EFFECT OF HERBICIDES AND FLOWER HEAD MATURITY ON THE GERMINATION OF NODDING THISTLE SEED

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SUMMARY

Nodding thistle (*Carduus nutans* L.) plants with capitula at three stages of maturity were treated with several herbicides. Germination of seed from capitula treated at full expansion was low with all treatments but seed of more mature capitula had significant viability. Treatment of plants by the late bud stage to prevent viable seed production is recommended.

INTRODUCTION

Plant species with either an annual or biennial life cycle are largely dependent on the production of viable seed to continue the species. Nodding thistle produces a large number of seeds, estimated at up to 20,000 per plant (Popay 1980). Integrated control programmes usually involve an overall application of herbicide directed at immature rosettes followed some time later by spot treatment of the survivors. The spot treatment, typically carried out in late spring and early summer, is applied to thistles at various growth stages from rosettes to flowering plants. Thus it is important to know the effect of herbicide treatments on the development and viability of nodding thistle seed.

A trial was established near Hinuera in the Waikato in which a number of herbicides were applied to nodding thistles with capitula (flower heads) at various stages of maturity.

METHODS AND MATERIALS

The trial site was on a sheep grazed pasture on a Tirau sandy loam soil. Treatments of MCPA (IWD MCPA), 2,4-D (HI ester 2,4-D), picloram + 2,4-D (Tordon 50 D), clopyralid (Versatill) and glyphosate (Roundup) were applied to nodding thistle plants in full flower on 6.2.87. Treatments (Table 1) were replicated three times. The overall spray of MCPA (Treatment 1) was applied with a precision sprayer delivering 300 litres/ha at 210 kPa while the spot treatments (Treatments 2-6) were applied by a knapsack sprayer through a Teejet 730 231 nozzle spraying to wet thistle foliage. Plots were 3m x 8 m.

Prior to treatment, three groups of plants, consisting of one to three plants per group, were selected on each plot for tagging capitula. Ten capitula (flower heads) at each of three stages of maturity were tagged on each group of plants. Thus for each herbicide, 90 capitula were tagged for each stage. The three stages of capitula maturity were as follows:

Stage 1: Florets fully open, no senescent tissue, pappus immature and unexpanded, seeds small, at anthesis.

Stage 2: Florets with senescent corollae, pappus developed but unexpanded, seeds pale but full sized, post-anthesis.

Stage 3: Corollae typically absent, pappus fully developed and expanding, seeds detaching from receptacle, post-anthesis.

Capitula from Treatment 7 (Table 1) were collected on the date of spraying and those from other treatments were collected 17 days after spraying. Except for Treatment 7, recovery of seed from Stage 3 capitula was poor due to natural seed release between spraying and collection.

Seeds of Stages 1 and 2 capitula were dried for 1 month, then separated from receptacle and pappus materials into one sample of seed for each group of plants. A

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TABLE 1: Percent of nodding thistle seeds* germinating after 3 weeks at room temperature.

Treatment	Stage of capitula maturity		
	1	2	3**
1. MCPA boom 1.5 kg ai/ha	4	43	53
2. MCPA spot 5 g ai/litre	0	36	48
3. 2,4-D spot 5 g ai/litre	1	26	36
4. picloram + 2,4-D spot 0.6 + 2.4 g ai/litre	3	39	31
5. clopyralid spot 3 g ai/litre	0	39	37
6. glyphosate spot 3.6 g ai/litre	1	24	34
7. Untreated (collected at spraying)	1	34	46
8. Untreated	40	66	25
LSD	—	22	—

* Seed collected 17 days after treatment for all Treatments except 7.

** Stage 3 seed samples represented only a small proportion of the total seed produced, as most of it was lost in the field prior to collection.

visual assessment was made on the extent of seed development for each sample before randomly drawing a subsample of 20 seeds for germinating. Subsamples were soaked for approximately 30 h in a 5% GA₃ solution to break any seed dormancy. Seeds from Stage 3 capitula were cleaned after 10 weeks of drying but were not soaked in GA₃ solution as most innate seed dormancy would have been lost by that time (Popay *et al* 1987). All seeds were germinated on moist filter paper in Petri dishes at room temperature. Every 2 days for 3 weeks germinated seeds were counted and removed. Since samples from Stage 3 capitula represented only a small portion of total seed, no statistical analysis was performed on these data.

RESULTS

Table 1 shows the percentage germination of seed from the three stages of maturity. Of the Stage 1 capitula, only seed from untreated capitula allowed to mature on the plants (Treatment 8) had significant viability. Sprayed Stage 1 capitula and those collected from untreated plants at the time of treatment contained little or no viable seed. Germination of seed from Stage 2 capitula was significantly higher than that of Stage 1 capitula. Seed from untreated Stage 2 capitula which were allowed to mature on the plant showed significantly higher germination than all other Stage 2 seed. There were no significant differences between herbicide treatments in the percentage germination of Stage 2 seeds.

Germination of seeds from untreated Stage 3 capitula collected at spraying was greater than equivalent Stage 1 seed and similar to that of Stage 2 seed. Germination of seed from Stages 2 and 3 capitula treated with herbicide was similar. Seed from untreated Stage 3 capitula collected 17 days after spraying gave poorer germination than seed from equivalently treated Stages 1 and 2 capitula. This was because most of the Stage 3 seed dropped in the field before collection leaving a high proportion of less developed seed.

DISCUSSION

The data presented here show that the stage of flower head maturity at treatment, is important in determining whether viable seed is produced by sprayed nodding thistle flowers. This confirms work by McCarty and Hatting (1975), and Wardle and Rahman (1987). The lower germination of seed from untreated flowers collected at tagging compared with that collected two weeks later, for both Stages 1 and 2, indicates seed at these stages was not fully mature. Visual assessment of the seed samples indicated that Stage 1 seed was relatively less developed than that of Stage 2, and that Stage 2 seed was generally not all fully developed. All herbicides apparently prevented seed from maturing further, possibly by reducing the flow of sap into the flowers, similar to the effect caused by removal of flowers by pulling. In the more mature Stage 2 flowers

where seed viability was significant at the time of treatment (34%), herbicide did not lower germination. This also indicates that herbicides were not translocated into the flowers sufficiently to kill the seed. A study by Phung and Popay (unpublished) supports this, in that the seed heads which had passed anthesis at treatment continued to produce viable seed.

Other workers have recorded a reduction in viability of ragwort seed after herbicide treatment (Coles 1967; Makepeace and Thompson 1982; Thompson 1983). They tested seed bulked from sprayed plants so the seed was likely to have come from flowers both before and after anthesis. Herbicide treatment of nodding thistle plants when their oldest flower heads are fully open or earlier, is likely to prevent substantial viable seed production. On a paddock scale where a range of growth stages are present, treatment before any plants go beyond the late bud stage is therefore recommended. No differences between herbicides were found in this trial. As flowers on regrowth generally contain viable seed, the ability of a herbicide to prevent regrowth should be the major factor determining choice of a chemical.

In conclusion, herbicide treatment of fully open flowers reduced the viability of seed compared to seed from more mature flowers. All of the herbicides commonly used for nodding thistle control achieved this, although the reduction in seed viability was no greater than would be achieved by cutting or pulling flowers.

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REFERENCES

- Coles, P.G., 1967. Ragwort control with picloram *Proc. 20th N.Z. Weed and Pest Control Conf.*: 32-36.
- Makepeace, W. and Thompson, A., 1982. Ragwort control using a rope wick applicator *Proc. 35th N.Z. Weed and Pest Control Conf.*: 256-260.
- McCarty, M.K. and Hatting, J.L., 1975. Effects of herbicide or mowing on musk thistle seed production. *Weed Research* 15: 363-367.
- Popay, A.I., 1980. Nodding thistle in crops and pastures, biology significance and control. *Ag link FPP* 359. Media Services, MAF, Wellington.
- Popay, A.I., Thompson, A. and Bell, D.D., 1987. Germination and emergence of nodding thistle (*Carduus nutans* L.). *Proc. 8th Australian Weeds Conf.*: (In press).
- Thompson, A., 1983. Pasture weed control by rope wick applicator. *Proc. 36th N.Z. Weed and Pest Control Conf.*: 96-98.
- Wardle, D.A. and Rahman, A., 1987. Influence of capitulum maturity on achene germination of *Senecio jacobaea* L. and *Carduus nutans* L. *N.Z. J. Agric. Research* 30: 117-120.