



1 Peanuts in Papua New Guinea

- Peanuts are a good income earner and an excellent protein source.
- Growing peanuts improves soil health.
- Residues left after harvest make good animal feed.

1.1 Introduction

Peanuts (*Arachis hypogaea*) are a hardy and well-adapted crop for Papua New Guinea (PNG). They are grown in a wide range of local farming systems, including seasonally drier areas and wet coastal regions (Figure 1). In PNG, peanuts are generally grown from sea level up to 1,850 m above sea level. Occasionally, in a few suitable areas, they are grown up to 1,950 m above sea level.

Peanuts originated in South America. Their history in PNG dates back to the early 1870s. During the late 1950s, exports of PNG-grown peanuts exceeded that of coffee. In 1959, 1,897 tonnes of peanuts were exported; in 1963, 2,212 tonnes were exported. A 1996 survey revealed that PNG production was approximately 21,000 tonnes per year. A 2003 survey of four well-known peanut production areas (Eastern Highlands Province, Markam

Valley in Morobe Province, National Capital District and East New Britain Province) produced an estimated 12,600 tonnes of peanuts, which earned a gross income of K29,359,000 (Wemin et al. 2006).

Today, peanuts are an important cash crop among smallholders, peri-urban gardeners and remote villagers. Peanuts are one of the top five popular income-generating crops; after coffee, they provide the major portion of family income in the highlands. Peanuts are particularly important to women, who devote much time and effort to their production and marketing (Photo 1). Farmers in remote villages appreciate peanuts as a crop that is easy to transport to markets, compared with other bulky and perishable crops such as sweet potato, Irish potato, banana, yam and taro. Larger agricultural enterprises see peanuts as an important rotational crop that has the potential to provide a cash return.

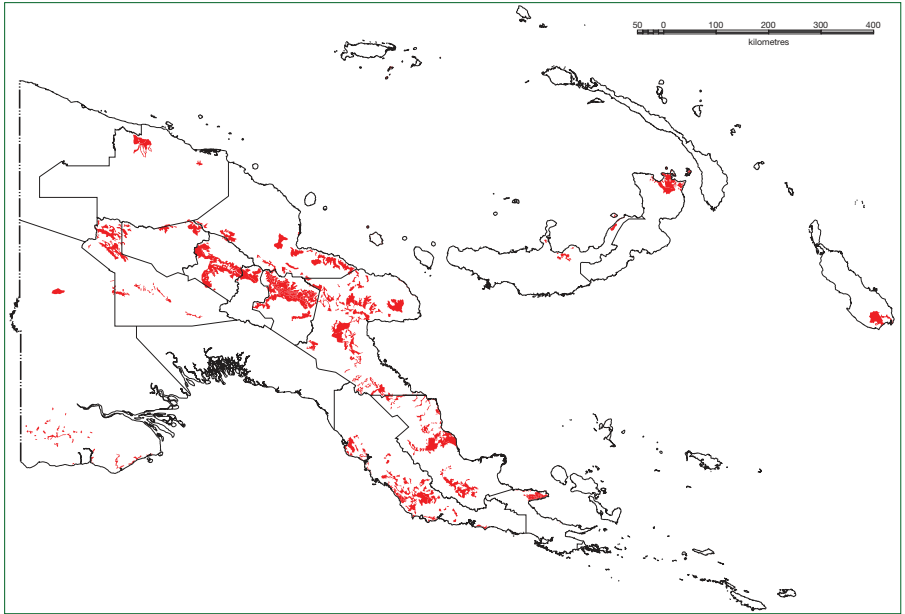


Figure 1 Distribution of peanuts in Papua New Guinea

(Source: Bourke and Harwood 2007)

From the 1960s to the mid 1980s, substantial efforts were made to establish a commercial peanut industry in the Markham Valley. The larger scale production, handling and marketing options resulted in larger field sizes, and the crop gained greater value as a source of income. The Markham area continues to reflect the ongoing importance of peanuts as a cash income source rather than a subsistence crop. The value of the peanut crop and the larger scale of operations mean that this area also has the most mechanised land preparation.

Nearly all peanuts produced in PNG are consumed domestically as food, and they represent an important part of the diet. However, yields can be erratic, and some are low (0.6 tonnes per hectare in the Eastern Highlands compared with 1.5 tonnes per hectare in the Western Highlands).

1.2 Why grow peanuts?

Peanuts are a recognised income-earning crop. In many areas, they are a major source of cash income for women. In coffee production areas, peanuts have been ranked the second highest income earner after coffee.



Photo 1 Earning cash income at a local market (Photo: D. Homare, NARI)



Photo 2 Peanuts are a healthy food source (Photo: L. Kuniata, Ramu Agri-Industries Ltd)

In a 2004 peanut production survey (Wemin and Geob 2004), every farmer indicated that they believed peanuts are a crop here to stay, and that there is much potential for further crop processing.

Peanuts are one of the most nutritious crops available and complement cereal and tuber food staples, which on their own lack the essential proteins necessary for a balanced diet (Photo 2). Peanuts can be used as a raw food, or preferably be cooked. As they contain 25–30% protein (on a dry weight basis) and 45% oil, peanuts provide an inexpensive, high-protein and high-energy food for humans and livestock. They can be made into products such as peanut butter (Photos 3, 4) or peanut oil, and are also a widely used ingredient in sweet biscuits, confectionery and ice-cream products.

Because peanuts are a legume crop, they are able to convert nitrogen from the air into a form that is available to the plants. Nodules on peanut roots contain soil bacteria called rhizobia that ‘fix’ nitrogen from the air. So growing peanuts helps to make soil more



Photo 3 Making peanut butter at a field day (Photo: A. Ramakrishna, NARI)

fertile, because some of the nitrogen they have fixed remains in the soil for the next crop. Returning peanut stems and other residue to the soil also helps improve soil fertility.

All parts of the peanut plant can be used for feeding cattle, pigs and poultry. After the pods are removed, peanut plants are high-quality feed (more than 10% protein) if most of the leaves are retained. The protein content will fall if leaf drop occurs as a result of diseases such as leaf spot or rust. After extracting



Photo 4 Savouring the taste of locally made peanut butter (Photo: A. Ramakrishna, NARI)

peanut oil, the remaining meal can be sold as a livestock feed. Empty peanut shells can also be used in cattle ration feed, as fuel, or for floorcovering litter in pig and poultry houses. Although peanuts are a good food source, animals or poultry must not be fed poor-quality peanuts; they may contain aflatoxins (Section 9), which can reduce animal growth and performance and, in extreme cases, can kill poultry.



2 Growth of the peanut plant

- Peanut seeds germinate in 5–7 days and emerge 6–14 days after planting.
- Peanuts are indeterminate in vegetative growth and reproduction.
- Flowering usually starts 3–5 weeks after emergence and continues for 4 weeks.
- Peanuts produce their pods underground.
- Pod maturation takes about 60 days from fertilisation.
- A summary of growth stages is given in Table 1.

2.1 Temperature

Peanut growth and development is controlled by temperature. The ideal growth temperature is 30°C; once night temperatures drop below 17°C, growth slows. Dry matter production drops by 25% when the night temperature reaches 15°C, and drops by 50% at 10°C. Temperatures above 35°C also slow growth.

2.2 Germination and emergence

A peanut seed is made up of an outer testa (skin), two cotyledons (seed leaves) and an embryo. The embryo is not totally protected by the cotyledons and can easily be damaged; therefore, care must be taken during harvesting, storage, shelling and planting.

Peanut seed germinates best between 20°C and 35°C. The crop germinates between 5 and 7 days after planting; a 10–15-cm-long taproot grows into the soil, and the cotyledons start emerging from the seed. Peanut seedlings can push through quite crusted soils. The cotyledons emerge ('crack') from the soil 6–14 days after planting, and unfold above the ground.

2.3 Vegetative growth

Unlike most other legumes, peanuts produce their fruit underground, and have four leaflets per leaf, instead of three. The leaflets partially fold up at night.

Peanuts are indeterminate in vegetative and reproductive development; this means the plant continues to grow leaves and stems

while it flowers and sets pods. Therefore, unlike determinate crops, which only have one flowering and fruit set, peanut pods constantly compete with the shoot for carbohydrates and nutrients.

2.4 Flowering

Flowering usually starts around 21–35 days after emergence, and continues at a high rate for about another 28 days, after which it slows considerably. Flowers are produced along the branches, and several can be produced at each node. Flowers can appear throughout the season.

Peanut plants have yellow flowers that open at night and are self-pollinated; therefore, bees are not needed for pollination. Usually, only 15–20% of flowers produce a pod.

2.5 Pegging

About 4–5 days after the ovary is fertilised, it begins to elongate and bend towards the soil. This is called a 'peg', and it enters the soil 8–12 days after fertilisation. The sharp tip of the peg allows it to penetrate the soil to a depth of 1–7 cm, if the soil is cool and moist. Pegs are more sensitive to soil compaction than roots are; as soils become harder, pegs can not penetrate as well.

The fertilised embryo in the tip of the peg develops and enlarges soon after the peg enters the soil. Several pegs can develop from a single node. Once the tips of the pegs have enlarged underground, they are called pods.



Photo 5 A mature peanut plant
(Photo: NARI)

2.6 Pod development

Pod development is the period between a peg entering the soil and the shell reaching full size. Pods take about 21–28 days to reach full size.

2.7 Pod fill

From about 60 days after planting, pods (shells) form and these are filled with developing kernels (seeds). The developing kernel takes some nutrients, particularly calcium and boron, directly from the soil through fine hairs on the pod. Refer to Section 4.2 for more information.

Table 1 Summary of peanut growth stages

Germination and emergence	<ul style="list-style-type: none">• Seed germinates between 5 and 7 days• Seedling emerges from the ground between 6 and 14 days
Vegetative growth	<ul style="list-style-type: none">• Seedling grows into plant• Plant continues to produce leaves and stems
Flowering	<ul style="list-style-type: none">• Starts 21–35 days after emergence• Major flowering period is 28 days• A small number of flowers continue to be produced for the rest of the plant's life
Pegging	<ul style="list-style-type: none">• Fertilised flowers produce a peg that grows down into the ground• Usually only 15–20% of flowers produce a peg
Pod development	<ul style="list-style-type: none">• After the peg enters the ground, its tip starts bulging and develops into a pod• The pod takes about 21–28 days to reach full size
Pod fill	<ul style="list-style-type: none">• Peanut kernels (seeds) grow inside the pod
Maturity	<ul style="list-style-type: none">• The shells harden• Internal shell colour changes to black• Plants are harvested when a large percentage of pods are mature

2.8 Maturity

As peanut pods mature, the shells harden. The internal shell colour changes from white to black, passing through yellow, orange and brown stages in between. The colour change inside the shell can be used as a guide to maturity (for further details, see Section 8.2.2). When the internal shell turns black, the peanut kernel is fully mature and starts separating from the shell. Photo 5 shows a mature peanut plant.

2.9 Seed dormancy

In most varieties, mature peanut kernels are dormant to some degree. Newly harvested kernels will not germinate straight away. The period of dormancy depends on the variety and storage conditions. If there is enough moisture available, some low-dormancy varieties may sprout in the field before harvest.



3 Planting requirements

- In some regions of Papua New Guinea, peanuts can be grown all year.
- Planting in the dry season without irrigation may cause poor yield and quality; choose the optimum planting time to avoid severe dry spells during crop growth.
- Peanuts can grow on a range of soils and slopes.
- Fields must:
 - be located in a sunny position and not be shaded
 - have a minimum soil depth of 30 cm to allow good crop growth
 - be well drained and not waterlogged
 - not have hard-setting soils
 - be pig and animal-proof.
- Repeated cropping of peanuts in the same ground can cause a build-up of diseases and pests, leading to a rapid decline in yield; crop rotation will:
 - reduce risk of soil-borne diseases and pests
 - decrease weed problems
 - allow other crops to use nitrogen that peanuts leave behind in the soil.

3.1 Choosing planting time

Peanut growth is sensitive to seasonal temperature and water availability. Although peanuts can grow all year in most Papua New Guinea (PNG) provinces, crops may be exposed to severe drought conditions depending on rainfall distribution during the

growing period. This results in low yields and poor kernel quality. To achieve high yields, the optimum planting time avoids severe dry spells during the crop growing period.

Data are limited for the best planting dates in many areas of PNG. However, peanut crop modelling research in the upper

Markham Valley, conducted as part of this Australian Centre for International Agricultural Research project, showed that October to January is the optimum window for planting peanuts, and that planting after February can result in poor yields (Figure 2) (Chauhan et al. 2006). Delaying planting in the upper Markham Valley may also lead to high aflatoxin risk (Figure 3); see Section 9 for more information on aflatoxins.

Similar yield and aflatoxin scenarios that used daily weather data from Aiyura, Eastern Highlands Province, showed that September to January was the optimum window for planting peanuts in the Aiyura Valley. Yields declined on either side of the optimum planting window, and crops planted from April to June had the lowest yields (Chauhan et al. 2006).

With some irrigation, dry season crops—grown from June to September—can actually produce higher yields and better quality peanuts than the wet season crop. This is because of the extra sunlight and low disease incidence during these months. Wet weather increases the incidence of leaf diseases such as late leaf spot and rust; therefore, foliar disease management becomes critical for high yields in wet season crops. Peanut crops exposed to long periods of wet and cloudy conditions will generally suffer an increased incidence of diseases, significantly reducing yields. See Section 7.5 for further information on diseases and their control.

Peanut crops are not grown in the highlands at altitudes of more than 1,950 m above sea level. These altitudes are too cold and cloudy, preventing peanuts from receiving enough sunlight for growth.

3.2 Choosing a peanut field

Peanuts can be grown successfully on a wide range of soil types and slopes in PNG. They are grown from flat fields to steep slopes of up to 30 degrees, and from the coastal lowlands to the highlands. To grow a good crop, the plants must receive sufficient sunlight; therefore, they must be planted in an open area that is not shaded by other crops or nearby forests.

Peanuts will grow and produce a crop in most soils, but the soil must not be too hard or too wet at harvest time. Long periods of waterlogging reduce oxygen supply to roots and their nodules, which restricts growth. The best soils for peanut crops are light clay loams and sandy loams. These soil types are well drained, have a good structure and do not set hard.

Hard-setting soils and high clay content soils can make harvesting very difficult. If the soil is too hard, it sticks to the pods and the pegs may break.

Peanut fields need to be kept free of pigs and other animals that can dig up plants, damage growing bushes or root up pods.

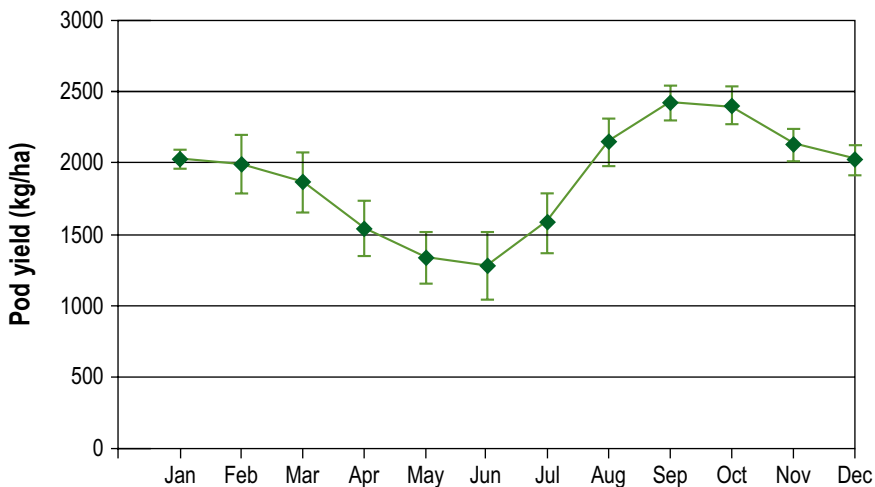


Figure 2 Predicted effect of planting time on pod yield

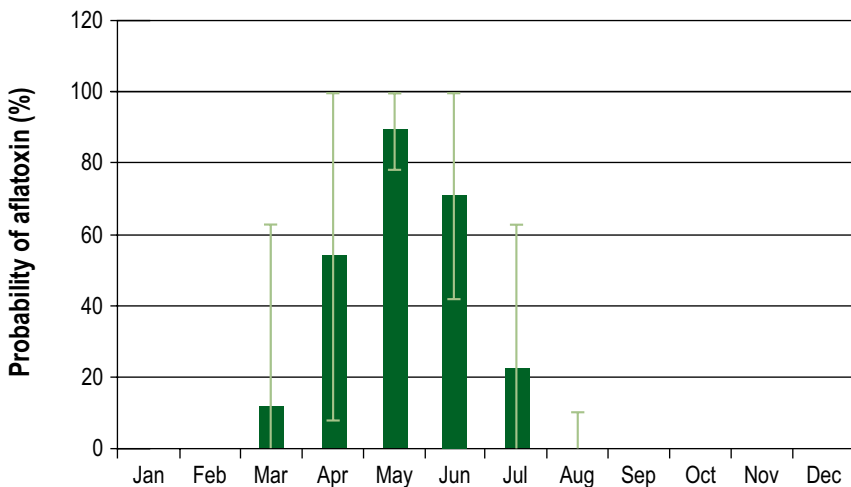


Figure 3 Predicted effect of planting time on aflatoxin risk in short duration varieties grown at Ramu

Note: The yield and aflatoxin scenarios in Figures 2 and 3 are simulated using the Agricultural Production Systems sIMulator (APSIM) peanut model and soil properties and daily weather data of Ramu Sugar during 1995–2006.

3.3 Rotating crops

Peanuts must be rotated with other crops to reduce the build-up of weeds and soil-borne pests and diseases. Planting peanut crops repeatedly in the same soil may reduce yields by up to 15% (DPI&F 2004).

Peanuts fix nitrogen from the atmosphere. Incorporating peanut hay into the soil therefore increases the availability of nitrogen and other nutrients to subsequent crops. Recent research at Ramu Agri-Industries Limited (Dr L. Kuniata, ARD Manager, Ramu Agri-Industries Ltd, pers. comm., 2007) revealed that growing peanuts in rotation with sugarcane increases cane yield compared to cane mono-cropping. Research in Queensland by the Department

of Primary Industries and Fisheries has shown that peanuts provide 50–75 kg nitrogen/ha to following crops (Dr Mike Bell, Principal Agronomist, DPI&F, pers. comm., 2008). As additional benefits, these organic nitrogen reserves leach through the soil less than highly soluble nitrogen fertilisers, and peanut crops often break the disease cycles of plant-specific pathogens (Dr Mike Bell, Principal Agronomist, DPI&F, pers. comm., 2008).

Constantly planting peanut crops one after another also encourages weeds to compete with the peanut crop. Planting a mix of crops will reduce particular weed problems. The best approach to weed control is to eliminate or minimise weeds, and prevent them from seeding in all fields and crop rotations.