

## BIOLOGICAL ACTIVITY OF DPX-L5300 IN SOME NEW ZEALAND SOILS

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### SUMMARY

Activity of DPX-L5300 was compared in soils collected from five major agricultural regions of New Zealand in the glasshouse. Of the bioassay species used viz., mustard (*Sinapis alba*), annual ryegrass (*Lolium multiflorum*) and subterranean clover (*Trifolium subterraneum*), mustard was the most sensitive. Activity through the soil was significantly affected by changes in soil pH and organic matter content. The herbicide was most active in a high pH (6.7) soil from Hastings and least active in a Hamilton soil with a low pH of 5.3. This effect was demonstrated with each bioassay species although mustard showed the relationship most clearly.

### INTRODUCTION

The sulfonylurea herbicide DPX-L5300 has been tested as a cereal herbicide since 1982 in the major cereal growing areas of the world. Results from these studies have indicated that it is a highly active post-emergence herbicide with excellent cereal crop tolerance (Ferguson *et al* 1985; Muntan and Bencivelli 1987). A major advantage of DPX-L5300 is its much shorter residual activity in the soil compared to many other sulfonylurea herbicides (Duffy *et al* 1987; Ferguson *et al* 1985).

In New Zealand DPX-L5300 was first registered as a herbicide for spot treatment of ragwort (*Senecia jacobaea*) and certain thistles in pastures. Some efficacy data on these two species were reported last year by Martin *et al* (1988). Recently it has also been registered here for control of broadleaf weeds in wheat, barley and oats. It has also shown promise for pasture renovation because of its good activity against clovers (*Trifolium* spp.) (Rahman and Ledgard, unpublished).

Experiments during the early development of DPX-L5300 have shown that chemical hydrolysis and microbial breakdown are its principal modes of degradation, and that it usually undergoes rapid chemical hydrolysis in the soil. These reactions are highly dependent, however, on soil characteristics including soil pH, soil organic matter and soil moisture (Beyer *et al* 1987; Ferguson *et al* 1985). Our initial studies on glasshouse 'standards' for DPX-L5300 suggested that the activity of this herbicide can vary widely between soils (Rahman *et al* 1988). The present study was conducted, therefore, to evaluate the biological activity of DPX-L5300 in some major agricultural soils of New Zealand.

### MATERIALS AND METHODS

Soil from the top 10 cm was collected in bulk from the different regions and stored in bins under ambient conditions for the duration of the trials. Details of the soils are given in Table 1.

**TABLE 1: Some characteristics of the five soils investigated.**

Soil	pH	Organic C (%)	CEC (meq/100g)	Sand (%)	Silt (%)	Clay (%)
Horotiu sandy loam	5.7	9.1	36.0	61	21	16
Hamilton clay loam	5.3	2.8	25.4	57	17	26
Hastings (silt loam)	6.7	1.8	19.5	17	49	24
Canterbury (silt loam)	6.0	2.7	18.9	30	33	28
Otago (sandy loam)	5.0	1.8	14.1	63	15	12

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Treatments included five to seven rates of DPX-L5300 (between 10 and 960 g/ha depending on soil type) plus an untreated control. The application rates of DPX-L5300 were individually made up in 1 litre volumetric flasks. For each trial the treatments were applied by one of two different techniques. In the first method they were applied with a moving belt CO<sub>2</sub> powered sprayer, fitted with an 8003 even spray nozzle to apply 300 litres/ha at 200 kPa, to the freshly seeded pots. The pots were then given 20 minutes of overhead irrigation (equating to approximately 7 mm of water) to wash the herbicide into the soil. With the second technique the solutions were applied with the same sprayer to bulk soil in 5 cm deep trays. After standing for 15 minutes to allow the applied spray to dry, the soil was thoroughly mixed, by vigorous shaking in a polythene bag for about 30 seconds to incorporate the herbicide, and then used to pot out the test species.

The test species, mustard, annual ryegrass and subterranean clover, were grown in 12 cm diameter pots. Twenty seeds of each were planted at 5 mm depth and thinned to 15 plants soon after emergence and before any herbicidal effects were apparent. There were four pots of each species per treatment.

For the duration of the trial the pots were sub-irrigated every 2-4 days as required to maintain the soil near field capacity. Plants were assessed regularly to determine amount and type of damage. After growing for 4-5 weeks the plants were harvested for dry matter determination. All trials were conducted in a glasshouse with day temperatures between 20-30°C and night temperatures dropping to 16°C.

#### RESULTS AND DISCUSSION

Results of four trials conducted between October and February (1987/88) showed slight differences in the activity of DPX-L5300 due to seasonal variation and different application techniques. However these were small compared to the differences due to soil type so the results from all the trials were averaged and are presented in Table 2. From these results approximate GR<sub>30</sub> values (the rate required to produce a 30% reduction in growth) were calculated for each species and soil type and are given in Table 3. The low level of activity of DPX-L5300 through the soil meant that the normally used GR<sub>50</sub> values could not be obtained even when the herbicide was applied at 32 times the recommended use rate of 30 g/ha.

The GR<sub>30</sub> values presented show that mustard was much more sensitive than the other bioassay species in all five soils. Other workers (James *et al* 1988; Rahman *et al* 1988) have also found that mustard is highly sensitive to a range of sulfonylurea herbicides including DPX-L5300. The activity of DPX-L5300 was highest in the Hastings soil (a silt loam) and lowest in the Hamilton clay loam soil. The latitude of these differences varied with the bioassay species but the trend was similar in each case.

When transformed GR<sub>30</sub> values (ln transformation) from the five soils were plotted against their pH, a significant correlation ( $P < 0.05$ ) was found in the case of mustard whereas ryegrass and subterranean clover were only significant at 10% ( $P < 0.1$ ). However when the GR<sub>30</sub> values were regressed with both pH and organic carbon all the species gave significant correlations with that of mustard being highly significant. To further verify the relationship between soil pH and the activity of DPX-L5300 a different batch of soil was obtained from Hastings. This soil came from the paddock adjacent to that previously sampled and analysis showed that it was similar in all respects except for pH which was 5.9 (compared with 6.7 for the first soil). Results for the activity of DPX-L5300 in this soil, as well as results for the same Horotiu soil used previously, are given in Table 4. Comparing the results from the two Hastings soils with those from the Horotiu soil (Tables 2 and 4) shows that the activity of DPX-L5300 was considerably reduced at the lower pH.

The breakdown of DPX-L5300 has been reported to be fastest in light textured, low pH soils and slowest in heavy, high pH soils (Beyer *et al* 1987). The soil residual activity of this herbicide is very short because it undergoes very rapid chemical hydrolysis in the soil. Laboratory experiments have demonstrated that aqueous hydrolysis of sulfonylurea herbicides is much more rapid under acidic conditions where a greater proportion of the molecules are in the neutral, hydrolytically susceptible form.

**TABLE 2: Effect of DPX-L5300 on dry matter of bioassay species grown in five soils from throughout New Zealand.**

Rate (g ai/ha)	Dry Matter (% of untreated)				
	Horotiu	Hamilton	Hastings	Canterbury	Otago
	Mustard				
10	—	—	42	61	—
20	—	—	27	45	74
30	76	—	23	39	67
60	66	—	12	17	41
120	50	—	0	0	21
240	33	—	0	0	20
480	27	—	0	0	0
LSD* (P<0.05)	11		7	9	6
	Ryegrass				
10	—	—	117	110	—
20	—	—	110	100	105
30	93	99	88	113	90
60	92	105	87	78	90
120	88	104	51	83	81
240	73	82	32	75	72
480	60	80	8	56	63
960	—	60	—	—	—
LSD* (P<0.05)	16	14	14	10	12
	Subterranean Clover				
10	—	—	135	94	—
20	—	—	123	83	115
30	107	124	106	80	96
60	109	119	67	69	123
120	85	109	55	46	116
240	77	82	45	29	82
480	65	80	5	24	61
960	—	57	—	—	—
LSD* (P<0.05)	15	14	17	15	15

— rate not tested

\* LSD (P&lt;0.05) between soils for all species = 10.

**TABLE 3: The rate (g ai/ha) required to give a 30% reduction in growth (GR<sub>30</sub>) in each of the test species grown in different soils.**

Soil	GR <sub>30</sub> Values*		
	Mustard	Ryegrass	Sub-clover
Horotiu sandy loam	27	320	300
Hamilton clay loam	—	(600)	(580)
Hastings (silt loam)	(1)	76	56
Canterbury (silt loam)	(5)	240	58
Otago (sandy loam)	25	320	370

— no data

\* numbers in brackets are extrapolated.

**TABLE 4:** Effect of DPX-L5300 on bioassay species grown in the Hastings soil with a lower pH (5.9) compared with the previously used Horotiu sandy loam soil (pH 5.7) — dry matter as % of untreated.

Rate (g ai/ha)	Mustard		Ryegrass		Subterranean clover	
	Horotiu	Hastings	Horotiu	Hastings	Horotiu	Hastings
15	77	106	93	113	104	101
30	62	95	94	112	103	111
45	48	90	99	107	102	121
60	38	83	100	108	97	105
LSD (P < 0.05)	12	11	N.S.	N.S.	N.S.	N.S.

Our glasshouse results with the five soils presented here support the findings that both pH and organic C have a marked influence on the biological activity of DPX-L5300 and that a reduction of pH in a given soil significantly reduces its biological activity (Table 4), presumably through a faster rate of degradation.

Many studies have confirmed that most of the biological activity of DPX-L5300 is through post-emergence foliar applications (Ferguson *et al* 1985). The results presented here, however have practical implications for the choice of succeeding crops and the waiting period before they can be planted into different soil types after treatment with DPX-L5300.

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