

# Nutrient removal- the hidden cost of chaff carts and windrow burning

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<b>Purpose:</b>	To determine the dollar value of nutrient removal by chaff cart or windrow burning systems of various crop types.
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## BACKGROUND

Removing weed seeds at harvest is a very successful and important tool in modern farming systems. For sustainable continuous cropping, weed seed removal at harvest is essential. Choosing which harvest weed seed management tool to use is a big decision. It is important to weigh up all of the costs of the various systems to compare apples with apples. Nutrient removal is often overlooked. In recent years most growers have adopted auto-steer on their header. For growers who burn narrow windrows to destroy weed seeds, this means that the windrow is now in the same place each year. When windrows are burnt the nitrogen goes up in smoke but the majority (90%) of the potassium stays behind in an available form.

## TRIAL DESIGN

### Chaff carts

Samples of chaff were collected from four different chaff carts during harvest 2011.

- The Perry and Thompson chaff carts were Tru-Fab carts (14m<sup>3</sup>) fitted with cross augers and air slinger chaff delivery attached to Case headers.
- The Cobley chaff cart is a Tru-Fab (14m<sup>3</sup>) cart that has been modified to deliver chaff by a conveyor belt system towed by a New Holland header.
- The Stokes chaff cart is a new Tecfarm cart 30m<sup>3</sup> that was built with conveyor belt delivery of chaff fitted to a Claas header.

Two chaff samples were taken from each chaff heap using a 14 litre core. Samples of crop residue were also taken from a 0.5m<sup>2</sup> quadrat adjacent to the chaff heaps on either side of header wheel tracks.

Samples were dried in an oven for five days at 40 deg C and then weighed to determine the bulk density (kg chaff /m<sup>3</sup>). The growers were asked to take accurate measurements of how many cubic metres of chaff they collected per tonne of grain harvested. The grain yield and crop harvest index were used to estimate the total crop residue in the paddock. This data was used to determine the amount of crop residue that was re-distributed into the chaff heap.

### Windrows

Crop residue samples were collected from two wheat paddocks where the grower had made narrow windrows using a chute mounted to the rear of the header. These windrows will be burnt in autumn 2012. In both cases windrows were 0.7m wide and were produced by a header with an 11m front.

A 0.5m section of windrow and 0.5m<sup>2</sup> quadrat of crop residue adjacent to the windrow was sampled, dried and weighed as described above. Once again the grain yield and crop harvest index were used to estimate the total crop residue in the paddock. This data was used to determine the amount of crop residue that was concentrated into the windrow.

## Nutrient removal

All samples were sent to the CSBP lab for analysis of the nutrients Boron, Calcium, Chloride, Iron, Magnesium, Manganese, Nitrate, Phosphorus, Potassium, Sodium, Sulphur, Total Nitrogen and Zinc. Only the results of Potassium and Total Nitrogen are presented here as all other nutrients were in relatively small amounts.

## RESULTS

Chaff carts removed 11 to 37% of crop residue from a paddock (table 1). This is much higher than previous estimates of 5 to 10%. The bulk density of chaff collected in a chaff cart ranged from 49 to 105 kg/m<sup>3</sup>.

**Table 1:** Summary of dollar value of major nutrients (potassium and nitrogen) re-distributed by chaff cart or windrow burning.

	Chaff cart			Windrow		
	Potassium	Nitrogen	Total	Potassium	Nitrogen	Total
<b>Wheat</b>	\$5.70	\$7.49	\$13.19	\$28.79	\$14.20	\$42.99
<b>Lupin</b>	\$20.41	\$21.24	\$41.65	No data		

The growers observed that they collected between 3 and 4.5m<sup>3</sup> of chaff per tonne of wheat harvested. They collect approximately one and half times as much chaff when harvesting lupin or canola compared to wheat. Residue removal from lupin crops by chaff cart is much higher than from cereal crops. The growers observed that lupin residue is pulverised to a finer state than cereal residue in the harvesting process, hence the greater tonnage of residue removal. Many growers with chaff carts comment that the volume of chaff per tonne of grain does not vary much between high yielding and low yielding crops.

Windrow burning concentrates 42 to 52% of crop residue into the windrow.

Crop residues measured in 2011 contained on average 0.6% potassium and 0.65% total nitrogen.

**Table 2:** Face value cost of harvest weed seed management tools – assuming 3000ha at 3 t/ha

	Capital cost	Running cost / ha*	Labour (burning /ha)	Total Cost /ha
<b>Harrington Seed Destructor</b>	Approx \$150K	\$12.20	\$0	\$12.20
<b>Chaff Cart</b>	\$50 to \$75K	\$3.10	\$2	\$5.10
<b>Windrow Burn</b>	\$500	\$0	\$2	\$2.00

\*Running cost includes interest, depreciation, insurance, fuel, ,maintenance

**Table 3:** Real cost of harvest weed seed management tools including nutrient removal – assuming 3000ha at 3 t/ha

	Running cost / ha*	Labour (burning /ha)	Nutrients (K & N) \$ /ha	Total Cost /ha
<b>Harrington Seed Destructor</b>	\$12.20	\$0	\$0	\$12.20
<b>Chaff Cart</b>	\$3.10	\$2	\$11.05	\$16.15
<b>Windrow Burn – header moves each year</b>	\$0	\$2	\$13.15	\$15.15
<b>Windrow Burn – header follows same path each year</b>	\$0	\$2	\$42.75	\$44.75

## DISCUSSION

This preliminary study suggests that both chaff carts and windrow burning removes significant amounts of nutrients from the paddock. Most of the K left behind in the windrows remains in the paddock. However, most harvesters now have auto-steer so these nutrients are effectively placed in the same strip each year. Growers who make windrows and have auto-steer are advised to embark on a program of moving the windrow across approximately 1m each year. If they do not move the header each year then all of the K is placed in the same strip each year which is essentially lost from the system which is a big cost to the grower (Table 3).

While the Harrington Seed Destructor (HSD) may be more capital intensive and more costly to run than a chaff cart or windrow burning, all of the nutrients contained in crop residue remain in the paddock. The true cost of all systems should be considered when deciding which method of harvest weed seed management to adopt. For a header harvesting 3000ha at an average yield of 3 t/ha the cost of the three systems is similar (assuming the header moves across 1m each year when making windrows) (Table 3). For a smaller area of crop the relative cost of the destructor and chaff cart increase due to the capital cost being spread over a smaller area.

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