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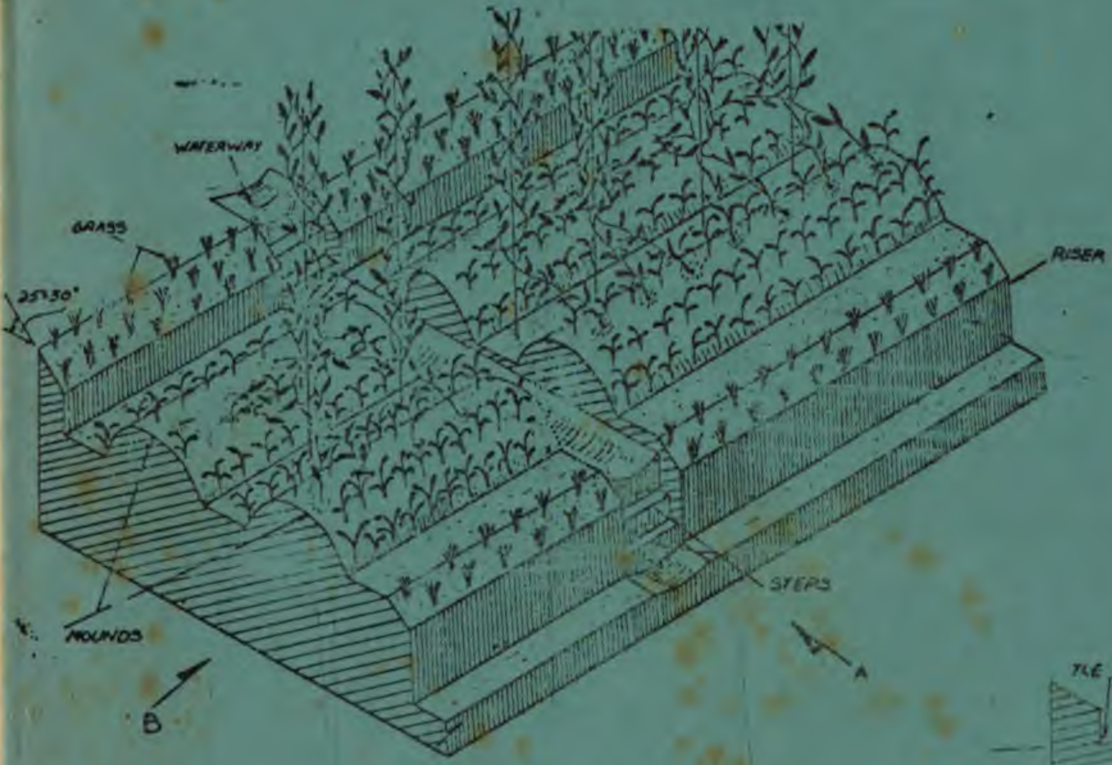
HILLSIDES PROJECT IN JAMAICA -
DEVELOPMENTAL POTENTIALS OF HILLSIDE AGRICULTURE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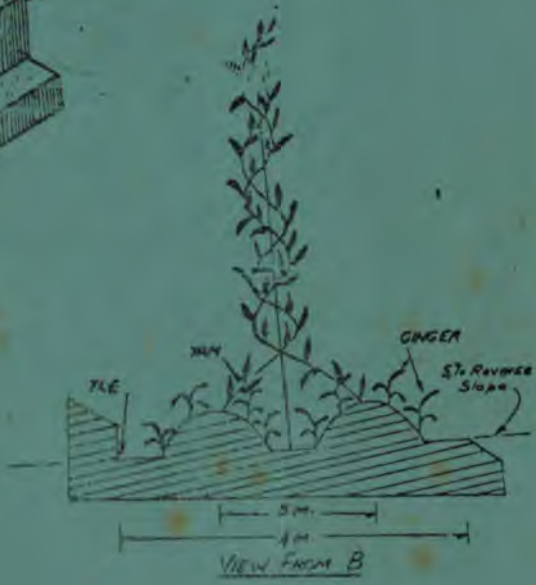
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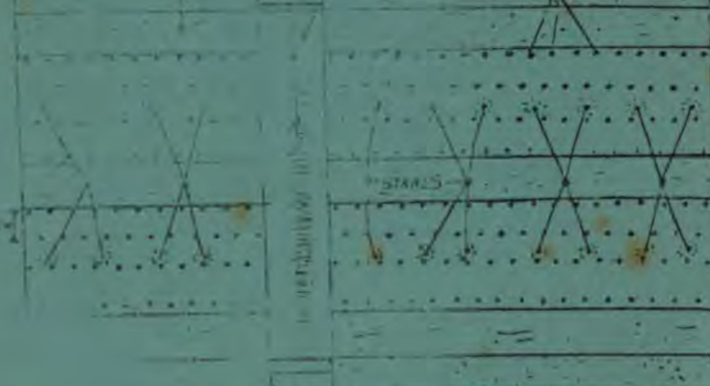
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THE ALLSIDES PROJECT IN JAMAICA - DEVELOPMENTAL POTENTIALS OF HILLSIDE AGRICULTURE

by

Abdul H. Wahab, Percy Aitken-Soux, Irving E. Johnson
and Howard Murray

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FOREWORD

The "Statistical yearbook of Jamaica 1978", published by the Department of Statistics, states on page 45 that:

- there are 190,582 farmers in the country;
- 149,703 farmers (78.6%) have less than 1.5 acres on the average and are classified in the 0 - 5 acre size stratum.

Several surveys conducted by IICA/Jamaica show an average household size among small farmers of seven (7) persons. This represents approximately fifty percent (50%) of the total population of Jamaica.

It can be stated that the small farmers are the sub-sector in agriculture principally responsible for the production of food for domestic consumption. It can also be pointed out that the normative policies of the Government are aimed at the small farmers because they:

- represent the lowest income category among farmers;
- are the largest food producers for domestic consumption;
- represent the population sector most affected by unemployment and low income;
- are the single largest source of rural-urban migrants; and
- are potentially the greatest producers of food for the country, as demonstrated by the "Allsides project".

It is a fact that most small farmers have their land in hillsides, which are subjected to heavy erosion and soil loss.

The "Allsides project" addresses itself to the situation of some of the most important problems affecting the small hillside farmers, and provides for them a technology at the level of their culture and arts, which can potentially increase their income, nutrition, standard of living as well as decrease unemployment.

This project, given its characteristics can be duplicated in other Island States of the English speaking Antilles, for the benefit of their population and national accounts while decreasing their dependency on imported foods.

Foreword Cont'd

We are very proud to present this prologue to the seminar being presented at Iowa State University. Following its evaluation after three years of implementation the Allsides project has been recognized as one of the most successful of IICA's projects in the Region.

DR. PERCY AITKEN-SOUX
DIRECTOR.

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No. III - 2 IICA-MAJ, "Hillside Farming in Jamaica", A Training Seminar, December 1978

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No. IV - 15 Norma Munguia, Percy Aitken, Abudl Wahab, Irving Johnson, "Salt Extraction by Solar Energy" A Mini-project. September 1980.

No. IV - 16 Abdul H. Wahab, Percy Aitken-Soux, Irving E. Johnson and Howard Murray, "The Allsides Project in Jamaica - Developmental Potentials of Hillside Agriculture". September 1980.

The Allsides Project In Jamaica -
Developmental Potentials of Hillside Agriculture[1,2]

Abdul H. Wahab, Percy Aitken-Soux, Irving E. Johnson[3]
and Howard Murray[4]

INTRODUCTION

Jamaica is the largest of the British Commonwealth islands within the Caribbean. It is located 18° North of the Equator at a longitude of 77° W. At the most distant points it is 146 miles long and 51 miles wide. The island occupies 4,411 square miles (11,400 km^2), 80% of which is hilly to mountainous. Over 50% of the island is characterized by slopes of 20° (36%) and greater and as a consequence only 30% of the total area lends itself to mechanized agriculture. The flat lands are dedicated mainly to the cultivation of export crops such as sugar cane, bananas while the hilly lands supply most of the domestically consumed foodstuffs and substantial quantities of animal protein.

Population as estimated in 1978 was 2,106,000 with 62% of the people living in rural areas. In 1978 population density based on arable land was 434 persons per km^2 and population was increasing at 1.5% per year.

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[1] Paper presented at the Seminar on Rural Development under the aegis of Iowa State University and The Inter-American Institute of Agricultural Sciences (IICA-OAS), held in Ames, Iowa, September 29 - October 3, 1980.

[3] Agricultural Research Specialist and F.S.B. Project Director, Mission Director and Agricultural Economist, respectively, IICA/Jamaica.

[4] Project Agronomist, Ministry of Agriculture, Jamaica.

Mortality in 1976 was 20.4 for 1,000 live births and life expectancy at birth was 70.6 years. In 1960 literacy was estimated to be 90%.

Distribution of arable land among farmers is characterized by a great imbalance as can be seen in Table 1. Data obtained during the Agricultural Census for 1968/69 revealed that there was a total of 190,582 farms of which 149,703 were less than five acres (2.02 ha) had an average size of 1.5 acres and represented 15% of all farm lands in Jamaica (1). Many land distribution and tenancy rationalization programmes have been implemented beginning 1969, so it is likely that changes in stratification of farms will have occurred since then. Demographically, small farmers constitute the most important group of producers of domestically consumed foods. These small producers are: (i) located on the hills; (ii) cultivate lands that are highly erodible and inherently infertile; (iii) practice low technology agriculture; and (iv) depend entirely on rainfall water for crop production.

The present socio-economic reality of Jamaica makes it imperative that inter alia, food imports be substituted by domestically produced foods, and that farm production and productivity be increased. In cognizance of this the Government of Jamaica has identified food production and rural employment as areas of high priority in its efforts to redress problems such as:

(i) inadequacy of supplies of domestically grown crops for home consumption;

(ii) high concentration of small farmers (<5 acres) on the hillsides (80% of all farmers);

(iii) serious erosion of hillside lands;

(iv) disparity in income distribution between the rural and urban populations (J$600 vs J$2,500[1] per capita per annum); and

(v) high unemployment (approximately 40% of the labour force) in the rural areas and as a direct consequence a high rate of migration of rural youths into the cities.

One of the first actions of the G.O.J. towards promoting increased food production was to quantify the extent of soil erosion on the hillsides resulting from improper cultural practices. In this context a series of studies over the period 1969 - 1973 resulted in the following principal conclusions:

(a) There is an average soil loss of 136 t/ha/yr (54t/ac/yr) from unprotected yam plots having a 17° slope, and as a consequence a reduction in soil fertility and productivity;

(b) when hillsides are bench-terraced soil loss is reduced to 18 t/ha/yr (7.3t/ac/yr), and soils can be cropped on a sustained basis (2).

Consequent to these findings the Government of Jamaica embarked on an ambitious programme of soil conservation throughout the island. By 1976, in recognition that: (i) soil conservation measures *ipso facto* were not enough to solve the problems of low food production on the hillsides; and (ii) bench terracing has become a very costly capital investment, (J$7,000 ha presently) and it was a *sine qua non* that viable production practices be developed and implemented for their effective utilization. Consequently, the Government of Jamaica requested IICA's assistance in developing viable systems of production for newly terraced soils.

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[1] J$ = US$0.56

THE PROJECT

The project encompasses 251 ha (622 ac) and consists of 233 farm families totalling 1,393 individuals (3). A detailed topographic survey of the project site indicates that over 55% of the area is characterized by slopes 15° and greater (4).

The predominant soil type of the area is an Ultisol locally classified as Wirefence Clay Loam, Map No. 32. As presented in Table 2, this soil is very highly acidic (pH 4.9) and contains high levels of exchangeable aluminum and is relatively infertile as evidence by medium, low and very low levels of N, P and K respectively. Annual precipitation over a three year period averaged 1980 mm (78 inches) and is characterized by a bimodal distribution pattern with wettest months occurring in May and October (fig. 1 - 5) Yam (Dioscorea Spp) a root crop and an important staple in Jamaica is grown by almost every hillside farmer who generally cultivate the crop on individual mounds with little or no regard to soil erosion control measures.

The overall objective of the project is to develop a body of knowledge on hillside farming and cropping systems conducive to changing the traditional pattern of hilly land farming (4). Specifically, it is expected that the project would develop production systems for bench terraces which could result in:

(a) increased levels of production and productivity;
(b) increased farm income;
(c) enhanced nutritional profiles of farm families; and
(d) increased opportunities for rural employment (4).

STRATEGY FOR ACHIEVING THE PROJECT OBJECTIVES

Following construction of bench terraces, the farmers' hillside plot is rendered flat and thus can be cultivated with more ease and greater intensity than before terracing. For instance, terraced land can be

used to great advantages in cropping systems in which yam grown on continuous mounds is intercropped with other row crops such as potatoes, ginger, peanuts and red peas. Such a multiple cropping system has the added advantage of: (i) substantially reducing splash erosion because of the continuous crop cover resulting from the crops selected for the system; and (ii) mitigating the hazards of farming under completely rainfed agriculture. (5)

More importantly however, is that a system of intercropping in the context of Jamaica hillsides ensures optimal exploitation of the dimensions of:

(a) space;
(b) available soil moisture;
(c) available soil nutrients and applied fertilizers;
(d) incoming solar radiation; and
(e) available farm labour.

Thus the strategy employed in achieving the project objectives was to:

(i) test and identify farming systems which are suited to the edaphic and climatic conditions of Allsides, Trelawny where farming is done entirely under rainfed conditions;

(ii) determine the financial feasibility of those systems of production which have been identified as being agronomically and nutritionally suitable for the area;

(iii) ascertain the feasibility of maintaining a combination of small (goats) and large (cattle) livestock from the forage produced on the risers of the terraces;

(iv) conduct rapid adaptive research aimed at solving problems related to soil and crop management e.g., fertility, liming, crop density and crop variety trials;

(v) produce acceptable seed material for distribution to adoptors of the improved technology; and

(vi) train national technicians in the areas of watershed management and research techniques with special emphasis on farming systems for hillsides.

Concomitantly, a vigorous programme of on-farm soil and water conservation works cum crop development is conducted on plots operated by the target group.

EXPERIMENTAL APPROACH AND METHODOLOGY

Consistent with the strategy spelled out above, research and developmental work was conducted inter alia on a total of 20 systems of production during the crop years 1977/78 and 1978/79. Beginning in October 1978 and again in March 1979 and 1980 respectively, work commenced on the further refinement and economic viability of eight of the more promising cropping systems. Presented in Figures 6 through 10 are the cropping patterns which have undergone and continue to undergo evaluation. For each cropping system the dates of planting and harvest of the respective component crops are plotted on scale. For example, in Figure 9, the planting and harvest dates of System 2, are as follows:

Yams - March 3, 1979 and February 13, 1980;
Irish Potato - April 20, 1979 and July 11, 1979;
Radish - July 17, 1979 and August 27, 1979; and
Peanut - September 20, 1979 and January 23, 1980.

Following construction of terraces in early 1977 and prior to crop establishment, lime in the form of marl and poultry manure each at the rate of 3 t/ha (1.2 t/ac) were applied to ameliorate soil acidity and low soil organic matter content respectively. Irrespective of the

cropping pattern, rates of fertilizer application for the first two crop years remained constant as follows:

N - 200 kg/ha as urea or ammonium sulphate;
P_2O_5 - 300 kg/ha as Triple Super Phosphate; and
K_2O - 150 kg/ha as Muriate of potash.

Commencing in 1980, the fertilizer dosage was altered to conform to a commercially available blend which the farmers are accustomed to using. Presently, their 1,440 kg of 12:24:12 is administered per hectare per crop year.

Irrespective of whether yellow yam (Dioscorea caynensis), the principal crop of the area is grown as a sole crop or in association with other crops, the density is kept constant at 10,000 plants/ha (4,050/ac). As shown in Figure 11, yams are planted on continuous mounds with rows spaced 1.5 m apart and at 0.67 m within the row. This requires approximately 8,000 kg of yam "heads" and 2,500 wooden stakes per ha for sowing and staking of yam vines. Irish potato planted with yam at the beginning of the crop cycle (fig. 12) is sown in rows spaced 0.75 m apart and 0.25 m within the row. This results in a crop density of 53,000 plants/ha (21,500/ac) and requires approximately 2 t/ha of seed material. Peanut when grown as an intercrop with yam at the commencement of the crop cycle and thereafter at six months (fig. 13 and 14) is seeded in consecutive and peripheral (with respect to yam) rows respectively, spaced 0.4 m apart and 0.15 m within the row. This results in a crop density of 166,000 and 83,000 plants/ha during the first and latter halves respectively of the crop cycle. The spatial arrangement used for red pea (Phaseolus sp. and Vigna sp.) at the beginning of the crop cycle (fig. 15), is rows 0.4 m apart and 0.15 m within the row. This results in a population of 166,000 plants/ha. Cropped with yam during the latter half of the crop year, sowing is done in rows peripheral to two consecutive yam rows at a density of 83,000 plants/ha.

Ginger when grown with yam for most of the crop year is sown in rows 0.4 m apart and 0.21 m within the row (fig. 16), giving a crop density of 125,000 plants/ha. Field observations included:

- (a) Crop adaptability;
- (b) total and marketable crop yields;
- (c) crop performance as affected by various planting dates;
- (d) response of crops to varying rates of N.P.K. and lime;
- (e) time-motion data on discrete operational variables involved in the production of each of the eight promising cropping systems inclusive of land preparation; and
- (f) variable costs of materials required for production of the crops.

Additionally, Napier grass (Pennisetum purpureum) was established on the risers of bench terraces to stabilize these structures thus rendering them less susceptible to erosion from heavy rains. As a spin-off, the forage was harvested at regular intervals and fed to four goats and two heads of cattle on a year round basis, observations were taken of forage yield and weight gains.

PRINCIPAL RESULTS AND ACCOMPLISHMENTS

Presented in Table 3 are equivalent yields of each crop component and cropping system tested during the 1977/1978 crop year. Yam yields were excellent when compared with those obtained by farmers in the project area(10 - 15 t/ha of marketable tubers); yields ranged from a low of 26.565 t/ha in the cropping system where sweet potato and red pea were included to 39.899 t/ha when ginger and sweet potato were grown in association with yam. Except for cropping system number 8 (yams grown in association with sweet potato followed by red pea) there was an appreciable increase in total yam output by every other treatment compared to the check treatment (system No. 1). Further, Irish potato of the red pontiac variety sown together with yam and harvested 85 days thereafter produced a yield of over 9 t/ha of good

quality tubers. Also, it was significant that other component crops such as onion, corn, pumpkin, cabbage, carrot, cassava, ginger and sweet potato performed poorly. This was attributed to several factors viz.: (i) poor seed quality which resulted in extremely poor crop stand in the case of onion and ginger; (ii) inability of the soil to supply adequate quantities of magnesium for acceptable corn growth and yield; (iii) inability of the cassava and sweet potato crops to accumulate carbohydrates despite excellent top growth; (iv) a high population of cabbage looper which rendered a high percentage of the heads unmarketable and (v) significant loss in carrot crop stand due to seed loss from yam mounds consequent to heavy rains and prior to seedling emergence.

The encouraging yam, potato and red pea yields coupled with the direct soil conservation benefits to be gained from yam cultivation on mounds and the demonstration of an improved farm cash flow situation which could accrue to the small hillside farmer stimulated further work at identifying viable systems of production.

During the 1978/1979 crop year, corn was again tested and new crops such as the 'dwarf determinate' variety of pigeon pea (UWI - 17), bodie bean (vigna spp), peanut and lettuce were included in the crop mixes as presented in Figure 7.

The yield data for each cropping system are presented in Table 4. Except for System 6 in which yams were grown with peanut and sweet potato an increase in saleable yam tuber yield over the yam monoculture was recorded for each of the other systems tested. Further, systems in which yam was intercropped with Irish potato, ginger and peanut produced saleable yields of 7.15, 3.06 and 2.13 t/ha respectively of these crops during the first half of the cropping cycle. Again, as was observed in the 1977/1978 crop, corn, onion, sweet potato and carrot performed poorly as intercrops. The pigeon pea crop yielded poorly whereas lettuce seeds failed to germinate. Overall, the legume mixes resulted in a fair level of performance.

To ascertain yield response of yams and other crop mixes when established during the September - October rainy season, four production systems were tested on semi-commercial sized plots. The crop mixes are presented in Figure 8 and consisted of:

(i) yam as a sole crop;
(ii) yam grown together with peanut followed in sequence by Irish potato and radish;
(iii) yam grown together with peanuts followed by Irish potato; and
(iv) yam grown together with African red pea and followed by peanut.

The yield data of yams and each component crop are shown in Table 5. Yam tuber yield was highest (27 t/ha) when this crop was grown as a monoculture and production declined by an average of 23% as other crops were intercropped with yam. Notwithstanding periods of sustained drought conditions which could have led to the overall lowering of yam yields, peanut performed well on both terraces which had been planted to this crop together with yam in the first half of the cropping year. Yields of whole sound kernels expressed at a moisture content of 10% averaged 1.45 t/ha and 0.78 t/ha during the first and latter halves respectively of the yam crop cycle. The Irish potato crops were severely affected by early and late blight. This resulted in immature ripening of the crop and as a consequence, tuber size was small. The radish crop performed well and when viewed in the context of its short maturity period (4 - 5 weeks) appears promising.

Following a detailed review of the results obtained from April 1977 to February 1979, eight crop mixes were established on whole terraces thereby simulating in size, farmers terraced plots. These terraces varied in hectarage from 0.02 to 0.07 ha (0.05 to 0.17 ac). The mixes were selected on the basis of their:

(i) demonstrated high yielding potential;
(ii) nutritional values;
(iii) ability to establish a good crop canopy at an early stage of the yam growth cycle;
(iv) ability to enhance farm income; and
(v) labour intensive requirements.

As indicated in Figure 9, the main crop continued to be yam and the intercrops were:

- Irish potato;
- Radish;
- Peanut;
- Red pea (Phaseolus and Vigna spp);
- Ginger;
- Sweet potato;
- Grain corn; and
- Cabbage

The crop cycle commenced in March 1979 and ended in February 1980. As previously stated, records were kept of all production inputs inclusive of costs of chemicals, fertilizers, and all the labour requirements for the various farming operations from field preparation through planting, crop care, harvesting, drying and delivery of produce at farm gate. Outputs were measured on total and saleable or edible yields and farm gate revenue was calculated by multiplying saleable yield by prices which prevailed at the time of crop harvest.

Crop yield data are shown in Table 6. Compared with the two previous years, yam tuber yields were low and averaged 18.1 t/ha of saleable materials for all eight cropping systems. However, these low yields are compensated for by the satisfactory yields of Irish potato (13.25 t/ha), radish (1.27 t/ha), peanut (2.51 t/ha), cow pea (1.5 t/ha) and ginger (13.87 t/ha). Again, crops such as corn, sweet potato and cabbage failed to perform well whereas red pea yields improved somewhat over previous years. Notwithstanding the fact that yam yields were greater

than those of the project farmers, available information indicates that several factors might have militated against higher yields. These are:

(i) inter-crop competition particularly when yam is intercropped with sweet potato;

(ii) sustained periods of unseasonably heavy rains which resulted inter alia in leaching and thus decreased effectiveness of applied fertilizers and other available soils nutrients;

(iii) a build-up in the levels of yam specific nematodes in the yam tubers which resulted in a high loss of marketable tuber material; and

(iv) late staking of yam vines (12 - 14 weeks after planting) due to unavailability of yam stakes at time of sprouting.

These are important aspects which must be taken into consideration in devising crop mixes, improving the performance of polycultures and providing a satisfactory basis for projecting revenue.

Economic Assessment

Summarized in Table 7, are the input costs incurred in producing each system, the outputs derived from each crop component and the returns per hectare exclusive of costs for terracing. In three of the eight systems viz., 2, 4 and 5, net farm income increased over the yam monoculture system by 111, 5 and 90%, respectively. Total output realized from the sale of crops exceeded those of the sole yam crop in size of the seven crop mixes. However, relatively high production costs were associated with a number of investigatory and improvement aspects. Adjustments must be made to ensure that they do not inappropriately negate the economic benefits which could have been obtained. These increased production costs are being reduced through:

(i) improved effeciency in field tillage, crop sowing and harvesting operations;

(ii) rationalization of the disease and pest control programme; and

(iii) rationalization of the soil - crop management programmes.

The results presented in Table 7 further indicate that on the hillsides of Jamaica farm family income could be increased several folds, provided that the farmer adopts the practice of polyculture together with improved technology. However, the high costs of production of the inter-crops would require the establishment of a closely supervised farm credit scheme to ensure that inputs are acquired and used on a timely schedule. Also, a strong Extension is a sine qua non to transfer the research information to the farmer - who is an individualist and manifests a behaviour which depicts the motto "Every Man for Himself". (6)

Another distinct advantage of polyculture at Allsides and other hilly areas in Jamaica is that the entire holding can be cultivated continuously versus the present traditional practice in which areas are allowed to go into fallow or "ruinate" for one year following three years of continuous yam cultivation. Farmers claim that this practice "enable the land to recover its strength". (6)

Nutritional Evaluation

One of the major problems of the developing countries today is inadequate food production. In Jamaica the critical shortage of foreign exchange requires a greater dependence on domestically produced foods. As in other islands of the Caribbean the small farmers will continue to play the dominant role in food production. They will require assistance to enable them to grow the right crop mixes which can supply a balanced food intake. A nutritional survey was conducted at the project site to ascertain levels of and consumption patterns of farm families (7). Inter alia it was found that daily per capita intake fluctuated between 1,250 and 1,954 kilocalories whereas protein from all sources fluctuated between 36 and 73 grams per capita per day. Yellow yams played a

dominant role in the diet providing from 15 to 30% of the total calories and up to 15% of the protein intake.

Based on the edible product yields of the 1979/1980 commercial trials food energy, protein and carbohydrate values were computed for each of the eight cropping systems (8,9,10). These values are presented in Table 8. The change in energy yield and food values relative to the yam monoculture are shown in Table 9. Figure 17 is a graphical representation of energy and food protein values obtained from each of the eight cropping systems. In terms of total nutritional energy, five of the seven crop mixes yielded more than the yam monoculture, the exceptions being yam inter-cropped with sweet potato and yam inter-cropped with red pea and cow pea. The energy contents varied from 57.25×10^6 kilojoules for yam alone, to 102.10×10^6 kilojoules when yam was intercropped with Irish potato, radish and peanut, an increase of 78% (Tables 8 and 9). Again protein and carbohydrate values were lowest (0.20 t/ha and 2.12 t/ha, respectively), for the yam/sweet potato system and among the highest (0.69 t/ha and 5.51 t/ha, respectively), when yam was intercropped with Irish potato, radish and peanut. Protein and carbohydrate values for the yam mono-culture were 0.31 t/ha and 3.14 t/ha, respectively. As expected the legume mixes viz., yam + peanut + red pea, and yam + cow pea + peanut produced the highest protein yields. Values were 0.76 and 0.67 t/ha, respectively and when compared to the yam monoculture outyielded it by 143% and 113%, respectively.

These results indicate that polyculture is a far more efficient producer of calories than monoculture when the same principal crop is included in both systems. Also, the multiple cropping systems performed superior nutritionally to the yam monoculture. It is gratifying to observe that within the project area of Allsides, a significant number of producers who previously grew root crops continuously are now including peanuts, cowpea, red pea and Irish potato in their cropping mixes. This will

result eventually in a more balanced dietary intake, by the target group.

Employment Evaluation

Jamaica as well as many other developing nations are experiencing rising unemployment. The rural areas are worst affected. Consequently there is a tendency for rural youths to migrate to the large cities. This trend has led to severe pressures on existing social and health facilities in the urban centers and as one direct consequence crime rates in the cities has increased considerably. In cognizance of this, deliberate efforts are made to create projects which have a favourable employment generation potential. Indeed, one of the objectives of the project was to demonstrate the employment potential by the adoption of a rational system of crop and soil management for the Allsides area.

Presented in Tables 10 and 11 are the observed monthly labour inputs required for the establishment and maintenance through to crop maturity of the eight cropping systems, evaluated on whole terraces during the 1979/1980 crop year. When contrasted with the traditional practices of the farmers there is little difference in the total labour required for yam monoculture produced on continuous mounds on the terraces, although there is variation on a monthly basis. Again, although farmers claim that they use more labour than that required by the project, for every cropping system used the labour requirements have been much greater than for the traditional farming practices. Another important consideration is related to the direct soil conservation benefits which will accrue from the use of continuous mounds on terraced land in such a system, i.e. a recorded soil loss of 18 t/ha/yr compared to 136 t/ha/yr sustained by farmers on plots having a 17° gradient (2). Systems 2 and 5 which produced the highest farm gate revenues and quantities of energy and protein were also shown to have high employment potentials. These findings are even more meaningful when cognizance is taken of the labour distribution patterns over the 12-month cropping cycle, as presented in Figures 18 - 20.

Livestock

The possibility of converting forage produced on the risers of terraces into animal protein was stated earlier in this report. It has been successfully demonstrated over the period 1977/1980 that two heads of large livestock (cattle) and four heads of small livestock (goats) can be maintained by zero grazing from the Napier grass produced on a total riser area of 0.07 ha (.18 ac).

Hence in addition to serving principally to stabilize risers, Napier grass could be used to significant advantage in enhancing farm income and increasing the availability of animal protein to the population of Jamaica. It is most important that the grass be zero-grazed to protect the risers from destruction by the animals.

The agro-socio-economic data reported herein that under rainfed conditions intensive farming of hilly lands in Jamaica could result in:

(i) increased food production;
(ii) increased farm income;
(iii) decreased rural unemployment;
(iv) improved standard of living;
(v) improvement in the Government's import substitution efforts;
(vi) an increase in G.N.P.; and
(vii) positively influencing the rate of national economic growth.

It is extremely gratifying that the improved technology is being adopted by a significant number of producers within the area and elsewhere. However, to achieve greater success it is necessary that a strong Extension Unit be set up together with a Farmers Credit Union, charged specifically with servicing the credit needs of the small hillside producer.

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TABLE 1 - Farms, Number, Size and Acreage in Jamaica in 1968 1/

Farm Size	Number	% of Total	Acreage	% of total Acreage
0 - 5	149,703	78.8	223,818	14.9
5 - 25	36,881	19.0	333,548	22.1
25 - 100	3,004	1.6	125,104	8.2
100 - 500	699	0.4	148,501	9.93
500 +	295	0.2	676,426	44.9
All Farms	190,582	100.0	1,507,397	100.0

1/ Source: Statistical Yearbook of Jamaica 1978.

Table 2 - Selected physical and chemical properties of the 0-45 cm soil layer of the Allsides, Trelawny soil (an Ultisol, locally classified as soil type No. 32, Wirefence Clay Loam), immediately after the soil was bench terraced (April 1977) and following the completion of the third year cropping cycle (February 1980).

Physical and Chemical Properties	Value
Sand (%)	15.21
Silt (%)	22.01
Clay (%)	62.78
Bulk density (g/cc)	1.16
Field capacity at 1/3 bar (%)	49.32

	April 1977	February 1980
pH (1:2:5)	4.9 vha [1/]	4.9 vha
Organic matter (%)	0.67 vl	3.09 ml
Nitrogen (%)	0.14 m	0.16 m
Phosphorus (ppm P_2O_5)	10 Vl	32 ml
Potassium (ppm K_2O)	109 L	111.50 L
CEC (meq/100 g)	18.50 m	21.00 m
Ca (" ")	5.28 m	6.26 m
Mg (" ")	1.51 m	0.96 L
k (" ")	0.24 L	0.25 L
Al (" ")	8.16	
Cu (ppm)	1.35	2.80
Fe (")	77.50	93.75
Mn (")	8.05	5.50
Zn (")	3.37	2.0

[1/] Vha - very highly acidic

Vl - very low

Ml - medium low

M - medium

L - low

Table 3. - Marketable yields of yellow yam (*Dioscorea cayenensis*) and other crops grown alone and in a polyculture system at Allsides, Trelawny, during the 1977/1978 crop year.

Cropping System	Crops	Marketable Yield (t/ha)	New Yam "Head" Yield (t/ha)	Change in Total Yam Yield Over Monocrop (%)
1	Yam alone	31.502	16.917	0
2	Yam	36.794	16.692	10.46
	Red Pea	0.552		
	Onion	0.053		
3	Yam	38.752	17.274	15.71
	Sweet Corn	7500 *		
	Red Pea	0.124		
4	Yam	35.441	16.713	7.71
	Grain Corn	0.761		
	Irish Potato	0.489		
5	Yam	34.480	17.289	6.92
	Irish Potatoes	9.286		
	Radish	1.587		
	African Red Pea	0.296		
6.	Yam	38.734	17.840	16.84
	Pumpkin	0.000		
	Sweet Corn	3133 *		
7.	Yam	33.006	17.010	3.30
	Cabbage	0.695		
	Carrot	0.108		
	Red Pea	0.093		
8	Yam	26.565	13.668	16.91
	Sweet Potatoes	2.129		
	Red Pea	0.105		
9	Yam	36.794	15.861	8.75
	Cassava	0.000		
	Red Pea	0.539		
10	Yam	39.899	17.032	17.58
	Ginger	0.000		
	Sweet Potatoes	1.616		

* Ears of corn.

Table 4. -Marketable yield of yellow yams (*Dioscorea cayenensis*) and other crops grown alone and in a polyculture system at Allsides, Trelawny during the 1978/1979 crop year

Cropping Systems	Crops	Marketable Yield (t/ha)	New Yam "Head" Yield (t/ha)	Change in Total yam yield over monocrop (%)
1	Yam alone	10.90	10.40	0
2	Yam	14.08	10.74	16.5
	Corn	0.304		
	Pigeon Pea	0.125		
3	Yam	15.82	11.16	26.7
	Red Pea (Ms Kelly cv)	0.455		
	Ginger	3.058		
4	Yam	12.60	9.78	5.1
	Bodie Bean	2.470*		
	Onion	0.131		
5	Yam	13.37	8.83	4.2
	Irish Potato	6.15		
	Radish	0.312		
	Cowpea (African red)	0.298		
6	Yam	10.32	9.18	-8.5
	Peanut	2.13		
	Sweet potato	0.00		
7	Yam	13.97	11.18	18.1
	Irish Potato	8.15		
	Peanut	0.274		
8	Yam	14.93	10.85	21.0
	Cowpea (African red cv)	0.373		
	Irish Potato	0.718		
	Lettuce	0.00		
9	Yam	14.16	12.08	23.19
	Red Pea (Tom red cv)	0.316		
	Peanut	0.163		
10	Yam	15.80	11.54	28.36
	Carrot	0.099		
	Bodie Bean	0.127*		

* Fresh pod yield

Table 5. - Marketable yields of yellow yam (Dioscorea cayenensis) and other crops grown alone and in a polyculture system at Site II, Allsides, during the October 1970 - November 1979 cropping period.

Cropping Systems	Crops	Marketable Yield (t/ha)	New Yam "Head" Yield (t/ha)	Change in Total Yam Yield Over Monocrop (%)
1	Yam alone	14.79	12.11	0
2	Yam	9.79	9.42	-28.6
	Peanut	1.46		
	Irish Potato	2.47		
	Radish	1.59		
3	Yam	10.56	8.02	-30.9
	Peanut	1.43		
	Irish Potato	2.13		
4	Yam	15.16	9.12	-9.7
	Red Pea (African red cv)	0.337		
	Peanut	0.78		

Table 6. - Marketable yields of yellow yam (Dioscorea caynensis) and other crops grown either alone or in a system of polyculture at Allsides, Trelawny during the period March 1979 - February 1980

Cropping System	Crops	Marketable Yield (kg/ha)	New Yam "Head" Yield (kg/ha)	Change in Saleable Yam Yield (%)
1	Yam as sole crop	13.03	9.85	0
2	Yam +	9.80	9.88	-14.0
	Irish potato +	13.25		
	Radish +	1.27		
	Peanut	0.77		
3	Yam +	7.53	8.71	-29.0
	Peanut +	2.51		
	Red pea (Ms.Kelly)	0.40		
4	Yam +	8.22	9.06	-24.5
	Cow pea (African red)+	1.50		
	Peanut	0.45		
5	Yam +	9.50	8.02	-23.4
	Red pea (Tom red)	0.34		
	Ginger	13.87		
6	Yam +	7.33	5.12	-45.0
	Sweet potato	1.31		
7	Yam +	13.08	9.92	0.52
	Grain corn +	0.28		
	Cabbage	0.00		
8	Yam +	7.95	8.25	29.2
	Red Pea (IICA/Duva)+	0.73		
	Cow pea (African red)	0.43		

Table 7. - Total inputs, outputs and benefits of eight cropping systems validated at Allsides, Trelawny during the period March 1979 - February 1980

Cropping System	Cropping Pattern	Input Costs/System/ha 2/			Outputs by crop component/ha	Return from System 1/	%Increase (Decrease) over yam monocrop
		Labour 3/	Materials	Total			
1	Yam as sole crop	3,230.65	8,499.03	11,729.68	17,277.65	5,547.97	0
2	Yams+				15,165.68		
	Irish potato+				9,110.00		
	Radish+				2,797.81		
	Peanut				1,689.70		
	Total for system	6,520.96	10,527.20	17,048.16	28,763.39	11,715.23	III
3	Yam+				12,643.31		
	Peanut+				5,536.14		
	Red Pea				2,194.50		
	System totals	7,161.22	9,897.66	17,058.88	20,373.95	3,315.07	-4
4	Yam+				13,407.06		
	Cowpea +				6,600.00		
	Peanut				984.74		
	System totals	6,019.73	9,125.46	15,145.19	20,991.80	5,846.61	5
5	Yam+				13,335.62		
	Red Pea+				1,881.00		
	Ginger				15,271.97		
	System totals	5,073.58	14,898.10	19,971.68	30,488.59	10,516.91	90
6	Yam+				9,348.52		
	Sweet potato				577.27		
	System totals	3,641.91	9,470.45	13,112.36	9,925.79	(-3,186.57)	(-)
7	Yam+				17,372.32		
	Corn+				123.92		
	Cabbage				0.00		
	System totals	3,833.77	8,964.94	12,798.71	17,496.24	4,697.53	(-)
8	Yam+				12,515.25		
	Red Pea+				4,004.00		
	Cowpea				1,883.20		
	System totals	7,209.36	10,242.08	17,451.44	18,402.45	951.01	-88

1/ Difference between outputs and inputs inclusive of labour

2/ All figures are in Jamaica $ = US$0.56

3/ Labour costs were computed at J$10.20 per man-day

able 8.- Nutritional values based on Marketable yields per hectare of eight cropping systems established at Allsides (Site I) 1979 - 1980.

		Crop yield (tons)	kJx10^6	kcalx10^6	Protein yield (tons)	Carbo-hydrate yield (tons)
System 1	Yam	13.03	57.25	13.68	0.31	3.14
System 2	Yam	9.79	43.01	10.28	0.24	2.36
	Irish Potato	13.25	45.46	10.63	0.27	2.52
	Radish	1.27	1.06	0.25	0.01	0.53
	Peanut (shelled)	0.58	13.57	3.24	0.17	0.11
	Total		102.10	24.40	0.69	5.51
System 3	Yam	7.53	33.08	7.91	0.18	1.82
	Peanut (shelled)	1.89	44.48	10.63	0.49	0.34
	Red Pea	0.40	5.63	1.35	0.09	0.24
	Total		83.19	19.99	0.76	2.40
System 4	Yam	8.22	36.11	8.63	0.20	1.98
	African Red Cowpea	1.50	23.79	5.69	0.38	0.88
	Peanut (shelled)	0.35	8.14	1.95	0.09	0.06
	Total		68.04	16.27	0.67	2.92
System 5	Yam	9.50	41.74	9.98	0.23	2.29
	Red Pea	0.34	4.82	1.15	0.08	0.21
	Ginger (fresh)	13.87	27.28	6.52	0.22	1.25
	Total		73.84	17.65	0.53	3.75
System 6	Yam	7.33	32.20	7.697	0.18	1.767
	Sweet Potato	1.31	6.41	1.53	0.02	0.359
	Total		38.61	9.22	0.20	2.12
System 7	Yam	13.08	34.93	13.73	0.31	3.15
	Sweet Corn	0.47	1.89	0.45	0.02	0.10
	Cabbage	-				
	Total		36.82	14.18	0.33	3.25
System 8	Yam	7.95	34.93	8.35	0.19	1.92
	Red Pea	0.73	10.26	2.45	0.16	0.44
	African Red Cowpea	0.43	6.79	1.62	0.11	0.05
	Total		51.98	12.42	0.45	2.41

Notes: 1 kcal (kilocalorie = 4.184 kJ (kilojoules).

Values for peanut were calculated using a shelling % of 75.

Table 9. - Comparing nutritional values of marketable crop yields per hectare of yam monocrop system with those of seven other cropping systems

Cropping System	% Increase over yam monocrop in quantity of:		
	Energy	Protein	Carbohydrate
2. Yam+Irish Potato+Radish+Peanut	78	118	76
3. Yam+Peanut+Red Pea	46	143	-23
4. Yam+Cowpea (African Red)+Peanut	19	113	-7
5. Yam+Red Pea +Ginger	29	68	19
6. Yam+Sweet Potato	-33	-38	-32
7. Yam+Sweet corn+Cabbage	4	6	4
8. Yam+Red Pea+Cowpea (African red)			

Table 10. - Comparison of monthly labour inputs (man-days) per hectare for cropping systems established at Allsides, during the 1979/1980 crop year with farmers traditional practice

Month	Farmers*	CROPPING SYSTEM							
		1	2	3	4	5	6	7	8
March	55	147	147	147	147	147	147	147	147
April	50	54	90	203	68	120	69	81	111
May	20	18	31	18	41	18	18	24	18
June	31	0	11	6	3	4	19	3	21
July	0	12	140	16	150	67	12	18	218
August	0	0	44	157	0	22	0	4	0
September	25	17	49	54	53	17	17	31	85
October	6	6	7	8	6	6	6	6	9
November	24	9	10	41	11	9	16	9	14
December	9	0	1	0	2	0	0	0	31
January	50	1	57	52	109	1	1	1	1
February	62	52	52	0	0	86	52	52	52
Total	323	316	639	700	590	497	357	376	707

* Traditional practices of the farmers

CROPPING SYSTEMS:

1. Yam as sole crop
2. Yam & Irish potato & Radish & Peanut
3. Yam&& Peanut & Red Pea
4. Yam & Cowpea (African red) & Peanut
5. Yam & Red Pea & Ginger
6. Yam & Sweet Potato
7. Yam & Corn & Cabbage
8. Yam & Red pea & Cowpea

Table 11. - Manual Labour required (man-days) for the establishment, maintenance and harvest of eight cropping systems tested at Allsides, Trelawny, during the 1979/1980 crop year

Cropping Systems	Man-days per hectare	Increase over yam monocrop	% Increase over yam monocrop
Yam as sole crop	316	-	-
Yam & Irish Potato & Radish & Peanut	639	323	102
Yam & Peanut & Red Pea	700	384	122
Yam & Cowpea & Peanut	590	274	87
Yam & Red Pea & Ginger	497	181	57
Yam & Sweet Potato	357	41	13
Yam & Grain Corn & Cabbage	376	60	19
Yam & Red Pea & Cow Pea	707	391	124

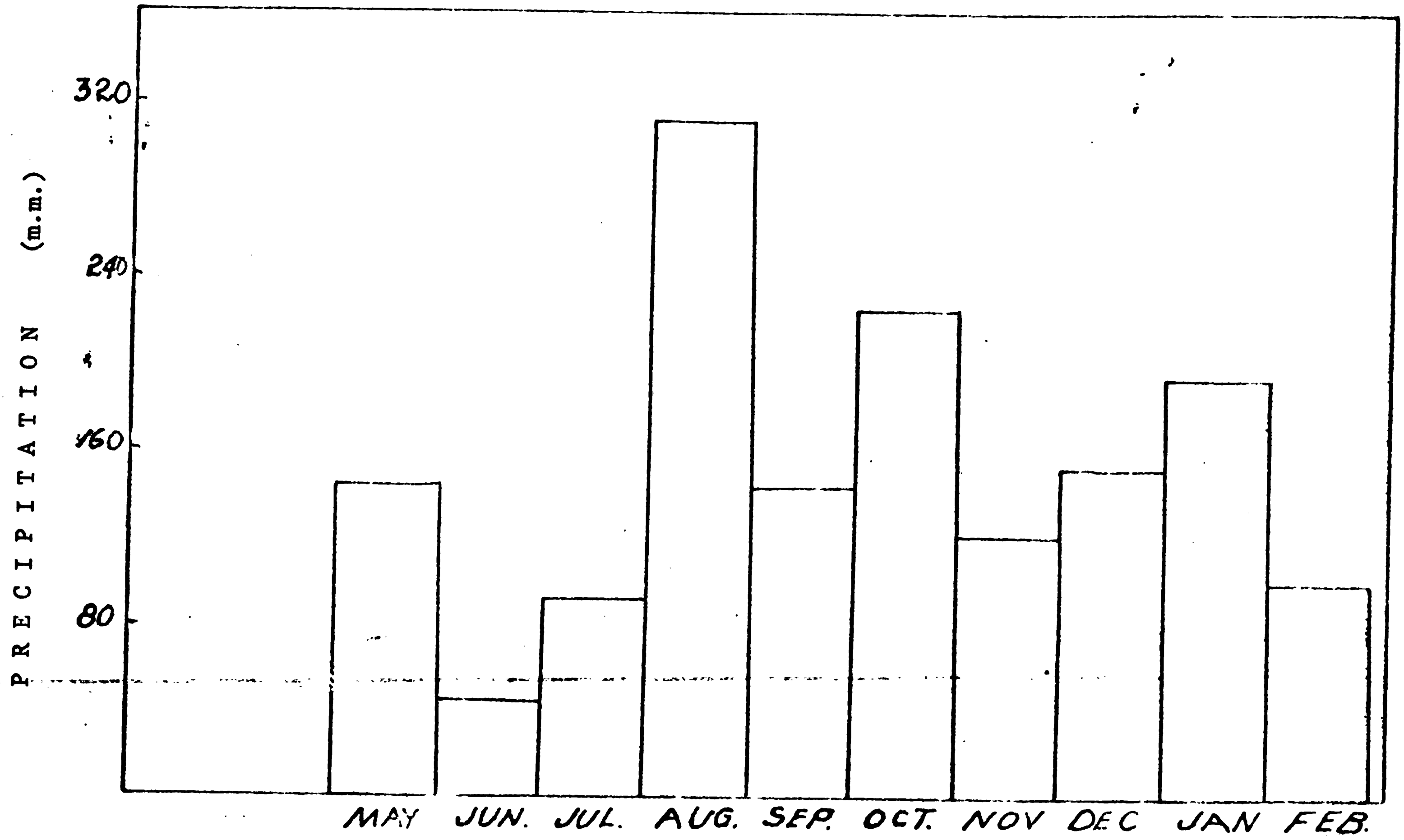


Fig. 1. - Histogram of total monthly rainfall at Allsides, Trelawny May 1977 - February 1978.

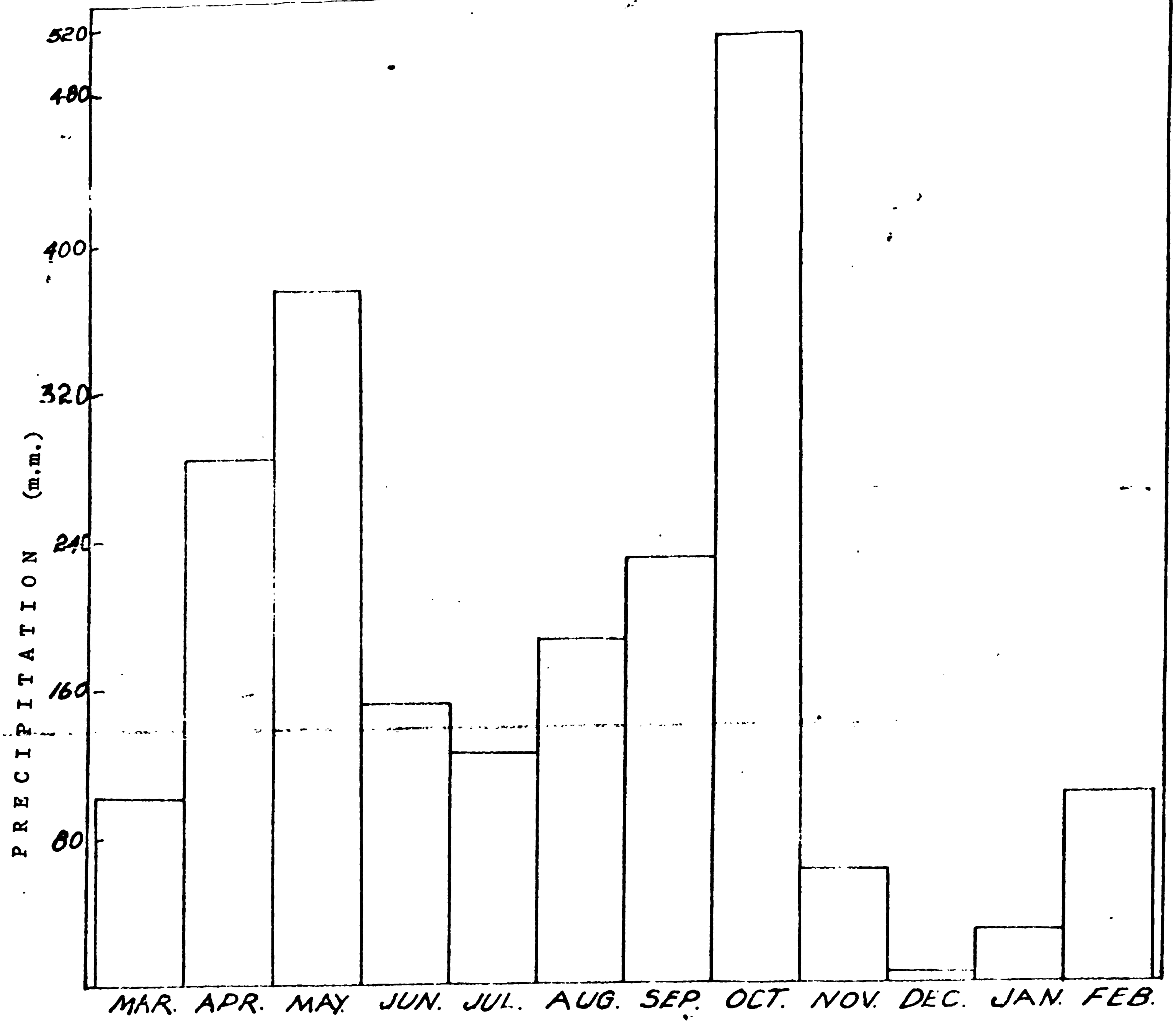


Fig. 2. - Histogram of total monthly rainfall at Allsides, Trelawny March 1978 - February 1979.

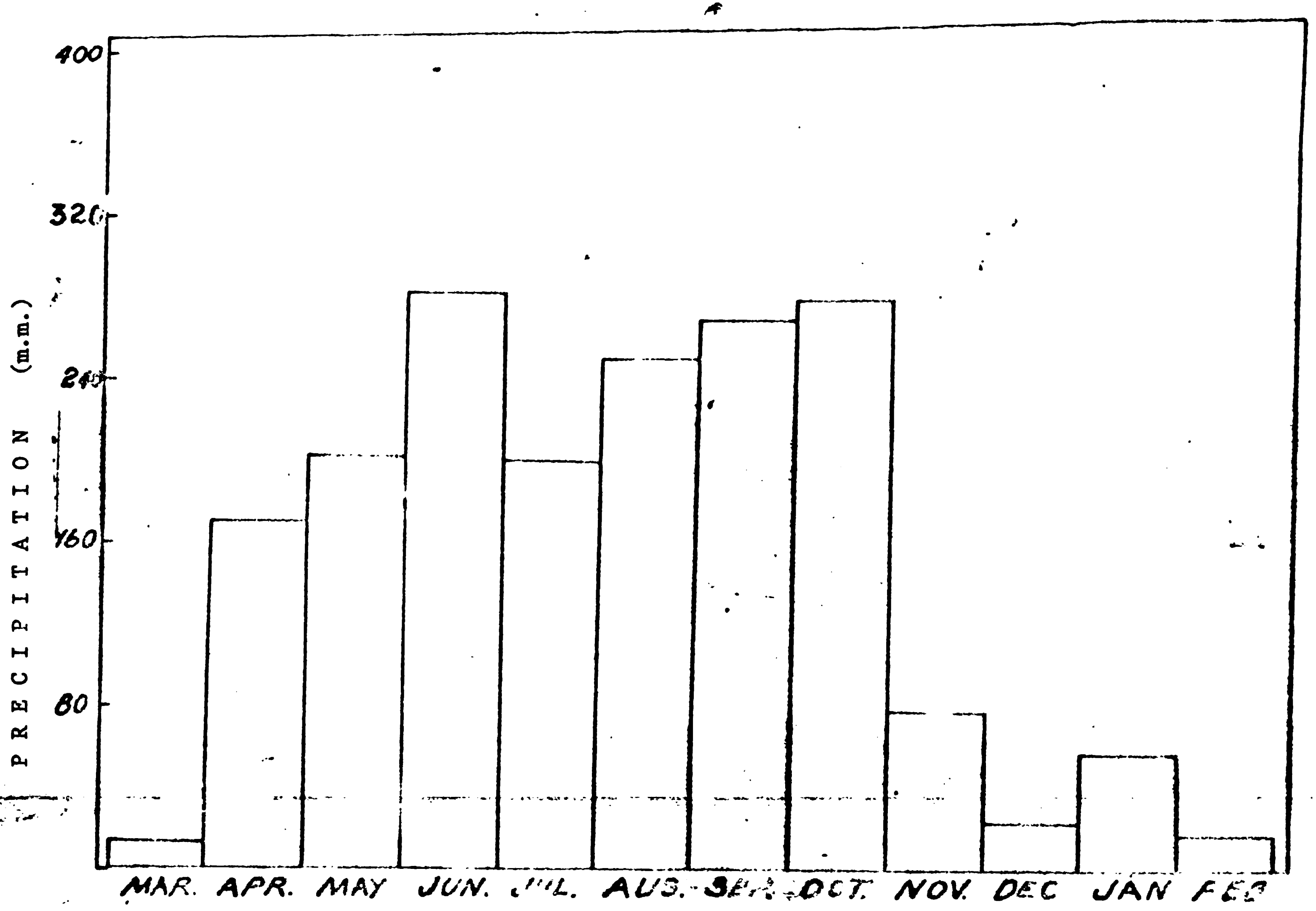


Fig. 3. - Histogram of total monthly rainfall at Allsides, Trelawny March 1979 - February 1980.

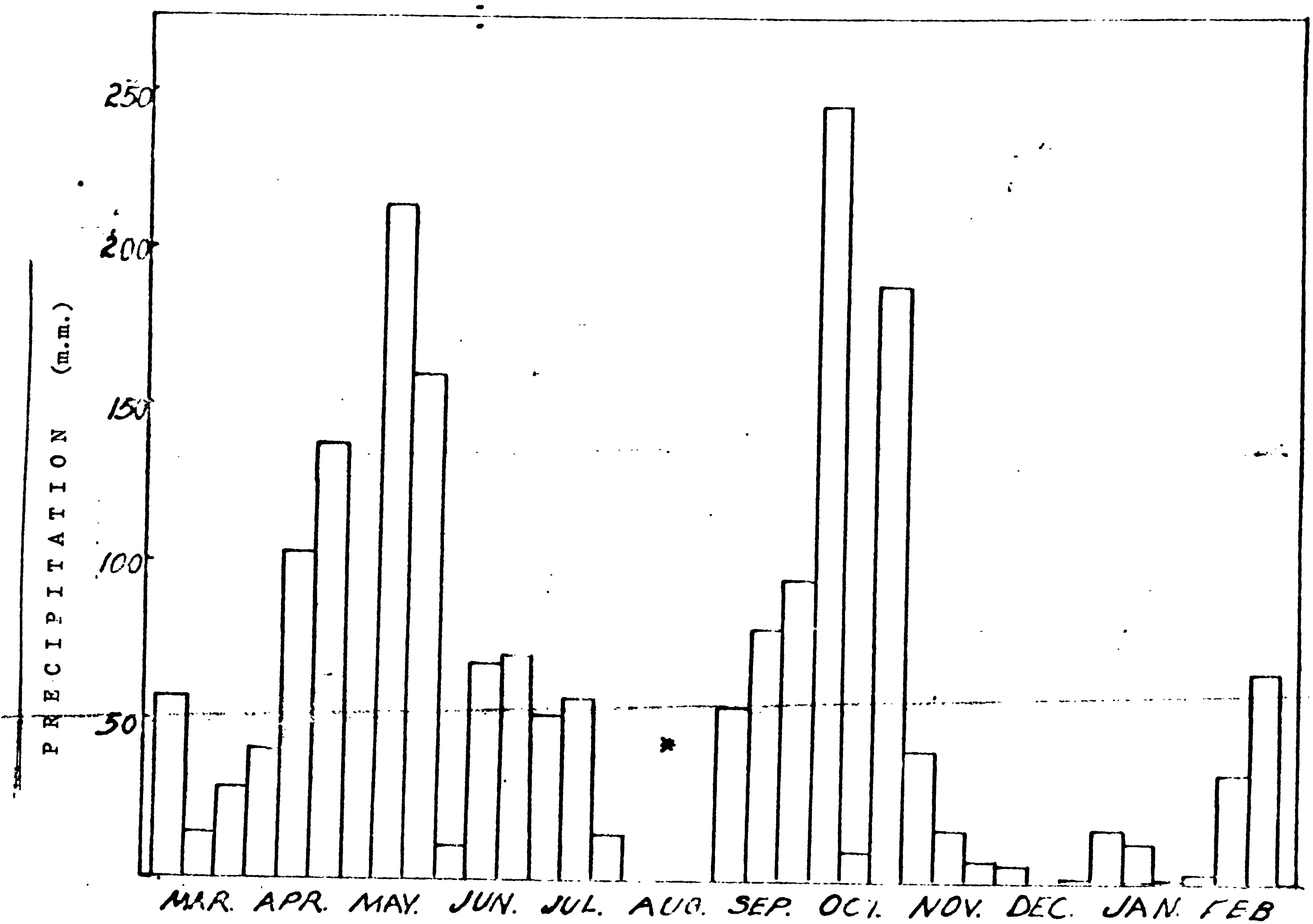


Fig. 4. - Histogram of total rainfall as 10 day totals at Allsides, Trelawny, March 1978 - February 1979.

* August totals unavailable.

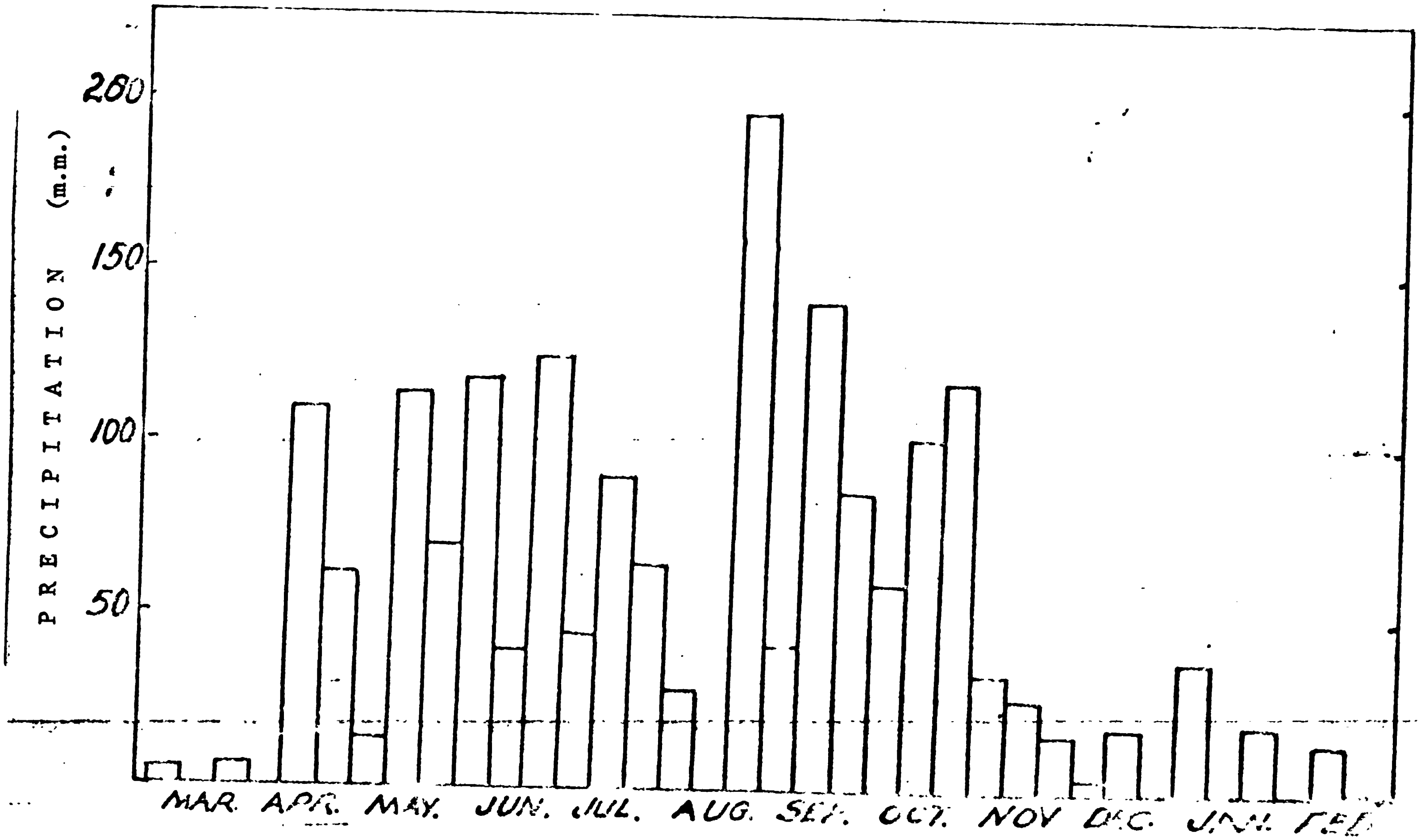


Fig. 5 - Histogram of total rainfall as 10 day intervals at Allsides, Trelawny, March 1979 - February 1980.

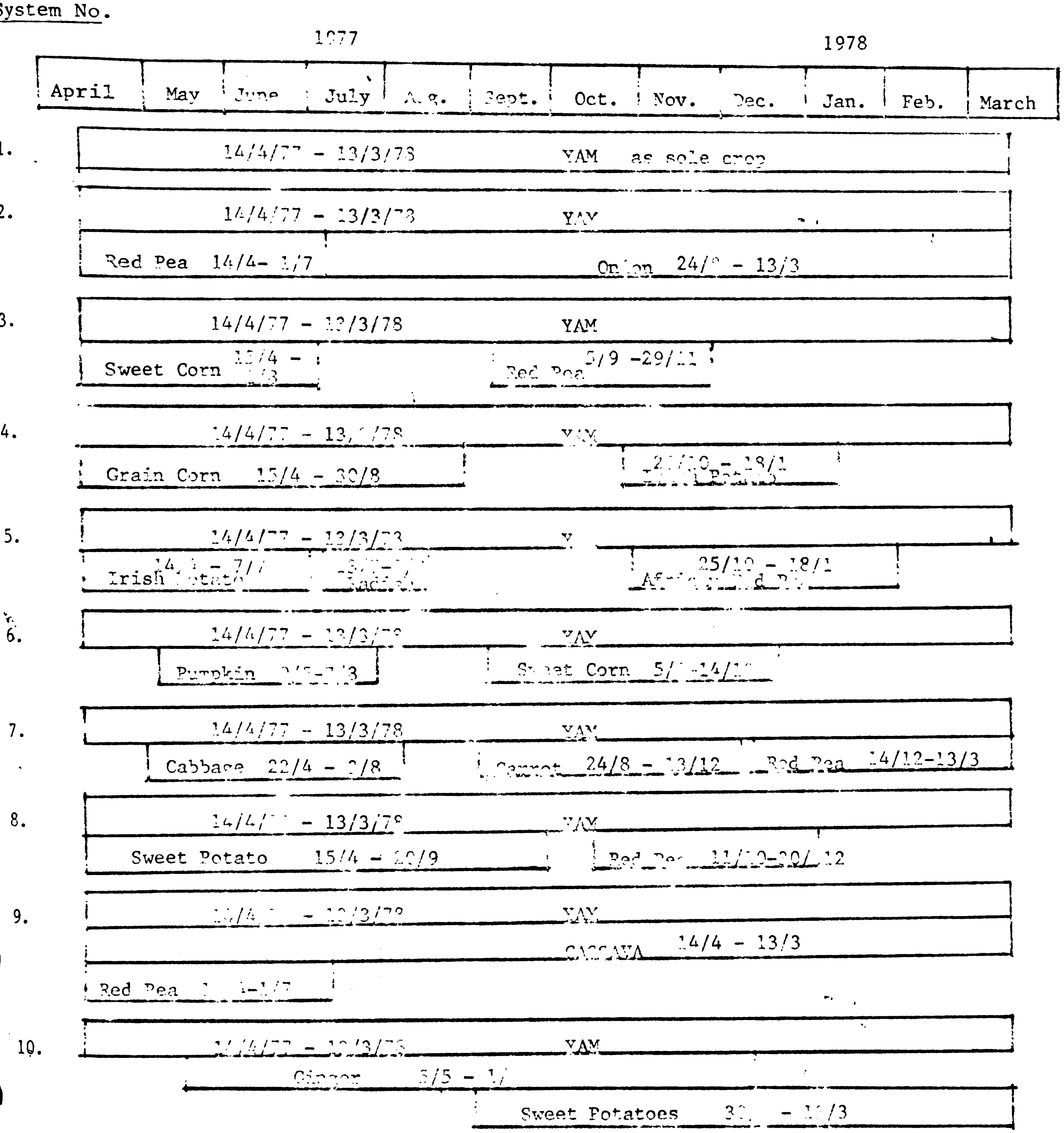


Figure 6 - CROPPING SYSTEMS ESTABLISHED AT ALLSIDES TRELAWNY DURING PERIOD APRIL 1977 TO MARCH 1978.

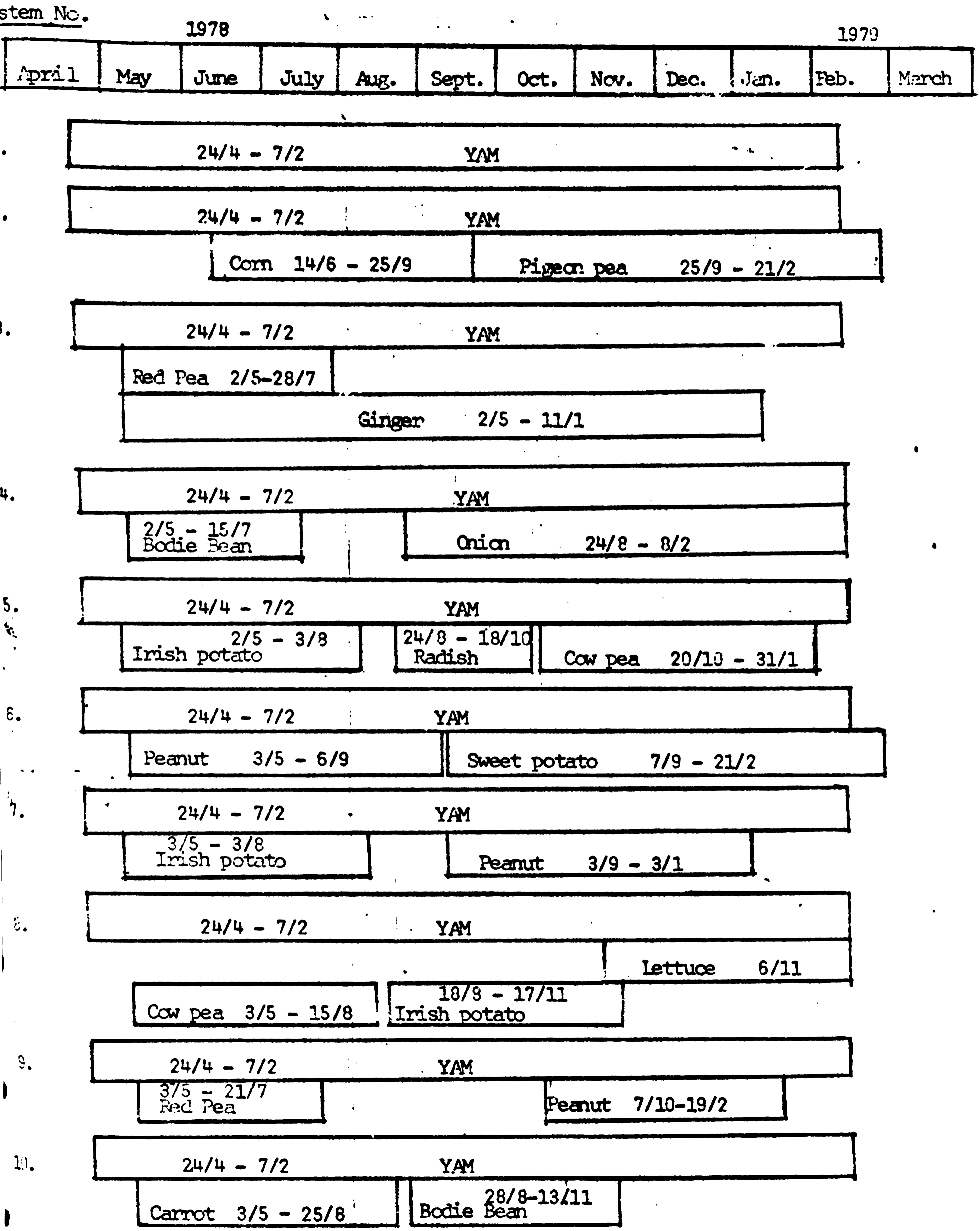


Figure 7 - CROPPING SYSTEMS ESTABLISHED AT ALLSIDES TRELAWNY DURING PERIOD APRIL 1978 TO FEBRUARY 1979.

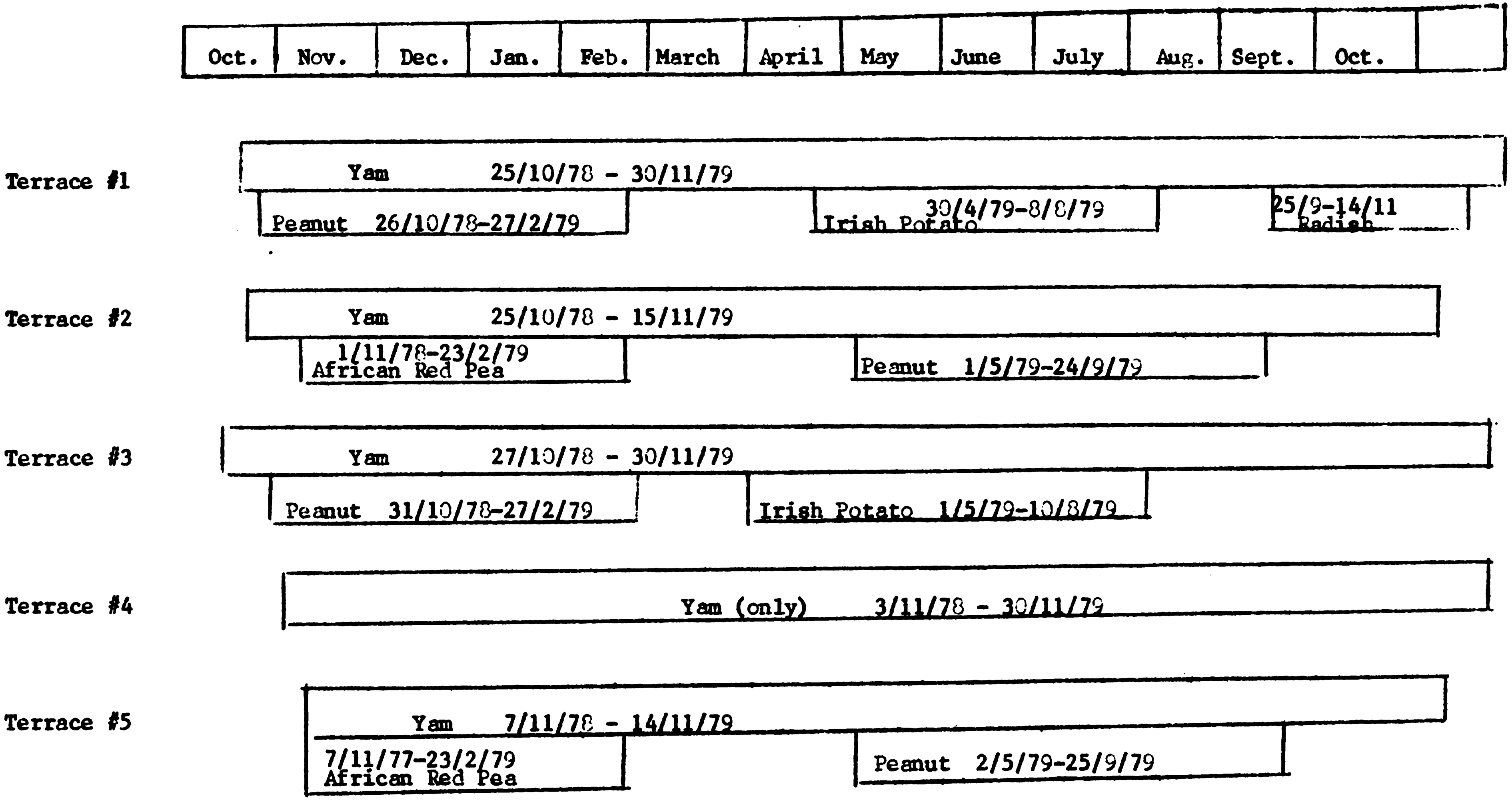
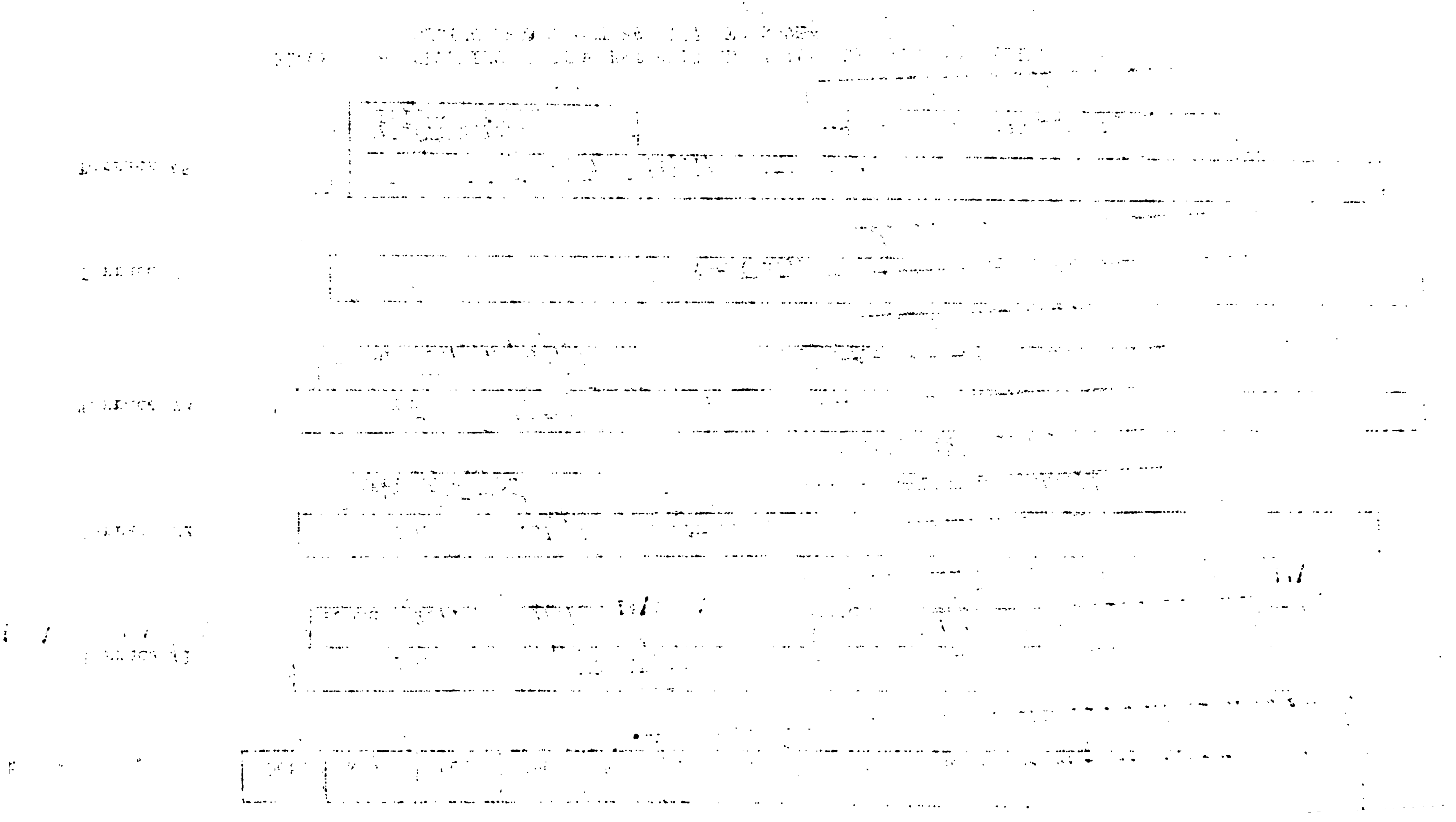


Figure 8.- CROPPING SYSTEMS ESTABLISHED AT ALLSIDES TRELAWNY (SITE III) DURING PERIOD OCTOBER 1978 TO NOVEMBER 1979.



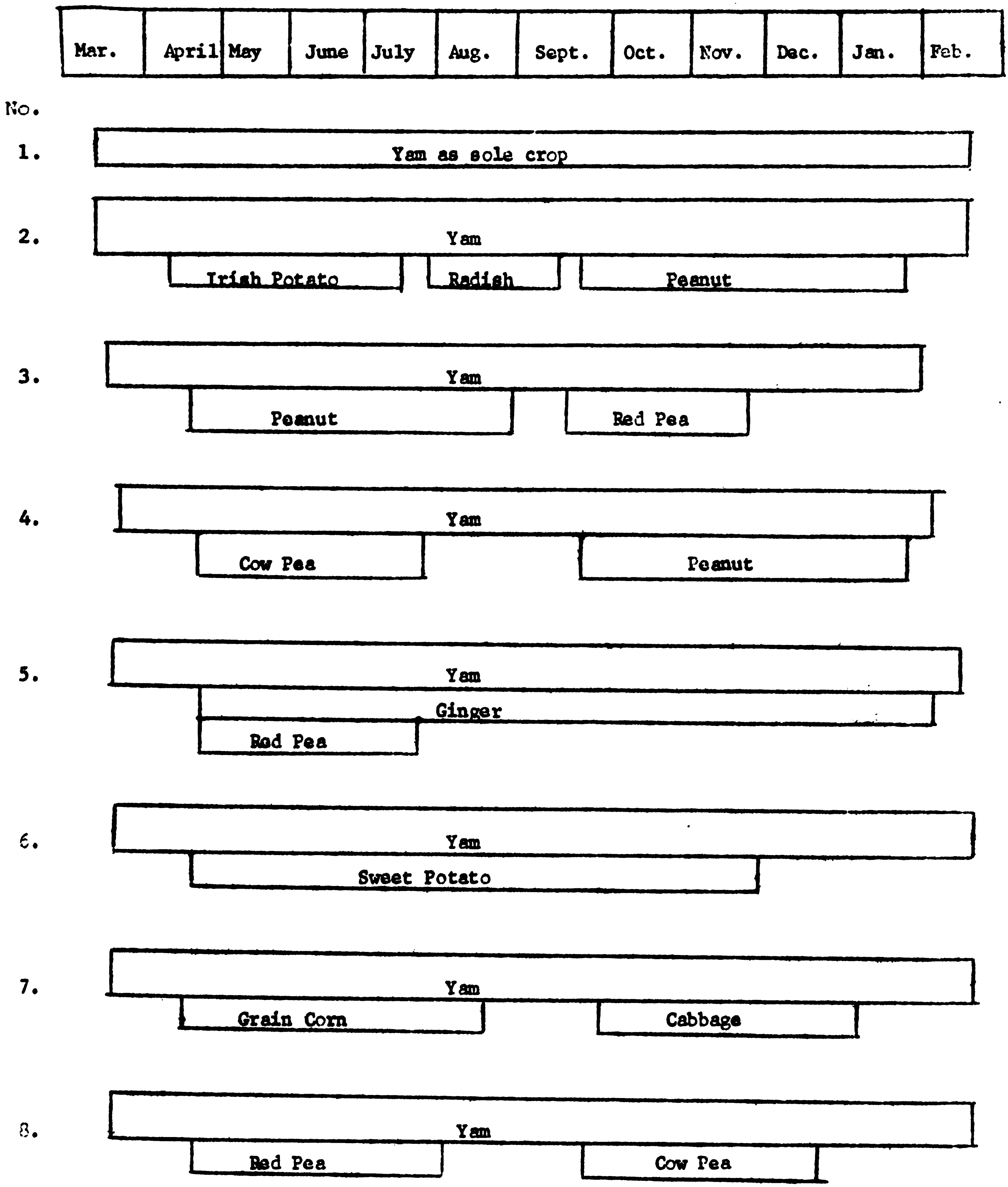


Figure 9.- CROPPING SYSTEMS ESTABLISHED AT ALLSIDES TRELAWNY (SITE I) DURING PERIOD MARCH 1979 TO FEBRUARY 1980.

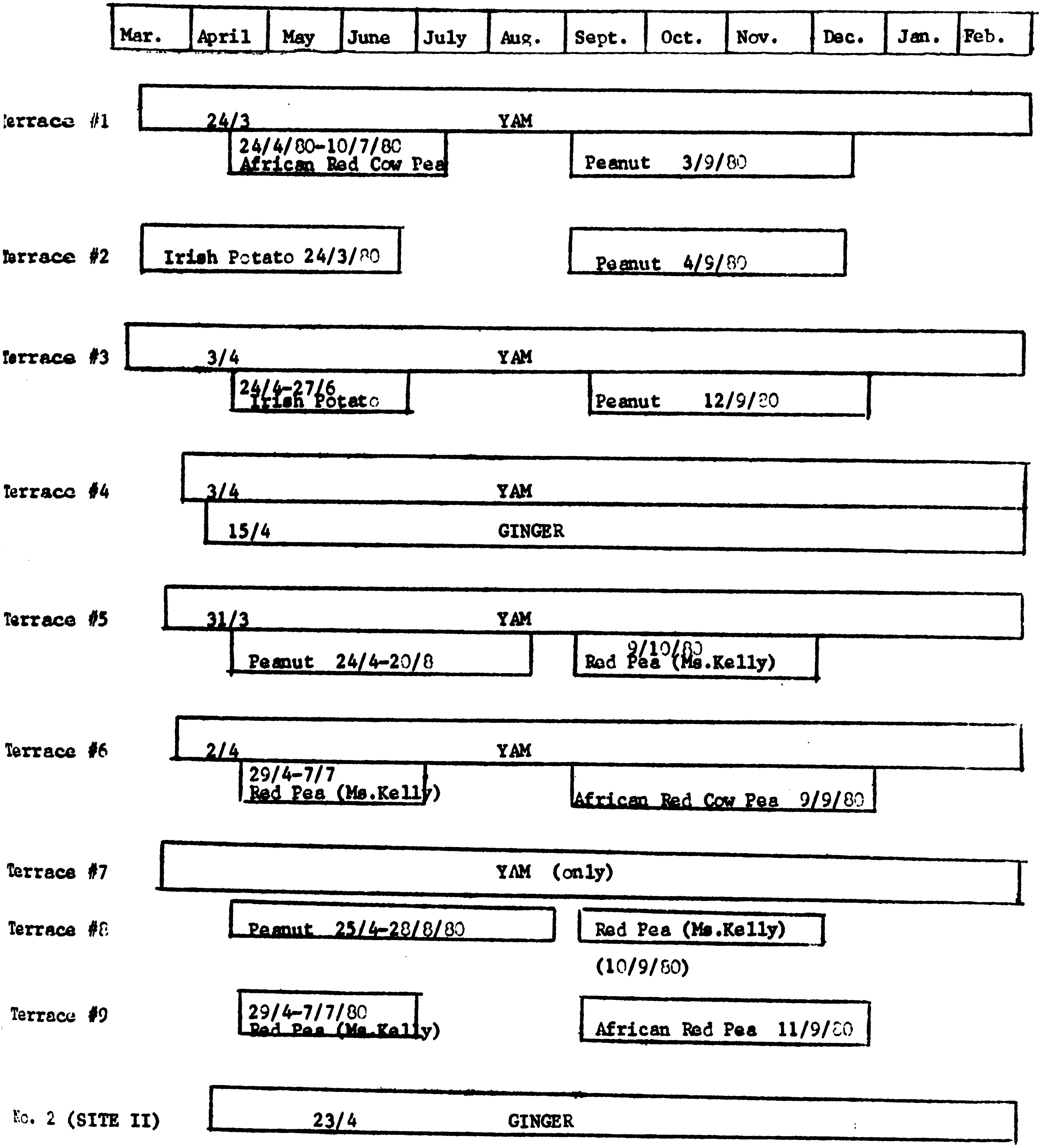


Figure 10.- CROPPING SYSTEMS ESTABLISHED AT ALLSIDES TRELAWNY(SITE I) DURING PERIOD MARCH 1980 TO FEBRUARY 1981.

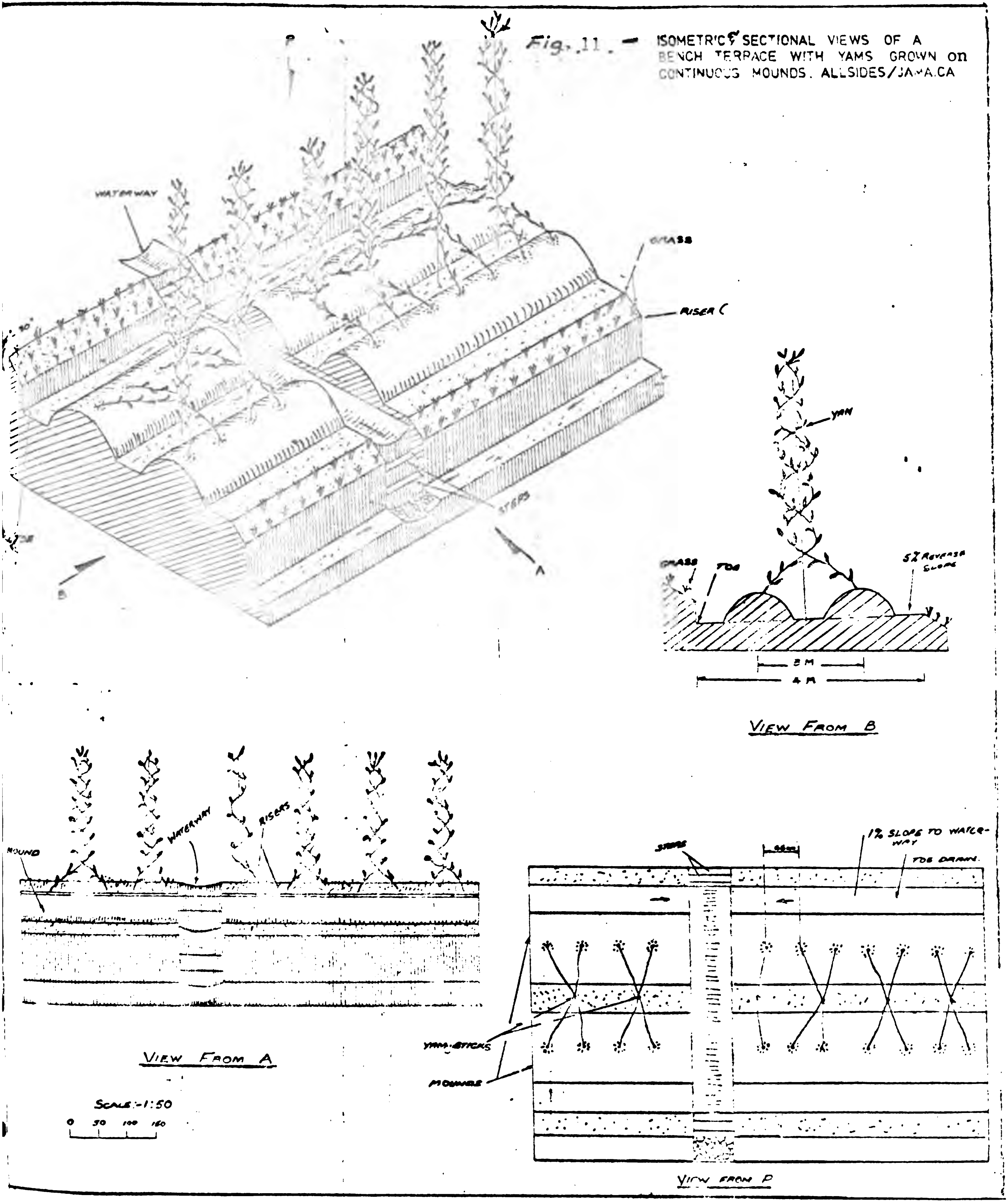
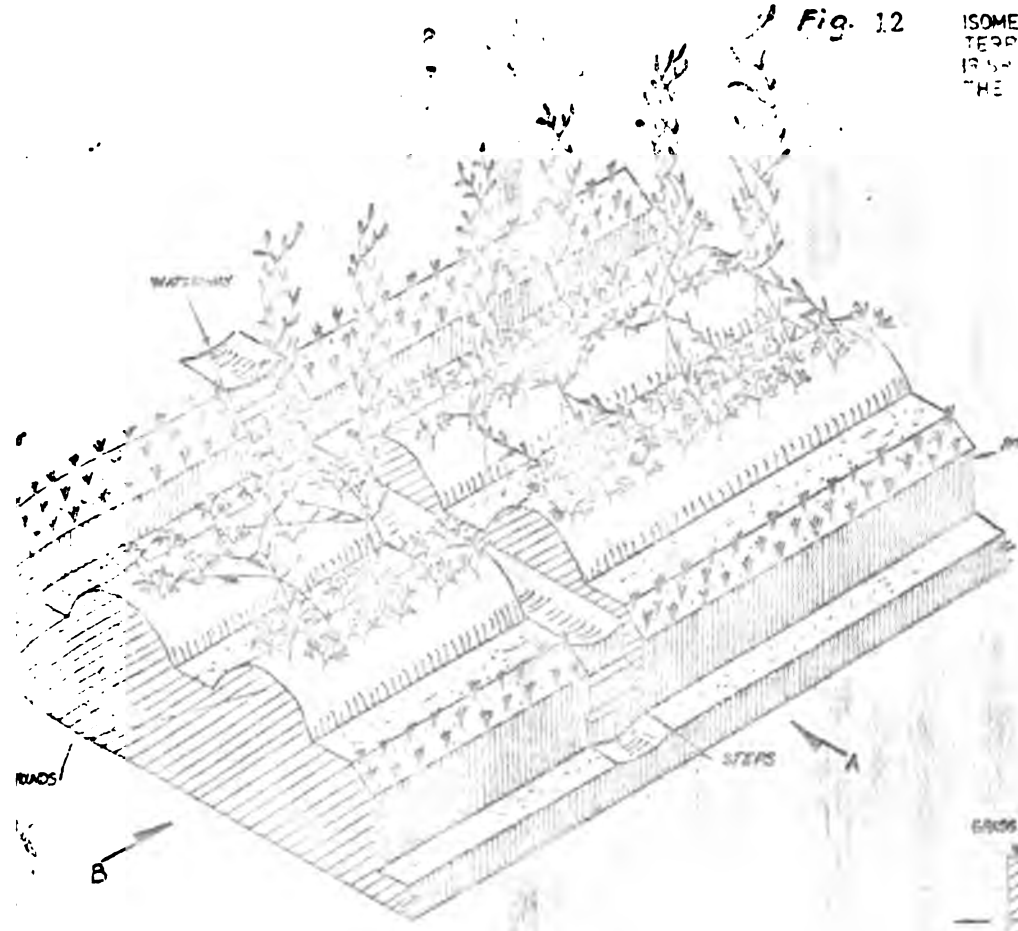
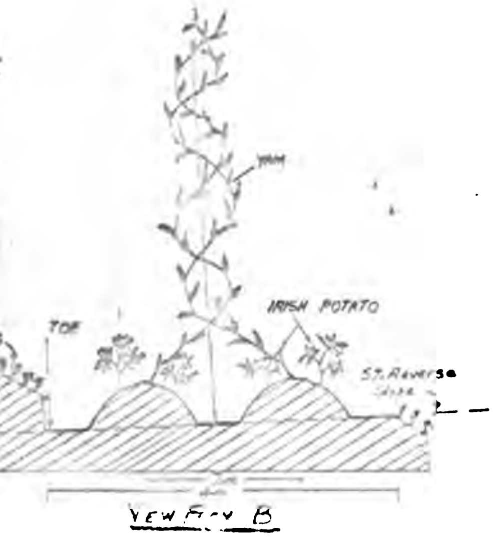


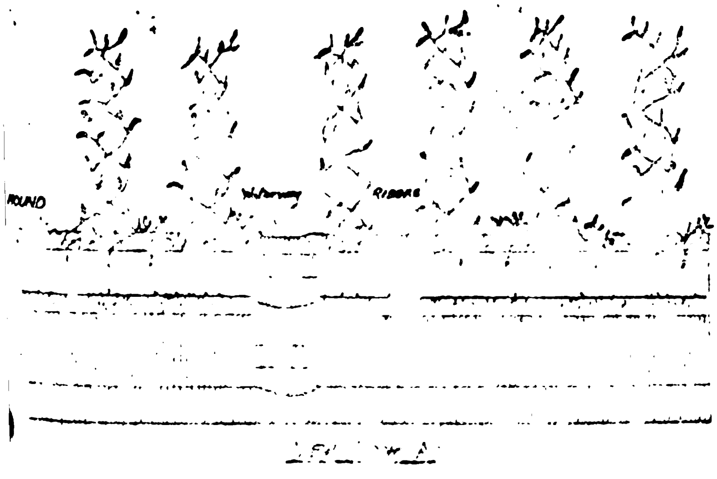
Fig. 11 — ISOMETRIC & SECTIONAL VIEWS OF A BENCH TERRACE WITH YAMS GROWN on CONTINUOUS MOUNDS. ALLSIDES/JAMAICA

WATERWAY
GRASS
RISER C
STEPS
TOE
A
B
YAM
GRASS
TOE
5% REVERSE SLOPE
3 M
4 M
VIEW FROM B
MOUND
WATERWAY
RISERS
VIEW FROM A
SCALE:-1:50
0 50 100 150
STEPS
1% SLOPE TO WATERWAY
TOE DRAIN
YAM STICKS
MOUNDS
VIEW FROM P

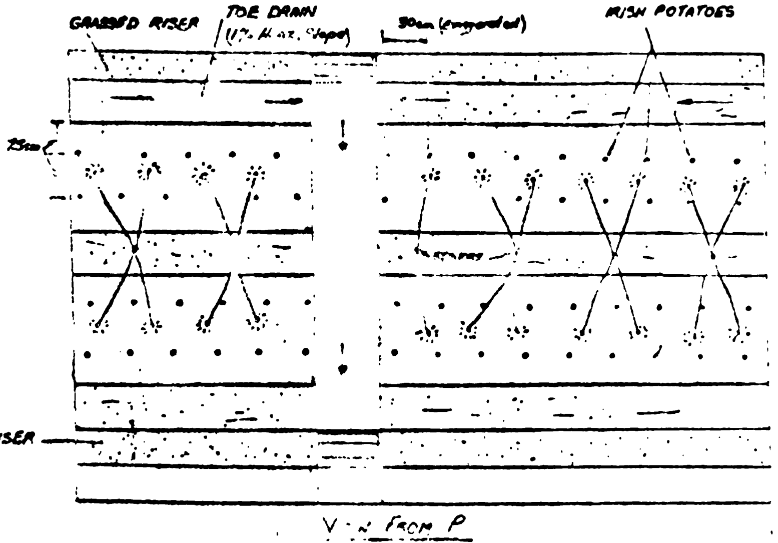
Fig. 12 ISOMETRIC & SECTIONAL VIEWS OF A BENCH TERRACE SHOWING YAMS INTERCROPPED WITH IRISH POTATO DURING THE FIRST HALF OF THE YAM CROP CYCLE. (11 months)


WATERWAY
RISER
MOUNDS
STEPS
A
B


YAM
GRASS
TOE
IRISH POTATO
5% Reverse slope
VIEW FROM B


MOUND
Waterway
RIDGES
VIEW FROM A

SCALE 1:50


GRASSED RISER
TOE DRAIN (1% Horz. Slope)
30cm (exaggerated)
IRISH POTATOES
25cm
GRASSED RISER
VIEW FROM P

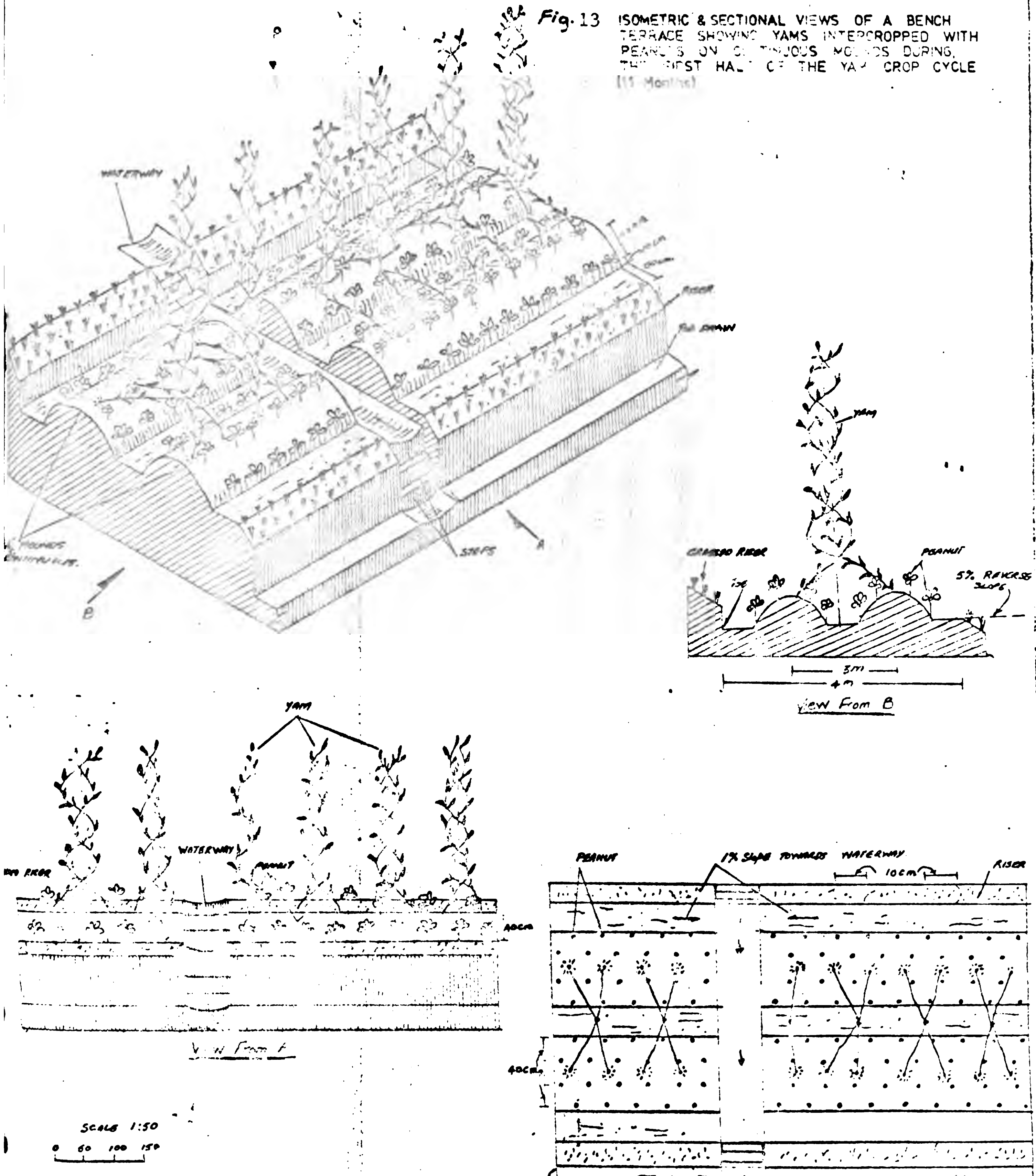

WATERWAY
RISER
FALL DRAIN
MOUNDS
STEPS
A
B
YAM
GRASSED RISER
PEANUT
5% REVERSE SLOPE
3m
4m
View From B
YAM
WATERWAY
PEANUT
40cm
View From A
SCALE 1:50
0 50 100 150
PEANUT
1% SLOPE TOWARDS WATERWAY
10cm
RISER
40cm
View From P

Fig. 13 ISOMETRIC & SECTIONAL VIEWS OF A BENCH TERRACE SHOWING YAMS INTERCROPPED WITH PEANUTS ON CONTINUOUS MOUNDS DURING THE FIRST HALF OF THE YAM CROP CYCLE (11 Months)

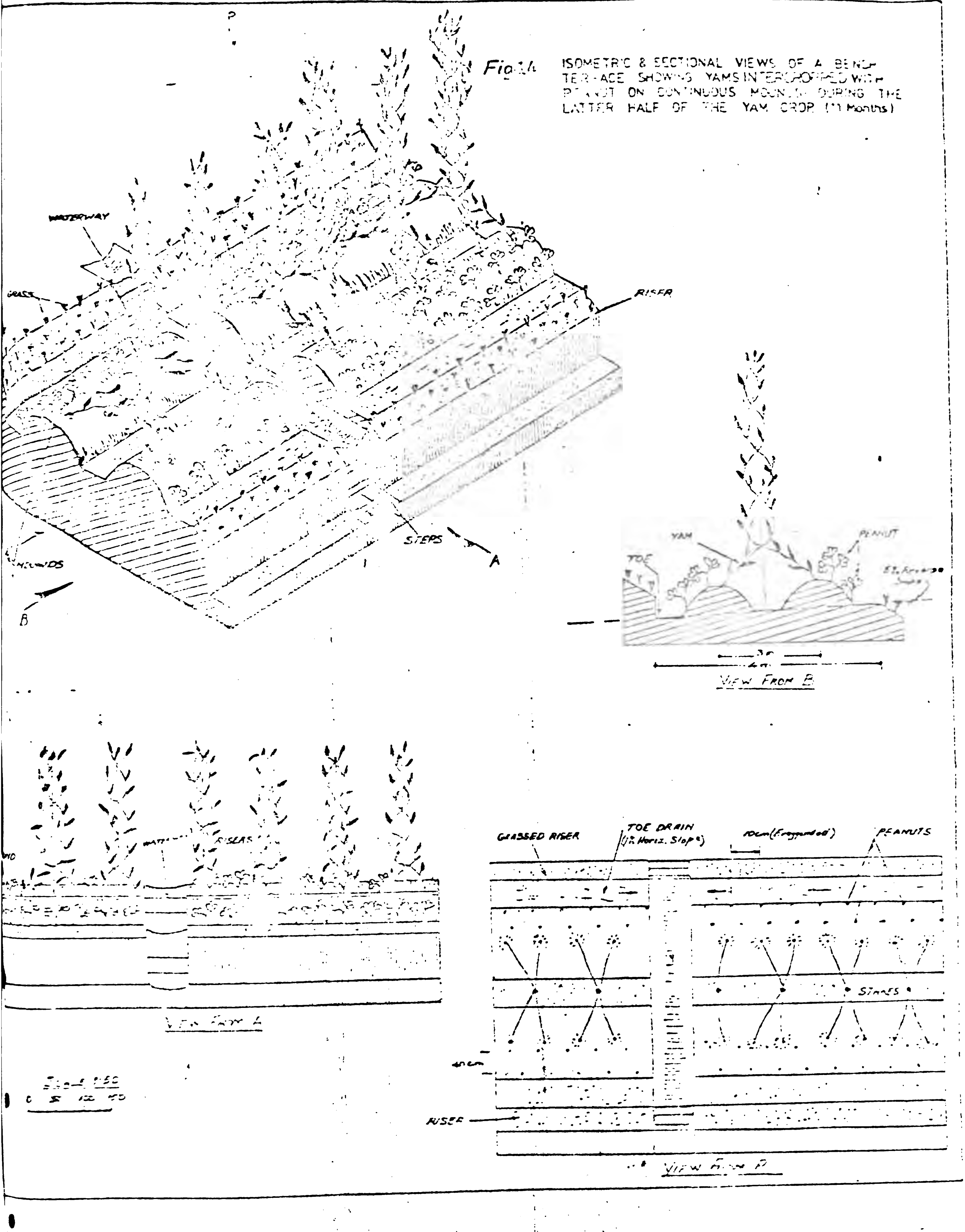
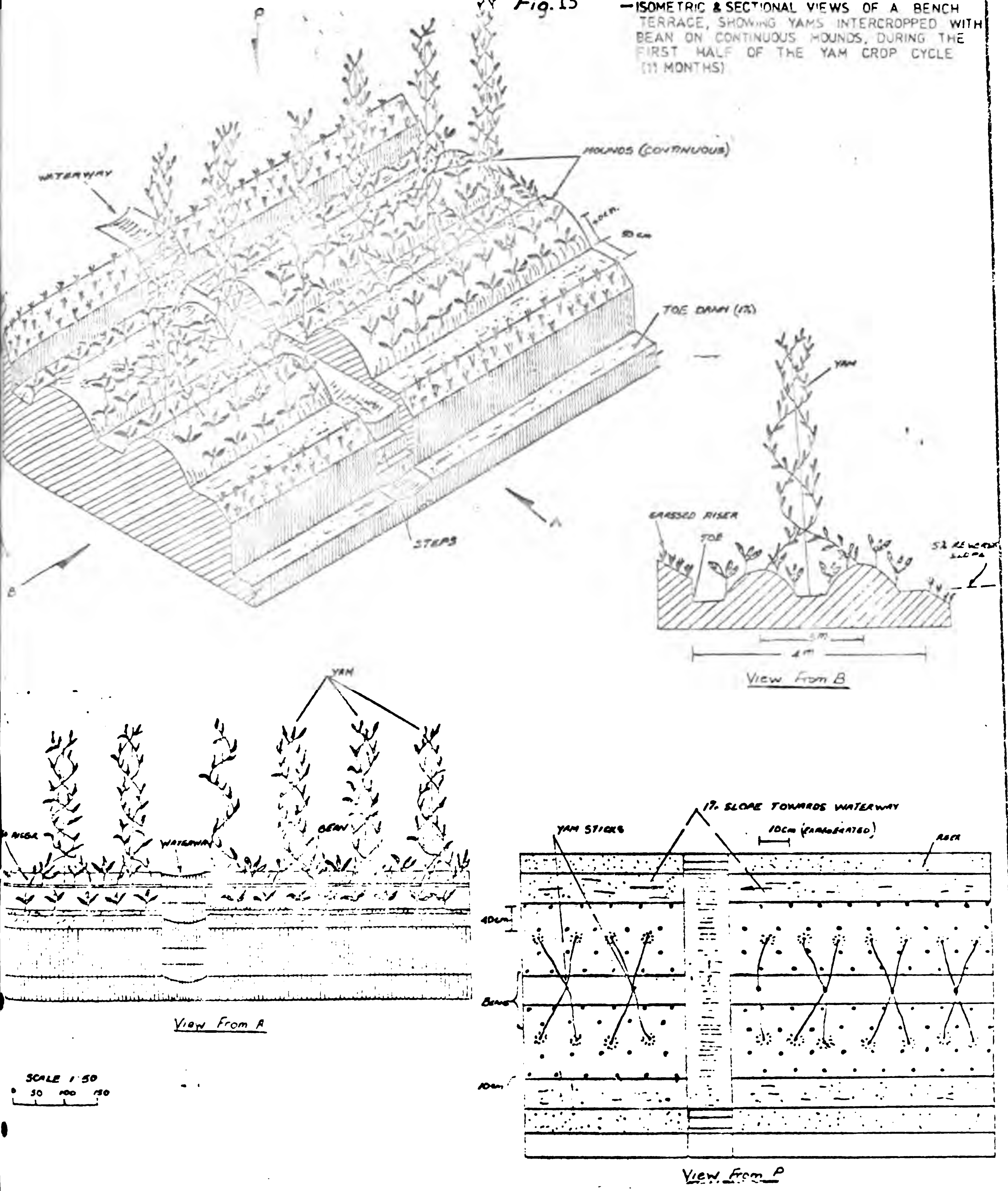


Fig.14 ISOMETRIC & SECTIONAL VIEWS OF A BENCH TERRACE SHOWING YAMS INTERCROPPED WITH PEANUT ON CONTINUOUS MOUNDS DURING THE LATTER HALF OF THE YAM CROP (11 Months)

P
WATERWAY
GRASS
RISER
STEPS
A
MOUNDS
B
TOE
YAM
PEANUT
3m
4m
VIEW FROM B
RISERS
VIEW FROM A
Scale 1:50
GRASSED RISER
TOE DRAIN
(1% Horiz. Slope)
10cm (Enlarged)
PEANUTS
STAKES
40cm
RISER
VIEW FROM P

Fig. 15 —ISOMETRIC & SECTIONAL VIEWS OF A BENCH TERRACE, SHOWING YAMS INTERCROPPED WITH BEAN ON CONTINUOUS MOUNDS, DURING THE FIRST HALF OF THE YAM CROP CYCLE (11 MONTHS)

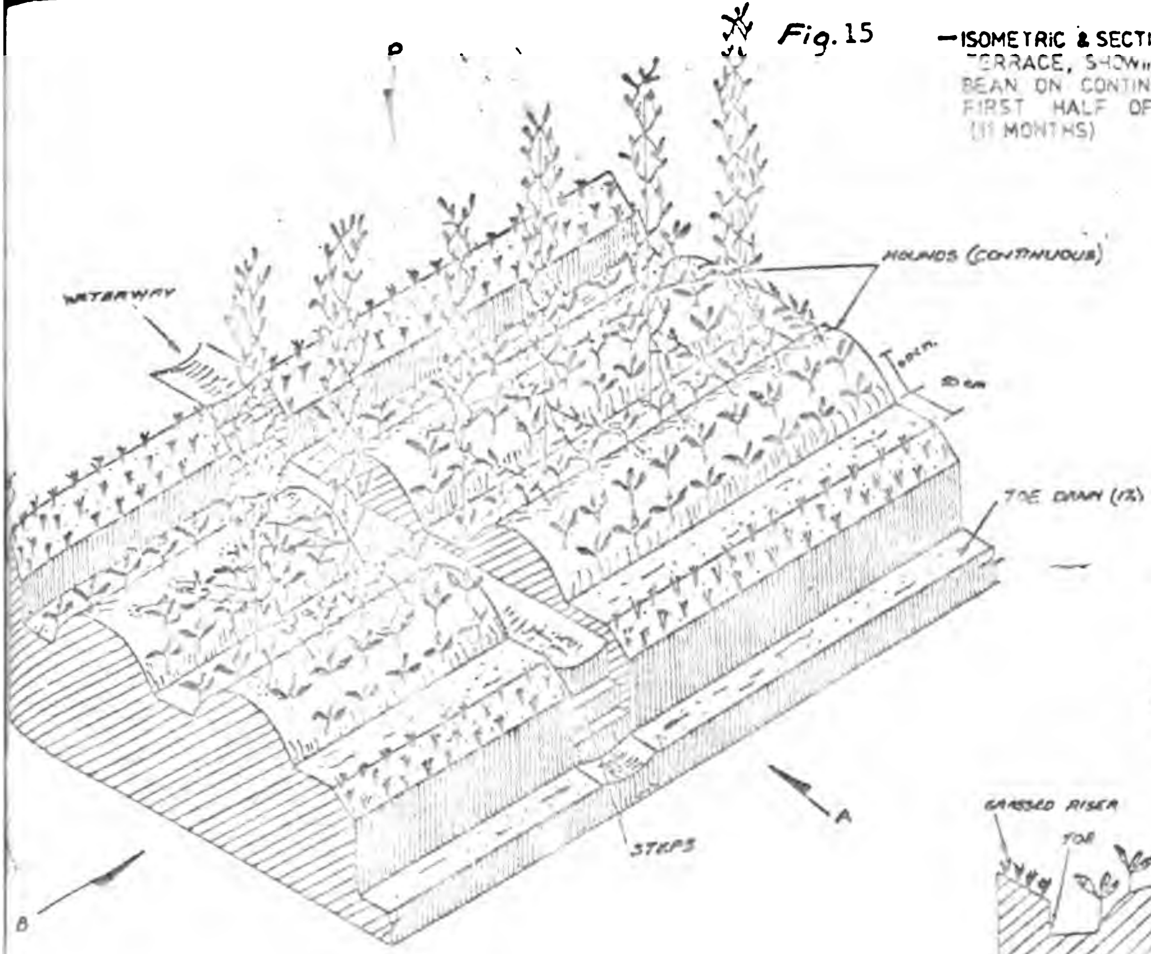

P
WATERWAY
MOUNDS (CONTINUOUS)
10cm
50cm
TOE DRAIN (1%)
A
STEPS
B
YAM
GRASSED RISER
TOE
5% REVERSE SLOPE
5m
4m
YAM
RISER
WATERWAY
BEAN
SCALE 1:50
0 50 100 150
1% SLOPE TOWARDS WATERWAY
YAM STICKS
10cm (EXAGGERATED)
RISER
40cm
Beans
10cm

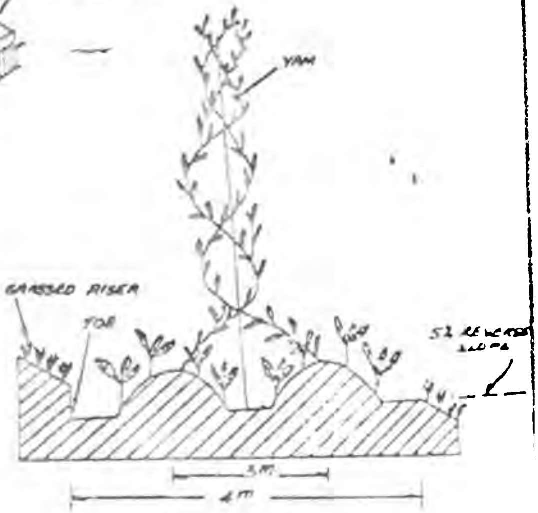
View From B

View From A

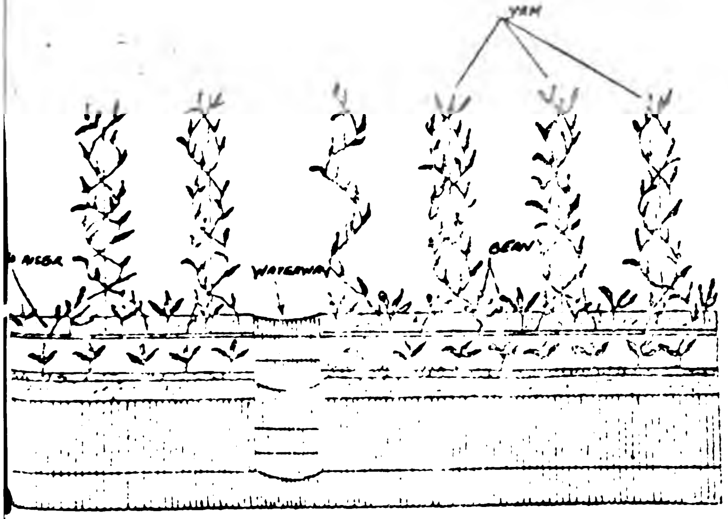
View From P

Fig. 15 —ISOMETRIC & SECTIONAL VIEWS OF A BENCH TERRACE, SHOWING YAMS INTERCROPPED WITH BEAN ON CONTINUOUS MOUNDS, DURING THE FIRST HALF OF THE YAM CROP CYCLE (11 MONTHS)


P
WATERWAY
MOUNDS (CONTINUOUS)
60cm.
50cm
TOE DRAIN (1%)
STEPS
A
B

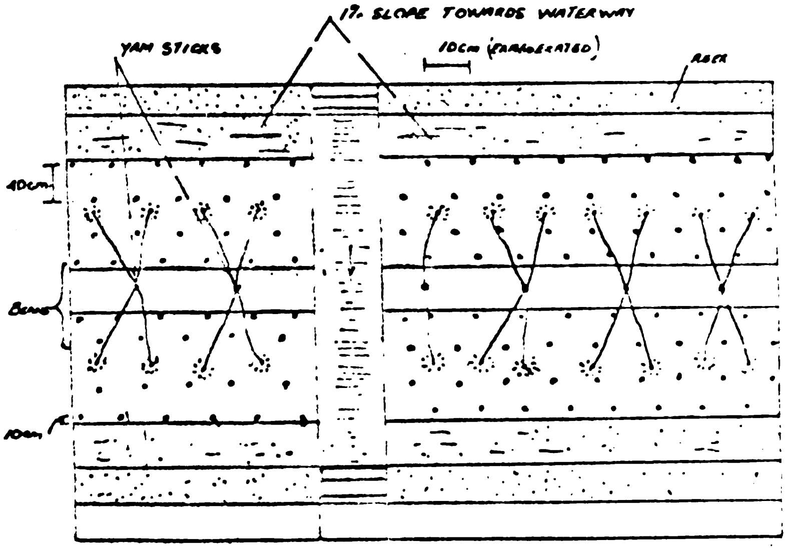

YAM
GRASSED RISER
TOE
5% REVERSE SLOPE
3m
4m

View From B


YAM
RISER
WATERWAY
BEAN

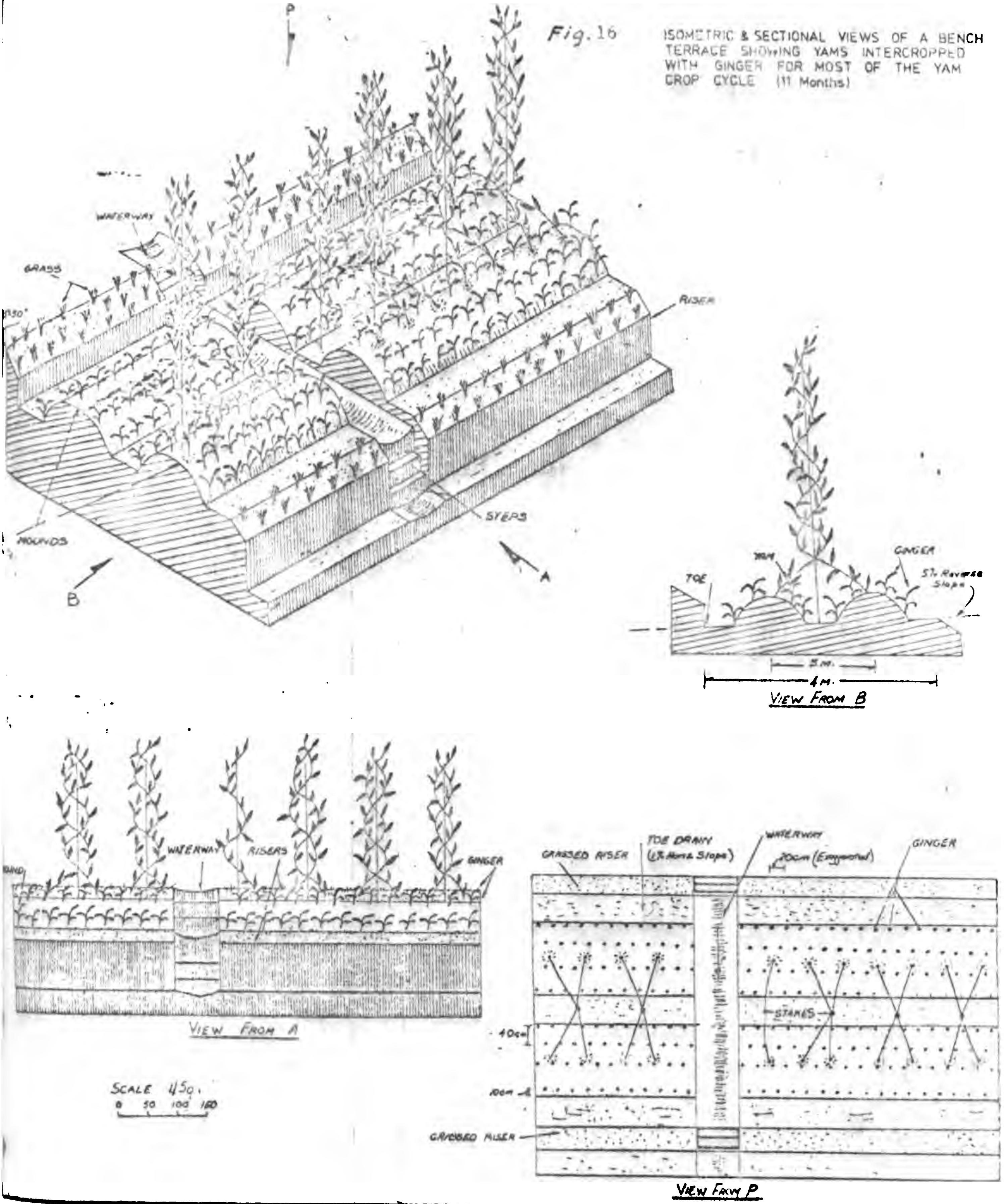
View From A

SCALE 1:50
0 50 100 150


1% SLOPE TOWARDS WATERWAY
YAM STICKS
10cm (EXAGGERATED)
RISER
40cm
BEANS
10cm

View From P

Fig. 16 ISOMETRIC & SECTIONAL VIEWS OF A BENCH TERRACE SHOWING YAMS INTERCROPPED WITH GINGER FOR MOST OF THE YAM CROP CYCLE (11 Months)


P
WATERWAY
GRASS
130°
RISER
STEPS
MOUNDS
B
A
TOE
YAM
GINGER
5% Reverse Slope
5m.
4m.
VIEW FROM B
WATERWAY
RISERS
GINGER
VIEW FROM A
SCALE 1/50.
0 50 100 150
GRASSED RISER
TOE DRAIN (1% Horiz. Slope)
WATERWAY
20cm (Exaggerated)
GINGER
STAKES
40cm
100cm
GRASSED RISER
VIEW FROM P

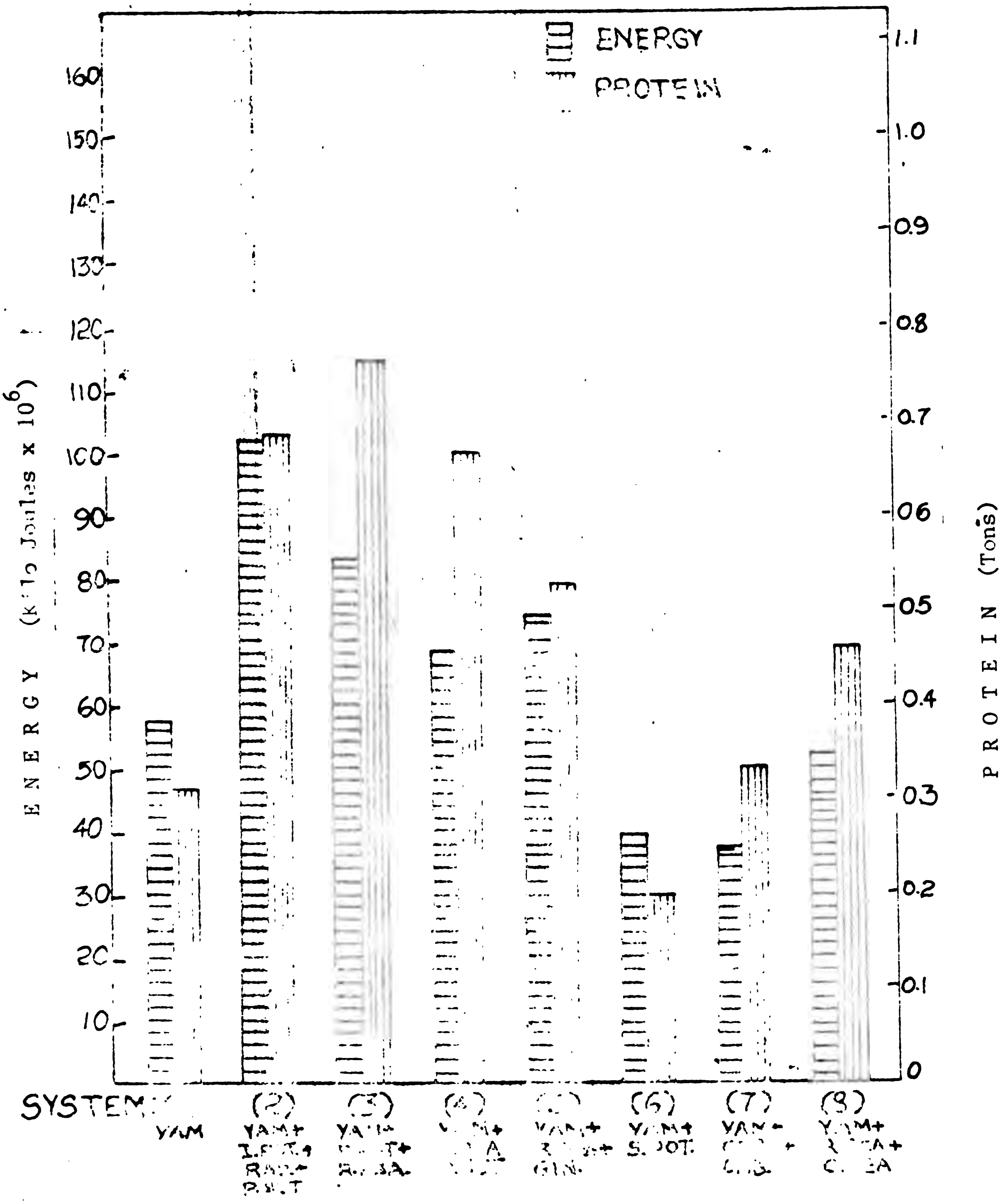


Figure 17. - Energy and protein values based on marketable yields per hectare in 1979 - 1980 of yam as monocrop system (1) and seven intercrop Systems (2 -)

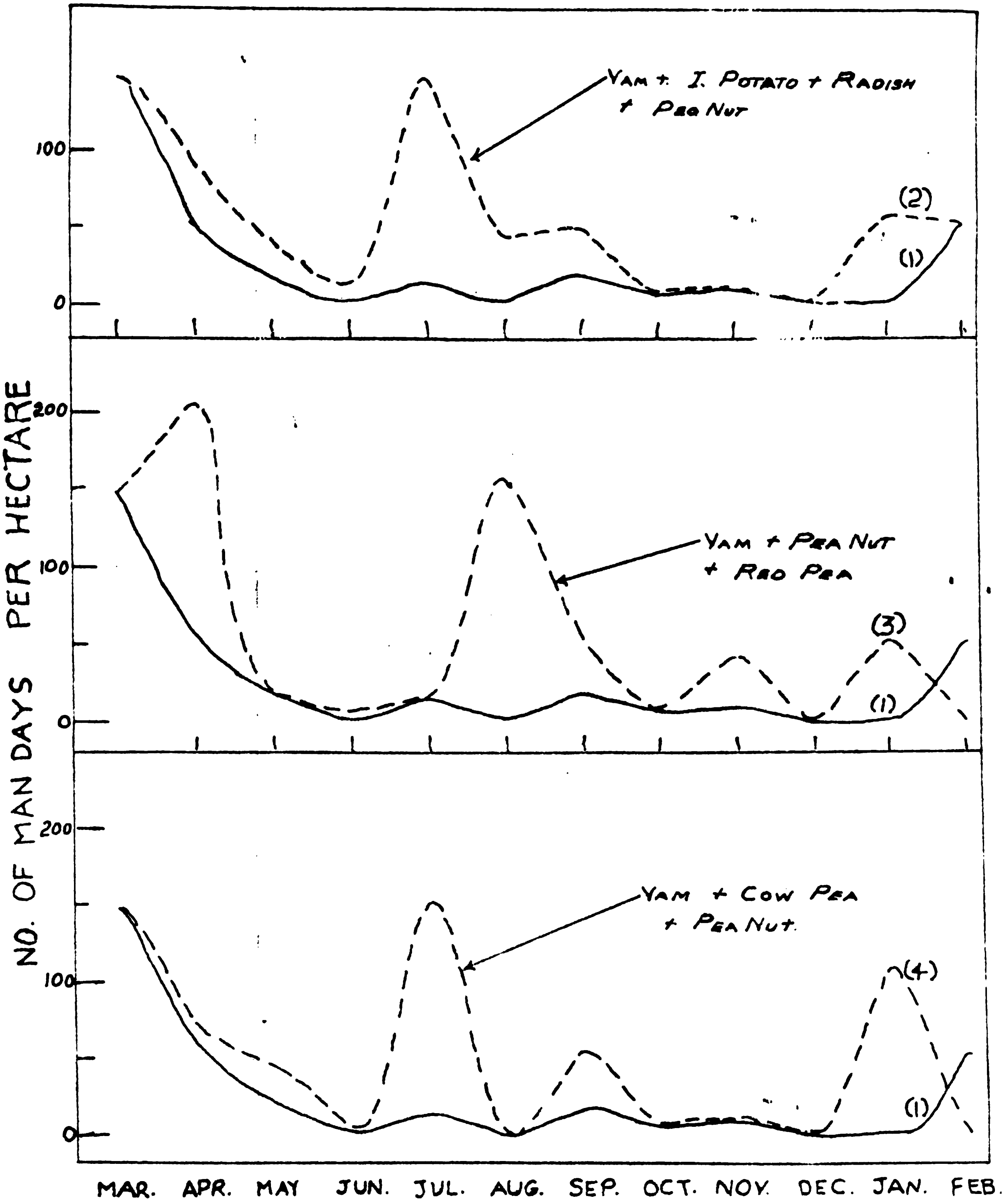


FIG. 18 COMPARING MONTHLY LABOUR REQUIREMENTS DURING 1979-80 FOR YAM MONOCROP SYSTEM (1) WITH INTERCROP SYSTEMS (2-4).

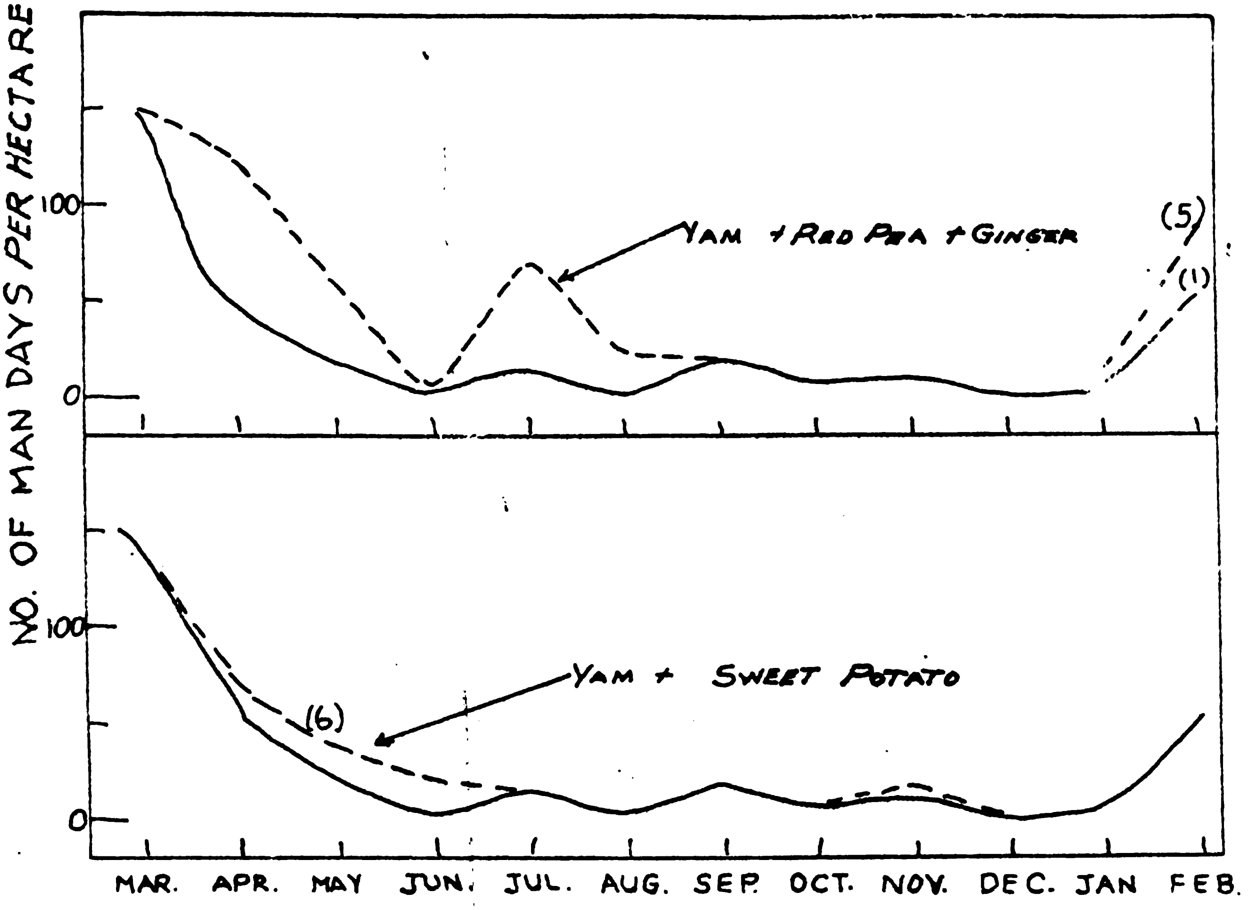


FIG 19 COMPARING MONTHLY LABOUR REQUIREMENTS DURING 1979-80 FOR YAM MONOCROP SYSTEM (1) WITH INTERCROP SYSTEMS (5 + 6).

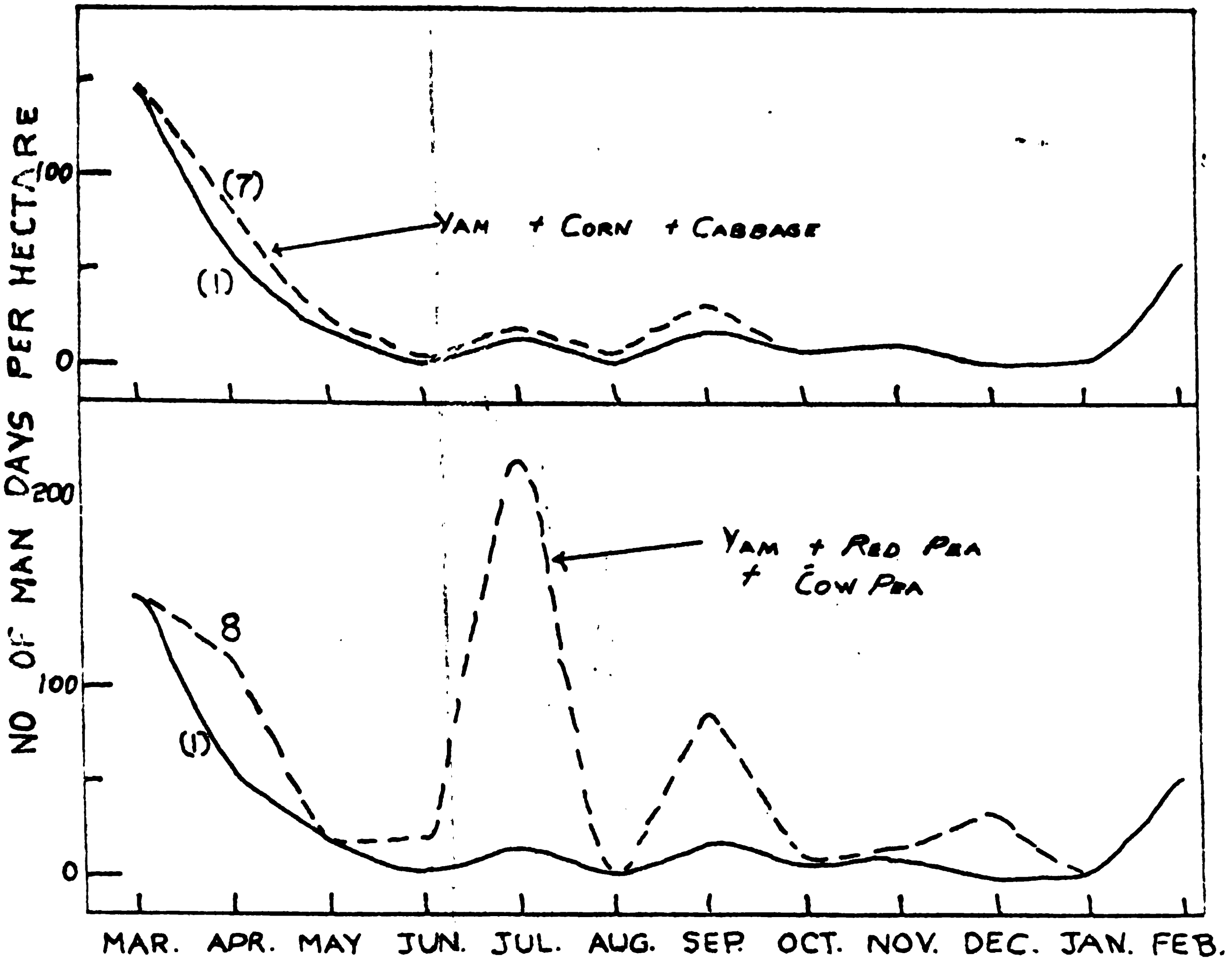


FIG 20 COMPARING MONTHLY LABOUR REQUIREMENTS DURING 1979-80 FOR YAM MONOCROP SYSTEM(1) WITH INTERCROP SYSTEMS (7+8).

FECHA DE DEVOLUCION

26 ENE 1983			
2 MAR 1984			

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Autor

The allsides project in Jamaica - development

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2 MAR 1984	George Buchmire