SEASONAL INFLUENCES ON FRUITING OF ROUGH LEAF PINEAPPLES

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ABSTRACT

To determine the environmental stimulus to flowering and fruiting in rough leaf pineapple (Ananas comosus *Merr.*), *meteorological and pineapples production records were examined from New Britain and the Northern Province. Fruit numbers at Keravat and average minimum (night) temperatures over a 4-week period 22 weeks prior to harvest were correlated* (-0558***) *as were fruit numbers and sunshine hours* (0.367*). *Partial correlation showed that the effect of sunshine hours was not significant when the effect of minimum temperature was removed. It is concluded that floral initiation in the rough leaf pineapple is greatest during periods of low night temperatures.*

INTRODUCTION

Pineapple fruiting is seasonal in Papua New Guinea although not as seasonal as in some overseas pineapple growing areas. In the Markham Valley, rough leaf pineapples only flower consistently from mid year until December (Hunter and Sickey 1972). At Saiho in the Northern Province (J. Horne, unpubl. data) and at Keravat on New Britain, production is highest some time in the period October to March with a smaller flush in the first half of the year, perhaps in March, April, May or June. Production is lowest in the dry months July, August and September and there may be no fruit at all maturing during this period. However the fruiting behaviour varies greatly from year to year. Information provided by various Department of Primary Industry staff suggests that in many areas in Papua New Guinea, the period of greatest production is November to February.

Pineapples show almost no photoperiodicity. In normal growth and development the changes from vegetative to floral growth take place only after the plant has reached a certain stage of maturity and accumulation of stored materials, coincident with certain climatic conditions (Collins 1960, p.215). Van Overbeek and Cruzado (1948) in Puerto Rico showed that flower formation under natural conditions is due to a drop in night temperature during the winter season. In the Ivory Coast the principal cause of natural floral differentiation in the pineapple seems to be a decline in solar radiation rather than a drop in night temperatures, although a decline in maximum temperatures and short day length also cause flowering (Teisson 1972).

To determine the environmental stimulus to flowering and fruiting in Papua New Guinea, meteorological and rough leaf pineapple production records were examined from Keravat and Saiho. An understanding of the meteorological conditions that cause flowering naturally should allow a farmer to induce flowering at other times to even out production throughout the year or produce out-of-season fruit.

The climate at Keravat (latitude 4° 21' S) is weakly seasonal and quite variable from year to year. During the drier months of May to October, rainfall tends to be lower, number of sunshine hours tends to be higher, maximum temperatures tend to be slightly higher and minimum temperatures tend to be slightly lower.

MATERIALS, METHODS AND RESULTS

When flowering hormone is applied to rough leaf pineapples the resultant fruit mature over a four-week period 20 to 24 weeks later (Bourke, unpublished data). Thus meteorological records were examined from Keravat and Saiho for periods five months prior to periods of high production. It was found that periods of high production were preceded about five months beforehand by periods of high daily sunshine and low rainfall, often following a period of low daily sunshine. Conversely periods of a few weeks of high sunlight and low rainfall were usually followed by a flush in production about five months later, although not always.

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Records of fruit numbers from the Keravat pineapple planting material trial (Bourke 1976) were grouped into 36 four-weekly periods for the period January, 1972 to early October, 1975. The trial had been bearing for nine months by January, 1972 and it was considered that there were an adequate number of suitably large plants for the natural stimulating conditions to be effective. Number of sunshine hours (as recorded by a Cambell Stokes recorder), rainfall and average daily maximum and minimum temperatures were computed for the corresponding period 22 weeks prior to the yield recording period (*Table* 1). Twenty-two weeks was selected as it is the mean time from flower initiation to fruit maturity for this variety. The correlation coefficients between fruit numbers and various meteorological parameters were computed (*Table* 2).

There are significant correlations between average minimum temperature and fruit number and between number of sunshine hours and fruit number. As well there are significant correlations between most of the various meteorological parameters recorded.

***Table* 1.—Fruit number per 4 weeks and meteorological data for corresponding period 22 weeks earlier**

First day of 4-week recording period	Fruit number per 4-weeks	Meteorological data for 4-week period 22 weeks earlier			
		Sunshine hours	Rainfall mm	Average daily maximum temperature °C	Average daily minimum temperature °C
31/12/1972	126	183.2	103	29.88	20.58
28/1/1973	21	175.3	35	30.69	20.62
25/2/1973	34	209.1	156	31.31	20.36
25/3/1973	5	211.1	159	31.88	21.47
22/4/1973	18	111.0	312	30.56	22.48
20/5/1973	13	174.4	289	30.40	22.72
17/6/1973	0	144.2	297	30.36	22.84
15/7/1973	8	168.4	149	30.99	22.90
12/8/1973	3	146.5	315	30.99	23.33
9/9/1973	4	187.2	240	31.47	22.79
7/10/1973	10	205.3	71	31.75	22.19
4/11/1973	3	172.2	180	31.11	21.98
2/12/1973	15	177.7	115	30.83	21.33
30/12/1973	41	199.8	167	31.11	21.13
27/1/1974	20	220.8	97	31.92	21.39
24/2/1974	64	223.1	137	31.77	21.15
24/3/1974	20	169.1	377	31.55	22.04
21/4/1974	45	200.4	38	31.42	21.90
19/5/1974	17	189.3	126	31.53	21.77
16/6/1974	112	235.3	100	31.65	21.38
14/7/1974	18	160.1	157	30.85	22.09
11/8/1974	0	172.9	300	31.32	21.90
8/9/1974	14	156.1	332	30.84	21.84
6/10/1974	32	209.4	218	31.57	21.48
3/11/1974	124	188.8	147	31.14	21.29
1/12/1974	51	206.3	41	31.52	21.25
29/12/1974	50	185.9	166	31.45	21.14
26/1/1975	115	214.7	123	31.78	20.59
23/2/1975	197	219.3	172	32.28	20.85
23/3/1975	64	157.9	345	31.31	21.75
20/4/1975	17	131.2	200	30.92	22.33
18/5/1975	43	138.2	130	30.39	22.08
15/6/1975	64	107.1	85	30.25	22.14
13/7/1975	27	130.3	290	30.40	22.11
10/8/1975	28	155.7	359	30.60	22.26
7/9/1975	66	181.0	97	31.19	22.28

To separate the effect of minimum temperatures and other meteorological parameters on fruiting, partial correlation coefficients for minimum temperature, fruit number and the other parameters were derived (*Table* 3).

Table 2.—Correlations coefficients for fruit numbers per 4 weeks and meterological data for corresponding period 22 weeks earlier

Comparison	Correlation coefficient	Level of significance
Average minimum temperature v. fruit number	-0.558	p=0.001
Sunshine hours v. fruit number	0.367	p=0.05
Rainfall v. fruit number	-0.306	p=0.1
Average maximum temperature v. number	0.233	NS
Sunshine hours v. average maximum temperature	0.759	p=0.001
Sunshine hours v. average minimum temperature	-0.591	p=0.001
Average minimum temperature v. rainfall	0.479	p=0.01
Sunshine hours v. rainfall	-0.463	p=0.01
Average minimum temperature v. average maximum temperature	-0.313	p=0.1
Rainfall v. average maximum temperature	-0.209	NS

Minimum temperature and fruit number are significantly correlated when the effect of either sunshine hours, rainfall or maximum temperature is removed. However there is no correlation between sunshine hours, rainfall or maximum temperature and fruit number when the effect of minimum temperature is removed.

DISCUSSION AND CONCLUSIONS

Floral initiation in rough leaf pineapples is closely associated with low minimum temperatures. The nature of the data does not allow the conclusion that this causes flowering, although this is likely.

This conclusion has an important practical application. Flowering can be induced artificially by applying napthaleneacetic acid, calcium carbide, acetylene solution or other substances to the plant. To even out production peaks during the year or to bring plants into bearing when fruit from naturally induced flowers are not available, a farmer can apply the flowering inductant during periods when night temperatures are high.

Because the period from flower initiation to flower appearance is shorter and less variable than the period to fruit maturity, better correlation may have been obtained between the appearance of flowers and meteorological conditions six to seven weeks previously.

Table 3.—Partial correlation coefficients

Comparison	Constant factor	Partial correlation coefficient	Level of significance
Average minimum temperature v. fruit number	Sunshine hours	-0.455	p=0.05
Sunshine hours v. fruit number	Average minimum temperature	0.056	NS
Average minimum temperature v. sunshine hours	Fruit number	-0.500	p=0.01
Average minimum temperature v. fruit number	Rainfall	-0.493	p=0.01
Rainfall v. fruit number	Average minimum temperature	-0.053	NS
Average minimum temperature v. rainfall	Fruit yield	0.390	NS
Average minimum temperature v. fruit number	Average maximum temperature	-0.529	p=0.01
Average maximum temperature v. fruit number	Average minimum temperature	0.055	NS
Average minimum temperature v. average maximum temperature	Fruit number	-0.236	NS

The rough leaf pineapple plant appears to be very sensitive to the effect of minimum temperature on flower initiation as the four-weekly averages for the period studied ranged from 20.4°C to 23.3°C only. This is higher than the average minimum night temperatures of 15.6 to 16.7°C that induce flower initiation in Puerto Rico (van Overbeek and Cruzado 1948).

It should be noted that the appropriate meteorological conditions will not always induce flowering. Plant size and previous flowering history are also important. If plants are too small or if many plants in a garden have already flowered, cold nights will not cause a significant number of plants to flower.

It is of interest to note that most fruit trees at Keravat bear in the November to January period with a secondary fruit flush in about April to May (D. W. Loh, pers. comm.). Examples are the avocado, durian, galip, jak fruit, malay apple, mangosteen, rambutan, sapodilla and velvet apple. It is likely that flower initiation of the fruit trees at Keravat is also caused by low minimum temperatures.

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