

Cultivar release

‘Puna II’ forage chicory (*Cichorium intybus* L.)

W. RUMBALL

R. A. SKIPP

R. G. KEOGH

R. B. CLAYDON

AgResearch Grasslands
Private Bag 11 008
Palmerston North, New Zealand

Abstract ‘Puna II’ forage chicory (*Cichorium intybus* L.) was bred from ‘Grasslands Puna’ chicory by selection for tolerance to the fungus *Sclerotinia*, cool-season activity, greater uniformity, and higher levels of the sesquiterpene lactones, lactucin and lactucopicrin. It is intended for use as a pure sward on non-milking farms, and as a component of mixed swards on all grazing farms. Breeding took place from 1992 to 1997, and involved two interdependent screening paths, for (1) tolerance to *Sclerotinia* and (2) vigour and uniformity, then high levels of lactucin and lactucopicrin. In most years, the seed harvested from each path was incorporated also into the alternate path for the following year. The two paths were combined in 1997 to provide a final single breeding population. ‘Puna II’ is more uniform than ‘Grasslands Puna’ in morphology and leaf shape. It is also more erect and much more winter-active, and at least as persistent. It is much more persistent than a cultivar bred simultaneously for dairy farms (‘Choice’) but slightly less winter-active, and has higher combined levels of lactucin and lactucopicrin. About 3% of ‘Puna II’ plants bear only pink flowers, rather than blue.

Keywords ‘Puna II’ forage chicory; *Cichorium intybus* L.

INTRODUCTION

‘Grasslands Puna’ chicory (*Cichorium intybus* L.) was the first cultivar of chicory bred specifically for use as a forage (Rumball 1986). Since this herb species was relatively unknown to pastoral agriculture, ‘Puna’ attracted much research following its release. It was readily eaten by all classes of animal, promoted high growth rates in them, and had virtually no harmful side effects (Barry 1998). However, ‘Puna’ had some agronomic shortcomings, including a lack of persistence in mixed swards. One cause of this was selective overgrazing, but another suggested cause was susceptibility to fungal diseases such as *Sclerotinia* in both pure and mixed swards.

A breeding project was undertaken to improve persistence in chicory by selecting for greater tolerance to *Sclerotinia* spp. This would be done both directly, by artificial inoculation and screening of plants, and indirectly by selecting for higher levels of the sesquiterpene lactones, lactucin and lactucopicrin. These chemicals were regarded as being involved in the chemical defence of chicory against insect herbivores (Rees & Harborne 1985), and perhaps therefore also provided resistance to diseases. Since the same chemicals could leave a bitter taste in milk, however, the new cultivar might not be as appropriate in pure swards for dairy farms, and accordingly a separate cultivar (‘Choice’) would be bred in parallel for dairy use (Rumball et al 2003). Both new cultivars would be made also more uniform in leaf and plant morphology than ‘Puna’.

ORIGIN

There were two selection paths running in parallel, to follow different strategies for increasing persistence. Each path provided seedlings for screening in the alternate path in the following year.

Selection for *Sclerotinia* tolerance (path 1)

In 1992, plugs of Potato Dextrose Agar containing *S. sclerotiorum* and *S. minor* were attached to the leaves of 65 'Puna' seedlings at the 7–11 leaf stage. After 11 days, each seedling was scored for the severity of lesions and leaf death. The least affected plants (c. 20% of the total number) were retained, grown-on, and interpollinated at flowering time. In 1993, seed from these plants, plus seed from the parallel selection path (described below), were grown to provide a second generation for screening, but this time against *S. sclerotiorum* alone. About 160 seedlings were used in each of four screenings carried out over the next few weeks. In each case, plants with the least severe leaf symptoms were retained, and grown-on to provide a population of "tolerant" plants. Those which flowered that year (c. 30% did not) were interpollinated, and the seed harvested in bulk.

During 1994, three further screens were carried out with *S. sclerotiorum*, using the selection made from the previous year plus new plants from the parallel selection path. On each occasion, the tolerant plants were retained. At flowering time, all flowering plants, plus those that had not flowered the previous year, were interpollinated.

During 1995, a further three screenings were done, each again using c. 120 plants. Inter-pollination of all selected plants, including those from earlier generations that had not previously flowered, took place at the end of the year. This mixed-generation selection process was continued with five screenings during 1996, and completed with a further four screenings during 1997.

Selection for vigour/uniformity and lactucin/lactucopicrin (path 2)

From 1992 to 1995, a population was developed from 'Puna' by selection for vigour and uniformity in the field. From these, 1000 plants were screened for concentrations of lactucin and lactucopicrin (Rumball et al. 2003). In 1995, following completion of these assays, the 29 plants with the highest combined levels of lactucin/lactucopicrin were removed and interpollinated in an isolation house. The progeny, plus the most recently selected progeny from the parallel *Sclerotinia* project, was re-screened for lactucin/lactucopicrin levels during 1996. Again, those plants (47) with the highest combined levels were interpollinated. The resulting seed was used in the final year of screening for *Sclerotinia* tolerance during 1997. By this process,

the two parallel selection paths were combined into one during the final generation of selection.

At an early stage of the programme, a single plant was discovered that carried only pink flowers, rather than the all-blue flowers of other plants. Crossing experiments with this plant showed that the pink flower colour was controlled by a single recessive gene. Further studies indicated that it did not appear to be linked with either competitive performance or seed set. Accordingly, it was decided to retain these pink-flowered plants at up to 5% of the high-lactucin population, as a means of distinguishing it from the low-lactucin selection in a simultaneous programme (Rumball et al. 2003).

At the end of 1997, a final selection of plants was made and interpollinated. The resulting nucleus seed was sent to AgResearch, Lincoln for further increase. The selection was named 'Puna II'. It was granted Plant Variety Rights in New Zealand on 19 June 2002.

DESCRIPTION

Compared with 'Grasslands Puna', 'Puna II' chicory is much more uniform, and produces many times more winter forage ('Puna' is largely winter-dormant). The leaf margins of 'Puna II' are predominantly smooth and entire, while a large percentage of 'Puna' leaves are highly crenated to fully compound and undulating. 'Puna II' plants are also more erect. The two cultivars have similar degrees of leaf blistering, but 'Puna' has higher levels of anthocyanin coloration in both ribs and laminae.

Compared with 'Choice', 'Puna II' is slightly less winter active, and shows a higher proportion of leaves with red coloration during cold weather. About 3% of 'Puna II' plants contain only pink flowers—all other plants of 'Puna II' (and 'Puna' and 'Choice') are totally blue-flowered. Full descriptions of both 'Puna II' and 'Choice' are given in their Plant Variety Rights applications.

'Puna II' has not been compared with 'Puna' for *Sclerotinia* tolerance since breeding was completed, but an improvement was already noticeable when the two paths of the project were combined in 1997.

In data collected from the PVR application, 'Puna II' had more than twice the lactucin/lactucopicrin level of 'Puna' at the single harvest conducted. In a separate trial with eight comparative harvests over 13 months, however, it averaged about

the same as 'Puna': both cultivars fluctuated considerably through the seasons (R. G. Keogh unpubl. data), for as yet unidentified reasons.

USE AND PERFORMANCE

Whereas 'Choice' chicory is targeted specifically for use in dairy farming systems, 'Puna II' is intended as a general purpose replacement for 'Puna' on all farms, and in mixed pastures on dairy farms. It is expected to be more uniform, more winter-active, and perhaps more persistent, than 'Puna'. In a sward trial at Palmerston North, over 400 plants of the interim populations leading to 'Puna II' were planted into a grass sward, and compared with 'Puna' for survival after 2 years; 64 and 60% survived respectively, compared with 11% for 'Choice'. However, trials on its productivity and

persistence since breeding was completed have yet to be done.

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