Unsprayed Pigeon Pea Refuge Agronomy

Establishing and growing an attractive irrigated pigeon pea refuge is an important tool in the Resistance Management Plan.

The following information is intended to assist growers establish and maintain effective pigeon pea refuges. It is not part of the Resistance Management Plan (RMP) and growers should refer to the RMP for refuge requirements.

While pigeon pea is a hardy, deep-rooted crop typically grown in dryland situations, it is not currently offered as a dryland refuge option as establishment, and timing and duration of flowering can be problematic.

**Planting**

**Field selection**

Pigeon pea can be grown in a wide range of soils, however is very prone to waterlogging, so select fields with good surface and internal drainage. Avoid areas where water tends to back up after irrigation and/or heavy rainfall.

All refuges should preferably be planted into a fallow or rotation fields that have not been planted to cotton in the previous season so as to avoid the likelihood of ratoon or volunteer cotton in refuges. The presence of Bollgard II volunteers and ratoon cotton in any refuge will diminish the value of the refuge and may impose additional selection pressure to *Helicoverpa* spp. to develop resistance to the Bt Cry 1Ac and Cry 2Ab proteins produced by Bollgard II.

Remediation practices will be required if Bollgard II plants are present in pigeon pea crops.

Field selection should be taken into consideration and refuges should be planted on one side of, or next to, a Bollgard II field. Sprayed crops and unsprayed refuges that are planted in adjacent fields must be separated by sufficient distance to minimise the likelihood of insecticide drift onto the unsprayed refuge. To minimise the possibility of refuge attractiveness being affected by herbicide drift, non-herbicide tolerant refuges should also be separated from herbicide tolerant Bollgard II cotton crops by a sufficient distance to minimise drift but not more than 2 kilometres from the Bollgard II cotton.

Nitrogen fixation by legumes such as pigeon pea is optimal in soils with very low residual soil nitrogen. Field selection should take this into consideration.

As with many other legumes, pigeon pea has been shown to have Allelopathic properties which may inhibit the growth and performance of the following season’s crop. This should be taken into account if large fields are planted.
Timing

Pigeon pea requires a minimum soil temperature of 17°C and rising (similar to mungbeans and soybeans). Depending on location, this will normally occur in October–November. Pigeon pea is a photoperiod sensitive plant, and there is a wide range of flowering times among varieties. Therefore, choice of variety and sowing date will strongly affect when it flowers.

Variety

Quest is currently the only variety available for refuge purposes. There is ongoing research to identify improved varieties, particularly for Northern cotton growing areas.

Given the usual planting time for cotton refuges, Quest takes 65 to 80 days to flower. With the right conditions it will continue to flower for a long period. To ensure Quest is attractive to *Helicoverpa* spp. during the same period of time that cotton is attractive (flowering), refuges should be planted within the two week period prior to planting Bollgard II, or if not possible, completed within three weeks of the first day of sowing Bollgard II*.

*See RMP for details.

Seeding rates

Aim for an established plant population equivalent to 20 plants/m². Higher plant populations tend to produce plants with thinner stalks, making crop residues easier to handle. Evenly spaced, lower plant populations can still be attractive and tend to produce larger plants that flower for longer and can cope better with water stress. To maintain attractiveness, it is important to comply with the required plant stand of not less than four plants per metre.

Seed germination percentages can vary greatly (<30% to >80%). Growers are advised to have a current germination test for either purchased or farm-saved seed. The proportion of hard seed can also influence the number of plants established, often above expectations.

Seed size is normally in the range of 6,000–10,000 seeds/kg. Generally a sowing rate of 25–40 kg/ha is used, but allowances must be made for planting conditions and seed quality.

Seed bed preparation and planting

Ensure seedbed preparation is reasonable to avoid replants. Reasonable preparation is described as that which seed can be sown to a depth of no more than 5cm. Levelling of any seed trenches created during planting is important, particularly when residual herbicides have been used and/or the field is to be watered up. The use of press wheels with light pressure has been shown to improve emergence.

Pre-irrigation and planting into moisture is generally recommended over watering up. Some growers choosing to water up the refuge with the rest of the field, then replant into this moisture if a replant is required.
Inoculum and fertiliser

Pigeon pea requires inoculation with Group J inoculant. To ensure efficacy of inoculant, follow all label requirements and directions regarding storage, handling and application. Nodulation will be limited in high nitrogen soils. A well grown crop of pigeon pea can fix up to 38 kg/ha of nitrogen. However grown in soils with moderate to high background nitrogen, pigeon pea can leave the soil depleted of nitrogen. Pigeon pea is much more sensitive to phosphorus deficiency than cotton. In soils with long cropping histories where soil phosphorous may be depleted, pigeon pea is likely to respond to addition of phosphorus and zinc. Like cotton, pigeon pea is highly VAM dependent and in long fallow situations, it may even be more responsive to phosphorous and zinc.

Weed management

Pigeon pea grows slowly particularly when planted into low soil temperatures, therefore will be a poor competitor with weeds.

While there are a number of herbicides available for use under permit, as seen in the table below, inter-row cultivation can be a useful tactic. However cultivation can inadvertently kill (the Bt-susceptible) Helicoverpa pupae present in the soil at the time. For this reason it is a requirement that once Bollgard II cotton begins to flower the corresponding refuge should not be cultivated. The presence of Bollgard II volunteers and ratoon cotton in any refuge will diminish the value of the refuge and must be removed as soon as possible. Cotton volunteers can be controlled in pigeon pea crops with Broadstrike® herbicide from Dow AgroSciences.

Herbicides available for use in pigeon pea PERMIT NUMBER –PER10217

<table>
<thead>
<tr>
<th>Active Ingredient</th>
<th>MOA</th>
<th>Concentration and formulation</th>
<th>Application rate of product</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flumetsulan</td>
<td>B</td>
<td>800 g/kg WG</td>
<td>25 or 50g/ha @ 150 L/ha</td>
<td>Now registered for control of volunteer cotton in pigeon pea Do not apply post emergent treatments if rain is likely within 4 hours. Do not irrigate (any method) treated crop of pasture for 48 hours after application. May be banded (&gt;40%) over the row or broadcast. Minimum spray volume 150 L/ha for optimum results.</td>
</tr>
<tr>
<td>Metribuzin</td>
<td>C</td>
<td>750 g/kg WG</td>
<td>470 g/ha</td>
<td>Registered for control of volunteer cotton in pigeon pea. Refer to label for critical comments.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>480 g/L SC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prometryn</td>
<td>C</td>
<td>500 g/L:</td>
<td>Apply up to 4.5 L per hectare.</td>
<td>Apply up to the maximum rate pre planting and incorporate, or as a post emergent directed spray towards the base of established plants.</td>
</tr>
<tr>
<td>Prometryn</td>
<td>C</td>
<td>900 g/kg:</td>
<td>Apply up to 2.5 kg per hectare.</td>
<td></td>
</tr>
<tr>
<td>Trifluralin</td>
<td>D</td>
<td>480 g/L:</td>
<td>Apply up to 2.3 L per hectare</td>
<td>Apply up to the maximum rate pre planting and incorporate.</td>
</tr>
</tbody>
</table>
Note: Only apply to pigeon pea crops that are to be destroyed at the end of the season or to be harvested for seed for refuge replanting only. No crop product or crop residue is to be fed to livestock. Refer to all labels and permit conditions.

### Irrigation

Pigeon pea is extremely sensitive to water logging, and flood irrigation is generally not ideal for this crop. However it is the most common form of irrigation and growers need to be manage this carefully. For example, it is advisable to delay irrigating if heavy rain is predicted and practices such as watering every second row, can be useful in supplying water to the crop, while reducing the risk of waterlogging by leaving room in the soil profile to make use of rainfall.

While pigeon pea generally requires less irrigation water than cotton, it is important to ensure crops do not become too water stressed as this will impact on attractiveness. Flowering will be delayed under periods of extreme moisture stress and this situation appears to be one of the biggest problems facing an efficient refuge system. If there is moisture present, pigeon pea will respond very quickly with attractive regrowth after insect attack.

<table>
<thead>
<tr>
<th>Active Ingredient</th>
<th>Mode of Action</th>
<th>Concentration and formulation</th>
<th>Application rate of product</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butroxydim</td>
<td>A</td>
<td>250 g/L:</td>
<td>Apply 180 grams per hectare.</td>
<td>Apply the specified rate as a post emergence spray over the top of the pigeon pea crops.</td>
</tr>
<tr>
<td>Fluazifop-p</td>
<td>A</td>
<td>212 g/L:</td>
<td>Apply 1 L per hectare.</td>
<td></td>
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<tr>
<td>Fluazifop-p</td>
<td>A</td>
<td>128 g/L:</td>
<td>Apply 1.6 L per hectare.</td>
<td></td>
</tr>
<tr>
<td>Sethoxydim</td>
<td>A</td>
<td>186 g/L:</td>
<td>Apply 1 L per hectare.</td>
<td></td>
</tr>
<tr>
<td>Haloxyfop</td>
<td>A</td>
<td>130 g/L:</td>
<td>Apply 600 mL per hectare.</td>
<td></td>
</tr>
<tr>
<td>Haloxyfop</td>
<td>A</td>
<td>520 g/L:</td>
<td>Apply 150 mL per hectare.</td>
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</tr>
<tr>
<td>Clethodim</td>
<td>A</td>
<td>240 g/L:</td>
<td>250 to 375 mL/ha (2–3 leaf stage)</td>
<td>Always apply with D-C-trate at 2 L/100 L or Hasten or Kwickin at 1 L/100 L or Uptake at 500 mL/100 L spray volume. The lower doses will provide effective control if applied under ideal conditions to weed that are smaller, actively growing and free from temperature or water stress.</td>
</tr>
<tr>
<td>Quiazalofop</td>
<td>A</td>
<td>99.5 g/L:</td>
<td>250–750 mL/ha (dependent on growth stage and species of weed)</td>
<td>Refer to permit for growth stages of species and critical comments.</td>
</tr>
</tbody>
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Harvest of pigeon pea refuge crops

Harvest or destruction of aerial parts of a pigeon pea refuge should only be carried out after Bollgard II lint removal has been completed. In New South Wales and Southern Queensland, soil disturbance should only occur after Bollgard II cotton fields have been pupae busted, (to ensure maximum emergence of pupae from refuges), and preferably left uncultivated until the following October to enable the emergence of overwintering pupae. In Central Queensland soil disturbance of refuge crops can only occur two weeks after final defoliation of the Bollgard II cotton. Growers in Central Queensland using pigeon pea for trap crop purposes should refer to the late summer pigeon pea trap crop requirements of the RMP for full details.

For additional information

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