

Introduction.

(1) Use of Surveys in Agriculture.

The agricultural resources of many tropical countries are relatively underdeveloped and food supply in such countries is often inadequate to meet the needs of a rapidly increasing population. The aim of agricultural departments, in such countries, is to increase the output of agricultural produce either by intensifying or extending existing practices or by introducing new methods which are applicable under their conditions.

In the past the lack of sufficient preliminary work has been responsible for the failure or only partial success of several agricultural development schemes in various parts of the world (Stamp 1953). Because of the wide diversity of conditions under which farming is carried out it is important that before newly formulated improvements are put into operation in the field such proposals should be investigated experimentally under the local conditions and their effects on the established agricultural pattern determined. To this end it is important to investigate existing methods and decide what potential there is, if any, for increased production.

Before a given area can be improved estimates of present production and existing marketing facilities are required. If production is increased then marketing arrangements may also need to be extended. Other problems include the classification of land on a land utilisation basis, the estimation of population density and the incidence of pests and diseases; upon these and like problems the success or failure of improvement programmes may well depend.

Sample surveys facilitate the collection of information about these problems and before launching a new development scheme the results of agricultural surveys should be carefully studied. Much economy of effort and capital will be gained if future development schemes are planned with the results of carefully conducted surveys

in mind.

Land utilisation surveys are useful in assessing the production (present and potential) available from any area and details of the necessary planning and of some of the problems which may confront land utilisation surveys are given in the reports of the two surveys (Castle, Devonald, Hannagan, Humphreys, Mitchell 1955; Buckler, Furber, Morgan, Murfitt 1956) previously carried out by Imperial College students.

Where a subject such as disease incidence in agricultural crops is concerned, sample surveys (for reasons explained later in Section A (1)) are much more readily carried out than complete censuses and, partly because of this and partly because the amount of data to be handled is much less, the results of such surveys are available sooner; since disease incidence within any crop varies seasonally this is particularly important. The results of a survey showing the incidence of disease within a crop only apply at the actual time when the survey is carried out.

Sampling is also very suitable for obtaining a range of information about tree crops and this melanose survey illustrates the general principles involved. Our particular problem was to estimate disease incidence in something of the order of 70 million Trinidad grapefruit; sampling was obviously required for a population of this size. We developed the sampling methods with the particular problems of perennial orchard crops in mind. The selection of the final stage sampling units depends on the assumption that both fruit and disease are uniformly distributed over the bearing portion of the tree. This part of the sampling scheme can therefore only be applied to populations where these conditions exist but the rest of the sampling scheme could equally well be applied to other orchard crops.

Therefore this report, as well as giving an account of the present survey, serves also as an example of how the principles of

applying sampling methods to surveys may be used in agriculture, since all of these principles (and some others) are applicable to varying degrees to all sample surveys. Because of this a part of this report (Section A) is given to a brief account of the theory of sampling in order to show how, and why, the sampling methods of the melanose survey were used.

(2) Choice of the Survey.

The team decided at the outset that it would not be concerned with repeating and amplifying the previous surveys concerned with (i) land utilisation (Castle et al. 1955; Buckler et al. 1956) or (ii) food gardens (Currie et al. 1957). However a number of other projects were discussed before the incidence of melanose disease in grapefruit was finally selected as a suitable subject.

Rather peculiar considerations influenced the choice of a survey for a team of post-graduate students and these were

- (a) the time available for executing the field work was limited to three weeks of the Christmas vacation;
- (b) a maximum of about 30 enumerators would be available if the scope of the field work demanded so much field work;
- (c) it was not essential, though of course desirable, that the survey would provide information of great agricultural interest;
- (d) a suitable frame should either be available or easily constructed;
- (e) the subject should readily illustrate the general principles of sampling;
- (f) the survey would not involve questionnaires to farmers who had recently been besieged by lengthy questionnaires from the Department of Agriculture in the Agricultural Survey 1956, from the Central Experimental Station in their Citrus Survey 1956 and from returns required by the C.C.G.A. a-f v good

A survey of melanose disease in grapefruit based on observations by enumerators in the field satisfied these requirements better than

other subjects considered.

(3) The Nature and Importance of Melanose Disease.

Dr. A.F. Camp (1956) after a rapid inspection of Trinidad citrus suggested that much scope existed for increasing both overall production and the percentage of fruit acceptable for export.

One important factor causing citrus fruit disfigurement is melanose disease caused by the fungus Diaporthe citri. Fruit is disfigured by small black spots which may coalesce in severe attacks and cause extreme marking. The vigour of the tree is also reduced by the death of young foliage and thus melanose depresses production of fruit per tree as well as marking fruit. Quality is a prime requisite of grapefruit sold for the fresh fruit export trade and since melanose spots are not removed by washing or other practicable treatment it is obvious that the control of melanose disease throughout the island would increase both overall production and percentage of shippable fruit, thereby increasing the profits of the Trinidad citrus industry.

In other citrus growing countries control of melanose is obtained by copper sprays and Camp (1956) is of the opinion that, even under Trinidad conditions of heavy rainfall, two applications of copper sprays would achieve effective control. At the present time little or no spraying is done in Trinidad and until some estimate is gained of the damage caused by melanose it is not possible to forecast whether such a control would prove an economic investment to any or all citrus growers. This survey gives some indication of the distribution of the disease in the island and the varying intensity of infection from tree to tree and from estate to estate. At the same time it must be stressed that the results of this investigation apply strictly to the harvest season 1957 - 58. Because the total crop and reputedly the severity of the disease varies considerably from year to year repetition of this survey

would be necessary to obtain fully reliable results on which to formulate a control policy should this be desirable.

(1) The Theory of Sampling.

In carrying out any survey the choice exists between employing a complete census, in which all individual units of the population are inspected, or, depending on the nature of the problem, a sample survey in which only some of the individuals are inspected. Complete censuses are usually more accurate than sample surveys in that they are not subject to sampling errors but they are more expensive and time consuming and it is worth noting that, although periodic population censuses are taken in many countries, most of the statistics required for planning are obtained by some form of sampling. Sample surveys can be checked for accuracy which were not possible in the case of a complete census and it is much less likely that errors will be introduced by the sampling process than by the process of selecting the sample. Moreover, providing the sample is carefully selected, the errors introduced by the sampling process can be separately estimated by statistical methods.

It should be noted that in the present survey the use of a sample survey was chosen for the whole of the project and not for individual parts of the project. The use of a sample survey was chosen for the whole of the project and not for individual parts of the project. The use of a sample survey was chosen for the whole of the project and not for individual parts of the project.

(2) Choice of the Sampling Method.

The term "sample" is defined as "a set of units or portion of an aggregate of material which has been selected in the manner that it will be representative of the whole aggregate". The choice of the sampling method is determined by the nature of the problem and the nature of the population. The choice of the sampling method is determined by the nature of the problem and the nature of the population. The choice of the sampling method is determined by the nature of the problem and the nature of the population.