Introduction

Ceora\(^{(1)}\) is the first grass pea (\textit{Lathyrus sativus}) cultivar to be bred and released in Australia. A hardy annual legume with a growth habit similar to field pea, grass pea is intended to fulfil a multi-purpose role as a low cost, low input grain legume, green forage species, hay or green manure crop.

Grass pea is one of approximately 160 species in the genus \textit{Lathyrus} and is a weak-stemmed trailing plant with prostrate growth in winter becoming more vigorous, many-branched and semi-erect in spring. The pea flowers are pale blue or white. Pods are flat and contain one to six angular seeds. Seed size is less than that of field pea or lupin, but larger than that of vetch.

Also know as chickling-pea, Indian-pea or khesari, grass pea has a long history of cultivation for human food and forage in central, southern and Eastern Europe, North Africa, Ethiopia, West Asia, the Indian sub-continent and China.

The species is reputed for its hardy nature with superior tolerance to waterlogging and infertile soils compared to most other legume species. It is relatively drought tolerant, disease resistant and can withstand moderate frost.

Status of Ceora\(^{(1)}\)

In its wild form, grass pea contains the toxin 3-(N-oxalyl)-L-2,3-diaminopropionic acid (ODAP) and the consumption of large quantities of the grain by humans can lead to the neurological disorder known as ‘lathyrism’. A similar disorder may occur in some animals fed exclusively on grain with high ODAP concentrations. For this reason, grass pea is excluded from the Western Australian ‘Permitted and Quarantine Species List’ and therefore cannot be imported without special permission.

Occurrence of lathyrism in humans and animals has generally been associated with a diet made up exclusively of grass pea grain containing high levels of ODAP (0.5-1.5\%). Ceora\(^{(1)}\) is a low ODAP selection from a cross made by CLIMA in 1994 between a low ODAP (0.05\%) line from Bangladesh and a line from Pakistan containing 0.43\% ODAP. Levels of ODAP measured in Ceora\(^{(1)}\) grain are:

- 1997 <0.04\%
- 1998 0.09\%
- 1999 0.05\%

The very low levels of ODAP present in Ceora\(^{(1)}\) are considered to not pose any threat to human or animal health and for this reason its cultivation is permitted in Western Australia. All other cultivars or lines of \textit{Lathyrus sativus} are prohibited from entry into Western Australia.

ODAP occurs at much lower levels in green forage and does not pose a risk to grazing livestock. Horses are reported to be the most sensitive animals and, as a reasonable precaution, should not graze on grass pea dominant pastures.

Growing Ceora\(^{(1)}\) grass pea (\textit{Lathyrus sativus}) in Western Australia

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Utilisation
Grass pea grain has been used as a nutritious human food and animal feed for hundreds, possibly thousands of years. As there is no world trade in grass pea grain, the immediate end use for grain is likely to be on-farm supplementary feeding.

*Ceora* provides excellent potential as a multi-purpose crop for feed grain in cattle and sheep, fodder, hay and green manure. As *Lathyrus* is a legume, *Ceora* will provide residual nitrogen to following cereal and oil seed crops.

Soils and rainfall
Grass pea grows well on a wide range of soil types and this is one of the attractions of the species. Best results will be obtained on soils where the pH in CaCl$_2$ is greater than 5.0 at the surface and increases with depth. Grass pea has a higher tolerance to waterlogging than other legume crops such as lupin, field pea, chickpea, vetch and faba bean.

Grass pea is best adapted to medium to high rainfall regions with an annual rainfall of greater than 325 mm.

Agronomy
Much is still to be learnt about the agronomy and management of *Ceora* in the field. In general terms the management of *Ceora* will be similar to that applied in the production of vetch (*Vicia* spp) or chickling vetch (*Lathyrus cicera* cv. Chalus) in Western Australia.

Time of sowing
The superior disease tolerance of grass pea compared to field pea or vetch means that grass pea may be sown from mid-April onward as a grain, forage, hay or green manure crop.

The drought tolerance of the species means that later sowings can be used where a delay is required for weed control or to fit the sowing of other crops.

Sowing rate
In medium to high rainfall zones (greater than 325 mm annual rainfall), the target plant density is 50 plants per square metre. This is equivalent to sowing rates of about 50-75 kg/ha depending on germination percentage and seed size. In low rainfall areas (less than 325 mm), or later sowing, up to 80 plants per square metre is recommended (80-100 kg/ha). Higher sowing rates will increase forage yield.

Inoculation
Inoculate grass pea with Group E inoculum every year. Poor nodulation will result in low nitrogen fixation, low yield and smaller rotation benefits.

Fertiliser
Grass pea is tolerant of infertile soils, but requires fertilisation for commercial production. Maintenance applications of phosphorus (10-15 kg/ha of phosphorus) should be applied at sowing. A starter dose of nitrogen (10-15 kg/ha) at seeding may be useful if the surface pH of the soil is less than 6.0 in CaCl$_2$.

Sowing depth
Sow grass pea at a depth of 4-6 cm. If the crop is to be harvested for grain, roll the paddock as for field pea. This will minimise harvester wear and soil contamination of the grain.

Weed control
Grass pea is vulnerable to early weed competition and sowing should be delayed to allow for the control of germinated weeds with knockdown herbicides prior to planting.

Herbicide trials have shown that grass pea is tolerant of a number of herbicides, however, few selective herbicides are registered for use on grass pea crops. Check with local agronomists or the Department of Agriculture before applying any herbicides.

Diseases
*Ceora* is susceptible to Sclerotinia white mould (*Sclerotinia minor & S. Sclerotiorum*). This disease causes premature plant death and thus a reduction in plant density in well-grown crops. White mould first becomes apparent at the start of flowering and is most likely to be seen in the higher rainfall zones (>450 mm). White mould can infect all pulse crops, indeed all broad-leaved crops. In one instance at Dongara in 2005, *Ceora* appeared to be more susceptible to white mould than chickpea, which is classed as a susceptible species.

Within well-grown crops from the start of flowering, single plants or small groups of plants, turn yellow and die rapidly. Lesions usually develop near the ground and have a white fluffy, cotton wool appearance. Lifting off the white fluff may reveal hard black ‘grains’, these are the sclerotia or survival structures of the fungus. The overall appearance of this disease is similar to botrytis grey mould in chickpea and lentil, however the diseases are easily distinguished by the colour of the fungal mat. White mould has a bright white cotton wool appearance, while botrytis grey mould produces a grey and downy fluff. Sclerotinia survives on stubble or in the soil as sclerotia (the black grains in the white mat).

Figure 2 Seed of *Ceora*
and may persist for several years. Spores produced in winter or spring will infect susceptible hosts such as legume crops, canola and broadleaf weeds. Cereals do not develop this disease.

Fungicides will not control this disease so it can only be managed by rotating susceptible host crops with non-susceptible crops (i.e. cereals). Do not grow Ceora \(^{1}\) in close rotation with other pulse crops, lupin, canola or pastures containing legumes or broadleaf weeds. The disease is favoured by warm humid conditions, similar to the conditions that favour botrytis grey mould and chocolate spot. Spread of infection within the crop is limited as the majority of lesions occur from primary inoculum (the spores produced from the previous years’ trash and sclerotia); secondary spread only occurs through direct contact between infected plants or plant parts (e.g. flowers that drop due to infection) and new hosts. The number of affected plants within a crop will usually increase through spring.

Powdery mildew and downy mildew affect grass pea in some environments, but is unlikely to be a serious problem in Western Australia.

*Lathyrus sativus* is generally moderately resistant to the aphid-borne virus Bean yellow mosaic virus (BYMV). When aphids transmit the virus and infection occurs, symptoms include initial vein clearing of leaves followed by leaf mottle, leaf deformation and plant stunting. Aphids normally spread BYMV to grass pea crops from infected pastures dominated by subterranean clover. However, the virus is seed borne at a low level (about 0.2%) in *L. sativus*, therefore sowing contaminated seed can also introduce the virus to a crop. BYMV is most likely to damage grass pea crops in high rainfall areas.

Infection with BYMV is minimised by sowing healthy seed distant from legume pastures dominated by subterranean clover. Sowing at high seeding rates to rapidly generate a dense plant canopy may also shade out early-infected plants thereby reducing the virus source for further virus spread. Insecticide application to control aphids is unlikely to stop the spread of the virus.

Alfalfa mosaic virus (AMV) and Pea seed-borne mosaic virus (PSbMV) also infect *L. sativus* and are seed borne in this species (1-5 % seed transmission rates recorded). They are most likely to cause problems when virus-infected grass pea seed is sown. Symptoms of AMV include leaf mottle, chlorotic spotting of leaves, tip death and severe plant stunting. Symptoms of PSbMV are leaf pallor, leaf mottle, leaf deformation, tip necrosis and plant stunting. Infection with AMV and PSbMV is minimised by sowing healthy seed.

**Insect pests**

Grass pea is less susceptible to red-legged earth mite and lucerne flea than field pea and other legumes. Spraying is recommended if infestations are severe. Aphids are generally not a serious pest of grass pea, but can spread viral diseases such as BYMV. Check and spray if infestations are severe and causing physical damage.

Native budworm (*Helicoverpa*) can damage all legume crops including grass pea. Eggs are laid from August to November and the small caterpillars feed on the developing pods and seeds. As per *Lathyrus cicera* (cv. Chalus), spray an insecticide if the number of caterpillars average more than 2 per 10 sweeps.

**Figure 3 Ceora \(^{1}\) at advanced podding stage**

**Harvesting**

Harvesting grass pea requires similar techniques to field pea. Crop lifters will work well in dense crops, but pick-up fronts are preferable in thin or uneven crops. Harvesting should occur as soon as pods lose their green colour and the plants become brittle. Delayed harvest may increase lodging and pod shatter.

Ceora \(^{1}\) has a smaller seed size than field pea, therefore care should be taken that appropriate sieves are fitted.

Stubble can be safely grazed by sheep and cattle, but excessive grazing should be avoided on sandy surface soils to prevent wind erosion.

**Role in farming systems**

Ceora \(^{1}\) has been released as a robust, low-cost multi-purpose grain legume with the flexibility to be used as a grain crop, forage or hay crop or for green manure. Like other legumes, when used in rotation, Ceora \(^{1}\) will act as a break crop for root and stubble-borne diseases of cereals, provide the opportunity for grass weed control, fix nitrogen and can produce modest yields of relatively high protein grain.

It is best to follow Ceora \(^{1}\) with a cereal crop. This provides the best opportunities to remove volunteer plants of Ceora \(^{1}\), and to maximise its value as a leguminous break crop. It is highly unlikely that Ceora \(^{1}\) will survive following a cereal phase of two or more years due to its low level of hard seed.

It is not advisable to follow Ceora \(^{1}\) with a broadleaf crop such as lupin, chickpea, field pea, faba bean, lentil, vetch or canola. Many of the herbicides that may be used for in-crop control of Ceora \(^{1}\) will also damage these crops.

Some rotations that maximise the benefits of Ceora \(^{1}\) and reduce its weed potential are:

- Ceora \(^{1}\)/Wheat/Barley/Faba bean/Wheat/Barley
- Ceora \(^{1}\)/Wheat/Barley/Canola
- Ceora \(^{1}\)/Wheat/Canola/Barley

These rotations do not include Ceora \(^{1}\) more than one year in four. This is likely to maximise gross margins,
reduce weed control costs and risk of disease. Growers are already following similar rotations using *Lathyrus cicera* (cv. Chalus).

A pasture phase may follow a Ceora crop, but is not recommended as growers will lose the rotation benefits Ceora offers to a following cereal crop.

**Ceora – meeting biosecurity requirements**

As with all new crops, it is important that growers consider biosecurity requirements particularly during the first few years of production. Meeting biosecurity requirements will minimise the risk any new species may pose to existing crops and farming systems.

**Genetic purity**

Maintaining the low ODAP status of Ceora is critical to the successful release and development of the crop, just as maintaining low alkaloid levels has been critical to the success of the lupin industry. Because grass pea has a significant level of outcrossing, the presence of other grass pea lines (even with equivalent low ODAP levels) could lead to outcrossing and the production of high ODAP lines through transgressive segregation. Therefore other grass pea cultivars should not be grown in association with Ceora.

**Minimising carryover of seed**

Biosecurity requires strict attention to control of seed and volunteer plants. This will minimise the presence of Ceora in following crops or pastures and prevent it from becoming a weed off-site.

Harvesting Ceora is similar to field pea and it is inevitable that some harvest losses will occur. More seed will be shed from pods if harvesting is delayed, or when mature plants are left in the paddock as standing forage. Ceora has a similar hard seed content to other grain legume crops (less than 2%) therefore it is likely to be present in following crops or pastures.

Steps that growers should take to minimise the carryover and spread of Ceora include:

- Careful cleaning of all seeding and harvesting equipment before movement out of Ceora paddocks.
- Using Ceora in the correct place in rotation. Ceora may be managed best as part of a cereal rotation.
- Controlling volunteer plants in paddocks and around farm buildings.
- Controlling Ceora plants in following cereal crops using selective herbicides.
- Using Quality Assured systems to track the handling, production and storage of Ceora.

**Control of volunteer Ceora**

Following a Ceora crop, volunteer plants can be controlled using a wide range of knockdown and in-crop or pasture herbicides.

Prior to a cereal crop being sown, a knockdown herbicide alone, or in combination with 2,4D amine or ester, should provide adequate control of broadleaf plants like Ceora.

Ceora plants are most susceptible to herbicides during the early seedling stage. Once plants reach the 4 to 6 node stage they become harder to kill and growers may need to apply specific broadleaf herbicides to remove Ceora from cereal crops.

If in-crop weed control of Ceora is required, herbicides registered for broadleaf weed control in cereals are likely to be effective, but check with local agronomists or the Department of Agriculture before applying any herbicide.

**Acknowledgment**

This Farmnote was developed from results of research funded by the Rural Industries Research and Development Corporation (RIRDC), the Grains Research and Development Corporation (GRDC), the Centre for Legumes in Mediterranean Agriculture (CLIMA) and the Western Australian Department of Agriculture.

Ceora is protected by Plant Breeders Rights.