Assessing Harvester Damage and Pest Control Practices in Alfalfa Seed

Harvesters are moving rapidly through the alfalfa seed fields in the San Joaquin Valley. At this point, you can only hope you have done everything right during the season to prepare for a good, clean crop, and hope that it doesn't start raining before you complete the harvest.

Most of the alfalfa seed crop in California is harvested by spray curing followed by direct combining with self-propelled combines. Losses from these machines depend on a number of factors such as field conditions, crop conditions, machine adjustments and operation. To minimize seed losses and obtain high quality seed, machine adjustments and operation must match the field and crop conditions.

Assessing Harvester Damage

Assessing damage resulting from field operations is a simple process. First, combines should be inspected immediately before harvest begins. Calibrate the cylinder concave clearances and adjust the cylinder speed (RPM). Once the harvester begins to operate, draw a sample of seed from the bin and determine the percent injury. Injury is not always visible, even when using a hand lens. A microscope provides the proper magnification to detect hairline cracks or breaks in the seed coat, or damage to the seed itself.

A quick estimate of damage is often valuable and can be obtained by checking 4 to 10 seed samples. One damaged seed in a sample of 100 seeds indicates 3 to 5% damage. Two or three damaged seeds indicate 5 to 10% damage. If the percent injury is 5% or more, adjust the combine cylinder speed downward until the damage index falls below 5%. Seed samples should be tested throughout the harvest period to determine if conditions of weather, crop, or combine have changed to cause an upward trend in the damage index.

Most seed damage is due to either impact in the cylinder because of *small loads*, or *excessive cylinder speeds*. When small amounts of material pass through the cylinder, seed damage tends to be greater than when the load is heavy, although seed *losses* increase with heavy loads. Loads may be balanced by increasing or reducing the speed of the combine as it moves through heavy and light areas in the field. By varying the forward speed of the combine, the amount of straw fed into the harvester remains fairly constant.

With regard to cylinder speed, a balance between damaged seed and incomplete threshing must be achieved. Reducing cylinder speed will reduce damage to the seed, but if speeds are *too* low seeds will not be removed from the pod during threshing. Lower speeds also leave the straw in much better condition - longer pieces and less chaff - so that the seed can be separated and cleaned more efficiently with less loss over the rear of the machine. Excessive speeds tend to overload the shoe by breaking up the straw to a greater extent.

Using damage assessments to adjust combines would greatly improve the quality of harvested seed. Every lost or damaged seed occurring during harvest is removed from the grower's profit. After the crop is grown and the seed is ready for harvest, don't lose it through poor operating methods!

Assessing Pest Control Practices

Seed samples collected from the harvester can also be used to assess pest management practices. For example, the level of insect damage caused by sucking insects (lygus and stink bugs) and by the seed chalcid can both be evaluated by examining seed from the harvester bin.

Lygus bugs present in the field after pods form will feed on the immature seeds, causing them to shrivel and turn brown. High lygus damage may be the result of delaying treatments too long, or of selecting ineffective treatments.

The signs of lygus damage should not be confused with water or heat-damage which would result in seeds that are lightweight, wrinkled, cracked, or off-colored. Water damage is caused by rain or irrigation water contacting the seed close to the soil.

Chalcid damage is easily detected since the adult emerges by chewing a conspicuous hole through both the seed and the seed pod. Chalcid problems can be corrected by proper clean-up after harvest and spring clip-back management.

When examining seed from the harvester, also evaluate the weed seeds in the sample. Even though common weeds in the field may not be cause for denying certification, when the lot is cleaned to remove soil and weed seeds, alfalfa seed can be lost in the process.

TABLE 1. RELATION BETWEEN CYLINDER RPM AND PERIPHERAL SPEED

Periph. speed ft/min	Cylinder rpm 18-in. diam.	20-in. diam.	22-in. diam.
3500	742	668	608
4000	848	764	694
4500	954	860	781
5000	1060	955	868
5500	1166	1050	954
6000	1271	1146	1040
6500	1379	1241	1127

Cyl. rpm	Peripheral speed, ft/min. 18-in. diam.	20-in. diam.	22-in. diam.
700	3300	3660	3920
800	3770	4190	4480
900	4240	4710	5040
1000	4710	5240	5600
1100	5190	5760	6160
1200	5660	6280	6710
1300	6130	6810	7280

Use the left-hand table to find the cylinder rpm corresponding to a desired peripheral speed. The right-hand table may be more convenient to use in finding the peripheral speed that corresponds to a known rpm. The general relation is:

$$\text{rpm} = \frac{12(\text{ft/min})}{\pi\,(\text{diam., inches})} = 3.82\,\frac{(\text{ft/min})}{(\text{diam., inches})}$$

Estimating Seed Losses

As the harvester makes its way through the field, seed can be lost in front of the machine as well as in back. As discussed in the previous article, many adjustments can be made to minimize the loss that comes from the back of the machine such as cylinder speed and ground speed.

To estimate the loss of free (threshed) seed over the harvester shoe or the straw walkers, use a seed dockage pan with appropriate-sized holes, placed on top of a blank pan. A 7/64-inch round-hole top pan is recommended for alfalfa seed. Hold the two pans in a sampling location and shake them vigorously, primarily in a horizontal direction, while following the combine for four steps (11 ft.). Then count or estimate the number of seeds in the bottom pan. A close-packed, single layer of alfalfa seeds contains about 250 seeds per square inch.

In checking the cleaning shoe, take samples at the center and near both sides of the area where most of the chaff is discharged. Also take three samples in the airstream above the rear of the shoe. The walker loss can be checked in a similar manner.

One should remember that estimates of free-seed losses obtained in this manner are only rough approximations and are likely to be lower than actual losses. The normal range of total seed loss over the rear of the harvester for the recommended feed rates is from 1.5 to 3% of the seed yield (dirt weight). Combines properly adjusted for a rate of forward travel that does not overload any part of the machine will probably lose 2-6 lbs/acre of free seed over the shoe and less than 0.5 lbs/acre of free seed over the walkers. For a properly adjusted cylinder and shoe, the unthreshed seed loss will usually be 3 - 4 times the total free seed loss, but this loss is very difficult to estimate.

Shatter Losses

A tremendous amount of uncollected alfalfa seed is left in the field due to shatter at the combine cutter bar. These losses occur during the lifting action of the plant lifters, cutting action at the cutter bar, and gathering action of the header auger. Shatter losses from the header can be determined by counting the average number of alfalfa seeds per square foot of harvested land area, and dividing the number of seeds by 5 to obtain the loss in pounds per acre. A convenient rule of thumb to use in estimating shatter losses is that each 5 seeds per sq. ft. found on the ground represents about 1 pound of seed per acre.

Research conducted in Fresno County seed fields tested and perfected a method to reduce the cutter bar shatter losses. Air jets are attached to the harvester to provide an air blast in front of the cutter bar to blow seed shattered by the shaking action of the cutter bar back on to the platform. This saves seed that would otherwise be dropped on the ground. During the development and testing of this system, growers and harvesters *conservatively* estimate 60 lbs/acre average savings. In most cases, the air jet attachment will pay for itself in two weeks of harvesting. For more information, contact me at this office.

Factors for Estimating Alfalfa Seed Losses

Assumed number of seeds per pound	Loss, lb/acre for each 100 seeds discharged from full rear width of machine during 11 ft of forward travel					
	For any width of cut, W*	11-ft cut*	13-ft cut*	15-ft cut*	17-ft cut*	19-ft cut*
220,000	1.80/W	0.16	0.14	0.12	0.105	0.095

*Actual width of cut. Usually about 1 ft less than header width in solid plantings. In row plantings, actual width of cut = number of rows x row spacing.

Example: Estimating Shoe Free-Seed Loss

Header width = 16 ft, width of cut = 15 ft, shoe width = 44 in, sampling-pan width = 11 in. Estimated numbers of seeds in three samples from the chaff discharge area were 550, 450, and 530, and in three samples from the airstream area were 90, 120, and 120.

Solution: Sum of averages is (550 + 450 + 530) ÷ 3 = 510
(90 + 120 + 120) ÷ 3 = 110
510 + 110 = 620 seeds
Ratio of shoe width to pan width is 44/11 = 4.0
Number of seeds discharged across the full width of the shoe is
620 x 4.0 = 2480
From the 15-ft column in the Table 2, the loss factor is 0.12

Hence, the loss is $0.12 \times \frac{2480}{100} = 3.0$ lb/acre

As an approximation for a 13 to 17 ft. width of cut, one can assume that dividing the number of seeds discharged from the full rear width during 11 ft. of forward travel by 800 will give the loss of alfalfa seed in lbs/acre.

Example: $\frac{2480}{800} = 3.1$ lbs/acre

Suggested Combine Adjustments

Cylinder speed: 4000-5000 ft/min. (Use lower speeds whenever possible). Clearance between the closest cylinder bar and concave should not be less than 1/8 inch nor more than 3/8 inch. Check all cylinder bars to find the closest bar. On some combines it is possible to adjust the clearance at both the front and rear of the concave. Normally, the front clearance is twice the rear clearance, but in no case should either clearance be greater than 3/8 inch or less than 1/8 inch.

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