

Wheel Track Losses

In Small Grains

David W. Cobia

One of the costs associated with postemergent application of herbicides in small grains with ground sprayers is the potential reduction in yield resulting from damaged plants and compacted soil in the wheel tracks. The size of this yield reduction, if any, has been debated considerably, particularly among individuals comparing the merits of ground and aerial application.

Two surveys have been made to investigate the extent of wheel track damage to small grain under field conditions in Cass, Eddy and Foster counties. The purposes of this report are to present the findings of the 1970 survey and to list the hypothesized relevant variables and problems of obtaining precise answers.

Dr. Cobia is associate professor, Department of Agricultural Economics. Assistance in experimental design and processing samples was received from H. L. Kucera, Department of Agricultural Engineering; J. D. Nalewaja, Department of Agronomy; and L. W. Schaffner, Department of Agricultural Economics.

Procedure

Farmers in Cass, Eddy and Foster counties expecting to use ground spray equipment on barley, hard red spring wheat, durum and oats were contacted just prior to the spraying seasons to obtain their cooperation. The cooperating farmers provided information on equipment used, general crop conditions such as variety, soil type, moisture level, and field location. At the time the field was sprayed, each farmer placed two stakes 15 feet apart in the sprayer wheel track in three locations about 100 feet from the road so the wheel tracks could be located at harvest. The farmers recorded growing conditions and crop growth at and following the time of spraying and then returned the surveys. Paired samples were obtained just before the fields were swathed. The paired samples were one yard wide to obtain possible border effect and two yards long. One of the pair was taken from the wheel track and the other adjacent to the wheel

Table 1. Average yields per two square yards out of and in the wheel tracks of post emergence herbicide application equipment and related data for specified crops, Cass, Eddy, and Foster counties, North Dakota, 1970.

Crop	Number of Paired Comparisons	Average Yield ¹		Reduction in Yield		Estimated Loss of Income Per Acre ³	Confidence Level ⁴
		Out of Tracks	In Tracks	Sample	Field Basis ²		
Identification Column	(1)	(2)	grams (3)	(4)	percent (5)	(6)	percent (7)
Barley	53	284	271	4.6	.61	\$.30	80
Durum	22	312	283	9.3	1.24	.62	90
Oats	18	316	288	9.1	1.21	.54	70
Wheat (hard red spring)	61	355	343	3.2	.41	.20	80

¹Yields of 1x2-yard paired samples.

²Assumes a 45-foot swath width and two-wheel tracks.

³Assumes a cash income of \$50 per acre for barley, durum, and wheat; and \$45 per acre for oats.

⁴The probability that a reduction in yield in the tracks will take place under similar conditions.

track. In most of the fields, six paired samples were obtained. The samples were placed in individual sacks, dried, threshed and weighed.

Results

Yields of samples taken from the wheel tracks compared to those taken adjacent to the wheel tracks averaged 9.3 per cent lower for durum, 9.1 per cent lower for oats, 4.6 per cent lower for barley and 3.2 per cent lower for wheat (see column 4, Table 1). Durum was also the most susceptible grain to wheel track damage, according to a smaller Cass county survey in 1969.

The actual loss for the entire field would be substantially less than this because the samples do not reflect the proportion of ground covered by wheel tracks. The swath width and number of wheel tracks must also be considered. For example, with two wheel tracks and a 45-foot swath, the average reduction in total crop yield due to wheel tracks would be 1.24, 1.21, .61 and .41 per cent for durum, oats, barley and wheat (see column 5, Table 1). These reductions in yields could result in losses of income ranging from \$.20 to \$.62 per acre depending on total yield and price (column 6, Table 1).

The figures reported in Table 1 are averages. A reduction in yield from wheel tracks for a particular field is subject to chance and other factors, such as temperature, crop maturity, soil moisture and soil type. Yields in some cases were actually higher in the tracks than out of the tracks. However, on an overall basis and under conditions similar to those existing for the sampled fields, one could be confident that 90 per cent of the time a reduction in yield would occur in a durum field and 70 per cent of the time in a hard red spring wheat field (see column 7, Table 1).

An attempt was made to see if there was an association between wheel track losses and growing conditions. The results indicated that losses from wheel track damage were:

- (1) lower when application takes place during early stooling,
- (2) lower in sandy soils than other soil types,
- (3) higher in dry soils, and
- (4) lower on hard soils.

Data also were collected on size and per cent wear of tires, level of weed infestations and spring moisture, temperature, crop height, number of leaves, and moisture and temperature one week following application of the herbicide. No relationships between these factors and wheel track losses were observed.

It is very difficult to determine the precise impact of damage by wheel tracks under field condi-

tions because of the uncontrolled variables and likely interaction among them. For example, variation observed within the fields may be from such factors as (1) differences in seeding and fertilizer application rates and depths within the swath; (2) overlaps and skips for seeding and fertilizer; (3) variability in soil quality; and (4) wheel tracks made in previous passes in the field. The Department of Agricultural Engineering at North Dakota State University, in cooperation with Branch Experiment Stations, is conducting further research on wheel track loss from postemergent application equipment in an attempt to minimize differences in yield from these factors.

Research on wheel track damage to emerged crops is extremely limited. Modest efforts on potatoes and small grains have been reported in Canada, New York and North Dakota (1, 2, 3). It was reported in these studies that average reductions in yield from wheel tracks were 4.5 and 17 per cent for potatoes and one bushel per acre for barley.

Summary and Conclusions

Significant economic losses from ground post-emergent application equipment amounting to from .4 to 1.2 per cent in total yields were observed in small grains. This translates to a \$.20 to \$.62 cents per acre loss depending on yield and price. Durum seemed to be the most susceptible crop in terms of the probability and level of loss. Stage of plant growth, soil type, soil moisture and hardness of soils also influence the level of loss. The Department of Agricultural Engineering at North Dakota State University is conducting experiments which will attempt to verify some of these results under more controlled conditions.

Farmers should consider the probability of reduced yield from wheel tracks and agronomic conditions when selecting the equipment to apply postemergent herbicides to small grains. We have yet to determine what conditions are present when no reduction or an increase in yield occurs. However, under conditions similar to those prevailing in Cass, Eddy and Foster counties in 1970, there is, on the average, a reduction in yield from wheel tracks of postemergent application equipment.

References

1. Philpotts, L. E., 1971. **Aircraft Services Versus Ground Methods for Spraying Potatoes in New Brunswick**, AFA-TN 6, The Associate Committee on Agriculture and Forestry Aviation, National Research Council of Canada.
2. Nichols, R. C., 1971. **Wheel Row Damage to Potatoes**, Report of the Seventh Northeast Aerial Applicators Conference, Cornell University, Ithaca, New York, March 16-18.
3. Jacobson, L. A. and R. L. Post, 1969. **Wheel Track Damage Vs. Aerial Application**, The North Dakota Seed Journal, March.