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Sheep for weed control:

New approach to herbicide resistance management

Weeds is the term used to describe plants that interfere with human aspirations and activities – also called unwanted or problem plants. This viewpoint is from a human perspective, however. From nature's viewpoint, weeds fulfil key functions – for instance stabilisation of soil, pioneering species in areas denuded of vegetation, food, medicine and shelter for animals and humans, serving as energy resource (firewood) and more.

Utilisation of weeds by browsers and grazers is determined by several factors, including the type of animal, weed type, alternative food plants and the environment. Although the nutritive value of a weed may be high, it may be toxic or unpalatable due to chemicals produced by the plant.

Livestock and game might not feed on a particular weed, even though it is not toxic, because the animal has not 'learned' to ingest it and prefers other vegetation. Animals are forced to ingest plants that would normally be avoided or rarely utilised when drought and overgrazing cause significant reduction in plant biomass and species diversity.

Hairy fleabane (*Conyza bonariensis*) is a commonly occurring weed in many parts of the world, where it causes serious yield loss in annual and perennial crop systems. In South Africa, this weed poses a serious threat in both the summer and winter rainfall regions. In countries bordering on the Mediterranean, hairy fleabane is considered as one of the most prevalent weeds (Omar, 2010).

Sheep utilising hairy fleabane

Hairy fleabane is classified as a summer weed as it flowers in summertime, but seeds can germinate in any season, provided that sufficient soil moisture is available. Seedlings and mature plants can withstand dry conditions and seedlings can survive long dry periods in the rosette growth stage.

In regions with a Mediterranean climate, such as the Western Cape, summers are dry and scarcity of plants for grazing as well as increased fodder prices are common. This is what prompted the research conducted by Omar (2010) in Palestine. He investigated the value of the most common weed in the country, hairy fleabane, in the production of lambs.

The study was motivated by the following:

- Natural pasture in Palestine is only available periodically, and at times not at all.
- The use of grain crops, such as maize, sorghum, wheat and soya bean, and their seed as sources of fodder conflicts with food for human consumption.
- Crops used for fodder are expensive.
- Hairy fleabane is widespread, occurring in large numbers in Palestine and in many other countries where prolonged dry spells are the norm and rainy periods the exception.

Omar's research indicates that hairy fleabane in Palestine contains 20% crude protein (CP) and 27% crude fibre, as well as other nutritional properties at levels which are significantly higher than maize, soya bean, wheat, barley and sorghum. It was found that 10 to 15% content of hairy fleabane in fodder for lambs resulted in significantly increased daily weight gain (DWG) compared to the same percentage content of other fodder types.

A maize field near Vredefort where zero tillage has been practised for at least a decade, with high dependence on glyphosate herbicide. Virtually all the green weed plants pictured here are hairy fleabane that were treated with glyphosate herbicide three weeks earlier.



Hairy fleabane flowering.



Transformation into multi-stemmed hairy fleabane plants due to regrowth from buds below the part of the stem (apical growth point) grazed off by sheep.



Three weeks after treatment with glyphosate, the hairy fleabane plants had not been killed by the herbicide treatment, and sheep selectively removed those parts showing symptoms (yellowing of youngest leaves) of glyphosate damage.

Control of resistant weeds

In South Africa, hairy fleabane is absent or occurs rarely on farms where sheep are present and allowed to graze on crop fields in areas otherwise heavily infested with the weed. An example of such a situation is a farm in the Moorreesburg district, where for the past 20 years sheep production has been integrated with a wheat-medic crop rotation.

The farmer is convinced that sheep are the only effective tool for keeping hairy fleabane in check in summer and that the role of sheep in controlling rye grass (*Lolium*) weeds in winter is underestimated.

It is a well-known fact that herbicide resistance is widespread in both hairy fleabane and rye grass populations across the Western Cape. Recently (2015/16), the herbicide resistance research team of the University of Pretoria (UP) has identified high glyphosate tolerance leaning toward glyphosate resistance in hairy fleabane populations in the north-western Free State.

Resistance to glyphosate herbicide in South Africa has to date been proven in three prominent weed species, namely hairy fleabane, rye grass and common plantain (*Plantago lanceolata*).

The nutritional value of all three these weeds has been determined as high (Botanical Society of South Africa, 1994; Omar, 2010; Dickinson, 2010). In the case of common plantain, the following is stated: "Animals prefer the weed and farmers at one stage considered growing it as a pasture." (*Field Flower Guide No. 6*, Botanical Society of South Africa, 1994).

Case study in Vredefort

Observations made in 2015 on maize fields in the Vredefort district

confirmed that sheep feed on hairy fleabane, and that this phenomenon has significant implications for the successful management of this weed – in particular with regard to the weed's high tolerance (leaning toward resistance) to the popular herbicide, glyphosate.

In August 2015, the maize fields in question were being prepared for planting, by applying a herbicide product containing glyphosate to a weed spectrum consisting virtually exclusively of hairy fleabane (*Photograph 1*). Three weeks later, the herbicide's effect was limited to yellowing (chlorosis) of leaves at the apical growth point. This was considered ineffective weed control, since the particular herbicide and dosage employed ought to have killed the plants.

It soon became clear that sheep grazed the hairy fleabane plants in a highly selective way – only leaves that turned chlorotic (yellow) due to the sub-lethal glyphosate effect were ingested and green leaves were not grazed at all (*Photograph 2*). Over the next three weeks, the plants of which the apical growth point and chlorotic leaves were grazed off showed vigorous regrowth from buds lower down the compressed stem (*Photograph 3*).

The alarming consequence of intervention by sheep was that hairy fleabane plants carried more than ten stems that would bear flowers, instead of just one which develops under normal circumstances. Moreover, the sheep removed most of the glyphosate present in the plants, allowing regrowth unimpeded by the herbicide. Intensive grazing by sheep from the time hairy fleabane emerges, would probably be a better solution for effective control of this weed.

Stimulation of plant growth

It is known that sub-lethal levels of glyphosate occurring in plants can, in fact, stimulate plant growth – a phenomenon called 'hormesis' (Duke and Belz, 2011). Glyphosate can be used as a ripening agent for sugarcane. A relatively low dosage has a sub-lethal effect, causing the inhibition of vegetative growth and an increase in sucrose concentration.

The sub-lethal effect which glyphosate had on hairy fleabane in the Vredefort district possibly made it more palatable to sheep, and clarifies why they favoured that part of the plant where the herbicide had the greatest effect – i.e. the apical growth point and youngest leaves.

Follow-up research conducted in a greenhouse at UP confirmed that the Vredefort hairy fleabane population exhibited high tolerance, leaning toward resistance to glyphosate herbicide. There is a high risk that this population could become glyphosate-resistant, unless urgent steps are taken to mitigate the evolution of herbicide resistance.

Herbicide resistance management strategies are well documented and frequently communicated on the South African Herbicide Resistance Initiative (SAHRI) website: www.up.ac.za/sahri. Prof Reinhardt is project leader of the SAHRI, which is based in the Department of Plant and Soil Sciences at UP. For more information and references, contact Prof Reinhardt, dean of the Villa Academy, extraordinary professor of weed science at UP and extraordinary professor at the Department of Agronomy at Stellenbosch University (SU), on 083 442 3427 or email dr.charlie.reinhardt@gmail.com. 🌱