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Preliminary measurements of grain wasted by field-feeding Mallards

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Abstract

Harvestable grain wasted by field-feeding Mallards (*Anas platyrhynchos*) was measured on 20, 60-m² plots of swathed barley and compared with data from 10 protected control plots. The ratio of wasted grain to eaten grain was highest (about 2:1) during early feeding activities by Mallards and decreased as more grain was eaten. The estimate was generous because experimental conditions favoured a high rate of grain waste. We predicted benefit/cost ratios for purchased lure crops at a levels of wasted grain/eaten grain ratios based on the derived equation, and varying numbers of fields visited by Mallards in lieu of a lure crop. A benefit/cost of 2:1 is a fair average. We recommend additional experiments.

Introduction

When waterfowl, particularly ducks, feed on swathed grain they not only eat the grain but also waste some by trampling and fouling. To the farmer who loses both ways, it matters little whether the grain in eaten or wasted. It is, however, of concern to the crop protection manager, who tries to make the most efficient use of lure crops, and who must evaluate feeding programs in terms of benefit/cost – in this case, the value of commercial grain saved over costs of protection. Under the assumption that lure crop grain is completely used, the predicted ratio of wasted/eaten commercial grain without the lure crop generates the benefit/cost factor. The higher the rate of wastage caused by ducks the greater will be the benefit when ducks feed on lure crop grain rather than commercial grain. Justification for feeding programs is based mainly on the premise that the ducks would otherwise use several commercial grain fields and, in so doing, initially cause excessive damage to these fields through high wastage (Smith 1968:44). Most of the grain that falls to the ground when the ducks first feed on swaths is not immediately eaten. However, the longer they feed in a field, the more of this grain they recover from the ground (MacLennan 1973:32).

Estimates of grain wasted by ducks as well as by harvesting procedures are needed to evaluate crop protection programs. These estimates, when combined with consumption rates, also are used to extrapolate loss of grain yields to duck numbers, or conversely, duck numbers to predicted grain losses.

Hammond (1961:75) suggested that the ratio of wasted grain/eaten grain could be as low as 0.5:1 with damp grain (less shattering) but as high as 4.5:1 when grain was dry. Elsewhere, Hammond (1950:15) stated that the rate of wastage was lower for thinner swaths, when grain was damp, and for varieties of grain which are more shatter-resistant. (Dry durum wheat was used to derive the 4.5 value.) The relationship between the wasted/eaten ratio and the length of time ducks fed on the grain was not considered.

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The objective of our study was to estimate the ratio of wasted barley to eaten barley at several levels of use by Mallards.

Methods

The experiment was conducted on a lure crop of barley on the Last Mountain Lake Wildlife Management Area in 1978. We chose a 22-ha field in the northeast corner of the management area because it had been used by Mallards in the past and it was comparatively easy to observe birds on it.

Birds using the field were monitored during morning and evening feeding periods throughout the experiment. We estimated the maximum numbers using the field and noted their location from a nearby observation tower.

The barley was cut with a 4.9-m (16-ft) swather. Narrow strips were left standing between swaths to ensure a uniform width (Fig. 1). Experimental plots were 12.3 m long, providing a plot area of 60 m². On the day that the grain was swathed, we marked 10 control plots, randomly located on the part of the field that was most visible from the tower. We protected these plots from birds by covering them with 2-cm-mesh plastic netting staked to the ground.

Originally, we planned to mark and analyse 10 utilized plots at each of three stages of duck use: after two or three feedings, after five or six feedings and when the grain was more or less completely eaten by Mallards. After each stage we were to protect the utilized plots from further feeding with netting.

When the ducks began feeding, however, it became apparent that they could eat all the grain in the sampled area in just two or three feedings. Therefore, we modified our original plan and allowed the main flock to feed on the sampled area just once. We then kept the birds off the field and prevented further feeding. We marked 20 plots, subjectively including some areas that had been used lightly. Much of the area had been used so heavily that we could have obtained no useful data from sampling it.

We modified methods used by Dodds (1974) to calculate grain yields and waste.

First loss (L_1)

The grain lost on the ground before and during swathing (Fig. 1) is the first loss (L_1). When birds eat this naturally lost grain it is not part of the "bird damage". To estimate the first loss we collected grain from 180, 0.1-m² sub-plots randomly located in the stubble area beside the windrow of main plots. The mean value of grain thus collected was extrapolated to 60 m² to estimate L_1 in control plots. For utilized plots, the mean value was extrapolated to 45 m², or that area not covered by the swath. For the remaining 15 m² covered by the swath, we assumed L_1 was unused and therefore equal to the average amount estimated for control plots. This amount was added to that estimated for 45 m² to calculate total L_1 in utilized plots.

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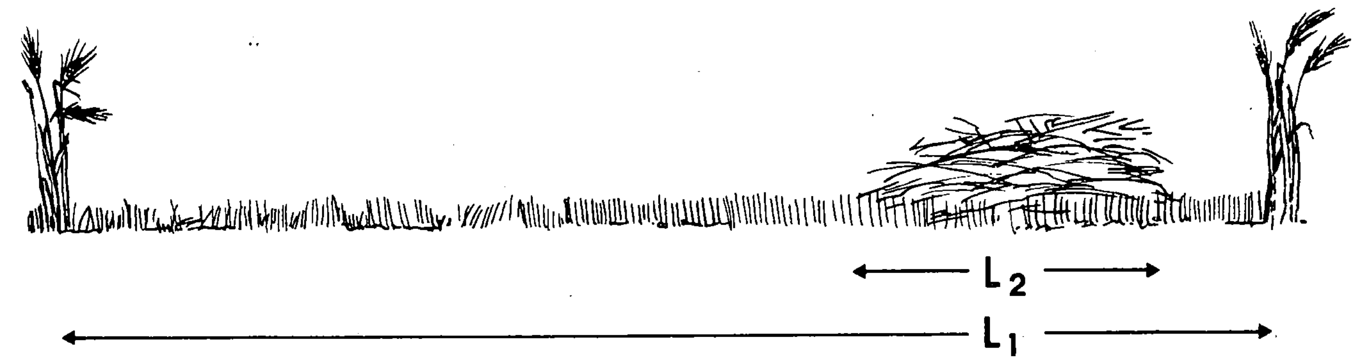
Figure 1
Cross-section of a plot illustrating zones sampled for grain waste



Yield
To collect the yield (Y), we harvested the windrow from each plot using a farm combine with a conventional pickup. After a plot was combined, the machine was operated standing still for 15 s, by which time the flow of grain was negligible. Straw and chaff were not scattered.

Second loss (L_2)
The loss in the windrow area of control plots is the second loss (L_2), and on fully protected plots it is the grain lost when the swath is combined. On our control plots it apparently included some loss due to ducks landing and walking on the netting. Therefore, considering the condition of the grain, we arbitrarily assumed a mean loss due to combining of 5 bu/ha (Dodds and Dew 1958, Dodds 1974), or 645 g on a 60-m^2 plot.

We increased yield estimates for control plots by the difference between measured L_2 and 645 g. Since waste due to ducks in utilized plots was legitimate, we used our own estimates. We sampled L_2 in each plot with four 20 times 122-cm sub-plots situated at right-angles to the windrow after combining. Loose grain, heads, etc., were gathered from the sub-plots and later cleaned and weighed. Because this measure included L_1 from the windrow area (15 m^2), we reduced it by the mean amount (384 g) estimated from control plots to derive L_2.

Calculations
Capital letters are for mean values from control plots; lower case letters are for utilized plot values.

Y	= yield
L_1	= natural and swathing loss
L_2	= all other losses
P	= potential yield = $(Y + L_1 + L_2)$
Y - y	= decrease in yield due to birds
P - p	= total grain eaten
$(P - p) - (L_1 - l_1)$	= amount of harvestable grain eaten
$l_2 - L_2$	= amount of harvestable grain wasted by birds

$$\frac{l_2 - L_2}{(P - p) - (L_1 - l_1)} = \frac{\text{harvestable grain wasted}}{\text{harvestable grain eaten}}$$

After the barley was swathed, we collected three samples from three different swaths every 2 days for measuring moisture content. Samples were hand threshed, weighed "wet" and dried at 100°C for 48 h to obtain dry weight. However, all weights for yield and loss samples were based on air-dried (room temperature) state.

Results and discussion
The barley field was swathed on 15 August. Measurements from control plots indicated a yield of about 96 bu/ha before any grain was lost. Moisture content 1 day after swathing was 11%, indicating a level at swathing much below the 35–40% recommended for swathing commercial barley (Dodds 1974:9), and likely close to the 14% level acceptable for straight combining. During the 25 days between swathing and combining, moisture content fluctuated between 10 and 31% and was 16% when the plots were combined.

Bird numbers
Mallards started feeding in the field on 1 September and their numbers increased rapidly until there were about 23 000 present on the evening of 6 September (Table 1). A few ducks used the sampled area that evening, but the main flock did not feed there until the morning of the 7th, after which the experiment was ended.

We observed some ducks landing and walking on protected control plots, but we were unable to determine how extensive this "use" was because of poor light condi-

tions and the fact that we had not marked plot locations conspicuously.

Table 1
Numbers of Mallards feeding in the barley field

	Estimated number	
Date	AM	PM
1 Sept.	? (fog)	3 500
2	800	8 000
3	10 650	10 000
4	4 300	10 000
5	8 000	14 400
6	14 000	23 000
7	21 000	*

*Birds kept off field until sampling completed.

Control plots
Average loss of grain in control plots due to natural causes and swathing (L_1) was 1153 g in the area not covered by the windrow and 1537 g for the entire plot (Table 2). In the latter case, the loss represented 12% of the potential yield or about 11.8 bu/ha. Although several variables may affect natural and swathing losses, the relatively high loss in this case was probably due to the dryness of the grain when it was swathed, which caused excessive shattering (Dodds 1974:8).

Mean loss of grain due to all other causes (L_2) was 1892 g/plot or about 14.5 bu/ha. The extended period between swathing and combining (25 days) and the dryness of the grain probably contributed to the relatively high loss during combining, although the swath was moderately heavy, held up well on the stubble, and virtually all of it was picked up with the combine. Losses occurring within the combine after pickup seldom exceed 2.5 bu/ha (Dodds 1974:7–8). We believe part of the L_2 loss – likely more than one-half – was caused by ducks landing and walking on the covered control plots. Thus, for data analyses, we used a mean L_2 value of 645 g/plot. Yield estimates were increased correspondingly (Table 2).

Utilized plots
Most, if not all, of the utilization of plots where ducks ate grain apparently occurred during one feeding. Therefore, we used the proportion of potential yield that was eaten as an index of use. This varied from 25 to 98% in the 20 plots; 15 plots exceeded 50% utilization. Some plots were selected because they received comparatively light use. Thus, the overall use was greater than the data indicated. Since the observed use occurred during a single feeding, lower levels of use must involve smaller feeding flocks or situations where birds are scared off soon after landing.

Most of the grain in the stubble area that had been lost during and prior to swathing (L_1) had been eaten and this grain disappeared relatively early in the feeding visit. Its contribution to the total amount eaten was inversely related to overall use (Fig. 2). Although we were unable to observe the distribution of feeding ducks relative to individual swaths, we believe the high use of grain on the ground between the swaths resulted from the large numbers of Mallards present. In large flocks, relatively more ducks – likely those that are socially subordinate – are forced to use areas between swaths. Observations of field-feeding Mallards elsewhere indicated that smaller flocks (e.g. <500) made little use of the stubble area during early visits.

Grain wasted
The ratio of wasted grain to eaten grain decreased as utilization increased (Fig. 3), confirming the relationship commonly proposed (Smith 1968:44). Under the relationship shown, absolute amounts of grain wasted by ducks would increase to the level of 30% utilization (i.e. 30% of all the grain eaten). At that point it would equal the amount of grain eaten. Beyond that point, the amount of wasted grain would decrease with increased utilization (more ducks and/ or more feeding visits) until, at 100% utilization, there would be no waste; all the grain would be eaten.

Table 2
Summary of grain measurements from 10, 60-m^2 control plots

Item	Grams
Yield	
$\bar{x}$	10 319
SD	2 992
Range	7 304 – 16 363
$Loss_1$	
$\bar{x}$	1 537
SD	964
Range	203 – 2 940
$Loss_2$	
$\bar{x}$	645*
Range	–
Potential yield	
$\bar{x}$	12 501
SD	3 051
Range	8 899 – 18 723

*Mean value used; see Methods (Second loss).

Our data indicated a maximum ratio of about 2:1 under the experimental conditions. We consider the estimate generous because grain condition throughout the experiment favoured excessive shattering and hence, high wastage by ducks.

Figure 2
Relationship of total grain utilization and the contribution of L_1 grain

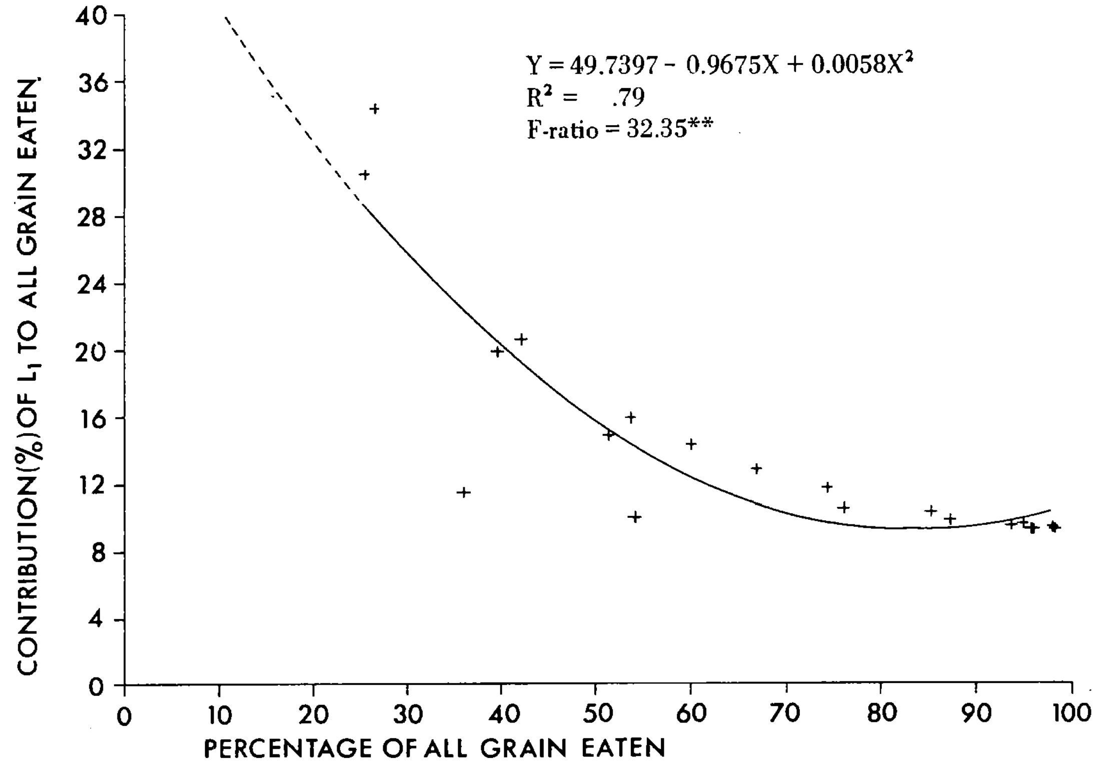
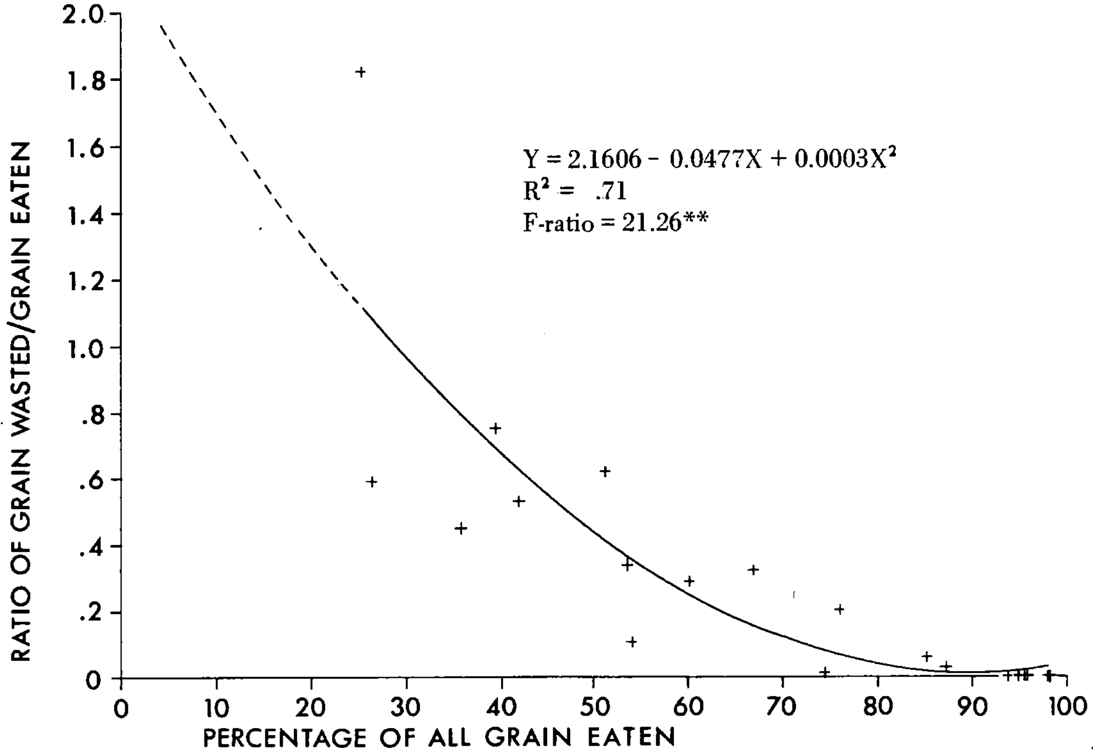


Figure 3
Relationship of total grain utilization and the ratio of grain wasted to grain eaten



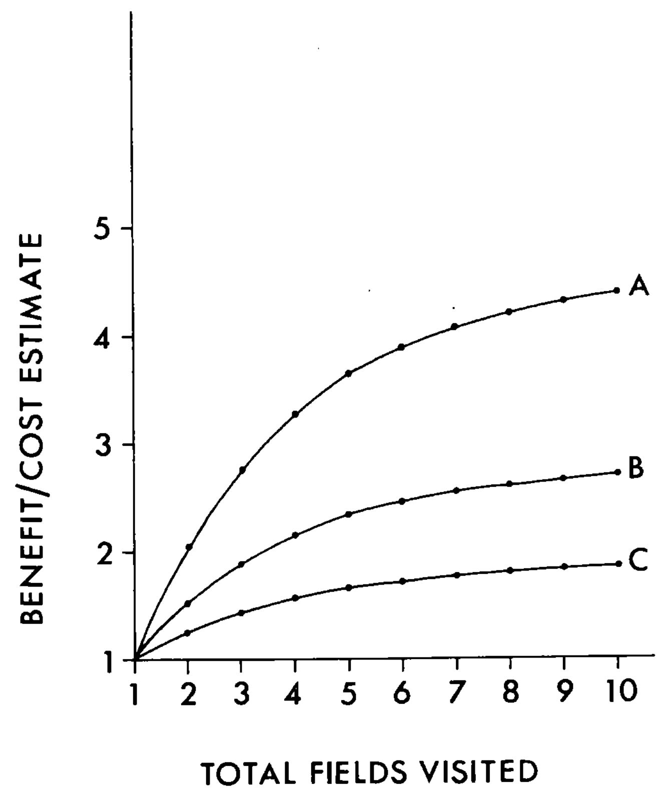
Evaluating lure crops

The principal benefit of a purchased lure crop is in reducing grain waste by ducks since grain that is eaten costs the same whether in a lure field or not. While various factors have been used to estimate this benefit, one practice is to assume that for each unit of lure crop grain eaten, twice that amount of commercial grain is saved; hence, a benefit/cost ratio of 2:1.

We developed a simple model to predict benefit/cost of a purchased lure crop at three levels of wasted/eaten ratios from our regression (Fig. 3), and varying numbers of fields that ducks might visit in the absence of the lure crop. We assumed each field equal in yield to the lure field and that grain consumption would be evenly divided among the visited fields; e.g. if five fields were visited, 20% of the grain from each would be eaten in lieu of 100% from the lure crop. This provided a value for X (Fig. 3) from which to estimate the rate of wastage for a given number of visited fields.

Although the factors that determine a benefit/cost estimate vary, we believe the value of 2 is a fair average. Curve B (Fig. 4) is considered generous because the wasted/eaten regression (Fig. 3) represents a liberal estimate as grain condition in the experiment favoured high wastage. At times, ducks do obtain some grain from harvested fields. When such grain is "saved" by feeding the ducks with a lure crop, the overall benefit/cost would be lowered. Presumably, harassment is the reason ducks move from field-to-field in search of food. Though we lack data on this aspect, excessive harassment seems to cause ducks to eat more natural foods. Like the grain in harvested fields, when natural foods are replaced with lure crop grain, the overall benefit/cost decreases. On the other hand, the use of many different fields would increase the benefit/cost factor. Experienced observers agree that the average number of fields used in lieu of a lure crop probably would not exceed five. Finally, differences in grain values ($/bu) between the lure crop and the grain saved could alter the benefit/cost estimate either way.

Figure 4
Predicted benefit/cost of purchased lure crops at three levels of waste/eaten ratios and varying numbers of fields visited in lieu of lure crop. Curve B is based on waste/eaten ratios from Fig. 3 regression, curve A is double that rate and curve C, one-half that rate



Recommendations

Further improved experiments must be made. The grain should be swathed at a higher moisture level, i.e. one normally used for commercial grain swathing. It should be possible to choose a field that, historically, has been used by Mallards soon after swathing. If the foregoing conditions can be met, there should be more chance that feeding flocks will be smaller; hence, more opportunity to follow our original plan that involved several feedings. Finally, the protective netting must be elevated to prevent ducks from damaging protected plots.

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