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INDAZIFLAM – A NEW HERBICIDE FOR PRE-EMERGENT CONTROL OF WEEDS IN TURF, FORESTRY, INDUSTRIAL VEGETATION AND ORNAMENTALS

Jyri Kaapro[1] and John Hall

ABSTRACT

Indaziflam is a new pre-emergent herbicide under development for the control of weeds in turf, forestry, industrial vegetation and ornamentals. Indaziflam inhibits cellulose biosynthesis in plants. It belongs to the alkylazine group of herbicides. In turf, C4 warm-season turfgrass species generally have good tolerance to indaziflam. In forestry plantations, indaziflam can be applied pre- or post-planting to Pinus species and post-planting to Eucalyptus species. Indaziflam has been in field development in Australia since 2005. Indaziflam is used at a low rate ranging between 50 and 150g a.i./ha. Indaziflam has favourable human health and ecological profiles.

Keywords: Indaziflam, forestry, turf, industrial, ornamental.

INTRODUCTION

Indaziflam is a new herbicide which potentially provides pre- and post emergence control of broadleaf and grass weeds. It was first registered in 2010 for use on turf by the U.S. Environmental Protection Agency. Indaziflam represents a new chemistry from the alkylazine chemical class. The alkylazines work by inhibiting cell wall biosynthesis. Indaziflam is the most potent inhibitor of cellulose biosynthesis so far discovered. Compared to many other pre-emergence herbicides indaziflam has a longer half-life in the soil (>150 days) which may allow for greater flexibility with application timing. Indaziflam also inhibits crystalline cellulose deposition in the plant cell wall, severely affecting cell wall formation, cell division as well as cell elongation. This means that fully developed leaves, tissues and organs are not or hardly affected by the compound since cell wall formation is already completed and no new cellulose synthesis occurs. Indaziflam is also used as a soil herbicide. It inhibits seed germination of weeds. Hence, it must be applied prior to weed emergence. Post-emergence efficacy has been seen, given right conditions, up to a weed stage of 2 leaves. With indaziflam being a lipophilic compound, adequate soil moisture is required on application.

Indaziflam has the potential to control a broad spectrum of weeds and provides long-lasting efficacy at low application rates. It

[1] Bayer Crop Science Pty Ltd. 391-393 Tooronga Rd. Hawthorn East 3123 Corresponding author's email: jyri.kaapro@bayer.com

controls annual grasses at rates of 25 to 100 g a.i./ha by inhibiting cellulose biosynthesis in susceptible species (Myers *et al*. 2009). Indaziflam presents a new mode of action for pre-emergence annual grass control which may be of benefit to turfgrass managers particularly where dinitroaniline resistance has been observed in wintergrass (*Poa annua)* and crowsfootgrass *(Eleusine indica)* in the southeastern United States (Cutulle *et al*., 2009; Isgrigg III *et al*., 2002; Mudge *et al*., 1984; Vaughn *et al*., 1990). Compared to some other pre-emergent herbicides, indaziflam is more water soluble, mobile, and persistent in aerobic soil environments. The water solubility of indaziflam is 2.8 mg/L (at 20C^{o}), the Koc value is <1000 mL/g and the soil half-life is > 150 (Senesman 2007; Tompkins 2010). In turf the control of summer and winter weeds historically includes separate control programs in spring (for summer weeds) and autumn (for winter weeds). Perry *et al*. (2011) showed that indaziflam could provide control of some summer and winter weeds from one application with residual pre-emergence activity extending 29 weeks after treatment.

RESULTS

Turf

Annual grass weeds in sport and recreational turf are a major problem in Australia. A variety of selective pre and post-emergent herbicides are used for the management of these weeds. The most significant species are *P. annua*, *E. indica* and *Digitaria* sp.

In Australia in 2005 a trial program commenced to evaluate indaziflam as a pre-emergent herbicide for the control of these grass weeds in established warm season (C4 grass species) turf swards. Overseas research had established that significant phytotoxicity occurs with indaziflam when applied to established cool season species such as *Agrostis* sp., *Lolium perenne*, *Poa* sp. and *Festuca* sp.

From 2005 to 2009 nine trials were conducted with indaziflam in turf situations to examine control of the three previously mentioned weeds. A summary of the results is shown in Table 1. Based on these trials and overseas research an effective rate for the control of *Digitaria* is turf situations is 75g a.i./ha. For *P. annua* and *E. indica* 50 g a.i./ha is an effective rate.

Indaziflam turf safety has been tested in Queensland at the facilities of the Department of Employment, Economic Development and Innovation and in NSW at the turf research plots of the University of Sydney. These trials have shown good turf safety on varieties including couchgrass (*Cynodon dactylon*), hybrid couchgrass (*C.dactylon* x *C. transvaalensis*), kikuyu (*Pennisetum clandestinum*), buffalograss (*Stenotaphrum secandatum*), zoysia (*Zoysia* sp.) and Queensland blue couch (*Digitaria didactyla*).

Table-1. The range of weed control (%) when compared to untreated control treatments across warm season turf trials done in Australia between 2005 and 2009 with indaziflam 200SC.

		indaziflam g/ha					
		37.5g	40g	50g	75g	80g	100g
Weed Species	***Poa annua***	94-96%	99%		93-100%	99%	100%
	***Digitaria* sp.**	69-98%	94-97%	89%	97-100%	100%	94-100%
	Eleusine indica		100%	100%		100%	100%

Forestry

Indaziflam evaluation in *Pinus* and *Eucalyptus* forestry plantation commenced in Australia in 2008. Over 2008 and 2009 over 20 forestry trials were conducted in the major forestry growing areas on mainland Australia. These trials covered both pre and post planting on *Pinus* and *Eucalyptus* species.

The trial results (Table-2) have generally shown weed control to be dose related and stronger with monocot species rather than dicots.

While the trials have shown indaziflam to give good weed control in some situations, it has become evident that to expand the weeds spectrum in many cases indaziflam will require tank mixing with another residual herbicide. To date the mixing partners which have been tested have been hexazinone in *Pinus* and simazine and sulfometuron in *Eucalyptus*. The trials with these mixing partners have demonstrated that it has been possible maintain good efficacy while reducing the rate of the older chemicals.

Table 2. The mean weed control (%) when compared to untreated control treatments across *Pinus* and *Eucalyptus* forestry trials in Australia in 2008 and 2009.

	Indaziflam g/ha		
	75g	150g	300g
Total	37%	46%	61%
Monocots	50%	64%	75%
Dicots	42%	36%	47%

The trials have shown indaziflam to be safe pre and post-planting on *Pinus* species, but only safe pre-planting on *Eucalyptus* species. Phytotoxicity is experienced on Eucalyptus species when indaziflam is applied post planting.

DISCUSSION

Bayer Environmental Science will market indaziflam in turf under the trade name Specticle®. This Australian registration into the turf market will be followed by planned entries into the ornamental, forestry and industrial vegetation management segments. The rates used will be from 50 g a.i./ha (turf uses) to 150g a.i./ha (industrial vegetation management). Indaziflam will be registered in these segments in the U.S.A, Latin America and Asia Pacific. Australia will have the first registration of this product in turf in 2012.

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