AGE, SIZE AND FATE OF NODDING THISTLES

A.I. POPAY, R.B. MITCHELL, A. THOMPSON

*Research Division, MAF, Palmerston North,
Mosgiel and Hamilton*

Summary

Natural populations of nodding thistle (*Carduus nutans*) in pasture were studied in three districts - Hawkes Bay, Waikato and Otago. A range of sizes was present at most sites at most times but in the autumn and winter thistles 5 cm or less in diameter formed the bulk of the populations. Mortality rates were high, especially among small thistles. Larger thistles present during autumn, winter or early spring were committed to flowering during the next summer whilst smaller plants could flower in either the first or second summer. Thistles which grew rapidly in the winter and spring were most likely to flower in the first summer.

INTRODUCTION

One possible reason for poor control of nodding thistle is that both large and small plants are often present at the time of spraying, and larger thistles are more resistant to normal rates of herbicide. There is no available information on what governs the size distribution of thistles within a population nor on the history and fate of thistles of different sizes.

Such information could be useful in planning thistle control programmes and could help to suggest improved methods of controlling thistles. Observations on the age and size structure of thistle populations have been made at several sites and the results are presented here.

MATERIAL AND METHODS

Since September 1976, detailed studies of population sizes and of the size and fate of individual nodding thistle plants have been made on a hill pasture on Ngaparau Farm, Raukawa Road, in central Hawkes Bay. Six plots each 6 x 2 m were marked out in September 1976. The position of each thistle in these plots was recorded on a map and the thistle was marked with a numbered plastic tag fastened to the ground with wire. The diameter of each thistle rosette was measured and the number of leaves counted. The site was visited at intervals, when all marked thistles were found and measured and any new plants were tagged, measured and mapped.

Similar observations have been made, since April 1978, at two sites in Otago - at Enfield and Maheno. At each site three plots each 4.7 x 2.1 m were marked out and the position of thistles within the plots marked on a map. At regular intervals the sites were revisited and the size of all thistles noted.

In the course of trials on spraying thistles by helicopter, thistle sizes were measured in August 1977 on four trial sites in the Atiamuri district of Waikato (Thompson 1979). The sites were again visited in November 1977 and in February 1978 and previously measured thistles were relocated and measured if still present. Data reported here are from unsprayed control plots.

RESULTS

The relationship between rosette diameter and the number of leaves of a plant is shown in Fig. 1 for thistles at the Hawkes Bay site. Thistles measured at other sites showed very similar relationships. Since leaf number is so closely related to thistle diameter, only the latter measurement is used in presentation of the rest of the data.

Fig. 1. Relationship between rosette diameter and number of leaves per plant at the Hawkes Bay site. Thistles were measured and their leaves counted several times a year between September 1976 and April 1979. A total of 2465 observations were made.

The distribution of thistle sizes within populations at different times of the year is shown in Fig. 2, as is the fate of thistles within each size group. Although mortality rates at one of the Otago sites were particularly high, size distribution and thistle behaviour at both sites were similar so that data from both sites have been combined. Similarly, data from the four Waikato sites were pooled. Data for corresponding periods over the 3 years of observations in Hawkes Bay have also been combined, since differences in thistle sizes and behaviour were relatively small from one year to the next.

At all sites and dates, except Otago in April, a range of thistle sizes was present. In Hawkes Bay, the majority of thistles present in autumn or winter were 5 cm or less in diameter. In spring and summer larger thistles predominated. In the Waikato and Otago, the highest proportion of thistles present at any time were those with diameters of 1 - 5 cm.

It can be seen from Fig. 2 that the size of a thistle is important in determining its future behaviour. Mortality rates of small thistles were very high on all sites at all times. In autumn, winter or early spring, over 85% of thistles in the 1 - 5 cm size group died without flowering. The larger a thistle, the less likely it was to die without flowering.

In Hawkes Bay, studies were carried out for long enough to determine the proportions of thistles flowering in their first or second

Pasture Weeds

summer (Fig. 2). For the Waikato and Otago, the progress of thistles was only followed until the first autumn and although most of the thistles still present in autumn would probably flower in the second summer, some would also die without flowering. Consequently "flower second summer" proportions for the Waikato and Otago in Fig. 2 are probably over-estimated, and "die without flowering" proportions are under-estimates.

Fig. 2. Size distribution of thistle rosettes, and future behaviour in relation to rosette diameter, in populations at three localities sampled at different times of the year.

Pasture Weeds

Fig. 3. Growth patterns of thistles at the Hawkes Bay site, in relation to their ultimate fate. The 1977-78 population emerged between March and July 1977; the 1978-79 population emerged between February and April 1978.

In April, thistles larger than about 10 cm had probably germinated in the previous autumn, winter or spring, had therefore already passed through one summer in the rosette stage and could only flower in the next

Pasture Weeds

summer. At that time of the year, thistles 5 cm or less in diameter which survived to flowering could flower in their first or second summer. Thistles larger than 10 cm in July or larger than 15 cm in August always flowered in the first summer: smaller ones could flower in the first or second summer. In October-November some thistles within any size group could adopt either flowering strategy, although almost all thistles greater than 20 cm in diameter flowered in the first summer.

The growth patterns of thistles of comparable ages - emerging in March to July 1977 or in April 1978 - on the Hawkes Bay site are shown in Fig. 3. Thistles destined to flower in the first summer grew rapidly in the spring and, by October or November, were significantly larger than the other thistles present. Similarly, thistles which were going to flower in the second summer tended to be larger than those which were going to die without flowering. It is interesting to note that thistles, even those which were eventually going to flower, could become smaller both in diameter and leaf number. This usually happened during the summer and was probably the result of drought stress. In the 1977-78 population, thistles which were going to flower in the second summer did not start to grow rapidly until the spring before flowering, whilst in the 1978-79 population, a period of rapid growth occurred in the early autumn, so that these thistles were very large by the end of April. The summer of 1978-79 was wetter than that of 1977-78, which may have been responsible for the different growth patterns in the two years.

DISCUSSION

Nodding thistle can behave either as a winter annual, emerging in the autumn and flowering in the following summer, or as a biennial, emerging in the autumn or early winter and flowering in the second summer. This is true in Nebraska (McCarty and Scifres 1969), in Australia (Medd and Lovett 1978) and in New Zealand (Popay and Thompson 1979). Medd and Lovett (1978) showed that, in the absence of inter-specific competition, thistles emerging in autumn always flowered the following summer; those emerging in June or July flowered in either the first or second summer and those emerging in late winter or spring did not flower until the second summer.

In New Zealand, autumn germinated thistles in pasture can flower in either the first or second summer (Popay and Thompson 1979), although mortality rates, especially in young thistles, are very high. From the observations described here, it seems that growth rates during the late winter and spring are important in determining when a thistle is going to flower. Thistles over 5 cm in diameter in April, over 10 cm in July, over 15 cm in August-September or over 20 cm in October-November are likely to flower in the first summer, if they survive till then. Smaller thistles at each date can adopt either flowering strategy, although many will die without flowering.

These observations suggest that it is possible to some extent to predict the behaviour of individual thistles and therefore of populations. A thistle larger than 16 cm in diameter in August-September has a greater than 50% chance of flowering and will do so in the following summer. A population containing a high proportion of such thistles at that time of the year will almost certainly produce a large crop of flowering plants in the summer.

It may be possible to manipulate thistle populations by appropriate pasture management. Intense pasture competition may be responsible for high thistle mortality rates and also for limiting rapid spring growth of some thistles. Intensification of this competition by adequate fertiliser inputs, by prevention of insect damage to pastures and by suitable grazing

Pasture Weeds

management could increase seedling mortality and could minimise the number of thistles which flower in their first year. Thistles which do not flower in their first summer are usually large and conspicuous by the second winter and are therefore easy to grub or spot spray.

ACKNOWLEDGEMENTS

R. Blomfield, D. K. Edmonds, F.A. Meeklah, Thai Phung and P. Sanders for technical assistance. D. F. Wright for assistance with statistics. The farmers on whose properties we worked for allowing their thistles to grow unchecked.

REFERENCES

- McCarty, M. K. and Scifres, C. J., 1969. Life cycle studies with nodding thistle. *Research Bulletin Nebraska Agricultural Experimental Station*, No. 230, 15 pp.
- Medd, R. W. and Lovett, J. V., 1978. Biological studies of *Carduus nutans* (L.) ssp. *nutans* II. Vernalisation and phenological development. *Weed Research* 18:369-372.
- Popay, A. I. and Thompson, A., 1979. Some aspects of the biology of *Carduus nutans* L. in New Zealand pastures. *7th Asian-Pacific Weed Science Society Conference* (in preparation).
- Thompson, A., 1979. Helicopter spraying of nodding thistle with two rates of water. *Proc. 32nd N.Z. Weed and Pest Control Society Conf.*