credit Emma Leonard, AgriKnowHow

crop nutrition

chapter 6

Crop nutrition

Impact on hay quality

- Feed analysis
- Colour

A nutrient balance is one way of calculating nutrient requirements as oat hay removes significant quantities of all the major elements - nitrogen, phosphorus, sulphur and especially potassium. Zinc and manganese levels should also be considered. A tonne of hay can also remove 15kg of lime.

Removal differs from cereal crops cut for grain with nitrogen removal reduced but potassium, calcium and magnesium removal greatly increased.

The starting point for a nutrient balance is the current soil nutrient status and the predicted nutrient removal for the target hay yield (Tables 6.1a & b). Surface and deep soil nitrogen are useful when budgeting for a hay crop grown on heavier soils.

Oat growth is strongly influenced by temperature and early sown crops generally make adequate growth with low to moderate fertiliser inputs at seeding. If seeding is delayed, oat crops become far more responsive to applied fertiliser as root and aerial growth slows in response to colder conditions.

For best results, phosphorus, potassium and trace elements required during early growth should be applied in or under the seed row. More mobile nutrients such as nitrogen and sulphur can be applied during the growing season by a range of methods. Some trace elements, such as manganese, can be rapidly immobilised in the soil, so foliar application may be the most appropriate.

Nitrogen at seeding

To produce a balance between quantity and quality, nitrogen application at seeding should be moderate (40-80kg/ha). Nitrogen may not even be required, if there is about 80kg/ha of available nitrogen in the top 60cm at seeding.

There is a strong relationship between seedbed nitrogen, variety maturity and quality (Figure 6.1) but this is also influenced by rainfall. Variety specific agronomy packages are being developed and should be referred to when available.

Oat crops that have ready access to nitrogen, especially during early growth, result in hay with lower levels of water soluble carbohydrate (WSC) and proportionally higher fibre content. Both of these factors are negative in terms of hay quality, especially for the export market.

Research has shown that both early and late sown crops will have lower levels of WSC when they receive over 80kg/ha of nitrogen at seeding.

In low rainfall regions, where early growth is limited due to lack of soil moisture, high levels of nitrogen in the soil or as fertiliser have a less negative impact on hay quality than in medium and high rainfall regions.

In wet seasons, leaching can occur, especially in sandy soils. In this situation, delaying or splitting nitrogen application will help reduce nitrogen loss.

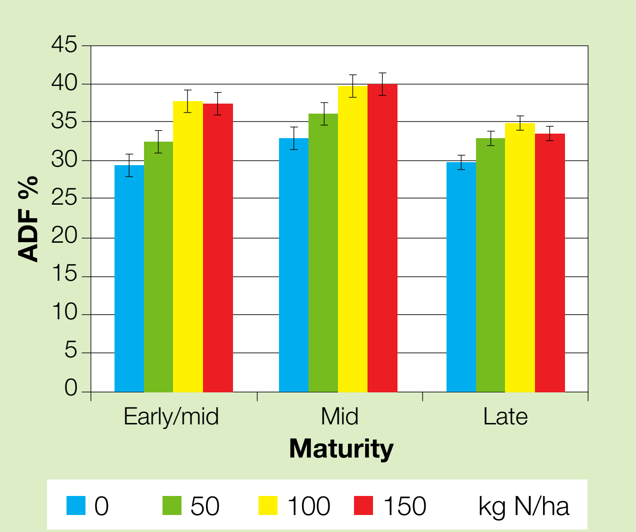

Figure 6.1 Interaction between variety maturity and fibre content under increasing seed bed nitrogen – *source Agrilink Agricultural Consultants.*
The impact on quality was more negative in early and mid season varieties.

If applied in close proximity to the seed, high rates of nitrogen (over 30kg N/ha as urea) at seeding increase the risk of damage to germinating seedlings by ammonia toxicity. The degree of damage depends on row spacing and the lateral spread of seed and fertiliser within a row (see Table 5.2).

Therefore, seed and nitrogen fertiliser should be separated by:

- deep or side banding;
- broadcasting prior to seeding with incorporation by seeding or rainfall; or
- broadcasting after seeding with incorporation by rainfall.

Post emergent nitrogen

Growth stages should be used to determine the appropriate timing for additional nitrogen applications (see Chapter 2). To maximise quality, any late nitrogen should be applied between GS25, tillering, and GS31, stem elongation. Before this stage, additional nitrogen increases yield, but after this point it can accumulate as nitrates and reduce quality.

Table 6.1a Kilograms of major nutrients removed with every tonne of commodity harvested.

Commodity Removed	Nitrogen		Phosphorus		Potassium		Sulphur		Calcium		Magnesium	
	Ave	Range	Ave	Range	Ave	Range	Ave	Range	Ave	Range	Ave	Range
Oat hay	11	8-13.5	2	1.2-2.2	20	15-30	2	1-3.5	8	5-11	8	5-11
Medic hay	30	18-32	3	2.5-3.5	25	20-30	2	1-3.5	9	7-12	9	7-12
Wheat grain	23	14-28	3	2-5.5	5	2.0-7	2	1-3.5	0.4	0.2-0.7	0.4	0.2-0.7
Barley grain	20	13-28	2.7	2-5.1	5	2.0-7	2	1-3.5	0.4	0.2-0.7	0.4	0.2-0.7
Field pea grain	41	35-45	4.5	3.5-7	10	8-15	4	3-6	1	0.7-2	1	0.7-2

Table 6.1b Grams of minor nutrients removed with every tonne of commodity harvested.

Commodity Removed	Copper		Zinc		Manganese		Molybdenum		Iron		Boron	
	Ave	Range	Ave	Range	Ave	Range	Ave	Range	Ave	Range	Ave	Range
Oats hay	4	2-20	20	6-40	9	7-15	1	Range unknown	Little comparative information available		4	2-80
Medic hay	5	2-20	20	7-40	15	10-20	1.2				25	10-100
Wheat grain	3	1-30	15	7-40	30	15-80	1.8				2	1-100
Barley grain	3	1-30	15	7-40	25	15-80	1.8				2	1-100
Field pea grain	6	1.5-50	25	8-40	9	7-15	2				10	2-100

Note: The figures are average removals published for southern Australian conditions.

The range represents the extremes of variation that are encountered due to soil type and nutrient level, the length of growing season and the total yield.

Examples: 1) removals are likely to be greater where soil levels are high and conversely removals may be low where soil levels are low.

2) removals are generally higher where the growing season is longer, as significant root uptake occurs while there is adequate soil moisture.

3) removals per tonne may be lower where yields are extremely high and dilution occurs.

Table 6.1c Nutrient removal from stubble burning based on kilograms lost in every tonne of cereal stubble – *source Landcare South Australia.* Divide cereal grain yield by 0.55 to estimate stubble weight. Trace elements will also be lost and organic carbon will not be returned.

	Nitrogen	Sulphur	Phosphorus	Potassium
Kg/ha per tonne of stubble	5	1.5	0.5	7.5
Lost in	smoke	smoke	ash if blown	ash if blown

Where soil fertility is high, hay crops are prone to lodging. This causes the lower stem to be shaded and become bleached, resulting in a poor feed test and visual assessment.

If growth rates decline or nitrogen deficiency symptoms are observed, applications of 25kg/ha of nitrogen can be sufficient.

Excess nitrogen applied to the crop can occasionally result in hay with nitrate nitrogen levels greater than 500ppm, which is unacceptable to many hay markets.

Phosphorus

Response of oat hay to phosphorus (P) is similar to cereal crops grown for grain, therefore application rates at seeding are the same as for other grain crops.

There is some research to suggest that hay grown on high phosphorus fixing soils has a higher phosphorus requirement than grain crops.

Local agronomic advice and experience should be sought.

Potassium

Cutting hay removes greater levels of potassium (K) than cereals harvested for grain (Table 6.1a). Particular attention should be given to potassium in the nutrient budget, especially for crops grown on light sandy soils.

Research from Western Australia (WA) has shown that to optimise the response to fertiliser N, adequate K fertiliser must be applied.

If potassium deficiency is identified by soil analysis, then apply 40 to 80kg/ha of muriate of potash (KCL).

If growth rates decline or nitrogen deficiency symptoms are observed, applications of 25kg/ha of nitrogen can be sufficient.

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