WEEDY ST. JOHN'S WORTS (*HYPERICUM* SPP.) IN NEW ZEALAND

A. J. HEALY

Botany Division, DSIR, Christchurch

The genus *Hypericum* is represented in New Zealand by two indigenous and ten adventive species, and by a range of herbaceous and shrubby ornamentals. The wild species include weeds of waste places and grassland, some which cause or are suspected of causing photosensitivity conditions in livestock, with three having legal status as scheduled weeds under the Noxious Weeds Act 1950.

As a group, the St. Johns' worts have well marked botanical characteristics:

- i. *plants* herbaceous or shrubby, hairless (except *H. montanum*), perennial (sometimes annual in *H. mutilum*):
- ii. *stems* round, angled, or with raised lines or winged (Fig. 1), often reddish-coloured:
- iii. *leaves* in opposite pairs, close-set or distant, stalkless (occas. short-stalked in *H. humifusum*), hairless (very short hair on underside in *H. montanum*), lighter-green or blue-green on underside, with pellucid (transparent) glands or dots, and black glands near the margin on the underside (absent in some herbaceous and all shrubby species), margins entire (Fig. 2, 3):
- iv. *flowers* yellow, regular, large or small, solitary or few to many in terminal heads (Fig. 4); *sepals* 5, equal or unequal, entire or toothed, with or without black marginal glands (Fig. 5); *petals* 5, longer than sepals (shorter in *H. mutilum*, about as long in *H. androsaemum*), dried remains persistent in fruit in herbaceous species (Fig. 4b), deciduous and without black glands in shrubby species; *stamens*

FIG. 1: Diagrams showing stem character: a. round. b. lined. c. 4-angled. d. 4-angled, angles winged.

usually numerous, often conspicuous, arranged in 3 or 5 groups or bundles, deciduous in shrubby species, persistent below capsule in herbaceous species; *styles* 3 in herbaceous species, 3 or 5 in shrubby species, often long and persistent on the capsule (Fig. 4b):

- v. *fruit* a dry, dehiscent or semi-dehiscent capsule (except in *H. androsaemum*, succulent, berry-like) 3- or 5-celled, many-seeded (Fig. 4b):
- vi. *seeds* small, brownish, with reticulate coat (Fig. 4b).

IDENTIFICATION OF SPECIMENS

- i. Select a representative plant, or better, examine several plants.
- ii. Determine stem character by examining stems externally, and cutting through with a sharp knife.
- iii. Pellucid leaf glands are seen by holding a leaf against a light source, and black glands by examining the underside near the margin.
- iv. A simple hand lens greatly assists in checking stem, leaf, and sepal characters.
- v. Stem leaves should be used; leaves from barren, prostrate, basal shoots commonly differ in shape from stem leaves.

KEY TO SPECIES

1. Shrub or sub-shrub, to 3.5 m tall; leaves large, 3-10 cm long; flowers (1.5)-2.5-9 cm diam. (large-leaved forms of *H. montanum* with flowers $\pm$ 1.5 cm diam. fall in this option); black glands absent from leaves, sepals, and petals; petals and stamens deciduous; styles 3-5 2
 Herb, often woody below; leaves small, to 2.5 cm long; flowers small, less than 2 cm diam. (small-leaved forms of *H. androsaemum*—fruit succulent, berry-like, and *H. calycinum*—rhizomes present, fall in this option); black glands often present on leaves, sepals, and petals; petals and stamens persistent; styles 3-5 6
2. Stems 4-angled; strong wiry rhizomes present; flowers 7-9 cm diam.
H. calycinum
 Stems (and branches) round, or 2-edged, or with 2 raised lines; rhizomes absent; flowers (1.5)-2.7 cm diam. 3
3. Stems (and branches) 2-edged or with 2 raised lines 4
 Stems (and branches) round 5
4. Petals about as long as sepals; fruit succulent, berry-like, red, black at maturity *H. androsaemum*
 Petals much longer than sepals; fruit dry, a $\pm$ dehiscent capsule
H. inodorum

FIG. 2: Undersides of leaves: a, black glands absent near margin, *H. calycinum*. b, black glands close-set near margin, *H. montanum*. c, pellucid glands (by transmitted light), with few black glands near margin, *H. perforatum*.

FIG. 3. Undersides of leaves: a. reticulate venation, *H. calycinum*. b. very short hairs, with black glands near margin, *H. montanum*. c. pellucid glands (by transmitted light), and a single black gland, *H. perforatum*.

FIG. 4: Drawing showing: a. parts of a flower. b. capsule, with persistent petals and stamens, characteristic of herbaceous species, *H. perforatum*; seed, with reticulate seed coat.

5. Underside of leaves very short hairy, with black glands near margin; sepals sharp-toothed, with black glands *H. montanum*
 Underside of leaves hairless, without black glands; sepals without teeth or black glands *H. hookerianum*
6. Rhizomes stout, wiry; stems bluntly 4-angled; black glands absent; flowers 7-9 cm diam.; petals and sepals deciduous *H. calycinum*
 Rhizomes absent, or slender; stolons present or absent; stems various; black glands often present; flowers small, to 2 cm diam.; petals and stamens persistent 7
7. Leaves very small, 2-3 mm long $\times$ 0.5-1 mm broad *H. japonicum*
 Leaves more than 3 mm long 8
8. Stems 4-angled, 4-lined, or 4-winged 9
 Stems round or 2-lined 12
9. Stems strongly 4-winged, erect, to 1 m tall, with scattered black glands; plant of swampy places *H. tetrapterum*
 Stems 4-angled, not winged, erect or prostrate, to 50 cm tall or long, without black glands; plant of wet or dry places 10
10. Stems prostrate, ascending towards tips, weak, slender, often rooting and forming patches; leaf margins flat or undulate; flowers 2.5-5 mm diam.; petals as long as or little longer than sepals *H. japonicum*
 Stems erect, branched from base or above middle; leaf margins flat or rolled downwards and inwards; flowers 2-12 mm diam.; petals shorter than to longer than sepals 11

FIG. 5: Drawings showing sepal character: a. margins entire, black glands absent, *H. perforatum*: b. margins irregularly toothed, black glands absent, *H. humifusum*: c. margins entire, with close-set fringe of black glands, *H. pulchrum*: d. margins toothed, each tooth with apical black gland, *H. montanum*.

11. Stems stiff, from a wiry, woody stock, branching from base, unbranched above; leafy margins rolled downwards and inwards; flowers 8-12 mm diam.; plant of drier places, espec. modified tussock grassland *H. gramineum*
 Stems not from woody stock; branched only above the middle; leaf margins $\pm$ flat; flowers 2-4 mm diam.; plant of swampy places *H. mutilum*
12. Stems 2-lined; margins of sepals entire or few-toothed, black glands absent or few and scattered 13
 Stems round, raised lines absent; sepal margins entire or toothed, evenly fringed with black glands (if black glands few, stems prostrate to ascending) 15
13. Black glands absent from leaves, sepals, and petals; flowers 1.5-2 cm diam.; petals about as long as sepals; fruit succulent, berry-like, black at maturity *H. androsaemum*
 Black glands present on leaves and petals, often on sepals; flowers 0.5-2 cm diam.; petals evidently longer than sepals; fruit dry, a dehiscent capsule 14
14. Stems prostrate to ascending, slender, to 20 cm; flowers 0.5-1 cm diam.; 1-5 at ends of stems; sepals unequal, 2 broad, 3 narrow, entire or toothed *H. humifusum*
 Stems erect, stout (basal barren shoots $\pm$ prostrate and slender), to 1 m tall; flowers 1.5-2 cm diam.; usually many in broad flat-topped heads; sepals $\pm$ equal, entire *H. perforatum*

15. Stems prostrate or ascending, slender, to 20 cm; flowers 0.5-1 cm diam.; sepals unequal, 2 broad, 3 narrow, marginal black glands few or absent *H. humifusum*
- Stems erect, stout or slender, to 1 m tall; flowers 1-1.5 cm diam.; sepals $\pm$ equal, margins entire or toothed, with evenly spaced black glands 16
16. Leaves 2-3-(5) cm long, underside with very short hairs; sepals sharply toothed, each tooth with black gland at apex *H. montanum*
- Leaves 0.5-2 cm long, underside hairless; sepals entire, with close-set, small marginal black glands in upper half *H. pulchrum*

DESCRIPTION OF SPECIES, DISTRIBUTION, ETC.

1. *HYPERICUM ANDROSAEMUM* L. (TUTSAN)

Shrub or sub-shrub, 1.5 m tall; *branches* with 2 raised lines; *leaves* 3-10 cm long, ovate, with minute pellucid glands, black glands absent; *flowers* (1.5)-2.5 cm diam., smallest of the shrubby species, in 2-8-flowered groups; *sepals* unequal; *petals* about as long as sepals; *styles* 3; *fruit* succulent, berry-like, globose, $\pm$ 1 cm diam., red, turning purple-black at maturity.

The relatively small flowers with petals about as long as sepals, 2-lined stems, and berry-like fruit distinguish this from the other three shrubby species.

Initially a garden escape, it is suspected toxic to livestock, and scheduled under the Noxious Weeds Act 1950. In some districts, it is still erroneously identified as "St. John's wort". The undersides of the leaves often show the orange pustules of the introduced rust, *Melampsora hypericorum* Wint.; this causes some premature defoliation, but exercises no significant control of the weed. Seeds are dispersed by birds.

A significant weed in higher rainfall districts in both islands; occurs as scattered shrubs, or forms dense shrubby communities about bush margins and in poorer reverting hill country, in damp gullies, waste places, etc. May occur alone, but more frequently with other adventive and indigenous shrubs and bracken in reversion growth. (Adventive: Europe, North Africa.)

2. *HYPERICUM CALYGINUM* L. (ROSE OF SHARON)

Low-growing sub-shrub, to 80 cm, with stout wiry reddish rhizomes, colony-forming; *stems* erect, unbranched, bluntly 4-angled; *leaves* 3-10 cm long, oblong to ovate, with small pellucid glands, black glands absent; *flowers* yellow, 7-9 cm diam., solitary or 2-3 together, terminal; *petals* much longer than sepals; *styles* 5; *capsule* $\pm$ 2 cm long.

Differs from the other shrubby species by the rhizomes and 4-angled stems, and from the herbaceous species by the stout rhizomes, absence of black glands on leaves, sepals, and petals and the very large flowers.

A troublesome persistent horticultural escape in older cemeteries, especially in eastern South Island districts the stout rhizomes penetrating and breaking up masonry. Now being planted as a ground cover on banks and other hard-to-clothe habitats, including highway median strips and traffic islands. Forms dense low communities which resist invasion by adventives and indigenes alike.

Occurs in waste places, on roadsides, old homestead sites, rarely in pasture, in localities through both islands. (Adventive: S.E. Europe.)

3. *HYPERICUM GRAMINEUM* Forst.f. (*HYPERICUM GRAMINEUM*)

Erect wiry perennial, to 25 cm tall, from woody stock; *stems* unbranched or branched only from base, 4-angled; *leaves* in distant pairs, 6-18 mm long, ovate to lanceolate or oblong, pellucid glands many, black glands absent; *flowers* golden-yellow, 6-12 mm diam., solitary or several, terminal; *petals* longer than sepals, without black glands; *sepals* without black glands; *capsule* to 7 mm long.

Could be confused with stunted H. perforatum which differs in the 2-lined stems, wiry rhizomes or stolons, and black glands on leaves and sepals; with H. japonicum, which differs in the prostrate, 4-angled stems, leaf pairs close-set, and leaf margins flat or undulate; with H. mutilum which has flat leaves, stems branched only above the middle, petals shorter than sepals; and with more erect forms of H. humifusum, which differ in the stems round or 2-lined, and leaves flat, with black glands on the underside.

Has been suspected of causing a photosensitivity condition in sheep in Canterbury and Otago, but field observations have not confirmed this.

Occurs in both islands in induced *Notodanthonia* grassland, in reverting grassland in hill country, and modified tussock grassland, most frequent in modified tussock grassland in the South Island. (Indigenous: also in Australia, Tasmania, and New Caledonia.)

4. *HYPERICUM HOOKERANUM* Wight et Arn. (*HOOKEER'S HYPERICUM*)

Erect bushy shrub, to 3.5 m tall; *branches* round, reddish; *leaves* 3.5-10 cm long, ovate to oblong, with very small pellucid glands, black glands absent; *flowers* yellow, to 7.5 cm diam., in 5-7-flowered lateral and terminal groups; *sepals* without black glands; *styles* 5, long.

Differs from the other large-leaved shrubby species by the taller habit and branches round, without lines.

The plant wild in New Zealand is the true *H. hookerianum*, used as an ornamental many years ago. Commonly seen in New Zealand gardens now, but not yet found in the adventive state, is the very similar *H. hookerianum* cv. 'Rowallane' (= *H. leschenaultii* × *hookerianum* cv. 'Rogersii'); it differs in the narrower, clawed sepals, sometimes with minute apical point (sepals always rounded in the typical form of *H. hookerianum*).

A garden escape of waste places, roadsides, about bush margins, in secondary growth, and in fern and scrub, localities between Westport and Ross. (Adventive: Himalaya region.)

5. *HYPERICUM HUMIFUSUM* L. (*TRAILING ST. JOHN'S WORT*)

Prostrate to ascending perennial, ± mat-forming, root often stout and woody; *stems* to 30 cm long, slender, 2-lined or round, becoming erect towards tips; *leaves* variable, pairs close-set, 4-12.5 mm long; ± rotund to elliptic, occas. short-stalked, upper with, lower usually without pellucid glands, scattered black glands near margins; *flowers* yellow, 5-10 mm diam., in few-flowered terminal heads; *sepals* very unequal, 2 broad, 3 narrow, margins entire, or with irregular teeth, black glands present or absent; *petals* as long as to longer than sepals, often with black glands in upper half; *capsule* 6-10 mm long.

Liabile to be confused with H. gramineum and H. japonicum, which differ in the stems 4-angled and leaves without black glands, and with stunted H. perforatum, which differs in the stouter, $\pm$ erect stems and $\pm$ equal, narrow, entire sepals.

Widely distributed through both islands, more frequent in some North Island localities, absent or very scarce in some South Island districts; tolerant of a wide range of soil and climatic conditions, it occurs on dry stony roadsides, poorer grassland, manuka scrub, modified tussock grassland, and in wet, acid, clay soils on flats or shady aspect hill country. (Adventive: Western and Central Europe.)

6. *HYPERICUM INODORUM* Mill. (= *H. elatum* Ait.)

Bushy shrub, to 2 m tall; branches 2-lined; leaves 3-8 cm long, ovate to oblong, with minute pellucid glands, black glands absent; flowers 2.5-3 cm diam.; sepals without black glands; petals longer than sepals; styles 3, very long; capsules to 1 cm long.

Might be confused with H. androsaemum which also has 2-lined stems, but which differs in the petals about as long as sepals, and fruit succulent and berry-like.

A garden escape established, and known only from wasteland, Kaingaroa, near Kaitia. (Adventive: Madeira.)

7. *HYPERICUM JAPONICUM* Thunb. (SWAMP HYPERICUM)

Delicate, slender, prostrate, patch-forming perennial; stems very slender, often brownish- or reddish-purple, 4-angled, rooting below, ascending towards tips; leaves often very small, 2-8 (10) mm long, green to purplish-brown ovate to oblong, with pellucid glands, black glands absent, margin flat or undulate (crisp), leaf-pairs close-set; flowers orange-yellow, to 2-6 mm diam., solitary or several; sepals without black glands; petals as long as or slightly longer than sepals, without black glands; capsule to 2.5 mm long.

Recognized by the weak, prostrate stems and small, orange-yellow flowers, H. japonicum is confused with H. gramineum which differs in the erect stems, leaves in distant pairs with edges rolled downwards, and with H. humifusum which has tougher, 2-lined or round stems, and leaves with black glands.

Very delicate, mat-forming plants with minute leaves 2-3 mm long $\times$ 0.5-1 mm broad occurs in some localities, and are currently placed with this species; these may belong to *H. pusillum* Choisy, an imperfectly known species described early last century.

This widely distributed species has been long suggested as responsible for the photosensitivity condition—facial dermatitis or swamp disease—in parts of Otago and Canterbury, but field investigations in the last decade do not confirm this view. The stems and leaves are sometimes heavily infested and distorted with the orange-yellow pustules of the native rust, *Uromyces waipoua* McNabb.

Widely occurring in damp situations throughout; with *Galium perpusillum*, *Mentha cunninghamii*, and *Pratia* spp., it forms communities marginally about swamps and tarns in some South Island tussock grassland areas. (Indigenous: also in Australia, Tasmania, and northwards to Japan.)

8. *HYPERICUM MONTANUM* L. (MOUNTAIN HYPERICUM)

Stout, erect perennial, from a woody base, to 1 m tall; stems stiffly erect, round, unbranched; *leaves* largest of the herbaceous species, 2-5 cm long, ovate to elliptic, very short hairy on underside (Fig. 3b), upper pairs distant, with few pellucid glands, black glands many and close-set; *flowers* pale yellow, 1-1.5 cm diam., few to many in compact terminal heads distant for uppermost leaf-pair; *sepals* narrow, margin sharply toothed, each tooth with apical black gland (Fig. 5d); *petals* to 12 mm long, with or without black glands; *capsule* to 8 mm long.

A distinct species, readily recognized by the stout, stiffly erect, round stems, distant leaf pairs, very short hairy leaf underside, and heavy, blackish aspect of the dense fruiting heads. Differs from all species treated in having hairs on the underside of the leaves, and sepals sharply toothed, with large black glands.

Established and spreading in bracken and scrub on high rainfall hill country (with *H. perforatum* and *H. pulchrum*), north bank of Wairau River, between Kaituna and Te Rou, Marlborough. Scheduled under the Noxious Weeds Act 1950. (Adventive: Europe to W. Asia, N. Africa.)

9. *HYPERICUM MUTILUM* L.

Slender, erect herb, to 40 cm, annual or perennial; *stems* 4-angled, simple, or branched above the middle; *leaves*, ovate to oblong, 5-20 mm long, with pellucid glands, black glands absent; *flowers* small, 2-4 mm diam., in few- to many-flowered heads; *sepals* without black glands; *petals* 1.5-2 mm long, shorter than sepals, black glands absent; *capsule* 2.5-4 mm long.

Readily distinguished from other species of wet places: H. humifusum differs in the 2-lined or round stems and leaves with black glands, H. japonicum in the prostrate stems and H. tetrapterum in the stout, 4-winged stems, leaves with black glands, and petals longer than sepals.

Recently found in swampy places in the North Cape district; a second specimen has been seen, reputedly from Tutira, Hawke's Bay, but the actual locality is doubtful. (Adventive: North America.)

10. *HYPERICUM PERFORATUM* L. (ST. JOHN'S WORT)

Erect perennial, to 1 m tall, from woody base, with slender rhizomes or stolons, and dark-green $\pm$ prostrate barren shoots in autumn and winter; *stems* woody below, often stout, 2-lined; *leaves* lanceolate to oblong or ovate, 1-2 cm long, with many pellucid glands and occasional black glands, leaves often rolled downwards and inwards in dry situation; *flowers* 1-2 cm diam., few to many in dense or open, $\pm$ flat-topped heads; *sepals* equal, narrow, entire, black glands occasional or absent, sometimes with pellucid or brownish linear streaks; *petals* with scattered black glands or black streaks; *capsule* 6-8 mm long.

Differs from luxuriant forms of H. gramineum in the 2-lined stems and black leaf glands, from H. humifusum in the equal entire sepals and larger flowers, from H. montanum by the 2-lined stems, and leaves hairless below, and from H. pulchrum in the larger, lighter green leaves, narrow sepals without marginal black glands, and petals not reddish-tinged.

In part originally a garden escape, in part from seed introduced as an impurity in pasture mixtures last century, this weed is established in

troublesome amount in grassland, especially in some South Island tussock grassland communities; it is scheduled under the Noxious Weeds Act 1950. In addition to competing with sward species, this plant contains a photo-dynamic substance, hypericin, which causes a photosensitivity condition in livestock; associated is a hypersensitivity effect on the central nervous system. Biological control measures have been initiated, two leaf-feeding beetles (*Chrysolina hyperici* Forst. and *C. quadrigemina* Suffr.) and a foliage gall-producing fly (*Zeuxidiplosis giardi* Kieff.) have been introduced and established in some South Island infestations. St. John's wort is still confused by some with ragwort (*Senecio jacobaea*) because of the similarity in growth habit and the yellow flowers.

Established in waste places, on roadsides, in sown grasslands, and widespread in modified tussock grassland in eastern South Island localities, often forming extensive communities. (Adventive: Europe, W. Asia, N. Africa.)

11. *HYPERICUM PULCHRUM* L. (SLENDER ST. JOHN'S WORT)

Erect slender perennial, to 90 cm tall, from woody crown; *stems* round, reddish; *leaves* broadly-ovate, 0.5-2 cm long, with pellucid glands, black glands absent; *flowers* 1-1.5 cm diam., yellow, with reddish-tinge (buds reddish), in few-flowered groups; *sepals* broadly rounded, margin in upper half fringed with small, close-set black glands (Fig. 5c); *petals* reddish-tinged, usually with some black glands; *capsule* to 8 mm long.

Most likely to be confused with H. perforatum which differs in the 2-lined stems, lighter green leaves, sepals narrow without fringing black glands, and petals not reddish-tinged.

Established locally in fern and secondary growth in reverting hill country grassland under higher rainfall conditions: Mt. Bruce, Ruamahanga River near Mauriceville; Speeds Valley, Koromiko, between Picton and Tua Marina; north bank of Wairau River, between Kaituna and Te Rou; Whale's Back, inland road between Waiau and Kaikoura. (Adventive: Europe.)

12. *HYPERICUM TETRAPTERUM* Fries (SQUARE-STEMMED *HYPERICUM*)

Stout, erect perennial, to 1 m tall, with slender stolons; *stems* 4-angled, angles winged, with scattered black glands; *leaves* 1-3.5 cm long, 5-9-nerved from base, ovate, with pellucid glands and scattered black glands; *flowers* pale yellow, 1-2 cm diam., in dense terminal clusters; *sepals* equal, often without black glands, or with a single gland near acute apex; *petals* without black glands, rarely a few near margin; *capsule* to 8 mm long.

Readily recognized by the distinct wings on the stem angles and black glands on the stems.

Local in swampy situation: Akatarawa, between Upper Hutt and Waikanae; Abbot's Creek, near Featherston; between Burwood and North Brighton, Christchurch. (Adventive: Europe, W. Asia, N. Africa.)

ACKNOWLEDGEMENTS

My thanks are expressed to Mrs Beverley McCulloch, Botany Division, DSIR, for the drawings in Figs. 1, 4-5, and the lettering in Figs. 1-5, C. J. Miles, Crop Research Division, D.S.I.R. for photographs in Figs. 2a, b, 3a, b and J. Somers Cocks for the photographs in Figs. 2c, 3e.

WEED CONTROL IN CEREALS

CHAIRMAN'S SUMMARY

G. W. MASON

Ivon Watkins-Dow Ltd., New Plymouth

An excellent example of the results of field trials carried out over four years was provided by F. C. Allen and T. J. Smallridge. Results were presented in detail for 7 trials out of the 16 which provided varying seasonal and site effects for evaluating new wild oat herbicides in comparison with the standard chemicals barban and tri-allate. Chlorfenprop-methyl appeared the most promising new post-emergence herbicide, but because 12 times the dosage of the standard barban was used, lower rates should be further evaluated. The intriguing possibility of combining control of both broad-leaf weeds and wild oats seems to have proved satisfactory only with chlorfenprop-methyl and mecoprop. Other combinations seemed to have reduced effectiveness on wild oats, which could become a more serious crop competitor with the removal of the broad-leaf weeds.

L. A. Scherp set out to determine whether application of tri-allate for wild oat control could be extended from its use in spring cereals, to autumn- and winter-sown wheat. With two yield trials he was satisfied that this practice can be recommended with a reasonable safety margin. Because conditions for thorough soil incorporation must be observed it often seems necessary to incorporate the tri-allate well ahead of wheat sowing. A fine, free-flowing soil must be available to use effectively the recommended weighted harrows with levelling bar.

Some interesting new data presented by F. A. Meeklah *et al.* indicated that early broad-leaf weed control in wheat using one of the mixed contact-residual herbicides plus mecoprop appears to induce additional cereal tillering. In the paper an imposing array of herbicide mixtures were applied on spring-sown wheat at two sites. Unfortunately, only one site finally carried a challenging weed population which the Otago/Southland wheat grower normally must control. Trial site selection should have also included one or more of the more difficult-to-control weeds such as wire-weed, cornbind, fumitory, cleavers and possibly mayweeds.

Divergent opinions were expressed during the discussion on the ideal time of application of cereal herbicides. For the Otago/Southland grower, Californian thistle demands either a second herbicide application following the two-leaf stage treatment, or a combination treatment at full tillering at the more susceptible rosette stage of the thistles. The possibility of farmers wishing to apply systemic fungicides with their herbicide treatment at full tillering suggests the herbicidal effectiveness and safety of this practical compromise should be investigated.

A preliminary evaluation was presented by S. Rae of two new herbicides, chlortoluron and bromofenoxim, for weed control in wheat and barley. Bromofenoxim is a contact non-residual type herbicide with promising *Polygonum* control potential. Chlortoluron is a urea type herbicide used in Europe for annual grass weeds but promising in New Zealand for spurrey and possibly fumitory control. It is unfortunate that 8 well replicated trials did not produce quantitative data for more complete evaluation of these herbicides. Tank mixture combinations with phenoxy herbicides of these compounds are likely to be required for adequate broad-spectrum weed control to include perennial resprouting species such as Californian thistle.