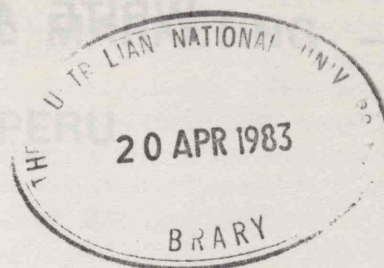


Harvest

volume 8 no. 3
third quarter 1982



HARVEST



Vol. 8, No. 3

Third Quarter 1982

CONTENTS

Solving the problem of rural marketing - an example from Peru - By Joe Mahase	103
Goats in Enga Province - By Ann Southall	107
Papua New Guinea's tuna fishery in 1982 By David J. Doulman	110
Communication - with special reference to D.P.I. By Stuart Hayfield	117
The performance of Irish potato in the highlands By Swithun Goodbody	123
Book Review - The Papua New Guinea Atlas Reviewed by J. Stark	126
Information wanted. A fruit gall wasp of citrus in Papua New Guinea - By Elaine J. Brough	128
Entomology Bulletin: No. 7 Protection of seedlings from cutworm damage - By B.M. Thistleton	131
Entomology Bulletin: No. 19 Fruit flies By J.W. Ismay	134
Entomology Bulletin: No. 20 Insect pests of winged bean. I. <i>Leucoptera</i> - a leaf miner By Elaine J. Brough	138
Plant Pathology Note: No. 18 Bacterial soft rot of vegetables - By Derek Tomlinson	141
Contributions to HARVEST	145
Abbreviations used in HARVEST	146

Editor: Catherine Kilroy

Cover: Busisi Siwaka

WRITE AN ARTICLE FOR HARVEST

Third Quarter 1983

Vol. 8, No. 3

CONTENTS

HARVEST has articles on all aspects of primary industry including agriculture, fisheries, forestry and livestock. It is read by researchers, extension workers, students and teachers all over Papua New Guinea and overseas.

Because of this, HARVEST articles help to keep everyone in touch with new developments in primary industry in Papua New Guinea.

This means that writing an article for HARVEST is a very good way of letting people know about your work and about the primary industries of your area.

There is more information on how to write for HARVEST at the end of this issue. If you have any problems about writing an article then the HARVEST editor will be pleased to help.

Readers' comments on articles in HARVEST or on the magazine in general are welcomed. Please address any letters to The Editor, HARVEST, Publications Section, D.P.I., P.O. Box 417, Konedobu.

SOLVING THE PROBLEM OF RURAL MARKETING -

AN EXAMPLE FROM PERU

By Joe Mahase, Extension Research Officer, Education and Training Branch, D.P.I., Konedobu

INTRODUCTION

Papua New Guinea could home-produce most of its food needs. However, the target of self-sufficiency (producing all our own food) is still a long way off.

One reason for this country's failure to produce enough food is the change in the way people live over the last 10-15 years. Until recently, most people grew their own supply of staple foods. Today many people no longer do this. As a result, staples have become marketable (can be sold for money). Growing food is becoming more commercial and competitive, but at the same time, marketing systems for fresh produce are still undeveloped.

There is definitely better marketing for imported foods such as rice, flour and tinned food. So, in the growing demand for food, local produce is in unfair competition with goods produced specially for marketing.

Problems with marketing can only slow down better production.

In this article a project in Peru, South America, is described. A marketing system was set up in a rural area, with help from the local farmers. Although the project is 'Back-to-front' (that is, a marketing system was set up



The position of the Piura region in Peru, and (inset) the position of Peru.

before there were goods to sell), it is working well and fits in well with the traditional way of life.

SETTING UP THE PROJECT

This 'back-to-front' marketing project was started in the Andean region of Piura, in Peru. This is a mountainous area, isolated from the main economic centres. Agricultural methods are traditional. The area has all the problems of an under-developed, poor and isolated region.

The people there see that their most serious problem is marketing their products.

Before the project started, the sale of any surplus (extra) food production by the farmers was controlled by middlemen. Farmers were forced to buy goods from these people at high prices, in exchange for their farm products. There were no places for storing surplus production. Also there was no Farmers Association where the farmers could get together to solve the problems which faced them all.

The project started after regular contact and discussions between the farmers and the Piura Planning Institute, which is part of the local government organisation. The National University of Piura was asked to design a project to deal with the main problem of marketing. So, in 1976 a project was drawn up within the framework of an Integrated Development Project for the area concerned.

HOW THE PROJECT WORKS

This project brings back into use a very old tradition of *tambos*, and adapts it to a present day need - hence it is called the Tambo project. *Tambos* are traditionally community meeting places along main routes. Today they are basically community centres providing social organization for the peasants. They are designed as training and extension centres where farmers can buy agricultural goods (e.g. fertilizers, tools, seeds) and sell their surpluses. In the project, each tambo will have a storehouse.

The *tambos* are run by the farmers themselves.

All the basic work needed to set up this marketing project is being done through another very old tradition - the *mingas*, i.e. the free contribution of one week's labour per month per family, in collective work. Thus the farmers are building the *tambos* and storehouses, and carrying out road building and road improvements.

Although F.A.O. agreed to help financially, and approved the plans for setting up the *tambos* in 1979, it had taken almost four years before this to obtain full approval. In spite of this, the farmers started working on the project before it had been approved. They could see that they had a real and urgent need and this was enough to push them into action.

Once the collective work began, a peasants association was formed. The association was very necessary because:

1. It formed a permanent and active body responsible for the administration of the *tambos*.
2. It stood up to the private interests who held economic power in the region.
3. It took on the role of distributing goods to the various economic centres.

In 1980, the officers of the peasant association met with members of the University and the permanent team who looked after the project. This meeting led to the setting-up of the first inter-disciplinary team to work in the area.

The agricultural people in the team were able to help farmers to improve production. Since marketing outlets were already

organised, the farmers could feel safe about the sale of their surpluses.

The results of the training for the farmers were quickly seen in successful harvests of maize, beans, peas and potatoes. Livestock rearing also benefited because of better rearing and health care. Overall, the agricultural development in the region has been much improved by the market outlets, run by the people themselves.

The Tambo project is progressing so well, that it has been adopted by a state agency (ORDENORTE) as an experiment in regional planning. As a result, this type of 'back-to-front' approach to rural development, has been accepted.

Participation from the people and local initiative (ideas) are now giving rise to regional and national policy decisions. The University itself became a 'pupil' of the people. It changed its Integrated Development Projects to take more action on a smaller scale, rather than a large scale economic approach.

SOME LESSONS FOR PAPUA NEW GUINEA

The Tambo project is concerned with solving the problem of marketing. The effort in this was used to start off a bigger Integrated Development Project in the area. Perhaps a few lessons could be found in it which are relevant to Papua New Guinea.

1. Marketing before production?

There is a definite increase in the effort to grow more food in Papua New Guinea. New techniques in agriculture - mechan-

ization, improved cultivars, pest and disease control, etc. are being introduced. However, these efforts may not be successful if no proper arrangements are made for distributing and marketing the produce.

For example, Enga Province is already a large producer of vegetables in Papua New Guinea, and has the potential to produce much more. There has been much encouragement for farmers to set up business groups to grow more vegetables, but not for business groups to market them.

Farmers already find it hard to sell their produce because of the difficulty in reaching the main towns. There are no storage facilities at either production or marketing sites. Also there are no refrigerated vehicles to transport produce from the cool climate of the highlands to the hot, humid coastal region.

At the same time we see fresh food from overseas sold at very high prices in, for example, Port Moresby supermarkets. The same varieties are grown in the Highlands. It might be better for this country to transport home-produced vegetables to the main centres and sell them at profitable prices. Transport costs are high, but then so are the costs of transporting produce from overseas.

The Peruvian example points to a lesson in setting up a marketing system as a first step towards improved production. Storage facilities enable some control over production and distribution. Without suitable storehouses it is impossible to regulate supply, as if produce is not sold at once, it goes to waste.

2. Using traditions in development

Papua New Guinea, as well as Peru, has many very rich social institutions which could be used in rural development. There is the Papua New Guinean version of the 'mingas' (voluntary collective work). There is perhaps a need to make more use of these traditions, rather than allowing people to become dependent on help from outside the community.

3. Farmers' Associations

If we see Agricultural Extension work as passing on useful information to as many people as possible, as quickly as possible, then the present one-to-one approach is not really good enough.

Farmers' Associations could help here. Advice and information could be passed on through the Association to all the farmers involved. Farmers could get together and talk about problems together.

Farmers' Associations would be a useful way to start an organised education programme. Also, perhaps more solidarity (supporting each other) amongst farmers would help make rural areas as attractive as urban areas to live in.

FURTHER READING

Zabale, Ana (1981). A 'back-to-front' project in Peru. *Ideas and Action*. No. 140 (1981 Issue 2). F.A.O., United Nations, Rome.

GOATS IN ENGA PROVINCE

By Ann Southall, Livestock Officer, Division of Primary Industry,
Wabag, Enga Province

INTRODUCTION

Enga Province has a population of about 1000 goats. These are owned in groups of twos and threes by local villagers.

Up until May 1981 there was no regular supply of new goats into Enga to provide new blood for the local herds. Hence it was decided to set up a breeding herd at Wabag High School to try and meet the demand for goats in the Province.

In May 1981 seven goats were brought back from the Chimbu Province to form the basis of the herd. Fortunately some money was obtained from an aid organisation to allow more goats to be brought up from Lae and the Southern Highlands. The herd now consists of 20 breeding nannies and two billy goats.

DAILY ROUTINE

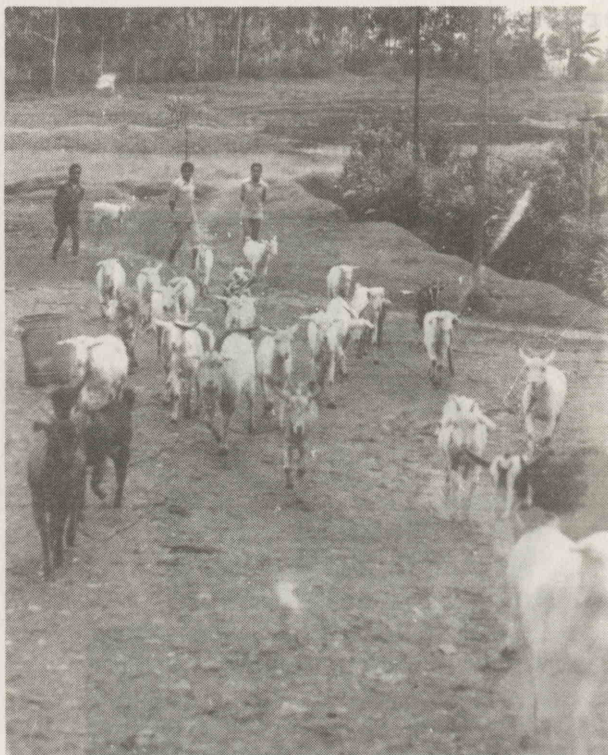
There are four boys in charge of the goats. These boys tether them out in the morning before school starts and bring them in again after school.

Over the Christmas vacation a goat paddock was put up by some of the boys. So now goats are only tethered out when the pasture in the paddock has been eaten down. This gives the pasture time to recover.

Groups of students from different agriculture classes take it in turns to clean out the house where the goats are kept at night. The manure is used on the school gardens. Grass is also cut and dried on top of the goat-house roof to be used as bedding.

HOUSING

The goats are kept in the school piggery at night as there are plenty of spare pens not occupied by pigs. Each pen



Goats being brought out in the morning

has a mineral block to provide the goats with the necessary minerals and salt. This helps to prevent weak new-born kids and breeding problems.

A kidding pen has just been built. New-born kids with their mothers are put here at night. There is a kerosene fire at the side to heat the pen and dried grass is used as bedding. This helps to keep the new-born kids warm and dry and therefore reduces deaths.

HUSBANDRY

Once a month all the goats are drenched for worms by the boys and every two months dung samples are sent to the laboratory in Port Moresby for worm counts to be done. Some goats come into the herd with a nil worm count and are easily infected from other goats with worms. With this regular drenching the worm count of the herd as a whole is decreasing.

Every now and again the hooves are looked at, and trimmed where necessary. Softening of the hooves can be a problem when on wet ground. This is



Drenching a nanny goat for worms

overcome by walking the goats through a foot-bath containing a 5% Formol solution.

BREEDING

The young kids kept as herd replacements are mated when they have stopped growing at 11 months old. They will kid when they are 16 months old. Three months after kidding they will be mated again.

The boys help to keep breeding records of kidding dates, sex of the kids, the number of kids born and when nannie is mated again. This is made easier by the fact that all the goats have numbered ear tags.

To prevent inter-breeding the billy goat will be changed every year. One billy is hired out to local people so that they can introduce new blood into their herds.

So far most of the goats that have kidded have had twins; one even had triplets.

Problems have occurred in some cases with the mothers not having enough colostrum and milk.



Hoof trimming

This has mainly been with new goats brought in from areas with poor pasture. Bottle feeding has been tried in these cases but with very little success.

The weaners which are not kept as herd replacements are sold to local people at 5 months of age for K30.00.

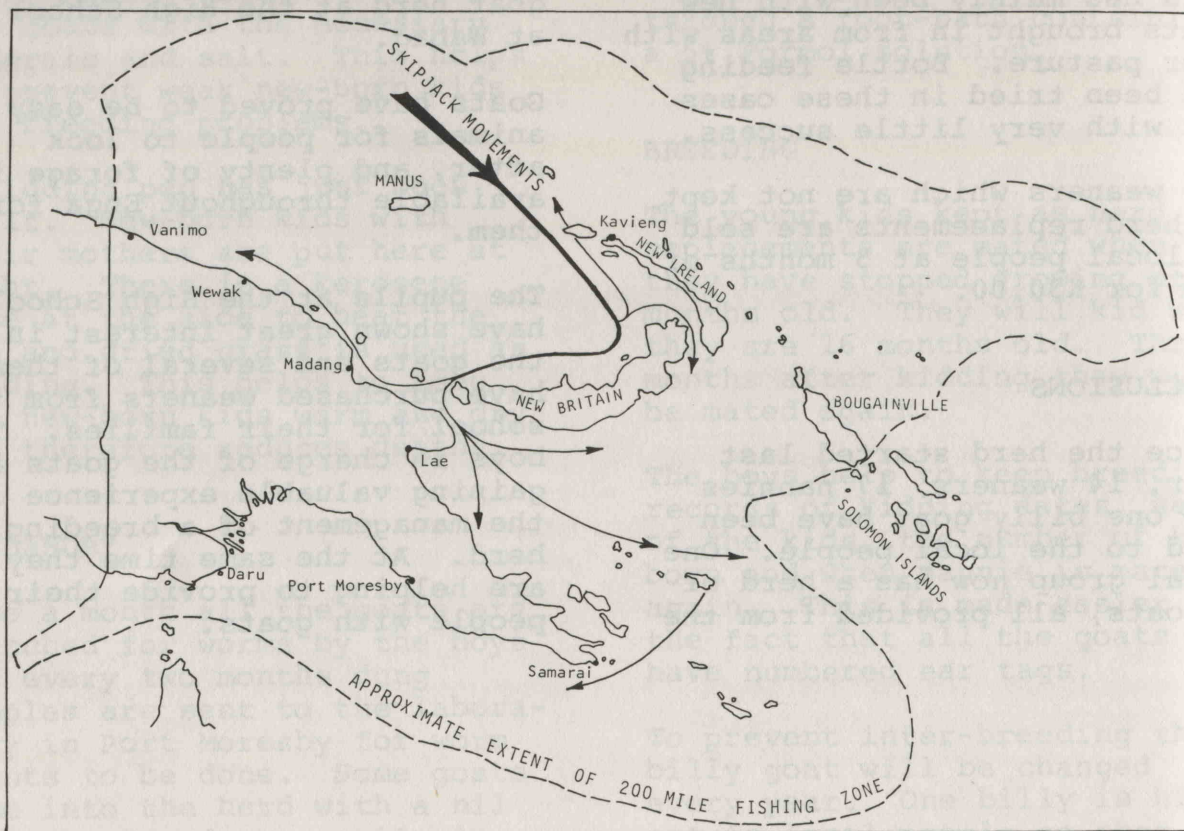
CONCLUSIONS

Since the herd started last year, 14 weaners, 17 nannies and one billy goat have been sold to the local people. One local group now has a herd of 9 goats, all provided from the

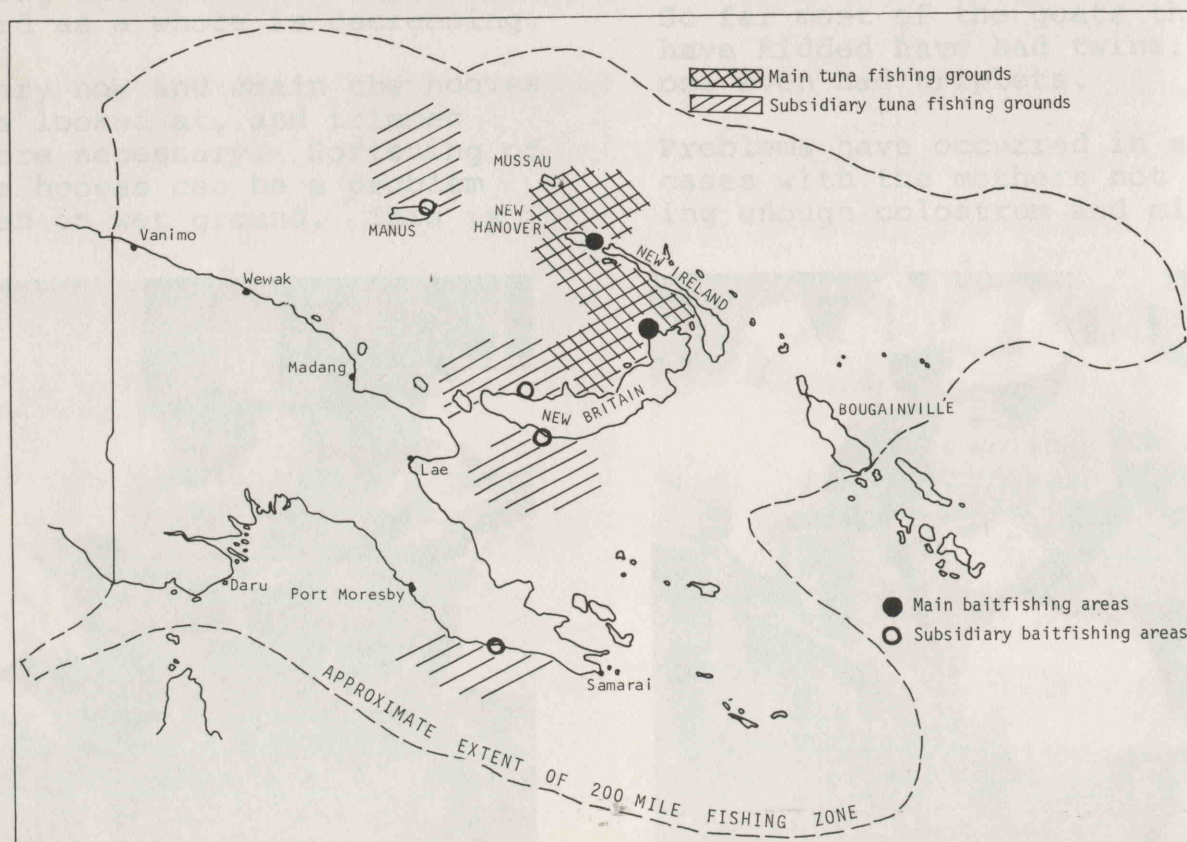
goat herd at the High School at Wabag.

Goats have proved to be easy animals for people to look after, and plenty of forage is available throughout Enga for them.

The pupils at the High School have shown great interest in the goats and several of them have purchased weaners from the school for their families. The boys in charge of the goats are gaining valuable experience in the management of a breeding herd. At the same time they are helping to provide their people with goats.



Skipjack tuna migration patterns in Papua New Guinea waters



The main tuna fishing grounds and baitfishing areas in Papua New Guinea waters

PAPUA NEW GUINEA'S TUNA FISHERY IN 1982

By David J. Doulman, Economist, D.P.I. Fisheries
Division, Kanudi

INTRODUCTION

In recent months there has been much discussion about the status of Papua New Guinea's domestic tuna fishery. It has been correctly reported in the press that the Kavieng-based fishery will not operate in 1982. This means that Papua New Guinea has temporarily lost one of its most important export industries. It will cause unemployment for at least 900 Papua New Guinean fisherman, and others employed by the two fishing companies.

In addition, the country will lose about K20 million in foreign exchange. The national government and the East New Britain Provincial Government will lose between K2 million and K3 million in tax. Also, village people who live where the baitfish are caught will not receive baitfish royalty payments (payment for fish taken out of their traditional waters) of about K0.5 million in 1982.

The purpose of this article is to try to explain some of the very complicated factors that forced the pole and line tuna fishery to close early in 1982.

The article first describes the industry. It then analyses the 1982 situation. It then discusses the action which is being taken internationally to equalise supply and demand.

Finally, conclusions are drawn about the industry's future in Papua New Guinea.

THE TUNA FISHING INDUSTRY

Papua New Guinea's pole and line tuna fishery started operations in 1970. This followed research findings which showed that the waters surrounding Papua New Guinea contained stocks of tuna and baitfish which could support commercial fishing operations. Since the fishery began, most fishing activity has been based around New Hanover in the New Ireland Province and Cape Lambert in the East New Britain Province. This is for two reasons:

- There are reliable supplies of suitable baitfish in these areas.
- It is possible to fish for tuna all year round.

Other areas of Papua New Guinea are also known to have good baitfish grounds. These areas are not fished either because of political problems or because tuna is present only at certain times of the year.

The areas where good baitfish grounds are known to exist, and the main migration patterns within Papua New Guinea waters are shown in the maps on the opposite page.



Fishing for tuna using the pole-and-line method

The pole and line method of catching tuna depends on the use of live baitfish. Baitfish is needed to attract tuna close to the catcher boat.

Whilst fishing, fishermen stand around the bow and stern and hook the tuna with a fishing pole which has a barbless hook attached to it by a short line. After a fish is hooked, the fisherman flicks it over his shoulder onto the boat. He then throws his line back into the water.

After the tuna is caught it is transferred each day to a large mothership which is anchored



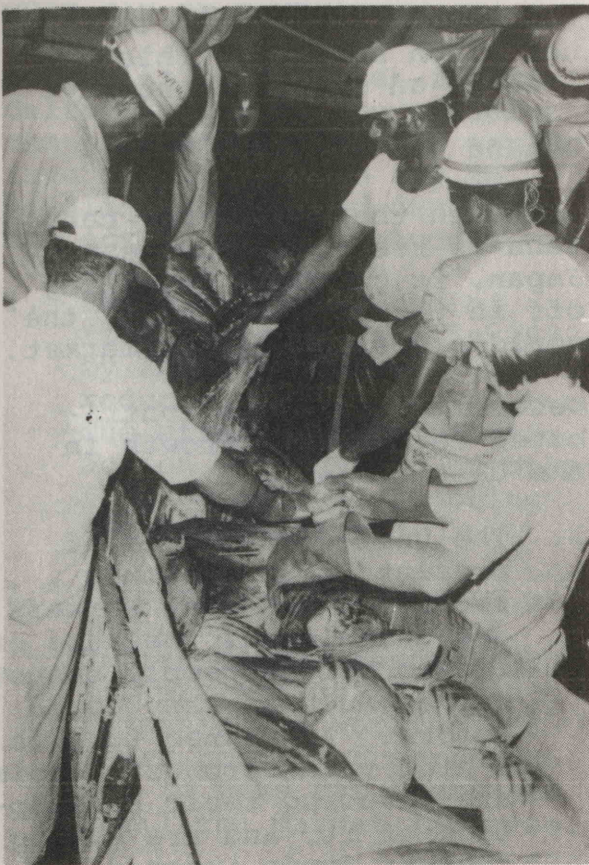
A catcher boat



Taking in a catch of baitfish

close to the baiting grounds. The tuna is stored on the mothership until it is transported to destinations overseas where it is canned.

Initially, all fishermen employed on the catcher boats were from Okinawa in Japan, or from Korea. Now, an increasing number of Papua New Guineans are learning the necessary fishing skills. Each catcher boat employs about 24 people. Around half of these are now Papua New Guineans.



Tuna being transferred on a conveyor belt from a catcher boat to the mothership

Each year about 40 catcher boats operate in the domestic tuna fishery. The total catch of these boats varies from year to year. Fishermen claim that good fishing years alternate with bad fishing years. The highest total catch taken in the fishery was in 1978 (49 000 tonnes). In 1981 only 24 000 tonnes were landed.

In 1980 one of the fishing companies introduced a new method of fishing to Papua New Guinea. The method is called purse-seining. It does not require live baitfish and it uses more complicated equipment than pole and line operations. In future it is expected that purse seining will become more common in the domestic tuna fishery, because it is a more efficient method of fishing than the pole and

line method. As a result, production costs are lower.

Each year the Papua New Guinean pole and line fishing boats produce about 2% of the world's total production of skipjack tuna. Most of the catch goes to the United States, 16% to Japan and 4% to other countries.

The United States is the world's largest market for canned tuna. About 60% of all tuna canned in the world is consumed there. Thus, Papua New Guinea is very dependent on the United States market for the sale of its catch. When that market is depressed, the fishing industry in Papua New Guinea is directly affected.

When the world market price for tuna is low, Papua New Guinea can do little to change the situation, because only a very small percentage of the world tuna production comes from this country. Papua New Guinea has to take whatever prices are offered, however low.

An important part of the tuna fishery is obtaining baitfish. Baitfish royalties are paid by the fishing companies to the people who own the baitfish in return for being able to catch and use the bait. These royalty payments provide a cash income for people who otherwise would have no productive use for the baitfish.

The baitfish royalty payment is set at 2½% of the value of tuna exports. On average, royalty payments made to village people each year have been about K0.5 million.

During 1981 there were two companies based in Papua New Guinea fishing for tuna. They were Star-Kist (PNG) Pty Ltd. (parent company from the United

States) and New Britain Fishing Industries Pty Ltd (parent company from Japan). Both companies have their headquarters in Rabaul.

THE SITUATION IN 1982

In early 1982 Star-Kist and New Britain Fishing Industries indicated that they would not start fishing operations in February as they usually do each year. The companies informed the government that as the world tuna market is very depressed, they would only be able to sell at extremely low prices. At these low prices neither the fishermen nor the companies would be able to cover production costs. They would therefore lose money. The companies decided that the best thing to do, from a financial point of view, would be not to fish in 1982. Their boats would be left un-used until market conditions got better.

To understand the reasons causing the present depression in the world tuna market, we will discuss the two things which determine price: supply and demand. The problem is that world tuna supplies are greater than world tuna demand at the moment.

Supply

Production of skipjack and yellowfin tuna has been rising fast over recent years. Most of the increased production has been coming from the Western Pacific Ocean where stocks of tuna are very high. Most of the vessels fishing there are from the United States, Japan and the Philippines.

The extra tuna being fished is mainly for canning. However,

the demand for canned tuna has not risen so fast. This has lead to an excess of supply.

Demand

Although the demand for canned tuna is rising in Europe and Japan, it has been levelling off in the United States, the world's most important market.

Several things have contributed to the slow growth in the United States.

1. The United States is at present in an economic recession and many workers are unemployed. Because of rising prices people cannot buy as much as they could before. As canned tuna is a high value product people are reducing their consumption of it, and are buying cheaper foods instead.
2. The prices of foods such as poultry and hamburger meat, which people can use instead of tuna, are very low compared to canned tuna. In fact production costs have gone down over recent years because of increased production efficiency in the poultry and grain industries of the United States. So these products have become more attractive from the point of view of price.
3. The tuna canning companies have been trying to reduce their stocks of canned tuna. The reason for this is that it has become too expensive to hold canned products ready for sale. By selling their stocks, they have increased the supply of tuna on the market. At the same time the demand by canners for current production of tuna has gone down.

WHAT CAN BE DONE?

Action is being taken in the United States to try to solve the problems facing the world tuna market, and to try to equalise supply and demand. The action taken includes:

1. Reducing the number of fishing trips made in 1982, by American vessels, and so reducing the supply of tuna. The effectiveness of this action will depend on other fishing nations adopting the same measures.
2. Temporary closing down or reducing the output of United States canneries. Workers are helping the companies by working for fewer hours and agreeing not to have pay increases until the market improves.

By reducing the supply of fish to the canneries and by canneries reducing production, it is hoped to speed up an improvement in the United States tuna market. Indirectly this will benefit the industry in Papua New Guinea.

THE FUTURE OF PAPUA NEW GUINEA'S TUNA FISHERY

Although Papua New Guinea is in a very good position to fish for tuna, the costs involved in our fishery are high compared to other countries.

One way to reduce production costs is for the government to remove taxes on industrial inputs such as fuel. The government could also remove export tax on tuna when export prices fall equal to or below production costs. This system is already used for export crops such as palm oil, copra, coffee and cocoa.

Papua New Guinea needs to try to sell its tuna to countries other than the United States. Europe, especially France, Italy and Spain, is a major market for tuna, and generally higher prices are obtained than in the United States. It is therefore important to develop market outlets in Europe so that the fishery does not depend so much on the United States.



A catch of tuna

CONCLUSION

As with all commodities, prices in the tuna industry move up and down. Based on past trends, tuna prices can be expected to be depressed every 3 or 4 years. However, the depression of prices in 1982 is worse than usual because it has come at the same time as the recession in the United States.

Market commentators are not sure when or by how much, tuna prices will recover. Some people believe that the lowest prices have been reached, and that prices will improve before the end of 1982. Recent price movements indicate that this is likely to be the case.

As economic conditions improve in the United States, the demand for tuna should also improve. Tuna is a preferred food in the United States, so consumers are expected to switch back to it despite competition from cheaper foods.

Experts in economics do not agree about when economic recovery in the United States, will take place. However, there are indications that some recovery is expected by late 1982 and early 1983.

Because Papua New Guinea is part of the international tuna

industry, recovery here will depend on international events - especially in the United States. As a small world producer, there is little Papua New Guinea can do to speed up the recovery of the industry. However, we should realise that the presence of tuna in Papua New Guinea's water is not enough on its own to guarantee a domestic fishery in future. Production costs must be considered so that tuna produced within Papua New Guinea by the domestic fleet costs less compared with tuna from other countries.

FURTHER READING

Dalzell, P.J. (1980). Baitfish research in New Ireland. *Harvest* 6(3): 109-116.

Wankowski, J.W.J. (1979). The Papua New Guinea pole-and-line tuna fishery. *Harvest* 5(2): 109-188.

Wankowski, J.W.J. (1979). The Japanese purse seine tuna fishery. *Harvest* 5(3): 140-151.

Wankowski, J.W.J. (1980). Management of the New Ireland bait fishery. *Harvest* 6(3): 117-123.

COMMUNICATION - WITH SPECIAL REFERENCE TO D.P.I.

By Stuart Hayfield, Area Economist, D.P.I., Daru

INTRODUCTION

Good communication is the key to success. We need it to have a fulfilling life and to carry out our jobs properly. Little or nothing is achieved without communication. Just think of how many times you have communicated today: 'Could I have a beer'; 'please send this letter to Headquarters'; 'I need some help with this project'; and so on.

However, perfect communication is almost impossible. Something always 'gets in the way', or people understand things differently.

This article describes types and levels of communication with particular reference to the Department of Primary Industry. Some suggestions for improving communication are also given.

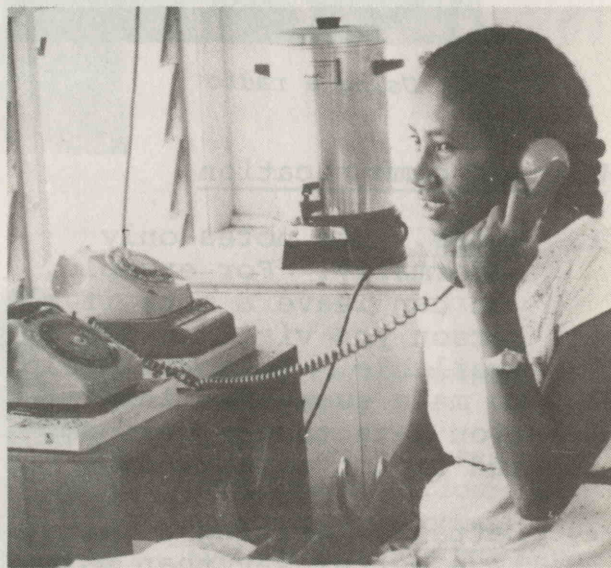
It is hoped that people at all levels will ask themselves such questions as, 'Who else needs to know about the work I am doing?', 'Who could give me help or advice?' and so on.

Communication should always be two-way. Apart from giving out information or instructions, there should be feed-back. Feed-back should be as quick as possible, but the time varies with the different types of communication.

TYPES OF COMMUNICATION

Verbal communication (talking)

1. Face to face. Actually talking to someone face to face is a good way to communicate. A person's reaction and understanding can be seen at once.
2. Telephone. Telephoning sometimes causes misunderstanding, but it is a good way of sending a message immediately to someone not located near you. Unfortunately not all places in Papua New Guinea are linked

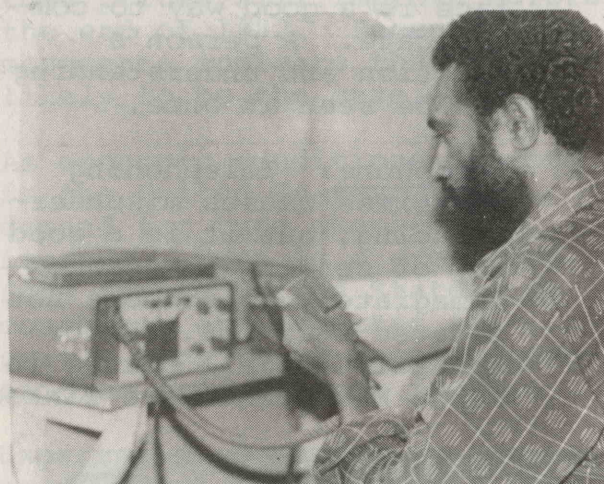


Using a telephone

This article is taken from a paper presented at the D.R.D.O.'s conference in Daru, May 1982.

by phone (e.g. large areas of Western Province have no telephones). Also, using a telephone is quite expensive.

3. Radio. This is useful for contacting outstations. However, using the radio is often limited to 'scheduled' times. Because of interference, the message is not always clear, and some words may have to be spelt out using code (A = alpha, B = beta, C = charlie, etc.).

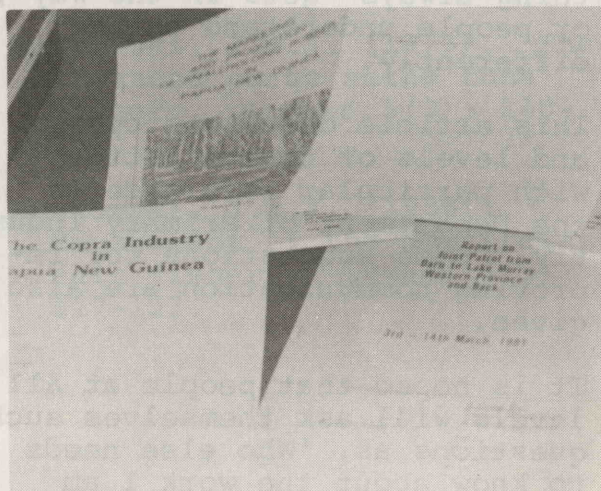


Using a radio

are answered - even if it is just to say that a letter has arrived.

3. Telegrams. Telegrams are used when an urgent message has to be passed quickly to someone. Great care must be taken to prepare a short, clear message. This will save money and prevent misunderstandings. Telegrams can only be sent between places with a telephone or radio. A telex is similar to a telegram. Longer messages can be sent, but both sender and receiver must have a telex machine.

4. Reports. Reports are used for a full explanation of a subject. (For example, patrol reports, feasibility studies, financial statements). They must be circulated to all the people who need to know about the subject.



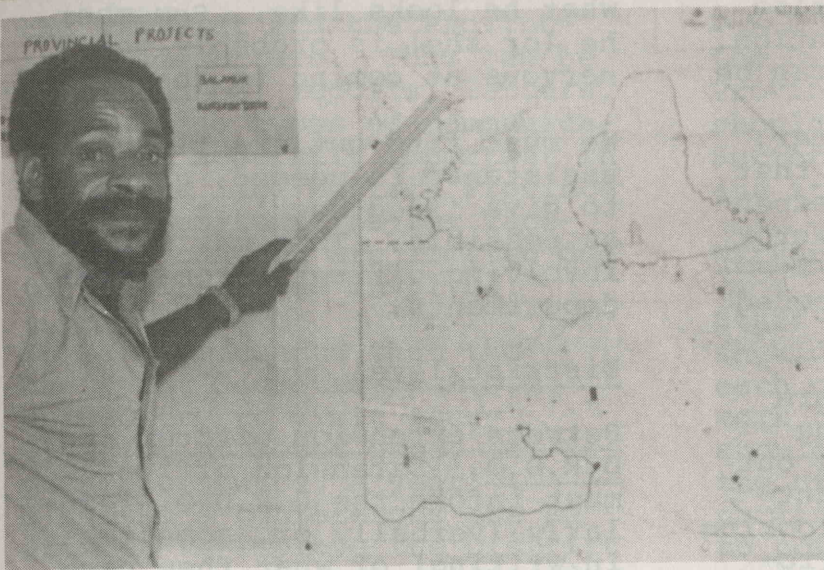
Examples of various reports

Written communication

1. Notes. Use notes only informally. For example, you can leave a note if a person you visit is not available. This will help to make sure that information gets to the person, and is not forgotten.
2. Letters. Writing a letter is a better way than using a telephone or radio to explain complicated things. Also, enclosures (e.g. tables, charts) can be sent. However, the postal service is sometimes slow and we must be patient. Also it is important that letters

Visual communication

1. Charts/posters. These can help make a complicated subject clearer, and they can attract people's attention. Pictures are used to help people remember things better.



VISUAL COMMUNICATION

Baron Nakuk, Provincial Wildlife Officer, Daru, pointing out an area on a map.



COMMUNICATION AT VILLAGE LEVEL

Thomas Malaisa, Provincial Livestock Officer, Daru, talking to a villager about livestock projects.



COMMUNICATION BETWEEN DEPARTMENTS

Kakau Biribudo, Business Development Officer, Rage Augerea, Development Bank, and Iangana Dau and Seyou Baidama from D.P.I. assessing and trying to help a combined pig, poultry and vegetable project owned by Mr Jeffrey Tabua of Daru.

2. Films/videos. These also attract people's attention. Ways of doing things can be shown, and this helps people understand better. The disadvantages are that films and videos are expensive, and a film projector or video machine, and a source of power are needed.

3. Field demonstrations. Field demonstrations are very useful for showing villagers how to carry out procedures such as planting, tapping rubber, looking after animals, etc. Problems are the expense and difficulty in organising such demonstrations. However, they are well worth the effort.

LEVELS OF COMMUNICATION

Village level

The Department of Primary Industry exists to serve the agricultural population, so communication at village level is the most important of all. Without it, all other communication in D.P.I. is almost useless.

The villager is the most important person in our work as D.P.I. officers. We must always be polite, and as helpful as possible. It is best to visit the villager in his own place as often as we can. This involves regular patrols.

We must always be prepared and pleased to talk to a villager who comes into the office for assistance. This happens especially in provinces like Western Province where a lot of villages are hard to reach and therefore not often visited. The villager should be welcomed, not turned away. It does not matter how he is dressed or

what he looks like. Remember, he (or she) is probably very nervous at coming to the office.

We must find out exactly what assistance is needed, and try to give 'feed-back' as quickly as possible. This may mean involving officers from other departments.

District level

Between extension officer and D.R.D.O. Extension officers must inform the D.R.D.O. regularly (verbally or, sometimes, in writing) of what they have been doing. In turn, the D.R.D.O. should comment on this. There needs to be regular advice and checking. It is very important that the D.R.D.O. knows exactly what his staff are doing, and he should help them as much as possible.

It would be a good idea for larger districts to have six monthly, or even quarterly, staff meetings.

Between departments. D.P.I.'s work must be coordinated with that of other departments and organisations, e.g. Business Development and the Development Bank. Each should know about the others' plans, and if possible, joint patrols should be arranged. This saves cost, and topics can be investigated and discussed at the same time. I have seen this working particularly well in Kiunga, where D.P.I. officers and the Development Bank work well together.

It is essential that various departments communicate. This can be through regular, but not too many meetings.

Provincial level

District to Province, Province to District. There must be regular communication between

the District and the Provincial Headquarters. This can be by telephone, reports, letters, etc. These types of communication are specially important in Provinces like Western Province where opportunities for face-to-face contact are limited due to the distances involved.

It is recommended that the Assistant Secretary/P.R.D.O. should try to visit every District at least once, and if possible, twice, a year. D.R.D.O.'s conferences are an attempt to improve the District to Province communication and it is important that we make full use of them.

As stated earlier, communication must be two-way. When a District Officer writes to the Province, the letter must be replied to as soon as possible. A maximum time of one week from receiving the letter should be allowed before a reply is sent.

Sometimes only a simple acknowledgement is needed, for example, 'Thank you for your letter, concerning; I am making investigations into the matter.' Then there should be a later feed-back when the investigations are completed. There are occasional problems with our postal service so when a letter is received, it must be acknowledged or else it may be thought to be lost.

It is also extremely important that when staff from Provincial Headquarters plan to visit a District, they inform the D.R.D.O. or his deputy. Plenty of time beforehand should be allowed and the purpose of the visit should be clearly explained. It is best to do this both by letter and telephone or radio. It is good manners, and also helps with the D.R.D.O.'s planning and makes for a more useful visit. In turn when

D.R.D.O.'s or other staff from the District, plan to visit Provincial Headquarters, they should inform the Assistant Secretary asking his permission and stating the reason.

Within Provincial Headquarters

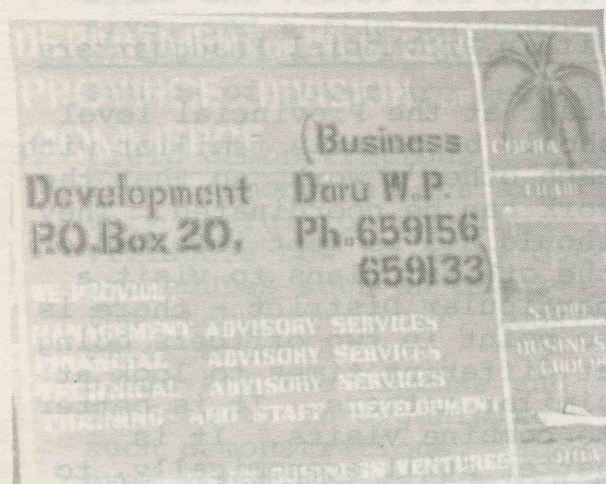
Staff at the Provincial level should be broadly familiar with each other's work, so that the work can be coordinated. They should all be kept informed of the others' plans to visit a particular District - there is no point in two officers going at different times to look at similar matters. It is better to combine visits. It is better still economically, to send one officer to look at all aspects, if the officer is competent enough.

One way of helping to achieve a coordinated approach would be to have regular staff meetings, say every two weeks. The Assistant Secretary would chair the meetings. Officers would describe the previous two weeks work, and present plans for the following two weeks or more. Joint visits could be arranged at these meetings.

Between departments. As stated in the section on communication at District level, it is essential that D.P.I.'s work is co-ordinated with that of other departments and organisations. This is also true for the Provincial level. One way of doing this is at the regular Provincial Management Team meetings. There then needs to be 'feed-back' from the representative at the meeting to the rest of the Provincial staff. This could be done at the staff meetings mentioned above.

Apart from this, there should be other formal and informal contact. Again, it is a good idea to arrange joint visits or

P.N.G. DEVELOPMENT BANK



Communication between departments is very important - both at the district and the provincial levels.

patrols. If, say, Business Development are investigating setting up a business to retail vegetables, then clearly D.P.I. should be involved. On the other hand, if D.P.I. had been contacted first, then we should then work jointly with Business Development.

There should also be contact with other Departments; one committee that assists with this is the Provincial Nutrition Committee with representatives from Health, D.P.I., N.B.C., Office of Information, Business Development and Education participating. But more contact is needed.

National Headquarters level

The communication between Provincial and National Headquarters is now slightly confused by decentralisation. It could be thought that this has placed something of a barrier in the way of this important line of communication. Under the present Provincial system, the Assistant Secretary for D.P.I. (P.R.D.O.) is responsible to the Secretary of the Provincial Departments. In theory all communications and lines of authority run via the Secretary.

So the P.R.D.O. is in charge of agricultural development in the province. He is not strictly responsible to National Headquarters. However, there needs to be regular contact for such matters as technical advice.

The locating of an Area Economist, who is part of National Headquarters, in a province is an attempt to improve this contact. But breakdowns do occur. It has happened that representatives from D.P.I. Headquarters have visited an area but no-one at District or Provincial level was informed beforehand. This should not be allowed to happen.

Lastly, there should be some communication between Provinces, particularly neighbouring ones. This is partly provided by the regular P.R.D.O.'s 'Kivung' but this is not really enough.

CONCLUSION

It is hoped that this article provides 'food for thought'.

The message should be clear - we cannot exist alone, we must communicate with others, we must find out what they are doing and tell them what we are doing.

THE PERFORMANCE OF IRISH POTATO IN THE HIGHLANDS

By Swithun Goodbody, Food Crops Agronomist, Simbu Land Use
Project, Kundiawa

INTRODUCTION

Although in the lowlands sweet potato can be ready for harvesting after 3-4 months, it can take very much longer to reach maturity in the highlands. At the limit of cultivation in Simbu Province at about 2600 m a.s.l. (above sea level), the smallholder may have to wait 11-12 months after planting before he can start harvesting his crop. This means that there must be long-term planning for food requirements and a large area of ground must be under cultivation at any one time. Also fences to keep pigs out of gardens must be made to last a long time for a relatively small return of sweet potato.

Other root crops should therefore be considered as high-energy foods.

Cassava and yam do not grow at such high altitudes and taro takes even longer than sweet potato to reach maturity. Some varieties need almost 2½ years. The Irish potato (*Solanum tuberosum*) however, gives high yields in a short time and is suited to a cool, moist climate like that of the highlands of Papua New Guinea.

ADVANTAGES OF IRISH POTATO

The Irish potato is a temperate crop although it comes originally from the highlands of

tropical South America above 2000 m a.s.l. In the Papua New Guinea highlands it takes about 80-100 days to reach maturity depending on the altitude and the variety, and its yields are generally much higher than those from sweet potato. So not only do you get a harvest much sooner than you would from sweet potato, but you also get a bigger harvest.

New varieties of Irish potato are imported to Papua New Guinea from Australia by the National Seed Potato Project of D.P.I. N.S.P.P. holds a number of varieties. Six of these were assessed in two trials in the Simbu Province - one at 2400 m and the other at 1500 m a.s.l.



Young potato plants

In both trials 12-12-17 fertilizer was applied at planting at a rate of about 500 kg/ha. The high altitude trial was on a silty loam soil at a 20° slope. The mid altitude trial was on a clay soil at a 10° slope.

The results of the trials are given in Table 1. For comparison, Table 2 shows some examples of sweet potato yields in Simbu Province. These yields are recorded from ordinary village gardens, selected at random. No bought fertilizer was used.

There is obviously a big difference in the yields you can expect from different varieties.

In both these trials 'Caliban' did badly.

'Sequoia' is the variety recommended by the N.S.P.P. and this is the variety that did best at the higher altitude.

'Sequoia' was selected as the main variety for Papua New Guinea potato production on the basis of high yields in trials mostly around 1500 m a.s.l., so the poorer performance in the mid altitude trial was possibly because of a soil effect.

There are bound to be differences like this in different areas. However, 'Sequoia' has in general shown itself to be the best and most reliable yielder.

TABLE 1. PERFORMANCE OF SIX VARIETIES OF IRISH POTATO AT TWO DIFFERENT ALTITUDES

Altitude (m a.s.l.):	Yield (t/ha)		Average tuber weight (kg)		Days to harvest	
	2400	1500	2400	1500	2400	1500
'Caliban'	5.5	7.5	0.08	0.09	101	93
'Tasman'	20.8	9.8	0.09	0.10	101	81
'Up-to-date'	17.3	12.2	0.04	0.11	101	93
'Pontiac'	22.9	16.2	0.12	0.15	101	81
'Red la Soda'	16.7	13.3	0.07	0.10	101	81
'Sequoia'	25.2	10.7	0.09	0.10	101	93

TABLE 2. SOME EXAMPLES OF SWEET POTATO YIELDS AT DIFFERENT ALTITUDES IN SIMBU PROVINCE

Altitude (m a.s.l.)	Days to first harvest	First harvest yield (t/ha)
2640	323	2.5
2480	328	3.7
2160	279	10.2
1440	151	9.8



Harvesting potatoes in the Chimbu Valley

PROBLEMS WITH IRISH POTATO

Irish potato, however, is a more difficult crop to grow than sweet potato. To perform well, it requires fertile soils (particularly in terms of phosphate). It must be harvested when it is ready or the tubers will rot.

Its main problem is disease. Because of this, potatoes should not be grown continually in the same patch of ground: the crop must be rotated so that disease is not carried over into the next crop. The most serious diseases are bacterial wilt and target spot.

Target spot which is caused by the fungus (*Alternaria solani*) results in circular blotching of the leaves. Nearly all plants are attacked by it unless they are sprayed regularly with a fungicide. The disease causes the plants to dry off before they are properly mature, and in this way reduces yield. If the disease enters the crop during the early growth stages, yield can be substantially reduced.

Bacterial wilt is a more serious disease because there is no cure for it. This disease causes the plants to wilt and die, and also causes the tubers to rot.

The only way to avoid this disease is to plant seed which is known to be free of the disease. It should be planted in land that has not had infected potatoes growing in it. Great care must be taken to avoid carrying soil from other places onto the land (e.g. on feet or spades). Any land that is known to have had infected plants growing in it should not be replanted to potatoes for several years after the last volunteer potatoes (potatoes growing from old tubers left in the ground) have died out. The longer the land can be left, the better.

Another very serious disease is late blight, caused by *Phytophthora infestans*. This can completely destroy crops. Fortunately, it is not present in Papua New Guinea and new imports are always carefully screened for the disease.

Tubers store well in a cool, dry, fairly dark place and can be kept for about three months.

FURTHER READING

Muhuju, Bubia (1981). The National Seed Potato Project Harvest 7 (4): 145-149.

Notes on Potato Production (1980). Kuk Agricultural Research Station.

Potatoes. Farming Notes: No. 27 (1981). D.P.I., Konedobu.

Purseglove, J.W. (1968). *Tropical Crops*. Longman, London.

Tomlinson, D. (1981). Bacterial wilt Harvest 7 (4): 180-182.

BOOK REVIEW-

THE PAPUA NEW GUINEA ATLAS

Reviewed by J. Stark, Chief Land Use Officer, D.P.I.
Land Use Section.

PAPUA NEW GUINEA ATLAS - A NATION IN TRANSITION, edited by David King and Stephen Ranck was published in early 1982 by Robert Brown Associates (Australia) Pty Ltd, together with the University of Papua New Guinea. It costs K9.95.

This new atlas is designed to replace an earlier atlas edited by Ward and Lea, and published in 1970. Both books are set out in the same way - that is, very small scale maps with notes about each map, including suggestions for further reading. This allows us to compare the two atlases. Changes in human geography in Papua New Guinea over the last 10 years can be easily seen.

The use of coloured photographs and sometimes coloured maps has certainly made the new atlas more attractive. However, the choice of which maps have been coloured is hard to understand. Complex maps such as geology, vegetation, soil and landforms are in black and white, while the very simple livestock map is coloured.

The wide range of maps included is very impressive, especially in human, commercial and historical geography. Amongst others likely to be of special interest to readers of HARVEST are the maps on settlement patterns, farming systems, cash crops, livestock and fishing.

The biggest weakness of the PAPUA NEW GUINEA ATLAS is that in following the lay-out of the Ward and Lea atlas, the maps have been made much too small. The scale chosen is suitable for a sketch map in a simple text book on the geography of Papua New Guinea. It is not suitable for an atlas.

For example, in the relief map (showing altitude), there is no room to name even one mountain range. Only four contours (lines joining points at the same altitude above sea level) are used. The landforms map shows that the 200 m a.s.l. altitude is very significant in the topography (shape of the land - mountains, plains, etc.) of Papua New Guinea. However, the first contour in the relief map is at 300 m. This might have resulted because of the choice of scale.

In some cases, the problems of using too small a scale become impossible to overcome. These are cases, such as land use potential which depend on the physical environment (such as altitude, rainfall, etc.). C.S.I.R.O. found it a difficult job to produce an agricultural land use potential map at a much bigger scale. Therefore, it is even more difficult to reduce the information on this large map, to the small size used in the PAPUA NEW GUINEA ATLAS.

We would advise serious workers on the physical environment of Papua New Guinea who need an atlas, to use the much older JACANDRA ATLAS. This contains maps of a much more useful size.

In spite of the criticisms above, the PAPUA NEW GUINEA ATLAS contains much valuable information on the human, commercial and historical geography of Papua New Guinea. The information is neatly, pleasingly and concisely presented.

We hope that the many users of the atlas will realise that the small scale maps have only limited use. If people are aware of this, they will be less likely to draw incorrect conclusions from the maps.

Copies of the PAPUA NEW GUINEA ATLAS can be obtained from most good bookshops, or you can order it from:

Gordon and Gotch (P.N.G.) Ltd
P.O. Box 3395
PORT MORESBY

INFORMATION WANTED

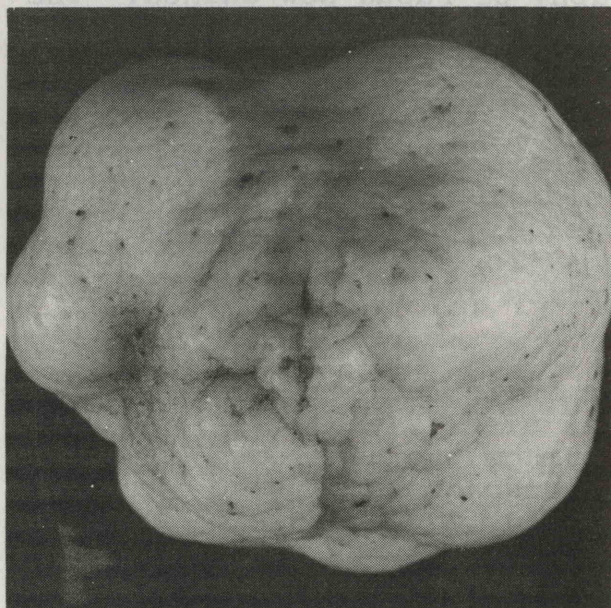
A FRUIT GALL WASP OF CITRUS IN PAPUA NEW GUINEA

By Elaine J. Brough, Lecturer in Entomology,
Biology Department, University of Papua New Guinea

INTRODUCTION

The fruit of the West Indian lime, *Citrus aurantifolia*, is sold at markets in Papua New Guinea and is commonly called muli or sapora. People who grow lime trees in the Port Moresby area often find that some of the fruits become very misshapen as they mature. When these misshapen fruit are cut open, the black remains of dead insects are often found lying in tough, hard, circular patches.

The damage is caused by a small black wasp. This wasp has not been reported from other South Pacific countries. It is possible that it is found only on the island of New Guinea.



The deformed fruit of a mature West Indian lime which has been infested by the wasp

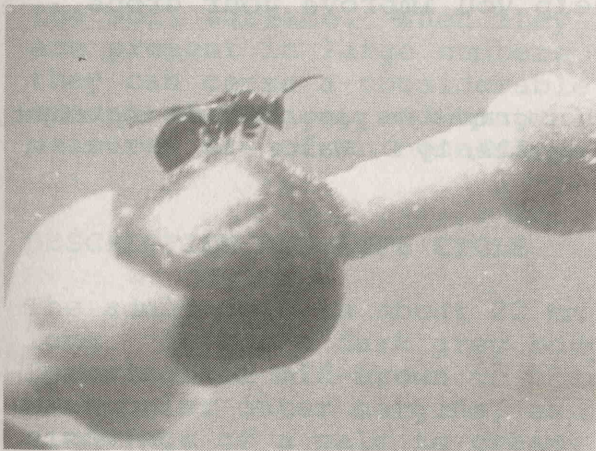


The same fruit as in the picture above, cut in half to show the galled tissue and the remains of dead wasps

Within Papua New Guinea it has been collected from limes at Marshall Lagoon, Boroko, Laloki and Bereina in Central Province; from Ferguson Island in Milne Bay Province; and from Afore in Northern Province. It has been recorded only from West Indian limes although there is one unconfirmed report of it being present in a grapefruit.

BIOLOGY AND IMPORTANCE

The female wasp lays its eggs in the developing fruit of the lime flower, usually when the petals are dropping and the young fruit is exposed.



A female wasp about to lay eggs into the young developing ovary of a lime flower. The petals have dropped

The larvae, which hatch from the eggs, cause the developing fruit to form gall tissue (abnormal growth) around them. Thus each larva comes to lie in a small cavity surrounded by soft gall tissue. The larvae feed and grow within these galls and finally pupate (enter a resting stage) within the enlarged cavity. Several batches of eggs may be laid in one fruit and as many as 165 developing larvae have been found in a single young fruit weighing only 4.5 g.



A cross section of a young lime showing developing wasp larvae, living in soft fleshy galls which have pushed aside the juicy flesh of the fruit

When the adult wasps emerge from the pupal stage they chew a tunnel through the gall tissue to the outside of the fruit. The females fly off to seek new fruit in which to lay their eggs. The abandoned fruit continues to grow but becomes more and more misshapen; the gall tissue hardens and the exit holes become surface scars. The juicy edible flesh of the lime is very reduced and may even be completely absent in fruit that has been heavily infested.

Usually not all the adult wasps can make their way out of the fruit and some die within their galls. These are the black bodies found when the fruit is cut open.

SPECIMENS AND INFORMATION WANTED

To help with mapping the distribution of this pest insect, the author would be grateful to receive any citrus fruit which

is misshapen as described in this article and illustrated in the photographs on page 128.

Put the fruit into a plastic bag which has no holes in it, and tie a tight knot at the top of the bag to close it. Then wrap it in a strong paper bag or carton and post to:

Dr. E.J. Brough
Biology Department
Box 320 University P.O.
WAIGANI
National Capital District.

All postage costs will be re-funded.

Information about the fruit is also needed. Write this in pencil on a piece of paper and put it into the paper bag or carton. The information needed is:

1. The type of citrus tree from which the fruit came, i.e. lime, orange, grapefruit, etc.
2. The name of the nearest village or post office, or plantation.
3. The name and address of the person who found the fruit.

Your help in providing this information will assist in finding a way to control this very destructive insect pest, and help you improve your crops.

Photographs on page 128 and top right, page 129, by D. Waite

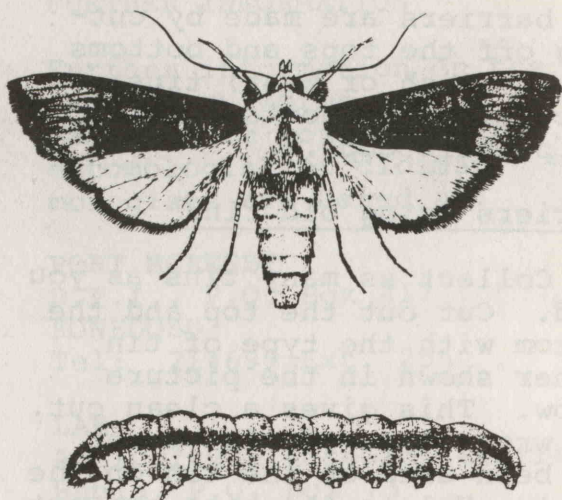
ENTOMOLOGY BULLETIN: NO. 7 – PROTECTION OF SEEDLINGS FROM CUTWORM DAMAGE

Revised Sept. 1982. Supercedes previous issues of this bulletin.
(First published June 1980)

By B.M. Thistleton, Entomologist
Kuk Agricultural Research Station, Mt. Hagen

INTRODUCTION

Cutworms are the larvae (young stages) of a moth called *Agrotis ipsilon*. They live in the soil where they feed on a wide range of plant material during the night. Often, they chew through the stems of young seedlings at, or just below, the soil surface. When they are present in large numbers, they can cause a considerable amount of damage, and control measures are often necessary.



DESCRIPTION AND LIFE CYCLE

The adult moth is about 22 mm long. It has a dark grey body, forewings of mid-brown to black with paler outer margins, and hindwings of a pale to creamy brown with well-marked dark veins. The eggs are creamy white, changing to reddish yellow and then blackish before hatching. They are dome-shaped, about 0.5 mm in diameter, with 30-40 vertical ribs. They are laid singly or in small groups at the base of the stems of plants or on the soil surface.

On hatching, the larvae remain in the soil during the day and come out onto the surface to feed at night. Here they chew the bases of the stems of plants, particularly young seedlings. Often the stem is completely chewed through and the seedling appears as if it

Cutworm adult (top) and larva (bottom) shown about 1.5 times their natural size

has been cut off at ground level. The length of the larval stage varies from a few weeks to several months depending on the food supply. The mature larva is about 45 mm long, slate-grey or dark green in colour with a shiny, greasy looking skin. When disturbed, it usually curls up quickly to form a circle. Pupation occurs in cells in the soil from which the adult moth finally emerges.

ECONOMIC IMPORTANCE

Cutworms feed on a large variety of seedlings, often causing considerable losses. They are widely distributed in Papua New Guinea occurring both in the lowlands and in the highlands.

CONTROL

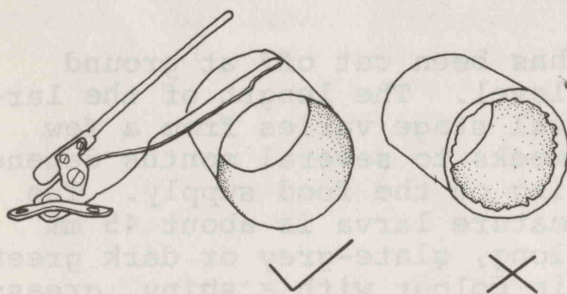
Physical control

Seedlings can be protected against cutworms by placing a barrier around them. The method is useful for people with small gardens, or those who live a long way from town and cannot get chemicals easily.

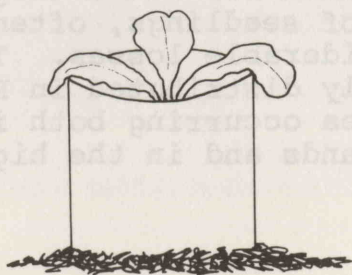
The barriers are made by cutting off the tops and bottoms of old (fish or meat) tins; or by cutting the bottoms out of old plastic cups.

Barriers using old tins

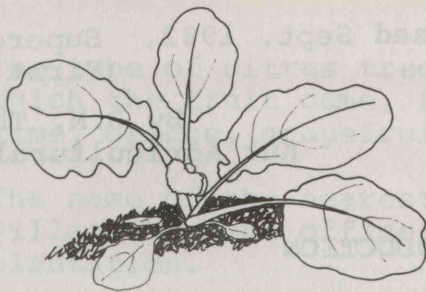
1) Collect as many tins as you need. Cut out the top and the bottom with the type of tin opener shown in the picture below. This gives a clean cut. The wrong type of tin opener has been used on the tin on the right. Unless the tins are cut properly, they will disturb the roots of the seedlings when they are taken away later on.



2) Place a tin over each seedling at planting time. If you wait a day or two, it may be too late, as the cutworms will start eating your seedlings almost straight away.

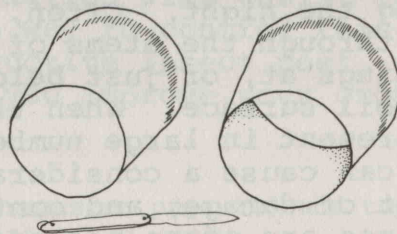


c) When the seedlings are strong, the tins should be removed gently, without disturbing the roots.

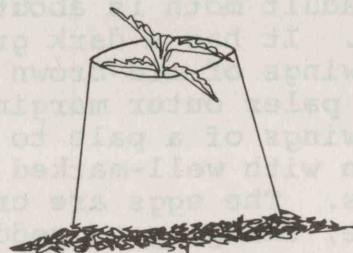


Barriers using plastic cups

1) Use a knife to cut the bottom out of the plastic cup.



2) Place a plastic cup over each seedling at planting. If you wait a day or two it may be too late.

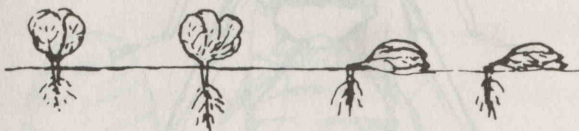


3) When the plants are strong remove the plastic cups. You will find that they can be removed easily, but take care not to disturb the roots.



Chemical control

Cutworms can be controlled by drenching (soaking) the soil around the bases of the seedlings with either DDT or lindane. Care should be taken that these two insecticides do not touch the leaves of the plant. Alternatively, a soil drench of either insecticide can be applied to the ground before the seedlings are planted out.



Damage caused to cabbage seedlings by cutworm larvae

DDT should be used at a strength of 0.1%. To prepare this, add 40 ml of DDT 25% Miscible Oil to 10 litres of water.

Lindane should be used at a strength of 0.02%. This is prepared by adding 12.5 ml of Gammaphex (16% w/v lindane emusifiable concentrate) to 10 litres of water.

FURTHER READING

Jones, F.G.W. and Jones, M.G., (1966). *Pests of Field Crops*. Edward Arnold: London. 406 pp.

Kimber, A.J. and Calcinai, B. L. (1980). *An Easy Way to Control Cutworms*. Aiyura Bulletin No. 13. October 1980.

Kranz, J., Schmutterer, H. and Koch, W. (1977). *Diseases, Pests and Weeds in Tropical Crops*. Verlag Paul Parey: Berlin and Hamburg. 666 pp.

Metcalf, C.L. and Flint, W.P. (1962). *Destructive and Useful Insects, their Habits and Control*. McGraw-Hill: New York, San Francisco, Toronto and London. 1087 pp.

Swaine, G. (1971). *Agricultural Zoology in Fiji*. H.M.S.O.: London. 424 pp.

FURTHER INFORMATION

Further information on the control of cutworms can be obtained from your nearest D.P.I. entomologist or didiman. Entomologists are based at:

PORT MORESBY
D.P.I., P.O. Box 417
KONEDOBU
Tel: 214699 Ext. 255

LAE
Agriculture Research Centre
Bubia, P.O. Box 73
LAE
Tel: 424933

MT. HAGEN
Kuk Agricultural Research Station, P.O. Box 339
MOUNT HAGEN
Tel: 551377

KIMBE
Dami Oil Palm Research Station
P.O. Box 165, KIMBE
Tel: 935194

RABAU
Lowlands Agricultural Experiment Station, P.O. Keravat
E.N.B.P.
Tel: 926251 or 926252

Copies of this Entomology Bulletin are available from: The Publications Officer, Publications Section, D.P.I., P.O. Box 417, Konedobu.

The revision of this entomology bulletin is based upon information previously published in Aiyura Bulletin No. 13.

FRUIT FLIES

By J.W. Ismay, Entomologist, D.P.I., Konedobu

INTRODUCTION

Tephritid fruit flies are flies whose larvae or maggots attack many kinds of ripening fruits and vegetables. They may cause extensive damage to crops in Papua New Guinea.

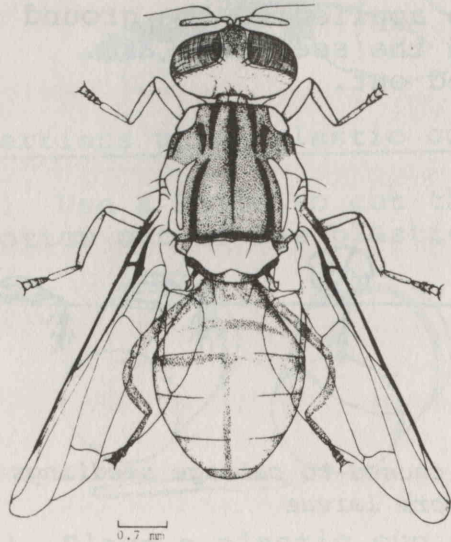
DESCRIPTION

There are many different species (kinds) of tephritid fruit flies in Papua New Guinea. Most are black or red-brown with yellow markings on the body. They range in size from 5 mm to 12 mm. Most have dark marks on the wings. Any flies like this which are attracted to, or reared from fruit or vegetables are likely to be tephritid fruit flies.

BIOLOGY

The female fly lays its eggs under the skin of the fruit. When they hatch the larvae bore into the fruit which then quickly starts to rot. The fully grown larva is about 10 mm long, whitish, sharply pointed at the head end and rounded at the tail. Tephritid fruit fly larvae are able to jump 2 to 3 cm and this behaviour is most often seen when the larvae are exposed after cutting open an infested fruit.

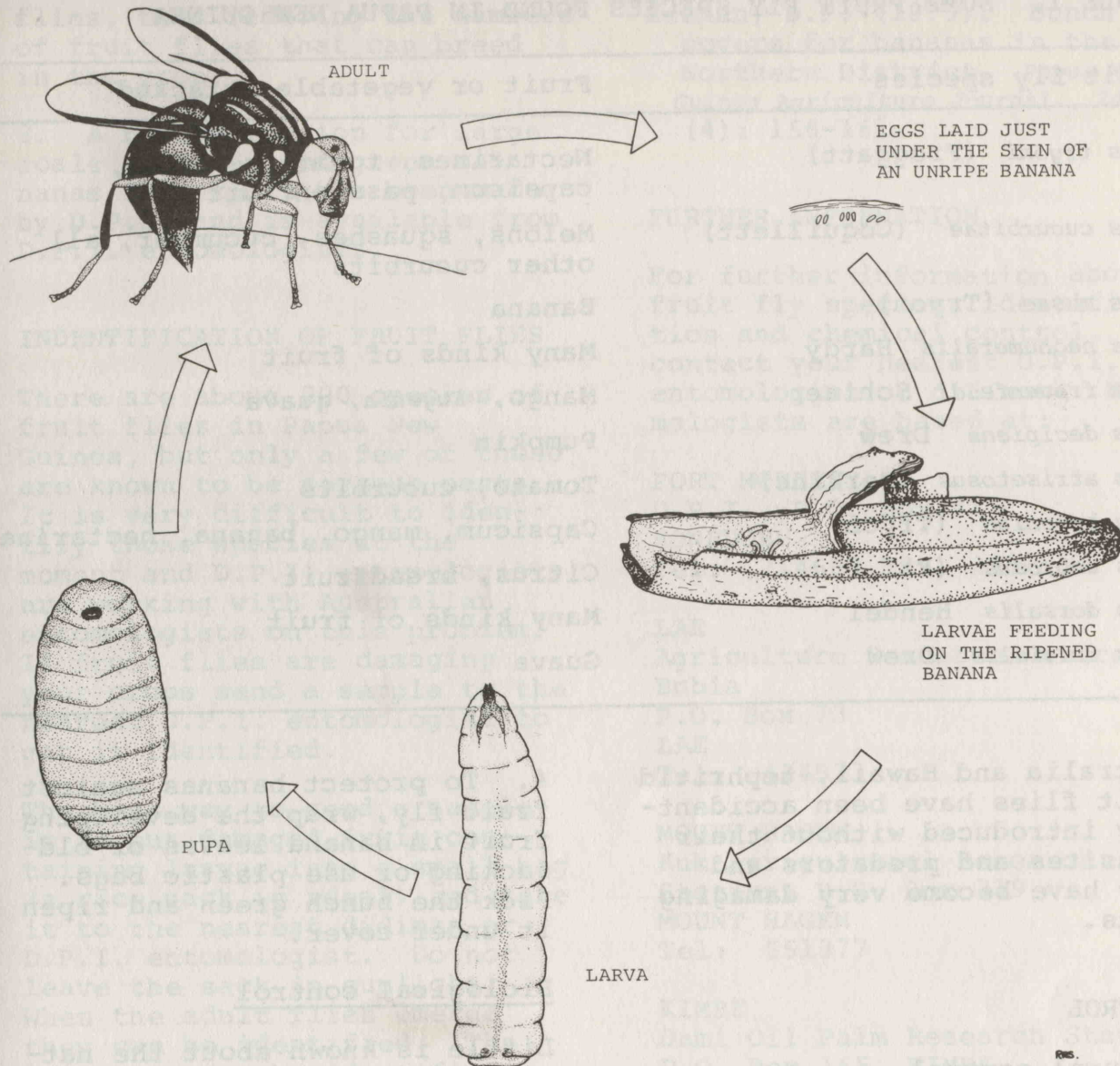
The developmental period varies from species to species. The



The banana fruit fly, adult stage

life cycle of the banana fruit fly, *Dacus musae*, given here is typical of most tephritid fruit flies in Papua New Guinea.

Female banana fruit flies lay batches of 7 to 12 eggs just below the skin of an unripened banana. The eggs are laid while the bananas are still green, a few days before they change colour and ripen. The eggs hatch 3 to 11 days later and the larvae eat the soft fruit. The larvae mature within 8 to 9 days and they drop out of the rotting fruit to pupate (enter the resting stage) in the damp soil at the base of the banana plant. The pupa is reddish-brown, cylindrical and broadly rounded at both ends.



Stages in the life cycle of the banana fruit fly

The pupal stage lasts 7 to 10 days. The adult fruit fly then emerges and becomes sexually mature about 2 weeks later. Under normal lowland conditions the usual life span for a generation is 4 to 5 weeks.

ECONOMIC IMPORTANCE

Tephritid fruit flies are important because of the damage done to mature fruit by their larvae. The fruit is eaten by the larvae and this quickly becomes rotten and inedible. Different species of tephritid fruit fly attack different kinds

of fruit and vegetables. Table 1 shows the fruit and vegetables attacked by some species of fruit flies in Papua New Guinea.

Despite the many species of fruit fly and the many kinds of fruit and vegetables that they will attack, serious economic damage in Papua New Guinea is at present uncommon. This may be because fruit flies have been in Papua New Guinea for many years and their natural enemies keep them under control and also because at present there are no really large areas of land planted to fruit crops. In some countries, including

TABLE 1. SOME FRUIT FLY SPECIES FOUND IN PAPUA NEW GUINEA

Fruit fly species	Fruit or vegetable attacked
<i>Dacus tryoni</i> (Froggatt)	Nectarines, tomato, <i>Eugenia</i> , capsicum, passionfruit
<i>Dacus cucurbitae</i> (Coquillett)	Melons, squashes, cucumber, all other cucurbits
<i>Dacus musae</i> (Tryon)	Banana
<i>Dacus neohumeralis</i> Hardy	Many kinds of fruit
<i>Dacus frauenfeldi</i> Schiner	Mango, <i>Eugenia</i> , guava
<i>Dacus decipiens</i> Drew	Pumpkin
<i>Dacus atrisetosus</i> (Perkins)	Tomato, cucurbits
<i>Dacus bryoniae</i> (Tryon)	Capsicum, mango, banana, nectarine
<i>Dacus umbrosus</i> (F)	Citrus, breadfruit
<i>Dacus dorsalis</i> Hendel	Many kinds of fruit
<i>Dacus trivialis</i> Drew	Guava

Australia and Hawaii, tephritid fruit flies have been accidentally introduced without their parasites and predators and they have become very damaging pests.

CONTROL

Cultural control

1. Always pick your fruit or vegetables promptly. If they can ripen after picking, pick them before they are ripe and ripen them under cover.
2. Clear away any fallen or rotting fruit or vegetables from the garden and surrounding areas.
3. Many fruit flies will live in several kinds of fruit and vegetables. If you have fruit flies in your garden check that they are not also living in wild fruits in the surrounding bush. If you remove these alternate host fruits it will help protect your garden.

4. To protect bananas against fruit fly, wrap the developing fruit in banana leaves or old sacking or use plastic bags. Pick the bunch green and ripen it under cover.

Biological control

Little is known about the natural enemies of fruit flies in Papua New Guinea. The only recorded natural enemy of the banana fruit fly is a black earwig called *Chelisoches morio*, which is common on banana bunches in the field. *Chelisoches* has been seen to eat fruit fly larvae and exert some biological control.

Chemical control

1. If there are many fruit flies and other methods of control fail, use 0.5% Dimethoate. Spray weekly when required and wait 7 days before using the crop.
2. 'Dak-pot' fruit fly lure will attract and kill male fruit

flies, thus reducing the numbers of fruit flies that can breed in the crop.

3. A recommendation for large scale treatment of green bananas for export has been made by D.P.I. and is available from D.P.I. entomologists.

IDENTIFICATION OF FRUIT FLIES

There are about 200 species of fruit flies in Papua New Guinea, but only a few of these are known to be serious pests. It is very difficult to identify those species at the moment and D.P.I. entomologists are working with Australian entomologists on this problem. If fruit flies are damaging your crops send a sample to the nearest D.P.I. entomologist to get it identified.

The best way to send a sample is to put damaged fruit containing larvae into a small bag (a rice sack is ideal) and take it to the nearest didiman or D.P.I. entomologist. Do not leave the sack in sunlight. When the adult flies emerge they can be identified. The larvae cannot be identified.

You may also see small yellow or brown flies about 2-3 mm long attracted to rotting or decaying fruit. These are lesser fruit flies (*Drosophila*) and are of no economic importance because they only attack fruit that is already rotten.

FURTHER READING

Smith, E.S.C. (1977). The banana fruit fly, *Dacus musae* (Tryon), in Papua New Guinea. In Enyi, B.A.C. and Varghese, T. (Eds). *Agriculture in the Tropics*. University of Papua New Guinea.

Heenan, D.P. (1973). Bunch covers for bananas in the Northern District. *Papua New Guinea Agriculture Journal*. 24 (4): 156-161.

FURTHER INFORMATION

For further information about fruit fly species, identification and chemical control, contact your nearest D.P.I. entomologist or didiman. Entomologists are based at:

PORT MORESBY
D.P.I., P.O. Box 417
KONEDOBU
Tel: 214699 Ext. 255

LAE
Agriculture Research Centre
Bubia
P.O. Box 73
LAE
Tel: 424933

MOUNT HAGEN
Kuk Agricultural Research
Station, P.O. Box 339
MOUNT HAGEN
Tel: 551377

KIMBE
Dami Oil Palm Research Station
P.O. Box 165, KIMBE
Tel: 935194

RABAU
Lowlands Agriculture Research
Station, P.O. Keravat
E.N.B.P.
Tel: 926251 or 926252

Copies of this Entomology Bulletin can be obtained from: The Publications Officer, Publications Section, D.P.I. P.O. Box 417, Konedobu.

(Illustrations: R.E. Sutherland)

INSECT PESTS OF WINGED BEAN 1. *LEUCOPTERA* — A LEAF MINER

By Elaine J. Brough, Lecturer in Entomology,
Biology Department, University of Papua New Guinea.

INTRODUCTION

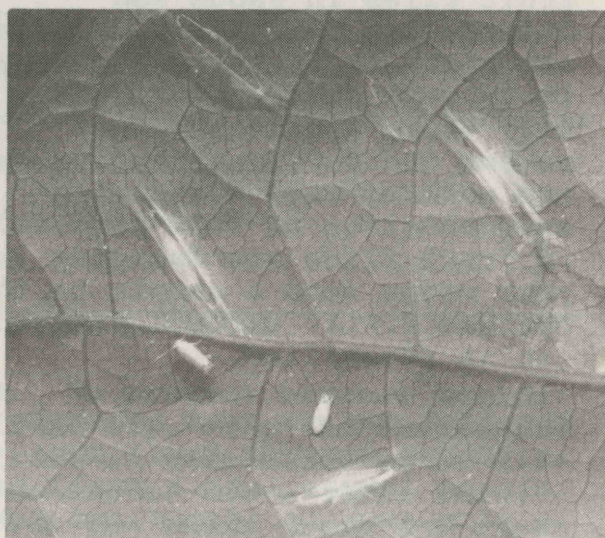
Winged beans (*Psophocarpus tetragonolobus*) do not suffer seriously from insect attack when grown in traditional mixed gardens. However, when they are grown as a monoculture both in the lowlands and the highlands a number of damaging insects are found. One of these is a moth, *Leucoptera psophocarpella* - a leaf miner.

DESCRIPTION AND BIOLOGY

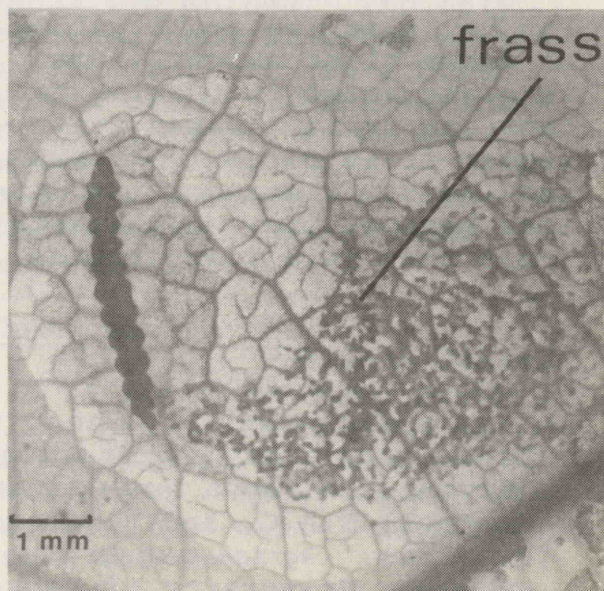
The adult insect is a small white moth. It lays its eggs on the underside of a winged bean leaf. The eggs are very small, about 0.2 mm long, and not easily seen with the naked eye.

The tiny larva (caterpillar) develops within the egg and hatches by chewing through the floor of the egg. It then eats through the epidermis (skin) of the leaf and makes its way into the leaf itself. There it forms a tunnel (or mine) by eating the juicy soft middle tissue of the leaf.

There are four larval instars (stages). The growing larva gradually eats more and more of the leaf tissue until the shape of the tunnel changes into a circular blotch. The faeces (dung) of the larva remains in the tunnel. This is called frass.



Adult *Leucoptera* and their cocoons (pupal cases) on the underside of a winged bean leaf



A *Leucoptera* larva in its tunnel or mine

Finally the larva is ready to pupate (enter the resting stage) and change into the adult moth.

It leaves its tunnel by chewing a crescent-shaped slit in the upper surface of the leaf. The larva crawls to the edge of the leaf and suspends itself on a fine silk thread. After several minutes it pulls itself up to the lower surface of the leaf. Here it spins a cocoon in which it pupates.

The life cycle from egg to adult takes 21 days in the lowlands. It may be longer in the highlands.



Part of a winged bean crop which shows heavy damage to the leaves caused by *Leucoptera* larvae

ECONOMIC IMPORTANCE

This insect usually infests a crop without being noticed. This is because the first instar caterpillar makes a very small tunnel which runs alongside a vein in the leaf and is not very obvious. However, the numbers of *Leucoptera* in a winged bean crop can increase very rapidly because of the short life cycle. Therefore, during the 3-4 months required for the crop to mature, the damage done can be serious.

The skin of each deserted tunnel dries and turns brown and so forms a characteristic blotch. For this reason *Leucoptera* has been called the blotch miner. When many larvae have mined a leaf the damage becomes very obvious.

It is not yet known how much winged bean yields are reduced by this leaf destruction.



Detail of a leaf showing the obvious blotches of dead leaf tissue left by the tunnelling larvae

CONTROL

Chemical control

There are no recommendations for the control of *Leucoptera* at present.

Biological control

Two parasitic wasps, known to attack the larvae of *Leucoptera*, are being studied. These may prove to be useful in the biological control of *Leucoptera*.

FURTHER READING

Bradley, J.D. and Carter, D.J. (1982). A new lyonetiid moth, a pest of winged bean. *Systematic Entomology* 7: 1-9.

Brough, E.J. and Arura, M. (1981). The life history of the blotch miner *Leucoptera psophocarpella* (Lepidoptera: Lyonetiidae) and the damage it causes to the winged bean *Psophocarpus tetragonolobus*. *Science in New Guinea* 8 (3): 171-180.

Lamb, K.P. (1978). Insect and mite pests of winged bean (*Psophocarpus tetragonolobus*) and their control. In Singh, S.R., Ajibola Taylor, T. and Van Emden. H.F. (Eds). *Insect Pests of Grain Legumes and Their Ecology*. Academic Press, London.

FURTHER INFORMATION

For further information about *Leucoptera*, contact your nearest D.P.I. entomologist or didiman. Entomologist are based at:

PORT MORESBY

D.P.I., P.O. Box 417

KONEDOBU

Tel: 214699 Ext. 255

LAE

Agriculture Research Centre
Bubia

P.O. Box 73, LAE

Tel: 424933

MOUNT HAGEN

Kuk Agricultural Research
Station, P.O. Box 339

MOUNT HAGEN

Tel: 551377

KIMBE

Dami Oil Palm Research Station
P.O. Box 165, KIMBE

Tel: 935194

RABAUL

Lowlands Agricultural Experiment
Station, P.O. Keravat
E.N.B.P.

Tel: 926251 or 926252

Copies of this Entomology Bulletin can be obtained from: The Publications Officer, Publications Section, D.P.I. P.O. Box 417, Konedobu

Photograph on page 138, lower right, by D. Waite

PLANT PATHOLOGY NOTE: NO. 18

BACTERIAL SOFT ROT OF VEGETABLES

By Derek Tomlinson, Plant Pathologist, Agriculture
Branch, D.P.I., Konedobu

INTRODUCTION

Bacterial soft rots affect many types of vegetables as well as a number of ornamental plants and field crops. They are most common and distinctive on introduced vegetables such as cabbage, cucumber, tomato, squash, carrot, onion and potato. They are less common on traditional subsistence crops.

A number of different types of bacteria can produce soft rots, but the most important ones by far are three closely related bacteria combined in a single group known as the *Erwinia caratovora* group. The bacteria are named after a biologist, Erwin Smith, who first isolated them from a rotting carrot (*Caratovora* = carrot devouring). Two of these bacteria, *Erwinia caratovora* var *caratovora* and *Erwinia chrysanthemi* attack a wide range of plants whilst the third bacterium in the group (*Erwinia caratovora* var *atroseptica*) only infects the English potato.

The diseases caused by these bacteria occur world-wide. They probably cause greater economic loss than any other bacterial plant disease. Losses are particularly severe in hot, humid climates especially where storage facilities are inadequate.

SYMPTOMS

Symptoms are similar on all

hosts. A water-soaked region first appears, almost always associated with a wound caused either by an insect or by cultivating tools. This then enlarges rapidly in area and depth. It becomes soft and watery as the plant tissue is broken down by the activity of the bacteria. The infected tissue is rapidly invaded by other secondary bacteria which live off the decaying tissues in the same way as the original pathogen.

The combined activity of all these bacteria can reduce a whole fruit or vegetable to a soft watery mass within a few days of infection. At the same time a characteristic foul smell is produced.

When root crops are infected in the field, symptoms may also develop in the lower stem. The stem becomes soft and watery and turns brown or black. This is especially common in the English potato. This particular form of the disease on potato is known as 'black leg'.

Infection of succulent leaves and stems is rarely serious in the field. However, if rotting starts in storage, it spreads rapidly and may cause total loss of the stored produce.

DISEASE CYCLE

The bacteria survive in infected fleshy organs in storage



An English potato plant infected with 'black leg'. Rotting in the lower stems (the dark areas) has caused some of the shoots to collapse.

and in the field, in the soil, or in the pupae of a number of insects. Vegetables may become infected directly from bacteria surviving in the soil. Infection usually takes place through wounds either on the roots or on the stem just above the soil line. In potato, the more common method of infection is from using infected seed tubers which often contain the bacteria but show no symptoms. These pathogens grow best in warm, wet conditions. This often leads to heavy losses in the field.

Insects often cause the bacteria to enter the host tissue. Insects also very effectively spread infection both between plants in the field, and in storage. The bacteria can survive for a time in, or on, all stages of the insect. Insect larvae become contaminated when they crawl about in in-



A section through an English potato infected with 'black leg'. The black rotted area will eventually spread through the whole tuber.

festes soil or on rotting plant material. The mouthparts of adults become contaminated as they feed on the host plant. When these insects attack healthy plants or storage organs by boring holes into them, they transfer the bacteria into the new host tissue.

CONTROL

Control of bacterial soft rot is almost entirely based on cultural and sanitary practices: keep storage buildings clean; do not leave debris lying about; wash walls and floors with diluted solutions of formalin or copper sulphate.

Avoid wounding plants and stored products as much as possible and store only undamaged produce. Remove infected products from storage as soon as they are noticed, and burn them

immediately. Stored products should be dry, and packed to allow good air circulation. Where possible, humidity of storage spaces should be kept low. The temperature should also be kept low (about 10°C).

In the field, plant susceptible crops in well-drained soil, space them well to allow adequate ventilation and do not water using overhead irrigation. Two to three year rotations with non susceptible cereals or legumes have been claimed to reduce the incidence of the disease.

Chemical sprays to control the rot are ineffective. However control of the insect vectors can often reduce disease incidence markedly.

FURTHER INFORMATION

Further information may be obtained from the Chief Plant Pathologist, D.P.I., P.O. Box 417, Konedobu.

Copies of this Plant Pathology Note, and of others in the series are available from the Publications Officer, Publications Section, D.P.I., P.O. Box 417, Konedobu.

CONTRIBUTIONS TO HARVEST

CIBA-GEIGY

Plant Protection and Animal Health Products

Ciba-Geigy Limited, developers and manufacturers of crop protection, animal health and hygiene chemicals worldwide, with a range of chemicals for Papua New Guinea conditions.

Plantations and Crop Protection

metolachlor **NUVACOL WP** Control Black Pod and Corker of Cocoa, Cinnamon, Pepper, Pyrethrum and Phytophthora diseases of all crops and vegetables.
dichlorvos **NUVACOL** Long-term and Permethrin control in all crops.

The aim of HARVEST is to help keep everybody informed about what is happening in primary industry all around Papua New Guinea.

If there is any work going on in your area which you think would be interesting to other HARVEST readers, we would be pleased to hear about it.

Articles can be about a single topic or project, the work of a group of people, or the primary industry of a particular area.

Articles should be presented simply and be fairly short (not more than about 3000 words, or 6-7 typed pages) with plenty of black and white photographs or other illustrations, if possible.

Two copies of each article, typed with double spacing and wide margins, should be sent to the Editor, HARVEST, Publications Section, Department of Primary Industry, P.O. Box 417, Konedobu.

Stored Products

fenitrothion **SUMITHION** For grain storage areas and for control of beet beet and sorption.
azamethiphos **ALFACRON** For long residual treatment of warehouses and grain storage areas.

Herbicides for Plantations and Crops

amido **FLOWABLE** **GESATOP 500 FW** For Sorghum, Maize, Sugar Cane.
simazine **FLOWABLE** **GESATOP 500 FW** For Sugar Cane, Plantation crops.
ametryne **FLOWABLE** **PRIMATOL 2 500** For Cocoa, Coffee, Pineapples.
metolachlor **DUAL 720 EC** For grass control in Maize and Tobacco.
fluron **FLOWABLE** **DURON** For Coffee, Sugar Cane.

Distributed throughout Papua New Guinea

By
Faintons & Crawfield (P.N.G.) Ltd.

Registered trademarks

ABBREVIATIONS USED IN HARVEST

UNITS

L	litres	mm	millimetres
g	grams	cm	centimetres
kg	kilograms	m	metres
t	tonnes	V	volts
s	seconds	W	watts
min	minutes	in	inches
h	hours	ft	feet
y	years		

LATIN ABBREVIATIONS

c.	<i>circa</i> (= about)	et al.	<i>et alia</i> (= and others)
cf.	<i>confer</i> (= compare)		

OTHER ABBREVIATIONS

c.d.a.	controlled drop application	var	variety
sp.	species	>	more than
spp.	species (plural)	<	less than
ssp.	subspecies	%	percentage
u.l.v.	ultra low volume		

ORGANISATIONS

C.S.I.R.O.	Commonwealth Scientific and Industrial Research Organisation
D.P.I.	Department of Primary Industry
F.A.O.	Food and Agriculture Organisation of the U.N.
U.N.	United Nations
W.H.O.	World Health Organisation

Plant Protection and Animal Health Products

Ciba-Geigy Limited, developers and manufacturers of crop protection, animal health and hygiene chemicals worldwide, offer a range of chemicals for Papua New Guinea conditions.

Plantations and Crop Protection

metalaxyl	RIDOMIL® WP	Controls Black Pod and Canker of cocoa, Downy Mildew, Pythium and Phytophthora diseases of field crops and vegetables
dichlorvos	NUVAN®	Longicorn and Pantorhytes control in cocoa.
monocrotophos	NUVACRON®	Systemic insecticide for trunk injection in special situations.
diazinon	GESAPON®	Controls many insect pests including cutworm in vegetable crops, stem borers of rice, Citrus leaf miner, mealy bugs of pineapples.

Domestic Pests/Hygiene

azamethiphos	ALFACRON®	Cockroach control — long residual control
diazinon	NEOCID®	Flies, fleas, mosquitoes, cockroach, bed bugs and carpet beetles — medium residual control.
fenitrothion	SUMITHION®	Cockroach and hide beetles control.

Animal Health

diazinon	NUCIDOL®	Fleas and ticks of dogs. Lice and mange of pigs. Lice, ticks and flies of cattle, horses.
phosmet	PROLATE CATTLE SPRAY	Controls ticks and buffalo fly on cattle.
iodofenphos	NUVANOL®	Flies, ticks on cattle, horses and dogs.
nitroscanate	LOPATOL®	Removes roundworms, hookworms and tapeworms in dogs.
azamethiphos	ALFACRON®	Lice and mites on poultry. Fly and spider control in poultry sheds.

Stored Products

fenitrothion	SUMITHION®	For grain storage areas and for admix treatment of corn and sorghum.
azamethiphos	ALFACRON®	For long residual treatment of warehouses and grain storage areas.

Herbicides for Plantations and Crops

atrazine	FLOWABLE GESAPRIM 500 FW	For Sorghum, Maize, Sugar Cane.
simazine	FLOWABLE GESATOP 500 FW	For Sugar Cane, Plantation crops.
ametryne	FLOWABLE PRIMATOL Z 500	For Cocoa, Coffee, Pineapples.
metolachlor	DUAL 720 EC	For grass control in Maize and Tobacco.
diuron	FLOWABLE DIURON	For Coffee, Sugar Cane.



Distributed throughout Papua New Guinea
by —
Harrisons & Crosfield (PNG) Ltd.,

® Registered trademarks



ICI Papua New Guinea Pty Ltd

manufacturers and distributors of

AGRICULTURAL CHEMICALS

- * Gramoxone, Paracol, Butoxone 245T, Methoxone MCPA, Amoxone 24D, Diurex, Dowpon, Ambush, Actellic, Orthene, Malathion, Gamaphex and other herbicides, insecticides and fungicides.

VETERINARY CHEMICALS

- * Nilverm Worm drench. Oral and injectable formulations available for cattle. Also formulations for pigs and poultry. Promicide cattle spray and Hibitane disinfectant. Screw Worm Smear, Malawash and Exterm M.

VISQUEEN POLYTHENE FILM AND BAGS

- * Blue and yellow coffee film. Polythene bags including seedling planting bags Building and industrial film.

FERTILIZER

- * A complete range of fertilizers is available for plantation and agricultural use.

AMMUNITION

- * 12 gauge shot gun cartridges. 22 rim fire etc.



ALSO

- * Hortico Garden Products and Seeds, Explosives, Swimming Pool Chemicals, Detergents and Disinfectants.

Full technical advice is available from our experienced representatives.

Head Office:

P.O. Box 1105, Lae, Papua New Guinea
Air Corps Road, Lae
Telephone: 42 3633
Telegrams: Impkemix Lae
Telex: NE 42413

Branch Office:

P.O. Box 106, Port Moresby
Spring Garden Road, Hohola
Telephone: 25 4903, 25 2062



PAPUA NEW GUINEA PTY LTD