The *Nassella* workshop

Proceedings of a joint program between The Weed Science Society of Victoria and the St. Albans Campus of the Victoria University.
Sponsors: The Weed Science Society of Victoria Inc., Department of Natural Resources and Environment, CRC for Weeds Management Systems and NSW Agriculture.
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Identification of South American tussock weeds

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Introduction

Of the 400-odd species of grass in Victoria, 180 are introduced (Ross 1996). By far the greatest majority of these are from Mediterranean countries and the Cape region of South Africa. This is due to the similarity of climates and soils to those found in Victoria, and that these areas were the principal source of agricultural crops and settlers in this State. The proportions of exotic versus native species of grass are similar for other States, but the exact figures are difficult to ascertain.

Only 17 species of naturalized grass in Victoria originate from South America (Walsh 1994). Of these, several species, although weedy, are currently of little consequence to bushland or cropland (e.g. perennial species of *Bromus, Panicum racemosum*, *Paspalum quadrifarium*, *P. urvillei*). Other species (e.g. buffalo grass, *Stenotaphrum secundatum*) are generally regarded as useful and rarely escape into bushland, leaving a few species that are regarded as seriously invasive of natural or created plant communities. These are species of *Paspalum* (common paspalum, *P. dilatatum* and water couch, *P. distichum*) the pampas grasses (*Cortaderia jubata* and *C. selloana*), the tussock-forming species of *Nassella* (*N. charruana, N. hyalina, N. leucotricha, N. neesiana* and *N. trichotoma*), *Achnatherum caudatum* (formerly *Stipa caudata*), and to a lesser degree *Piptochaetium montevidense.*

Interestingly, it is only in the past few decades that *Cortaderia,* like *Nassella* and *Achnatherum,* has been identified as having a strongly weedy tendency, with an apparently rapid extension of range in the past few years.

Identification

The apparent recent spread of some of the South American tussock weeds may be partly false, they may have been overlooked and confused with related native species of the widespread and locally common genus *Austrostipa* (formerly *Stipa*), the spear-grasses. Not only do *Nassella* species, *Achnatherum,* and to a lesser extent (at least in Australia) *Piptochaetium* and *Jarava* resemble *Austrostipa* physically, but their similar ecological requirements makes identification (and management) problematical.

The transferral of species formerly included in *Stipa* to *Nassella, Achnatherum, Jarava* and *Austrostipa* results from recent research, and to some extent is controversial. Future research may result in the reassignation of some species to their old genera, or to some currently unrecognized, new genera. Some species currently included in the same genus resemble more strongly (at least superficially) members of other genera (e.g. *Piptochaetium montevidense* and *Nassella trichotoma*). Consequently, for the purposes of simple field recognition, it is recommended that the species are identified individually, rather than being identified hierarchically (i.e. identifying first to genus and then to species).

The key to species identification (Table 1) has been cast in this manner, but a separate key to genera (Table 2) is also provided.

The stipoid grasses (those belonging to the tribe Stipeae) are very distinctive within the grass family Poaceae. *Nassella, Achnatherum, Piptochaetium, Jarava* and *Austrostipa* all belong to the Stipeae whose distinctive characters are outlined below.

Vegetative characters

Generally the plants are strongly tussock forming perennials (except amongst the native species, i.e. *Austrostipa*). Leaves are usually narrow, often inrolled, with a short, firmly membranous and sometimes fringed, ligule (the short collar on the inner or upper surface of the leaf at the blade / sheath junction) (Figures 1, 2 and 3).

Identification to species of stipoid grasses relying solely on vegetative characters, however, is unfortunately unreliable. Although within a local area, a keen observer will be able to distinguish several species, there are currently no simple vegetative means of identification that can be universally applied without examination of ultrastructural characteristics such as epidermal morphology, distribution of silica bodies and stomatal distribution.

Floral characters

The inflorescence (the flowering parts collectively) is a panicle borne on an unbranched (or very rarely branched near the base) culm (flowering stem). The individual spikelets comprise two, often purplish, glumes (papery bracts), usually larger than and enclosing a single floret (the majority of grasses have several florets per spikelet, Figure 1). Each floret consists of a hardened lemma and a palea (together, the lemma and palea form the 'husk' of the seed), and at the tip of the

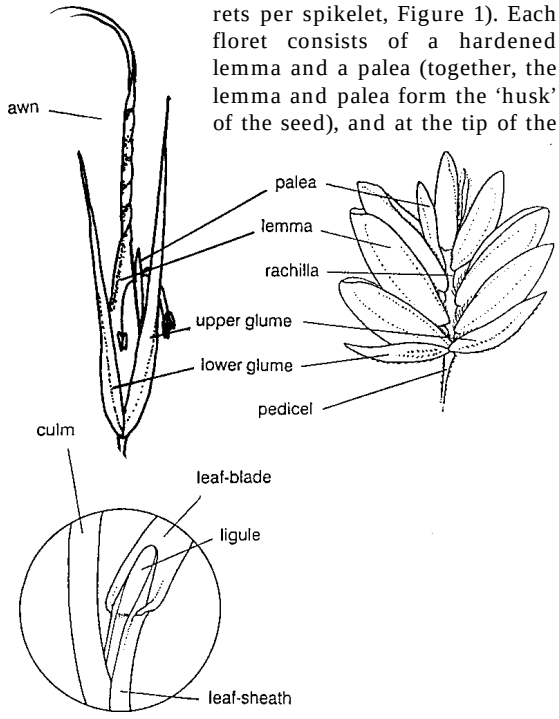

Figure 1. Above: characteristics of a stipoid spikelet (upper left) and a more typical grass spikelet, e.g. a member of the genus *Poa* (upper right). Below: generalized vegetative features of diagnostic value.

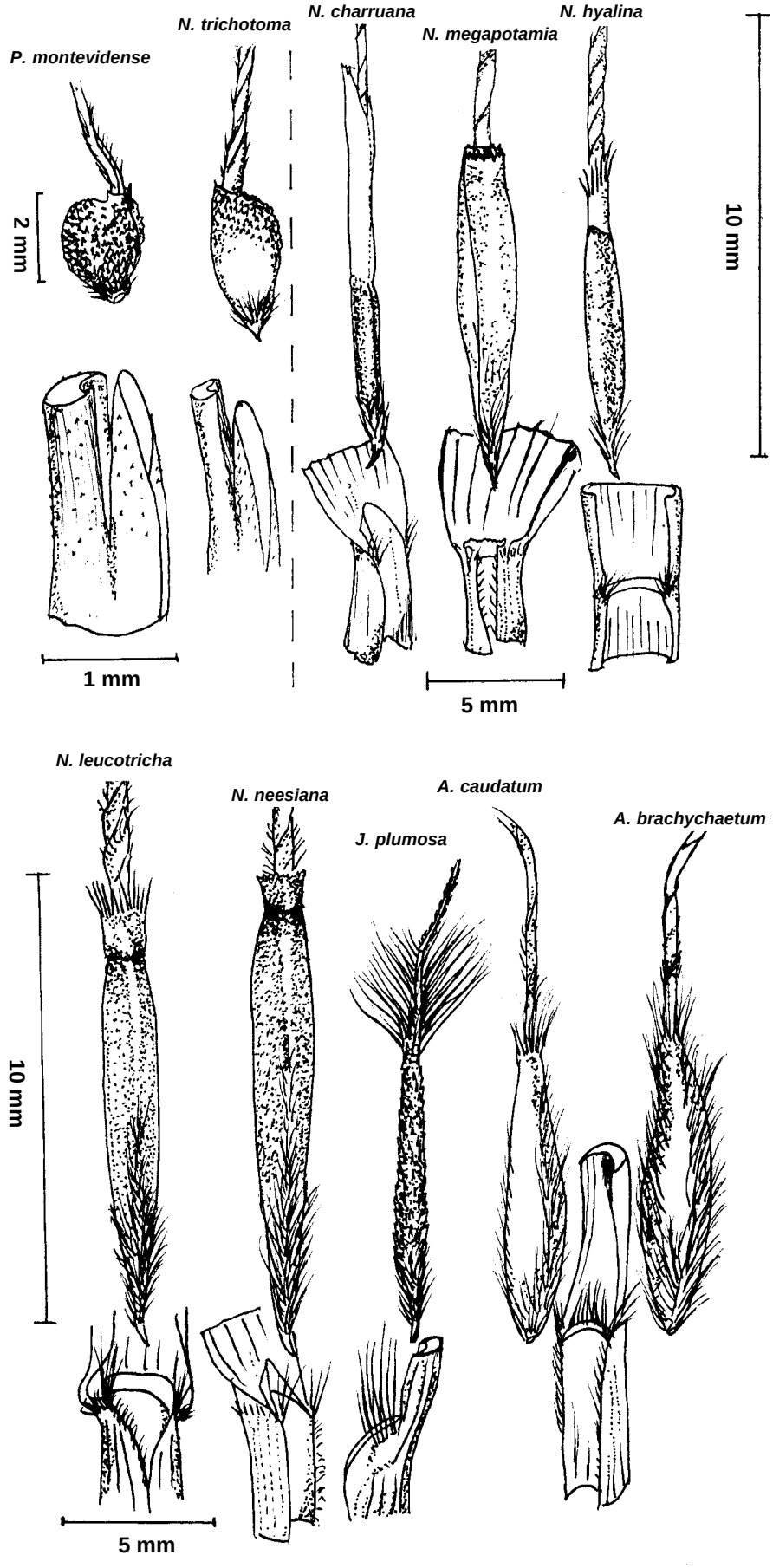

Figure 2. Florets and ligules of South American tussock-grasses naturalized in Australia.

lemma is an awn (bristle) usually considerably longer than the lemma itself (Figure 1).

If a suspect grass combines these vegetative and floral characteristics, it is almost certainly a member of the Stipeae. The dichotomous key (Table 1) should allow ready identification of a specimen collected within Australia. Each couplet of like-numbered alternatives leads to either a species name or another couplet. Follow the lead within each couplet that best describes the unknown specimen until a name (hopefully the correct one) is reached.

General observations

It is a characteristic of newly invading species, not only grasses, that in the absence of predators or disease populations expand rapidly, to the virtual or complete

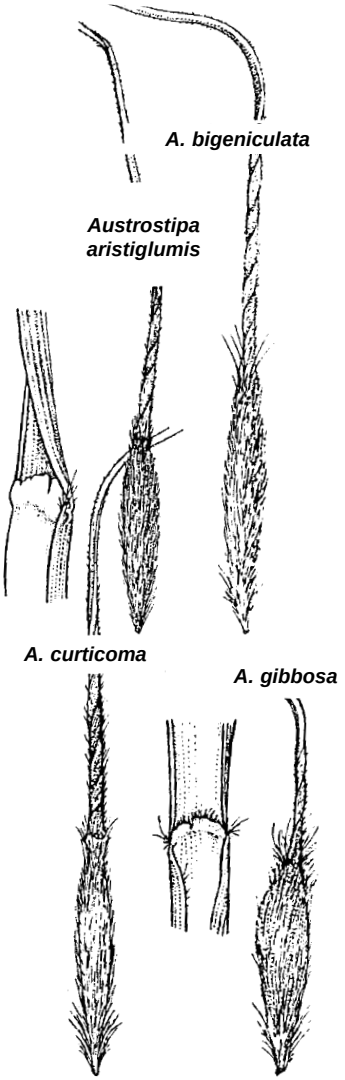

Figure 3. Florets and ligules of four native *Austrostipa* species (for comparison with Figure 2). Note absence of collar of tissue surrounding awn-base (present in most naturalized species of *Nassella*).

exclusion of species or communities formerly occupying the site. This characteristic has been recorded recently for most of the South American tussock-grasses naturalized in Victoria. Native species, usually in balance with other species in the plant community(ies) in which they occur, rarely entirely dominate. Some exceptions exist, such as those species occurring in extreme or particularly unusual environments, e.g. coastal dunes and cliffs, watercourses, saltmarsh, heavily shaded sites, or in areas which have recently been disturbed, or conversely have been unburnt for unusually long periods.

Table 1. Key to South American species of stipoid grasses in Australia (adapted from Walsh 1994).

1.	Lemma short (1.5–3 mm long) and relatively broad (no more than 4 times longer than wide); glumes 4–7.5 mm long 2
1	Lemma at least 4 mm long, relatively slender (at least 5 times longer than wide); glumes at least 6 mm long; glumes longer than 6 mm 3
2.	Lemma almost as wide as long; awn about 1 cm long, readily detached from lemma at maturity; Melbourne suburbs, Victoria ..... ***Piptochaetium montevidense***
2.	Lemma more than twice as long as wide; awn 25–35 mm long, remaining firmly affixed to lemma at maturity; New South Wales, Victoria, Tasmania ..... ***Nassella trichotoma*** (serrated tussock)
3.	Lemma with a collar of firm tissue surrounding the base of the awn, the collar often crowned by a ring of spines or coarse bristles 4
3.	Lemma without a collar, lacking a ring of spines or bristles, but sometimes a ring or tuft of hairs present 8
4.	Collar of lemma about as long as or longer than main body of lemma (i.e. that part enclosing the seed), lacking crowning spines or bristles; Melbourne suburbs, Victoria ..... ***Nassella charruana***
4.	Collar of lemma much shorter than main body of lemma, crowned by a ring of short spines or bristles 5
5.	Lemma 3.5–5 mm long (not including awn), the hairy, spine-like base (callus) less than 1 mm long; New South Wales, Victoria ..... ***Nassella hyalina***
5.	Lemma longer than 5.5 mm (not including awn), the callus longer than 1 mm 6
6.	Glumes 8–10 mm long; spines of lemma collar minute (c. 0.1 mm long); Canberra area, Australian Capital Territory ..... ***Nassella megapotamia***
6.	Glumes 11–20 mm long; spines or bristles of lemma collar conspicuous 7
7.	Summit of collar with erect bristles 0.6–1.5 mm long at maturity; glumes 11–15 mm long; awns 35–60 mm long; inflorescence usually much taller than leaves; Victoria ..... ***Nassella leucotricha*** (Texas needle-grass)
7.	Summit of collar with slightly spreading spines to 0.5 mm long at maturity; glumes 16–25 mm long; awns 60–90 mm long; inflorescence usually about the same height as leaves; South Australia, New South Wales, Victoria ..... ***Nassella neesiana*** (Chilean needle-grass)
8.	Apical 1.5–2 mm of lemma with copious spreading hairs 4–8 mm long (almost as long as lemma itself); lemma usually longer than glumes; Adelaide area, South Australia ..... ***Jarava plumosa***
8.	Awn lacking longer apical hairs, or if these sometimes present, attached at very apex (not over apical 1.5–2 mm) and much shorter than lemma; lemma shorter than glumes 9
9.	Awn longer than 20 mm; lemma with sharp-pointed basal callus; cleistogenes not produced; all States ..... ***Austrostipa*** (native spear-grasses)
9.	Awn less than 20 mm long; lemma without a prominently pointed basal callus; modified seeds (cleistogenes) often produced at base of culms, covered by leaf-sheaths 10
10.	Lemma hairy over most of the body (sometimes with a 'bald' area either side of the dorsal nerve); New South Wales, Tasmania ..... ***Achnatherum brachychaetum***
10.	Lemma hairy along dorsal nerve and toward margins, glabrous from base to apex between these lines; New South Wales, Victoria, Tasmania ..... ***Achnatherum caudatum***

Table 2. Key to genera of South American and native stipoid grasses in Australia (from Jacobs and Everett 1996).

1.	Palea longer than lemma, with a distinctly central, longitudinal groove; awn readily detaching from lemma at maturity ..... ***Piptochaetium***
1.	Palea shorter than lemma, rarely longitudinally grooved; awn not readily detaching from lemma at maturity 2
2.	Apical 1.5–2 mm of lemma with copious spreading hairs 4–8 mm long (almost as long as lemma itself); palea less than half as long as lemma ..... ***Jarava***
2.	Awn lacking longer apical hairs, or if these sometimes present, attached at very apex (not over apical 1.5–2 mm), shorter than lemma, and palea almost as long as lemma 3
3.	Palea less than 30% as long as lemma; lemma very tough, usually hard and roughened at maturity; main cells of lemma epidermis shorter than wide ..... ***Nassella***
3.	Palea generally more than 30% as long as lemma; lemma membranous to tough, smooth or roughened at maturity; main cells of lemma epidermis generally much longer than wide 4
4.	Palea membranous to papery; awn less than 20 mm long; lemma without a prominently pointed basal callus ..... ***Achnatherum***
4.	Palea firm to hard; awn longer than 20 mm; lemma with sharp-pointed basal callus ..... ***Austrostipa***

For identification of species of *Austrostipa* in Victoria or Australia (as species of *Stipa*), see Walsh (1994) and Vickery *et al.* (1986) respectively.

But through the greater part of Victoria these conditions do not apply, and dense growths of plants formerly unknown or uncommon in an area are cause for concern.

While there are several introduced grass species that form extensive single-species swards, most of these are rhizomatous, such as *Pennisetum clandestinum* (kikuyu) and *Cynodon dactylon* (couch), or annuals such as *Briza* species (blowfly grasses), *Vulpia* species (squirrel-tail fescues or silver grasses), *Avena* species (oat-grasses) and *Schismus barbatus* (Arabian grass).

Tussock-forming perennials that occur in dense, uniform stands, readily displacing the 'resident' species or communities, include *Phalaris aquatica* (canary grass) and *Lophopyrum elongatum* (tall wheatgrass). Both of these deep-rooted species have been extensively grown in areas prone to salination. They are both now proving to be a severe threat to native grassland communities. Both have flattish leaf-blades, the former to 20 mm wide, the latter to approximately 6 mm wide. Both are readily distinguished from stipoid grasses by the absence of awns on the lemmas, and by the narrow, more or less cylindrical inflorescences.

Should Table 1 not provide a satisfactory identification of a grass believed to be a member of the Stipeae, or if other grasses, unknown to local agriculture officers, are proving cause for concern, a flowering or seeding specimen should be forwarded to an appropriate agency for expert identification (usually the State Herbarium, situated in each of the Australian capital cities). The specimen may represent the first wave of the invasion of a potentially troublesome or devastating weed and its early detection and eradication could save untold expense and hours of labour.

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The distribution and impact of South/North American stipoid grasses (Poaceae: Stipeae) in Australia

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Abstract

The current and potential distribution of ten introduced South/North American stipoid grass weeds is documented. The known ecology and the impacts on agriculture and the indigenous vegetation are presented. *Nassella trichotoma* has significant impacts on both agriculture and the environment. *N. neesiana* is among the most serious environmental weeds of grassland and grassy-woodland communities in southeast Australia. *N. leucotricha* and especially *N. hyalina* are serious environmental weeds of grassland communities, particularly on the Victorian Volcanic Plains. *Achnatherum caudatum* and *A. brachychaetum* have the potential to become very serious agricultural and environmental weeds, as they possess abundant cleistogenes that promote dispersal and survival under cultivation. *A. brachychaetum* remains poorly known due to its similarity and confusion with *A. caudatum*. *N. charruana* poses a significant weed threat due to its invasiveness and unpalatibilty. *N. megapotamia* and *Piptochaetium montevidense* are poorly known species with little to no information available on their ecology and weed status in Australia. Attempts to eradicate *Jarava plumosa* in South Australia have proved difficult. Ten recommendations are made.

Introduction

Many potential weeds are regarded as 'sleepers' whose populations may slowly increase (lag phase) but not be noticed for many years, before they increase dramatically making eradication almost impossible. Groves (1986) divided this weed invasion process into three phases. An introduction phase (the process of invading a previously unoccupied region), a colonization phase (the process of being able to survive and reproduce, producing a self-perpetuating population) and a naturalization phase (the weed disperses widely and creates further self-perpetuating populations which become incorporated into the resident flora). The introduction of several South and North American stipoid species into Australia has raised concerns about the impacts these grasses could have on both agriculture and the environment.

The Stipeae (Family: Poaceae) is a cosmopolitan tribe of approximately 450 species in 14 genera (Barkworth 1993, Reyna and Barkworth 1994, Jacobs and Everett 1996). Including the indigenous genus *Austrostipa*, there are six stipoid genera in Australia, five of which are of exotic origin. These are *Achnatherum*, *Jarava*, *Nassella*, *Piptochaetium* and *Piptatherum*. *Achnatherum* is the largest and most widespread genus. It occurs in Africa, Eurasia, New Zealand and North and South America (Barkworth 1993) but is primarily of Eurasian / North American origin. *Jarava*, a recently resurrected genus (Jacobs and Everett 1997), is endemic to South American. *Nassella* is essentially from South America while *Piptochaetium* is from both North and (mainly) South American. *Piptatherum* is (mainly) Eurasian but is also represented in North America and is represented by only one species in Australia, *P. miliaceum* (L.) Coss. As this species appears to be confined to urban settlements (Walsh and Entwisle 1994) it will not be considered. Species of the other genera are cause for serious alarm from both an environmental and agricultural perspective.

In Australia 11 species of exotic stipoid species are naturalized. They are: *Achnatherum brachychaetum* (Godron) Barkworth, *A. caudatum* (Trin.) S.W.L. Jacobs & J. Everett, *Jarava plumosa* (Sprengel) S.W.L. Jacobs & J. Everett, *Nassella charruana* (Arech.) Barkworth, *N. hyalina* (Nees) Barkworth, *N. leucotricha* (Trin. & Rupr.) Pohl., *N. megapotamia* (Spreng. ex Trin.) Barkworth, *N. neesiana* (Trin. & Rupr.) Barkworth, *N. trichotoma* (Nees) Hack. ex Arechav., *Piptatherum miliaceum* and *Piptochaetium montevidense* (Spreng.) Parodi. Due to the resemblance of these South / North American stipoid species with indigenous *Austrostipa* species, they can be easily overlooked as weeds, increasing their likelihood of successful naturalization.

The ability of a weed to invade, reproduce and increase is largely dependent upon habitat and its adaptive characteristics (i.e. dispersal adaptations, seed production etc.). Habitat has been defined as