

**SOME ASPECTS OF THE BIOLOGY OF CREEPING KNAPWEED
(ACROPTILON REPENS) IN VICTORIA**

G.H. Pritchard

Keith Turnbull Research Institute, Department of
Conservation and Environment, Victoria 3199, Australia

Summary

Creeping knapweed is an introduced herbaceous perennial weed which typically grows in dense patches to the exclusion of other species. Initially a weed of irrigated vines and fruit, it has become a serious competitor of cereal crops and dryland pastures in north-western Victoria. Its extensive perennial root system resists control efforts and is its main means of propagation. Shoots appeared after roots were removed to a depth of 120 cm. Individual patches had average annual increases in area of 33 to 53%. Root fragments as short as 2.5 cm can produce shoots if planted at shallow depths. Shoots emerged from 5 cm root pieces planted at 15 cm, but not at 30 cm depth. Root pieces are able to withstand desiccation for up to 3 days at temperatures (day/night) of 15°/5°C, but not at higher temperatures.

Introduction

Creeping knapweed or Russian knapweed (Acroptilon repens (L.) DC., syn. Centaurea repens L.) is native to the southern and eastern U.S.S.R., Asia Minor, and Mongolia (3, 7). A weed of dryland and irrigated crops in the USSR (2, 4), it is now a weed in Australia, the U.S.A., Canada, South Africa, Argentina, and India (1). The first Australian record of the plant was in 1907 from north-east Victoria, near Wangaratta (latitude 36°S). It subsequently appeared in South Australia, southern New South Wales, and west of Toowoomba in southern Queensland.

In Victoria, creeping knapweed was largely a weed of irrigated vines along the Murray River between Swan Hill and Merbein (5), until the 1970s when it spread into adjacent dryland cereal areas (where the mean annual rainfall is 275-375 mm). In 1983 the net area on dryland properties was estimated at 3260 ha, in paddocks which totalled 36,700 ha; net infestations on irrigated and non-agricultural land was estimated at 940 ha.

Life cycle and growth habit

The plant has a root system of creeping horizontal and deep vertical roots which produce new shoots each spring. Initial growth is a rosette, then a flower stalk develops and flowers appear in early summer. After seeding, the top growth dies off in late summer or autumn. Cultivation, except in the winter months, stimulates new shoot growth from the roots, so active growth can be observed throughout the summer and autumn until the topgrowth is killed by cooler winter temperatures. Infestations commence as small discrete patches, which typically increase in size and number and, in extreme cases, coalesce to form an almost continuous cover. Mean shoot densities as high as 69 m² have been recorded in Victoria, but 20-40 shoots m² are more usual.

Economic effects

(a) Cereals. In an examination of weed density thresholds in Victorian cereal crops (8), A. repens was the most competitive of

the nine species considered (7 were annuals). The yield-density relationships developed from four sets of data indicated that a density of 30 shoots m^{-2} would result in yield losses of 54 to 75%. In five herbicide trials in which control of the weed was maintained for about 12 months before harvest, the untreated controls yielded between 9% and 52% lower than the best herbicide treatments (6). Cereal crops are up to 3 months old when A. repens shoots first emerge, but the weed has its major effect by depleting the soil of moisture and nutrients in the previous summer.

(b) Annual pasture. The effect of A. repens on the production of an annual ryegrass (Lolium rigidum)/barrel medic (Medicago tribuloides) pasture was measured in a cutting experiment. An infested area and an adjacent area free of A. repens were fenced in April, to exclude sheep, before the autumn growth commenced. Each area contained 12 plots of 4.5 x 4.5 m. Commencing in late May, there were four sampling dates, at 8 or 9 week intervals until mid-November when the pasture had senesced. On each date, a new quadrat of 1 m^2 was cut to ground level in each of the 12 plots in each area. At the final sampling in November the mean density of A. repens in the infested area was 24.6 shoots m^{-2} .

A. repens reduced the dry matter production of the other pasture species by 62%, 31%, 34% and 52% respectively at the May, July, September and November cuts. If the yield from A. repens was included (sheep will eat the plant) the total production for the season, was reduced by 42% by the presence of A. repens.

Biology of root system

The initial introduction of the weed into Australia would have been as seed, and seed is probably the source of new infestations which are remote from existing plants. However, seedlings are very uncommon in the field, and may only be important in occasional favourable seasons. Much of the spread of the weed is vegetative. The vigour and regenerative powers of the root system is a major factor in the difficulty of controlling the weed.

(a) Regenerative capacity. The ability of the root system to regrow from depth was demonstrated by excavating 1 m^2 plots to depths of 15, 30, 60, 90 and 120 cm. The holes were lined with sheet metal (to prevent the incursion of roots from outside) and then refilled with soil free of A. repens. This was done on 18 May when no top growth was present. In the unexcavated plot and the plot excavated to 15 cm, the first shoots of A. repens appeared on the surface on 20 August. The first shoots from 30, 60, 90 and 120 cm appeared 2, 5, 8 and 16 weeks later respectively.

(b) Rate of vegetative spread. The perimeters of six discrete patches of A. repens were mapped for up to 4 years. This was done both in paddocks under continuous pasture, and in paddocks with a cropping rotation. The area of the patches was obtained by measuring scale drawings with a planimeter. The initial size of the patches ranged from 108 to 207 m^2 , that is, approximate diameters of 12 to 16 m. There were average annual increases in area of 33 to 53%, with increases in individual years of up to 68%. This increase in size of the patches represents an average annual outward growth at the perimeters of about 0.9 to 1.5 m. The outward growth was not confined to the spring-summer period; increases were also recorded between autumn and spring. While the highest average annual increase was recorded under a cropping rotation involving cultivation, increases were not consistently less under continuous annual pasture.

(c) Regeneration of root fragments. The worst infestations are usually associated with cultivation and increases in the size of existing infestations appear to be mainly due to the transport of root pieces during cultivation. The regenerative capacity of root pieces was examined in several studies. In pot trials, regeneration of root pieces was greater from shallow than from deeper plantings. Thus 5 cm-long root pieces planted in pots at depths of 2.5, 15 and 30 cm, produced means of 8.6, 1.1 and 0 shoots per 10 root pieces respectively. Pieces as short as 2.5 cm, when planted at 5 cm depth, did not give significantly less shoots per unit length than pieces of 10 or 20 cm. However at a planting depth of 15 cm, 2.5 cm-long pieces produced no shoots while longer lengths still produced some shoots.

The ability of severed root pieces to survive when brought to the surface by cultivation was assessed in a laboratory study. Horizontal root pieces, 10 cm long, were kept on dry trays for 1 to 7 days before being planted, 5 per pot, at a depth of 5 cm in moist soil. Control pieces planted immediately produced a mean of 4.0 shoots per pot. Root pieces held at temperatures (12 hr day/12 hr night) of 15°/5°C for 1, 3 and 7 days before planting produced means of 1.3, 0.8 and 0 shoots per pot respectively. No shoots were produced following drying temperatures of 25°/10°C for 3 and 7 days or 30°/15°C for 1, 3 or 7 days.

These results suggest that, while root pieces have a limited survival period under dry conditions, normal cultivation, which is relatively shallow, and conducted while the soil is moist, is likely to encourage the survival of severed root pieces, thereby increasing the density and size of existing patches and starting new infestations if pieces are dragged by cultivation equipment.

References

1. Holm, L., Pancho, J.V. Herberger, J.P. and Plucknett, D.L. (1979). 'A Geographical Atlas of World Weeds' pp 7, 75. John Wiley and Sons, New York.
2. Ivanova, T.S. (1966). Experimenting with a biological method for controlling Russian knapweed. Izvestiya Akademii Nauk. Tadzhik. SSR (Otdel. Biol. Nauk.), 2, 51-63. [in Russian] (Weed Abstracts, 1969, 18, 858).
3. Moore, R.J. and Frankton, C. (1974). The Thistles of Canada. pp 94-5. Canada Department of Agriculture, Ottawa.
4. Mordovets, A.A. and Golovin, V.V. (1976). Control of Acroptilon repens under irrigated conditions. Zashchita Rastenii, 12 48-49. [in Russian] (Weed Abstracts, 1978, 27, 3557).
5. Parsons, W.T. (1973). 'Noxious Weeds of Victoria'. p 60. Inkata Press, Melbourne.
6. Pritchard, G.H. (1984). Control of creeping knapweed on cereal fallows. Proceedings 7th Australian Weeds Conf., Perth, pp 286-290.
7. Robbins, W.W., Bellue, M.K. and Ball, W.S. (1951). 'Weeds of California.' p 442. California Department of Agriculture, Sacramento.
8. Streibig, J.C., Combellack, J.H. and Pritchard, G.H. (1989). Estimation of thresholds for weed control in Australian cereals. Weed Research, 29, 117-126.

Acknowledgments

P. Luke and P.J. Andrew provided invaluable assistance in the conduct of the field and glasshouse studies.