Lessons learnt growing plug plants for whin and calaminarian grassland

Northumberland Wildlife Trust used plug plants to restore areas of calaminarian and whin grassland across the county. Although there were considerable successes, some problems were encountered. Lessons learnt in the first year were taken forward and resolved in the second year. A 'tough' approach to growing plug plants was undertaken for these types of grasslands, as the soil conditions are often shallow and well drained with periods of drought. This guidance note details some of the tips and advice that they found out when growing plug plants.

Ensuring that seed is properly cleaned

All seeds were cleaned removing all non-seed plant debris before the seed was stored in paper bags in a fridge until they were sown. Although a minor point, given that some seeds are very small, it is important to ensure that they are sown thinly and pricked-out if seedlings are clustered together.

Planting out plug plants on whin grassland
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Substrate composition

Where possible, the eventual soil conditions were mimicked:

- for the calaminarian grassland, this meant mixing 50% calaminarian soil taken from soil scrapes created for the transplanting of the plugs with 40% non-peat based seed compost made from sheep's wool and bracken, and 10% inert gravel for drainage. Calaminarian soils are largely sand based in Northumberland and are very well-draining suggesting that the plants prefer these conditions.
- for whin grassland, the non-peat based compost was mixed with whinstone chippings (5-10 mm diameter) and a small amount of whinstone dust at a ratio of 1:1 whin to compost. The chippings and dust were used to create a similar chemistry and pH to the soil the plugs would be transplanted into, as well as providing good drainage.

Age of plug plants

All plug plants were grown for a minimum of 6 months but ideally for over a year and were transplanted when roots were seen to grow out of the bottom of the pots. This enabled the establishment of a good root system. Younger plants were not easy to transport to site and transplant and, as such, had lower survival rates.

Germination and survival

Some species, such as mouse-ear hawkweed and alpine pennycress, had a greater germination rate of up to c. 80%) in comparison to others, like common rockrose, wild thyme, mountain pansy, maiden pink and spring sandwort, which had up to 30% germination. One species, thrift, did not

Plug planting on calaminarian grassland © Naomi Waite | Northumberland Wildlife Trust

germinate at all. Possible reasons for this variation in germination include:

- **ripe seed** - seed was collected from all species at the same time and it is likely that some may not have been fully ripe. As conditions often vary throughout a season, it can be difficult to pin-point exactly when a species will produce ripe seed. It is recommended that seed is collected in small amounts throughout the season.
- **cleaning seed** - seed may not have been cleaned sufficiently and additional debris may have caused fungus to destroy the seed. Cleaning seed prior to any storage is extremely important.
- **vernalisation** - many seeds need vernalisation, which is a period of cold often including frost before warm weather signalling spring. All sown plugs were kept outside rather than in a greenhouse, with the exception of mountain pansy. Although, there were warm and cooler periods during the time plugs plants were out, there were no frosts occurred. This could have been rectified by having short periods where the seeds were stored in the freezer.
- **scarification** and **delayed germination** - some species have a hard seed coat, such as common rockrose. This is a survival mechanism for the plant and the coat breaks after several periods of vernalisation from frosts and/or microbial activity. Initially, no scarification was undertaken on seeds with a hard seed coat and there were low levels of germination. However, in the second year the seeds were rubbed lightly across sandpaper to allow water to enter and trigger germination. This resulted in more seeds germinating. There was also germination of common rockrose seeds in plugs that were kept

for over a year, showing how long it may take for some species to germinate with a hard seed coat.

- **watering rates** - during year one mountain pansy seeds were sown in the calaminarian sites and into plugs. The germination rate was less than 3% for sown seed, and survival rate of the plug plants was just 1%. The plugs were watered by rain and intermittently by hand during dry periods. In year two, seeds were planted in the same substrate mix; however the plugs were then moved to a greenhouse for regular watering to maintain slightly damp soil. There was nearly 80% germination. After six months, these plants were returned to outside conditions to 'harden off' before being transplanted on site. For the remaining species watering was restricted to rainfall, with hand-watering only undertaken if it did not rain for more than 2 days. The aim was to discourage the plants from producing roots specialised for high rainfall climates, as neither whin or calaminarian grassland retain water in the soil.
- **mycorrhizal fungi** - although some seeds germinated, notably common rockrose in the second year and wild thyme, the young plug plants did not flourish. In year two, mycorrhizal fungi were added to aid germination. Mycorrhizal fungi were purchased from a garden supplier and were added to the plugs as the seed was sown. Although little change was found in the germination rates, the plants grew more vigorously and established larger root systems.

Transplanting plug plants

Year one plug plants were planted out in late February after the majority of winter frosts. All plugs were watered-in when transplanted into their final site, but no additional watering was undertaken. The timing of plug planting was, however, coincided with a period where consistent rainfall was predicted. Initial survival (after a month and a half) was found to be 100%, however mid-summer surveys found longer term survival rates reduced to less than 20% on the whin grasslands. Drought was thought to be the factor causing the death of many of the seedlings as the spring had very little rainfall.

Year two plug plants were planted out in autumn before any frosts to allow some root growth prior to wet weather and frosts. These plants were only watered-in and no further watering was undertaken as consistent rainfall was expected. The calaminarian species were also protected by placing some vegetation over the plants to protect from water evaporation for the first 2 weeks. Stone were also put around the plants to protect root systems from drought and heavy frosts. This resulted in nearly 100% survival of plug plants. The whin species were transplanted into slightly deeper soils of over 4 cm to increase survival rates.

Firming in a plant on whin grassland
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