29/10/63

A NATIONAL STUDY ON THE MARKETING DISTRIBUTION

AND

USE OF AGRO-PESTICIDES IN SRI LANKA

(Part of a study undertaken for the ARSAP/ESCAP-UN)

PONNIAH MANICKAVASAGAR
Plant Protection Officer

1st July, 1979.

Plant Protection Service,
Department of Agriculture,
Gannoruwa, Peradeniya,
Sri Lanka.

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ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC
THE UNITED NATIONS BUILDING, RAJADAMNERN AVENUE
BANGKOK 2, THAILAND.

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AGR 1/16/16
AGR 2/2/22

16 March 1979

Dear Mr. Manickavasagar,

With reference to the study on agro-pesticides marketing, distribution and use in Sri Lanka which you agreed to carry out for us, we would like to request that all the references viz. documents and data collected for the study be sent to us after completion-of the study. They will be kept for retrieval purpose in our Information/Documentation Unit as part of the information-sharing programme of the network.

Referring to the "Guidelines for the national study on agro-pesticides marketing, distribution and use" on existing training programmes, we would also like to receive copies of any training manuals, pest identification charts on insects, diseases and weeds, technical leaflets, posters and drawings explaining use of pesticides and application equipment, instructions on storage and hazards, prevention and treatment in case of poisoning, if you happen to come across these types of information. In short, any relevant material issued by government or private industry in local or internationally used languages would be helpful.

The information can be mailed to us through the office of the United Nations Development Programme (UNDP) in your country or if you choose to send it to us directly, we will be glad to reimburse you for the cost of mailing.

Thank you for your co-operation.

Yours sincerely,

K. H. Zevering
Project leader, ARSAP
Agriculture Division

Mr. Ponniah Manickavasagar
Plant Protection Service
Gannoruwa
Peradeniya
Sri Lanka

Guidelines for the preparation of a national study on the marketing, distribution and use of agro-pesticides[1/]

1. Main results expected:

(1) a compilation and analysis of time series data, including the most recent information available, regarding the import and manufacture/formulation of agro-pesticides

(2) an analysis of agro-pesticides consumption patterns

(3) information on application equipment

(4) the identification and analysis of the main factors contributing to or constraining the use of agro-pesticides by smallholders in food and cash crop production

(5) a survey of government policies and programmes on the promotion and regulation of pesticides use and training on pest and disease control, especially with regard to smallholders agriculture

(6) a survey of private industry training and promotion programmes related to the handling and application of agro-pesticides at the dealer and/or farm level

(7) a description of the existing marketing and distribution system and an analysis of the cost-price structure of major groups or selected formulations of pesticides

(8) crop-wise information on pest damage, quantified if possible, and on common control measures, including non-chemical methods

(9) an analysis of the economics of pesticides use at the farm level

(10) data on poisoning incidents as a result of pesticides use in agriculture

A final section would be required on information and data gaps encountered and recommendations for the improvement in the country of data collection and monitoring.

2. Explanatory notes on main results expected and listed under 1 above

(1) The data needed are:

(a) imports of technical grade pesticides (tonnage and c.i.f value)

.../or

1/ The term 'pesticides' is used generically to cover all major groups such as insecticides, fungicides, herbicides; the prefix 'agro' is used to differentiate their use in crop protection from other types of pest and disease control.

or as much detail as reported by Customs

(b) domestic manufacture of technical grade pesticides (tonnage and ex-factory value)

(c) similar information on formulations as in (a) and (b). If not possible then only by group (e.g. dust, WDP, EC, granules etc.)

(d) manufacturing/formulation capacities in the country and their utilization (list of firms if possible)

(e) plans for capacity expansion

(f) list of pesticides importers and their respective share in total imports of different materials.

2) Information on consumption broken down if possible

(a) by final use in agriculture, public health, veterinary protection, other uses

(b) by major groups, e.g. insecticides, fungicides, herbicides etc.

(c) by crops or crop groups (only total quantities and value of grouped technical materials needed)

(d) by product, if possible crop by crop

(e) by regions or other geographical units

(f) by size strata of agricultural holdings

(g) by tenurial status of farmers

(h) by category of agricultural land (e.g. irrigated, non-irrigated)

(i) by agricultural sectors (e.g. estates, smallholders)

Desirable data are also percent of farmers using different types of pesticides and percent of cultivated or crop area treated.

3) Information on application equipment:

(a) numbers of different types (dusters, sprayers etc.) imported over the years, including most recent information

(b) ditto manufactured in the country
(c) sales prices of application equipment

4) This section analyses factors which are not directly related to the farm economics of pesticides use (which is dealt with in (9), such as (a) credit supply; (b) government or industry promotion programmes; (c) introduction of HYVs and irrigation expansion; (d) historic incidences of certain pests or diseases; (e) supply and acceptance, including quality and safety factors; etc.

.../(5)

(5) This section on government policies and programmes is a kind of status report on:

(a) government legislation/regulations and degree of enforcement with regard to standards of registration, quality control and safety

(b) government-sponsored promotion programmes, including demonstrations

(c) fiscal and tariff policies affecting the domestic sales price of pesticides

(d) government-sponsored training on pesticides use, handling, crop protection that will directly benefit or facilitate the efficient and safe application by farmers

(e) government research and research facilities directly related to crop protection

(6) This section on private sector activities on training and promotion is similar in scope as (5)-(b) and (5)-(d) above.

(7) This section deals with:

(a) a description of the manner in which the country's distribution of agro-pesticides through both public and private channels is organized and their respective market shares

(b) sales forecasting and importation scheduling methods followed by the main importers/distributors

(c) storage capacity maintained by distributors at different levels of distribution

(d) a price analysis in terms of the unit costs and margins at successive levles of distribution, such as at the importer/producer level, the wholesale level and the retail level; this analysis should be attempted for major groups or selected formulations of agro-pesticides

(e) retail price statistics for a number of years, including the most up-to-date data

(8) This section is a review of:

(a) the incidence and severity of the pests and diseases that may cause economically significant pre- and/or post-harvest losses, enumerated and described crop by crop

(b) data indicating the percent of crop area estimated to be affected in particular years (by type of pest/disease)

(c) data on the known extent of damage sustained in given years; the extent of damage may be quantified in different ways,

.../depending

depending on data availability (percent yield loss, percent crop damage etc.); this information is required by type of pest/disease

(d) methods of pest and disease control that have been or are commonly used and their effectiveness

(e) recommended control measures if any (including non-chemical methods);

(f) actual control methods followed by smallholders as reported or recorded by extension workers and researchers

(9) This section should contain:

(a) an analysis of the economic returns to the application of agro-pesticides. It requires an assessment based on experimental or research data of the value of losses avoided through application of pesticides in relation to the cost of the control materials used

(b) data on the cost of pesticides as percent of total farm production cost

(10) This section requires a statistical analysis of available records on poisoning incidents resulting from pesticides use, broken down if possible by sector (agriculture, domestic, industrial etc.).

3. Terms and conditions of the study

The study will be carried out on Special Service Agreement (SSA) with ESCAP. specifying a maximum period from the date of the SSA of 4 months.

The study may be undertaken by more than one researcher working in close co-operation for the purposes of achieving as complete a survey as possible.

The person(s) listed in the SSA will be entitled to a honorarium of US$ depending on the degree of completeness of the study following the guidelines prepared by ESCAP. If more than one researcher are specifically involved the amount will be shared by agreement.

The researchers will be required to submit a first draft report by the end of the 4 months, preferable earlier, to ESCAP. The ESCAP secretariat, if necessary, may return the report with a request for improvements, amplifications or further elaboration of certain sections, before payment of the honoraria.

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C O N T E N T S

4. Agricultural development in Sri Lanka and factors indirectly affecting the use of pesticides.

The national economy of Sri Lanka is based on agriculture. Prior to gaining independence in 1948 Sri Lanka was a major exporter of tea, rubber and coconut. It imported most of its food requirements with the foreign exchange thus earned. Even though the economic activity of the export orientated, large scale plantation sector has a tradition of organisation, dating back over a hundred years, declining export prices in recent times have imposed an increasingly severe strain on the country's foreign reserves.

Little attention was paid to domestic food production prior to 1948 though the country possessed the capacity to produce the entirety of its food requirements. The peasant farming sector, which is chiefly concerned with the cultivation of rice and other field crops, had not made a significant break through towards achieving higher production levels. Even at present, 45% of the Island's food requirements are met by imports. In order to conserve valuable foreign exchange spent on food imports, the State realised the scope for increasing domestic food production. The possibility of increasing agricultural productivity exists in both the plantation and peasant sectors, but there is clearly more scope for development in the latter. Policies were formulated by successive Governments to strengthen the peasant section and achieve self-sufficiency in the production of food.

4. a. The State enacted the Paddy Lands Act in 1956 to provide security of land tenure to tenant cultivators. In 1970 the Act was extended to cover rice and other field crops.

4. a2. A scheme of floor prices for selected commodities and guaranteed purchasing was instituted. The price supports acted as an incentive for higher production of these crops.

4.a3. The State implemented the Land Reform Law in 1972, whereby the ownership of rice land was limited to 10.1 hectares and other agricultural lands to 20.2 hectares. The excess land was distributed among the landless. This would lead to increased employment opportunities, easing congestion in thickly populated areas and increased productivity.

4.a4. Bans were introduced to limit the importation of most food items, including chillies, onions, pulses and spices. The ban along with the guaranteed purchasing scheme helped to boost local produce and reduce foreign exchange expenditure.

Quantity imported and local production of selected crops
(in metric tons)

Year	Rice		Chillies		Onions		Potatoes	
	Import	Production	Import	Production	Import	Production	Import	Production
1958	58,928	520,598	14,456	14,375	50,972	37,393	43,949	1,088
1967	381,000	782,320	14,741	28,915	58,358	38,423	18,396	11,508
1977	538,480	1,143,914	NA	42,976	.002	67,494	143.0	29,100

(Source: Department of Census and Statistics, Colombo)

4.a5. A major step taken to increase the land under cultivation was the restoration of ancient tanks in the Dry Zone. There are approximately 180 major irrigation tanks and several minor village tanks (with a capacity to feed less than 160 hectares) in the Dry Zone. These were renovated and new irrigation schemes established. The land around the schemes were colonised for agricultural production.

Extent of rice fields under Irrigation Schemes
(in hectares)

Year	Major Irrigation Schemes	Minor Irrigation Schemes
1960	131,676	136,847
1967	162,602	156,630
1977	208,460	181,051

(Source: Department of Census and Statistics)

4.a6. The accelerated River Valleys Development Schemes are expected to provide more lands with irrigation. It is anticipated that an additional .4 million hectares will become irrigable during the next 5 years.

4.a7. The average cropping intensity in the surface irrigated schemes is

A major crop of rice, followed by a second crop of rice depending on water availability is raised on these lands. The cultivation of other field crops like pulses is being introduced in the well drained rice fields to increase the cropping intensity.

Lift irrigation has been provided in some of the colonisation schemes for the cultivation of crops like chillies in the highlands.

4.a8. A tube well drilling project is in operation in the North-Western belt, which is underlain by sedimentary limestone bed rock. Underground water is tapped for the cultivation of other field crops.

4.a9. Tax incentives are provided to induce the private sector to get involved in the agricultural development of the Dry Zone.

4.a10. New improved strains with higher yields have been released for cultivation:-

Rice - Bg 11-11, Bg 90-2, Bg 34-8, Bg 34-6, Bg 94-1, LD 66, BW 78, 62-355.

Maize - Thai-Composite and T.48

Finger Millet - MI 301 and MI 302

Sorghum - IS 2941

Chillies - MI_1 and MI_2

Cowpea - MI 35, Arlington and Bombay Cowpea

Groundnut - Red Spanish, Uganda erect, MI_1

Soya Bean - Bragg and PB_1

Sesam - MI_1 and MI_3

Over 75% of the land under rice is planted with improved varieties.

Extent under improved rice varieties
(in hectares)

Year	Extent
1970	536,570
1974	666,845
1977	692,269

(Source: Department of Agriculture, Peradeniya)

4.a11. Quality seed for planting is provided by over 25 seed production stations belonging to the Division of Seeds and Planting Material of the Department of Agriculture, and by selected private seed farms. The total extent of the State seed stations is 1,417 hectares.

4.a12. The State supports a 50% subsidy on fertilizers. The State Urea factory at Sapugaskande and the apatite deposits of Epawela in the Dry Zone will augment the fertilizer stocks of the Island.

Fertilizer use in rice cultivation
(in metric tons)

May - September	Quantity	November-January	Quantity	Total
1965/66	27,860	1966	14,353	42,213
1969/70	57,911	1970	32,130	90,041
1974/75	27,055	1975	16,745	43,800
1976/77	54,210	1977	28,354	82,564

(Source: Department of Agrarian Services)

4.a13. The crop insurance scheme covers rice.

Crop Insurance

Year	Acreage covered (hectares)	Premium recovered (£)	Indemnity Paid
1958/59	9,547	587	1,368
1960/61	9,547	1,039	430
1965/66	80,432	29,671	9,392
1969/70	84,215	23,278	59,374
1976/77	145,336	190,776	197,900

(Source: Agricultural Insurance Board)

4.a 13: CROP INSURANCE

The Crop Insurance scheme operated by the Department of Agrarian Services was inaugurated as a pilot project in 1958. It covered rice crop only. With the enactment of the Crop Insurance Act No.13 of 1961, the scheme was gradually expanded to 80,939 hectares of rice in selected areas of 16 districts. At that time, coverage varied from £.8.22 to £.14.83 with a uniform premium of £.0.49 per hectare. A 10% higher coverage was offered to farmers who adopted improved methods of cultivation. The performance of the pilot project carried out by the Department of Agrarian Services in respect of a few selected years is summarised below:-

Operation of Crop Insurance Pilot Project

Year	Hectares covered (h)	Premia Recovered (£)	Indemnity paid (£)	Difference between Indemnity paid and premia collected (£)
1958/59	9,543	587	1,368	- 781
1962/63	26,346	5,590	3,886	+ 1,704
1966/67	81,213	21,126	64,713	- 43,588
1969/70	84,215	23,278	59,374	- 36,096

(Source: Department of Agrarian Services)

During the period 1958/59 to 1969/70 premium dues were £.0.38 million. Premia collected amounted to £.0.15 millions, and £.0.37 millions were paid as indemnities. It will be observed that the pilot scheme would have been profitable for the State, and a self financing one without any premium subsidy, if the entire premium dues were collected.

4.a.13:1 Agricultural Insurance

The Agricultural Insurance Law No.27 of 1973 was established for undertaking the business of agricultural insurance for specified crops and livestock, and this law repealed the Crop Insurance Act No.13 of 1961.

The law is put into motion by the Agricultural Insurance Board appointed by the Minister of Agricultural Development and Research. The Board comprises of the Chairman, Commissioner of Agrarian Services, Director of Agriculture, Commissioner of Co-operative Development, representatives from People's Bank, Bank of Ceylon or any Bank approved by Government, Insurance Corporation of Sri Lanka and the Paddy (Rice) Marketing Board. The Board started functioning in 1975.

The Chairman, General Manager, 4 Directors, 36 Assistant Directors and 26 Field Officers are responsible for the enforcement of the Law.

Every person having an interest in rice crop is deemed to have entered into a contract of insurance with the Board. Insurance coverage and premium is variable for each Agrarian Service Centre areas, depending on agro climatic regions, soil fertility, availability of irrigation, risk factor and yield per hectare. At the inception, the coverage was £.57.66 per hectare, but was raised to £.82.37 in 1979. The premium per hectare per season ranges from £.0.66 to £.3.71. Indemnity payments range from £.2.5 to £.107 per hectare. The premium has to be paid each season before cultivation commences. In order to obtain loans from the Government, Insurance is a pre-requisite. There is no subsidy on premium paid. However, there are moves for a 40% subsidy on the premium.

The performance of rice insurance by the Agricultural Insurance Board since 1975 to 30/6/79 is summarised below:-

Operation of the Agricultural Insurance Programme (Position as at 30/6/79)

Year	Hectares cultivated ('000h)	Hectares insured ('000h)	Premia collected ('000£)	Indemnity paid ('000£)	Difference ('000£)	Participatio %
1975	717	131	166	217	-51	18.3
1976	798	144	194	214	-20	18.0
1977	861	253	364	222	+142	29.4
1978*	844	96	167	266	-99	11.4

* Provisional

(Source: Agricultural Insurance Board)

Investigations are under way on the feasibility of starting an insurance scheme for cotton cultivation.

4.a14. The Department of Agrarian Services was charged with the responsibility of agricultural credit in 1947. Subsequently the People's Bank and then the Bank of Ceylon and other Commercial Banks began advancing credit for agricultural purposes.

Agricultural Credit (in '000£)

Financial Year	Loans granted
1947/48	145.20
1951/52	294.5
1956/57	731.1
1965/66	937.8
1969/70	1,979.4

(Source: Department of Agrarian Services)

New Agricultural Credit for rice cultivation

Year	Loans granted
1974/75	2,553.5
1976/77	2,438.3

(Source: People's Bank)

4.a15. Marketing of agricultural commodities was improved by the establishment of bodies like the Paddy Marketing Board, The Marketing Federation, The Marketing Department, etc.

Guaranteed price and Quantity of rice purchased by the Paddy Marketing Board.

Year	Purchases as % of total production	Rice equivalent in 1000 tonnes	Price/Bushel (in '000£)
1958	44.26	230.4	0.4
1965	58.95	304.8	0.46
1969	21.12	197.7	0.66
1974	27.20	297.3	1.0
1977	44.80	349.3	1.1

(Source: Paddy Marketing Board)

Such Institutional changes and technological advances resulted in increased productivity.

Area cultivated with rice and other field crops (in hectares)

Year	Rice	Chillies	Onions	Potatoes
1960	595,945	12,517	5,782	406
1967	663,535	23,898	7,532	1,354
1977	828,418	51,728	8,386	3,111

Yield of Rice per hectare (in bushels)

Year	Quantity
1958	84.96
1967	101.93
1974	113.61
1977	108.68

(Source: Department of Census & Statistics)

4.b. There are no social inhibitions to the use of pesticides. So far, the use of pesticides has had no adverse side effects on the environment and the society. But the State has been concerned over the use of certain pesticides, which are used by the State Health Services for the control of certain insect vectors of human diseases. As a consequence the State Department of Agriculture has tried to ban the use of Malathion and Fenitrothion in agriculture. These are used extensively in Malaria eradication and it is feared that the mosquito would develop cross resistance much more rapidly.

Unlike in most South East Asian countries, fish is not reared in rice fields. Thus the application of insecticides or herbicides does not pose a problem to the peasant rice farmer. Even before the advent of modern pesticides the application of wood ash, common salt and the use of 'charmed water' was in vogue.

5.a1. State Policy on Pest Control

The need for pest control was realised very early by the State. In order to enforce pest control in Sri Lanka, the Plant Protection Ordinance No.10 of Sri Lanka was enacted on 27, July 1924. It provides for the eradication, destruction and prevention of pests and diseases occurring in Sri Lanka. Failure to control declared pests is punishable by law.

Of late all pesticides imported into Sri Lanka had to be approved by a Pesticide Formulary Committee. The committee sets the limits on the type and quantity of pesticides imported into the Island. Following the liberalised import policy of the present Government, a free market exists in the sale of pesticides.

The Sri Lanka Bureau of Standards is charged with the responsibility of setting the standards for pesticides marketed in the Island. It does this in consultation with the Research Institutes and pesticide marketeers in the private sector.

5.a2. State legislation for the registration of pesticides and quality control.

There are no regulatory measures at present to control the manufacture or formulation of pesticides and ensure the quality of the marketed product in Sri Lanka. Legislation will soon be enacted in the State Assembly, to define approved standards for the registration, importation, preparation, storage, transportation and sale of pesticides. The draft of the legislation is in the final stages of deliberation.

The law when enacted will be known as the 'Control of Pesticides' law. The law will be implemented by the Pesticides Formulary Committee, through the Plant Protection Service.

The law requires that any pesticide intended for use in Sri Lanka should be registered with the Pesticide Formulary Committee by the producer

or marketeer. The person tending the application for registration should furnish the following information:-

The name and address of the applicant and producer.

The proposed trade name of the product.

A copy of the container label and samples of the container.

Documents supporting the statements made by the manufacturer with regard to the use, potency, stability in storage, methods of use, composition, chemical nature, date of expiry, etc. of the product.

Toxicological data, methods of analysis of the formulation, methods of determining product residues in the crops for which the product is intended.

Manufacture batch number and other related information.

The acceptance of an application for registration depends, in addition to the above considerations, on the exactness of the label to be affixed to the container, a copy of which is submitted along with the application. The label should contain the following information in Singhala and Tamil languages:-

Name and address of the manufacturer.

The trade name of the product.

The word 'poison' displayed prominently in red.

The common name of the active ingredient of the formulation.

The composition of the active ingredient.

Directions for the use of the product and the precautions to be observed.

The antidote to be administered and other details.

The shelf life of the product.

The licence number.

A licence is issued on acceptance of the application by the Formulary Committee. The manufacturer or marketeer is thereafter expected to

adhere strictly to the conditions laid down by the Pesticides Law. If he were to contravene any provisions of the law, his registration may be cancelled, the licence withdrawn and the person is punishable by law.

The law also provides for the maintenance of the quality of the product to approved standards, during the various phases of marketing. The law empowers 'Authorised Officers' to conduct periodical checks of the product while in storage, transport and at the sales outlets. The aim is to prevent the sale of adulterated or deteriorated products and thereby ensuring product quality. Samples drawn from the stores or sales outlets, shall be examined by authorised analysts. The law bars anyone from selling adulterated, decomposed or deteriorated pesticides.

With regard to the safety of the registered pesticides to consumers, the law lays down the following conditions:-

The pesticide cannot be in close juxtaposition with foodstuffs either during storage, transport or at the sales outlets.

When stored in bulk, the law requires the pesticides to be stored in special stores, constructed for this purpose. The stores should be kept under lock and key. A prominent notice indicating the hazardous nature of its contents should be displayed prominently outside the stores.

Further, the committee should be convinced of the steps taken for the safe storage and handling of the product while in transit, before accepting the application for registration.

The committee will also prescribe the maximum residue level permissible in the harvested produce. No person shall be allowed to harvest or export the produce till a certain minimum period (the waiting period) has elapsed.

Under exceptional conditions, the Minister of Agricultural Research and Development may prohibit the sale of certain substances to safeguard the environment or wild life resources, other than such noxious plants and

animals, whose control is desired. He may also include conditions for the field evaluation of certain substances.

5.b. Government sponsored promotional programmes and demonstrations

Agriculture in Sri Lanka consists of the 'plantation' sector, which is capital intensive, and the 'peasant' sector which provides the Island with the bulk of its grain, pulses and vegetables for consumption. Sri Lanka earns most of its foreign exchange through the export of tea, rubber, coconut and minor export crops, grown by the plantation sector. The Department of Agriculture caters for the needs of the peasant sector.

5.b1. The peasant sector

The promotional activities for agricultural development in the peasant sector are executed chiefly by the two divisions of the Department of Agriculture, namely the Division of Agricultural Extension and the Division of Agricultural Education and Training. Up to 1978 the Island was divided into 22 agricultural districts:-

Agricultural Districts and Extent

District	Total land area (sq. kilometers) (including inland waters)	Actual land area (sq. kilometers)
Colombo	2,093	2,051
Kalutara	1,615	1,606
Kandy	2,367	2,360
Matale	1,995	1,995
Nuwara Eliya	1,227	1,227
Galle	1,689	1,674
Matara	1,247	1,247
Hambantota	2,624	2,592
Jaffna	2,586	2,498
Mannar	2,497	2,479

Vavuniya	3,801	3,709
Batticaloa	2,633	2,463
Amparai	3,052	2,986
Trincomalee	2,714	2,618
Kurunegala	4,775	4,766
Puttalam	3,038	2,976
Anuradhapura	7,275	7,127
Polonnaruwa	3,449	3,403
Badulla	2,823	2,818
Moneragala	7,213	7,136
Ratnapura	3,240	3,240
Kegalle	6,842	6,842
TOTAL	65,600	64,630

In 1979 the districts of Colombo and Vavuniya were split to form Gampaha and Mullativu respectively, thus forming 24 administrative districts. Extension has been decentralised into the districts, where the District Agricultural Extension Officer (DAEO) is responsible for agricultural activities. The office staff of each district consists of the DAEO, assisted in his duties by one or more Additional DAEO and Agricultural Officers (AO) and Agricultural Instructors (AI). The Agricultural Instructors at the district office function in the capacity of Subject Matter Officers (SMO), covering the various disciplines of agriculture like Plant Protection, Rice, Horticulture, Other Field Crops, etc. There is at present a total of 42 staff officers in the Agricultural Officers cadre (includes DAEO, Additional DAEO, Agricultural Officers) and 127 Subject Matter Officers (AI) at the district level. An Agricultural Instructor for Plant Protection (AIPP) is attached to each district office. The AIPP comes under the administrative control of the DAEO and is

technically serviced by the Plant Protection Officer (PPO), who operates from the Head Quarters of the Department at Peradeniya. The Plant Protection Officer makes regular inspections of all parts of the Island to assess the pest situation, direct the control of pest outbreaks and review the progress in crop protection operations. There exists a two way flow of information between the PPO and the AIPP in the districts. At the district level, the AIPP is chiefly responsible for the promotional work in Plant Protection. He does it in consultation with the PPO and the District Agricultural Extension Staff.

The Department of Agriculture has encouraged the use of pesticides from as early as 1946, when chemicals like DDT and MCPA became available. In order to develop a system of integrated pest control, the Department insists that pesticides should be recommended as a last resort. But, in general, it is observed that the first choice of most extension workers while advising farmers, is the use of pesticides.

Bitter memories of the coffee leaf rust, which wiped out the coffee industry of Sri Lanka, prompted the State to develop a body for providing agriculture with the necessary research backstopping in Entomology and Mycology. In 1919 a 'Plant Pest and Disease Inspection Division' was established in the Department of Agriculture to serve as a liason service between the plantation sector and the Divisions of Entomology, Mycology and Botany. It was later charged with the function of implementing the provisions of the Plant Protection Ordinance of 1942. In 1953 the 'Pest and Disease Extension Service' was launched with financial assistance from Canada. It's scope was extended to cover advisory work in Plant Protection; the Service was the responsibility of the Division of Agricultural Research. To make it a more effective organisation, a 'Plant Protection Service'

was established in October 1959, which had closer links with the Agricultural Extension Division, while at the same time liasing with the research institutes. The Service, headed by a Plant Protection Officer and 9 Agricultural Instructors (PP) stationed in the 9 provincial towns served the 22 agricultural districts.

The Plant Protection Service was further expanded in 1968 with the appointment of Agricultural Instructors (Plant Protection) for each of the 22 districts. Financial assistance was sought from the UNDP in 1972 to strengthen the Service by way of increased mobility, literature, audio visuals and educational facilities and training for district personnel. The UNDP/FAO project SRL/74/008 became operative in July 1975, with Mr. M.J.Watt as FAO Adviser and Mr.P.Manickavasagar, Plant Protection Officer as the local counterpart. The Plant Protection Service functions as the primary body, directing extension and educational activities in Plant Protection at present. Plant Protection mobile units have been established in 10 districts, namely Jaffna, Anuradhapura, Mannar, Polonnaruwa, Batticaloa, Amparai, Colombo, Hambantota, Matara and Kurunegala. Their function is to assist agricultural extension staff not only in crop protection, but also in Post Harvest Protection and the maintenance of pesticide applicators belonging to the Department of Agriculture. These units are equipped with vehicles, pesticide applicators and workshop facilities for repairing pesticide applicators. In the event of pest outbreaks, these units organise co-operative pest control operations in the affected areas. Examples of such operations are those conducted against the brown plant hopper of rice. The farmers are expected to purchase the insecticide and the DAEO loans the pesticide applicators free of charge. The pesticide application operations are organised by the Plant Protection Service and executed by the District Extension staff. Prior to the commencement of operations, farmers in the area are warned of the pending epidemic and

the actions they should take, through the contact farmers, special farmer training classes, public address systems, insertion of slides in cinema halls and through the schools. It is also broadcast over the radio.

The State implemented a scheme of 'free issue' of pesticides, following the first severe epidemic of brown hopper in the Island in 1974. Pesticides were issued free of charge to farmers in affected areas. It was subsequently withdrawn with the gradual reduction in pest population. The State has come to the rescue of farmers on more than one occasion in previous times by sponsoring aerial spraying of pesticides, when large tracts of cultivated areas were threatened by pests, e.g. the control of Spodoptera mauritia in 1953, BPH in Amparai in 1974.

The Department of Agriculture invites tenders annually for the supply of pesticides. The successful tenderer has to supply the Agricultural Officer (Supplies), who in turn issues the agrochemicals to the districts as and when the need arises. The Department further popularises the use of pesticides recommended by its Research Division, by making them available at the Agricultural Productivity Centers (APC). Approved pesticides are sold through the APCC. The APCC have now been renamed as Agrarian Services Centers (ASC) and come under the administrative control of the Department of Agrarian Services. The ASC houses the local officers of the Rural Bank, the Department of Agrarian Services and the Department of Agriculture. The range AI and the KVS (grass root level agricultural extension worker) attached to each ASC supervise extension activities in the area.

The purchase and sale of pesticides is being handed over to the Department of Agrarian Services (DAS). This Department is headed by a Commissioner of Agrarian Services. The structure of the DAS is as follows:-

Commissioner of Agrarian Services (1)
Deputy Commissioner of Agrarian Services (2)
Assistant Commissioner (at the district level) (34)
Divisional Officers (at the ASC level) (243)
Cultivation Officers (4500)

At present there are nearly 498 Agrarian Service Centers and 243 D.OO. A D.O. may cover 2 or more ASCC. The Agrarian Service is advised by the Department of Agriculture on the type of pesticides to be purchased and sold at the ASC.

Under a newly instituted scheme, the Cultivation Officers who function under the Divisional Officers of the Department of Agrarian Services, are issued with knapsack sprayers. These are made available to the farmers for their use free of charge.

Newly recommended pesticides and application techniques, information on which is provided by the PPO to the districts, are demonstrated in the field by the AIPP. The AIPP in consultation with the PPO and the DAEO selects the areas and lays out demonstration plots. Under the Training & Visiting (T&V) system, the contact farmer has become the focal point of most promotional activities. The field days and demonstrations are followed up with farmer training classes, where the message is conveyed to the farmers.

In pest prone areas, when the DAEO feels that there is a promising pesticide, he may invite the marketing organisation to conduct demonstrations in his district in order to popularise the use of the pesticide.

The Young Farmers Clubs (YFC) organised by the Division of Agricultural Extension, recruits its members from among the farming youth and schoolgoers who are inclined agriculturally. Agricultural matters including crop protection topics are discussed at the YFC meetings. The YFCC hold rallies and exhibitions, where the display of pesticides also occupies a prominent

place. In the past many private pesticide organisations participated, as well as donated prizes at such exhibitions organised by the Department of Agriculture. The presentations usually consisted of the products marketed by them, e.g. pesticide applicators, pesticide packs.

The Department also organises radio quiz programmes and competitions among YFC and other farmer organisations. Questions pertaining to pest and disease management,form a part of these competitions. Organisations like the YFC involve in carefully supervised agricultural projects and competitions, in which the use of pesticides forms an integral part, e.g. home gardens competition, banana cultivation competition.

The Field Trials Division of the Agricultural Research Division, conducts demonstration cum experimental trials in selected parts of the Island. This helps to create an awareness among the farmers of the practices recommended by the Department. To-date their activities have been confined to the testing of rice varieties and fertilizers.

The Field Trials Division functioning under an Agricultural Officer of the Division of Agricultural Extension, conducts an extensive 'minikit' programme. Minikits distributed to farmers contain seeds of an assortment of rice varieties, samples of pesticides and small quantities of fertilizers. The cultivator tests these in small plots in his field and selects for his use the combination of inputs that give the best results.

The Plant Protection Officer and the Division of Education and Training provide the field extension staff with information on crop protection and pesticides, through circulars, bulletins and newsletters and by way of regular inservice training courses conducted pre-seasonally and during the season.

5.b2. The Plantation Sector

The major crops of the plantation sector are tea, rubber and coconuts.

Plantation Crops and extent of cultivation

Crop	Acreage (hectares)
Tea	258,000
Rubber	227,000
Coconut	250,000

The plantation industry is serviced by three major institutes - the Tea Research Institute (TRI), the Rubber Research Institute (RRI) and the Coconut Research Institute (CRI). In addition, the Cashew Corporation for the cashew industry.

These institutes have comparable divisions for extension and promotional activities, though their scope and magnitude is limited. This may be due to the small number of cultivators involved in the plantation sector and the comparatively high degree of personal relationship often found between the cultivators and the personnel of the Institutes. Journals and Advisory Bulletins issued by the institutes serve as excellent promotional material as the literacy level among the cultivators in the plantation sector is high.

5.c. Fiscal Policies affecting sale prices

Up to October 1962, agrochemicals were more or less freely imported into the country. But in 1963, the Controller of Imports and Exports allowed 42 importers to import Rs.5,229,100/- worth of agrochemicals. This was with a view to conserve foreign exchange. This restriction led to a vehement protest by the importers. As a result, the Minister of Agriculture, Lands, Irrigation and Power appointed a committee to draw up a list of "drugs, chemicals and proprietary preparations required for use in agriculture". The committee comprised of the Deputy Director of Agriculture

(Research) as Chairman, representatives from Tea Research Institute (TRI), Rubber Research Institute (RRI), Department of Agrarian Services, the Entomologist, Pathologist and Agricultural Officer-Salvinia (Secretary) from the Department of Agriculture.

This committee, submitted a "Report of the Formulary Committee for agrochemicals" to the Minister on 18.11.64 along with a list of 15 approved importers, and the names of agrochemicals selling under the following categories:-

Insecticides and acaricides	..	26
Fungicides	..	19
Weedicides	..	17
Rodenticides	..	02
Fumigants	..	03
Molluscide	..	01

This committee was of opinion that the use of agrochemicals should be encouraged and a policy of strict import restrictions should not be applied.

This Formulary Committee for agrochemicals called for an estimate of agrochemicals from 15 importers in respect of 1965. The importers estimated Rs.14.27 millions. The committee approved as follows:-

Agrochemical requirements for 1965
(C.I.F. value in Rupees)

Agrochemicals	C Tea	R Rubber	O Coconut	P S Paddy and other field crops	Total Va
Weedicides	1,000,000	200,000	75,000	350,000	1,625,000
Insecticides	1,200,000	8,000	90,000	600,000	1,895,000
Fungicides	2,800,000	1,750,000	10,000	30,000	4,590,000
Fumigants and others	200,000	17,000	-	20,000	237,000
Total	5,200,000	1,975,000	175,000	1,000,000	8,350,000
Distribution among crops	92.3%	23.6%	2.1%	12%	

Value of imported material required for local formulation	200,000
	8,550,000

(Source: Ministry of Agricultural Development & Research)

Over the years, the committee copted representatives from the Ministry of Health, Ministry of Industry and Scientific Research, Sugar Corporation, River Valleys Development Board, Controller of Imports and Exports and the Plant Protection Officer of the Department of Agriculture. Presently it functions in the Ministry of Agricultural Development and Research.

As for 1978, the Formulary Committee approved the total value of Rs.36,000,000/- for import of agrochemicals, in terms of foreign exchange:-

Foreign Exchange Allocation for Import of Agrochemicals - 1978.

Numbers	Items	Value in Rupees
42	Insecticides	10,600,000
30	Fungicides	11,400,000
24	Herbicides	11,000,000
02	Acaricides	3,000,000
02	Nematicides	
03	Rodenticides	
02	Fumigants	
01	Molluscide	
		36,000,000

Of this Rupees 20 million was allowed for direct imports of formulated products by the 15 importers, and Rupees 16 million for local formulation by 5 of the importers.

(Source: Ministry of Agricultural Development and Scientific Research).

5.d. Government sponsored training

5.d1. The Division of Agricultural Education, Training and Information was created in 1977 to streamline agricultural education among professional agriculturists and agricultural teachers. Originally, this body was part of the Division of Agricultural Extension of the Department of Agriculture. It is assumed that knowledge imparted through this division would ultimately seep down to the farming community, thereby increasing farm efficiency.

Students passing out of high schools, with Science subjects and who wish to take to agriculture as a career, are trained at the following sixteen farm schools, run by the Division of Agricultural Education and Training:-

District	Location	Capacity (No. of students)
Jaffna	Thirunelvely	52
Jaffna	Kilinochchi	50
Vavuniya	Vavuniya	50
Kurunegala	Mariyapola	50
Matale	Pelwehera	49
Kegalle	Wagolla	18
Ratnapura	Karapincha	25
Colombo	Horana	30
Colombo	Walpita	105
Colombo	Ambepussa	50
Galle	Labuduwa	49
Amparai	Malwatta	20
Badulla	Bibile	50
Batticaloa	Karadianaru	25

(Source: Division of Agricultural Education & Training. Department of Agriculture, Peradeniya).

Plant protection is included in the syllabus. Graduates of these schools are eligible to apply for the post of KVS in the Department of Agriculture.

The School of Agriculture at Kundasale in Kandy district provides a two year career course and the graduates are awarded a diploma. This course covers a wider range of subjects, which include Plant Protection. Graduates of this diploma course may be considered for the post of Agricultural Instructors

in the Department of Agriculture or similar posts in allied State bodies like Tea Research Institute, Rubber Research Institute, Coconut Research Institute, Land Commissioner's Department, etc.

In-country inservice training courses are conducted for all levels of officers of the Department of Agriculture at the three Regional In-Service Training Institutes located at Maha Illuppallama of Anuradhapura district, Gannoruwa of Kandy district and Bindunuwewa of Badulla district. Here too, knowledge in plant protection is imparted. The plant protection course at these institutes are conducted by Subject Matter Specialists (SMS - degree holders of a University) and trainers. The trainers are experienced Agricultural Instructors who have been trained abroad. Experienced research personnel from Division of Entomology, Pathology, Herbology, Nematology and officers of the Plant Protection Service are also invited to address the trainers:-

Number trained at the In-Service Training Institutes on Plant Protection.

Year	Gannoruwa		Maha Illuppallama		Bindunuwewa	
	Dept. Officers	Others	Dept. Officers	Others	Dept. Officers	Others
1974		17	14			
1975	67	-	7	-	-	2
1976	112	84	25	-	27	24
1977	55	72	1			
1978	122	-	23			

(Source: Division of Agricultural Education, Training and Information. Department of Agriculture, Peradeniya).

SMOO (PP) operating at the district level are given at least one refresher training course annually (Please refer to annexure No.). The lecturers in Plant Protection of Farm Schools and School of Agriculture also follow

such courses.

In-Service trainings have been recently launched for members of the Sri Lanka Administrative Service, whose functions are closely linked to agricultural and rural development.

School children, school teachers, youth farmers and new settlers of State Colonisation Schemes are other categories of people, who are trained at the In-Service Training Institutes.

The Farm Machinery Training Centre at Puliyankulam of Anuradhapura district provided In-Service training for State Agricultural Officers and farmers in the maintenance and operation of pesticide applicators:-

Plant Protection Trainings at F.M.T.C. Puliyankulam

Year	Dept. Officers	Others	
		Officers	Farmers
1971	35	Not available	Not available
1972	23		
1973	33		
1974	5		
1975	35		
1976	195		
1977	11	8	59
1978	30	6	43

(Source: Division of Agricultural Education and Training. Department of Agriculture, Peradeniya)

The Agricultural Information Division, Colombo, and the recently established Documentation Centre, Peradeniya, are two arms of the Division of Agricultural Education and Training which publish journals, periodicals, newsletters which give pride of place to Plant Protection (Please see annexure No.).

5.d2. In the districts, Agricultural Extension Officers of the ranges are subjected to intensive training once a fortnight. This training is the responsibility of the Subject Matter Officers of the District Agricultural Office. They follow a schedule, whereby they visit each range in rotation.

It is mostly discussions on current plant protection problems and other aspects of agriculture. In special instances, as in pest prone areas, officers from the Plant Protection Service Headquarters conduct special trainings in the districts.

The Range A.I., in turn, along with his K.V.SS. organise farmer training classes where A.CO. and S.M.CO have a free exchange of views on the demonstrations conducted in farmers fields, and problems pertaining to plant protection. Such discussions provide a feed back from farmers to the officers of the Department of Agriculture.

5.d3. The Plant Protection Service conducts regular refresher courses for the 24 Subject Matter Officers Plant Protection. These seminars are of one to two weeks duration. Ten such courses have been conducted to-date. The aim is not only to refresh their memory, but also update their knowledge on current developments in plant protection.

The S.M.CO. (PP) are serviced by bulletins prepared by the Plant Protection Officer. (Please see annexure No.).

5.d4. The Plant Protection Service, in association with the Division of Agricultural Education and Training has recently embarked on an ambitious plan to train pesticide retailers in the handling and sale of pesticides. (Please see annexure No.).

5.e. State Research Facilities

5.e1. The Department of Agriculture

The Division of Agricultural Research of the Department of Agriculture may be regarded as the primary research body servicing the peasant sector. It has a total cadre of 120 Research Officers and 60 Experimental Officers.

24 Agroclimatic regions have been identified in Sri Lanka. These regions differ sharply from one another in their soil type, rainfall pattern and other agro ecological perimeters. The logical conclusion one would arrive at, is to decentralise research into the agro-climatic zones.

At present there are five major Regional Research Centres, three of which have been equipped to satisfactory levels. In addition to these, there are 7 Agricultural Research Stations and 6 Experimental Stations. The National Rice Breeding Centre is located at Batalagoda. The institutes, their staff position and the purpose for which they are established are given below:

Location	Research Officers	Experimental Officers	P u r p o s e
Regional Centres			
Gannoruwa	32	19	Rice, Vegetables, Fruits, Legumes, Yams and Tubers
Maha Illuppallama	24	04	Rice, Coarse grains, grain, legumes, oil and fibre crops and vegetables.
Bandarawela	09	01	Rice, other cereals, grain legumes, yams and tubers, condiments and vegetables.
Angunukolapelessa	08	03	Coarse grains, grain legumes, cotton and vegetables.
Bombuwela	05	01	Rice, yams and tubers
Batalagoda	06	01	Rice breeding.
Research Stations			
Sita Eliya	07	05	Potatoes, vegetables.
Thirunelvelly	04	04	Specific soil region
Paranthan	03	02	Rainfed rice.
Bentota	00	02	Bog and half bog soil
Kapalana	01	01	Minor export crops.
Vanathavillu	00	00	Coarse grains, grain legumes, oil and fibre crops and vegetables.
Karidian Aru	00	01	Rice.
Alutharama	00	00	Coarse grains.

Research Stations (contd.)

Ambalantota	01	00	Irrigated rice
Rahangala	01	00	Fruits and vegetables
Labuduwa	00	00	Rice
Kilinochchi	01	01	Coarse grains, grain legumes and vegetables.
Walpita	01	00	Horticulture.

The sub-stations are linked to their respective Regional Research Centres. 42 Departmental Stations are distributed throughout the Island. These are available for adaptive research trials whenever necessary. Under normal circumstances, they are utilised for the production of seed and planting material.

Research and investigations in Plant Protection is conducted in seven of these Research Centres. The number of personnel involved directly in plant protection is as follows:-

Field	Research Officers	Experimental Officers	Laboratory Technic
Entomology	12	05	05
Pathology	12	03	05
Herbology	04	-	-

Each Centre or Station handles plant protection problems specific to the region. Applied research is directed towards the screening of varieties for pest tolerance, screening of pesticides, determining effective dosage rates, etc. Basic research is conducted in the form of pest and disease surveys, pest population monitoring, weed composition surveys, defining economic threshold values, etc.

Coordinated rice varietal trials (CRVT) are conducted in observation plots, located in various parts of the Island. Research personnel working in diverse fields like breeding, plant protection, food technology etc. pool their efforts to select rice varieties best suited to each region. The CRVT is conducted by the Division of Agricultural Research.

Research programmes supported partly by foreign assistance are in operation

at the moment. Some of the foreign agencies associated in local research projects are the IRRI, ICRISAT, IDRC, CIDA, USAID and UNDP. Under the IRRI blast nursery programme, many accessions are screened for blast tolerance. Conversely, many cultivars from Sri Lanka have been entered for BPH screening at the IRRI. The TPI laboratories in England is assisting Sri Lanka in the isolation of sex pheromone of Cnaphalocrocis medinalis. Through co-operative arrangement with international agencies, aid in the form of equipment, literature and foreign exchange have been obtained to improve the quality of local research.

The pesticidal laboratory installed in the Chemistry Division of the Central Agricultural Research Institute, Gannoruwa, was equipped through aid obtained from the West German Agency for technical co-operation. The unit, equipped with two GLC machines has commenced formulation evaluation and residue analysis of pesticides and agricultural produce from 1975. The laboratory is capable of analysing the following pesticides for their active ingredient and physical properties:-

Aldrin	Dicofol	Formothion
BHC	Dimethoate	Malathion
Carbaryl	Endosulfan	Heptachlor
Carbofuran	Endrin	Parathion Ethyl
Chlordane	Fenitrothion	Paraquat
DDT	Fenthion	2,4-D (Methyl ester)
	M.C.P.A.	2,4,5-T (Methyl ester)

It has conducted todate residue analysis for chlorinated hydrocarbons in 405 samples of vegetables, fruits, water and milk. Methods for the analysis of organo-phosphorus and carbamate residues, are yet to be perfected. A total of 141 samples of formulations have been tested so far. The laboratory also possess a TLC apparatus. The foreign aid component also allows for the training of officers in advanced plant protection techniques in foreign

institutions. Three research workers in the Entomology Division and two in the Pathology Division hold doctoral qualifications. Six officers are at present abroad undergoing post-graduate training.

Library facilities for plant protection research are not adequate.

5.e2. Research Institute of the Plantation Sector

The Tea Research Institute has its Headquarters at Talawakelle. Sub-stations are found in Kottawa, Ratnapura, Passara and Hantane.

Research at present is mainly centered around the following projects:-

Shot Hole borer
Tea Tortrix
Termite
Blister Blight

The staff composition of the plant protection divisions of the T.R.I. is as follows:-

Division of Entomology and Nematology

Entomologist	1
Research Assistants	4
Experimental Officers	3
Technical Assistants	6
Laboratory Assistant	1

Division of Pathology

Pathologist	1
Research Assistants	3
Experimental Officers	2
Technical Assistant	1
Laboratory Assistant	1

The Division of Entomology and Nematology is associated in an international nematode survey programme. The T.R.I., working in collaboration with foreign institutes, has succeeded in isolating the sex pheromone of Homona coffearia.

Work with the pheromone is in progress. The T.R.I. is equipped with a GLC apparatus for detecting residues in the made tea.

The Rubber Research Institute is located in Agalawatte with two sub stations at Nivitigala and Kuruwita. Mainly field trials are conducted at the sub-stations, under the supervision of the research officers from the RRI. There are two research officers engaged in plant protection.

The Coconut Research Institute is located at Lunuwila with sub-stations at Madampe, Pallama, Rajakadaluwa, Kudawewa, Walpita and Lunuwila. Coconut nurseries have been established in 15 locations, from where pest free, quality seedlings are distributed to the public. The Crop Protection Division of the CRI is headed by the Crop Protection Officer who is chiefly engaged in pathological work. He is assisted by 3 Research Assistants who are mainly engaged in Entomological research. The supporting staff consists of an Extension Officer, 4 Technical Assistants, 1 Senior Field Assistant and 4 Field Assistants.

5.e3. Facilities at other Institutions.

Reasonable research facilities and trained staff are also available in the following institutes:-

The University of Sri Lanka
The Government Analyst Department
The Medical Research Institute
The Sri Lanka Institute for Scientific & Industrial Research.

6.b. Private sector promotional programmes

Private establishments engaged in the formulation and marketing of agricultural chemicals, invest a fair deal of money on advertisement and sales promotion. The public and the farming community in particular are informed of their products through advertisements in the papers. Radio spots and film slides are other means of mass media advertisements. The

radio advertisements may be either spots lasting for 15-45 seconds repeated at intervals, or feature items like a musical or dramatical interlude, lasting for 10-15 minutes, broadcast once a week. Most of the advertisements are timed to coincide with the cultivation season or a pest outbreak period. One particular company has recently imported a mobile cinema cum propaganda unit for its promotional activities.

Colourful posters are displayed at the retail and wholesale outlets. These posters either concentrate on a single product or advertise a range of products marketed by the establishment concerned. The Agrarian Service Centers and multi-purpose co-operative societies as some of the vantage points where posters are displayed.

Some companies conduct field demonstrations in farmers' fields to canvass for their products. Usually these are done in consultation with the officers of the District Agricultural Extension staff, in order to gain their goodwill and acceptance. Suitable sites are selected to give as wide a publicity as possible. Farmers in the neighbourhood are encouraged to attend these field demonstrations. In some areas, the sole distributor for the establishment of that area bears the expenses of the demonstrations. Sample packs of the products may be distributed during the demonstration among the farmers for testing. Pamphlets on the products are also distributed.

All these forces are brought into play, especially when introducing a new product. The main idea is to get the name of the product established. Boards are erected prominently in demonstration areas to familiarise the farmers with the product. The fantastic sales of Rogor(R) in Sri Lanka owes its success to establishing its name. In most of the vegetable growing areas of Sri Lanka Rogor(R) has become immensely popular, so much so that even local decoctions of sub-standard material sold under the same name have no difficulty in finding consumer acceptance, in spite of their poor performance in the field.

Small packs are in high demand. The farmer prefers a small pack costing from Rs.7 - 14/-, to a bigger pack which may cost from Rs.45 - 70/-. The reason is that the monthly income range of 80% of the rural households in Sri Lanka is less than Rs.400/-. As a result, most farmers favour a small pack. The marginal profit from smaller packs is lower, yet many companies market a fair proportion of their products in small packs to promote their use. Companies are also known to employ 'psychological warfare' tactics, where they take advantage of the farmers preference for pesticides with a pungent garlic odour, short squat containers instead of tall thin bottles, pesticides which enhance the green colour of the foliage, etc.

The basic principle underlying these manoeuvres is to create an awareness and consequently a demand for the pesticides at the farmer level. Once the demand is created, dealers in the farming areas are contacted by the companies and are offered sufficient incentives to sell their products. Most companies provide credit facilities to their sole distributors, wholesale distributors and established customers, the credit period being generally less than one month. Discounts given to the sole distributors vary from 15-25%. Usually the wholesaler passes half the discount to the retailer. The sole distributor and retailers rarely extend credit facilities to the customer.

Some establishments employ regional advisers in areas with high sales potential to intensify promotional activities. The advisers identify marketing problems and ensure an unhindered supply of the products. Regional depots may be sometimes constructed to facilitate timely delivery. Delivery vans, operated directly by the company or its sole distributors, deliver the goods to the door-step of the retailer.

Whatever methods are employed by the private sector, ultimately it is the retailer on whom the success of sales promotion rests. The reason is that the retailer is not only the connecting link but also the constant

link with the farmer in the marketing chain. Once the retailer gains the confidence of the farmer, thereafter he becomes his "friend, philosopher and guide". It is seen from experience that not less than 5 out of 10 farmers rely on the retailer for advice on pesticide use. An efficient retailer can easily convince his customers and promote the sales of a particular pesticide. As to which products he may canvass, of course, would depend mainly on the commission he receives.

The members of the multi purpose co-operative societies (MPCS) play a decisive role in the promotion of pesticide use. A part of the cultivation loans passed by the State banks are channelled to the farmers through the MPCSS. The farmers obtain a part of this loan in kind as fertilizers and pesticides from the MPCSS. The members of the MPCS are advised by the officers of the district agricultural office on the type of pesticides recommended by the department. But the final decision on the type and quantum of pesticides to be purchased rests with the MPCS. Since farmers are compelled to buy whatever is available at the MPCS, the decision of the society Manager directly or indirectly affects the sale of pesticides.

Executives and representatives of the pesticide establishments maintain regular contact with the Research, Extension and Educational personnel of the Department of Agriculture and Institutes catering for the plantation sector. This contact helps them to gauge the current line of thinking and chart out their course of action, for the expansion and promotion of their products in the future.

An easy means of gaining advertisements for one's products is to get them included in the recommendations of the State Agricultural Research Bodies. For this, the marketeer has to submit samples of his products for

intensive screening by the research staff. Once the product is accepted and recommended, the State propaganda machinery forms an additional prop to the promotional activities of the establishment.

Similarly, pesticide marketing establishments tender for applications called by the State, for the supply of agro pesticides. The successful tenderer becomes the supplier of pesticides to the Department of Agriculture or the Institute of the plantation sector. In the event of a pest outbreak, the supplier has to provide immediately the extension officer of the affected area with the tendered chemical. The farmers in the area will be advised by State Officers to use that particular product.

6.d. Private sector educational programmes

The staff of most pesticide establishments in Sri Lanka are equipped with a fair proportion of personnel with agricultural education (either at the degree or diploma level). This trend of recruiting agriculturally trained people has become more and more apparent in recent times, and some of the well established companies owe their success to recruiting experienced hands from the Department of Agriculture. Even in the selection of field canvassers and sales representative, preference is given to agriculturally trained people. But, unfortunately, once pressed into service, they tend to become totally sales motivated; as a result, most pesticide establishments have neither the time nor the interest to conduct educational programmes for the dealers and farmers. Secondly, a knowledgeable farmer or dealer may not always be to the advantage of the establishment. Possibly these are some of the reasons that may have prevented pesticide companies from embarking on an educational programme to improve the efficient use of their products.

Little basic research is conducted by the local establishments on the

product marketed by them. Basic information is supplied to them by their principals abroad. Based on such intelligence, local firms produce advisory leaflets for their distributors and customers. Typically an advisory leaflet contains information on the active ingredient, its composition, the range of pests controlled by the product and the crops on which it could be used, the dosage recommended, safety precautions and the action to be taken in case of accidents. (Please see annexure No. for a sample of advisory leaflets). The advisory leaflets may be considered as the only means of educational material from the marketing agencies available to the dealers and farmers.

The issue of advisory leaflets has become so routine that dealers and farmers hardly ever read them at all. More often, they refer to the instructions on the container label, which gives only the bare minimum information. The pamphlets are rarely issued to the farmers who make the purchase. Hence in actual practice, it may be concluded that information on the product is provided mainly by the container label. As the instructions on the label is brief, information obtained from it tends to be fragmentary.

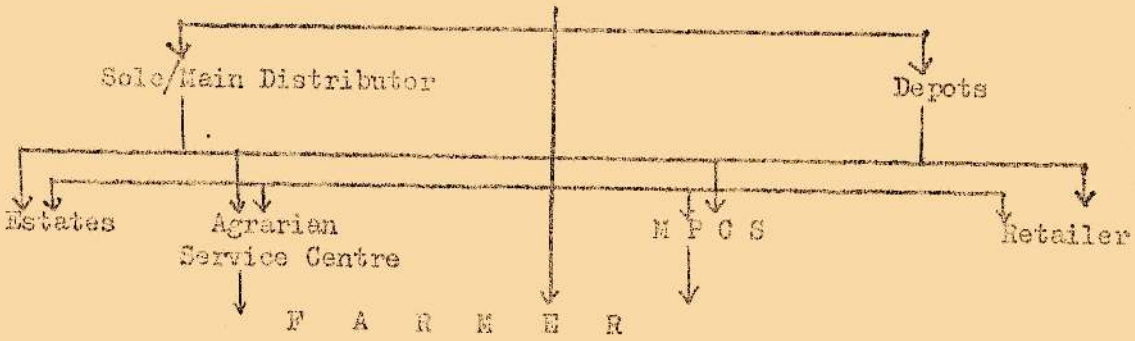
Field officers and representatives of pesticide establishments spend a fair deal of their time in discussions with their dealers and occassionly with farmers. The educational value of such intercourses is, however, limited, since they will naturally be biased towards the product.

7.a. Organisation of the distribution network.

Big pesticide establishments retain main or sole distributors in each district. Sometimes there may be 2-4 main distributors per district; on the other hand, one sole distributor may cater for more than one district. A few establishments operate regional depots, from where stocks are delivered to the retail points.

The main distributor in turn supplies the wholesalers, retailers and private estates in his district and also the Government agencies like the Agrarian Service Centers, Multipurpose Co-operative Societies and estates vested with the State (estates of the Sri Lanka State Plantation Corporation and Janatha Estates Development Board). Where depots are available, they may assist in the distribution. If they wish to, the retailers and Government agencies may obtain their requirements directly from the establishment.

GENERALISED FLOW CHART OF PESTICIDE DISTRIBUTION



7.b. Sales or market forecasting

All pesticide marketing establishments seem to practice some form of sales forecasting system. In the majority of cases, the sales in previous years form the basis on which forecastings are made. Other factors taken into consideration while planning for future sales are:-

1. Price of the products
2. Status of competitive products
3. Financial position of the farmers
4. The acreage under cultivation
5. The availability of irrigation facilities
6. The extent of sales promotion activities
7. Pest incidence
8. State policy.

It is difficult, if not impossible, to forecast the needs of the future without years of experience. Almost all the marketing firms in Sri Lanka import their products from their principals abroad. Most of the companies repack and sell the products, while some with formulation facilities prepare the formulation from the imported active ingredient solvents and emulsifiers. An over-estimate of requirements may result in slow movement of the product and increased overheads; while an under estimate may result in losing the market to competitive products.

8.a. Major pests and diseases

8.a1. Tea is the major earner of foreign exchange for the country. The shot hole borer (Xyleborus fornicatus) is an important pest in the mid country (elevation 150 - 1300 meters). Mites are of considerable importance in the Uva district, especially during the dry season. Blister blight (Exobasidium vexans) causes serious damage to the flush and young shoots of tea grown at elevation above 914 meters. The disease is particularly serious during periods of wet weather and overcast skies. Rubber is not attacked by any insect pest of economic importance. The most destructive disease of rubber is the leaf mildew (Oidium heaveae), which is prevalent in the Matale and Uva districts. The root diseases, specially the white root disease (Fomes lignosus) are gaining in importance.

The coconut leaf miner (Promecotheca cumingi) was the cause of a major epidemic eight years ago in the western part of the Island. At present it appears sporadically in isolated pockets. The coconut caterpillar (Nephantis serinopa) endemic in the eastern and southern sectors and in pockets of western and north-western sectors of the island causes serious destruction to the foliage. Subsequent to the recent cyclone disaster of 24 November 1978 in the Batticaloa district of the eastern coast, and the rotting of many fallen stems, the black rhinoceros beetle (Oryctes rhinoceros) may become

a major threat to the industry in the future. The coconut leaf scorch of unknown etiology is being increasingly reported from several areas of the coconut triangle.

Rice dominates the peasant farming sector and is grown in well over 680,000 hectares of land. The major pest of rice at present is the brown plant hopper (Nilaparvata lugens). It is found island wide, but is more serious in the eastern district where rice cultivation is staggered under the Gal Oya scheme. The leaf roller (Cnaphalocrocis medinalis) appears at all stages of the crop growth, causing much damage to the foliage. The rice bug (Leptocorisa acuta) is a cosmopolitan pest. The gall midge (Orseolia oryzae) is common in boggy soils; it is gaining prominence in tracts falling under the major irrigation schemes, where water management is of a low standard. The rice thrips (Baliothrips biformis) is severe in rice fields sown out of season. Similarly, the rice pentatomid (Scotinophora lurida) which used to be a serious pest in the southern districts is of little importance at present, but is making its appearance under the Iranamadu scheme in the north.

The Anguomois moth (Sitotroga cerealella), the grain weevils (Sitophilus sp.) and the lesser grain borer (Rhizopertha dominica) are important pests of rice in storage. Very little grain is stored at the farmer level except for seed purpose. The State owns the monopoly for the purchase of rice and it is stored in the State godowns. The bumper harvest expected and given inadequate storage space in the godowns, storage pests are bound to cause serious problems in the future.

The Onion caterpillar (Spodoptera exigua) is the most serious pest of onions and is restricted to the Jaffna peninsula in the north. It is an internal feeder of the foliage and resistant to most of the synthetic

organic pesticides. This pest will, in future, limit the acreage under onions during the March-July season.

Tur Dhal (Cajanus cajan) cannot be economically grown in this country due to the incidence of the pod borer complex. Cabbage grown in the vegetable growing areas of Nuwara Eliya and Kandy of the hill country is annually exposed to damage by the Diamond back moth (Xylostella maculipennis). The pest locates itself on the under surface of the leaves and is not easily accessible to chemical sprays.

The brinjal (egg plant) shoot borer (Leucinodes orbonalis)is a persistant pest of both the up and low country. Ineffective control at the shoot stage leads to severe attack by the pest at pod development.

The pulse beetle (Callosobruchus maculatus) causes great damage to stored green gram and cowpea. Over the last two years, large consignments of these pulses stored in the Government seed stores had to be rejected due to pest attack.

8.a2. Damage to cereals by diseases is negligible. Neck blast (Pyricularia oryzae) is frequently reported from sandy tracts like Kilinochchi and from highlands where traditional varieties of rice are raised as rainfed crops.

Damping off induced by species of Pythium, Rhizoctonia, and Macrophomina is common in the vegetable nurseries. Irish potato grown at the higher elevations of Nuwara Eliya is commonly attacked by late blight (Phytophthora infestans),but not on the crops of the Jaffna peninsula where it is grown at sea level. Anthracnose (Colletotrichum capsici) and the resulting die back phase, is of frequent occurrance in most chilli growing areas. Brown spot (Alternaria longipes) is frequently noticed in the tobacco crop.

Virus diseases, especially the mosaic and leaf curl diseases, infecting solannaceous crops are important. Potato grown in Nuwara Eliya is subject to considerable infection by potato viruses. The aphid transmitted mosaic of the pumpkin (Cucurbita maxima) has spread rapidly to most parts of the island.

8.a3. The perennial weed Imperata cylindrica is a problem in the tea plantations. It has attained pest status as a result of the regular surface weeding of the tea soils with the 'surandi' (a hand scraper). Weeds are also a serious problem in the cultivation of shallot onions, where the thin crop canopy favours rapid growth of weeds during the early stages of crop growth.

Echinochloa crusgalli possess a serious problem in the rice fields of the major irrigation schemes found in the Anuradhapura district. This problem may have arisen as a result of the continued use of MCPA alone; it is also possible that the pest is a new weed biotype.

Eupatorium odoratum, Cordia curassavica and the nut grass are weeds found growing extensively in the highlands of the dry zone. Water weeds like Eichhornea crassipes and Salvinia molesta affect agriculture indirectly by blocking irrigation channels, choking waterways and increasing evapo-transpiration. Salvinia is spread over 20,200 hectares and Eichhornea over 2,020 hectares.

8. b/c. Extent of damage

The well documented coffee leaf rust epidemic (Hemeleia vastatrix) of Sri Lanka wiped out a thriving coffee industry within the span of a decade in 1891. Production declined from 565 kg. to 377 kg. per hectare causing a monetary loss of over £.1,000,000 per annum. Blister Blight took a toll of the tea industry which replaced the coffee plantings, when

it broke out in epidemic form in 1944-50. About 80,900 hectares of tea situated above an elevation of 915 meters were threatened by the disease. Promecotheca cumingi destroyed a considerable acreage of coconuts in the western seaboard in 1971, before it was brought under control by the release of the parasite Dimmockia javanica. A total extent of 10,400 hectares of coconut palms were damaged between 1971-74.

In contrast to the plantation sector, the peasant sector is characterised by a large number of smallholders, many of whom operate at subsistence levels and own fragmented holdings. The absence of systematic records in the peasant sector makes it difficult to assess, with a fair degree of accuracy, the damage caused by various pests to field crops.

A minor epidemic of the rice swarming caterpillar (Spodoptera mauritia) was recorded in the Polonnaruwa district of the North Central Province in 1953. It was brought under control by the aerial spraying of insecticides sponsored by the Government. The only epidemic of any significance in the peasant sector was the outbreak of the brown hopper (Nilaparvata legens) in 1974. The pest spread to approximately 14,160 hectares of rice in the eastern coast and completely destroyed 2,833 hectares. Aerial spraying was again employed for its control.

The stored pests collectively inflict a loss of 5-10% on the grains and pulses held in storage.

The onion leaf caterpillar is so serious in the Jaffna peninsula and its control uneconomical that many farmers have ceased to cultivate shallot onions during the March-July season.

Shallot Onion cultivation in the Jaffna Peninsula

Year	Season	Extent (hectares)	Yield (tonnes)
1975	March - July	2,024	38,120
1976	"	1,942	26,980
1977	"	1,257	15,990

(Source: Division of Agricultural Extension)

Similarly, cultivators in many areas of the Jaffna peninsula and in up-country dry zone areas like Bibile and Badalkumbura have abandoned the cultivation of tobacco, due to the heavy incidence of mosaic and leaf curl diseases.

Tobacco extent and yield in Bibile and Badalkumbura

Depot	Year	Extent (hectares)	Yield (tonnes)	No. of Barn owners
Bibile	1973	144.00	75.01	26
	1977	40.50	22.60	16
	1978	15.40	7.62	08
Badalkumbura	1973	433.00	159.20	114
	1977	74.00	20.10	48
	1978	7.5	3.556	05

(Source: Agricultural Officer, Tobacco)
Dept. of Agriculture, Peradeniya.

Likewise, one can predict a marked reduction in the present extent cultivated under chillies, if the prices continue to fall due to the importation of chillies ; the main reason is the incidence of virus diseases, which make chilli cultivation uneconomical at low market prices.

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Pumpkin vines prove to be uneconomical and unproductive after infection by the pumpkin mosaic virus.

8.d1. Pest control recommendations for the plantation sector

Pesticide recommendations for the plantations crops are issued by the three research institutes - TRI, RRI and CRI.

The TRI recommends the use of "safe" insecticides like Fenthion combined with judicious pruning for the control of the shot hole borer. A sex pheromone trap has been developed for monitoring the tea tortrix population and an economic threshold value established. This enables cultivators to economise on pesticide use.

A disease forecasting system, based on changes in ambient factors and the growth pattern of the plant, has been formulated by the TRI and the RRI, for the control of the tea blister blight (controlled by spraying fungicides containing 50% metallic copper) and the rubber mildew disease (controlled by sulphur dusting).

The RRI recommends the cultivation of rubber below an elevation of 800' in order to avoid the oidium disease.

The CRI depends heavily on biological means of insect control. It has its parasite breeding laboratories in Lunuwila, Mylamba-veli and Colombo. Collections made from coconut estates locally as well as imported parasites are bred in the laboratory. These are mailed to cultivators in affected areas for release. The coconut leaf miner (Promecotheca cumingi) and the caterpillar (Nephantis serinopa) were brought under control in the western province by employing biological means of control.

Due to the small number of cultivators involved in the plantation sector, there is greater communication between the planters and the servicing institutes. As a result, the recommendation of the Institutes

are followed more or less 'in toto' by the cultivators. Planters on their own consult the institute frequently before taking any action. (Please refer to annexure No. for the recommendations of the TRI, RRI and CRI).

8.d2. Pest control recommendations for the peasant sector

The Department of Agriculture services the peasant farming sector. It adopts an integrated approach towards the control of pests and diseases. But it has been observed that the peasant cultivator tends to gravitate more towards the use of chemicals, at the expense of the other methods recommended by the Department, viz. Mechanical, Agronomic, etc.

The Department of Agriculture does not possess adequate manpower to handle the vast and spatially distributed peasant sector. About 28 Research Officers and 7 Experimental Officers distributed in 7 research centers conduct research into plant protection problems. On the Advisory and Extension side, there are in addition to the District Head Office staff, of whom mention was made earlier, 421 Agricultural Instructors operating in the ranges. Below the range Agricultural Instructors are the grass root level extension workers - the K.V.S., who number 1,683. With an estimated farm family total of 1,427,000, a K.V.S. has to cater for nearly 700 farm families distributed over an average land area of nearly 31.6 sq. kilos. This situation does not permit an intimate association between the Department and the sector it services. The T & V system of Agricultural Extension has been introduced to solve to a certain extent this critical gap in communication.

In most areas it has been observed that farmers, who are visited by officers of the Department of Agriculture, act according to the advice of the Agricultural Instructor or the KVS. But the number of farmers with whom the extension workers come into contact is only a minute fraction of the community. This results in the recommendations of the department not

being observed in its's full entirety in most places. (Please refer to annexure No. for the pesticidal recommendations of the department. Also refer to copy of the publication 'Plant Protection Manual' for chemical and non-chemical recommendations).

Where guidance from the department is lacking, the farmer usually turns to his neighbours, or the village pesticide retailer for advice. The pesticide dealer naturally would canvass for the use of pesticides on any occasion.

8.e1. Actual control measures adopted by farmers

It is observed that in general the use of pesticides has taken precedence over the other methods of pest control. This is in part due to the effective sales promotion drive undertaken by the establishments manufacturing pesticides and their retailers. It is but in rare instances, as in the case of shallot onion cultivation in Jaffna, where through necessity (the onion caterpillar is resistant to most insecticides) cultivators resort to other measures like crushing the egg masses, destroying infested leaves, operating light traps, etc.

8.e2. Pest protection measures are more consistently followed in areas like Nuwara Eliya, Welimada, Jaffna, Kandy and parts of Matale, where intensive cultivation is practised. The reason is that these farmers try to maximise their output from the small land holdings (0.1 - 0.2 hectare), which are a characteristic feature of these areas. In the very small holdings, a fair deal of attention is paid to crop sanitation e.g. removal of diseased leaves/plants. In most of the intensively cultivated areas, an established scheme of fixed spray schedules is discernible, e.g. Beans in Kandy and Matale districts are sprayed on fixed days with Anthio or Rogor

irrespective of the presence of pests; the Kondavil area in the Jaffna peninsula is an extreme situation, where onions are sometimes sprayed daily with Ambush and Sumicidine; blanket spraying with Antracol or Miltox or Tamaron is adopted for the cabbage and potatoes raised in the hill country.

Roguing is never practised and this is one of the causes for the rapid increase in virus diseases.

8.e3. Blanket treatment is adopted in rice, potatoes and cabbage grown in pest or disease endemic areas. The department advocates the blanket treatment of rice nurseries in areas where the rice gall midge has become endemic.

8.e4. Farmers engaged in the intensive cultivation of extensive areas of rice and cash crops like tobacco and chillies, rely more or less completely on pesticides to combat pest and disease problems. For instance, in lands falling under the major irrigation schemes, where the water level in the rice fields can be regulated at will, pests like Baliothrips biformes and S. mauritia can be easily controlled by submerging the seedlings; but instead the farmers go directly for pesticides.

The Ceylon Tobacco Company which supervises the cultivation of cigarette tobacco in the island, follows a fixed spray schedule for the control of aphids, white flies, caterpillars and fungi (causing damping off). The presence of plants killed by black shank (Phytophthora parasitica) or the bacterial wilt (Pseudononas solanacearum) among a growing crop a common sight in tobacco fields, reflects the scant regard tobacco farmers pay to crop sanitation.

8.e5. Investment in pesticides is generally low in rainfed upland cultivation.

8.e6. It is only in the control of weeds that the use of chemicals has lagged behind. Weed control is achieved mainly by mechanic al or mechanised weeding, or by the control of water in lowland cultivation of rice. But the use of herbicides in rice cultivation is gaining popularity in the Anuradhapura, Polonnaruwa, Amparai, Batticaloa and Matara disctricts which are faced with labour shortage during the cultivation season. Farmers prefer to use MCPA which is cheap at 30 fluid ounces per acre, though it does not control the annual graminaceous weeds. Even in areas where Proponil is used, farmers cheat themselves by using only 1/3 the recommended quantity. Tee or flood jets are hardly used in herbicidal spraying. The use of herbicides is also gaining ground in onion cultivation, where in the traditional onion growing area, labour charges have doubled.

8.e7. A considerable amount of cultivation is practised under the shifting cultivation system, which begins with the first showers of the momsoon. The investment in pesticides, similar to the other agricultural inputs, is low under shifting cultivation. Usually crops like coarse grains, tuber crops, sesame, pulses and chillies are grown in these lands with minimal capital inputs. For instance, the following figures were obtained from farmer surveys conducted in the Anuradhapura and Vavuniya districts, where maize and cowpea were raised under shift cultivation.

District	Anuradhapura		Vavuniya	
Crops	Maize	Cowpea	Maize	Cowpea
Total cost of production (per hectare)	22.45	21.26	72.94	42.27
Agro-chemicals	-	2.25	2.60	1.07
Percentage of total cost	0.00	10%	3.5%	2.5%

In the event of pest or disease incidence, little action is taken to control it.

8.e8. The smallholders in the plantation sector, who have traditionally held only a small percentage of the total acreage under plantation crops, (18% in Tea and 33% in Rubber) usually act on the lines suggested by their respective research institutes. Favourable State subsidy schemes and fair prices for their produce, have encouraged them to adopt regular plant protection measures.

A high degree of neglect is observable in those smallholdings, specially in the tea estates, where land was recently alienated under the Land Reforms Act. The dreadful state of these smallholdings is probably due to the inexperience of the new settlers and their low capital outlay.

9. Cost of Pesticides as percent of total farm costs

C r o p	Total Cost	Agro-chemicals	%
Irrigated rice	324.64	46.48	14.3
Rainfed rice	232.11	40.67	17.5
Irrigated chillies	764.01	206.25	26.99
Rainfed chilli	344.52	37.76	10.96
Irrigated peanut	325.93	0.00	0.00
Rainfed peanut	248.98	0.00	0.00
Rainfed tobacco	600.46	26.14	4.35
Rainfed manioc	275.98	0.00	0.00
Rainfed sweet potato	396.54	0.00	0.00
Irrigated green gram	222.56	14.52	6.52
Rainfed green gram	179.71	11.62	6.47
Irrigated cowpea	207.01	29.05	14.03
Rainfed cowpea	180.86	14.52	8.03
Irrigated black gram	201.93	14.52	7.19
Rainfed black gram	170.99	11.62	6.80
Irrigated soybean	281.84	14.52	5.15
Rainfed soybean	241.88	14.52	6.00
Rainfed maize	158.24	0.00	0.00
Rainfed sorghum	176.84	0.00	0.00

(Source: Research and Seed Multiplication Stations of the Department of Agriculture. Cost in US$ per hectare)

The figures are an average value and may differ from district to district. For instance, the expenditure on pesticides and the total cost of cultivation worked out for the Jaffna peninsula is as follows:-

	Crop	Total Cost	Cost of Agrochemicals	%
Irrigated	Onion	11,536/00	460/00	3.99
Irrigated	Chillies	15,018/00	2,500/00	16.65

(Source: District Agricultural Extension Officer, Jaffna, and The Jaffna District Agricultural Producers Union).

10. Poisoning resulting from Pesticide use.

The Department of Agriculture does not encourage the use of organo-mercurial fungicides, arsenical compounds and insecticides like DDT, Heptachlor, Endrin and Parathion, on the basis of mammalian toxicity and and residue of the end product. One of the criteria employed in the selection of insecticides for agricultural use is their safety to human beings, based on their LD 50 value. Malathion has been banned for agricultural use as it is used in Malaria control and there is a fear of cross resistance.

In spite of such stringent measures, many extremely toxic chemicals continue to be imported into the island, under the liberalised import policy of the State. They are in fact widely used by farmers, e.g. Endrin in rice and Ethyl Parathion in tobacco and vegetables. The labels on all pesticide containers warn the user of the poisonous nature of the contents. In addition some labels bear the skull and crossbones symbol. Some pesticide containers display the warnings in darker letterings. The antidote to be administered in the case of accidental

poisoning is also mentioned on the label. The advisory leaflets accompanying the pesticides, detail the safety precautions to be observed while using the product.

Although a large number of deaths have occurred due to pesticidal poisoning, farmers are yet indifferent to the handling of pesticides. It is not uncommon to see a spray operator smoking or chewing betel during spray operations. Protective clothing is hardly known and, in many instances, the operator is bare bodied, save a piece of cloth around the waist. Few wash their body with water and soap as advised in the leaflets. Farmers have been observed to give scant attention to the warnings in the leaflets and few ever take the trouble to read them. In the use of some versatile chemicals like Carbofuran which have a high oral toxicity (Oral LD 50 = 11mg/kg) and inhalation toxicity, the Department of Agriculture has repeatedly requested the farmers to cover their nose and mouth with a cloth but to no avail.

Most applicators are not maintained in proper condition for want of spares and after sales service. Spray liquid dripping from leaks and joints, comes into contact with the operator's body. This is especially serious in situations, where custom spraying of Parathion (Dermal LD 50 = 7 mg/kg) is undertaken. In some areas where spraying of extensive areas is undertaken by one or a few operators on a contract basis, the ill-clad operator is exposed to the toxin for long periods. Even quite recently, nine deaths were recorded in the Polonnaruwa district, where custom spraying of extensive rice fields is very common with Parathion.

The Government Analyst has reported several cases, where death following

spraying operations was due to insecticidal poisoning. These reports, though not an accurate estimate of the total number of deaths due to accidental poisoning by pesticides, gives a fair indication of the magnitude of the problem. The number of deaths reported is as follows:-

1964	..	137
1965	..	143
1966	..	178
1967	..	152
1968	..	249

In addition, pesticides are a popular means of committing suicide. Endrin, Parathion and Paraquat are notorious examples. In the plantations the arsenicals used in weed control has been the cause of many a suicide.

SCHEDULE I

* RECOMMENDATIONS FOR THE CHEMICAL CONTROL OF PESTS AND DISEASES IN TEA.

I PESTS. Tea Tortrix	Control
1. Homona coffearia	(a) Trichlorphon 50% EC 3.2 L. in 250 l/ha. water for mistblower sprayer or in 900 l/ha for Knapsack hand operated sprayer.
	(b) Methomyl 90% SP 420-500 g. in 900-1000 l water/ha. plus Tanac sticker at 30 ml/10 using only hand operated knapsack sprayer Avoid blanket treatment. Spot spray as and when caterpillars are in 2nd and 3rd instar stage.
2. Livewood Termite Postelectrotermes miltaris	(a) Methyl bromide treatment at 1 kg/40 sq.m of infested area.
	(b) 7 g. of carbofuran granule or terracur P in holes at the time of replanting.
3. Shot Hole Borer Xyleborus formicatus	(a) Fenthion 4.2 litres of fenthion 50% EC o 2.1 litre of fenthion 100% EC per hectar High volume application 890-1112 litres of water per hectare Low volume 170-225 litres of water per hectare.
4. Meadow Eelworms Pretylenchus roosi	(a) Thoroughly mix 7 g. of Fensulfothion 5% granules with soil in planting hole.
	(b) Place 3.5g. of Nemagon 10% G. at bottom of planting hole, cover with soil and plant, preventing feeder roots coming in contact with the fumigant.
II DISEASES	
1. Red Root Disease Poria hypolateritia	Methyl bromide fumigation at 1 kg/40 sq. of infested area.
2. Blister Blight Disease Exobasidium vexans	(a) Copper based fungicide containing 50% W/W metallic copper either as cuprousoxi or cuprous oxychloride at 204-273 g. in 56 l. of water per hectare. or (b) Nickel based fungicide at 273 g. in 56 l of water/hectare.

3. Red Rust Disease *Cephaleuros parasiticus*	Copper based fungicide containing 50% W/W metallic copper at 1120 g. in 450 litres of water/hectare.
4. Black Blight Disease *Rhizoctonia solani*	Copper based fungicide containing 50% W/W metallic copper at 1120 g. in 450 l. of water/hectare.

* Source:-
(Circulars No.15, 16, W2, D1, D2, D3, D4, D5 of the Tea Research Institute, Sri Lanka).

SCHEDULE II

* RECOMMENDATIONS FOR THE CHEMICAL CONTROL OF PESTS AND DISEASES IN RUBBER.

Disease	Control
1. Oidium Leaf Disease *Oidium heveae*	Dust sulphur 13.5 kg. per hectare at 3-4 day intervals for 5-6 weeks.

Source:-
* (Advisory Circular No.70 of Rubber Research Institute, Sri Lanka.)

SCHEDULE III

* RECOMMENDATIONS FOR CHEMICAL CONTROL OF PESTS AND DISEASES IN COCONUTS.

I Pests

1. Rat.	20 parts of bait material such as cereals manioc, groundnut, copra or partly burnt coconut kernel with one part of Warfarin rodenticide. Bait kept every 15'.
2. Termites.	(a) 28.5 ml. of aldrin 20% EC in 22 l. of water applied at the rate of 4.5 l. per seedling.
	(b) 15 ml. of chlordane 80% EC in 27 l. of water applied at the rate of 4.5 l. per seedling.
3. Red Weevil *Rhyncophorus ferrugineus*	20 ml. of demeton methyl 25% EC in 400 ml. of water applied into a tin funnel inserted to the trunk of the tree.
4. Coconut Scale Insect *Aspidiotus destructor*	Warm 9 litres of water and to this add 454 g. of laundry soap shavings stirring till these are completely dissolved. Remove soap solution from fire and add 18 litres of kerosene oil in small quantities stirring the mixture vigorously. This stock solution is diluted in 275 litres of water and sprayed to 20 grown up palms.
5. Black Beetle *Oryctes rhinoceros*	90 ml. of dieldrin 20% EC in 4.5 litres of water and applied at 200 ml. of this solution per palm to the bud region.

II DISEASE.

1. Bud Rot Disease *Phytophthora palmivora* *P.nicotiana var parasitica* .	Place a handful of coir dust in a small piece of jute hessian and tie up to make a small bag. Place this bag overnight in a fungicide solution made by dissolving 30 gms of a 50% wettable copper fungicide in 12 l. of water. Tie the bag to petiole of the newly opened leaf.
2. Leaf Blight *Helminthosporium incurvatum*	30 gms. of a 50% wettable copper fungicide in 12 l. of water. Spray fortnightly.

Source:
* (Leaflets No.29, 35, 37, 38, 39, 41, 42 of the Coconut Research Institute, Sri Lanka).

SCHEDULE IV

* RECOMMENDATION FOR CHEMICAL CONTROL OF MAJOR PEST OF CROPS.

A. PEST OF RICE

1. Rice Brown Plant Hopper
   Nilaparvata lugens;
   (a) Carbofuran 3% G. at 20 kg. per hectare
   (b) Propoxur 20% EC at 1400 ml. per hectare
   (c) BPMC 50% EC at 2100 ml. per hectare
   (d) MIPC 50% wp. at 2 kg. per hectare.

2. Rice Bug
   Leptocorisa acuta
   (a) BHC 10% dust at 20-28 kg. per hectare
   (b) Quinalphos 25% EC at 1400-2100 per hectare
   (c) Diazinon 40% EC at 1050-1750 per hectare
   (d) Fenthion 50% EC at 1400-2100 per hectare.

3. Rice Leaf Folder
   Cnaphalocrocis medinalis
   (a) Monocrotophos 60% EC at 1050-1400 per hect
   (b) Chlorophynifos 20% EC at 1050-1750 ml. per hectare.
   (c) Fenthion 50% EC at 1400-2100 per hectare.

4. Rice Gall Midge
   Orseolia oryzae
   (a) Carbofuran 3% G. at 15-20 kg. per hectare.
   (b) Diazinon 10% G. at 15-20 kg. per hectare.
   (c) BHC 6% G. at 35 kg. per hectare.
   (d) 150-215 gm. of carbofuran 3% G. or diazinon 10% G. or 365 gms. of BHC 6% G. per 100 sq.m. of nursery 8-10 days after sowing. Uproot seedlings 5 days after treatment.

5. Rice Thrips.
   Baliothrips biformis
   (a) Quinalphos 25% EC at 500-700 ml. per hecta
   (b) Dimethoate 40% EC at 500-700 ml. per hecta
   (c) Fenthion 50% EC at 500-700 ml. per hectare
   (d) Diazinon 50% EC at 500-700 ml. per hectare
   (e) Carbaryl 85% SP. 500-700 gms. per hectare.

6. Rice Yellow Stem Borer
   Tryporyza incertulas
   (a) Carbofuran 3% G. at 15-20 kg. per hectare.
   (b) Diazinon 10% G. at 15-20 kg. per hectare
   (c) BHC 6% G. at 35 kg. per hectare
   (d) For treating nursery, use rates recommende for Gall Midge control.

7. Rice Pink Stem Borer
   Sesamia inferens
   (a) Carbofuran 3% G. at 15-20 kg. per hectare
   (b) Diazinon 10% G. at 15-20 kg. per hectare
   (c) Monocrotophos 60% EC at 700-1000 ml. per h
   (d) Chloropyrifos 20% EC at 1000-2100 ml. per
   (e) Endosulfan 35% EC at 1000-1400 ml. per hec

8. Rice Leaf Feeding Caterpillars
Spodoptera mauritia
Nymphula depunctalis
Borolia venalba
Famara mathias

(a) Chloropyrifos 20% EC at 1000-1750 ml. per hectare.
(b) Fenthion 50% EC at 1400-2100 ml. per hectare.
(c) Monocrotophos 60% EC at 1000-1400 ml. per hectare.

9. Rice Pentatomid Bug
Scotinophara lurida

(a) BHC 10% dust at 20-30 kg. per hectare.
(b) Fenthion 50% EC at 1400-2100 ml. per hectare.
(c) Trichlorphon 80% SP at 560-1120 gms per hectare. Repeat in 7 days if necessary.

10. Rice Stem Fly
Atherigona exigua

(a) Trichlorphon 80% SP. at 560-1000 gms. per hectare.

11. Rice Whorl Maggot
Hydrelia Spp.

(a) BHC 6% G. at 35 kg. per hectare.
(b) Diazinon 10% G. at 20 kg. per hectare
(c) BHC 10% dust at 20-28 kg. per hectare
(d) Diazinon 50% EC at 700-1000 ml. per hectare.

12. Rice Field Crab

(a) Quinalphos 25% EC at 28 ml. in 4.5-9 l. of water.
(b) Diazinon 50% EC at 28 ml. in 4.5-9 l. of water.
(c) Fenthion 50% EC at 28 ml. in 4.5-9 l. of water.
(d) BPMC 50% at 28 ml. in 4.5-9 l. of water Squirt 56 ml. of solution per burrow.

13. Rice Field Mole Rat
Bandicota bengalensis

(a) Coumarin type rodenticide - 1 part in 20 parts of bait material.
(b) Chlorophacinone rodenticide - 1 part in 50 parts of bait material.
15-30 bait locations per hectare.

B. PESTS OF MAIZE AND SORGHUM

1. Stem Borer
Chilo zonellus

(a) Monocrotophos 60% EC at 700-2000 ml. per hectare.
(b) Endosulfan 35% EC at 500-2000 ml. per hectare.
2-3 applications at 10 day intervals.

2. Shoot Fly
Atherigona soccata — Carbofuran 3% G. at 15 kg. per hectare. Apply in seed furrows.

3. Cob Borer
Helicoverpa armigera
(a) Methmyl 90% SP at 630 g. per hectare.
(b) Methomyl 18-20% EC at 3000 ml. per hectare.
(c) Monocrotophos 60% EC at 1400-2100 ml. per hectare.

C. PESTS OF VEGETABLE CROPS

1. Onion Caterpillar
Spodoptera exigua
(a) Carbofuran 3% G. at 18-20 kg. per hectare, applied at or 5 days of planting.
(b) Phoxim 20% EC at 1400-2100 ml. per hectare.
(c) Diazinon 50% EC at 2800-4200 ml. per hectare
(d) Quinalphos 25% EC at 1050-1400 mk. per hectare - b.c.d. applied at 10 day intervals.
(e) Permethrin 25% EC at per hectare
(f) Fenvalerate 25% EC at per hectare.

2. Onion Thrips
Thrips tabaci
(a) Fenthion 50% EC at 1050-1400 ml. per hectare.
(b) Carbaryl 85% SP. at 350-700 gms. per hectare. Apply at 10 day intervals.

3. Cut Worm
Spodoptera litura
(a) BHC 20% EC at 2100-3500 ml. per hectare.
(b) Quinalphos 25% EC at 1750-2700 ml. per hectare.

4. Cabbage Caterpillars
Plusia ni
(a) Methamidophos 60 EC at 700-1000 ml. per hectare.
(b) Quinalphos 25 EC at 1400-2100 ml. per hectare.
(c) Monocrotophos 60 EC at 1400-2100 mk. per hectar

5. Brinjal Borer
Leucinodes orbonalis — Carbaryl 85 SP. at 1.5-2 kg. per hectare.

6. Brinjal Lace Bugs
Urentius echinus
(a) BHC 10% Dust at 15 kg. per hectare
(b) Carbaryl 85% SP at 1-2 kg. per hectare.

7. Aulacophara Beetles
Larvae
(a) BHC 10% dust.
(b) Chlorfenvinphos 25% WP at 6-8 kg. per hectare as a soil spray.
Adults
(a) Trichlorphon 80 SP at 840-1120 g. per hectare
(b) Carbaryl 85% SP at 1000-1500 g. per hectare
(c) Endosulfan 35% EC at 2800-3500 per hectare.

8. Epilachna Beetles — Trichlorphon 80% SP. at 840-1120 gm. per hectar

9. Paddle Legged Bug
Leptoglossus
Membraneous
(a) BHC 10% dust at 10-15 kg. per hectare

10. Fruit Fly
Cucurbit
Dacus cucurbitae
(a) Fenithion 50% EC at 1050-1400 ml. per hectare.

11. Potato Tuber Moth
Pthorimaea operculella
(a) Carbaryl 85% SP. at 1500-2100 gm. per hectare.

12. Sweet Potato
Tortoise Beetle
Aspidomorpha sp.
Carbaryl 85% SP. at 840-1820 gm. per hectare.

13. Sweet Potato Weevil
Cylas formicarius
Chlorfenvinphos 25% WP at 8 kg. per hectare.

D. PESTS OF PULSE CROPS

1. Bean Fly
Orhiomyia phaseoli
(a) Demeton methyl 25% EC at 1400-2100 ml. per hectare.
(b) Formothion 25% EC at 1400-2100 ml. per hectare.
(c) Monocrotophos 60% EC at 800-1100 ml. per hectare.
(d) Omethoate 50% EC at 800-1100 ml. per hectare.

2. Bean and Cowpea Pod Borers
Maruca testulalis
Lampides boeticus
Helicoverpa armigera
(a) Methomyl 90% SP at 630 gms. per hectare
(b) Methomyl 18% EC at 3000 ml. per hectare
(c) Monocrotophos 60% EC at 1400-2100 ml. per hectare
(d) Methamidophos 60% EC 1400-2100 ml. per hectare

3. Leaf Hoppers
Empoasca Sp.
(a) Dimethoate 40% EC at 430-700 ml. per hectare
(b) Endosulfan 35% EC at 560-770 ml. per hectare
(c) Monocrotophos 60% EC at 350-430 ml. per hectar

E. PESTS OF OIL CROPS

1. Ground Nut
Red Hairy Caterpillar
Amsacta moorei
BHC 10% dust at 10-15 kg. per hectare.

2. Leaf Miners
(a) Monocrotophos 60% EC at 800-1100 ml. per hecta
(b) Endosulfan 35% EC at 1400-2100 ml. per hectare

3. Castor Semi Looper
Achaea janata
Endosulfan 35% EC at 1000-1500 ml. per hectare

4. Castor Capsule Borer
Dichocrocis punctiferalis
BHC 10% dust at 10-15 kg. per hectare.

F. PESTS OF FRUIT CROPS

1. Cashew Stem and Shoot Borer Plocaderus ferrugineus		Endosulfan 35% EC at 1400-2100 ml. per hectare.
2. Helopeltis Bug Helopeltis antonic		BHC 10% dust at 30 kg. per hectare.
3. Mango and Citrus Fruit Fly Dacus ferrugineus		Fenthion 50% EC at 1050-1400 ml. per hectare.
4. Citrus Leaf Miner	(a)	Trichlorfon 80% SP at 1000-1500 gms. per hectare.
	(b)	Dimethoate 40% EC at 1050-1400 ml. per hectare.
5. Mango Leaf Hoppers		Fenthion 50% EC at 6 ml. in 7-9 l. of water per tree - use power sprayer.
6. Mango Weevils		Dimethoate 40% EC at 28 ml. in 9 l. water per tree. Repeat in two weeks.
7. Banana Stem and Corm Weevils	(a)	Carbofuran 3% G. at 0.5 kg. per 10 plants.
	(b)	Aldrin 20% EC at 28 ml. per 4.5 l. spray to drench.

G. GENERAL PESTS

1. Cut Worms	(a)	Carbaryl 85% SP.
	(b)	Trichlorphon 80% SP.
	(c)	Prothiophos 50% EC
Srodoptera litura		28 gms. or 28 ml. in 9 l. of water. Spray to saturate the soil around the base of plants.
2. Cockchafer Grubs Melolontha sp. Anomala sp.		Aldrin 20% EC at 42 ml. in 4.5 l. of water and drench soil.
3. Blister Beetle Mylabris pustulata		Carbaryl 85% SP. at 1050-2000 gms. per hectare. Repeat every 2 weeks if necessary.
4. Root Eating Ants Dorylus orientalis		Aldrin 20% EC at 42 ml. in 4.5 l. of water and drench soil.
5. Mites	(a)	Carbofenothion 20% EC at 1800-2600 ml. per hectare.
	(b)	Dicofol 40% EC at 1400 ml. per hectare
	(c)	Sulphur 80% WWP at 2800-3600 gms. per hectare

6. Aphids, Scales, Mealy Bugs, etc.	(a) Dimethoate 40% EC at 900-1800 ml. per hectare. (b) Demeton methyl 25% EC at 900-1800 ml. per hectare. (c) Phosphamidon 50% EC at 900-1800 ml. per hectare.
7. White Fly Demisia tabaci	(a) Dimethoate 40% EC at 800-1100 ml. per hectare. (b) Demeton methyl 25% EC at 800-1100 ml. per hectare. (c) Phenthoate 50% EC at 800-1100 ml. per hectare. (d) Phosphamidon 50% EC at 800-1100 ml. per hectare.
8. Snails and Slugs	Metaldehyde Mix 30 gm. of Meta with 1 kg. of rice bran and sufficient water to make a stiff mixture. Make about 120 balls and place them at 3-4 metre intervals in infested areas.
9. Parrots and Sparrows	Fenthion 50% EC at 28 ml. in 9 l. of water and spray the trap crop.
10. Grass Hoppers and Locusts	(a) BHC 10% dust at 15-20 kg. per hectare (b) Carbaryl 85% SP. at 1.5 to 2.5 kg. per hectare.

Source:

* (Compiled by Mr.M.Aanandasayanam, Subject Matter Specialist (Plant Protection), Division of Education, Training and Information, Department of Agriculture, Peradeniya, Sri Lanka, based on the findings of the Division of Research, Department of Agriculture, Peradeniya, 1979).

SCHEDULE V

* RECOMMENDATIONS FOR CHEMICAL CONTROL OF PLANT DISEASES

R I C E

1. Blast Disease *Pyricularia Oryzae*	1. Kasugamycin 2% ml. in 27 l. of water at the rate of 450 l. per hectare. 2. Ediphenphos 50% EC 28 ml. in 27 l. of water at the rate of 450 l. per hectare. 3. Benomyl 50% WP 28 gms. in 36 l. of water at the rate of 450 l. per hectare.
2. Sheath Blight *Carticium sasakii*	1. Benomyl 50% WP. 28 gms. in 37 l. of water at the rate of 450 l. per hectare.

RECOMMENDATIONS FOR CHEMICAL CONTROL OF VEGETABLE DISEASES

B E A N

1. Anthracnose Disease *Colletotrichum lindemuthianum*	Captan, Zineb, Maneb or Mancozeb 28 gms. in 12 l. of water at the rate of 450-540 l. per hectare.
2. Rust Disease *Uromyces appendiculatus*	1. Sulphur dust at 30 kg. per hectare. 2. Mancozeb 28 gms. in 12 l. of water at the rate of 450-540 l. per hectare.

GROUND NUT

1. Leaf Spot *Cercaspora personata*	Maneb 28 gms. in 12 l. of water at the rate of 450 l. per hectare.
2. Seed Rots *Fusarium Rhizopus Mucor Penicillium* etc.	Thiram at 28 gms. per 5 kg. of seed.

POTATO

1. Late Blight *Phytophthora infestans*	1. Mancozeb or Propineb 2 kg. in 800 l. of water per hectare. 2. Chlorothalonil 1.5 kg. in 800 l. of water per hectare.
2. Early Blight *Alternaria solani*	1. Mancozeb or Propineb 1.5 kg. in 800 l. of water per hectare. 2. Chlorothalonil 1 kg. in 800 l. of water per hectare.

COLOCASIA SPP.

1. Blight Disease *Phytophthora colocasiae*	50% Copper fungicide 2 kg. in 800 l. of water per hectare.

CARROT

1. Leaf Blight *Alternaria dauci* *Cercospora carotae*	Maneb, Mancozeb or Propineb 1.5 kg. in 800 l. of water per hectare.
1. Cercospora Leaf Spot *Cercospora beticola*	Maneb, Mancozeb or Propineb 1.5 kg. in 800 l. of water per hectare.

ONION

1. Leaf Disease *Alternaria spp.*	Mancozeb or Chlorothalonil or Propineb 1.5 kg. in 800 l. of water per hectare.

TOMATO

1. Late Blight *Phytophthora infestans*	Zineb, Maneb or Mancozeb 2 kg. in 800 l. of water per hectare.
2. Black Leaf Spot *Septoria lycopersici*	Zineb, Maneb or Mancozeb 2 kg. in 800 l. of water per hectare.
3. Anthracnose *Colletotrichum phomoides*	Mancozeb or Propineb 2 kg. in 800 l. of water per hectare.

BRINJAL

1. Phomopsis Blight *Phomopsis vexans*	50% Copper fungicide 2 kg. in 800 l. of water per hectare.

CUCURBITS

1. Downey mildew *Pseudoperonospora cubensis*	Zineb or Mancozeb 2 kg. in 800 l. of water hectare.

CABBAGE, CAULIFLOWER, ETC.

1. Club Root Disease *Plasmodiophora brassicae*	1. At transplanting: Quintozene 75% WP. 500 g. in 100 l. applied at 250 ml. per planting hole. 2. Quintozene 20% dust 40 kg. per hectare.

2. Leaf Blight
Alternaria brassicae — Mancozeb or Propineb 1.5 kg. in 800 l. per hectare.

BANDAKKA

1. Powdery Mildew
Erysiphe cichoracearum — Dusting with sulphur at 25 kg. per hectare.

RECOMMENDATIONS FOR CHEMICAL CONTROL OF SPICE DISEASES

TURMERIC

1. Leaf Blight
Colletotrichum capsici — 50% Copper fungicide at 2 kg. in 800 l. of water per hectare.

CHILLIE

1. Fruit Rot and Die-back
Colletotrichum capsici — Mancozeb, Propineb or Captan 2 kg. in 800 l. of water per hectare.

2. Leaf Spot
Cercospora capsici — Zineb, Mancozeb or Propineb 1½ kg. in 800 l. of water per hectare.

3. Powdery Mildew
Oidiopsis taurica
1. Dusting with sulphur at 25 kg. per hectare.
2. Sulphur 80 WP 2 kg. in 800 l. of water per hectare

PEPPER

1. Leaf Spot
Colletotrichum piperis — 50% Copper fungicide 2 kg. in 800 l. of water per hectare.

2. Leaf Disease
Pestalotia piperis — 50% Copper fungicide 2 kg. in 800 l. of water per hectare.

RECOMMENDATIONS FOR CHEMICAL CONTROL OF FRUIT DISEASES

BANANA

1. Anthracnose Disease
Gloeosporium musarum — 50% Copper fungicide 2 kg. in 800 l. of water applied to young developing fruits.

MANGO

1. Leaf Spot, Wither tip, Blossom Blight and Fruit Rot. *Gloeosporium mangiferae*	Zineb, Maneb, Mancozeb 1.5-2 kg. in 800 l. of water at 8-10 l. per tree.
2. Powdery Mildew *Oidium mangiferae*	Dust with sulphur at 10 kg. per hectare. Repeat in 7-14 day intervals.
3. Leaf Spot *Cercospora mangiferae*	50% Copper fungicide 2 kg. in 800 l. of water

PAPAW

1. Stem Rot *Phytophthora palmivora*	50% Copper fungicide 2 kg. in 800 l. of water per hectare.

CITRUS SP.

1. Scab *Elsinoe fawcetti*	50% Copper fungicide 2 kg. in 800 l. of water per hectare.
2. Powdery Mildew *Oidium tingitaninum*	1. Dust with sulphur at 10-15 kg. per hectare. 2. Sulphur 80 WP 2 kg. in 800 l. of water per hectare.
3. Pink Disease *Corticium salmonicolor*	50% Copper fungicide 2 kg. in 800 l. of water at 8-10 l. per tree.
4. Wither Tip *Colletotrichum Sp.*	50% Copper fungicide 2 kg. in 800 l. of water at 8-10 per tree.
1. Passion Fruit *Alternaria possiflorae*	50% Copper fungicide 2 kg. in 800 l. of water per hectare.

GRAPES

1. Downy Mildew *Plasmopara viticola*	50% Copper fungicide 2 kg. in 800 l. of water per hectare.
2. Powdery Mildew *Uncinula necator*	50% Copper fungicide 2 kg. in 800 l. of water per hectare.

APPLE AND PEARS

1. Scab Disease *Venturia inaequalis*	Mancozeb or Captan 2 kg. in 800 l. of water 5-8 l. per tree.
2. Powdery Mildew *Podosphaera leucotricha*	Sulphur 80 WP 2 kg. in 800 l. of water at 5-8 l. per tree.

SCHEDULE VI

* RECOMMENDATIONS FOR CHEMICAL CONTROL OF WEEDS

I WEEDWISE

PERENNIAL WEEDS

Cynodon dactylon Panicum repens Cyperus rotundus	Dalapon 20 kg/ha/450 l. water or Glyphosate 1½-2½ A.I./hectare.
	(a) Long term - Glyphosate 1½-2½ A.I./hectare. (b) Short term - mixture of Ioxynil and Ester of 2,4-D. 2.25 kg/450 l. water/hectare.
Mimosa eupatorium	Mixture of Pichloram and 2,4-D as their tri-isopropanol amine salts.
Perennial grass only:	Diuron 9-11 kg./ha.
Nut Grass and Perennial grasses.	Bromacil 7-9 kg/ha.

II CROPWISE

Rice	3,4-DPA 8.5 l./ha MCPA 11./ha. Paraquat Butachlor 22-25 kg/ha. Benthiocarb 20-25 kg/ha.
Maize	Mixture of Alachlor 1.6 - 2.7 kg/hectare and Atrazine 1 - 1.8 kg/hectare. Linuron 1 - 2.25 kg/hectare plus 0.25-0.50% of non toxic surfactant. or Amine salt of 2,4-D at 0.27 or 0.5 kg. AI/hectare.
Sorghum	Prometryne or Propazine or Propachlor.
Green Gram	Trifluarin or Alachlor.
Soya Bean	Oxadiazon 0.75-2 kg. per hectare.
Ground Nut	Oxadiazon 1-3 kg. per hectare
Sesam (Gingelly)	Diuron 0.5 kg/hectare.
Chillies (Red pepper)	Oxadiazon
Potato	Metribuzin 0.35-0.70 kg/hectare.
Onion and Garlic	Oxadiazon 1.1 kg/hectare or Fluorodifon 2.25 kg/hectare.

Sugarcane	Diuron 2.2 kg/hectare and Paraquat or Ioxynil and 2,4-D 1.6 - 2.25 kg/hectare.
Tobacco	Nitralin or Linuron or Ditranamine or Diphenamid or Metribuzin.
Cotton	After Maha harvest apply Glyphosate 1% - 2% A.I. Diuron or Fluometuron 1.6 - 2.25 kg/hectare as pre emergence. Followed with MSMA 50% WV as post emergence treatment - 1.4 kg of product to 250 l. water.
Pineapple	(a) Pre planting - Bromacil 2.25 kg/hectare + Diuron 2.25 kg/hectare.
	(b) Post planting - Diuron 2.25 kg/ hectare or Ametryne 1.1 kg/hectare.
	(c) Established planting - Bromacil 2.25 kg. per hectare.
Citrus	Bromacil 1.8 kg. and Diuron 1.8 kg/hectare.
Banana	Diuron 1.8 kg. + 1.4 l. Paraquat per acre or Diuron 1.8 kg/hectare + 0.25 - 0.50% non ironic surfactant.
Tea	Glyphosate 2% A.I.
Coconut	2,4-D as their tri-isopropanol amine salt or Ammonium Fosamine 1%-2% A.I.

* (Source: - Weed control in Agricultural Crops - Report prepared for the Government of Sri Lanka by Dr.E.Rochecouste, Weed Control Consultant).

FORMULARY OF AGRO-CHEMICALS - 1979

LIST I

Common Name	Chemical Name (CA usage)	Some Trade Names
INSECTICIDES & ACARICIDES		
acephate	OS-dimethyl acetylphosphoramidothioate	Orthene
aldrin	1,2,3,4,10,10-hexachloro-1α,4α,4aβ,5α,8α,8aβ-hexahydro-1,4:5,8-dimethanonaphthalene	Aldrex, Aldrin
HCH	mixed isomers of 1,2,3,4,5,6-hexachlorocyclohexane	Gammexane, etc.
BPMC	2-(1-methylpropyl)phenyl methylcarbamate	Baasa, Baycarb, Hopcin
bufencarb	mixture of 3-(1-methylbutyl)phenyl methylcarbamate and 3-(1-ethylpropyl)phenyl methylcarbamate	Bux, Metalkamate
carbaryl	1-naphthalenyl methylcarbamate	Sevin
carbofuran	2,3-dihydro-2,2-dimethyl-7-benzofuranyl methylcarbamate	Furadan, Curaterr
carbophenothion	S-[[(4-chlorophenyl)thio]methyl] O,O-diethyl phosphorodithioate	Trithion, Garrathion
chlordane	1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methano-1H-indene	Intox 8

P. MANICKAVASAGAR
Plant Protection Officer.

D = Dust
EC= Emulsifiable concentrate
F = Flowable
WP= Wettable Powder
L = Liquid

P = Paste
G = Granule
LC = Liquid concentrate
SP = Soluble powder.

N.B. The sign "<" appearing at the end of one line, and the sign ">" appearing at the beginning of the next line indicates that the word so joined is one word.

Common Name	Chemical Name	Some Trade Names
chlorfenvinphos	2-chloro-1-(2,4-dichlorophenyl)ethenyl diethyl phosphate	Birlane
chlorpyrifos	OO-diethyl O-3,5,6-trichloro-2-pyridyl phosphorothioate	Dursban, Lorsban
demeton-S-methyl	S-2-ethylthioethyl OO-dimethyl phosphorothioate	Metasystox
diazinon	O,O-diethyl O-[6-methyl-2-(1-methylethyl)-4-pyrimidinyl] phosphorothioate	Basudin
dichlorvos	2,2-dichloroethenyl dimethyl phosphate	Dedevap, Vapona, DDVP
dicofol	4-chloro-α-(4-chlorophenyl)-α-(trichloromethyl) benzenemethanol	Mitigon, Kelthane
dimethoate	O,O-dimethyl S-[2-(methylamino)-2-oxoethyl] phosphorodithioate	Rogor
endosulfan	6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,4,3-benzodioxathiepin 3-oxide	Thiodan
fenthion	O,O-dimethyl O-[3-methyl-4-(methylthio)phenyl] phosphorothioate	Lebaycid, Baytex
formothion	S-[2-(formylmethylamino)-2-oxoethyl]O,O-dimethyl phosphorodithioate	Anthio
isoprocarb	2-(1-methylethyl)phenyl methylcarbamate	MIPC, Etrofolan, Mipcin

Common Name	Chemical Name	Some Trade Names
methamidophos	O,S-dimethyl phosphoramidothioate	Monitor, Tamaron
methomyl	methyl N-[[(methylamino)carbonyl]oxy]ethanimidothioate	Lannate
methoxychlor	1,1'-(2,2,2-trichloroethylidene)bis[4-methoxybenzene]	
monocrotophos	dimethyl 1-methyl-3-(methylamino)-3-oxo-1-propenyl phosphate (E)-isomer	Azodrin, Nuvacron
MPMC	3,4-dimethylphenyl methylcarbamate	Meobal
omethoate	O,O-dimethyl S-[2-(methylamino)-2-oxoethyl] phosphorothioate	Folimate
parathion	O,O-diethyl O-4-nitrophenyl phosphorothioate	Folidol E.605, Niran, Fosfer Metox, Metacide.
parathion-methyl	O,O-dimethyl O-4-nitrophenyl phosphorothioate	Folidol M, Niran M
phenthoate	ethyl α-[(dimethoxyphosphinothioyl)thio]benzeneacetate	Cidial, Elsan, Papthion
phosphamidon	2-chloro-3-(diethylamino)-1-methyl-3-oxo-1-propenyl dimethyl phosphate (mixed isomers)	Dimecron
phoxim	α-[[(diethoxyphosphinothioyl)oxy]imino]benzeneacetonitrile	Volaton, Baythion
pirimiphos-methyl	O-[2-(diethylamino)-6-methyl-4-pyrimidinyl] O,O-dimethyl phosphorothioate	Actellic

Common Name	Chemical Name	Some Trade Names
propoxur	2-(1-methylethoxy)phenyl methylcarbamate	Unden
quinalphos	O,O-diethyl O-2-quinoxalinyl phosphorothioate	Ekalux
tetradifon	1,2,4-trichloro-5-[(4-chlorophenyl)sulfonyl]benzene	Tedion V-18
trichlorphon	dimethyl 2,2,2-trichloro-1-hydroxy-ethylphosphonate	Dipterex

FUNGICIDES

benomyl	methyl 1-[(butylamino)carbonyl]-1H-benzimidazol-2-ylcarbamate	Benlate
binapacryl	2-(1-methylpropyl)-4,6-dinitrophenyl 3-methyl-2-butenoate	Morocide
captafol	3a,4,7,7a-tetrahydro-2-(1,1,2,2-tetrachloroethyl)thio-1H-isoindole-1,3(2H)-dione	Difolatan
captan	3a,4,7,7a-tetrahydro-2-[(trichloromethyl)thio]-1H-isoindole-1,3(2H)-dione	Orthocide
carbendazim	methyl 1H-benzimidazol-2-ylcarbamate	Bavistan
carboxin	5,6-dihydro-2-methyl-N-phenyl-1,4-oxathiin-3-carboxamide	DMOC, Vitavax
chloroneb	1,4-dichloro-2,5-dimethoxybenzene	Tersan-SP
chlorothalonil	2,4,5,6-tetrachloro-1,3-benzenedicarbonitrile	Daconil
copper hydroxide	cupric hydroxide	Cupravit blue
copper oxide	cuprous oxide	Perenox, Yellow Cuprocide

Common Name	Chemical Name	Some Trade Names
copper oxychloride	copper chloride hydroxide	Cupravit, Cuprocene
dichlofluanid	1,1-dichloro-N-[(dimethylamino)sulfonyl]-1-fluoro-N-phenylmethanesulfonamide	Euparen
dinocap	a mixture of 4,6-dinitro-6-octylphenyl crotonates and 2,6-dinitro-4-octylphenyl crotonates;octyl being a mixture of the 1-methylheptyl-,1-ethylhexyl-, and 1-propylpentyl isomers	Karathane
dodine	dodecylguanidine monoacetate	Doguadine, Melitrex
edifenphos	O-ethyl SS-diphenyl phosphorodithioate	Hinosan
fenaminosulf	sodium [4-(dimethylamino)phenyl]diazenesulfonate	Dexon
fentin acetate	(acetyloxy)triphenylstannane	Brestan
folpet	2-[(trichloromethyl)-thio]-1H-isoindole-1,3(2H)-dione	Phaltan, Folpan
fuberidazole	2-(2-furanyl)-1H-benzimidazole	Voronit
fylomac	tetradecylpyridinium bromide	Fylomac
kasugamycin	O-3-O-[2-amino-4-[(1-carboxyiminomethyl)amino]-2,3,4,6-tetradeoxy-α-D-arabino-hexopyranosyl]-D-chiro-inositol	Kasumin
mancozeb	maneb (mixture with zineb);containing 20 % Mn and 2,5 % Zn	Dithane M-45
maneb	manganese 1,2-ethanediylbis(carbamodithioate) complex	Manzate D, MEB
MEMA	(cyanoguanidinato-N')-methylmercury	Panogen

Common Name	Chemical Name	Some Trade Names
MEMC	chloro(2-methoxyethyl)mercury	Ceresan, Agallol, Bayton
mercuric oxide	mercuric oxide	Santar A
metham-sodium	methylcarbamodithioic acid	Vapam, VPM
oxycarboxin	5,6-dihydro-2-methyl-N-phenyl-1,4-oxathiin-3-carboxamide 4,4-dioxide	Plantvax
phenylmercury acetate	(acetato-O)phenylmercury	Antimucin, PMA
phenylmercury chloride	chlorophenylmercury	Candressan, Viscous Liquid, PMC
propineb	[[(1-methyl-1,2-ethanediyl)bis[carbamodithioato]](2-)]zinc homopolymer	Antracol
quinomethionate	6-methyl-1,3-dithiolo[4,5-b]quinoxalin-2-one	Morestan, Chythioquinox
quintozene	pentachloronitrobenzene	Brassicol, PCNB, Fomac
streptomycin	O-2-deoxy-2-(methylamino)-α-L-glucopyranosyl-(1→2)-O-5-deoxy-3-C-formyl-α-L-lyxofuranosyl-(1→4)-N,N'-bis(aminoiminomethyl)-D-streptamine	Agrimycin 100
sulphur	sulphur	Thiovit, Wettable Sulphur, Sulphur Dust
thiophanate	diethyl [1,2-phenylenebis(iminocarbonothioyl)]biscarbamate	Topsin
thiophanate-methyl	dimethyl [1,2-phenylene-bis(iminocarbonothioyl)]biscarbamate	Topsin-methyl

Common Name	Chemical Name	Some Trade Names
thiram	tetramethylthioperoxydicarbonicdiamide	Fernasol Forte, Thylate, TMT Fuparene
tolylfluanid	1,1-dichloro-N-[(dimethylamino)sulfonyl]-1-fluoro-N-(4-methylphenyl)methanesulfenamide	Euparen M
vondozeb	mixed manganese and zinc 1,2-ethanediylbis(carbamodithioate) complex	MZ4
zineb	[[1,2-ethanediylbis(carbamodithioate)](2-)]zinc complex	Dithane Z78, Tiezene
ziram	(T-4)-bis(dimethylcarbamodithioato-S,S')zinc	Zerlate

HERBICIDES

alachlor	2-chloro-N-(2,6-diethylphenyl)-N-(methoxymethyl)acetamide	Lasso
thiobencarb	S-[(4-chlorophenyl)methyl] diethylcarbamothioate	Saturn
butachlor	N-(butoxymethyl)-2-chloro-N-(2,6-diethylphenyl)acetamide	Machete
2,4-D isopropyl ester	2,4-dichlorophenoxyacetic acid isopropyl ester	Weed Killer, D-Ester

Common Name	Chemical Name	Some Trade Names
2,4-D sodium or potassium salt	Na or K salt of 2,4-dichlorophenoxyacetic acid	Fernoxone, Weedone, Hedamol Weed Killer (D)
dalapon	2,2-dichloropropanoic acid	Dal Spray, Basapon, Dowpon, Ded-Weed
dimethametryn	N-(1,2-dimethylpropyl)-N'-ethyl-6-(methylthio)-1,3,5-triazine-2,4-diamine	
diuron	N'-(3,4-dichlorophenyl)-N,N-dimethylurea	Karmex, Venduron
glyphosate	N-(phosphonomethyl)glycine	Roundup
linuron	N'-(3,4-dichlorophenyl)-N-methoxy-N-methylurea	Afalon, Lorex
MCPA	4-chloro-2-methylphenoxyacetic acid	Weed Killer M-50, Agrozone
methabenzthiazuron	N-2-benzothiazolyl-N,N'-dimethylurea	Tribunil
metribuzin	4-amino-6-(1,1-dimethylethyl)-3-(methylthio)-1,2,4-triazin-5(4H)-one	Sencor
nitralin	4-(methylsulfonyl)-2,6-dinitro-N,N-dipropylbenzenamine	Planavin
paraquat	1,1'-dimethyl-4,4'-bipyridinium ion	Gramoxone
piperophos & dimethametryn	S-[2-(2-methyl-1-piperidinyl)-2-oxoethyl] O,O-dipropyl phosphorodithioate; and dimethametryn (see under dimethametryn)	Avirosan
propachlor	2-chloro-N-(1-methylethyl)-N-phenylacetamide	Ramrod

Common Name	Chemical Name	Some Trade Names
propenil	N-(3,4-dichlorophenyl)propanamide	3,4-DPA, Surcopur
simazine	6-chloro-N,N'-diethyl-1,3,5-triazine-2,4-diamine	Princep, Simanex
sodium chlorate	sodium chlorate	
NEMATICIDES		
carbofuran	2,3-dihydro-2,2-dimethyl-7-benzofuranyl methylcarbamate	Furadan, Curaterr
fenamiphos	ethyl 3-methyl-4-(methylthio)phenyl 1-methylethylphos( )phoramidate	Nemacur
fensulfothion	O,O-diethyl O-4-(methylsulfinyl)phenyl phosphorothioate	Dasanit, Terracur P
FUMIGANTS		
aluminium phosphide	aluminium phosphide	Phostoxin
chloropicrin	trichloronitromethane	Triclor
D-D soil fumigant	mixture of 1,2-dichloropropane and 1,3-dichloropropenes; and other chlorinated hydrocarbons	Nemex, Vidden D, D-D
methyl bromide	bromomethane	Brom-O-Gas

Common Name	Chemical Name	Some Trade Names
RODENTICIDES		
chlorophacinone	2-[(4-chlorophenyl)phenylacetyl]-1H-indene-1,3(2H)-dione	Liphadione, Drat
coumatetralyl	4-hydroxy-3-(1,2,3,4-tetrahydronaphthalenyl)-2H-1-benzopyran-2-one	Racumin
difenacoum	3-[3-(1,1'-biphenyl)-4-yl-1,2,3,4-tetrahydro-1-naphthalenyl]-4-hydroxy-2H-1-benzopyran-2-one	Rabak
warfarin	4-hydroxy-3-(3-oxo-1-phenylbutyl)-2H-1-benzopyran-2-one	Deth-mor
MOLLUSCICIDE		
metaldehyde	acetaldehyde (polymer)	Meta, Snail X, Snail Bait Pellets

FORMULARY OF AGRO-CHEMICALS - 1979

LIST II

INSECTICIDES & ACARICIDES

Common Name	Chemical Name (C A usage)
azinphos-methyl	O,O-dimethyl S-[(4-oxo-1,2,3-benzotriazin-3(4H)-yl)methyl] phosphorodithioate
dicrotophos	3-(dimethylamino)-1-methyl-3-oxo-1-propenyl dimethyl phosphate (E)-isomer
isofenphos	1-methylethyl 2-[[ethoxy[(1-methylethyl)amino]phosphino thioyl]oxy]benzoate
methiocarb	3,5-dimethyl-4-(methylthio)phenyl methylcarbamate
mercaptophos	O,O-dimethyl O-[3-methyl-4-(methylthio)phenyl]phosphorothioate
mevinphos	methyl 3-[(dimethoxyphosphinyl)oxy]-2-butenoate
permethrin	(3-phenoxyphenyl)methyl 3-(2,2-dichloroethenyl)-2,2-dimethylcyclopropanecarboxylate
phenvalerate	α-cyano-3-phenoxybenzyl α-isopropyl-4-chlorophenyl acetate
prothiophos	O-ethyl-O-(2,4-dichlorophenyl) S-propyl dithiophosphate
tetrachlorvinphos	2-chloro-1-(2,4,5-trichlorophenyl)ethenyl dimethyl phosphate Z-isomer

P. MANICKAVASAGAR
Plant Protection Officer

Common Name	Chemical Name
FUNGICIDES	
cypendazole	methyl 1-(5-cyanopentylcarbamoyl)benzimidazol-2-ylcarbamate
pyracarbolid	3,4-dihydro-6-methyl-N-phenyl-2H-pyran-5-carboxamide
pyrazophos	ethyl 2-[(diethoxyphosphinothioyl)oxy]-5-methyl-pyrazolo[1,5-a]pyrimidine-6-carboxylate
HERBICIDES	
bromacil	5-bromo-6-methyl-3-(1-methylpropyl)-2,4(1H,3H)-pyrimidinedione
MSMA	monosodium methanearsonate
neptalam	2-[(1-naphthalenylamino)carbonyl]benzoic acid
prometryne	N,N'-bis(1-methylethyl)-6-(methylthio)-1,3,5-triazine-2,4-diamine
vernolate	S-propyl dipropylcarbamothioate

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Plant Protection Officer.

FISONS

Conversion Factors

Compiled at Chesterford Park Research Station.

Notes

1 As far as possible British and Metric conversion factors in this list have been checked against B.S. 350: "Conversion Factors and Tables" and amendments.

2 The columns on each page are headed by the words "Multiply" "By", "To Obtain", e.g. to convert Acres to Dekares multiply by 4·047 or one acre = 4·047 Dekares.

3 For simplicity, indices have been used where necessary to avoid using a large number of zeros:—

Indices	Europe & UK	US	Metric prefix	Metric abbreviations
10^{24}	quadrillion			
10^{18}	trillion			
10^{15}		quadrillion		
10^{12}	billion	trillion	Tera	T
10^{9}	thousand million	billion	Giga	G
10^{6}	million	million	Mega	M
10^{3}	thousand	thousand	Kilo	K
10^{2}	hundred	hundred	Hecto	H
10^{-1}	tenth	tenth	deci	d
10^{-2}	hundredth	hundredth	centi	c
10^{-3}	thousandth	thousandth	milli	m
10^{-6}	millionth	millionth	micro	μ
10^{-9}	thousand millionth	billionth	nano	n
10^{-12}	billionth	trillionth	pico	p

4 Account has been taken throughout of the fact that 1 litre is not 1000 cc. but 1000·028 cc.

5 Conversions involving the weight of a volume of liquid have been calculated at 4°C for water or 0°C for mercury except where stated.

6 All figures underlined are exact values. Those not underlined are rounded values.

7 The following abbreviations have been used:— av = avoirdupois weights
ap = apothecaries weights

FISONS

Multiply	By	To Obtain
Acres	0.4734	Cayla Morgans
Acres	4.047	Dekares
Acres	6.336	Feet-miles
Acres	0.6993	Feddans (Sudan)
Acres	0.4047	Hectares
Acres	0.6173	Rich Plantation Acres
Acres	4.356×10^4	Square feet
Acres	4.047×10^{-3}	Square kilometres
Acres	4.047×10^3	Square metres
Acres	1.562×10^{-3}	Square miles
Acres	4.840×10^3	Square yards
Acre-feet	4.356×10^4	Cubic feet
Acre-feet	1.233×10^3	Cubic metres
Acre-feet	2.713×10^5	Gallons (Imp)
Angstrom unit	10^{-10}	Metres
Atmospheres	76.00	Cm of mercury
Atmospheres	1.013	Bars
Atmospheres	33.90	Feet of water
Atmospheres	29.92	Ins of mercury
Atmospheres	406.8	In of water
Atmospheres	1.033	Kg/sq cm
Atmospheres	14.70	Pounds/sq in
Atmospheres	0.9447	Tons/sq ft
Bars	0.9872	Atmospheres
Bars	10^6	Dynes/sq cm
BTU (Brit. Thermal Units)	777.5	Foot lbs
BTU	0.2520	Kilocalories
BTU	107.6	Kilogramme metres
BTU	0.0003	Watt-hrs
Bushels (Imp)	8.000	Gallons (Imp)
Centimetres	0.032781	Feet
Centimetres	0.3937	Inches
Centimetres	6.214×10^{-6}	Miles
Centimetres	0.01094	Yards
Centimetres of mercury	0.01316	Atmospheres
Centimetres of mercury	0.4461	Feet of water
Centimetres of mercury	0.01360	Kg/sq cm
Centimetres of mercury	27.85	Pounds/sq ft
Centimetres of mercury	0.1934	Pounds/sq in
Centimetres/sec	1.969	Feet/min
Centimetres/sec	0.03280	Kilometres/hr
Centimetres/sec	0.01943	Knots
Centimetres/sec	0.6000	Metres/min
Centimetres/sec	0.02237	Miles/hr
Centimetres/sec	2.728×10^{-4}	Miles/min
Cubic centimetres	3.531×10^{-5}	Cubic feet
Cubic centimetres	6.102×10^{-2}	Cubic inches
Cubic centimetres	10^{12}	Cubic microns
Cubic centimetres	1.308×10^{-6}	Cubic yards
Cubic centimetres	0.03520	Fluid oz (Imp)
Cubic centimetres	0.03382	Fluid oz (US)
Cubic centimetres	2.200×10^{-4}	Gallons (Imp)
Cubic centimetres	2.642×10^{-4}	Gallons (US)
Cubic centimetres	1.760×10^{-3}	Pints (Imp)
Cubic centimetres	2.113×10^{-3}	Pints (US)
Cubic centimetres	8.799×10^{-4}	Quarts (Imp)
Cubic centimetres	1.057×10^{-3}	Quarts (US)
Cubic cm/min	0.01320	Gallons (Imp)/hr
Cubic centimetres/sec	2.119×10^{-3}	Cubic feet/min
Cubic cm/sq ft	9.582	Gallons (Imp)/acre
Cubic cm/sq metre	0.0002	Gallons (Imp)/acre
Cubic cm/sq yd	1.056	Gallons (Imp)/acre
Cubic feet	2.296×10^{-5}	Acre feet
Cubic feet	1.728×10^3	Cubic inches
Cubic feet	2.832×10^4	Cubic centimetres
Cubic feet	0.02832	Cubic metres
Cubic feet	0.03704	Cubic yards
Cubic feet	996.6	Fluid oz (Imp)
Cubic feet	6.229	Gallons (Imp)
Cubic feet	7.480	Gallons (US)
Cubic feet	28.32	Litres
Cubic feet	49.83	Pints (Imp)
Cubic feet	59.85	Pints (US)
Cubic feet	62.29	Pounds of water at 62°F
Cubic feet	24.92	Quarts (Imp)
Cubic feet	29.92	Quarts (US)
Cubic feet/hr	0.1069	Gallons (Imp) /min

Multiply	By	To Obtain
Cubic feet/hr	0.1247	Gallons (US)/min
Cubic feet/min	472.0	Cubic cm/sec
Cubic feet/min	0.1666	Gallons (Imp)/sec
Cubic feet/min	0.1247	Gallons (US)/sec
Cubic feet/min	0.4719	Litres/sec
Cubic feet/sec	2.832	Cubic yards/min
Cubic feet/sec	373.7	Gallons (Imp)/min
Cubic feet/sec	448.8	Gallons (US)/min
Cubic feet/sec	0.6222	Million gals. (Imp)/day
Cubic feet/sec	0.6463	Million gals. (US)/day
Cubic feet/sec	1.699×10^3	Litres/min
Cubic feet/sec	3.737×10^3	Pounds of water/min
Cubic inches	16.39	Cubic centimetres
Cubic inches	5.787×10^{-4}	Cubic feet
Cubic inches	1.639×10^{-5}	Cubic metres
Cubic inches	2.143×10^{-5}	Cubic yards
Cubic inches	0.5767	Fluid oz (Imp)
Cubic inches	0.5541	Fluid oz (US)
Cubic inches	3.605×10^{-3}	Gallons (Imp)
Cubic inches	4.329×10^{-3}	Gallons (US)
Cubic inches	1.639×10^{-2}	Litres
Cubic inches	0.02631	Pints (Imp)
Cubic inches	0.03163	Pints (US)
Cubic inches	0.03936	Pounds of water at 62°F
Cubic inches	0.01442	Quarts (Imp)
Cubic inches	0.01732	Quarts (US)
Cubic metres	6.107×10^{-4}	Acre feet
Cubic metres	35.31	Cubic feet
Cubic metres	6.102×10^4	Cubic inches
Cubic metres	1.308	Cubic yards
Cubic metres	220.0	Gallons (Imp)
Cubic metres	264.2	Gallons (US)
Cubic metres	1.760×10^3	Pints (Imp)
Cubic metres	2.113×10^3	Pints (US)
Cubic metres	880.0	Quarts (Imp)
Cubic metres	1.057×10^3	Quarts (US)
Cubic metres/hr	5.239×10^{-3}	Million gals. (Imp)/day
Cubic microns	10^{-12}	Cubic centimetres
Cubic microns/sq cm	6.963×10^{-9}	Gallons (Imp)/acre
Cubic yards	7.646×10^5	Cubic centimetres
Cubic yards	27.00	Cubic feet
Cubic yards	4.666×10^4	Cubic inches
Cubic yards	0.7646	Cubic metres
Cubic yards	168.2	Gallons (Imp)
Cubic yards	202.0	Gallons (US)
Cubic yards	764.5	Litres
Cubic yards	1.345×10^3	Pints (Imp)
Cubic yards	1.616×10^3	Pints (US)
Cubic yards	672.7	Quarts (Imp)
Cubic yards	807.9	Quarts (US)
Cubic yards/min	0.4500	Cubic feet/sec
Cubic yards/min	2.803	Gallons (Imp)/sec
Cubic yards/min	3.366	Gallons (US)/sec
Cubic yards/min	12.74	Litres/sec
Degrees (angle)	60.00	Minutes (angle)
Degrees (angle)	0.01745	Radians
Degrees (angle)	2.778×10^{-3}	Revolutions
Degrees (angle)	3.600×10^3	Seconds (angle)
Degrees/sec	0.1667	Revolutions/min
Dekares	0.2471	Acres
Dekares	0.1000	Hectares
Drams (Av)	27.34	Grains
Drams (Av)	1.772	Grammes
Drams (Av)	0.0625	Ounces (Av)
Drams (Av)	3.906×10^{-3}	Pounds (Av)
Dynes	1.019×10^{-3}	Grammes weight
Dynes	1.019×10^{-6}	Kilogrammes weight
Dynes/sq cm	10^{-6}	Bars
Dynes/sq cm	1.413×10^{-3}	Pounds/sq in
Fathoms	6.000	Feet
Feddans (Sudan)	1.038	Acres
Feet	30.48	Centimetres
Feet	0.1667	Fathoms
Feet	12.00	Inches
Feet	3.048×10^{-4}	Kilometres
Feet	0.3048	Metres
Feet	1.894×10^{-4}	Miles

Multiply	*By*	*To Obtain*
Feet	0.3333	Yards
Feet of water	0.02949	Atmospheres
Feet of water	2.242	Centimetres of mercury
Feet of water	0.8827	Inches of mercury
Feet of water	0.03048	Kg/sq cm
Feet of water	30.48	Kg/sq metre
Feet of water	62.43	Pounds/sq ft
Feet of water	0.4335	Pounds/sq in
Feet/min	0.5080	Centimetres/sec
Feet/min	0.01667	Feet/sec
Feet/min	5.080×10^{-3}	Metres/sec
Feet/min	0.01829	Kilometres/hr
Feet/min	0.01136	Miles/hr
Feet/sec	60.00	Feet/min
Feet/sec	1.097	Kilometres/hr
Feet/sec	0.5921	Knots
Feet/sec	18.29	Metres/min
Feet/sec	0.6818	Miles/hr
Feet/sec	0.01136	Miles/min
Fluid oz (Imp)	28.41	Cubic centimetres
Fluid oz (US)	29.57	Cubic centimetres
Fluid oz (Imp)	1.003×10^{-3}	Cubic feet
Fluid oz (Imp)	1.734	Cubic inches
Fluid oz (US)	1.805	Cubic inches
Fluid oz (Imp)	0.9608	Fluid oz (US)
Fluid oz (US)	1.041	Fluid oz (Imp)
Fluid oz (Imp)	0.0500	Pints (Imp)
Fluid oz (US)	0.0625	Pints (US)
Fluid oz (Imp)/acre	0.07020	Litres/hectare
Fluid oz (US)/acre	0.07309	Litres/hectare
Fluid oz (Imp)/sq ft	27.23	Gallons (Imp)/acre
Fluid oz (Imp)/sq yd	30.25	Gallons (Imp)/acre
Foot-miles	0.1212	Acres
Foot pounds	1.286×10^{-3}	BTU
Foot pounds	3.239×10^{-4}	Kilocalories
Foot pounds	0.1383	Kilogramme-metres
Foot pounds	3.766×10^{-7}	Kilowatt hrs
Foot pounds	3.703×10^{-4}	Watt hrs
Foot pounds/min	0.01667	Foot pounds/sec
Foot pounds/min	3.030×10^{-5}	Horsepower
Foot pounds/min	2.200×10^{-5}	Kilowatts
Foot pounds/min	0.02200	Watts
Foot pounds/sec	60.00	Foot pounds/min
Foot pounds/sec	1.818×10^{-3}	Horsepower
Foot pounds/sec	1.356×10^{-3}	Kilowatts
Foot pounds/sec	1.356	Watts
Gallons (Imp)	3.686×10^{-6}	Acre feet
Gallons (Imp)	0.1250	Bushels (Imp)
Gallons (Imp)	4.546×10^{3}	Cubic centimetres
Gallons (US)	3.785×10^{3}	Cubic centimetres
Gallons (Imp)	0.1605	Cubic feet
Gallons (US)	0.1337	Cubic feet
Gallons (Imp)	277.4	Cubic inches
Gallons (US)	231.0	Cubic inches
Gallons (Imp)	4.546×10^{-3}	Cubic metres
Gallons (US)	3.785×10^{-3}	Cubic metres
Gallons (Imp)	5.946×10^{-3}	Cubic yards
Gallons (US)	4.951×10^{-3}	Cubic yards
Gallons (Imp)	4.546	Litres
Gallons (US)	3.785	Litres
Gallons (Imp) or (US)	8.000	Pints (Imp) or (US)
Gallons (Imp) or (US)	4.000	Quarts (Imp) or (US)
Gallons (Imp)	1.201	Gallons (US)
Gallons (US)	0.8327	Gallons (Imp)
Gallons (Imp) water	10.00	Pounds of water at 62°F
Gallons (US) water	8.327	Pounds of water at 62°F
Gallons (Imp)/acre	0.1041	Cubic cm/sq ft
Gallons (Imp)/acre	1.164	Cubic cm/sq metre
Gallons (Imp)/acre	0.0936	Cubic cm/sq yd
Gallons (Imp)/acre	1.164×10^{8}	Cubic microns/sq cm
Gallons (Imp)/acre	3.973×10^{-3}	Fluid oz (Imp)/sq ft
Gallons (Imp)/acre	0.0331	Fluid oz (Imp)/sq yd
Gallons (Imp)/acre	2.296×10^{-5}	Gallons (Imp)/sq ft
Gallons (Imp)/acre	2.066×10^{-4}	Gallons (Imp)/sq yd
Gallons (Imp)/acre	4.422×10^{-5}	Inches of rain
Gallons (Imp)/acre	11.23	Litres/hectare
Gallons (Imp)/hr	76.77	Cubic cm/min

Multiply	*By*	*To Obtain*
Gallons (Imp)/min	2.676×10^{-3}	Cubic feet/sec
Gallons (US)/min	2.228×10^{-3}	Cubic feet/sec
Gallons (Imp)/min	0.01577	Litres/sec
Gallons (US)/min	0.06309	Litres/sec
Gallons (Imp)/min	9.633	Cubic feet/hr
Gallons (US)/min	8.021	Cubic feet/hr
Gallons (Imp)/sec	9.633	Cubic feet/min
Gallons (US)/sec	8.021	Cubic feet/min
Gallons (Imp)/sec	0.2567	Cubic yards/min
Gallons (US)/sec	0.2971	Cubic yards/min
Gallons (Imp)/sec	272.8	Litres/min
Gallons (US)/sec	227.1	Litres/min
Gallons (Imp)/sq ft	4.356×10^{4}	Gallons (Imp)/acre
Gallons (Imp)/sq yd	4.840×10^{3}	Gallons (Imp)/acre
Gallons (Imp) water/min	0.429	Tons water/24 hours
Grains	0.06858	Drams (av)
Grains) 1 grain avoirdupois	0.06480	Grammes
Grains) 1 grain apothecaries	2.286×10^{-3}	Ounces (av) or (apo)
Grains) 1 grain troy	2.083×10^{-3}	Ounces (troy)
Grains)	0.04167	Pennyweights (apo) or (tr)
Grains)	1.429×10^{-4}	Pounds (av)
Grains)	1.736×10^{-4}	Pounds (apo)
Grains/gallon (Imp)	0.01425	Grammes/litre
Grammes	0.5643	Drams (av)
Grammes	15.43	Grains
Grammes	0.03527	Ounces (av)
Grammes	0.6430	Pennyweights (tr) or (apo
Grammes	2.204×10^{-3}	Pounds
Gramme weight	981.0	Dynes
Grammes/cu cm	10.02	Pounds/gallon (Imp)
Grammes/litre	70.15	Grains/gallon (Imp)
Grammes/litre	0.1604	Ounce/gallon (Imp)
Grammes/litre	0.01002	Pounds/gallon (Imp)
Grammes/litre	1000	Parts per million (ppm)
Grammes/sq ft	93.03	Pounds/acre
Grammes/sq metre	0.07306	Hundredweights/acre
Grammes/sq metre	8.922	Pounds/acre
Grammes/sq yard	0.00827	Hundredweights/acre
Grammes/sq yd	10.67	Pounds/acre
Halfpennies (old)	2.083×10^{-3}	£ sterling
Hectares	2.471	Acres
Hectares	10.00	Dekares
Hectares	1.076×10^{5}	Square feet
Horsepower	3.300×10^{4}	Foot pounds/min
Horsepower	550.0	Foot pounds/sec
Horsepower	1.014	Horsepower (metric)
Horsepower	0.7461	Kilowatts
Horsepower	746.1	Watts
Horsepower (metric)	0.9863	Horsepower
Hundredweights	50.80	Kilogrammes
Hundredweights/acre	12.55	Grammes/sq metre
Hundredweights/acre	10.50	Grammes/sq yd
Hundredweights/acre	125.5	Kilogrammes/hectare
Inches	2.540	Centimetres
Inches	0.08333	Feet
Inches	0.02540	Metres
Inches	1.578×10^{-5}	Miles
Inches	0.02778	Yards
Inches of mercury	0.03342	Atmospheres
Inches of mercury	1.133	Feet of water at 4°C
Inches of mercury	13.60	Inches of water at 4°C
Inches of mercury	345.3	Kgs/sq metre
Inches of mercury	70.73	Pounds/sq foot
Inches of mercury	0.4912	Pounds/sq inch
Inches of rain	2.261×10^{4}	Gallons (Imp)/acre
Inches of water	2.458×10^{-3}	Atmospheres
Inches of water	0.07350	Inches of mercury at 0°C
Inches of water	25.40	Kgs/sq metre
Inches of water	5.202	Pounds/sq ft
Inches of water	0.03613	Pounds/sq in
Irish Plantation Acres	1.031	Acres
Irish Plantation Acres	7.810×10^{3}	Square yards
Kilocalories	3.968	BTU
Kilocalories	3.083×10^{3}	Foot pounds
Kilocalories	1.163×10^{-3}	Kilowatt hrs
Kilocalories/min	0.06996	Kilowatts
Kilocalories/min	69.96	Watts

Multiply	By	To Obtain
Kilogrammes	0.01968	Hundredweights
Kilogrammes	2.205	Pounds
Kilogrammes	9.842×10^{-4}	Tons long
Kilogrammes	10^{-3}	Tons metric
Kilogrammes	1.102×10^{-3}	Tons short
Kilogrammes weight	9.806×10^{5}	Dynes
Kilogramme-metres	1.085×10^{3}	BTU
Kilogramme-metres	7.031	Foot pounds
Kilogramme-metres	2.711×10^{-4}	Kilowatt hrs
Kgs/hectare	7.968×10^{-3}	Hundredweights/acre
Kgs/hectare	0.8922	Pounds/acre
Kgs/litre	10.00	Pounds/gallon (Imp)
Kgs/sq cm	0.9679	Atmospheres
Kgs/sq cm	73.56	Cms of mercury
Kgs/sq cm	32.81	Feet of water
Kgs/sq cm	28.96	Inches of mercury
Kgs/sq cm	2.048×10^{3}	Pounds/sq foot
Kgs/sq cm	14.22	Pounds/sq inch
Kgs/sq metre	3.281×10^{-3}	Feet of water
Kgs/sq metre	2.895×10^{-3}	Inches of mercury
Kgs/sq metre	0.03937	Inches of water
Kgs/sq metre	8.922×10^{-2}	Pounds/acre
Kgs/sq metre	2.048	Pounds/sq foot
Kilometres	3.281×10^{3}	Feet
Kilometres	0.6214	Miles
Kilometres	1.094×10^{3}	Yards
Kilometres/hr	27.78	Centimetres/sec
Kilometres/hr	54.68	Feet/min
Kilometres/hr	0.9113	Feet/sec
Kilometres/hr	0.5396	Knots
Kilometres/hr	16.67	Metres/min
Kilometres/hr	0.2778	Metres/sec
Kilometres/hr	0.6214	Miles/hr
Kilometres/hr/sec	0.2778	Metres/sec/sec
Kilometres/litre	2.825	Miles/gallon (Imp)
Kilometres/litre	2.352	Miles/gallon (US)
Kilometres/min	16.67	Metres/sec
Kilometres/min	0.6214	Miles/min
Kilowatts	4.425×10^{4}	Foot pounds/min
Kilowatts	737.6	Foot pounds/sec
Kilowatts	1.340	Horsepower
Kilowatts	14.33	Kilocalories/min
Kilowatt hrs	2.655×10^{6}	Foot pounds
Kilowatt-hrs	860.6	Kilocalories
Kilowatt-hrs	3.680×10^{5}	Kilogramme-metres
Knots	51.48	Centimetres/sec
Knots	1.689	Feet/sec
Knots	1.853	Kilometres/hr
Knots	1.152	Miles/hr
Litres	0.03532	Cubic feet
Litres	61.03	Cubic inches
Litres	1.308×10^{-3}	Cubic yards
Litres	0.2200	Gallons (Imp)
Litres	0.2642	Gallons (US)
Litres	1.760	Pints (Imp)
Litres	2.114	Pints (US)
Litres/hectare	14.24	Fluid oz (Imp)/acre
Litres/hectare	13.08	Fluid oz (US)/acre
Litres/hectare	0.08902	Gallons (Imp)/acre
Litres/min	5.886×10^{-4}	Cubic feet/sec
Litres/min	3.666×10^{-3}	Gallons (Imp)/sec
Litres/min	4.403×10^{-3}	Gallons (US)/sec
Litres/sec	2.119	Cubic feet/min
Litres/sec	0.07840	Cubic yards/min
Litres/sec	13.20	Gallons (Imp)/min
Litres/sec	15.85	Gallons (US)/min
Metres	10.19	Angstrom units
Metres	3.281	Feet
Metres	39.37	Inches
Metres	10^{6}	Microns (Micrometres)
Metres	1.094	Yards
Metres/min	1.667	Centimetres/sec
Metres/min	0.05468	Feet/sec
Metres/min	0.06000	Kilometres/hr
Metres/min	0.03728	Miles/hr
Metres/sec	196.8	Feet/min
Metres/sec	3.600	Kilometres/hr

Multiply	By	To Obtain
Metres/sec	0.06000	Kilometres/min
Metres/sec	2.237	Miles/hr
Metres/sec	0.03728	Miles/min
Metres/sec/sec	3.600	Kilometres/hr/sec
Micrograms/sq cm	8.922×10^{-2}	Pounds/acre
Microns (Micrometres)	10^{-6}	Metres
Miles	1.609×10^{5}	Centimetres
Miles	5.280×10^{3}	Feet
Miles	6.336×10^{4}	Inches
Miles	1.609	Kilometres
Miles	0.8684	Nautical Miles
Miles	1.760×10^{3}	Yards
Miles/gallon (Imp)	0.3540	Kilometres/litre
Miles/gallon (US)	0.4252	Kilometres/litre
Miles/hr	44.70	Centimetres/sec
Miles/hr	88.00	Feet/min
Miles/hr	1.467	Feet/sec
Miles/hr	1.609	Kilometres/hr
Miles/hr	0.8684	Knots
Miles/hr	26.82	Metres/min
Miles/hr	0.4470	Metres/sec
Miles/hr	0.01667	Miles/min
Miles/min	2.682×10^{3}	Centimetres/sec
Miles/min	88.00	Feet/sec
Miles/min	1.609	Kilometres/min
Miles/min	26.82	Metres/sec
Miles/min	60.00	Miles/hr
Milligrammes/litre	1.000	Parts per million
Million gallons (Imp)/day	1.536	Cubic feet/sec
Million gallons (US)/day	1.547	Cubic feet/sec
Million gallons (Imp)/day	163.4	Cubic metres/hr
Minutes (angle)	0.01667	Degrees (angle)
Minutes (angle)	2.909×10^{-4}	Radians
Morgens (Cape)	2.116	Acres
Nautical miles	1.152	Miles
Ounces (av)	16.00	Drams
Ounces (av)	437.5	Grains
Ounces (av)	0.0625	Pounds
Ounces (av)	28.35	Grammes
Ounces (av)	0.9115	Ounces (troy)
Ounces (av)	2.790×10^{-5}	Tons (long)
Ounces (av)	3.125×10^{-5}	Tons (short)
Ounces (av)	2.835×10^{-5}	Tonnes (metric)
Ounces (troy)	480.0	Grains
Ounces (troy)	20.00	Pennyweights
Ounces (troy)	0.08357	Pounds
Ounces (troy)	1.097	Ounces (av)
Ounces (av)/gall (Imp)	6.236	Grammes/litre
Ounces (av)/acre	70.05	Grammes/hectare
Ounces (av)/sq ft	2.722×10^{3}	Pounds/acre
Ounces (av)/sq metre	292.9	Pounds/acre
Ounces (av) sq yd	244.5	Pounds/acre
Parts per million	10^{-3}	Grammes/litre
Parts per million	1.000	Milligrammes/litre
Parts/million (water)	2.713	Pounds per acre foot
Pence (old)	4.167×10^{-3}	£ sterling
Pence (old)/pound wt	9.333	£ sterling/ton (long)
Pence (old)/pound wt	8.333	£ sterling/ton (short)
Pence (old)/pound wt	9.186	£ sterling/tonne (met.)
Pennyweights (troy) or (ap)	24.00	Grains
Pennyweights (troy)	1.555	Grammes
Pennyweights (troy)	0.0500	Ounces (troy)
Pints (Imp)	568.3	Cubic centimetres
Pints (US)	473.2	Cubic centimetres
Pints (Imp)	0.02009	Cubic feet
Pints (US)	0.01671	Cubic feet
Pints (Imp)	34.68	Cubic inches
Pints (US)	28.88	Cubic inches
Pints (Imp)	5.683×10^{-4}	Cubic metres
Pints (US)	4.732×10^{-4}	Cubic metres
Pints (Imp)	7.433×10^{-4}	Cubic yards
Pints (US)	6.189×10^{-4}	Cubic yards
Pints (Imp)	0.5683	Litres
Pints (US)	0.4732	Litres
Pints (Imp)	20.00	Fluid oz (Imp)
Pints (US)	16.00	Fluid oz (US)

Multiply	By	To Obtain
Pints (Imp)	1.201	Pints (US)
Pints (US)	0.8327	Pints (Imp)
Pints (Imp) or (US)	0.1250	Gallons (Imp) or (US)
Pounds	256.0	Drams
Pounds	5.760×10^5	Grains (apoth) or (troy)
Pounds	7.000×10^3	Grains (av)
Pounds	453.6	Grammes
Pounds	0.4536	Kilogrammes
Pounds	16.00	Ounces (av)
Pounds	14.58	Ounces (troy)
Pounds	0.03108	Slugs
Pounds	4.464×10^{-4}	Tons (long)
Pounds	5.000×10^{-4}	Tons (short)
Pounds of water	0.01605	Cubic feet
Pounds of water	27.71	Cubic inches
Pounds of water	0.1070	Gallons (Imp)
Pounds of water	0.1201	Gallons (US)
Pounds of water/min	2.670×10^{-4}	Cubic feet/sec
Pounds/acre	0.01041	Grammes/sq ft
Pounds/acre	0.1121	Grammes/sq metre
Pounds/acre	0.00372	Grammes/sq yd
Pounds/acre	1.121	Kilogrammes/hectare
Pounds/acre	1.121×10^{-4}	Kilogrammes/sq metre
Pounds/acre	11.21	Microgrammes/sq cm
Pounds/acre	3.673×10^{-4}	Ounces/sq ft
Pounds/acre	3.954×10^{-3}	Ounces/sq metre
Pounds/acre	3.306×10^{-3}	Ounces/sq yd
Pounds/acre foot	0.0005	Parts/million (water)
Pounds/cubic inch	1.728×10^3	Pounds/cubic foot
Pounds/cubic foot	5.787×10^{-4}	Pounds/cubic inch
Pounds/gallon (Imp)	0.09980	Grammes/cubic cm
Pounds/gallon (Imp)	99.80	Grammes/litre
Pounds/gallon (Imp)	0.09980	Kilogrammes/litre
Pounds/gallon (Imp)	1.201	Pounds/gallon (US)
Pounds/gallon (US)	0.8327	Pounds/gallon (Imp)
Pounds/sq inch	0.06805	Atmospheres
Pounds/sq inch	5.171	Centimetres of mercury
Pounds/sq inch	6.895×10^4	Dynes/sq cm
Pounds/sq inch	2.307	Feet of water
Pounds/sq inch	2.036	Inches of mercury
Pounds/sq inch	27.68	Inches of water
Pounds/sq inch	0.07031	Kgs/sq centimetre
Pounds/sq ft	0.03591	Centimetres of mercury
Pounds/sq ft	0.01602	Feet of water
Pounds/sq ft	0.01414	Inches of mercury
Pounds/sq ft	0.1922	Inches of water
Pounds/sq ft	4.882×10^{-4}	Kgs/sq centimetre
Pounds/sq ft	4.882	Kgs/sq metre
Pounds sterling £	480.0	Halfpennies (old)
Pounds sterling £	240.0	Pence (old)
Pounds sterling £	20.00	Shillings (old)
£ sterling/ton (long)	0.1071	Pence (old)/pound wt
£ sterling/ton (met.)	0.1093	Pence (old)/pound wt
£ sterling/ton (short)	0.1200	Pence (old)/pound wt
Quarts (Imp)	1.137×10^3	Cubic centimetres
Quarts (US)	946.4	Cubic centimetres
Quarts (Imp)	0.04016	Cubic feet
Quarts (US)	0.03342	Cubic feet
Quarts (Imp)	69.36	Cubic inches
Quarts (US)	57.74	Cubic inches
Quarts (Imp)	1.137×10^{-3}	Cubic metres
Quarts (US)	9.464×10^{-4}	Cubic metres
Quarts (Imp)	1.597×10^{-3}	Cubic yards
Quarts (US)	1.238×10^{-3}	Cubic yards
Quarts (Imp) or (US)	0.2500	Gallons (Imp) or (US)
Quires	24.00	Sheets (paper)
Radians	57.30	Degrees
Radians	3.438×10^3	Minutes
Radians	0.1592	Revolutions
Radians	2.063×10^5	Seconds (angle)
Radians/sec	9.550	Revolutions/min
Radians/sec/sec	573.0	Revolutions/min/min
Reams	480.0	Sheets (paper)
Revolutions	360.0	Degrees (angle)
Revolutions	6.283	Radians
Revolutions/min	6.000	Degrees/sec
Revolutions/min	0.1047	Radian/sec

Multiply	By	To Obtain
Revolutions/min	0.01667	Revolutions/sec
Revolutions/min/min	1.745×10^{-3}	Radians/sec/sec
Revolutions/min/min	2.778×10^{-4}	Revolutions/sec/sec
Revolutions/sec	60.00	Revolutions/min
Revolutions/sec/sec	3.600×10^3	Revolutions/min/min
Seconds (angle)	2.778×10^{-4}	Degrees (angle)
Seconds (angle)	4.848×10^{-6}	Radians
Sheets (paper)	0.01667	Quires
Sheets (paper)	2.083×10^{-3}	Reams
Shillings (old)	0.0500	Pounds sterling
Slugs	32.17	Pounds
Square centimetres	1.076×10^{-3}	Square feet
Square centimetres	0.1550	Square inches
Square feet	2.296×10^{-5}	Acres
Square feet	929.0	Square centimetres
Square feet	9.290×10^{-6}	Hectares
Square feet	144.0	Square inches
Square feet	9.290×10^{-8}	Square kilometres
Square feet	0.09290	Square metres
Square feet	3.587×10^{-8}	Square miles
Square feet	0.1111	Square yards
Square inches	6.452	Square centimetres
Square inches	6.944×10^{-3}	Square feet
Square inches	645.2	Square millimetres
Square kilometres	247.1	Acres
Square kilometres	1.076×10^7	Square feet
Square kilometres	0.3861	Square miles
Square kilometres	1.196×10^6	Square yards
Square metres	2.471×10^{-4}	Acres
Square metres	10.76	Square feet
Square metres	3.861×10^{-7}	Square miles
Square metres	1.196	Square yards
Square miles	640.0	Acres
Square miles	2.788×10^7	Square feet
Square miles	2.590	Square kilometres
Square miles	2.590×10^6	Square metres
Square miles	3.098×10^6	Square yards
Square millimetres	1.550×10^{-3}	Square inches
Square yards	2.066×10^{-4}	Acres
Square yards	1.976×10^{-4}	Irish Plantation Acres
Square yards	9.000	Square feet
Square yards	8.361×10^{-7}	Square kilometres
Square yards	0.8361	Square metres
Square yards	3.229×10^{-7}	Square miles
Tonnes (metric)	10^3	Kilogrammes
Tonnes (metric)	3.527×10^4	Ounces (av)
Tonnes (metric)	0.9842	Tons (long)
Tonnes (metric)	1.102	Tons (short)
Tons (long)	1.016×10^3	Kilogrammes
Tons (long)	3.584×10^4	Ounces (av)
Tons (long)	2.240×10^3	Pounds
Tons (long)	1.016	Tonnes (metric)
Tons (long)	1.120	Tons (short)
Tons (short)	907.2	Kilogrammes
Tons (short)	3.200×10^4	Ounces (av)
Tons (short)	2.000×10^3	Pounds
Tons (short)	0.9072	Tonnes (metric)
Tons (short)	0.8929	Tons (long)
Tons/sq foot	1.059	Atmospheres
Tons water/24 hrs	0.1556	Gallons (Imp) water/min
Watts	44.26	Foot pounds/min
Watts	0.7376	Foot pounds/sec
Watts	1.341×10^{-3}	Horsepower
Watts	0.01434	Kilocalories/min
Watt-hrs	3.412	BTU
Watt-hrs	2.655×10^3	Foot pounds
Yards	91.44	Centimetres
Yards	3.000	Feet
Yards	36.00	Inches
Yards	9.144×10^{-4}	Kilometres
Yards	0.9144	Metres
Yards	5.682×10^{-4}	Miles