Small-Seed Legume Harvesting

clover and alfalfa seed threshing losses minimized by minor modifications and adjustments of present machines

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A total of 115 field test runs made during the 1951 harvest season indicate that present harvesting machines, with minor modifications and careful adjustment, can do a satisfactory job of threshing seed of alfalfa and some kinds of clover—provided the load is kept at a reasonable level.

Two different makes of 12-foot, self-propelled combines and one platform type harvester were tested. Most of the trials were with alfalfa seed, a few were on defoliated Ladino clover, and the remainder were on Kenland red clover.

In addition to the field work, 85 tests were conducted on a cleaning shoe from a self-propelled combine, which was set up in the laboratory.

Clover Threshing

Three combines, identical except for the type of cylinder used—the rasp bar, the spike tooth, and the V-bar—were operated in the same field for the threshing experiments.

The V-bars are similar to the standard rasp bars, but are *V* shaped with the center leading and the ends of the bars swept back. The centers of the V-bars pass over the concaves first, with the threshing action progressing out toward the ends of the bars as the cylinder is rotated. The edges of the V-bar corrugations are more abrupt and the bars are thicker than the conventional rasp bar.

The V-bar was definitely superior to the rasp bar in its ability to thresh clover seed. In the Kenland red clover, using flax rolls and a cylinder speed of 5,000 feet per minute, the rasp bar cylinder left about twice as much unthreshed seed as the V-bar—5% as against 2½% at a loading of 60 pounds per minute. As cylinder speed was increased, a higher percentage of seed was threshed out. At the higher speeds, the difference between the two cylinders was not so great—2½% as against 1% at 6,000 feet per minute and 60 pound loading.

The amount of material passing through the cylinder affected the quality of the threshing. The loss of unthreshed seed appeared to be directly proportional to the load—as the load was doubled, the threshing losses also doubled.

In the red clover, at cylinder speeds of 5,000 feet per minute peripheral speed, the V-bar did slightly more damage than the rasp bar—about 4% as against 3% at 60 pounds per minute. As speeds were increased, the rasp bar did somewhat more damage to the seeds, but the V-bar damaged a considerable higher percentage. At a cylinder speed of 6,000 feet per minute, the V-bars damaged over twice as much seed as the rasp bars—12% compared with 4½% at 60 pounds per minute.

The load in the cylinder had a significant effect on seed breakage. When small amounts of material were passing through the cylinder—seed damage tended to be greater than when the load was heavy. The rasp bar cylinder running at 5,000 feet per minute damaged 5% of the seed when the machine was handling 30 pounds per minute, but only 2% when handling 90 pounds per minute. At lower material rates or higher cylinder speeds this effect was even more marked. The thresher should be kept loaded at a rate high enough to prevent undue seed damage, but low enough to keep seed losses from being excessive.

Too few runs were made with the spike tooth cylinder in clover to make a definite comparison with the other types, but its performance appeared to be similar to the rasp bar.

Alfalfa Threshing

The performance of the V-bar was less striking in alfalfa. When both cylinders were operating at 4,000 feet per minute—with flax rolls—the rasp bar lost one and one-half to two times as much unthreshed seed as the V-bar. The over-all loss, however, seldom went above 2%, and was usually lower. The cylinders were tested at no other speeds.

Load had about the same effect on alfalfa seed threshing as in clover. Threshing losses increased in proportion to the load within the normal range of operation, although not at nearly such a steep rate as in clover.

In alfalfa the V-bar generally did little, if any, more damage than the other cylinders. However, damage from the V-bar occasionally did rise to excessive levels. Until the cause of this excessive breakage

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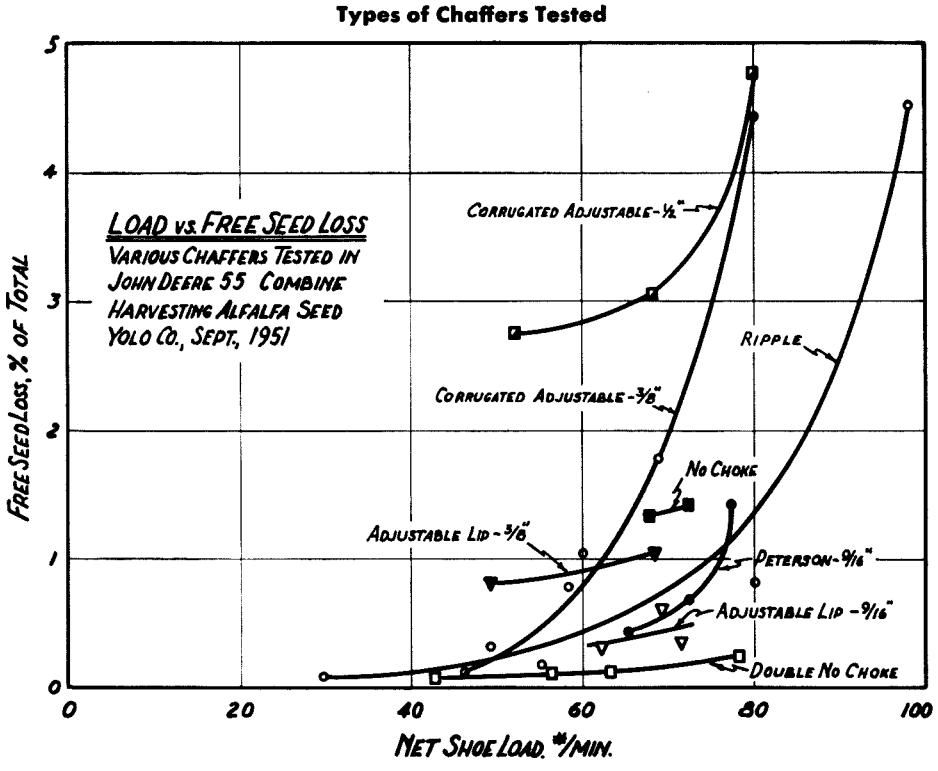

LEGUMES

Continued from preceding page

is determined, V-bars should be used in alfalfa only with great care.

The amount of material passing through the cylinder had a pronounced effect on seed damage in alfalfa. In one case, a machine operating at a very light load damaged 17% of the seed. When the material rate was tripled, the damage dropped to around 7%.

The spike tooth cylinder was tested extensively in alfalfa where it performed very much the same as the rasp bar.

The Cleaning Shoe in Alfalfa

In alfalfa the standard grain-type straw walkers carried half of the weight of material passing through the machine. The cleaning shoe handled the other 50%. In addition, the shoe carried a large volume of tailings which were returned to the cylinder and recirculated. Thus the amount of tailings increased the shoe load 60% to 70%.

Laboratory and field tests indicated that the most significant single factor affecting the loss of free seed was the amount of material passing over the shoe. As the load was increased, the seed loss went up sharply.

A number of different chaffers were tested in machines operating in alfalfa. In most cases the wind from the fan was adjusted until tests with a sampling pan indicated that the free seed loss over the shoe was at a minimum at normal material rates. Then runs were made at several different material rates without further adjustments. The graph on page 11 shows the results of these tests.

The type of material passing over the chaffer affected its operation. Straw had a much more adverse effect on separation than an equal weight of fine material. The free seed loss was normally influenced by the bulk, rather than the weight, of material passing over the shoe. Apparently tailings did not have as adverse an effect on separation as might be expected.

The double chaffer tested—with a No. 2 no-choke in the usual position and a larger No. 0 no-choke about 3" above—gave the best results. The drawback with the double chaffer was that too high a percentage of free seed was deposited in the tailings.

Typical Seed Losses under Average and Heavy Loads in Irrigated Alfalfa and Red Clover Stands with Seed Yields of 800 to 900 Pounds per Acre.

Crop	Swath width feet	Speed mph	Mat'l rate lb./min.	Seed losses, % of total yield		
				Free	Unthreshed	Damaged
Alfalfa	9	0.6	60	0.01	0.3–1.2	2 & up
	9–10	1.2–1.5	120	0.2–1	0.8–1.5	0–3
Clover	8½	0.4–0.5	40	0.2–0.3	2–5	3–4
	8½	0.8–0.9	80	0.3–0.5	4–11	1–3

The standard adjustable lip chaffer gave the next best results—when properly adjusted with the sieve open 9/16". When the chaffer was only 3/8" open, the losses were considerably greater.

A ripple chaffer — a nonadjustable type—performed well in alfalfa. This chaffer had crosswise corrugations or steps, with 3/4" openings along the back side of the steps. At lower material rates the ripple chaffer was very efficient, although at higher rates the loss went up rapidly. There seemed to be little tendency for the stems and sticks to fall through and clog the sieve underneath. The nonadjustable chaffer may not do quite so good a job as a properly-set adjustable chaffer, but it is much superior to an improperly set adjustable unit.

Field tests on the effects of the amount of wind on the ripple chaffer performance showed that as air velocity decreased from a maximum, seed losses decreased, up to a certain point. With further reduction in air velocity the seed loss began to increase. This was contrary to laboratory results, where seed losses continued to decline as the wind was decreased. The apparent cause of this discrepancy was the tremendous increase in recirculated tailings in the field machine at lower wind rates. At minimum wind, well over half the material on the shoe was recirculated tailings, and these excessive tailings undoubtedly boosted the free seed losses.

An analysis of the tailings under normal conditions indicated 10% to 20% of the total seed yield was recirculated in the tailings. Furthermore, three fourths of the material collected in the tailings is superfluous, and could be eliminated without losing any unthreshed pods.

Small amounts of tailings apparently fill up the spaces in the straw, without greatly increasing the volume of the load. In this case there is comparatively little increase in free seed loss. Even when an excessive amount of tailings is present, the resulting loss of free seed is not so great as would be caused by an equal volume of straw.

The Cleaning Shoe in Clover

In red clover the straw walkers retained only about 30% of the total material, while the other 70% loaded up the shoe. On the other hand, the tailings rates were lighter than in alfalfa, averaging only 25% of the net shoe load.

Three types of chaffers were compared in clover. The most effective one tested was the adjustable lip sieve open 1/2" to 5/8". The ripple chaffer showed greater losses, particularly at higher material rates. The chaffer setup with the highest free seed loss was the double no-choke arrangement, which performed so well in alfalfa.

The studies reported here indicate small-seeded legumes can be threshed satisfactorily with present types of harvesters if properly modified, adjusted and machine loads are kept at the proper level.

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CONDITIONERS

Continued from page 6

almost filled to the depth wetted. Within a few days in well-drained soils, some of this water will move downward and perhaps horizontally. The amount of water retained by the soil after drainage has occurred is called the field capacity. Plants can not extract all of this moisture for their normal functioning, and wilting occurs at a moisture content characteristic of the soil which is called permanent wilting percentage. For practical purposes, the difference between field capacity and permanent wilting percentage is the available water.

The field capacities of soils can be estimated by standard laboratory determinations called the moisture equivalent and one-third atmosphere percentage. The permanent wilting percentages may be obtained directly by growing small sunflower plants in the soils or estimated indirectly by what is called the fifteen-atmosphere percentage.

By measuring the effect of soil conditioners on these soil-moisture characteristics, their influence on total soil moisture available to plants can be evaluated.

Moisture equivalents and sunflower permanent wilting percentages were determined for Yolo soils ranging in texture from loamy sand to clay. CRD-189 at the rate of 0.1% by weight was mixed

Continued on page 15