THE SCOPE AND FUNCTION OF PLANT PROTECTION LEGISLATION IN CEYLON WITH SPECIAL REFERENCE TO INSECT PESTS

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INTRODUCTION.

WITHIN the scope of this subject, which is more popularly known as plant-quarantine, are included not only the legal restrictions on plants and plant products for the purpose of preventing the introduction of insect pests, diseases and weeds of foreign countries, but also the regulations designed to aid in the control, extermination, or eradication of established pests and diseases for purposes of protecting agricultural enterprise and preventing infestation of crops in free areas by dangerous pests and diseases.

In all agriculturally advanced countries there is a very well developed organization for the purpose of carrying on the necessary measures with regard to plant protection from insect pests and diseases, as this is a very important function with regard to the agricultural development and progress of any country. This importance can be better realized when the actual loss caused by pests is examined. The annual damage done by pests to agriculture, livestock and animal products in the Indian Empire was estimated to be in the neighbourhood of 1,800,000,000 rupees at the conference of Imperial Entomologists held in 1930. In America the annual loss entailed by one single insect pest, the cotton boll-weevil, is estimated at about 200,000,000 dollars.

In spite of such obvious losses, in the early days of agricultural development in this and other countries, plants and plant products were brought into or sent out of a country with little or no thought of the insect pests and diseases that might be transported along with them. In fact it is only within the last half century that any serious attempt at legislation to restrict the spread of insect pests, diseases and weeds or to otherwise control the damage caused by them has been attempted in any country. The importance of utilizing legislative measures in plant protection becomes evident when it is remembered firstly, that the worst pests in a country are generally the introduced pests; secondly, that many features concerning the handling of agricultural products are and have to be under the control of individuals who cannot be fully cognisant of the significance of the presence and dispersal of plant pests and diseases; thirdly, that very prompt and sometimes extensive measures have to be suddenly taken for the protection of crops and finally, that it is necessary for enforcing a co-operative effort with regard

to crop protection amongst agriculturists who cannot realize the effectiveness of collective action or the far-reaching danger brought about by individual indifference.

In Ceylon the first plant-quarantine regulations date back to the Insect Pest and Quarantine Ordinance, No. 5 of 1901, under which the chief regulations were regarding the restriction of the importation of cocoa and pepper plants. In 1903 a fumigatorium for the disinfection of plants was built and subsequent regulations were issued for the compulsory inspection of all imported plants and planting material, as well as fruits of the citrus family imported for consumption. These regulations were constantly augmented and the Ordinance revised from time to time as new pests and diseases came into significance, both from the point of view of preventing the introduction of foreign pests and diseases, as well as controlling indigenous ones. The existing regulations are embodied in the latest revision of the Plant Protection Ordinance, No. 10 of 1924, which has replaced all the earlier Ordinances regarding plant protection, and is published in the *Government Gazette* No. 8,399 of September 30, 1938.

GENERAL PRINCIPLES.

Plants as well as animals in a given natural area can be said to be practically in a stage of biological equilibrium. This refers to the characteristics and distribution of the plant species as well as to the occurrence of pests and diseases. Minor fluctuations and changes occur on account of weather and similar factors, but in any one place new pests and diseases do not normally suddenly appear as long as purely natural causes alone are in operation. In such cases susceptible types have been exterminated and the principle of the survival of the fittest firmly established. The agricultural activities of man, however, such as plant breeding and selection, the creation of new strains of plants, plant introduction and distribution of desirable varieties, transportation of living plants, cuttings, roots and tubers, introduce factors which can temporarily upset this biological equilibrium. It is, however, largely possible for man to take the necessary steps to prevent such upsets or detrimental effects following on the interaction of such factors and this is what plant-quarantine attempts to do.

There can be no question but that the feasibility of excluding pests and diseases of plants from free areas is dependent upon biological principles and that one aspect of the problem must consist of an examination of the fundamentals underlying the distribution and the dispersal of organisms. This again is dependent on a proper co-ordination of facts relating to the nature of the pests and diseases to be dealt with, their country of origin, their host relations, the native home of their host, their general prevalence, climatic relations, manner of spread and similar factors. To be sound, however, plant-quarantine should not only be reasonably probable of attainment from a biological stand-point but it should also be economically justified, and it should not unnecessarily restrict the rights and liberties of the people. It is only after a careful consideration of all these various aspects that it is possible to draw up a justifiable plant-quarantine and introduce it as a working system.

Geographical Aspects.—The relative position and isolation of any particular land mass has a profound effect on its fauna and flora, and therefore particularly on the phytophagous fauna of the place. Ceylon, although an Island, is extremely close to the mainland of Asia and appears to have been connected with it until comparatively recent times. The general features of its insect fauna are therefore, where not identical, closely allied to those of India and South-eastern Asia, and there will be therefore relatively few insects of typical Asian origin which are altogether peculiar to Ceylon either in their presence or absence. Amongst these, however, there would be a large proportion of insects which are pests of comparatively recently developed or highly specialized economic crops, and many of these again may be physiological strains or races of comparatively generalized and widespread species, which are normally of negligible economic importance. Also, Ceylon being a relatively small Island, there exists the practicability of possible extermination of such specialized pests when they do occur, if attempts are made to do so before they have been able to firmly establish themselves.

Biological Aspects: Feeding Habits.—Plant-feeding insects are of greatly varied habits with regard to their nature and host plants. Some like the fruit-flies and seed-weevils attack exclusively the fruits or seeds. Others such as the shoot-borers and plant-sucking bugs though normally attacking the shoots may also attack the flowers and young fruits or pods. Others such as the leaf-eating caterpillars and the stem-borers confine their attention to those special aerial vegetative parts, while still others attack only the roots or tubers and are subterranean in some or all of their stages. The most important of all these pests from the point of view of dispersal are those which attack the final or agricultural product derived from the crop, which product is generally marketed and distributed; and those again which attack or may be associated with the reproductive parts such as tubers, bulbs and cuttings which are distributed for planting. There is also the question of host range, some insects being very specialized in their host preference and being confined to a single species of host plant, but more usually related species or even all genera of the same family may serve as hosts, while some are actually extremely cosmopolitan and attack widely separate host plants.

Resistance and Longevity.—Apart from the particular stage of the plant attacked a very important factor relating to dispersal is the relative resistance of a particular pest to lack of food and desiccation. In this respect the most important group of insects are the beetles, which, on account of a very well developed body protection, are capable of remaining for very long periods not only without feeding but also removed from their normal or natural environment. They can thus be transported by accidental association with commercial products connected with the crop plant or even with products not directly connected with the host crop concerned. Further, there are some insects which pass through relatively long inactive stages either in the egg, transitional or adult form. These stages are normally passed in some internal, inconspicuous or concealed situation and are frequently protected by a resistance which is a very great deal higher than that of the normal active insect.

General Habits.—Finally, dispersal is largely determined by general habits of locomotion and activity of the insects. Some species of insects are

capable of flying long distances or may be capable of being carried by the wind over still greater distances. Others are limited largely to movements of their host plants upon which they feed and develop. On the whole, however, it may be said that the movement of insects by their own activities are very limited and in the case of an Island the problem of preventing the introduction of pests is largely one relating to human activity.

Plant Diseases.—With regard to the nature of diseases and their methods of dispersal all that need be stated here is that fungi and parasitic bacteria are specific organisms and, though microscopic in size, are just as definite in character and habits as ordinary plants and insects.

Weeds.—The prevention or destruction of plant weeds is another important aspect of plant protection which may be mentioned and has to be given very serious consideration in any plant-quarantine system, owing to the ease with which such weeds may be introduced and spread either by uninformed deliberate introduction or contamination with planting material and agricultural produce.

Economic Aspects.—The true purpose of quarantine is to avoid the undesirable economic consequences that result from the introduction and spread of various pests and disesases. An ideal plant-quarantine regulation would be one that excluded a plant pest with no costs of enforcement and with no interference with commerce or travel. Some plant-quarantine regulations approach this ideal. In framing regulations the cost of excluding by quarantine plant pests and diseases must be compared with the cost of controlling them if introduced. The cost to producers may be great or it may be practically nothing at all. If it is a pest that requires entirely different methods of control from those used for pests already present then the costs are greater. If controlled by the same methods as for existing pests the costs are practically nil. The same kind of analysis holds true for the cost of enforcing or maintaining plant-quarantine against specific pests. It is necessary then to balance the total costs of maintaining all of the quarantine regulations against all of the benefits derived from excluding possible pests and diseases. It must be remembered that many of the benefits derived from the exclusion of pests and diseases may be but intangible future probabilities and at the same time the regulations for enforcing them may impose much interference and additional duties with regard to the normal straightforward procedure in commerce and travel.

ADMINISTRATIVE PROCEDURE.

As naturally must be the case the administration of plant-quarantine is in the hands of the department directly concerned with crop development, namely, the Department of Agriculture. Quarantine is considerably simplified in a country like Ceylon on account of its being an Island and hence with effective physical barriers to pest migration and dispersal, and also on account of its relatively small size. The fundamental basis for the administration of plant-quarantine is the provision of facilities and personnel for the inspection of plants and plant products both growing in the Island and entering the Island from outside, and even leaving the Island. The latter is for the protection of countries to which plants or plant products from this

country may be exported and from which this country expects similar guarantees. The other more or less complementary factor to inspection is the provision for destroying or otherwise dealing with pest infestation and pest epidemics.

Exclusion of Foreign Pests.—The field of action in this case is first confined to reasonable limits by a restriction of the points of entry of plants and plant products into the country, and the necessity for all such products coming within the range of examination of having to pass through a central inspecting organization, so placed as to cause the least possible inconvenience and delay. In the examination of planting material for insect pests it must be borne in mind that mere examination for superficially placed or attached insect stages will not suffice. The surface of the plant or planting material should be minutely examined for any break or disorganization or even discolouration on the surface. If any such is revealed the tissue must be carefully cut and examined for any internal or concealed stages of the pest. If any diseased or dying tissue is revealed such planting material must be rejected and destroyed irrespective of the presence or absence of specific organisms. It is further essential to examine minutely not only the planting material or plant product itself, but all accompanying material including especially soil and also the package material and wrappings of the consignment. A sound quarantine cannot ordinarily permit the passage of host plants or host plant material which originate in an infested area merely on condition that inspection fails to reveal infestation. Many plant feeding insects which are likely to be transported on nursery stock or fruit have certain stages which are inconspicuous or hidden and are therefore not easily detected. In certain cases inspection of every part of a plant, perhaps with a magnifying glass, would be required to enable an inspector to say positively that it is free from infestation. This is particularly true of scale insects which have a habit of hiding themselves beneath bud scales or bark. Many boring insects are detected only with great difficulty in their early stages, as is also true of fruit-infesting insects such as fruit-flies and seed-borers. Relatively few insects are so conspicuous when occurring on nursery stock, especially when in the egg stage which may be inserted within the plant tissue, that the inspection, necessarily cursory, given in connection with commercial shipments, is a reliable safeguard against infestation. In plant diseases a considerable time must usually elapse before conspicuous symptoms appear and from the quarantine standpoint it becomes quite impossible to inspect for such diseases. It is therefore necessary to completely cut off certain products from certain sources on account of the physical impossibility of excluding all risk of introduction in the case of certain pests and diseases, however great the care exercised in examination may be and however faithfully the principles involved in plant-quarantine are applied.

In the case of insect pests a proper fumigation treatment is very often adequate to get rid of such pests which may not be so readily detected by casual examination and completely adequate ofcourse in getting rid of most insect infestation which can be seen and detected, thus affording a ready means of clearing such infested material and making it acceptable. Provision is therefore made for the exposure of such material to poisonous gases or fumigants, and at present Ceylon is well provided in this respect by a well

equipped and staffed Fumigatorium in Colombo under the charge of the Agricultural Department, through which all plants and planting material imported into the Island must pass through for examination and treatment if necessary.

In order to ascertain for what particular foreign pests special provision should be made, it is necessary to examine the factors which would make such introduced pests serious. Among these are the significance of the pest in its native home; the countries in which it occurs and the relative geographical position of such countries; the amount of trade in plants and agricultural produce between this Island and such foreign countries; the relative uniformity of climate throughout the year in many agriculturally important areas of the Island; the presence of alternate and attractive host plants by which continuous rapid multiplication would be possible and the absence of insect and other enemies found in its original native habitat. The last two factors are very important ones in determining abundance and destructive potentialities of introduced pests of originally minor significance. Finally, there is the indirect importance of insect pests as possible vectors of plant diseases. In short the importance of a foreign pest from the point of view of quarantine would be based on the significance of its economic importance and the chances of migration and dispersal to Ceylon.

With regard to crops of major economic value in Ceylon the most important from the point of view of pests is Coconut. Among pests of this crop we have three of the most destructive already endemic in this Island. There are still, however, equally important ones such as the bearded weevil *Rhina barbirostris* L. and the rhinoceros beetles *Strategus Spp.* of the West Indies, which, however, lose much of their importance to Ceylon on account of their absence in any countries of the East. In India, fortunately, there are no coconut pests of major importance other than those present in Ceylon, but in Malaya there are four very important caterpillar pests which can be very destructive. These are the Coconut Nettle grub *Setora nitens* Walk., the Coconut Case caterpillar *Mahasena corbetti* Tams., the Coconut Spike caterpillar *Tirathaba rufivena* Walk., and the Zygaenid caterpillar *Artona catoxantha* Hamps. For the protection of this crop in Ceylon therefore the importation of coconut plants is completely banned from all countries, and coconuts in husk are allowed only through the Port of Colombo and allowed release only with a certificate of freedom from pest and disease. In this way all minor pests such as scale insects are also effectively excluded. With regard to the other major crops, Tea and Rubber, the restrictions that exist are related largely to the prevention of diseases, there being no pests of major economic importance which could be normally introduced.

With regard to Paddy which has now assumed a status of major economic importance, there are again no major pests of real significance which can be normally introduced. This is largely due to the fact that in the case of annuals such as paddy, which are planted from seed, no movement of actual plants will take place and no significant pests of the paddy plant are actually associated with the harvested seed. A certain amount of vigilance, however, is necessary with regard to introduction, through accidental association with straw, soil or other plants, of pests like the rice mealy bug *Ripersia oryzae* Gr. and the climbing cutworm *Cirphis albistigma* M. of India.

With regard to minor economic crops of Ceylon which have, however, great potential significance, Cotton, Sugar cane, Tobacco and Citrus are worthy of special attention from the point of view of insect pests. Although cotton, like paddy, is planted from seed and actual plants are not therefore moved about, the boll or fruit with its contents the lint and seed are normal commercial products, and hence any pests which are likely to be associated with them have to be specially provided against. The principal pest in this connection is the notorious Mexican cotton boll weevil *Anthonomus grandis* Boh. now present in most cotton growing countries of the West. To eliminate risk of its introduction any seed, unginned cotton or raw ginned cotton of any species of Gossypium grown in the Western hemisphere, is not allowed into Ceylon except through Colombo and except from Bombay, or with a certificate of fumigation from the Collector of Customs, Bombay. Further in order to keep out Indian cotton pests such as the stem-boring weevil *Pempheres affinis* Fst. fumigation at Colombo of all imported consignments of cotton seed or raw cotton is compulsory.

In the case of Sugar cane the only material which is imported are setts or pieces for planting, which can be of course an excellent channel for the introduction of numerous pests and diseases. Of the more important pests which can be introduced are the Sugar cane borers such as *Diatraea saccharalis* Fab. and *Castnia licus* Fab. (West Indies, &c.), and *Diatraea sticticraspis* Hmps., *Diatraea venosata* Wlk. and *Scirpophaga nivella* Fb. (India) and *Sphenophorus* (*Rhabdocnemis*) *obscurus* Boisd. (New Guinea, Hawaii, Fiji, Australia, &c.). There are also minor pests such as leafhoppers which can become serious if introduced, as was the case with the Hawaiian leafhopper *Perkinsiella saccharida* Kirk., an Australian species of minor importance which once nearly threatened the sugar industry in the Hawaiian Islands with extinction. To counteract all risk of introduction of pests and diseases of Sugar cane into Ceylon, therefore, the Ordinance provides that no sugar cane setts be imported into the Island, other than those imported by the Director of Agriculture, and thus an expert quarantine is necessarily observed for such material.

In the case of Tobacco no planting material except seed is normally imported and the chances of introduction of any serious insect pest are therefore negligible. The important pests of Tobacco which are absent from Ceylon are the Tobacco root bug *Stibaropus tabulatus* Sch. of India, and the Tobacco flea beetles *Epitrix Spp.* and the Tobacco bud worm *Chloridea virescens* Fabr. of America.

With regard to fruit the most serious foreign pest of importance to Ceylon is the Mediterranean fruit-fly *Ceratitis capitata* Wied., whose entry is safeguarded by the complete prohibition of the importation of fruit from all the Mediterranean countries, and also from other countries containing this pest unless treated according to a prescribed manner which ensures the death of any accidental infestation. The introduction of fruit pests in general is also safeguarded by the restriction of imported fruit to the port of Colombo alone, with the compulsory inspection and treatment to which all imported consignments of fruit have to be subjected. An important pest of Citrus plants absent from Ceylon but present in India is the Citrus Stem borer

Chloridolum alcamene Thoms. Important foreign pests which are absent from Ceylon but whose chances of introduction are negligible are the San Jose scale *Aspidiotus perniciosus* Coms., the Japanese beetle *Popillia japonica* Newm., the Oriental fruit moth *Laspeyresia molesta* Busck and the Codling moth *Carpocapsa pomonella* L.

There are still a few pests which should be mentioned for the exclusion of which no special legislation yet exists but which may sooner or later require special measures. Such for instance are the Indian pests, the Red hairy caterpillar *Amsacta albistriga* Wlk., a cosmopolitan feeder on numerous food crops which has a dangerously long quiescent subterranean pupal stage, the Jak bud weevil *Ochyromera artocarpi* Motsch., the white borer of Coffee *Xylotrechus quadripes* Chevn., and the pepper berry borer *Longitarsus nigripennis* Motsch. These and many others of relatively smaller importance are solely dependent for their exclusion on the care and sense of responsibility of the inspecting service maintained at Colombo for imported material.

Most of the pests, however, which are mentioned above as well as numerous others of smaller significance cannot be normally introduced except in or accompanying actual plants or planting material. Under the circumstances a quarantine administration which ensures the limitations of the avenues of entry to only one where a careful and responsible inspection service is maintained and enforced as is the case in Ceylon—since material coming in by train to Talaimannar and by air to Ratmalana are conveyed by sealed van to the Colombo Fumigatorium—is adequate within reasonable limits for keeping out any serious pests and diseases. This, however, should not engender any false sense of security, as any laxity entertained in formulating prohibitions against really important pests is fatal in the long run, as may be seen in the excellent example afforded by the Coffee berry borer *Stephanoderes hampei* Ferr., originally a native of Africa but probably introduced into Ceylon from Java. This pest was first recorded in Ceylon in 1935, at which time in fact it appeared to be fairly well established. It is very probable that it could have been kept out if the importation of coffee seeds had been rigorously excluded from all countries in which the pest occurred.

The Control of Indigenous Pests.—Apart from the provision mentioned for the examination of imported plant material the Plant Protection Ordinance also provides extensive power for control or eradication of established pests and diseases. Thus there is provision for the appointment of inspecting officers who are given the power of entering and examining any plants or any crop on any private property for the purpose of detecting plant pests and diseases and taking the necessary action with regard to their elimination. Of these pests the very serious or important ones are proclaimed and the owner or occupier is compelled by the alternative of fine or imprisonment to carry out the necessary eradication of such pests on his land in the manner specially prescribed. All technical officers on the staff of the Department of Agriculture are given the powers of inspection for pests and diseases with of course due protection of the rights of the owner of private property against the direction of these privileges against any feature other than that of pest and disease eradication.

Particular emphasis is of course placed on such pests and diseases as may be wont to spread rapidly and assume epidemic proportions as for

instance the nettle grubs of Tea, as well as on those whose dispersal is very good and would normally by breeding in any one locality or estate cause serious damage to other estates and localities. Such for instance is the case of the two serious beetle pests of coconuts whose prevalence, multiplication and spread is entirely due to lack of sanitary attention on neglected coconut plantations.

The crop pests declared and proclaimed up to date in Ceylon are—(1) The Shot hole borer of Tea (*Xyleborus fornicatus* Eich.); (2) The Black Beetle of Coconuts (*Oryctes rhinoceros* L.); (3) The Red weevil of Coconuts (*Rhynchophorus ferrugineus* F.); (4) The Coconut caterpillar (*Nephantis serinopa* Meyr.); (5) The Root weevil of Plantains (*Cosmopolites sordidus* Germ.); (6) The Stem weevil of Plantains (*Odoiporus longicollis* Oliv.); (7) Nettle-grubs (*Limacodidae*); (8) The Coffee berry borer (*Stephanoderes hampei* Ferr.); (9) The Paddy pentatomid (*Scotinophara lurida* Burm.)

CONCLUSION.

Comparing the plant protection legislation of various countries it will be seen that generally speaking there is very much less restriction on the movements of plants and plant products in Ceylon than is to be found in any agriculturally important country. The risk involved in this comparative freedom from the more tedious aspects of plant-quarantine is partly offset by the advantages derived on account of Ceylon being an Island and on account of the great care taken by the Agricultural Department in ensuring minute and responsible inspection at the port of introduction, and the cultivation of imported planting material under careful observation and control. Further the minor crops have not yet gained any appreciable economic significance and this is also largely the reason why comparatively few or no compulsory measures are laid down for the control of serious existing pests and diseases of these crops, or even for a crop such as paddy which has now acquired major importance.

It will be clear from what has been stated that a general tightening up of regulations and introduction of new ones relating to pest, disease and weed control will be very desirable if any intensification in the agricultural development of the Island is to be achieved. Little purpose, however, can be served by the mere introduction of new legislative measures, if the administrative machinery whereby they can be enforced is lacking. This is clearly seen in the case of the pests of coconut in Ceylon, where legislation is doing but little to keep these pests under control. It would be very desirable when conditions are more stable and definite and the economic significance of particular crops can be more clearly envisaged, that due emphasis be placed on this subject by the development and elaboration of scouting and survey work very necessary with regard to pest and disease control, so that the more effective and economical procedure of " prevention " can be exploited rather than the more troublesome and expensive " cure ".

It is obvious that until the value of intensification of agricultural effort is fully realized it will not be possible for an agricultural country like Ceylon to achieve any substantial progress in agricultural development, nor will it be possible for an economic crop to make an appreciable contribution towards the wealth of the country. The history of agriculture in many

countries has repeatedly shown that though pest and disease control are two of the most decisive factors in the intensive development of any economic crop, they have been in the past, the factors most frequently underestimated and overlooked. Further, it is also important to realize that to achieve effective pest and disease control it is necessary to win the understanding and co-operation of the agricultural public towards this most obvious side of the question, namely the legislative measures laid down for the achievement of pest and disease control in the country. A long term view is essential for properly evaluating this aspect and this can hardly be expected from the uneducated and hand-to-mouth agriculturist; but with the rapid progress now being made in the welfare of the peasant cultivator, this becomes a practical proposition. Complete success in pest control efforts can, however, only be finally achieved by the education of the agricultural public in the effectiveness of scientific method and co-operative effort, and last but not least the special duty and responsibility of the individual citizen and more particularly the agriculturist in this matter.

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