MOVEMENT OF HEXAZINONE SPOTS APPLIED TO HILL SLOPES

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SUMMARY

In three trials hexazinone (1.0 to 4.0 g/spot) was applied to the surface or at 10 cm depth on sloping land and its movement followed over the next year. Rainfall in the week following application was high (44-57 mm). In two trials on a 25-30° slope pasture was killed up to 8 m downhill from surface and 2.5 m from sub-surface application. On a 12-15° slope, where hexazinone concentrations in soil were bioassayed, the chemical penetrated to a depth of at least 30 cm and moved at least 2 m down the slope.

INTRODUCTION

Hexazinone may be useful as a soil-applied treatment for controlling woody weeds (Bowers and Porter 1975; Preest 1980) and a suitable spot-applicator for this type of use has been developed by Porter (1979). Hexazinone is water soluble (32,000 ppm at 25°C) and can sometimes leach downhill, causing pasture damage (Harrington 1980).

The present experiments investigated movement patterns occurring after spot application of hexazinone on slopes and the resulting effect on pasture grasses.

METHOD

Experiment 1 was conducted on a hillside pasture dominated by browntop (*Agrostis tenuis*). Hexazinone water soluble powder (WSP), mixed at 22.5 g/litre water was applied either as a surface spot (20 cm²) or was subsurface injected at a depth of 10 cm, at 1.0 and 2.0 g/spot. Treatments were replicated 4 times and were applied on 7 November 1979, to slopes of 25-30°. The soil type was a Kumeroa hill soil, derived from sandstone (D. Cowie pers comm), OM 7%, clay 18%, pH 5.5. Rainfall for the weeks before and after treatments, was 12 and 57 mm respectively. The site was regularly grazed with sheep. Movement of hexazinone was determined by measuring the length and width of the patch of dead vegetation 1 m downhill from the point of application.

Experiment 2 repeated Experiment 1 at the same site, with an additional treatment; subsurface injection of hexazinone liquid (250 g/litre) at 2.0 g/spot. Treatments were applied on 18 January 1980. Rainfall for the weeks before and after treatment, was 38 and 48 mm respectively.

Experiment 3 was conducted at Massey University near Palmerston North on a pasture dominated by perennial ryegrass (*Lolium perenne*). Hexazinone liquid (250 g/litre) was applied either as a surface spot or a subsurface injection at a depth of 10 cm at 2.0 and 4.0 g/spot. Treatments were replicated 5 times and were applied on 8 April 1980 to slopes of 12-15°. The soil type was a Tokomaru silt loam with 12% OM, 30% clay and pH 6.1. Rainfall for the weeks before, and after application was 17 and 44 mm.

In this trial soil cores were collected at distances 0, 25, 50, 100 and 200 cm downhill from the 4.0 g/spot treatments 20 and 41 days after application. Four 2.5 cm diameter cores were taken to a depth of 30 cm, divided into 4 and the 7.5 cm sub-samples from each depth bulked. The samples collected at 20 days were frozen at -15 °C until the 41 day samples were collected. All samples were then dried at room temperature and sieved to 4 mm.

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The sieved soil was placed in waxed paper pots (180 cm³) and oat seeds (*Avena sativa* cv Florida) sown 1 cm deep at a rate of 15 seeds/pot. The pots were placed in a glasshouse at 20-25°C, watered when necessary and thinned to 10 seedlings/pot 9 days after sowing. After 32 days, the plants were cut to ground level and dried.

The concentration of hexazinone in the soil samples was determined by a calibration series of 8 different concentrations of hexazinone in soil, ranging from 0.04 to 5.0 ppm, and replicated 4 times. Oats were grown in the treated soil as above giving a GR₅₀ concentration of 0.46 ppm. Control plants were grown in untreated soil from the 4 sampling depths and used to correct for the minor differences in growth in the soil from different depths.

RESULTS AND DISCUSSION

Movement down slope

Two weeks after treatment hexazinone movement downhill for surface application was 8.1, 5.4 and 1.5 m respectively for experiments 1, 2 and 3 (Fig. 1). In all three experiments rainfall was high (44 to 57 mm) in the week following application. The degree of movement increased with rainfall (Experiment 1 > 2 > 3) and slope (Experiment 1 and 2 > 3). Gravimetric soil moisture at time of treatment was recorded only for Experiment 1, but was high (54%).

Sub-surface application significantly reduced downhill movement of hexazinone, by 69, 38 and 80% in Experiments 1, 2 and 3 respectively, 2 weeks after application (Fig. 1). This suggests that surface flow was a major component of the hexazinone movement.

Length of the dead patches declined with time (Fig. 1), although dead patches were still visible one year after treatment. The recovery of patches was in part prevented by sheep preferentially camping on bare patches, particularly in Experiment 3. However bioassay plants died after emergence on soil collected from the top 5 cm of bare patches 20 months after application.

Doubling the application rate increased downhill movement by 35% on average but this increase was significant in Experiment 3 only.

There was no difference in the movement patterns of the water soluble powder compared with the liquid formulation. The average width of dead vegetation for the three experiments 50 to 100 cm downhill from the point of application was 26 cm.

Fig. 1: Changes in size of dead pasture patches for the three trials with surface (unbroken line) and sub-surface (dotted line) applications of hexazinone. The bars indicate standard errors.

Movement into soil

Percolation (leaching) and hexazinone concentration were determined by bioassay. Concentrations greater than 1.2 ppm completely killed assay plants and could not be separated. On the basis of differences in plant dry weights (Fig. 2) hexazinone levels were lower at 6 weeks than at 3 weeks. There was significantly less hexazinone throughout the sampling zone with sub-surface than with surface applications. Samples collected at the application point and 25 cm downhill both had hexazinone levels greater than 1.2 ppm. There was a detectable decline in hexazinone at each sampling from 50 to 200 cm downhill. There was significantly less hexazinone in the 0-7.5 cm depth than in the other three depths. This difference was more clearly defined at the second sampling date and probably resulted either from herbicide breakdown in this top layer, or from percolation to deeper levels. Decomposition of hexazinone is mainly by microbial action (Rhodes 1980) and microbial activity is usually greatest in the surface layers of the soil.

Iso-concentrations of hexazinone were estimated (Fig. 3) from the bioassay data. Hexazinone moved deeply into the soil, and Fig. 3 suggests that a proportion of hexazinone moved below the limit of the sampling zone at 30 cm. Rahman (1981) reports that following a broadcast application of hexazinone at 2 kg/ha (equivalent to 3 ppm in the top 10 cm of soil) no percolation beyond 10 cm occurred on a silt loam, while some percolation to the 10-20 cm depth occurred after 3 months on a sandy loam. However, this rate is equivalent to 0.4 mg over an area of 20 cm² compared to the 1-4 g over 20 cm² applied in the present trials.

A 4 g hexazinone spot distributed evenly through a soil volume of 200 x 30 x 30 cm, approximately the dimensions over which the chemical was found in Experiment 3, would give a concentration of 22 ppm. However, less than 1 ppm was determined over most of the sampled volume (Fig. 3) and as the half life of hexazinone in soil is usually greater than 1 month (Rhodes 1980), the low concentration of hexazinone is unlikely to have resulted from chemical breakdown. This suggests that a large amount of the applied chemical was either leached out of the system or remained in a narrow column close to the point of application, so that the dead pasture strips developing downhill from the point of application appear to result from only a small proportion of the applied hexazinone.

Fig. 2: Mean bioassay values for various treatment factors. The small bars show standard errors.

Fig. 3: Hexazinone iso-concentration diagrams for the two methods of application and the sampling times. Striped zones denote concentrations greater than 1.0 ppm, stippled zones concentrations less than 0.4 ppm, and plain zones have intermediate concentrations.

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