



NORTHERN

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# GRDC™ GROWNOTES™



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GRAINS RESEARCH  
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# PEANUTS

## SECTION 4

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## PLANT GROWTH AND PHYSIOLOGY

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BOTANICAL TYPES | GROWTH AND DEVELOPMENT | SEED DORMANCY



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# Plant growth and physiology

The peanut (*Arachis hypogaea*) is a summer-growing legume that originated in South America and is well adapted to warmer regions of Australia. If conditions allow, it can show perennial characteristics and survive for several years.

Like other legumes, peanuts do not rely on soluble N in the soil to supply the plant's N requirements. Rather, rhizobial bacteria 'infect' the roots and take N<sub>2</sub> from the atmosphere, making it available to the plant. Unlike other legumes, the mature fruit develops into a legume pod underground (Photo 1) and the plant has four leaflets per leaf, not three.



**Photo 1:** *Inverted peanut bush.*

Peanut pods are made up of an outer shell that usually contains two kernels. About 70% of the pod's weight is kernel. The kernels are high in oil (44–56%) and protein (22–30%). Depending on variety and conditions, the peanut plant can grow to a height of ~60 cm and can spread up to 100 cm. The plant is unique in that it flowers aboveground and then, once pollinated, produces its fruit below the soil surface.

The flowers, which are small, yellow and pea-shaped, are produced in the axils of the leaves. The flowers are self-pollinated, usually at night. After the ovary is fertilised it begins to elongate and grow towards the soil.

This 'peg' (as it is called) reaches the soil about 7–10 days after pollination. The ovary is carried in the tip of the peg and starts to grow into a pod after it pushes into the soil. Pods will not develop unless there is darkness, mechanical resistance and moisture.<sup>1</sup>

## 4.1 Botanical types

Peanuts are divided into two broad botanical types based on the following differences:

- the branching pattern of the plant
- the dormancy of the seed
- the maturity of the plant.

The Virginia group does not produce flowers on the central branch, only on the lateral branches. The seeds show some dormancy and the crop is relatively late maturing (130–170 days). Within the Virginia group, there are both erect and Runner (prostrate) types (Photo 2).

<sup>1</sup> PCA/DPIF (2007) The peanut plant, Peanut Company of Australia/Department of Primary Industries and Fisheries Queensland, [http://www.pca.com.au/bmp/pdfs/2a\\_peanut\\_plant.pdf](http://www.pca.com.au/bmp/pdfs/2a_peanut_plant.pdf)

**i** MORE INFORMATION

GC Wright *et al.* (1991) Physiological analysis of peanut cultivar response to timing and duration of drought stress. *Australian Journal of Agricultural Research* 42.

RCN Rachaputi. More efficient breeding of drought-resistant peanuts in India and Australia. Adoption of ACIAR Project outputs 2003–2004.



**Photo 2:** Some varieties have runner, or prostrate, growth habit.

The Spanish group produces erect plants with flowers on both the central and lateral branches. The seeds of the Spanish group show little dormancy and the crop is early-maturing (100–130 days).

The crop matures in about 18–24 weeks depending on variety and season temperatures (Photo 3).<sup>2</sup>

Forage peanuts are used for grazing and for groundcover in orchards. These are different species from the varieties grown for their edible kernels. One species, Pinto’s peanut (*Arachis pintoi*), is grown in areas of Queensland and NSW with average annual rainfall >1,000 mm. The kernels are much smaller than the cultivated types and are not suitable for the edible trade.<sup>3</sup>

<sup>2</sup> G Wright, L Wieck, P Harden (2015) Peanut production guide, August 2015. Peanut Company of Australia, <http://www.pca.com.au/wp-content/uploads/2016/11/PWH-Peanut-Production-Guide-2015.pdf>

<sup>3</sup> PCA/DPIF (2007) The peanut plant. Peanut Company of Australia/Department of Primary Industries and Fisheries Queensland, [http://www.pca.com.au/bmp/pdfs/2a\\_peanut\\_plant.pdf](http://www.pca.com.au/bmp/pdfs/2a_peanut_plant.pdf)



**i MORE INFORMATION**

KJ Boote (1982) Growth stages of peanut (*Arachis hypogaea* L.). *Peanut Science* 9.

BE Warrick. Plant growth and development of peanuts. Soil, Crop and More Information.



**Photo 3:** Trials such as this help plant breeders to assess the qualities of new varieties under field conditions.

## 4.2 Growth and development

The length of each growth stage depends mainly on temperature. Peanuts are not as sensitive to daylength as soybeans; however, long days and high night temperatures can alter the balance between growth of the bush and the pods. A typical growth cycle for a Virginia variety in both south and north Queensland is shown in Table 1.<sup>4</sup>

**Table 1:** Growth stages of a Virginia peanut variety in southern and northern Queensland.

Growth stage	Days after planting	
	Southern Qld	Northern Qld
Planting to emergence	6–14	6–12
Emergence to first flower	20–40	28–38
Flowering	35–65	28–65
Pegging	45–75	36–75
Pod-filling	60–130	55–130
Harvest maturity	140–150	125–150

### 4.2.1 Germination and emergence

A peanut seed has two cotyledons, or seed leaves, and an embryo. After emergence, the cotyledons unfold above the ground. The embryo is not totally protected by the cotyledons and can easily be physically damaged during the harvesting, storage, shelling and planting operations.

A damaged embryo will not develop properly, and although it may germinate and establish, yield will be much lower than from undamaged seed. Plants growing from

<sup>4</sup> PCA/DPIF (2007) The peanut plant, Peanut Company of Australia/Department of Primary Industries and Fisheries Queensland, [http://www.pca.com.au/bmp/pdfs/2a\\_peanut\\_plant.pdf](http://www.pca.com.au/bmp/pdfs/2a_peanut_plant.pdf)

damaged seed often have a curled or J-shaped root system. This defect can also be a symptom of pre-emergence herbicide damage.

It is recommended that peanut seed is planted at soil temperatures of at least 18–20°C, but seed will germinate best at soil temperatures of 20–35°C. The radicle, or root, takes 1–2 days to emerge from the seed.

After 5 days, the taproot is 10–15 cm long. Lateral roots then start to develop and secondary roots grow from the laterals. After 5–10 days, the root is supplying minerals from the soil to the plant.



**Photo 4:** Peanuts take 7–14 days to emerge.

Effective rooting depth of the peanut plant is ~100–120 cm. Where there are no soil restrictions, the peanut plant has a long, spike-shaped root up to 150 cm long, with the primary root system branching to a depth of 60–80 cm.

Emergence through the soil, known as ‘cracking’, begins 6–14 days after planting (Photo 4). Dry or cool soils can delay emergence for up to 3 weeks, often resulting in poor establishment due to soil-borne disease.

Emerging peanut seedlings can push through quite hard and crusted soil, hence the term ‘cracking’, but very crusted soil will restrict emergence.<sup>5</sup>

#### 4.2.2 Vegetative growth

After 20 days, there may be 8–10 fully expanded leaves. Unlike most legumes, peanuts have 4 leaflets per leaf, which partially fold up at night.

Peanut foliage can grow at a daily rate of 150–200 kg/ha once full canopy cover is reached.

Peanuts are indeterminate in vegetative and reproductive development. This means the plant does not stop growing in order to flower and produce a crop. Plants continue to grow leaves and stems while flowering and setting pods. The pods must, therefore, compete with the shoots for carbohydrate and nutrients. Indeterminate crops are more likely to be able to compensate for low levels of insect damage.

There are differences in determinacy between varieties. The Virginia types are more determinate than Spanish types. Newer varieties achieve higher pod yields than older

<sup>5</sup> PCA/DPIF (2007) The peanut plant, Peanut Company of Australia/Department of Primary Industries and Fisheries Queensland, [http://www.pca.com.au/bmp/pdfs/2a\\_peanut\\_plant.pdf](http://www.pca.com.au/bmp/pdfs/2a_peanut_plant.pdf)



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varieties, because a larger portion of the newer varieties' growth goes into pods than to vegetation.

### 4.2.3 Flowering

Virginia types, including the Runner types typically grown today, start flowering about 28–40 days after emergence and continue for 25–30 days. Flowers can appear throughout the season.

The yellow flowers open at night, self-pollinate in the early morning and wither by evening of the same day (Photo 5). Flowers grow along the branches and each node can produce several flowers. Generally, only ~15–20% of flowers successfully produce a pod. A plant may have 200 pods.

Drought and temperatures >35°C will reduce the number of flowers produced. If water stress reduces flower number, the plant can recover by producing a flush of flowers when adequate water is received.

Low humidity and high temperatures at flowering can cause short-term plant water stress. This results in flowers with pistils that are too short and adversely affects the vitality of the pollen grains, reducing the chances of fertilisation.

Peanuts are self-pollinated; therefore, bees are not needed and different varieties can be grown side by side with little contamination.<sup>6</sup>



**Photo 5:** The small yellow flowers open at night, self-pollinate in the early morning and wither by evening.

### 4.2.4 Pegging

After the ovary is fertilised, it begins to elongate and bend towards the soil. The peg, or strings, can be seen about 1 week after fertilisation. The pegs hang down from the stems and continue to grow until they have penetrated the soil (Photo 6). Because one node can produce several flowers, several pegs can develop from a single node.

Pegs may be 2–15 cm long. However, those longer than ~7 cm often do not reach the ground or penetrate the soil adequately. If these long pegs develop a pod, it is more likely to be immature and lost at harvest.

<sup>6</sup> PCA/DPIF (2007) The peanut plant, Peanut Company of Australia/Department of Primary Industries and Fisheries Queensland, [http://www.pca.com.au/bmp/pdfs/2a\\_peanut\\_plant.pdf](http://www.pca.com.au/bmp/pdfs/2a_peanut_plant.pdf)



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Pegs enter the soil 8–12 days after pollination. The tip of the peg is sharp, allowing it to penetrate the soil to a depth of 1–7 cm under cool, moist conditions. Most of the pegs that only penetrate 1–1.5 cm develop a pod, but the rate of development is slower.

As soils become harder, it is more difficult for the pegs to penetrate. The pegs are more sensitive to soil compaction than are the roots, so soil moisture, which ‘softens’ hard soils, can be critical at this stage.

The fertilised embryo is in the tip of the peg and begins to develop and enlarge soon after entering the soil. After the tip of the peg enlarges underground, it is called a pod.<sup>7</sup>



**Photo 6:** *The peg forms at the base of the flower and grows down into the soil before the pods begin to develop*

### 4.2.5 Pod development

The period between the peg entering the soil and the shell reaching full size is called pod development. Pod development lasts ~30 days and relies on the soil surface being kept moist. This is a critical time for irrigators.<sup>8</sup>

### 4.2.6 Podfill

From about 60 days onwards, pods are formed and filled. Pods are full size about 3–4 weeks after peg burial, even though seed growth inside the pod has barely begun. The shell reaches maximum dry weight well before the kernels.

Peanut pod numbers can increase at a daily rate of 100,000–500,000 pods/ha over a 15–25-day period, and pod weight can increase at a daily rate of up to 100 kg/ha for the 75–150 days after emergence.

<sup>7</sup> PCA/DPIF (2007) The peanut plant, Peanut Company of Australia/Department of Primary Industries and Fisheries Queensland, [http://www.pca.com.au/bmp/pdfs/2a\\_peanut\\_plant.pdf](http://www.pca.com.au/bmp/pdfs/2a_peanut_plant.pdf)

<sup>8</sup> PCA/DPIF (2007) The peanut plant, Peanut Company of Australia/Department of Primary Industries and Fisheries Queensland, [http://www.pca.com.au/bmp/pdfs/2a\\_peanut\\_plant.pdf](http://www.pca.com.au/bmp/pdfs/2a_peanut_plant.pdf)



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Some nutrients, particularly Ca and boron, are absorbed through minute hairs on the peg and shell. This method of nutrient uptake is relatively inefficient, which means that peanuts have a much higher soil Ca requirement in the top 5–10 cm of soil than other plants.

When soil Ca levels are very low, the developing kernels abort and the empty shell is called a 'pop' (Photo 7).<sup>9</sup>



**Photo 7:** Pops (shells without a kernel or with a shrivelled kernel) of Virginia or Runner types are typical of low soil calcium levels. A mild deficiency may cause the embryo to turn dark.

### 4.2.7 Maturity

Crops may take 110–170 days (16–24 weeks) to reach harvest maturity, depending on variety, planting time, seasonal conditions and location. Temperature largely controls the time to harvest.

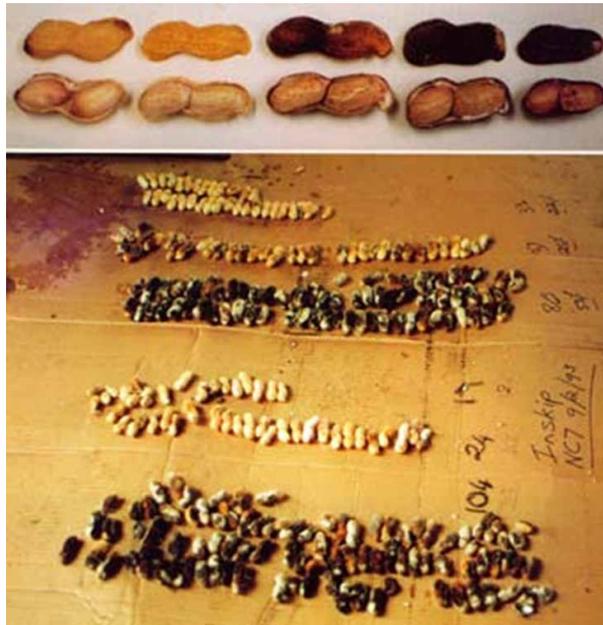
As peanuts mature, the inside layer of the shell changes colour from white, through yellow, orange, brown to black. This gives an indication of harvest maturity.

Once the pods mature, the pegs begin to deteriorate, particularly if foliar diseases have affected the crop. Yield loss begins to occur if peanuts are not harvested within 7–10 days of peak maturity, because the pegs weaken and the pods fall off the plant.

Peanuts often produce a very uneven crop, with a range of mature and immature kernels present at harvest. The relative proportion of mature and immature kernels is assessed and will affect the quality grading of the crop (Photo 8). The payment systems are based on grading the crop into different-sized kernels, each with a different value. Immature or small kernels receive a lower price.<sup>10</sup>

<sup>9</sup> PCA/DPIF (2007) The peanut plant. Peanut Company of Australia/Department of Primary Industries and Fisheries Queensland, [http://www.pca.com.au/bmp/pdfs/2a\\_peanut\\_plant.pdf](http://www.pca.com.au/bmp/pdfs/2a_peanut_plant.pdf)

<sup>10</sup> PCA/DPIF (2007) The peanut plant. Peanut Company of Australia/Department of Primary Industries and Fisheries Queensland, [http://www.pca.com.au/bmp/pdfs/2a\\_peanut\\_plant.pdf](http://www.pca.com.au/bmp/pdfs/2a_peanut_plant.pdf)



**Photo 8:** *Inspect the kernels to determine the best time to harvest.*

### 4.3 Seed dormancy

Mature peanut kernels are dormant to some degree. Interestingly, seeds that develop at the peg end of the pod have a longer dormant period than those at the opposite end.

The period of dormancy depends on variety and storage conditions.

Spanish types have virtually no dormancy (5–50 days), whereas Virginia types can be dormant for 100–120 days.

If sufficient moisture is available, seeds with little or no dormancy period can sprout in the field before harvest. Currently grown Spanish varieties can have this problem, but pre-harvest sprouting is generally not problem with Virginia or Runner types.<sup>11</sup>

<sup>11</sup> PCA/DPIF (2007) The peanut plant, Peanut Company of Australia/Department of Primary Industries and Fisheries Queensland, [http://www.pca.com.au/bmp/pdfs/2a\\_peanut\\_plant.pdf](http://www.pca.com.au/bmp/pdfs/2a_peanut_plant.pdf)