# Pigeonpea – agronomy, performance & system fit

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## GRDC code

DAQ2308-002RTX: NGN - Evaluating new pigeonpea genetics in southwest Qld

## Take home message

This project evaluated pigeonpea (*Cajanus cajan* L.) as a high-value summer pulse for the GRDC Northern Region, focusing on its potential for broad-scale dryland production. Rising demand for pigeonpea grain in India, its nitrogen-fixing ability, and its resilience make pigeonpea a promising option. Trials conducted across southern and central Queensland assessed new experimental lines for yield, agronomic traits, and commercial viability. The results demonstrated super-quick maturity (flowering in 45–50 days) and grain yields of 1.4–1.9 t/ha in favourable conditions and 0.98–1.1 t/ha in marginal environments. The crop's height (60–100 cm) and minimal lodging allow easy mechanised harvesting. Challenges include pest pressure (*Helicoverpa spp., Maruca vitrata*), limited registered herbicide options, desiccation, and charcoal rot in central Qld. Smaller seed size in super-quick lines also requires improvement through breeding or agronomic management. Recommendations include developing Integrated Pest and Weed Management strategies, refining agronomic practices, and expanding regional trials. Market opportunities, particularly in India, are promising. Through further research, extension, and industry collaboration, pigeonpea has strong potential to become a sustainable and profitable summer crop in the GRDC Northern Region.

## Background

Pigeonpea provides a major opportunity for GRDC Northern Region farmers, processors and exporters to build global markets for healthy, trusted and sustainable high-value pulse commodities. Global demand for plant-based protein is growing exponentially due to consumer preference, population growth, and increasing concerns about sustainability. Pulses offer a sustainable, healthy, high-quality protein source for nutritious and functional foods.

The GRDC Northern Region already has a strong reputation for producing and exporting high quality pulses to the world. Our proven success with chickpea and mungbean has also highlighted the potential of pulse crops to deliver profits and improved sustainability outcomes. However, growers need a 'summer version of chickpea'. Unfortunately, current options for broadacre summer pulse production are limited. Mungbean, peanut, and soybean lack the resilience, drought tolerance, and ease of management required for broad-scale dryland production. Pigeonpea is the most promising option to fill the critical gap for northern region growers.

Pigeonpea (*Cajanus cajan* L.) is a widely adapted tropical grain legume crop with a reputation for resilience to climate variability and its ability to fix nitrogen. Pigeonpea grain is highly valued in key export markets, particularly India, where it is a staple food and the primary ingredient in the iconic dish, ‘toor dal’. Our grain exporters can leverage their ongoing success with chickpeas and supply reliable quantities of high quality pigeonpea to meet the growing demand in India.

In 2024-25, India imported over 1.2 million tonnes of pigeonpea, primarily from Myanmar and central Africa (India pigeon pea import estimates rise - Igrain July 2025). Import volumes are expected to increase due to a persistent shortfall in domestic production and growing demand in India, particularly for higher quality grain. Australia already enjoys a global reputation for delivering premium pulse exports with traceable provenance.

In recent years, new opportunities for pigeonpea production in Australia have emerged. The availability of super-quick maturing experimental lines, advancements in pest management, increased grower expertise in pulse crop management, and the establishment of pulse markets in Asia have created favourable conditions for pigeonpea adoption.

New pigeonpea experimental lines from the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in India were imported by the Department of Primary Industries (DPI) and sourced from the Australian Grains Genebank (AGG). As part of a DPI initiative, these lines were reselected, screened at multiple sites, and the seeds of the most promising lines were multiplied. Replicated regional trials were conducted as part of this project, marking the first evaluation of these experimental lines in Australia. The selected lines exhibited super-quick maturity, short and uniform plant height, and a compact flowering window.

The primary objective of this project was to evaluate the performance of new pigeonpea experimental lines across a range of regional trial sites in southern and central Queensland, assessing their suitability for local growing conditions. The trials also demonstrated current best management practices in agronomy, pest management (insects and weeds), and desiccation, while identifying gaps requiring further research. Field walks at the research sites provided opportunities for targeted extension activities and interactive discussions with interested farmers. This research supports the ongoing growth of the pulse industry in the GRDC Northern Region and underscores the potential of pigeonpea as a sustainable and profitable high-value summer pulse crop for growers, processors, and exporters.

## Method

Trial sites were established in dryland cropping areas in southern and central Queensland during the 2023-24 and 2024-25 seasons, as listed in Table 1 below. Where on-farm sites were not available, or where logistics (i.e. planting rain or site access) posed significant challenges, the trials were established on research stations. These sites were selected to represent a range of rainfall and soil types in the target regions.

**Table 1:** Location of pigeonpea trial sites in Queensland in 2023-24 and 2024-25 seasons.

| Site | Latitude | Longitude | Nearest town | Property | Planting Date |
|---|---|---|---|---|---|
| 1 | 26°34'22"S | 151°49'32"E | Kingaroy | DPI Kingaroy Research Facility | 1 Nov 2023 |
| 2 | 27°50'49"S | 151°27'27"E | Millmerran | Tosari Crop Research Centre | 12 Dec 2023 |
| 3 | 26°50'30"S | 150°52'52"E | Warra | Aloe Farming Company | 13 Dec 2023 |
| 4 | 23°31'28"S | 148°12'31"E | Emerald | Central Qld Smart Cropping Centre | 16 Jan 2024 |

| Site | Latitude | Longitude | Nearest town | Property | Planting Date |
|---|---|---|---|---|---|
| 5 | 28°06'12"S | 150°20'33"E | Billa Billa | ‘Murra Cul Cul’ | 6 Dec 2024 |
| 6 | 27°07'21"S | 150°08'21"E | Condamine | ‘Home-Leigh’ | 16 Dec 2024 |
| 7 | 23°31'30"S | 148°12'37"E | Emerald | Central Qld Smart Cropping Centre | 9 Jan 2025 |
| 8 | 26°34'45"S | 151°49'43"E | Kingaroy | DPI Kingaroy Research Facility | 20 Jan 2025 |

Most sites were emerging from a long fallow period preceded by either sorghum or maize. All sites had close to a full moisture profile. Prior to planting soil samples were taken for nutrition analysis and Predicta B testing. On some sites, a pre-plant (flumioxazin e.g. Valor®) or pre-emergent (pendimethalin e.g. Stomp Xtra®) herbicide was applied, as required, and a pre-plant application of glyphosate was also made to control remaining weeds.

All sites were planted using a zero till small plot research planter, at a row spacing of 50 cm and plot length of 10 m or 12 m, with three replicates. A starter fertiliser (e.g. Granulock Z® from Incitec Pivot) was applied at a rate of 40-60 kg/ha in a furrow beside the seed. Rhizobia inoculant (Group J) was applied to the seed using water injection into the furrow at planting. The target population was 30 plants/$m^2$ and the planting depth was approx. 7-10 cm.  Laneways were established by slashing or spraying at 4 to 6 weeks after planting. Weeds were controlled using post-emergent herbicides.

Insect populations in each trial were closely monitored during all stages, and insecticide application was required in all trials. *Helicoverpa spp*. and *Maruca vitrata* populations were controlled using chlorantraniliprole (e.g. Vantacor®) at first flower emergence, followed by a second spray of clothianidin (e.g. Shield®) or indoxacarb (e.g. Steward®) approximately three weeks later, particularly in trials with infestations of pod-sucking bugs. Good insect control was achieved in most trials, except for Kingaroy and Emerald in 2024-25, where prolonged periods of rain at flowering delayed insecticide applications, resulting in significant yield loss.

Emergence counts were taken at each site 12 to 14 days after planting. Phenology stages were recorded from the first emergence of flowers through to physiological maturity. Plant height was measured prior to desiccation of the crops. After harvesting, 100 seed weights were determined for each plot. Hand-cut biomass subsamples were collected from at least one experimental line at each site prior to desiccation. The subsamples were processed to give an estimate of harvest losses and provide data for simulation modelling.

Local growers, agronomists and grower groups were invited to field walks held during pod-fill stage at each site, except for Emerald in 2024-25 where rain made accessing the site difficult. These field walks were well attended (approx. 120 people total at three sites in each year) and the focus of promotional articles and social media posts from GRDC, DPI, and the Woods Group.

When the trials reached physiological maturity and approx. 90% pods had turned brown, the trials were desiccated using a chemical desiccant. Prior to harvest, if the crop persisted, the trial was also sprayed with diquat (e.g. 3 L/ha Reglone®) to quickly reduce leaf area.

Plots were harvested approximately two weeks after desiccation using a standard small plot harvester (Kingaroy Engineering Works). Minor adjustments were made to drum speed, grain sieves and fan speed to provide a clean harvest sample. Whole-grain samples from each plot were then weighed and sub-sampled for grain quality analysis. Grain quality sub-samples were analysed for protein content, seed size and fractionation, hectolitre weight, and seed colour. Trial data were analysed by the DPI Biometry group.

A summary of weather conditions at each site is presented in Table 2. Sites like Warra and Kingaroy in 2023/24 experienced relatively favourable growing conditions with moderate mean maximum temperatures (29.6 °C and 30.4 °C, respectively), fewer extreme heat days above 35 °C (11 and 7 days) and higher in-crop rainfall (484 mm and 457 mm). In contrast, Billa Billa in 2024/25 faced harsher conditions, with 41 days above 35 °C (included four days with maximum temperatures exceeding 40 °C during flowering), minimal rainfall (170 mm), and a higher mean maximum temperature (32.7 °C), which negatively impacted crop performance. Kingaroy in 2024/25 stands out for its significantly lower mean maximum temperature (26.9 °C) and the high number of days below 10 °C (18), indicating a cooler growing season that may have delayed crop development. The growing season in Emerald in 2024/25 extended over seven months due to insect damage at flowering and the subsequent regrowth, resulting in a very high number of days above 35 °C (34) and the highest number of days below 10 °C (62).

**Table 2:** Summary weather data for all sites in 2023/24 and 2024/25.

| Trial | Mean Minimum Temp (°C) | Days Min below 10°C | Mean Maximum Temp (°C) | Days Max above 35°C | In-crop Rainfall (mm) | Cumulative Solar Radiation (kWh/m$^2$) |
|---|---|---|---|---|---|---|
| 2023/24 Emerald | 19.4 | 8 | 31.6 | 26 | 165 | 566 |
| 2023/24 Kingaroy | 17.9 | 0 | 30.4 | 7 | 457 | 779 |
| 2023/24 Tosari | 17.1 | 4 | 31.1 | 29 | 384 | 873 |
| 2023/24 Warra | 16.9 | 5 | 29.6 | 11 | 484 | 749 |
| 2024/25 Billa Billa | 19.5 | 0 | 32.7 | 41 | 170 | 756 |
| 2024/25 Condamine | 17.9 | 4 | 31.7 | 28 | 279 | -- |
| 2024/25 Kingaroy | 15.2 | 18 | 26.9 | 0 | 237 | 653 |
| 2024/25 Emerald | 14.7 | 62 | 28.4 | 34 | 458 | 895 |

## Results

*Grain yield*

Across all trials, several lines consistently yielded well. From these lines, five entries were selected as the top performers across years and trial sites – referred to as the “top five” entries.

A summary of grain yield results (Table 3) shows variability in yields across sites and years. Warra (2023-24) was the highest yielding site, achieved a mean yield of 1.58 t/ha and the top five entries averaged 1.79 t/ha. In contrast, Billa Billa and Condamine recorded the lowest mean trial yields of 0.94 t/ha and 0.87 t/ha, respectively, suggesting suboptimal growing conditions.

The selected top five entries consistently outperformed the site mean yield in all trials, highlighting the potential for targeted selection of high-performing varieties. For example, at Tosari in 2023-24, these top five entries averaged 1.48 t/ha, significantly higher than the overall mean of 1.22 t/ha. This trend underscores the importance of identifying and promoting elite varieties to maximise productivity and suggests potential to further increase yield with targeted breeding.

The highest individual entry yields provide insight into the yield potential at each site. For example, Warra in 2023-24 recorded the highest individual yield across all sites and years (1.97 t/ha), suggesting that this site had both favourable conditions and a well-adapted variety. Conversely, the best performing line in the 2023-24 Condamine trial yielded only 1.04 t/ha, indicating limited yield potential under these conditions.

The Emerald trial in 2024-25 achieved significantly higher yields compared to 2023-24. However, this trial was atypical as severe damage by insects at the time of initial flowering resulted in additional flushes of flowers, extending the season. The results in Table 4 reflect the grain yield produced after the crop recovered and compensated for the initial damage.

**Table 3:** Grain yield (t/ha) of entries in regional pigeonpea trials in Queensland in 2023-24 and 2024-25.

| Year | 2023-24 | | | | 2024-25 | | | |
|---|---|---|---|---|---|---|---|---|
| Site | Kingaroy | Warra | Tosari | Emerald | Billa Billa | Condamine | Kingaroy | Emerald |
| Mean yield (all entries) | 1.37 | 1.58 | 1.22 | 1.21 | 0.94 | 0.87 | 0.90 | 1.54 |
| Mean yield (top five) | 1.60 | 1.79 | 1.48 | 1.40 | 1.07 | 0.98 | 0.97 | 1.84 |
| Highest entry | 1.71 | 1.97 | 1.78 | 1.43 | 1.11 | 1.04 | 0.98 | 1.87 |

*Days to first flower*

Table 4 summarises of the observed differences in phenology (time to first flower) for the tested pigeonpea lines across trial sites in 2023-24 and 2024-25. Average time to first flower ranged from 45 days at Kingaroy in 2024-25 to 58 days at Tosari in 2023-24. The earliest flowering entries consistently flowered several days before the site mean, with Warra in 2023-24 recording the shortest time to first flower (44 days). Conversely, Tosari in 2023-24 had the latest flowering entry (67 days).

**Table 4:** Days to first flower of entries in regional pigeonpea trials in Queensland in 2023-24 and 2024-25.

| Year | 2023-24 | | | | 2024-25 | | | |
|---|---|---|---|---|---|---|---|---|
| Site | Kingaroy | Warra | Tosari | Emerald | Billa Billa | Condamine | Kingaroy | Emerald |
| Site Mean | 53 | 50 | 58 | 49 | 50 | 50 | 45 | 53 |
| Earliest entry | 48 | 44 | 51 | 46 | 46 | 47 | 43 | 49 |
| Latest entry | 65 | 63 | 67 | 55 | 56 | 54 | 47 | 57 |

*Days to physiological maturity*

The pigeonpea lines typically reached physiological maturity at 110 days from sowing. However, the days to physiological maturity varied among trials and to a lesser extent among test lines within trials. The observed days to physiological maturity for pigeonpea entries for trial sites in

2023-24 and 2024-25 is shown in Table 5. The late sown (16 January) Emerald trial in 2023-24 recorded the shortest site mean (86 days to physiological maturity) and the earliest maturing entry (82 days), suggesting that the later planting time at this site shortened the maturity period. In contrast, the duration to physiological maturity at sites like Kingaroy, Warra, and Tosari in 2023-24 was longer (site means 110, 108, and 109 days, respectively), these sites had extended growth periods, potentially allowing for higher biomass or yield accumulation. Across all sites, the earliest entries consistently matured several days before the site mean. The late planted (20 January) Kingaroy trial in 2024-25 showed a notable reduction in both mean duration to physiological maturity (102 days) and earliest entry (95 days) compared to the previous year (site mean 110 days and earliest entry 105 days, planted 1 November), possibly reflecting the different planting times and response to environmental differences. Despite the higher temperatures, the extended daylength associated with the November planting delayed flowering and maturity compared to the January planting, which occurred with a shorter daylength. The extended time to physiological maturity at Emerald in 2024-25 was caused by severe insect damage to the initial flush of flowers and pods. Although the trial largely recovered, crop maturity was delayed by several months.

**Table 5:** Days to physiological maturity of entries in regional pigeonpea trials in Queensland in 2023-24 and 2024-25.

| Year | 2023-24 | | | | 2024-25 | | | |
|---|---|---|---|---|---|---|---|---|
| Site | Kingaroy | Warra | Tosari | Emerald | Billa Billa | Condamine | Kingaroy | Emerald |
| Site Mean | 110 | 108 | 109 | 86 | 105 | 108 | 102 | 158 |
| Earliest entry | 105 | 102 | 105 | 82 | 100 | 102 | 95 | 151 |

*Height*

Table 6 presents the range (tallest and shortest entry) and mean plant height of the pigeonpea entries for all trial sites in 2023-24 and 2024-25, reflecting site-specific growing conditions and varietal performance. Emerald in 2023-24 recorded the tallest site mean (99 cm) and the tallest individual variety (137 cm), suggesting favourable conditions for vigorous growth, such as good early season rainfall and high temperatures. In contrast, Kingaroy had shorter plants in both years, with site means of 60 cm in 2023-24 and 62 cm in 2024-25, and the shortest entries (49 cm and 55 cm, respectively). This is potentially explained by the red Ferrosol soils, which have limited rooting depth at this site. Tosari in 2023-24 exhibited the greatest variability, with the tallest entry reaching 147 cm and a site mean of 94 cm, suggesting that this site supported a broad range of growth habits.

**Table 6:** Height (cm) of entries in regional pigeonpea trials in Queensland in 2023-24 and 2024-25.

| Year | 2023-24 | | | | 2024-25 | | | |
|---|---|---|---|---|---|---|---|---|
| Site | Kingaroy | Warra | Tosari | Emerald | Billa Billa | Condamine | Kingaroy | Emerald |
| Site Mean | 60 | 75 | 94 | 99 | 75 | 67 | 62 | 80 |

| Year | 2023-24 | | | | 2024-25 | | | |
|---|---|---|---|---|---|---|---|---|
| Site | Kingaroy | Warra | Tosari | Emerald | Billa Billa | Condamine | Kingaroy | Emerald |
| Shortest entry | 49 | 60 | 78 | 83 | 67 | 58 | 55 | 73 |
| Tallest entry | 103 | 124 | 147 | 137 | 90 | 78 | 79 | 99 |

## Discussion

The key outcome of this project investment (DAQ2308-002RTX) was to determine the yield potential and agronomic requirements for profitable pigeonpea production in the GRDC Northern Region. Eight trials were completed, with three trials in Southern Qld and a fourth in Central Qld in each of two years, providing the preliminary data required to assess the viability of a pigeonpea industry. The trials also provided insights into the potential issues for pigeonpea cultivation and identified key areas requiring further research.

*Grain yield*

The experimental lines included in these trials were sourced from the ICRISAT pigeonpea breeding program in India and were selected for early maturity, low photoperiod sensitivity, and a height and canopy structure suitable for mechanised harvesting. These ICRISAT experimental lines have not previously been evaluated in regional trials in Australia.

In general, the trial sites in 2023-24 experienced higher rainfall and milder temperatures than the sites in 2024-25 (Table 2) and produced higher yields. This is typical of the dryland farming regions in the central and southern Downs, as well as the Burnett region in southern Queensland. The mean yield of sites in 2023-24 ranged from approx. 1.2 t/ha at Tosari to approx. 1.6 t/ha at Warra (Table 3). These figures likely underestimate actual yields due to an estimated 10-15% grain loss from pod shattering between desiccation and harvest, as well as the limitations of the small plot harvester used. More timely harvest will reduce shattering losses, and commercial harvesters can be more precisely adjusted to minimise harvest losses.

In general, the trial sites in 2024-25 experienced lower rainfall and higher temperatures, than the trial sites in 2023-24, typical of the western Downs and Maranoa farming regions in southern Queensland. The mean yield of sites in 2024-25 ranged from 0.87 t/ha at Condamine to 0.94 t/ha at Billa Billa (Table 3). Again, these figures likely underestimate the actual yields, due to pod shattering and harvest losses. Both Billa Billa and Condamine experienced a severe heat wave, with four consecutive days of temperatures exceeding 40 °C during early flowering (Table 2), which likely reduced pollination, seed set, and overall yield potential. Grain yield at the Kingaroy site in 2024-25 was reduced by an infestation of bean pod borer (*Maruca vitrata*) during flowering. Insecticide control was not possible due to prolonged wet weather. This also occurred at Emerald in 2024-25 where an infestation of bean pod borer removed all the developing flowers and pods in the trial during a period of wet weather, making it impossible to access the trial and apply insecticides. In this case, the crop fully compensated for the insect damage and produced a mean yield of 1.54 t/ha. The only penalty was that the harvest was delayed by around two months. The trial means, although helpful in comparing performance between years and trials, underestimates the potential of the crop, as the performance of the best lines is counterbalanced by that of poorly performing lines.

In both years at all sites, the mean yield of the top five lines (selected as the top performers across all trials) and the yield of the highest yielding entry (Table 3) was significantly higher than the mean yield of all entries at each site. The selection of the highest yielding line for commercialisation will significantly lift the yield potential of the pigeonpea crop in these growing regions.

*Days to first flower*

The renewed interest in pigeonpea has primarily been driven by the development of new super-early maturity types that offer multiple benefits in the GRDC northern region. Previous commercial varieties released in Australia, such as ‘Sunrise’ (an indeterminate, late maturity variety used as an insect refuge crop in cotton) and ‘Quest’ (a determinate late maturity variety released by the University of Queensland in the 1980’s), were found to be unsuitable for commercial grain production. These varieties had the disadvantage of (i) very late maturity (e.g. 65-80 days to first flower), (ii) a long flowering window (e.g. four weeks for Quest, two months for Sunrise), and (iii) sensitivity to photoperiod, where the variety will flower in response to shortening daylength. Access to new varieties that are early or super-early in maturity, have a narrow flowering window and are insensitive to photoperiod are key requirements to successfully establishing a pigeonpea industry in the northern region. Varieties with these characteristics can be grown successfully under lower rainfall conditions, will be less susceptible to *Helicoverpa* and *Maruca* damage due to less time available for pest infestations to develop. These varieties can be protected with one or two insecticide sprays during critical flowering and podding stages and have a much wider planting window.

In general, the experimental lines evaluated in these trials had super-early maturity, with the mean days to first flower ranging from 45 days at Kingaroy in 2024-25 to 58 days at Tosari in 2023-24 (Table 4). The earliest individual entry at each site ranged from 43 days at Kingaroy in 2024-25 to 51 days at Tosari in 2023-24. Flowering dates at Tosari in 2023-24 were 7–8 days later than other trials, likely due to heavy rainfall after emergence, which caused waterlogging and slowed plant development. Pigeonpea is known to be susceptible to waterlogging, which causes plant stress and slows down plant development.

The number of days to first flower did not vary greatly across the sites despite a range of planting dates. Trials planted from 1 November to mid-December showed similar flowering times, suggesting the lines were relatively insensitive to photoperiod changes during this period. Previous trials and seed increase blocks planted in October have also shown a similar number of days to first flower (data not shown). However, the number of days to first flower did decline slightly in trials planted in January (e.g. Emerald in both years and Kingaroy in 2024-25), suggesting that these lines do have some sensitivity to photoperiod when developing in a period of declining daylength.

*Days to physiological maturity*

Similar to the time to flowering discussed above, most entries reached physiological maturity in 105-110 days after planting (Table 5). The length of time to maturity was similar for a range of planting times (November to December), suggesting that these lines are relatively insensitive to photoperiod.

*Height*

Pigeonpea plant height is an important trait to ensure efficiency of harvesting. If varieties are too short, picking up the crop with a commercial harvester can be challenging, which may lead to reduced grain quality and physical contamination of the grain sample with soil and crop stubble. If varieties are too tall, with excessive biomass and low harvest index, commercial harvesting can be slow and inefficient, resulting in reduced grain recovery due to unthreshed pods.

In these trials, most lines reached heights of 60–100 cm (Table 6), with variation largely driven by environmental conditions. It was noticeable that pigeonpea grown on red Ferrosols at Kingaroy was 20-30% shorter than pigeonpea grown on black or grey Vertosols. No evidence of lodging was observed in any trials, despite heavy rain and wind before harvest at some sites, such as Warra in 2023-24 (for comparison, many mungbean crops in the district suffered severe weather damage or complete crop loss).

*Harvestability*

All trials in this project were harvested with a standard small plot harvester. Some adjustments were required to the drum speed, concave-drum distance, sieves and fan speed to produce a clean sample. The height of the pod-bearing canopy of pigeonpea was always well above the ground level and crop-lifters were not required. This experience suggests that commercial harvesting equipment can be used for harvesting pigeonpea with no major modifications required.

*Plant population and row spacing*

The target population in these trials was 30 plants/$m^2$ or 300,000 plants/ha, which is equivalent to a planting rate of around 30-35 kg/ha, depending on seed size and germination. These trials suggest that this population was appropriate in these environments. Pigeonpea is known to compensate well for changes in plant population. As a rule, an established population of 20-30 plants/$m^2$ should maximize yield in lower rainfall environments and 30-40 plants/$m^2$ should maximise yields in higher rainfall environments. The GRDC agronomy trial project WSP2309-001RTX should produce further data on the optimal plant population.

The 50 cm row spacing used in these trials was appropriate in these environments. Previous research by DPI suggested that narrower rows may be more effective in high rainfall or irrigated environments and provide additional competition against weed growth. Wider rows may be advantageous in lower rainfall areas. Given the compensatory ability and the high light extinction coefficient (k) of pigeonpea, it may be that row spacing is of less importance in most environments, allowing growers to continue to use existing equipment. Further research may identify that the optimum population and row spacing, which is likely to vary for each growing region.

*Disease*

Only minor levels of disease occurred in these trials, and no chemical control was required at any site. Phytoplasma was only detected at a very low level at most sites and only occasional plants were infected with *Phytophthora, Fusarium* and various leaf spot diseases. An exception were the trials at Emerald in 2023-24 and 2024-25, where significant amounts of charcoal rot (*Macrophomina phaseolina*) were identified late in the growing season. This did not occur in any of the trials in southern Qld, where charcoal rot is known to be widespread in sorghum and maize stubble. This suggests that charcoal rot may be more of a constraint to production in central Qld than southern Qld, although the central Qld sites were both conducted at the same location. Importantly, genetic variation was observed in the levels of charcoal rot among the lines, suggesting that variety selection may reduce the incidence of the disease.

*Insects*

Damage caused by insects, particularly *Helicoverpa spp.* and *Maruca vitrata*, is likely to be a major constraint to pigeonpea production, as pigeonpea flowers being highly attractive to these insect pests. In these trials, Vantacor® was applied to all trials at the first emergence of flowers and provided effective systemic control for approximately two to three weeks. Given the length of the flowering period of these super-early lines is around two weeks, a single application may provide sufficient control in many situations. Other insect pests of pulses, such as various pod-sucking bugs, jassids and mirids, were present in most trials and required occasional additional sprays to reduce damage. Fortunately, most insecticides registered for other pulse crops have pigeonpea listed on the product's label and should provide adequate levels of protection. However, little is known about the economic thresholds for these insect pests and should be a target of future research. Nuclear polyhedral virus products such as Vivus™ have been shown to provide effective control of *Helicoverpa* in preliminary studies with pigeonpea (Trevor Volp, pers. comm.) and should be considered as part of an integrated pest management approach.

*Weeds*

Weeds were not a significant problem in these trials and did not cause any yield loss. The chosen sites were relatively free of most problem weeds, and existing herbicide options were effective. Pre-planting and pre-emergent herbicides such as Valor® and Stomp® were effective for early weed control, but there are only a limited range of post-emergent herbicides available for grass weed control and none registered for broadleaf weed control. In previous research, DPI has conducted preliminary crop safety studies on a range of potential herbicides, and this data could be used to identify candidates for minor use permits, to improve the range of herbicides available for weed control in pigeonpea.

## Conclusion

The results of these successful trials suggest that the pigeonpea experimental lines evaluated in this project are well-adapted to the environments tested in southern and central Queensland. The best lines in favourable dryland environments in 2023-24 yielded 1.4 to 1.9 tonnes/ha. Under more marginal environments in 2024-25, the best lines still produced a grain yield of 0.98 to 1.1 tonnes/ha. It is reasonable to assume that this yield potential can be further enhanced by selecting the best genotypes, improving agronomy practices (planting time, plant population, row spacing, fertiliser, inoculation, insect and weed control) and optimising the harvest process (desiccation, harvest timing and harvester settings). Basic management practices for pigeonpea in these environments were established during previous research and refined through these trials. These practices can be further optimised with additional research and as future growers develop practical experience with the crop.

The pigeonpea experimental lines in this project began flowering 45–50 days after planting and reached physiological maturity within 100–110 days. Importantly, flowering and maturity dates were consistent across sites and planting dates, indicating that these super-quick lines have reduced sensitivity to photoperiod. This will allow farmers greater flexibility to plant these lines opportunistically after sufficient rainfall, rather than waiting for a specific calendar date.

The height of these lines (approximately 60–100 cm) is well suited to modern harvesters without requiring special modifications. Additionally, the absence of lodging ensures clean harvesting free from soil or stone contamination. Pigeonpea demonstrates high tolerance to rainfall during harvest, resulting in minimal losses due to sprouting or pod splitting.

Controlling insects will be key for successful production. Pigeonpea is especially vulnerable *Helicoverpa spp.* and *Maruca vitrata* during flowering and podding. Where insects are not adequately managed, yield loss can occur or crop development can be delayed, as occurred in the Kingaroy and Emerald sites respectively. Previous research by the DPI Pigeonpea Initiative suggests that these caterpillars and other pests can be controlled by use of currently registered insecticides and biocontrol agents. Further research is required to identify economic thresholds for insecticide use and to confirm whether other potential insect pests, such as mirids, contribute to economic losses. The development of an integrated pest management system for pigeonpea is highly advisable to reduce the cost of insect control and prolong the life of current insecticides.

Although weeds were not a significant constraint in these trials, there are significant gaps in the registered herbicides for post-emergent control of grasses and broadleaf weeds. There are also gaps in our understanding of how pigeonpea may be affected by residual herbicides, which are increasingly common in farming systems. Pigeonpea would benefit from an integrated weed management approach, combining agronomic practices with herbicide use, to reduce management costs, improve yields and reduce long-term weed seed banks. GRDC should explore options for minor use permits for additional herbicide modes of action to allow in-crop control of grass and broad leaf weeds.

These results confirm that pigeonpea is a viable crop for dryland farming in southern Queensland, but its potential in central Queensland remains less clear. Grain yield results suggest that the best varieties in southern Qld will also perform adequately in central Qld to allow commercial release. However, the highly variable climate and the lack of trial data from a range of sowing dates reduce the level of confidence in recommendations for central Qld. Additionally, the incidence of charcoal rot (*Macrophomina phaseolina*) in both years suggests that this disease may be an issue for pigeonpea production in central Queensland if susceptible varieties are grown. Future field trials in central Qld with varied planting dates and environmental conditions may provide a clearer understanding. The commencement of the GRDC Investment 'Alternative Pulses for Central Qld' project in summer 2025-26 should provide further information.

### References

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