Annex 5. Focus Groups

Executive Summary

1. Introduction

Defra commissioned ADAS to undertake a project to estimate the extent to which GHG emissions associated with N fertiliser use on arable crops in England could be reduced through optimal N timing, improving the prediction of N requirement and the development of longer-term technologies. This was to be achieved through the following objectives;

1. Estimate the potential to increase yield and reduce GHG emissions through altering N timing and assess whether this is influenced by factors such as region.
2. Estimate the level of imprecision in N fertiliser use and the effect on GHG emissions.
3. Evaluate the scope for altering N timing towards the optimum for minimising GHGs, identify barriers for change and assess whether these are influenced by factors such as region.
4. Evaluate the scope for minimising imprecision of fertiliser use and identify barriers for change.
5. Assess the potential for minimising fertiliser N requirement through the development of N efficient varieties and low N bread technology.
6. Estimate realistic changes to N use and GHG emissions that could be achieved with timescales.

A market research study was conducted in order to help achieve objectives 1-4. This report contains the findings of this study.

2. Method

The market research study was conducted in two stages. Firstly 300 telephone interviews were conducted amongst a representative sample of cereal, general cropping and mixed farms. Each interview lasted approximately 10 minutes and was conducted by a specialist interviewing agency, the Hill Taylor Partnership, using CATI technology (computer assisted telephone interviewing). The aim of the interviews was to understand current farm practice and decision making with regard to nitrogen fertiliser application and assess the likelihood of making changes to improve precision and timing of application. The telephone survey is reported in detail in Annex 4. The second stage involved 4 focus groups, one with agronomists and 3 with farmers. Each session lasted 1.5 to 2 hours and comprised 7-8 respondents. The aim was to explore in more detail the potential to change farm practice in order to reduce GHG emissions from N fertiliser application, and to understand barriers to change and how these could be overcome.

3. Focus group findings

3.1 Awareness of GHG emissions

Most farmers had very little knowledge of the GHG emissions associated with nitrogen fertiliser. There was a common misconception that ammonia was the GHG. Only a minority were aware of nitrous oxide emissions, and few understood its potency compared to carbon dioxide or methane.

GHGs were not currently a deciding factor when making decisions regarding nitrogen fertiliser application, primarily due to lack of information and knowledge about the nature and source of the emissions, but also as optimising yields and profit were the farmers' main priority. It was apparent that any potential change in practice needed to have at least a neutral impact on the farm business but most likely provide a benefit to the farm business, with sound scientific evidence to prove the need for change.

Many of the current farm practices aimed at optimising yields and minimising costs were consistent with reducing GHG emissions, e.g. applying the fertiliser in several splits, avoiding application onto wet soil, applying when the crop is growing and not applying more than the crop can take up. Farmers were aware of loss of nitrogen from leaching and run off and took action to avoid this, motivated by the need to avoid wasting expensive fertiliser, to maximise yields and profit, and to comply with NVZ regulations.

3.2 Timing of application

Farmers perceived that they had already increased the number of splits used over recent years and in the main felt they had reached the optimum or maximum number that was practical for their business. The barriers to increasing the number of splits included concerns over being able to apply in appropriate weather conditions or at an appropriate stage in the growth of the crop. There was also some concern that additional splits could mean applying the fertiliser every 2 or 3 weeks, which would not provide sufficient time for the crop to take up each application. The smaller and mixed farms particularly had issues over lack of time. Having said this, if sound scientific evidence could show that adding another split was beneficial to yield it is possible that some farms could adapt, at least in favourable weather conditions. The telephone survey findings appear to support this.

Prospects for waiting an extra few days in addition to the days the farmers usually wait after heavy rain was not straight forward. Farmers already waited until the land was fit for travelling, but the time each farmer had to wait varied according to soil type, temperature and humidity levels and also the weather forecast for the next few days. A major barrier for delaying N applications was lack of confidence in weather forecasts, and as a result farmers felt they could not afford to miss a suitable weather window. Encouraging farmers to apply in more splits would seemingly increase the problem of finding suitable weather windows and reduce the chance farmers could wait for longer before application. The telephone survey suggested that many farmers would wait at least five days, but it is possible that they were already doing this. In order to encourage any change in practice it is likely that farmers would again need sound scientific evidence that nitrogen uptake would improve as a result of the change, but would also need clear guidance on what a suitable soil moisture level would be. This in itself seems to create problems and an extra task of asking farmers to measure soil moisture.

3.3 Improving precision

Type of spreader and fertiliser

As identified by the telephone study, the spinning disc was the most commonly used spreader. A pneumatic spreader was thought to provide greater precision in terms of where the fertiliser was applied, allow N to be spread in a wider range of conditions (thereby increasing the number of days on which N could be spread), but it was more expensive to buy and maintain and more cumbersome on smaller farms and smaller fields. There was some evidence to suggest that the spinning disc could result in fertiliser being spread on headlands, roads, etc, particularly if used in windy conditions.

In line with the telephone survey findings most farmers seemed to regularly calibrate their spreader, particularly those in Farm Assurance schemes. The mixed farms not in these schemes were more likely not to calibrate, particularly as livestock were often seen as higher priority. Striping in fields was evidence to agronomists that the machines were not always calibrated regularly. The evidence suggests that regulation needs to cover all farm types or those not calibrating need evidence to show benefits to their farm business that will out-weigh the additional cost and time input.

As identified by the telephone survey the farmers were most often using solid fertiliser. There was some belief that liquid fertilisers would be taken up more quickly by the plant, however there were a number of disadvantages: potential problems in storing the liquid fertiliser tanks, cost, corrosion of the spreader, scorching of the plants and reliance on a contractor (if one was used).

Information systems

As indicated by the telephone survey, many farmers appeared to use RB209, PLANET or TAG data to aid their nitrogen fertiliser decisions and many also took the advice of an agronomist. It was clear from the focus groups that the agronomist was often supplier based. The decisions were often made jointly between the agronomist and farmer, as the farmer felt he knew the needs of his land much better than the agronomist. In line with the telephone survey findings, the mixed farms appeared less likely to use an agronomist for fertiliser decisions, even though they used one for advice on pesticides etc., the reasons being that they were concerned about additional costs, did not feel an agronomist could add to their knowledge and a feeling that perhaps an agronomist would not consider that a small farm or mixed farm was a viable proposition for them. It would seem that these farmers were thinking of an independent agronomist.

Although many of the farmers and agronomists used RB209, there was some evidence that this was primarily to comply with regulations, rather than because it offered a benefit. TAG data was preferred by some as it was considered more accurate and up to date. It should be recognised that TAG has a strong influence in the Lincoln area where a farmer and agronomist focus group was held and this may not be representative of England. RB209 received a number of criticisms in that the data was inaccurate and not sensitive to different soil types. Many farmers used RB209 as a guide but still heavily relied on their own knowledge of the land and previous cropping. A small proportion of farmers did not appear to have heard of RB209.

There was some inconsistency with regard to the amount of nitrogen the farmers and agronomists thought it appropriate to apply. The farmers believed they were applying the optimum amount in order to maximise yields and minimise costs. Some agronomists felt farmers didn't always apply enough fertiliser. However farmers sometimes felt that RB209 didn't recommend sufficiently high doses of nitrogen. This area merits further investigation as it could have a substantial impact on application precision. There also seems to be a need for a system that farmers have more faith in.

Taking into account nitrogen in the soil, manure and crop

Most farmers appeared to be taking soil nitrogen into account, although as shown by the telephone survey there was much variation in the way this was done, i.e. by soil testing, estimating from look-up tables or by using the farmers' knowledge and experience. Even the process for soil testing varied, with some farmers testing the same fields annually whilst others rotated the fields that were sampled. It would seem therefore that there is room for improving the way in which farms take the soil nitrogen into account to improve the precision of application, and that guidance is needed on the best approach. If soil testing was to be encouraged it would be

important to overcome concerns over inconsistencies and inaccuracies in testing, due mainly to different transportation and storage conditions, and also to clearly show that there was a benefit in doing this compared to only using look-up tables, given the time and cost involved.

Although the farmers took manure nitrogen into account when deciding how much manufactured nitrogen to apply, there was again variation in the way this was done, i.e. using experience, testing or look-up tables. The method often varied according to the type of manure. Poultry manure was most likely to be tested due to the high nitrogen content. There was a perception that the amount of nitrogen in cattle manure will have little impact on the amount of manufactured nitrogen required.

Many, but not all, farmers appeared to be taking the crop nitrogen into account, in line with the telephone survey findings. Again the methods of assessing the nitrogen varied from measuring it by cutting and weighing a metre squared of crop, using satellite technology or sending a picture of the canopy to the BASF website in order to obtain an estimate of its N content. Other farmers observed plant growth or used past experience.

Nitrogen efficient varieties

Farmers and agronomists were interested in finding out about more nitrogen efficient varieties and would be interested in growing them as long as yields were as high as current varieties and there was a market for the crops. Triticale was not considered a viable option due to a perception of poor yields and a weak market for it.

Contents

1. Introduction and Objectives

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- Estimate the level of imprecision in N fertiliser use and the effect on GHG emissions.
- Evaluate the scope for altering N timing towards the optimum for minimising GHGs, identify barriers for change and assess whether these are influenced by factors such as region.
- Evaluate the scope for minimising imprecision of fertiliser use and identify barriers for change.
- Assess the potential for minimising fertiliser N requirement through the development of N efficient varieties and low N bread technology.
- Estimate realistic changes to N use and GHG emissions that could be achieved with timescales.

In order to help fulfil objectives 1-4 a market research study was conducted amongst farmers and agronomists. This report details the methodology and findings for this study.

2. Method and Sample

The study was conducted in two phases. Firstly a telephone survey amongst farmers and secondly a series of focus groups amongst agronomists and farmers. The telephone survey is reported in detail in Annex 4.

2.1 Focus Groups

Four focus groups were conducted in order to explore further the potential to improve N fertiliser application precision and timing on farm, understand any barriers to change and where possible identify how these barriers could be overcome.

One group was conducted amongst agronomists and three amongst farmers. The groups were conducted in Lincoln (1 agronomist and 1 farmer group), Huntingdon, Cambridgeshire and Thirsk, North Yorkshire. Each group lasted 1.5 to 2 hours and followed a pre-agreed topic guide. The topic guide can be found in the appendix to this report. Each group comprised 7-8 respondents, and each farmer group included a mix of cereal, general cropping and mixed farm types across a range of farm sizes. Respondents were recruited from contacts provided by Defra for the telephone interviews. Those who took part in the telephone interviews were asked if they would be prepared to help out with further research. The groups were facilitated by an experienced market research group moderator and an ADAS technical expert.

3. Focus Group Findings

3.1 Influence of GHG emissions on current practice

GHG emissions were clearly not at the forefront of farmers' minds when deciding when, how and how much nitrogen fertiliser to apply.

The key motivators in decision making with regard to nitrogen fertiliser application were to maximise yield and maximise profit. In order to achieve this, the farmers aimed to apply the optimum amount of fertiliser during weather conditions where the maximum amount of nitrogen would be available to the crop; in the appropriate number if splits and at a crop growth stage where the crop would take up and make use of the maximum amount of nitrogen. Farmers were also influenced by NVZ legislation to minimise leaching or run-off.

"It's in the back of your mind not in the front of your mind, but from a farming perspective what we're trying to do is get the optimum amount of nitrogen into that crop... the last thing we want is for it to go into the river or the dyke or the atmosphere, so although we are not planning to stop pollution directly, we stop pollution all the time." (Farmer, Lincoln)

"You have got your good arable practices so you shouldn't be starting 'til the middle of February onwards... you don't want to be going out on a solid frost – you can get run-off – we are thinking about all those things." (Farmer, Lincoln)

"It's a weather thing isn't it... you are either worrying about whether you have applied your nitrogen and its going to rain and wash it away, or its going to sit there and not be taken up by the crop." (Farmer, Huntingdon)

"Just do it from experience, we have two set dates that we have always sort of applied, like 10th March and 10th April for growing the crops and just depending on the weather whether you go on a bit sooner or a bit later." (Farmer, Thirsk)

"Have gone out later this year as the temperatures weren't there and the signs of growth weren't there; my sign of growth is new white root growth." (Farmer, Thirsk)

Thus farmers are conscious of not wasting fertiliser and maximising its uptake by the crop. These objectives will help to minimise GHG emissions.

The ideal application conditions for the farmers appeared to dry weather, shortly before rainfall. The dry weather during application ensured the fertiliser was not washed away and it was possible to travel on the land, whilst light rain after the application helped dissolve the solid fertiliser and wash it into the soil. High temperatures were not considered ideal.

"Couple that with the high temperature and urea and you get volatilisation." (Farmer, Huntingdon)

"You need to be as confident as you can when you put it on that there is a small bit of rain to get it into the soil, but not too much that it gets washed through... with long hot spells you get evaporation, so you just need to be conscious that you want it to do what you want it to do at the right time." (Farmer, Huntingdon)

Farmers claimed they had made many changes in practice over the last 10 years in order to increase the uptake of nitrogen and decrease any wastage, with the aim of maximising yield and profit and also reducing leaching. The biggest change appeared to be in the number of fertiliser applications, with little and often now being common

practice. This shows the farmers' willingness to adapt if there is clear scientific evidence to support the proposed changes.

"In recent years we have been in more like split dressings or going... 3 times at least... so it's not like you're putting it on in one go; it's little and often so the crop is taking it up as it goes." (Farmer, Lincoln)

There was some consideration of ammonia emissions amongst agronomists, for example advising against the use of urea given a higher level of ammonia emissions from this than other forms of nitrogen fertiliser. In the main advice was not given directly to farmers to help reduce GHG emissions.

The agronomists were very aware of conditions which would result in lower uptake or loss of nitrogen following application and advised farmers to apply in optimum conditions, i.e. when the soil wasn't saturated, nor too dry or frozen, but when the crop was growing.

"Timing: crop needs to be absolutely growing, roots need to be growing, you don't want waterlogged soil, you don't want wet soil." (Agronomist, Lincoln)

The agronomists were of the view that nitrogen application was actually an imprecise science given all the variables involved, and thus it was difficult to get exactly the right amount on at exactly the right time.

"When you think of all the variables, nitrogen application is an imprecise science anyway, when you think of all the list of things that can affect the variability – nitrogen cores, but even then they can be done wrong, structure of the soil can be an influence, ability of the plants to take up the nitrogen and so on." (Agronomist, Lincoln)

When challenged about whether they applied a little more nitrogen than recommended, the farmers were clear that they only applied what they considered the optimum amount. Excessive application would result in loss of profit and would cause the crop to lodge. In most years the nitrogen was too costly to apply excessively or waste. They were aware that increased nitrogen only increased yield up to a point, after which there was no increase in returns.

The agronomists tended to be of the view that farmers actually applied less than is recommended in RB209, and in fact they had occasions where they had to advise farmers to apply more to improve yields. Conversely some farmers felt RB209 did not recommend a high enough dose (see section 4.4.4), suggesting there may be some lack of confidence as to the optimum amount.

"The price of nitrogen makes you think about how much you put on as well." (Farmer, Thirsk)

"We try and put on the minimum amount to get the maximum yield possible." (Farmer, Lincoln)

"With nitrogen use you basically have got a nitrogen curve where the more you put on, you get to a certain level and it gets no higher so you try and put on the amount where the curve starts to tail off." (Farmer, Lincoln)

3.2 Knowledge of GHG emissions related to N fertiliser application

The level of knowledge about GHG emissions from nitrogen fertiliser application was on balance limited, although there was a considerable range in the amount the farmers knew.

Most seemed aware of the potential pollution threat from leaching or run off, but few had even considered the threat to the environment as a result of GHG emissions from nitrogen fertiliser application.

"With all your NVZs it's all about leaching isn't it, it's all about it going down and out but not about it going upwards." (Farmer, Thirsk)

"We have been farming NVZs and NSAs so the pollution of nitrogen has been rumbling on for a bit now." (Farmer, Lincoln)

"There have been articles haven't there about emissions, GHG emissions from fertiliser?" (Farmer, Huntingdon)

When prompted during the discussion about GHG emissions from nitrogen fertiliser, the most common (and incorrect) view was that ammonia was the GHG released, particularly from urea. A minority were aware that nitrous oxide was released.

"That we could get ammonium emissions which is worse than getting carbon dioxide emissions." (Agronomist, Lincoln)

Prior to informing the respondents about the potency of nitrous oxide in comparison to carbon dioxide, there was a common view that amounts released from nitrogen application were minimal and thus unlikely to cause any major damage to the environment. Having said this, a minority were aware of the potency of the nitrous oxide, but even so these farmers were not taking any extra steps to combat GHG emissions directly.

"I suppose if nitrogen is going to sit on the top and not going to drop in theory you could actually say that some of it is lost but I don't really think that's a big deal. I don't really think that a prill laying there is going to lose a lot in the short while it takes to dissolve; all it takes is a dewy night and it's dissolved into the soil." (Farmer, Thirsk)

"Is it the nitrous oxide that's released that's worse than the carbon dioxide that everyone is talking about?" (Farmer, Lincoln)

The farmers were also of the view that it is important to produce food and important to achieve maximum yields and to do this nitrogen fertiliser application was necessary. Comparisons were made by both the farmers and the agronomists, with the greater perceived impact of traffic and other forms of pollution, which led some to wonder if emissions from nitrogen fertiliser where really of concern in the grand scheme of things. It was often felt that the finger was unfairly being pointed at the farmer.

"But we are the primary producers of this world and whatever happens we have to go forward from there." (Farmer, Huntingdon)

"If we were really worried about emissions we would be building nuclear power stations as fast as we can." (Agronomist, Lincoln)

"Does it really matter; that's my question?" (Agronomist, Lincoln)

"You wonder in the whole picture of the world issue, the leaders want to improve food production, but on the other hand you can't do this and you can't do that; it's just very difficult to swallow sometimes. It's all nice words but there doesn't seem to be any help at the end of it." (Agronomist, Lincoln)

"I think it's a waste of time this greenhouse gas thing... you can't do anything about it – it's what we have to do to grow the crops to feed the world." (Farmer, Thirsk)

The manufacture of nitrogen fertiliser was thought likely to have a bigger impact on GHG emissions than application.

"I would imagine the manufacture and transport of nitrogen fertilisers would be the biggest issue." (Farmer, Lincoln)

There was little knowledge of specific Government targets aimed at reducing GHG emissions from agriculture.

Once provided with some information on GHG emissions from agriculture and specifically nitrous oxide emissions from nitrogen fertiliser application, the farmers and agronomists were keen to learn more and be provided with robust scientific facts.

"Good science – we don't want to be taking too many punts. For a start the emissions – we need to know really what's happening, not necessarily mathematical models." (Farmer, Lincoln)

3.3 Measures to potentially reduce emissions – improved precision

3.3.1 Type of fertiliser spreader

Most of the focus group respondents appeared to currently be using a spinning disc spreader, whilst a minority used a pneumatic spreader or an oscillating spout. The potential impact of the spreader type on GHG emissions from nitrogen fertiliser application was discussed with the respondents.

A pneumatic spreader was considered to provide the most accurate spread pattern ensuring the fertiliser was applied where needed even in windy conditions and even when using a cheaper fertiliser such as urea. A spinning disc spreader could be less accurate in this respect particularly in windy conditions and could result in striping, due to uneven application, with some fertiliser landing on roads or headlands. It was only considered possible to accurately spread to 12m with a spinning disc, whilst a pneumatic spreader could go to 24m.

The pneumatic spreaders, despite the advantage of accuracy of spread, were considered expensive to buy and maintain, difficult to get hold of nowadays, and potentially cumbersome due to the wide boom on small fields or farms, particularly where obstacles had to be negotiated.

"A lot more working parts, a lot heavier and about twice as expensive to buy." (Farmer, Thirsk)

"It's more accurate and not affected by wind." (Farmer, Lincoln)

"I think there's a big need for the machinery manufacturers to develop pneumatic spreaders because however accurate the spinning discs are claimed to be, they are never as accurate as the pneumatic spreader. They may get within a kilo of what you want on a field, because they have weigh cells and whatever else... but they are poor at putting what fertiliser you require on every square yard or metre. You can have massive variations over a given spread width and obviously you are applying in certain parts of the field in stripes, with 15-20% more your issues with nitrous oxide pollution are greater." (Farmer, Lincoln)

3.3.2 Calibration of the fertiliser spreader

Most of the farmers appeared to calibrate their fertiliser spreader regularly, which supports the findings of the telephone survey where 91% had calibrated it within the last year. A number of respondents running mixed farms however did not appear to be doing so. The motivators for calibrating the spreader were to comply with Farm

Assurance requirements, to improve precision and reduce wastage of both fertiliser and money.

"We are farm assured and we have to do it regularly." (Farmer, Thirsk)

"I do it every time we use it." (Farmer, Thirsk)

"Yes, that saves you money straight away." (Farmer, Lincoln)

"Usually start on the smallest field and work out from there... don't calibrate as such." (Mixed farmer, Thirsk)

"It's not the top of my priority list. If you've got a cow calving that takes priority... I'm a stock man not an arable man." (Mixed farmer, Lincoln)

The agronomists appeared to have mixed views over whether the farmers regularly calibrated their spreaders, however the more common view was that this is an area in need of improvement. Striping in fields was seen as evidence that machinery had not been calibrated. Farmers were thought not to calibrate because it costs money or due to lack of time.

"Most farmers don't calibrate enough... people spinning it into dykes and things, it's a real easy way of limiting the application." (Agronomists, Lincoln)

"Every time you drive around and see striping in the field you know that's the farmer losing money." (Agronomist, Lincoln)

"Most people know how to do it. Time's the biggest thing and attention to detail goes out the window." (Agronomist, Lincoln)

As well as calibrating the machinery, a number of farmers undertook tray tests to improve the spread pattern.

The farmers not currently calibrating their spreader were likely to need evidence that calibration would provide a benefit in terms of increased yield or reduced costs, before they would consider investing their time and money.

3.3.3 Liquid versus solid fertiliser

Although there is no clear evidence to suggest that liquid fertiliser generates fewer nitrous oxide emissions than solid fertiliser, the pros and cons of each were discussed with the farmers. The farmers were mostly using solid fertiliser usually in granules. There was some perception that liquid fertiliser would be taken up more quickly by the plant and thus generate fewer emissions, however there were a number of barriers to using liquid fertiliser. It would probably be applied with the sprayer used for pesticide application etc. meaning only one application could be carried out at any one time; alternatively a new machine had to be purchased just for the liquid fertiliser. Being able to use one machine for fertiliser and pesticides could however be potentially attractive to those on smaller farms if liquid fertiliser had proven benefits, but only if the cost of the fertiliser wasn't prohibitive and the current machinery could be used.

Storage was also an issue. The farmers did not necessarily have the storage facilities for liquid fertiliser. If the supplier delivered the fertiliser in tanks, these had then to be stored on farm. Timing of delivery was also mentioned, with the farmer being constrained by the time the supplier will deliver.

Liquid fertiliser was thought to be more costly than solid fertiliser, had the potential to scorch the crops and could corrode the sprayer.

"Liquid may be better for the environment because of the quicker uptake." (Farmer, Huntingdon)

"You have got to have the tank holding facilities on farm, whereas most of us have got barn space at certain times of the year where we can store solid fertilisers." (Farmer, Huntingdon)

"Your normal sprayer will probably not be able to cope with the liquid fertiliser; you need different sprayer to be able to cope with it." (Farmer, Thirsk)

"Liquid seems to have a short window when it's contracted: they bring it to you and that's when you're getting it." (Farmer, Thirsk)

"It's highly corrosive, and it tends to corrode your machines more than solid. You have also got more issues over storage and security of storage. If you spill solid you shovel it up; if you spill liquid it runs away." (Farmer, Thirsk)

3.3.4 Using RB209, PLANET or other systems

The farmers used a range of information to help decide how much fertiliser to apply, i.e. RB209, PLANET, TAG data and also past experience. Those who used RB209 appeared to be using it as a guide and still relied mainly on knowledge of their farm. It was evident that it was sometimes referred to just to comply with NVZ requirements. A number of farmers had chosen to use TAG data rather than RB209 as they felt this to be more relevant and accurate. A small proportion of farmers did not seem to be using any information tools and didn't seem to understand what RB209 was.

"I do by experience as well. I know each field and know what each crop's had and so if its the third or fourth crop I would give it a little bit more, if it's had a dose of slurry a bit less." (Farmer, Thirsk)

"You aim for a total dose. The first dose would depend on when I could get on and how much I put on, go on earlier I would put a bit less on as you are more vulnerable to rain if you get held up and then the total dose will be adjusted a bit from our experience." (Farmer, Thirsk)

"If the triangles go down where the headlands meet the main tramlines and the rest of the field stands you have got it right and if the triangles stand up you haven't given it enough… but if it all goes down you have given it too much." (Farmer, Thirsk)

Several of the agronomists used RB209, but again there was evidence to suggest this was sometimes a box-ticking exercise.

There were a number of issues with RB209 which had caused a loss of faith in it. RB209 was thought to recommend too small an amount of nitrogen, it did not contain data that was as up to date, accurate and relevant as TAG data and it was not sensitive to different soil types. There was also some frustration that it was revised regularly suggesting that the previous figures were inaccurate. The comparison with the TAG data seemed to occur in the Lincoln groups.

"The farmer who uses RB209 to make his decisions probably isn't a very profitable farmer because if you use the information that's in there you would not put enough nitrogen on to get maximum yield or maximum quality." (Farmer, Lincoln)

"It's a bit of a blunt tool because depending on your soil type and what you think your nitrogen indices are there are some big jumps up and down" (Farmer, Lincoln)

"We are keen on the tools, just not RB209; we use the information from TAG." (Farmer, Lincoln)

"We have tried to cut back on nitrogen to meet NVZ obligations, to try and follow RB209 for fear of being inspected by the Environment Agency, and the ultimate is because we have tried to cut back we have seen protein levels in biscuit wheat and milling wheat drop to a level that means it is no longer biscuit wheat or milling wheat." (Farmer, Lincoln)

"We are all supposed to adhere to RB209 aren't we, but knowing your farm, knowing your land, knowing what your land will take..." (Farmer, Huntingdon)

"RB209 gives you a total application and it's really for your knowledge for how that's split and things like weather and soil temperatures." (Farmer, Huntingdon)

"I am very suspicious of these new systems... they would have to show me through trials that it worked and not one year; it would have to be over 5 years." (Farmer, Huntingdon)

"The RB209 doesn't know what my land is capable of is one of the problems... what they tell you in RB209 doesn't mean that your farm is perfect for that situation, you'll still have to alter it to what they say in the guide. And what gets me about the guide is that it gets corrected every year, but in theory it shouldn't need to be altered. If it was that good a thing for people to go by, why is it being altered?" (Farmer, Thirsk)

A number of farmers were aware that TAG data provided for RB209 had not been used. There appeared a lack of faith now in both the system and the people developing it.

With regard to amount of nitrogen to apply, the agronomists thought the farmers were probably not using enough nitrogen, whilst the farmers felt they were applying the optimum amount for the best yield. However, the farmers seemed to think that RB209 was not telling them to use enough. The amount farmers are actually applying compared to the recommendations is worthy of further exploration.

3.3.5 Using an agronomist

Many of the farmers worked with an agronomist when making decisions about fertiliser application. This would sometimes be seen as a joint decision or a decision made by the farmer having taken advice from the agronomist, with the farmer being able to contribute his knowledge of the individual farm. There was some feeling that the agronomist would recommend applying more than the farmer wanted to apply in the interest of saving money.

"You will find that the agronomist will go belt and braces, you sit down have a chat about it... and you find you will be going at the top end of everything." (Farmer, Lincoln)

Not all the farmers used an agronomist for fertiliser decisions, however these farmers did use a supplier-based agronomist for fungicide and pesticide application decisions. It appeared that it was those on smaller farms who were less likely to use an agronomist for fertiliser decisions. One farmer questioned whether an independent agronomist would actually feel a visit to his small farm would be worthwhile.

"Use an agronomist for the herbicides and fungicides but the fertiliser application is all down to our judgement." (Farmer, Huntingdon)

Reasons for not using an agronomist for fertiliser decisions included the farmer feeling that he knew his land and the needs of his crop better, not being convinced an agronomist would make a difference and not really having thought about it for fertiliser.

"Until somebody proves something to us and over a period of time…" (Farmer, Thirsk)

"Would he be interested in coming to a smaller farm, just a 50 acre farm?" (Farmer, Thirsk)

"An awful lot of our direction is through our agronomist and they are not just being careful they are saying you need to start feeding your plants at this point now." (Farmer, Huntingdon)

Thus those farmers not using an agronomist would need to be convinced that the advice they received would provide benefits which would out-weigh the cost and would add to their knowledge.

3.3.6 Taking into account the soil nitrogen

Most of the farmers appeared to be taking the soil nitrogen into account, although this was either by experience, look-up tables or soil testing.

Many of the farmers had had the soil tested at some point, and this varied from being a one-off exercise to more regular testing of a sample of fields, for example on an annual basis, where either the same fields would be tested or the fields would be rotated over a 3-4 year time span. Thus there is considerable variation in the way farmers take soil nitrogen into account.

"You know what the previous crop has been." (Farmer, Thirsk – small farm)

"We had it tested 5 years ago and it's not been tested again." (Farmer, Thirsk- small farm)

The only reason this farmer had the soil tested was because it was free.

"I have done three fields this year... and I'll carry on doing those same three fields every year... and it just gives me a barometer each year where I am." (Farmer, Thirsk)

There were three main barriers to having soil tested at all or more frequently: cost, time and the perceived inaccuracy of the results. Test results were believed to vary according to which lab tested it and the transport and storage conditions. In addition some of those using look-up tables questioned the need to actually test the soil if this data was available and accurate.

"I would look at average results produced by TAG or whoever. If you are paying people like TAG to do trials work and then don't take any notice, what's the point in paying them?" (Farmer, Lincoln)

"I think that generally the most accurate is the farmer's judgement. Testing is one way of getting some sort of handle but it's so inaccurate; there are so many variables with testing: the time of day its tested, how the samples have been looked after, whether it's kept in a refrigerator makes so much difference to what the ultimate result of the test is." (Farmer, Lincoln)

The tests were thought to be quite costly, particularly for the smaller farms. The tests were also time-consuming if the farmer had to collect the samples, possibly taking a full day out of a busy work schedule.

"Soil testing isn't cheap though, is it? That's the whole top and bottom of it." (Farmer, Thirsk)

There was also the feeling that the test results did not always match RB209 data depending on the crop that was previously in the field.

In order to encourage more testing, the farmers needed proof that it would be beneficial in terms of reduced fertiliser input and cost and that it would be accurate. A suggestion was also made that the testing should be free.

"If it was worthwhile to test the nitrogen [rather than use look-up tables] to give me a useful saving in fertiliser or stop it going flat or more yield potentially." (Farmer, Thirsk)

"Soil testing has got to be accurate; this mish-mash we've got now is completely a waste of time." (Farmer, Lincoln)

A farmer in Lincoln and an agronomist questioned the need to take soil nitrogen into account if it was below 100 kg/ha as TAG trials had showed that this would not have an influence on yield.

The agronomists had mixed feelings about soil nitrogen testing given the inaccuracies in the results. They again were concerned that transportation and storage conditions could alter results, and were also aware that samples taken in one part of a field may not be a true reflection of what was happening in other parts of the field due to variations in soil type.

3.3.7 Taking into account the manure nitrogen

The farmers felt they were taking manure nitrogen into account, however there was variation in the way the farmers assessed the nitrogen as suggested by the telephone survey. On some farms the manure was tested (either by the contractor or the farmer), other farmers estimated it from look-up tables, whilst others used their own knowledge and experience.

"We know how much roughly we're putting on to the acre, and what's available out of that muck to the plant." (Farmer, Lincoln)

"Well we roughly know how many tonne we are putting on per acre and we are just using bog standard figures out of tables and we just take that off the nitrogen we put on in the spring." (Farmer, Thirsk)

"Mine came from the NVZ books." (Farmer, Thirsk)

None of the farmers seemed to have their cattle manure or slurry tested nowadays, although a small proportion had done so in the past. The farmers seemed more concerned at accurately gauging the amount of manure in poultry manure than cattle manure, given the higher nitrogen content, and more likely to adjust the amount of manufactured nitrogen when using pig manure. At least one farmer had poultry manure tested.

"We use poultry manure, we have it tested, but it's virtually the same as RB209 anyway" (Farmer, Lincoln)

"The amount of nitrogen in cattle slurry is quite minimal while nitrogen in pig manure is quite important... anything that's been spread with pig manure you put less nitrogen on and anything that's had cow manure you put more nitrogen on."

Regulation, in addition to ensuring maximum yields, was a key driver in estimating and recording the manure nitrogen. However, the agronomists were of the view that in some instances this was purely a form-filling exercise and did not necessarily accurately reflect what had happened on the farm. One farmer had clearly assessed the amount of nitrogen within the manure already applied to his farm prior to attending the focus group, using NVZ data, suggesting that this was not usual practice.

"They will have records to show what happened because it's a legal requirement; how much it fits reality is another question." (Agronomist, Lincoln)

"You have got to do it, as you are all fearing that one day the Environment Agency will turn up and will want to know what has gone on." (Farmer, Lincoln)

"Going off their tables. My cattle have produced about 4 tonnes of nitrogen, off 385 cubic meters… going off that NVZ thing." (Farmer, Thirsk)

There was some concern expressed over how evenly the manure was spread over the fields which would influence the amount of nitrogen available. There was also debate as to whether sampling would actually give a more accurate picture, not only because the evenness of spread would affect the amount of nitrogen each part of the field would receive, but also because the manure is an inconsistent product and as the nitrogen would alter according to how old the muck was.

"The problem is with muck. It's very inconsistent (re. the amount of straw), so how do you test it? So we just run on the standard figures." (Farmer, Thirsk)

"It's going to be a nightmare trying to get accurate samples" (Agronomist, Lincoln)

3.3.8 Taking into account the crop nitrogen when growing oil seed rape

Many but not all farmers seemed to be taking the crop nitrogen into account when growing oilseed rape, as suggested by the telephone survey. However, the way in which the nitrogen in the crop was assessed did vary.

Methods for measuring nitrogen included: assessing the green area index by sending off a picture of the canopy to the BASF website and in return receiving an estimate of the nitrogen content, using satellite technology, and cutting and weighing a metre squared of the canopy. Other farmers observed the plant growth or used past experience in order to determine the amount of nitrogen. The agronomists also mentioned the green area index, although a number were sceptical about this method describing it as out of date and not an exact science given that the amount of nitrogen would vary across the field.

"We are not actually measuring it, but we're still taking it into account based on the size of the crop." (Farmer, Lincoln)

"Some of mine is sent off for testing, but equally so the agronomist will be advising me on what's happening or whether things need to move forward. A lot of it is a gut feeling, knowing your job, weather conditions, how much rain we have had, temperatures and all those factors." (Farmer, Huntingdon)

One farmer felt that if you have sampled the crop and actually measured the nitrogen in the past, it was then possible to estimate the nitrogen in the future.

"If you have got to the stage where if you have done the test and weighed it yourself you can look at a crop and you can get a better assessment by looking at the entire field than cutting a square metre, as which square metre do you cut?" (Farmer, Lincoln)

3.3.9 Using nitrogen efficient crop varieties

The farmers were interested to know if varieties were available that would be more nitrogen efficient and would be keen to buy them if the cost and yield was in line with current varieties and there was a ready market for the crop. Maximising yield and disease resistance were the current motivating factors.

A number of farmers were aware of or had grown Triticale. Farmers did not however see this as a viable alternative to wheat, even for animal feed. They perceived that the crop was poor yielding and there was little or no market for it.

Both the agronomists and farmers felt there was little information on nitrogen efficient varieties and would like to see more.

"The farmers look at the list and they go for the highest yielding; they don't care if it will suit their soil type until we come along and say 'I wouldn't put that there.'" (Agronomist, Lincoln)

"It's just getting somebody to buy it that's the problem [Triticale]" (Farmer, Thirsk)

"It was the big thing, Triticale and then it died a death... a lot of people grew it when it was the height of maize and then that got killed off and the new varieties came out very short or standard like wheat height and then it kind of lost its market and died a death." (Farmer, Thirsk)

A small proportion of the farmers had found a value in Triticale, one for growing on sandy soils which were unsuitable for other crops, one to deter the rabbits and one was aware of it being used for pheasant cover.

"We do on blow-away sand, you can't grow anything else on it because it just dies off, but we can get 3 tonne an acre in a good year" (Farmer, Lincoln)

3.3.10 Reducing the amount of nitrogen applied

The farmers were not prepared to reduce the amount of nitrogen applied and thus reduce their yield, particularly as they felt it unlikely that anyone would compensate them for this reduced yield.

3.4 Measures to potentially reduce emissions – timing of application

3.4.1 Adding an extra application

Adding an extra application of nitrogen fertiliser but still maintaining the same total nitrogen input was discussed with the respondents. The reaction was that many had already increased the number of applications over time, based on evidence that this would increase yields. The farmers were typically using 2-4 splits, depending on the crop type. Although adding another split may not have been impossible, the farmers didn't seem particularly keen to do so. The farmers needed robust scientific evidence to show that adding another split was worthwhile, primarily to their farm business, before they were ready to consider adding an additional split.

"If I could see it would be better then maybe, but at the moment we have got a system that works." (Farmer, Lincoln)

There were a number of factors deterring farmers from adding this extra split:

- The belief that they were already using the optimum number of splits.

"I wouldn't want to do it because I think we are doing enough anyway." (Farmer, Lincoln)

- There may be no time to add an additional application at the end – this would delay the harvest, or would be inappropriate for the plant development.

"You've only got a two month window." (Farmer, Thirsk)

"We are 700 feet above sea level and the later you go on with the nitrogen, the later the harvest. Winter comes soon enough without late harvesting." (Farmer, Thirsk)

"Once you are out of April you don't want to be giving the plant any more." (Farmer, Thirsk)

- Adding another application may mean you don't give the plant the required dose at the right growth stage.

"You coincide your main dose at the point when it just rockets and takes off which is around growth stage 30 to 31. If you have gone in with an extra, say taken some of that main dose and split it and brought it back earlier then its vulnerable for leaching, because the crop isn't growing at that rocketing pace then it's not going to take it up." (Farmer, Thirsk)

"Because the crops are growing so slowly to start with, you just give them some when they need it." (Farmer, Huntingdon)

- Adding an additional split in between current applications could mean applying fertiliser every 2 or 3 weeks – this could be difficult logistically and may not allow the crops enough time to fully utilise each application.

"I can't see the point in putting fertiliser on more than three weeks apart because it takes three weeks for the plant to really take it up." (Farmer, Thirsk)

- Weather conditions may not be appropriate for adding another split.

"You would end up having to put it onto wet soil and you'd be releasing nitrous oxide and you'd be making ruts all over the field because you wouldn't be able to travel." (Farmer, Lincoln)

- Adding an extra split would be difficult for many farmers to fit into a busy workload, particularly if they were the only farm worker and also if they were running a mixed farm where the livestock were the main enterprise or accounted for much of the farmer's time.

"I go on twice. I could put it on at another split but it's time consuming against a one man band and the stock, because the stock is my main enterprise; the arable side is second fiddle in that respect." (Farmer, Thirsk)

"By the time I have been through with the sprayer 5 or 6 times, whatever, or 3 times with the sprayer with the fertiliser and doing it all with one machine, it would be getting later and later done with one machine." (Farmer, Lincoln)

"We could but at the moment we are stuck in two, because it's easier for us to work round. There's only me and Father on the farm; we could do a third split but the trouble is we'd be doing other jobs." (Farmer, Huntingdon)

There was also some concern over adding an additional application on milling or biscuit wheat, given that the timing of the third application particularly was important for determining the protein content of the wheat.

"You have to be careful though because of your plant uptake of nitrogen, the guys who are growing milling and biscuit wheat, the third dose is at a set time [to ensure right protein levels]." (Farmer, Thirsk)

An increase in cost was also a concern.

"If you are going over the crop three times, it's wasting fuel." (Agronomist, Lincoln)

However, one farm manager who seemed to operate on a forward-thinking, technically advanced farm did indicate that only last year an agronomist recommended adding an additional split to feed wheat. This advice was followed.

"We put four doses on the wheat last year and we are only growing feed wheats. The agronomists said to give it four doses and the weather allowed it." (Farmer, Thirsk)

The telephone survey showed that a high percentage of respondents would be at least fairly likely to add another application. The focus groups however suggested that actually encouraging farmers to change their practices would be dependent on a number of issues, namely the provision of sound evidence to show that this would make a difference to GHG emissions, that there would be benefit to the farmer in doing so, i.e. in terms of better yields, and that it was feasible given the weather conditions.

A minority of farmers were aware of a product that could be applied in one go, but would slowly release the nitrogen over time thus reducing loss and the need to make additional applications. Although there was some interest shown in this product, no-one was aware whether or not it actually worked.

3.4.2 Increasing the length of time prior to applying after heavy rain

The farmers were asked to consider whether it was possible for them to delay fertiliser applications after heavy rain for a day more than they do already.

It was clear that the farmers did not apply directly after heavy rain, primarily because the land would be unsuitable for travelling. The number of days a farmer would wait would be influenced by the soil type on his farm, with moisture levels in heavy soils taking longer to drop. There was however some knowledge that there would be lower uptake of nitrogen on wet soils due to leaching, rather than increased nitrous oxide emissions.

"Until the soil conditions are right and then you can travel on it." (Farmer, Huntingdon)

"On our black fen, we can leave it two hours and go again." (Farmer, Huntingdon)

The ability to or interest in waiting an extra day or more was dependent on a number of factors including how heavy the rainfall was, the weather conditions after the rainfall and thus how long it took the soil to dry out, and also the chance of it raining again in the next few days. The farmers could not afford to miss a suitable weather window if there was more rain forecast. Reliable forecasts were identified as an important barrier against delaying N applications because the farmers did not want to miss an appropriate weather window then find they could not apply due to bad weather.

"And when it's going to rain next... it influences how long you can leave it to dry." (Farmer, Huntingdon)

"Could be a couple of days. A bit of sun and everything changes." (Farmer, Huntingdon)

"Was it wet before the rain or dry before the rain?" (Farmer, Lincoln)

"Time period after rainfall isn't the right way to do it, because it depends on the evaporation in that period." (Farmer, Lincoln)

"The thing is if it dries after 3 or 4 days and we can travel then we need to be getting on." (Farmer, Lincoln)

“You end up picking your fields as well don’t you, the light lands are going to dry first so you get on your light lands first, the heavy land later.” (Farmer, Lincoln)

“Depends whether it’s going to rain again in another 2 or 3 days.” (Farmer, Thirsk)

The telephone survey showed that just over three quarters of the sample would follow advice not to apply fertiliser during the 5 days after heavy rainfall in order to reduce air pollution. It is likely that many farmers do this anyway after very heavy rain. However the focus groups have shown that it will not be that easy to bring about change and get the farmers to wait an extra few days over and above what they do now. In order to overcome the barriers to delaying application to some extent, the farmers needed more information on how much nitrogen would be saved and the impact this would have on their yield.