Anthelmintic resistance in dairy calves

James O'Shaughnessy, senior research officer at the Department of Agriculture, Food and the Marine, discusses anthelmintic resistance in dairy calves

Anthelmintic resistance (AR) is said to exist within a population of animals 'when there is a greater frequency of individuals within a population able to tolerate doses of compound than in a normal population and is heritable' (Prichard et al, 1980). As the worm genes coding for resistance appears to exist in all worm populations, cases of AR begin to appear shortly after the introduction of a new anthelmintic onto the market.

As the number of reports on the occurrence of anthelmintic-resistant cattle nematodes continues to grow worldwide (Gasbarre, 2014; Rose et al, 2015), it is now becoming increasingly important for producers to re-evaluate their approach to nematode control so that the effective lifespan of some of the currently used anthelmintics is not significantly reduced.

In Ireland, there have also been reports of AR (O'Shaughnessy et al, 2014; O'Shaughnessy et al, 2019). Both reports involved first grazing season (FGS) calves where ivermectin displayed a reduced efficacy in treating gastrointestinal nematode (GIN) infections. This is no real surprise given the popularity of macrocyclic lactones (MLs) such as ivermectin among producers as the treatment of choice for control of GIN infections (Charlier et al, 2010). Given that livestock production in Ireland is mainly a grass-based enterprise, the regular exposure of livestock here to nematode challenge means that any decline in the efficacy of available anthelmintics may result in significant penalties in animal performance, coupled with compromised animal welfare.

HOW DOES ANTHELMINTIC RESISTANCE DEVELOP?

There are a number of ways by which AR may develop on a farm. One of the main practices to contribute to its development is excessive treatment frequency as each time a treatment is given to a calf, the only nematodes to survive treatment are resistant types. Given the heritable nature of this trait, the proportion of resistant nematodes within that population will continue to increase over time as the treatment frequency increases. The closer the treatment intervals are to the prepatent period, the less the opportunity there is for newly acquired infective larvae derived from susceptible nematodes to establish. Other practices that favour the development of AR are under-dosing, the purchase of animals carrying resistant nematodes and the practice of dosing and moving to clean pasture. The practice of under-dosing allows the survival of partially resistant nematodes (heterozygous resistant) that would normally be killed if the correct dosage had been administered. Under-dosing can result from poor dosing techniques, the incorrect estimation of animal live weight or using faulty dosing equipment.

The speed that animals are re-infected after dosing can potentially be influenced by many factors. These include the level of pasture contamination that animals experience after dosing, the type of dose given (long- or short-acting) or if the animal is relatively immune to re-infection. One traditional dosing practice is now regarded as highly selective for AR. This is the 'dose and move' system whereby animals are dosed and move straightaway onto clean aftermath. In such a situation, the only nematodes to survive treatment will be resistant, ultimately resulting in the 'clean' pasture being contaminated with eggs from these resistant nematodes.

The size of the refugia-based population is another important determinant of the rate at which AR develops. The in-refugia population refers to that portion of the nematode population not exposed to anthelmintic treatment and is affected by factors such as treatment frequency and weather conditions. Although this is not commonly the case in Ireland, when using anthelmintics, account should be taken of the environmental conditions as this can lead to an increase in the rate at which AR develops. In periods where rainfall is minimal, the size of the free-living population is expected to be small. Therefore, any anthelmintic treatments during this period will also encourage the development of resistance.

HOW TO TEST FOR THE PRESENCE OF ANTHELMINTIC RESISTANCE

A drench test can be conducted in order to give some indication on how effective a particular anthelmintic is on a farm. This is where 10 animals are dung sampled a number of days post-treatment (seven days for levamisole and 14 days later if a benzimidazole or an ML is used) to determine their faecal egg counts. The test can be further improved by also sampling animals on the day of treatment to determine their faecal egg counts. This test is only an indication of how effective treatments are and cannot be used to definitely state that resistance is present. A more formal approach to testing is to conduct a faecal egg count reduction test where multiple anthelmintic classes are tested together. There are several reasons for the seven and 14-day testing intervals post-treatment. As anthelmintic treatment will lead to temporary egg suppression in female worms, there is a risk that that if calves are sampled too quickly post-treatment, it may appear as if the treatment has been successful as egg production from surviving females had temporarily halted. The post-treatment sampling interval must also be long enough to allow complete expulsion of eggs from dead worms whilst also short enough so that newly established patent infections do not develop.

DELAYING THE DEVELOPMENT OF AR

As a starting point, there needs to be regular contact between the farmer and his/her private veterinary practitioner on how best to achieve this goal. A farm-specific plan needs to be drafted and subject to regular review, given the numerous factors that determine the level of parasitism in cattle and sheep at pasture from season to season.

Aside from the regular veterinary input, there is a clear need to establish whether the products that are currently used on the farm are effective. This can be done by conducting a drench test or a faecal egg count reduction test to give an indication of anthelmintic efficacy as outlined above.

The farm should have a quarantine dosing strategy for purchased livestock. The choice of products used is important as it must be effective against both susceptible and resistant nematodes. Purchased stock should then be held off pasture for 48 hours after treatment to allow any nematode eggs produced before the treatment to be shed before moving onto pasture. After this, these animals should be turned out onto contaminated pasture.

It is very important to ensure that all dosing equipment is working correctly. Regarding the volume of dose administered, it is important to dose according to the heaviest animal in the group. However, in situations where there are significant differences in live weights between animals within the group, such that some animals might receive twice the recommended dose, farmers should split the animals into two or more groups and dose according to the heaviest in each category.

There should be a conscious effort to avoid the overuse of anthelmintics and to treat only when necessary. The decision to treat, where possible, should be based on a number of indicators such as faecal egg counts or live weight gain. These indicators for treatment should be regularly monitored and be used as aids to decide when treatment is necessary. This is further outlined below in the section on treatment options for FGS calves.

It must be borne in mind when deciding to dose that not all animals in a group may warrant treatment. In cattle, the same is also true as animals with the best live weight gains can potentially be left untreated. However, two potential exceptions to this should be noted. If some of these better performing cattle have high faecal egg counts, i.e. they are resilient; it may be potentially beneficial to the group to treat them as they will be adding significantly to pasture contamination levels. Secondly, in situations where there is an outbreak of dictyocaulosis, treatment is warranted for all animals in the group.

Grazing management strategies can be used on farms to potentially reduce the number of anthelmintic treatments needed. This is especially the case in farms that are not overstocked. Young stock can be grazed on pasture previously grazed by adults as opposed to by other young stock. This should allow for exposure to nematode challenge to encourage a buildup of immunity whilst reducing the

risk of clinical disease. Nonetheless, monitoring of animal performance and faecal egg counts should be conducted periodically.

TREATMENT OPTIONS FOR GASTROINTESTINAL NEMATODES INFECTIONS

Given that FGS calves will be parasite naïve when they are turned out to pasture, anthelmintics will be required at some point in the grazing season to control GIN challenge. The three potential control options for treating dairy calves in the FGS are strategic, therapeutic and tactical management.

- **Strategic**
  With the use of strategic treatments, calves are treated at predetermined intervals with anthelmintics. The first of these treatments are generally given within three weeks of turnout and this approach aims to limit pasture contamination with worm eggs and thus prevent a build-up on infective larvae on pasture later in the grazing season. Examples of this type of approach to GIN control are the ivermectin 3, 8 and 13-week programme (Vercruysse et al, 1995). Although this approach has proved effective with regards to parasite control, it does, given the frequency of treatments involved, encourage the development of AR.
- **Therapeutic**
  The second potential option to control GIN challenge is therapeutic management whereby calves are monitored for clinical signs of disease such as sudden live weight loss and/or diarrhoea and are only treated when these signs are observed. Given the considerable risk of poor calf performance as a result of subclinical disease or where a delay exists in treating for clinical disease, this approach is ill-advised.
- **Tactical**
  Probably the most sustainable option is the use of a tactical approach to GIN control whereby both calf faecal egg counts and live weight gain are monitored throughout the grazing season. Live weight in FGS calves can be determined with aid of a weigh band at various points in the grazing season in order to determine live weight gain.
  As a result of this approach, anthelmintic are used on an as needs basis. The one caveat with this approach is that lungworm infections may not be adequately controlled. It is always advised that if there are clinical signs of coughing within the grazing group that are suspected to be as a result of dictyocaulosis then appropriate anthelmintic treatment should be given without delay.

CONCLUSIONS

Although the development of AR is regarded as an inevitable consequence of anthelmintic usage, several different strategies can be employed on a farm to delay its progression. Notwithstanding this, it is imperative that at a minimum there is both farmer buy-in and good levels of communication between the private veterinary practitioner and the farmer.

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