71 lbs/a on treated fields (Table 2). The amount of savings attributed to the SC-DJ in fields that met selection criteria was 350 lbs/a or \$35.00 per acre, (sunflower seed at 0.10/lb), representing a cost-benefit ratio of 1:2.5. Based on the cost-benefit equation described by Dolbeer (1981), $x = y/b$, where y is the cost of the control measure per acre (\$14) and b is the efficacy of the control measure (78%). The break-even point for the use of this control measure is therefore $\$14/.78 = \$18/a$. Thus, \$10/a bird damage is needed for a farmer to break even using the SC-DJ (Figure 2). The \$18 damage cost represents about 18% bird damage in an average sunflower field yielding at 1,000 lbs/a. Sunflower damage surveys conducted in 1979 and 1980 showed that only 1.2% of the 909 fields surveyed in North Dakota fell into the 18% damage category (pers. comm., R. DeHaven). Thus the SC-DJ could only be used economically by a small portion of the farmers that can expect very high levels of damage.

Table 4. Cost of components and time required to establish one operational exploder/scarecrow in the field.

Component	Cost
Exploder (Double-John)	\$360.00
Pop-up Scarecrow mechanism (Proto-type)	340.00
CO ₂ tank plus value	36.00 (12/month rental) or 155.00 (owned)
Propane tank (20 lb)	35.00
CO ₂ gas	15.00
Propane gas	10.00
Hoses and connectors	10.00
Total	\$806.00 (\$925 if CO ₂ tank is purchased)
<u>Time</u>	<u>Cost (\$10/hr)</u>
Create access lane to device	\$ 5.00
Get Unit into field	10.00
Set-up of Unit	7.00
Minor adjustments-daily	5.00
Total	\$ 27.00
Total Cost	\$833.00

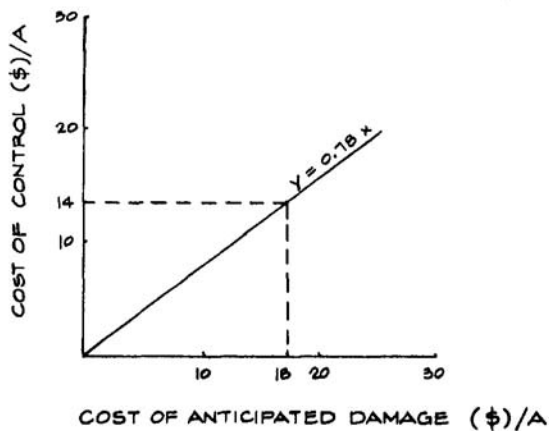


Figure 2. Cost-benefit equation for the combination scare devices used to reduce blackbird damage to sunflower in North Dakota, 1981 and 1982.

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