

Register of Australian Herbage Plant Cultivars

A. Grasses

3. Phalaris

(a) *Phalaris aquatica* L. (phalaris) cv. Holdfast

Reg. No. A-3a-8

Registered 19 March 1991

Originators: R. N. Oram and H. E. Schroeder

CSIRO Division of Plant Industry, GPO Box 1600, Canberra, A.C.T. 2601, Australia.

Registrar: R. N. Oram

Released by Head Licensee, South Australian Seedgrowers Cooperative Ltd, GPO Box 461, Adelaide, S.A. 5001, Australia.

Australian Journal of Experimental Agriculture, 1992, 32, 261–2.

Origin

Holdfast was developed by making crosses in 1972 between plants of PX 18, a progenitor 3 generations removed from Sirolan, and the original seed-retaining plant within cv. Australian from which Uneta was later developed. Four F₂ partial retainers were backcrossed to the original seed-retaining plant. BC₁ retainers were selected for fast winter growth and low concentrations of dimethyltryptamine alkaloids. These selected plants were outcrossed to Sirosa and Sirolan plants. The F₁ was backcrossed to the BC₁ retainers, and improved retainers were selected from the backcross progeny. This process of outcrossing and backcrossing was repeated for a third time, using 15 diverse Mediterranean accessions as outcross parents. Fifty-nine vigorous, low-tryptamine backcross plants were selected and polycrossed. The half-sib progenies were evaluated as replicated swards at Canberra and at the Agricultural Research and Extension Station, Temora, over 3 years (Oram and Schroeder 1984, 1987). Spaced plants were evaluated at Canberra for seed production and retention; 200 plants were selected from the families with the highest productivity and persistence in swards. Two offsets of each of these 200 plants were grown in a nutrient solution containing 10 mg Al/L at pH 4.1. The 53 plants with the best root growth were selected and polycrossed to give a breeding population designated BP 83.

The half-sib families in BP 83 were again tested in swards at Canberra and Temora for 3 years, and plants were selected from the best families on seed production traits from the Canberra spaced plant trial. The open, pollinated seed of the best 15 families in a spaced plant trial were bulked and tested as BP 87. Screening for root growth in a nutrient solution containing 10 mg Al/L gave 45 genotypes that produce Holdfast when interpollinated. Some agronomic testing of Holdfast was done under the code number BP 88.

An application for Plant Variety Rights has been accepted (Anon. 1990), and rights have been granted. CSIRO Division of Plant Industry will maintain pre-breeders' seed. Breeders',

basic, and certified seed will be produced by growers under contract to the Head Licensee.

Recommended for registration in the Standing Committee on Agriculture Scheme by the New South Wales Herbage Plant Liaison Committee.

Morphological description

Holdfast is like Sirosa in having large seedlings; thick, semi-erect tillers with long, broad leaves; and tall flowering culms (Anon. 1990). Seed is retained in the panicle because the rachilla is thickened and the callus of the lowermost sterile floret is displaced downwards. Most seeds have a gap, discernible at 15x magnification, between the inner edges of the calluses of the sterile florets. The upper sterile lemma is usually one-quarter to one-third of the length of the fertile lemma, but sometimes two-thirds as long, and broad and chaffy. The fourth floret, normally vestigial, rarely becomes fertile in Holdfast, with a small caryopsis.

Outer glumes of 48% of Holdfast plants are hairy. The root tips of 38% of Holdfast seedlings are red, the intensity varying from very faint to highly pigmented.

Agronomic characters

Holdfast is similar agronomically to Sirosa, although slightly less vigorous as a seedling (Anon. 1990) and during winter in older stands. Holdfast has a low level of summer dormancy, similar to the levels in Australian, Sirosa, and Sirolan, but much lower than in Sirocco.

Seed yields are considerably higher than those of Sirosa. At Naracoorte, BP 87 produced 50 and 90% more seed than Sirosa in the first and second years, respectively (S. Martyn pers. comm.). The extent of seed retention varies more between plants of Holdfast than Uneta, which has the same major genes for seed retention. Some Holdfast plants shed seeds readily, but others are difficult to thresh. Seed crops can be left to mature fully before a once-over harvesting operation (i.e. 2–3 weeks later than Sirosa), but multiple threshing may be required to extract tightly held seed.

Holdfast is slightly more tolerant of soil acidity than other cultivars. In a grazing experiment near Canberra, Holdfast yielded more than Sirosa on a limed acid soil containing 1–20 mg Al/kg in the subsoil. Sirosa is known to be more tolerant than earlier cultivars to aluminium toxicity in nutrient solutions (Culvenor *et al.* 1986); all cultivars are tolerant to manganese toxicity (Culvenor 1985). The yields of both Holdfast and Sirosa in quadrats were negatively correlated with subsoil exchangeable aluminium concentrations, and positively correlated with Bray phosphorus concentrations in the topsoil and subsoil (R. N. Oram, A. Pinkerton, T. R. James and J. P. Edlington unpublished data). On this soil, Holdfast herbage contained 17% more magnesium and had an 8% lower

potassium/(calcium + magnesium) ratio than Sirosa. Therefore, cattle grazing Holdfast under such conditions should be less susceptible to grass tetany (hypomagnesaemia) than those grazing Sirosa.

The role of the dimethyltryptamine alkaloids in causing 'phalaris staggers' and/or 'sudden death' is not completely understood (Culvenor 1987; Bourke *et al.* 1990). Nevertheless, the concentrations of extractable dimethyltryptamines were measured in the expanding leaves and the uppermost fully expanded leaves of spaced plants in winter. Holdfast had as low a concentration as Sirolan (0.4–0.5 mg/100 g fresh weight), whereas, Sirosa contained 2.9 mg, and the slow winter-growing group (Australian, Seedmaster, and Uneta) averaged 9.2 mg/100 g fresh weight.

Acknowledgment

We are grateful to the Wool Research and Development Council for funding the latter stages of the development and testing of Holdfast phalaris.

References

- Anon. (1990). Phalaris (*Phalaris aquatica* L.) variety 'Holdfast'. *Plant Varieties Journal, Australia* **3**, 12–13.
- Bourke, C. A., Carrigan, M. J., and Dixon, R. J. (1990). The pathogenesis of the nervous syndrome of *Phalaris aquatica* toxicity in sheep. *Australian Veterinary Journal* **67**, 356–8.
- Culvenor, C. C. J. (1987). Detrimental factors in pastures and forage. In 'Temperate Pastures: their Production, Use and Management.' (Eds J. L. Wheeler, C. J. Pearson and G. E. Robards.) pp. 435–45. (Australian Wool Corporation/CSIRO Australia: Melbourne.)
- Culvenor, R. A. (1985). Tolerance of *Phalaris aquatica* L. populations and some other agricultural species to excess manganese, and the effect of aluminium on manganese tolerance in *P. aquatica*. *Australian Journal of Agricultural Research* **36**, 695–708.
- Culvenor, R. A., Oram, R. N., and Fazekas de St Groth, C. (1986). Variation in tolerance in *Phalaris aquatica* L. and a related species to aluminium in nutrient solution and soil. *Australian Journal of Agricultural Research* **37**, 383–95.
- McWilliam, J. R., and Gibbons, C. N. (1981). Selection for seed retention in *Phalaris aquatica* L. In 'Proceedings XIV International Grasslands Congress.' Lexington, KY, U.S.A., 15–24 June 1981. (Eds J. A. Smith and V. W. Hays.) pp. 269–72. (Westview Pr.: Boulder, CO, U.S.A.)
- Oram, R. N., and Schroeder, H. E. (1984). Breeding for improved seed quality through seed retention in two *Phalaris* species. In 'Proceedings Australian Seeds Research Conference.' Lawes, Qld, September 10–13. pp. 188–91. (Queensland Department of Primary Industries: Brisbane.)
- Oram, R. N., and Schroeder, H. E. (1987). Breeding *Phalaris aquatica* L. for improved productivity, adaptation and utility for ruminants. In 'Temperate Pastures: their Production, Use and Management.' (Eds J. L. Wheeler, C. J. Pearson and G. E. Robards.) pp. 309–11. (Australian Wool Corporation/CSIRO Australia: Melbourne.)
- Sleper, D. A. (1979). Plant breeding, selection, and species in relation to grass tetany. In 'Grass Tetany.' (Eds V.V. Rendig and D. L. Grunes.) pp. 63–77. ASA Special Publication No. 135. (American Society of Agronomy: Madison, WI, U.S.A.)