GROWING INTRODUCED VEGETABLES IN THE LOWLANDS
1. THE LOWLANDS ENVIRONMENT

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INTRODUCTION

A large number of vegetables have traditionally been used in Papua New Guinea. Many of these grow well in the lowlands. When the missionaries and early colonists came, they brought seeds of other vegetable crops from their own countries. Most of the new introduced vegetables were found to grow well in the temperate highland climate, but many of them did not grow well in the tropical lowlands.

Newcomers to Papua New Guinea often find this difficult to understand, especially when they know that some vegetables like tomato originally came from the tropics. One reason is that these vegetables have been adapted by breeding to suit temperate climates where the temperatures, rainfall, diseases and insect pests are quite different from the lowland tropics.

Good markets have now developed particularly in large lowland urban centres like Port Moresby, Lae, Arawa and Rabaul for vegetables like tomatoes, cabbages and onions. Only part of the total demand for these vegetables is being produced in the lowlands. Some are produced in the highlands but transport to the lowlands is difficult and expensive. A lot of these vegetables are being imported into Papua New Guinea from Australia and New Zealand. So a lot of money is going out of the country, that could be going to local farmers, truck owners and middlemen.

The main thing which determines whether a crop can be grown, is the environment or climate. From research done in the last 10 years, we now know which of these introduced vegetables can be grown in the lowlands, and what the main problems are in producing them.

This article explains what the lowlands environment is like. In the next two articles each of the introduced vegetable crops is discussed, and the environmental or other limits for each species listed. We do not recommend whether a crop should be grown. The closer any crop is to the environmental limits of its cultivation, the harder it will be to grow. Whether it should be grown depends on things like the skill of the farmer, and the market price. In the final article the varieties recommended now are listed for each crop.

THE LOWLAND ENVIRONMENT

Climate and soil are the two most important things that make up the environment. The im-

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portant aspects of climate that affect crop growth in Papua New Guinea are temperature, rainfall, day length and sunshine.

Each crop has certain climatic needs for best growth. The most important aspect of climate for a certain crop might be the maximum or minimum air temperature, the soil temperature, day length or rainfall.

Temperature

For temperatures the mean maximum, mean, and mean minimum air temperatures are important. (The mean is the average.) Soil temperature also affects crop growth.

The main factor that affects temperature in Papua New Guinea is altitude. Basically, air temperature is lower at higher altitudes. Seasonal differences in temperature are only minor compared with differences because of altitude. An increase in altitude of only 400 m can make an important difference in the growth of crops. This is important for some introduced vegetables because they grow better at 500-600 metres above sea level than they do on the coast.

The relationship between the average maximum/minimum air temperature and altitude in Papua New Guinea is shown in the graph on the opposite page.

In the lowlands the temperature is made more even by the ocean. So in inland lowland areas with a dry climate (such as Kaiapit in the Markham Valley), the maximum air temperature is higher that on the coast, and the minimum temperature is lower.

There are two things that influence seasonal changes in temperature at coastal locations. The most important is latitude, and the other is the south-east season.

Latitude means distance from the equator. In general, the further from the equator (further south in Papua New Guinea), the greater the difference between winter and summer. The winter months (cooler ones) are during June, July and August. This is part of the south-east season.

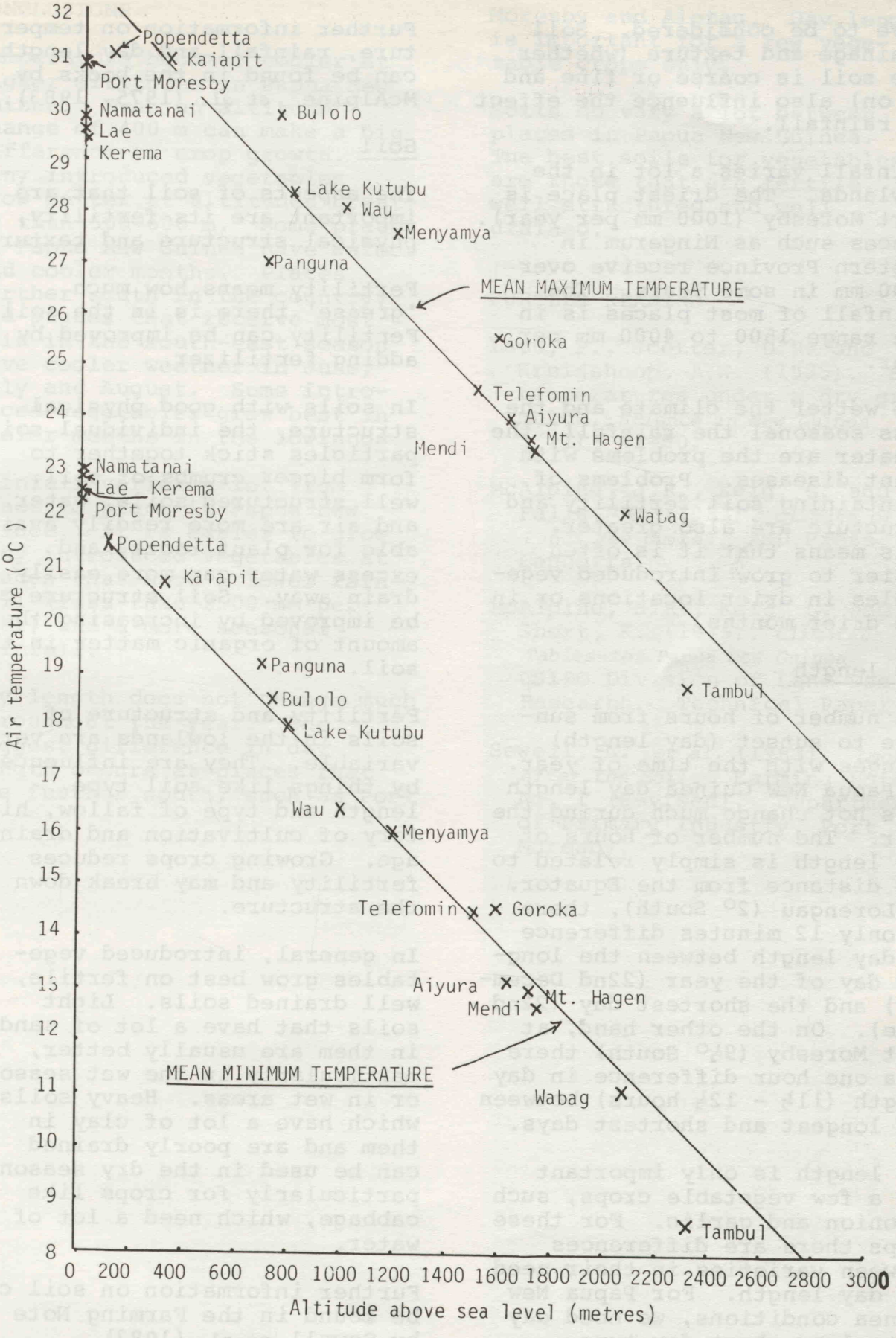
In coastal places like Lae, Finschhafen and Samarai which receive most of their rain during the south-east season, the maximum temperatures are lower at this time of the year. Port Moresby is also a little cooler during the middle of the year.

Smaller seasonal differences in temperature can be important because some of the introduced vegetables will grow in the cooler months in the lowlands, but not in the warmest months.

There is very little information on soil temperatures for the lowlands. Soil temperature changes with depth, soil moisture content and covering of a mulch or a crop. An experiment at UPNG by Latu *et al.* (1975) showed that the top 5 cm of soil under a mulch was about 10°C cooler than under bare soil during the day. At night the soil was about 30°C warmer under the mulch. Surface soil temperatures under bare soil can become very high in the lowlands (up to 50°C) This is too high for growth of many seedlings.

Rainfall

For rainfall, both the total and the seasonal distribution



The relationship between air temperature and altitude in Papua New Guinea

have to be considered. Soil drainage and texture (whether the soil is coarse or fine and so on) also influence the effect of rainfall.

Rainfall varies a lot in the lowlands. The driest place is Port Moresby (1000 mm per year). Places such as Ningerum in Western Province receive over 7000 mm in some years. The rainfall of most places is in the range 1500 to 4000 mm per year.

The wetter the climate and the less seasonal the rainfall, the greater are the problems with plant diseases. Problems of maintaining soil fertility and structure are also greater. This means that it is often easier to grow introduced vegetables in drier locations or in the drier months.

Day length

The number of hours from sunrise to sunset (day length) changes with the time of year. In Papua New Guinea day length does not change much during the year. The number of hours of day length is simply related to the distance from the Equator. At Lorengau (2° South), there is only 12 minutes difference in day length between the longest day of the year (22nd December) and the shortest day (22nd June). On the other hand, at Port Moresby (9½° South) there is a one hour difference in day length (11½ - 12½ hours) between the longest and shortest days.

Day length is only important for a few vegetable crops, such as onion and garlic. For these crops there are differences between varieties in their need for day length. For Papua New Guinea conditions, we need day neutral or short day type varieties.

Further information on temperature, rainfall and day length can be found in the books by McAlpine *et al.* (1975, 1983).

Soil

The aspects of soil that are important are its fertility, physical structure and texture.

Fertility means how much 'grease' there is in the soil. Fertility can be improved by adding fertilizer.

In soils with good physical structure, the individual soil particles stick together to form bigger crumbs of soil. In well structured soils, water and air are more readily available for plant roots, and excess water can more easily drain away. Soil structure can be improved by increasing the amount of organic matter in the soil.

Fertility and structure of soils in the lowlands are very variable. They are influenced by things like soil type, length and type of fallow, history of cultivation and drainage. Growing crops reduces fertility and may break down the structure.

In general, introduced vegetables grow best on fertile, well drained soils. Light soils that have a lot of sand in them are usually better, particularly in the wet season or in wet areas. Heavy soils which have a lot of clay in them and are poorly drained can be used in the dry season, particularly for crops like cabbage, which need a lot of water.

Further information on soil can be found in the Farming Note by Sewell *et al.* (1983).

CONCLUSIONS

Temperature becomes cooler at higher altitudes in Papua New Guinea. Even an altitude change of 400 m can make a big difference to crop growth. Many introduced vegetables grow better at altitudes greater than 500-600 m. Some places in Papua New Guinea have warmer and cooler months. Places further south in the country, and places that receive most rain in the south-east season have cooler weather in June, July and August. Some introduced vegetables grow best in cooler months in the lowlands.

Rainfall varies a lot from place to place in Papua New Guinea. It is easier to grow many introduced vegetables at places that have a lower rainfall (less than 2500 mm per year) and a more seasonal rainfall.

Day length does not change much throughout the year. The biggest difference in day length occurs at places that are further south, such as Port Moresby and Alotau. Day length is important for a few vegetable crops only.

Soils do vary a lot between places in Papua New Guinea. The best soils for vegetables are those that are fertile, well structured and well drained.

FURTHER READING

Latu, F., Scotter, D.R. and Kruijshoop, A.W. (1975). Soil temperatures under a dry grass mulch. *Science in New Guinea* 3 (1): 41-50.

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