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# Working Paper

# COMPARISON OF SUBSTITUTIVE CHEMICALS RECOMMENDED BY MANUFACTURERS AND AGRICULTURAL INSTITUTIONS FOR COTTON PEST CONTROL

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# COMPARISON OF SUBSTITUTIVE CHEMICALS RECOMMENDED BY MANUFACTURERS AND AGRICULTURAL INSTITUTIONS FOR COTTON PEST CONTROL

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## Introduction:

Information on pesticides is available to Indian farmers from three sources: technical literature[1] published by the manufacturing companies, recommendations made by the agricultural universities and departments of agriculture, and technical literature and recommendations issued by the formulators. Of these three sources information from the formulators is scattered; even a complete list of their names is difficult to obtain.

As yet no attempt has been made to compare the claims of the companies and the recommendations of the agricultural institutions. Such a comparison will be of importance in determining the limitations of these sources of information for the farmers. It will also lead to development of uniform practice in issuing recommendations so as to assist farmers in deciding as to which are the more accurate and acceptable practices.

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[1] The Insecticides Act also requires submission of technical data on pest control results, health hazards, and safeguards, the uses for which the product is recommended, among other relevant matters in support of registration of pest control products. Company recommendations are usually based on the results of tests sponsored by them and conducted by entomologists in the country or independently published results.

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Further, from the point of view of market assessment, it is important to know which are the substitutive pesticides to which the farmers have access and for which sales pressure is organized by manufacturers. In the respective marketing areas this information, if available, can help in a more accurate assessment of demand for a specific product and development of a suitable and selective thrust for marketing it.

## Objectives, Data, and Framework of Analysis

The main objective was to compare the structure and contents of recommendations made by the manufacturers and the agricultural institutions, so as to arrive at suggestions to ensure certain extent of uniformity consistent with the purposes for which such literatures are issued. The other objective was to identify substitutive products for each pesticide.

The printed literature of eighteen manufacturers[2] registered with Director General Technical Development, New Delhi was obtained for the products marketed by them.

The information obtained from sixteen manufacturers of insecticides was tabulated separately and then a summary was made giving the recommendations of these companies for all crops.

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[2] Manufacturers, company(ies) and industry are used interchangeably.

As this summary contained nearly 3000 entries, it was thought expeditious to first study the recommendations for cotton pests only, as cotton is one of the crops which suffers from many different types of ravages by pests, and attracts considerable plant protection.

The dosages were converted into active ingredients per hectare (ai/ha) recommended for each cotton pest and averaged. In one case recommendations were in percentages of active ingredients in the spray. For its conversion into ai/ha the standard quantity of spray used for calculation was 600 litres/ha. Further in converting the liquid formulation recommended in millilitre to kilogram the specific gravity was considered as unity.

For comparison, the pest control recommendations issued by four state agricultural universities and two departments of agriculture were also reviewed. Except one, all others were important cotton growing states. The recommendations of the universities were a part of the package of practices for crop production, while those of the departments were specifically for pest control. All this information was separately compiled and the dosage was averaged as in case of the manufacturers.[3]

Initially these were compared in respect of the structure of recommendations. Then a detailed comparison of the contents of recommendations in respect of chemicals recommended, their

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[3] Insecticides marketed as granules were excluded in the comparative study of recommendations for cotton pest control.

ages and number of applications for cotton pest control was
le.

As the cost of chemicals has an important bearing on their
(excluding local taxes)
ubstitutibility, the prices/obtained from the companies were used
o derive the price of a kilogram of active ingredient and then
iveraged for each insecticide.

In the process of analysing and comparing the recommendations, it also became possible to have a broad view of the types of formulations available for various chemicals, the size of packing, prices, and their variations.

From the price list, the price to farmers for a kilogram of active ingredient was derived for each company, each formulation and for each size of packing upto 5 litres of liquids. These were then averaged.

The current average prices for a kilogram of active ingredient of each insecticides/miticides, are given in Table 1. Table 2 contains the inter-company variations in prices of a few chemicals. Table 3 gives the list of insecticides/miticides specifically recommended by the manufacturers for cotton pest control. Their dosages recommended by the manufacturers and agricultural institutions, and their costs are given in Table 4.

Table 1

Average Price of a Kilogram of Active Ingredient of Insecticides

| | Dusting Powder A | Wettable Powder B | Liquid C |
|---|---|---|---|
| Aldrin | 140.82 | | 159.17 |
| BHC | 16.04 | 17.89 | |
| Carbaryl | 97.64 | 94.66 (L.V.102.50) | |
| Chlordane | 77.44 | | 140.92 |
| DDT | 28.95 | 43.60 | 76.26 |
| Dicofol (Acaricide) | | | 227.80 |
| Diazinon | | | 295.00 |
| Dichlorovos (DDVP) | | | 183.96 |
| Dimethoate | | | 234.33 |
| Endosulfan | 183.95 | | 227.44 |
| Ethion (Acaricide) | | | 153.81 |
| Fenitrothion | | | 193.92 |
| Fenthion | | | 135.29 |
| Heptachlor | 130.25 | | 168.00 |
| Lindane | 243.08 | | 215.00 |
| Malathion | 59.93 | | 72.20 |
| Metasystox | | | 317.73 |
| Monocrotophos | | | 394.20 |
| Parathion M | 140.66 | | 179.77 |
| Penthoate | 92.00 | | 172.00 |
| Phoslone | 192.00 | | 225.72 |
| Phosphomidon | | | 200.26 |
| Quinalphos | 120.00 | | 417.60 |
| Thiemeton | | | 377.71 |
| Trichlorofon | 159.40 | | |
| | Granules | | |
| Carbofuron | G 543.83 | | |
| Phorate | G 194.00 | | |
| Quinalphos | G 370.00 | | |

Table 2

Variations in Prices of Insecticides Marketed by Different Companies

Rs./Kg.ai

| Insecticide | No. of Units Marketing | | Size of Packing | | | | | All packings |
|---|---|---|---|---|---|---|---|---|
| | | | 5 lit. | 1 lit. | 0.5 lit. | 0.25 lit. | 0.100 lit. | |
| | 4 | Minimum | 179 | 186 | 189 | 196 | 267 | |
| | | Maximum | 235 | 243 | 250 | 273 | 273 | |
| | | Average | 210 | 216.5 | 232.3 | 243 | 278.3 | |
| | | Per cent variation over the average | -14.8<br>+11.9 | -14.1<br>+17.2 | -18.6<br>+ 3.3 | -19.3<br>+12.3 | - 4.1<br>+ 6.0 | -14.2<br>+ 10.1 |
| | 3 | Minimum | 167 | 169 | 177 | 188 | 228 | |
| | | Maximum | 188 | 183 | 196 | 202 | 250 | |
| | | Average | 178 | 181.3 | 187 | 199.3 | 239 | |
| | | Per cent variation over the average | - 6.2<br>+ 5.6 | - 6.8<br>+ 5.9 | - 5.3<br>+ 4.8 | - 5.7<br>+ 4.3 | - 4.6<br>+ 4.8 | -5.7<br>-5.0 |
| | 5 | Minimum | 60 | 64 | 68 | 72 | | |
| | | Maximum | 79 | 92 | 102 | 82 | | |
| | | Average | 68.2 | 74.4 | 80 | 78 | | |
| | | Per cent variation over the average | -12.0<br>+15.8 | -16.1<br>+23.7 | -15.0<br>+27.5 | - 7.7<br>+ 5.1 | | -12.7<br>+18.0 |
| | 4 | Minimum | - | 136 | - | 148 | 170 | |
| | | Maximum | - | 177 | - | 195 | 226 | |
| | | Average | - | 161.3 | - | 174.8 | 205.8 | |
| | | Per cent variation over the average | -<br>- | -15.7<br>+ 9.8 | -<br>- | -15.3<br>+11.6 | -17.3<br>+ 9.8 | -16.0<br>+10.4 |
| | | Average percentage variation for all chemicals | -11.0<br>+11.1 | -13.2<br>+12.9 | -13.0<br>+11.9 | -12.0<br>+ 8.3 | - 8.7<br>+ 6.8 | |

Table 3

List of Insecticides Recommended for Cotton Pest Control

| | |
|---|---|
| BHC, Chlordane, DDT, Heptachlor | Ethion, Fenthion, Fenitrothion, Formothion |
| Endosulfan | Lindane, Malathion, Metasystox |
| Carbaryl, Carbofuron | Monocrotophos, Parathion M, Penthoate |
| Dichlorovos (DDVP) | Phorate, Phoslone, Phosphomidan, Quinalphos |
| Diazinon, Dicofol, Dimethoate | Themeton, Trichlorofon |

Table 4: Comparison of Recommendations of Companies and Agricultural Universities/Departments for Cotton Pest Control

Average active ingredient recommended Kg/ha

Average cost of recommendations of companies in bracket Rs./ha

| | Dusting Powder | | Wettable Powder | | Liquid | |
|---|---|---|---|---|---|---|
| | Companies (Cos) | Institutions (Inst) | Cos. | Inst. | Cos. | Inst. |
| A. APHIS | | | | | | |
| BHC | - | - | 2.43 (Rs.43.47) | - | - | - |
| Carbaryl | 1.7 (Rs.166.00) | - | 0.91 (Rs.86.14) | 2.1 | - | - |
| DDT | | - | 0.25 (Rs.10.9) | - | - | - |
| Diazinon | - | - | - | - | 0.13 (Rs.38.35) | 0.18 |
| Dichlorovos (DDVP) | - | - | - | - | - | 0.180 |
| Dimethoate | - | - | - | - | 0.21 (Rs.49.21) | 0.14 |
| Endosulfan | 0.763 (Rs.140.35) | 0.55 | - | - | 0.464 (Rs.105.53) | 0.37 |
| Fenitrothion | - | - | - | - | 0.75 (Rs.145.44) | 0.41 |
| Fenthion | - | - | - | - | 0.375 (Rs.50.72) | |
| Formothion | - | - | - | - | - | 0.11 |
| Lindane | 0.21 (Rs.51.05) | - | - | - | - | |
| Malathion | 1.43 (Rs.85.60) | - | - | - | 0.563 (Rs.40.65) | 0.36 |
| Metasystox | - | - | - | - | 0.23 (Rs.73.08) | 0.1 |
| Monocrotophos | - | - | - | - | 0.175 (Rs.68.99) | 0.38 |
| Parathion | 1.1 (Rs.154.73) | 0.3 | - | - | 0.235 (Rs.42.25) | 0.3 |
| Penthoate | - | - | - | - | | 0.24 |

contd.. 2

| | Dusting Powder | | Wettable Powder | | Liquid | |
|---|---|---|---|---|---|---|
| | Cos. | Inst. | Cos. | Inst. | Cos. | Inst. |
| Phoslone | 0.593 (Rs.113.85) | 0.56 | - | - | 0.302 (Rs.68.17) | 0.39 |
| Phosphomidon | - | - | - | - | 0.25 (Rs.50.07) | 0.114 |
| Quinalphos | - | - | - | - | 0.25 (Rs.104.40) | 0.29 |
| JASSID | | | | | | |
| BHC | - | - | 2.13 (Rs.38.11) | 1.66 | - | - |
| Carbaryl | 1.688 (Rs.164.82) | - | 0.895 (Rs.84.72) | 1.18 | - | - |
| DDT | 1.65 (Rs.47.77) | - | 1.877 (Rs.81.84) | 1.03 | - | - |
| Diazinon | - | - | - | - | - | 0.180 |
| Dichlorovos | - | - | - | - | - | 0.180 |
| Dimethoate | - | - | - | - | 0.24 (Rs.56.24) | 0.21 |
| Endosulfan | 0.527 (Rs.96.94) | 0.55 | - | - | 0.57 (Rs.129.64) | 0.37 |
| Fenthion | - | - | - | - | 0.38 (Rs.51.40) | |
| Fenitrothion | - | - | - | - | 0.75 (Rs.145.44) | 0.55 |
| Formothion | - | - | - | - | 0.22 (Rs.62.04) | 0.153 |
| Malathion | 1.425 (Rs.85.40) | - | - | - | 0.563 (Rs.40.65) | 0.45 |
| Metasystox | - | - | - | - | 0.23 (Rs.73.08) | 0.162 |
| Monocrotophos | - | - | - | - | 0.175 (Rs.68.99) | 0.39 |
| Parathion | 0.3 (Rs.42.20) | 0.37 | - | - | - | - |
| Penthoate | - | - | - | - | - | 0.23 |
| Phosphomidon | - | - | - | - | 0.25 (Rs.50.07) | 0.186 |
| Phoslone | 0.393 (Rs.75.40) | 0.56 | - | - | 0.367 (Rs.82.84) | 0.41 |
| Thiemeton | - | - | - | - | 0.15 (Rs.56.66) | 0.11 |
| Trichlorofon | - | - | - | - | 0.75 (Rs.119.55) | - |

| | Dusting Powder | | Wettable Powder | | Liquid | |
|---|---|---|---|---|---|---|
| | Cos. | Inst. | Cos. | Inst. | Cos. | Inst. |
| THRIP | | | | | | |
| BHC | - | - | 2.13 (Rs.38.1) | 1.25 | - | - |
| Carbaryl | 1.858 (Rs.181.42) | - | 0.884 (Rs.83.68) | 1.44 | - | - |
| Chlordane | 1.25 (Rs.96.8) | - | - | - | 1.0 (Rs.140.92) | - |
| DDT | - | - | 2.25 (Rs.98.10) | 1.25 | | |
| Diazinon | - | - | - | - | - | 0.18 |
| Dichlorovos | - | - | - | - | - | 0.18 |
| Dimethoate | - | - | - | - | 0.233 (Rs.54.60) | 0.171 |
| Endosulfan | 0.585 (Rs.107.61) | 0.55 | - | - | 0.614 (Rs.139.65) | 0.362 |
| Fenitrothion | - | - | - | - | 0.75 (Rs.145.44) | 0.54 |
| Fenthion | - | - | - | - | 1.5 (Rs.202.88) | - |
| Formothion | - | - | - | - | | 0.143 |
| Malathion | 1.425 (Rs.85.40) | - | - | - | 0.56 (Rs.40.65) | 0.54 |
| Metasystox | - | - | - | - | 0.23 (Rs.73.08) | 0.137 |
| Monocrotophos | - | - | - | - | - | 0.384 |
| Parathion | 0.30 (Rs.42.20) | 0.35 | - | - | 0.270 (Rs.48.54) | 0.3 |
| Penthoate | - | - | - | - | | 0.23 |
| Phoslane | 0.593 (Rs.113.86) | 0.56 | - | - | 0.367 (Rs.82.84) | 0.41 |
| Phosphomidon | - | - | - | - | 0.25 (Rs.50.07) | 0.147 |
| Quinalphos | - | - | - | - | 0.25 (Rs.104.40) | 0.268 |
| Thiemeton | - | - | - | - | 0.15 (Rs.56.66) | 0.11 |
| D. MEALY BUGS | | | | | | |
| Carbaryl | 1.75 (Rs.170.87) | - | 0.86 (Rs.81.41) | - | - | - |
| DDVP | - | - | - | - | 0.49 (Rs.90.14) | |
| Dimethoate | - | - | - | - | 0.233 (Rs.54.60) | |
| Malathion | 1.6 (Rs.95.89) | - | - | - | 0.45 (Rs.32.49) | |

| | Dusting Powder | | Wettable Powder | | Liquid | |
|---|---|---|---|---|---|---|
| | Cos. | Inst. | Cos. | Inst. | Cos. | Inst. |
| WHITE FLY | | | | | | |
| BHC | - | - | - | 1.25 | - | - |
| Carbaryl | 1.967 (Rs.192.06) | | 0.868 (Rs.82.16) | | | 1.06 |
| DDT | - | - | 2.5 (Rs.109.00) | 1.25 | - | - |
| DDVP | - | - | - | | 0.49 (Rs.90.14) | - |
| Dimethoate | - | - | - | - | 0.237 (Rs.55.54) | 0.236 |
| Endosulfan | 0.9 (Rs.165.56) | - | - | - | 0.612 (Rs.139.19) | 0.421 |
| Fenitrothion | - | - | - | - | 0.63 (Rs.122.17) | 0.583 |
| Formothion | - | - | - | - | | 0.201 |
| Lindane | 0.23 (Rs.55.91) | - | - | - | - | - |
| Malathion | 1.25 (Rs.74.91) | - | - | - | 0.62 (Rs.44.76) | 0.526 |
| Metasystox | - | - | - | - | | 0.211 |
| Monocrotophos | - | - | - | - | 0.5 (Rs.197.1) | |
| Parathion | - | - | - | - | - | 0.4 |
| Phosphomidon | - | - | - | - | 0.25 (Rs.52.07) | 0.310 |
| Phoslone | 0.593 (Rs.113.86) | - | - | - | 0.36 (Rs.81.26) | 0.49 |
| RED COTTON BUG | | | | | | |
| BHC | 2.5 (Rs.40.10) | - | 1.375 (Rs.24.60) | - | - | - |
| Carberyl | 1.63 (Rs.159.15) | - | 0.85 (Rs.80.46) | - | - | - |
| DDT | - | - | - | 0.6 | | |
| DDVP | - | - | - | - | 0.49 (Rs.90.14) | |
| Endosulfan | 0.64 (Rs.117.73) | - | - | - | 0.61 (Rs.138.74) | |
| Fenitrothion | - | - | - | - | 1.25 (Rs.242.40) | |
| Formothion | | - | - | - | 0.22 (Rs.62.04) | - |
| Lindane | 0.23 (Rs.51.09) | - | - | - | - | - |

| | Dusting Powder | | Wettable Powder | | Liquid | |
|---|---|---|---|---|---|---|
| | Cos. | Inst. | Cos. | Inst. | Cos. | Inst. |
| Malathion | 1.25 (Rs.74.91) | - | - | - | 0.62 (Rs.44.76) | 0.3 |
| Monocrotophos | - | - | - | - | 0.10 (Rs.39.42) | - |
| Phoslone | 0.691 (Rs.132.67) | - | - | - | 0.519 (Rs.117.15) | - |
| Quinalphos | - | - | - | - | 0.28 (Rs.116.93) | |
| Trichlorofon | - | - | - | - | 0.867 (Rs.138.20) | |
| Parathion | 0.4(Rs.56.26) | - | - | - | 0.455(Rs.81.80) | |
| G. DUSKY COTTON BUG | | | | | | |
| BHC | 2.5 (Rs.40.10) | 2.5 | 0.62 (Rs.11.09) | - | - | - |
| Carbaryl | 1.967 (Rs.192.06) | - | 0.87 (Rs.82.35) | - | - | - |
| Endosulfan | 0.77 (Rs.141.64) | - | - | - | 0.57 (Rs.129.64) | - |
| Formothion | - | - | - | - | 0.22 (Rs.62.04) | |
| Malathion | 1.6 (Rs.95.89) | - | - | - | 0.45 (Rs.32.49) | |
| Monocrotophos | - | - | - | - | 0.10 (Rs.39.42) | |
| Parathion | 0.4 (Rs.56.26) | - | - | - | 0.28 (Rs.50.34) | |
| Phoslone | 0.691 (Rs.132.67) | - | - | - | 0.562 (Rs.126.86) | |
| H. FLEA HOPPER | | | | | | |
| Chlordane | 1.25 (Rs.96.80) | - | - | - | 1.0 (Rs.140.92) | |
| Fenthion | - | - | - | - | 0.38 (Rs.51.40) | |
| Fenitrothion | - | - | - | - | 1.13 (Rs.219.13) | |
| Formothion | - | - | - | - | 0.22 (Rs.62.04) | |
| Parathion | - | - | - | - | 0.38 (Rs.68.30) | |
| Trichlorofon | - | - | - | - | 0.85 (Rs.135.49) | |

| | Dusting Powder | | Wettable Powder | | Liquid | |
|---|---|---|---|---|---|---|
| | Cos. | Inst. | Cos. | Inst. | Cos. | Inst. |
| **MITES** | | | | | | |
| Carbaryl | 1.6 (Rs.156.22) | - | 1.0 (Rs.94.66) | 2.0 | - | - |
| DDVP | - | - | - | - | 0.49 (Rs.90.14) | |
| Dicofol | - | - | - | - | | 0.312 |
| Dimethoate | - | - | - | - | 0.23 (Rs.53.90) | 0.13 |
| Endosulfan | - | 0.55 | - | - | - | 1.05 |
| Fenitrothion | - | - | - | - | - | 0.66 |
| Formothion | - | - | - | - | - | 0.120 |
| Malathion | 1.25 (Rs.74.91) | - | - | - | 0.45 (Rs.32.49) | - |
| Metasystox | - | - | - | - | 0.23 (Rs.73.08) | 0.11 |
| Monocrotophos | - | - | - | - | 0.30 (Rs.118.26) | 0.53 |
| Parathion | 0.3 (Rs.42.20) | - | - | - | 0.185 (Rs.33.26) | 0.180 |
| Phosphomidon | - | - | - | - | 0.25 (Rs.50.07) | 0.094 |
| Phoslone | 0.79 (Rs.151.68) | - | - | - | 0.454 (Rs.102.48) | 0.408 |
| Penthoate | - | - | - | - | - | 0.25 |
| J. **PINK BOLLWORM** | | | | | | |
| Carbaryl | 1.96 (Rs.191.37) | 1.6 | 1.10 (Rs.104.13) | 1.4 | - | - |
| DDT | 1.95 (Rs.56.45) | - | 1.667 (Rs.72.68) | 1.24 | - | - |
| DDVP | - | - | - | - | 0.49 (Rs.90.14) | |
| Dimethoate | 0.34 (Rs. -) | - | - | - | 0.5 (Rs.117.17) | |
| Endosulfan | 1.0 (Rs.183.95) | 0.56 | - | - | 0.898 (Rs.204.24) | 0.547 |
| Fenthion | - | - | - | - | 1.75 (Rs.137.80) | |
| Fenitrothion | - | - | - | - | | 1.08 |
| Monocrotophos | - | - | - | - | 0.350 (Rs.137.97) | 0.402 |

| | Dusting Powder | | Wettable Powder | | Liquid | |
|---|---|---|---|---|---|---|
| | Cos. | Inst. | Cos. | Inst. | Cos. | Inst. |
| Parathion | 0.425 (Rs.59.78) | - | - | - | 0.28 (Rs.50.34) | - |
| Penthoate | - | - | - | - | - | 0.348 |
| Phoslone | 0.720 (Rs.138.24) | 0.64 | - | - | 0.562 (Rs.126.86) | 0.415 |
| Quinalphos | - | - | - | - | 0.28 (Rs.118.93) | 0.41 |
| Trichlorofon | - | - | - | - | 1.225 (Rs.163.39) | |
| SPOTTED BOLLWORM | | | | | | |
| Carbaryl | 1.96 (Rs.191.37) | 1.6 | 1.1 (Rs.104.13) | 1.4 | - | - |
| DDT | 1.95 (Rs.56.45) | - | 1.667 (Rs.72.68) | 1.23 | - | - |
| DDVP | - | - | - | - | 0.49 (Rs.90.14) | |
| Dimethoate | 0.34 (Rs. - ) | - | - | - | 0.5 (Rs.117.17) | |
| Endosulfan | 1.0 (Rs.183.95) | 0.56 | - | - | 0.898 (Rs.204.24) | 0.547 |
| Fenitrothion | - | - | - | - | 1.75 (Rs.339.36) | 0.755 |
| Fenthion | - | - | - | - | 1.75 (Rs.236.69) | |
| Monocrotophos | - | - | - | - | 0.35 (Rs.137.97) | 0.5 |
| Parathion | 0.425 (Rs.59.78) | - | - | - | 0.28 (Rs.50.34) | - |
| Penthoate | - | - | - | - | - | 0.476 |
| Phoslone | 0.79 (Rs.151.68) | 0.54 | - | - | 0.562 (Rs.126.86) | 0.511 |
| Quinalphos | - | - | - | - | 0.28 (Rs.116.39) | 0.405 |
| Trichlorofon | - | - | - | - | 1.025 (Rs.163.39) | |
| Phosphomidon | - | - | - | - | 0.25 (Rs.50.07) | |
| BUD MOTH | | | | | | |
| Carbaryl | 1.5 (Rs.146.46) | - | 0.9 (Rs.85.19) | - | - | - |

| | Dusting Powder | | Wettable Powder | | Liquid | |
|---|---|---|---|---|---|---|
| | Cos. | Inst. | Cos. | Inst. | Cos. | Inst. |
| CATERPILLAR (Data of Universities and Departments refer to Prodenia) | | | | | | |
| BHC | - | - | 2.13 (Rs.38.11) | - | - | - |
| Carbaryl | 1.85 (Rs.180.63) | 1.25 | 0.825 (Rs.78.19) | 0.988 | - | - |
| DDT | - | 1.25 | - | - | 0.617 (Rs.47.05) | - |
| DDVP | - | - | - | - | - | 0.864 |
| Endosulfan | 0.89 (Rs.163.72) | - | - | - | 0.54 (Rs.122.82) | 0.346 |
| Ethion | - | - | - | - | 1.9 (Rs.292.24) | |
| Fenitrothion | - | - | - | - | - | 0.25 |
| Fenthion | - | - | - | - | - | 0.247 |
| Monocrotophos | - | - | - | - | 0.2 (Rs.78.84) | - |
| Parathion | 0.4 (Rs.56.26) | - | - | - | 0.24 (Rs.43.15) | 0.24 |
| Penthoate | 0.50 (Rs.46.0) | 0.80 | - | - | - | - |
| Phoslone | 0.691 (Rs.132.67) | - | - | - | 0.56 (Rs.126.40) | - |
| Quinalphos | - | - | - | - | - | 0.185 |
| N. HAIRY CATERPILLAR | | | | | | |
| Carbaryl | 2.2 (Rs.214.81) | - | 0.86 (Rs.81.41) | - | - | - |
| Chlordane | 3.7 (Rs.286.53) | - | | - | 1.25 (Rs.176.15) | - |
| Parathion | 0.54 (Rs.75.96) | - | - | - | 0.51 (Rs.91.68) | - |
| O. LEAF ROLLER | | | | | | |
| BHC | - | - | - | 1.25 | - | - |
| Carbaryl | 2.1 (Rs.205.04) | - | 0.85 (Rs.80.46) | 1.03 | - | - |
| DDT | 1.94 (Rs.56.16) | - | 1.56 (Rs.68.02) | 1.23 | - | - |
| DDVP | - | - | - | - | 0.49 (Rs.90.14) | - |

| | Dusting Powder | | Wettable Powder | | Liquid | |
|---|---|---|---|---|---|---|
| | Cos. | Inst. | Cos. | Inst. | Cos. | Inst. |
| Dimethoate | - | - | - | - | - | 0.30 |
| Endosulfan | 0.90 (Rs.165.56) | - | - | - | 0.73 (Rs.166.03) | 0.563 |
| Fenitrothion | - | - | - | - | - | 0.692 |
| Formothion | - | - | - | - | - | 0.25 |
| Malathion | 1.25 (Rs.74.91) | - | - | - | 0.62 (Rs.44.76) | 0.63 |
| Metasystox | - | - | - | - | - | 0.25 |
| Parathion | 0.54 (Rs.75.96) | 0.40 | - | - | 0.51 (Rs.91.68) | |
| Penthoate | - | - | - | - | - | 0.494 |
| Phosphomidon | - | - | - | - | - | 0.494 |
| Phoslone | 0.691 (Rs.132.67) | - | - | - | 0.53 (Rs.119.63) | 0.52 |
| Quinalphos | - | - | - | - | - | 0.353 |
| Thiemeton | - | - | - | - | 0.15 (Rs.56.66) | - |
| Trichlorofon | - | - | - | - | 0.90 (Rs.143.46) | - |
| P. LEAF WORM | | | | | | |
| BHC | - | - | 2.13 (Rs.38.11) | - | - | - |
| Carbaryl | 1.85 (Rs.180.63) | - | 0.872 (Rs.82.54) | - | - | - |
| Endosulfan | 0.53 (Rs.97.49) | - | - | - | - | - |
| Ethion | - | - | - | - | 1.9 (Rs.292.24) | - |
| Q. HELIOTHES | | | | | | |
| Carbaryl | - | 2.2 | - | 1.43 | - | - |
| DDT | 3.13 (Rs.90.61) | - | - | - | - | - |
| Endosulfan | - | 0.525 | - | - | - | - |
| Parathion | - | - | - | - | 1.5 (Rs.269.66) | - |
| Penthoate | - | - | - | - | 1.0 (Rs.172.00) | - |

| | Dusting Powder | | Wettable Powder | | Liquid | |
|---|---|---|---|---|---|---|
| | Cos. | Inst. | Cos. | Inst. | Cos. | Inst. |
| **SEMILOOPER** | | | | | | |
| BHC | - | 2.5 | - | - | - | - |
| Carbaryl | 1.967 (Rs.192.06) | - | - | - | - | - |
| DDT | - | - | - | 1.2 | - | - |
| DDVP | - | - | - | - | 0.49 (Rs.90.14) | |
| Endosulfan | 0.8 (Rs.147.16) | - | - | - | 0.565 (Rs.128.50) | |
| Parathion | 0.4 (Rs.56.26) | - | - | - | 0.26 (Rs.46.74) | |
| Phoslone | 0.691 (Rs.132.67) | - | - | - | 0.53 (Rs.119.63) | |
| Quinalphos | - | - | - | - | 0.28 (Rs.116.93) | |
| **SWARMING CATERPILLAR** | | | | | | |
| Chlordane | 1.25 (Rs.96.80) | - | - | - | 1.0 (Rs.140.92) | |
| Fenthion | - | - | - | - | 1.25 (Rs.169.06) | |
| Trichlorofon | - | - | - | - | 0.983 (Rs.156.69) | |
| **STEM BORER** | | | | | | |
| Carbaryl | 1.5 (Rs.146.46) | - | 0.88 (Rs.83.30) | - | - | |
| Monocrotophos | - | - | - | - | 0.3 (Rs.187.10) | |
| **GREY WEEVIL** | | | | | | |
| BHC | - | - | - | 1.23 | - | |
| Carbaryl | 1.967 (Rs.197.06) | - | 0.868 (Rs.82.16) | 1.06 | - | - |
| DDT | - | - | - | 0.981 | - | - |

| | Dusting Powders | | Wettable Powder | | Liquid | |
|---|---|---|---|---|---|---|
| | Cos. | Inst. | Cos. | Inst. | Cos. | Inst. |
| Dimethoate | - | - | - | - | 0.24 (Rs.56.24) | 0.3 |
| Endosulfan | 0.9 (Rs.165.66) | - | - | - | 0.643 (Rs.146.24) | 0.481 |
| Fenitrothion | - | - | - | - | - | 0.583 |
| Formothion | - | - | - | - | - | 0.25 |
| Malathion | 1.25 (Rs.74.91) | - | - | - | 0.62 (Rs.44.76) | 0.63 |
| Metasystox | - | - | - | - | - | 0.25 |
| Monocrotophos | - | - | - | - | - | 0.4 |
| Parathion | - | - | - | - | - | 0.35 |
| Phosphomidon | - | - | - | - | - | 0.326 |
| Phoslone | 0.79 (Rs.151.68) | - | - | - | 0.497 (Rs.112.18) | 0.49 |
| Quinalphos | - | - | - | - | - | 0.271 |
| TERMITES | | | | | | |
| Heptachlor | 0.5 (Rs.65.13) | - | - | - | - | - |
| Chlordane | 3.7 (Rs.286.53) | | | | 1.25 (Rs.176.15) | |
| GRASSHOPPERS | | | | | | |
| BHC | - | 2.72 | - | - | - | - |
| FIELD CRICKET | | | | | | |
| BHC | - | 2.72 | - | - | - | - |
| CUTWORM | | | | | | |
| BHC | - | 2.70 | - | - | - | - |
| SCALES | | | | | | |
| Carbaryl | 1.5 (Rs.146.46) | - | 0.88 (Rs.83.30) | - | - | - |

FINDINGS:

The predominant formulation in which pesticides were marketed was, of course, the liquid emulsion (Table 1). DDT was the only chemical marketed in all the three formulations, i.e., dusts, wettable powder , and emulsion . BHC and carbaryl were marketed as dusting powder and wettable powder. The insecticides marketed as dusting powder and liquid emulsion were aldrin, chlordane, endosulfan, heptachlor, lindane, malathion,[4] parathion M, penthoate and phoslone. Carbofuron, and phorate were marketed only as granules, while quinalphos was marketed as granules, dusting powder and liquid. The rest of the insecticides, except trichlorofon which was marketed only as dust, were in liquid form.

Size of Packing and Prices

The most common size of packings for dusting powder was 25 kg. bag, followed by 50 kg. bag. Rarely 5 and 10 kg. containers were used for this type of formulation. For wettable powder 100 or 500 gm. cartons were used. Liquid formulations were packed in four to five sizes of containers. These were 5 litres, 1 litre, 0.5 litre, 0.25 litre and 0.1 litre. Some manufacturers also market in 25 litres

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[4] Malathion is sometimes specially formulated as wettable powder for public health programme.

containers for bulk use. For granules 5 kg. was the common packing, but a few companies marketed it in 1, 10, or 25 kg. containers.

Among the chemicals marketed as dusting powders and wettable powders, the price per kilogram of active ingredient was higher by 9.5 per cent in wettable poweders than for dusting powders. Of the ten insecticides which was marketed as dust and liquid emulsion , the price of liquid emulsion was 43 per cent higher than that of dust. This was even more in the organo-phosphorus (OP) group of insecticides, which possibly reflects the high cost of ingredients necessary for the formulating process.

The price of active ingredient of OP group of insecticides marketed as liquid tended to be higher by 45 per cent than the chlorinated hydrocarbons marketed in the same form.

The average price of all insecticides was 219 Rs./kg. of ai. Lately, granular insecticides have been introduced. These had the highest price per kilogram of active ingredient. As prices for pyrathroids were not available, they have been excluded from the study.

The price per unit of active ingredient was naturally higher in smaller liquid containers. The indices of their prices of a kilogram of active ingredient are: 1 litre 104.1, 0.5 litre 109.7, 0.25 litre 112.7 and 0.1 litre 121.4 when 5 litres = 100. A comparison of these prices between the group of large companies and

the rest showed that the former had some preference for marketing their products in 0.1 litre packing in addition to other packings. The incremental price of active ingredient of these large companies was not different from the rest upto 0.25 litre packing However, the price index for 0.1 litre packing of these large companies was much higher (123.8) than for the rest (115.9). The significance of this cannot be lost as it ultimately means that the small farmers, buying the smallest packing, pay a higher price.

Price Variations

Not all the insecticides were available in all packings. Further, they varied greatly in prices. A general conclusion regarding pricing by all manufacturers may, therefore, prove erroneous. Some of the chemicals were, however, marketed by more than one company. Comparison inter se was, therefore, feasible. The prices of one kilogram of active ingredient of four insecticides marketed by different companies were studied. The variations observed between companies are given in Table 2. The individual company's price varied greatly from the average price of all the companies marketing the same product. This variation was not uniform across the chemicals or the packing sizes. For different chemicals the average per cent variation over the average cost varied from as low as -5.7/+5.0 per cent to as high as -16.1/+10.4 per cent. Likewise, across different packings there were wide

differences. The differences were somewhat narrower in smaller size of packings. The prices of all the chemicals examined showed an average variation of -11.6/+10.2 per cent.

Comparison of Recommendations

Out of a total of 29 insecticides and miticides listed by companies, 27 are recommended for cotton pest control (Table 3). There were a few other chemicals for which technical literature was in circulation, and which were also recommended for cotton pests. However, as prices were not quoted for them it was assumed that they were not being marketed. Those insecticides, which are banned but for which literature is still in circulation were also excluded. The insecticides which do not stand included "specifically" for cotton pests in company list are aldrin and dicofol; the latter however is recommended by institutions.

Very few manufacturers stated the species of the pest. Therefore, in analysing their literature, sometimes problems arose about pest identification. However, we restricted ourselves to the common nomenclature followed by the companies. Twenty six pests including mites and termites were reported as pests of cotton by the companies for which chemicals are recommended. The number of recommendations by the companies for cotton insect/mite pests control totalled 379.

In general the recommendations by the universities and the departments were more detailed. All of them gave the recommendations for irrigated and unirrigated cotton separately. One of them also published varietywise recommendations for pest control.

Ten manufacturers recommended insecticides for groups of pests, out of which four also statedspecific pests against which they can be effective. Five companies recommended pesticides only for specific pests. Strangely enough, the literature of one manufacturer did not even mention crops, pests, or their groups against which the chemical can be used.

Four institutions gave recommendations for groups of pests and two issued recommendations pestwise.

For the quantity of insecticides to be used, the most common practice with the manufacturers was to state the quantity of formulation per unit area. Thirteen companies followed this practice. Out of these, 9 gave the quantity of spray needed per unit area also. A few companies differentiated between the quantity of formulation to be used for high and low volume sprays. One company indicated percentage of chemical to be used in the spray, without stating the quantity of spray needed per unit area. Two companies occasionally followed the practice of giving dosages in terms of active ingredient per unit area.

Instead of stating percentage in the spray, one manufacturer indicated the quantity of formulation per specified litres of spray and the quantity of the latter needed for unit area. One company did not give any indication of the dilution or quantity of formulation to be used.

None of the institutions stated the pesticides needed in terms of active ingredient per unit area. Four of them followed the system of stating the quantity of formulations needed per unit area, out of which two also stated liquid spray needed per unit area. One institution stated both the quantity of formulation per unit area as well as concentration in spray and the quantity of spray per unit area. In another case both the concentration in spray and the quantity of spray needed were stated. Each of these institutions followed the practice of recommending specific number of applications for cotton pest control. For unirrigated cotton, the recommended number of applications varied from one to six. The number of applications recommended for irrigated cottons varied from 6 to 15.

The practice of stating number of applications (4 to 10 applications) for cotton was followed by two manufacturers one of which also treated irrigated and unirrigated cotton separately. Two others recommended repeat application where necessary and one recommended increase in dosage depending on the severity of pest attack and the nature of leaf surface. Thus, most of the companies did not emphasize repeat applications where necessary.

Three of the states whose recommendations were studied, recommended mixtures of pesticides for cotton pest control. The mixtures recommended are toxaphane + DDT, BHC + DDT, DDT + parathion, BHC + carbaryl, dimethoate + carbaryl, dimethoate + DDT, carberyl + malathion, phosphomidon + DDT, and phosphomidon + carbaryl. In addition, mixture of sulfur and carbaryl was recommended. Out of 16 companies whose literature was examined, only three advocated use of mixtures, they were: DDT + malathion, fenitrothion + DDT, and parathion + DDT.

Substitutive Insecticides for Cotton Pest Control

Sixteen chemicals were recommended by companies for cotton aphis control, out of which institutions recommended only twelve. BHC, DDT, fenthion, and lindane were not included for aphis control by the institutions. DDVP and formothion and penthoate were in the recommended list of the institutions; specifically for cotton aphis (Table 4 A).

For jassid control sixteen chemicals were recommended by the manufacturers, out of which fenthion and trichlorofon were not in the recommendations of the institutions. The latter, however, recommended three additional ones which did not feature in company list. These were diazinon, DDVP and penthoate (Table 4 B).

Out of fifteen insecticides recommended by companies for cotton thrips control, chlordane and fenthion were not included by the institutions. Unlike the manufacturers they, however, specifically included diazinon, DDVP, formothion, monocrotophos and penthoate for thrips control (Table 4 C).

For white fly (Table 4 E), except DDVP and lindane, which were not in the recommendations of the institutions, nine other insecticides were also recommended by the institutions. These institutions also specifically recommended BHC, formothion, meta-systox, and parathion for cotton white fly control.

Red cotton bug did not commonly feature in the recommendations for cotton pest control by the institutions (Table 4 F). Out of 13 insecticides listed by manufacturers only malathion was indicated by the institutions for use against red cotton bug. The institution also recommended DDT.

Dusky cotton bug infrequently appeared as one of the cotton pests for which recommendations were issued by the institutions (Table 4 G). Only BHC, which was recommended by manufacturers, was the insecticide recommended by the institutions. Seven other chemicals were recommended by the manufacturers.

In the literature of the agricultural institutions cotton flea hopper did not occur at all. The companies recommended six insecticides for this pest (Table 4 H).

Total of ten insecticides/miticides were recommended for cotton mite control by the manufacturers, out of which seven were listed by the institutions (Table 4 I). Institutions had four more chemicals in their recommendations. This summary, however, is incomplete. Literature on acaricides may not specifically mention mites on cotton for which they may be effective.

Thirteen insecticides recommended for pink bollworm were also in the list for spotted bollworm control (Table 4 J,K). In addition phosphomidon was listed for control of the spotted bollworm. DDVP, dimethoate, fenthion, parathion, and trichlorofon, listed by the manufacturers for pink bollworm control were not in the recommended list of insecticides of the institutions. Likewise phosphomidon recommended for spotted bollworm was not in the list of institutions. The institution list included penthoate for bollworms. Parathion and DDT were the cheapest insecticides for bollworm control.

Bud moth, leaf roller, hairy caterpillar, and leaf worm, and semilooper, swarming caterpillar and caterpillar in general were referred to in the company pamphlets on cotton pests (Table 4 M to S). Out of these bud moth, hairy caterpillar, leaf worm, and swarming caterpillar did not feature in the institutions' package of practices for cotton pests. Prodenia was, however, specifically listed by these institutions. Amongst nine chemicals for caterpillar control recommended by the companies, carbaryl, DDT, endosulfan, parathion,

and penthoate were included by the institutions for Prodenia control. In addition, the latter recommended use of four other insecticides specifically for this pest. For leaf roller (Table 4 O) the list of insecticides was the longest. Out of eighteen chemicals,only nine featured in institutions' recommendations. From the remaining, DDVP, thiemeton, and trichlorofon were not in the list of the institutions.

The institutions recommended carbaryl and endosulfan for the control of Heliothes (Table 4 Q); the manufacturers, however, considered three different insecticides as being effective.

Nine insecticides were in the institutions' list for grey weevil control but were not given in the companies' literature. The five insecticides recommended by companies were also recommended by the institutions.

Cost of Cotton Pest Control

The high pesticide cost is attracting attention of farmers and policy makers. The present study enables us to know what the average cost would be for cotton pest control. As per manufacturers recommendations, the following were the average cost in Rs./ha for a single application:

Aphis 86.80, jassid 78.60, thrip 94.60, mealybug 88.60, white fly 103.20, red cotton bug 95.20, dusky cotton bug 85.80, flea hopper 110.60, mite 81.50.

Pink bollworm 124.90, spotted bollworm 138.60.

Bud moth 115.80, caterpillar 134.30, hairy caterpillar 154.50, leaf roller 103.20, leaf worm 99.70, Heliothes 177.40, semilooper 114.90, swarming caterpillar 140.70, stem borer 139.00, grey weevil 114.60.

Termite 175.90

Scale 114.90.

The average cost for controlling cotton pests came to Rs.111.90/ha for one application.

Comparison of Dosages Recommended by Manufacturers and Institutions

In case of cotton aphis control, for ten chemicals the companies recommendations on an average were higher by 35 per cent than those of institutions. In the remaining six, however, the institutional recommended dosages were higher by 60 per cent. For jassid control the ten chemicals for which companies recommended higher doses, they were higher by 26 per cent but for the remaining chemicals their recommended doses were lower by 39 per cent. These respective percentages for thrip were 30 and 26.6 per cent, for white fly 21 and 27 per cent. For pink bollworm eight chemicals for which manufacturers recommended increased dosages, they were

higher by 28 per cent, but for the remaining chemicals, the company recommended doses lower by 31 per cent. The corresponding percentages for spotted bollworm were 29 and 38. The trend is the same for remaining pests. The important conclusion is that generally manufacturers recommended higher doses in larger number of cases. But where the institutions' recommended doses were higher, for certain chemicals, they are even more than double the companies' recommended doses.

DISCUSSION:

There were many glaring differences between the recommendations of the manufacturers and the agricultural institutions. These differences pertained to both structure and contents. It is worth considering whether some common, minimum uniformity consistent with utility to farmers can be evolved. Based on the comparison presented earlier, the following suggestions are worth considering.

Often pesticides are effective for a number of pests at the same dosage, there is an advantage in recommending pesticides for groups of pests. Thus, for example, for cotton pests, one can consider the following groups: i) aphis, jassid, thrip, ii) bollworm, iii) mite, iv) caterpillar. A single insecticide or groups of insecticides can be recommended for each group.

As for the quantity to be used, it would be best to state the quantity of formulation to be used per units area as it will be easily understood by farmers. This has to be accompanied by the quantity of spray liquid needed per unit area for each crop. There will be some variations in the quantity needed as per vegetative growth of crops. For some crops where the spray liquid requirement will vary as per growth stages, e.g. cotton the relevant quantities needed should be stated.

Whether the quantity of formulation should vary with high and low volume spray, needs to be decided and incorporated in the recommendation.

The almost total absence of mention of active ingredient needed per unit area in extension literature may indicate the impracticability of using it, due to the difficulty faced by farmers as well as extension workers in comprehending the instructions. The practice of recommending percentage of active ingredient of pesticide is also difficult to adopt due to calculations - however simple to entomologists - involved.

Recommendation for irrigated, unirrigated crops and varietywise need of pest control, should be suitably included in extension literature of each state, but this need not be so in company literature. Its inclusion in the regional language literature of companies may, however, be useful.

As for the recommended number of applications, regional variations are bound to exist. It will be therefore, difficult for the manufacturers to include this aspect in their literature. Perhaps, as is sometimes the practice, the regional language translations of the company recommendation can profitably include this. In any case, it is important that companies should state that repeat application be made where pest persists.

It is a general practice of the universities and the departments to recommend mixtures. At this stage a general opinion cannot be formed about its toxicological justification, however it is known that a mixture lowers cost as it means spraying two insecticides together rather than separately. However, saving in cost of spraying alone cannot be an adequate reason for advocating it. Different mixtures of products can provide a tool for promotion of products but this has to be consistent with the cost/effectiveness of the pesticides.

Extension literature for farmers issued by the agricultural institutions refer to lesser number of pests than does company literature. It leads one to believe that the remaining ones appearing in company literature do not have a pest status of practical significance. Assuming this to be the case, one may reason that company literature being comprehensive, it will not emphasize pests of economic significance sufficiently. There is,

therefore, a need to differentiate major pests and the rest in company literature. This distinction can be brought out by depicting the two categories appropriately in the pamphlets.

Another difference pertains to the range of insecticides available to farmers as per industry's recommendation. Their literature usually indicated numerous substitutive insecticides. For cotton aphis control, for example, the industry's list included sixteen insecticides, but the agricultural institutions indicated only twelve. For bollworm control, four chemicals recommended by agricultural institutions do not appear in company literature. This discrepancy brings out the need for the industry as well as the agricultural institutions to exercise caution in making recommendations. The industry should refrain from recommending insecticides which are not effective; the institutions should not be unduly restrictive in the range of insecticides recommended.

The existing range of insecticides/miticides, offered by the manufacturers needs further research and review by the agricultural institution to ascertain if less expensive chemicals can be as effectively used as the costly ones. Further, the introduction of the practice of providing data on the degree of effectiveness of a panel of chemicals of workable efficiently in extension literature seems necessary. If this is accompanied by the actual or relative cost to farmers per hectare, it will help the users to exercise a rational judgement.

When all cotton pests for which recommendations were available from manufacturers and agricultural institutions were considered collectively, in 65 per cent of formulations the manufacturers' recommended dosages were higher than those of institutions. Only in two per cent of cases they were identical. From amongst those where institutional recommended dosages are higher, they were sometimes even double than those recommended by the manufacturers or even more for carbaryl and monocrotophos. All these differences need to be individually examined with reference to actual effectiveness as reported in research literature. The higher dosages for cotton pests control in comparable literature point to the possibility of lowering the cost to farmers. Any reduction in use due to this will also help in reducing the danger of environmental pollution which is showing up in areas of intensive plant protection.

## SUMMARY

Indian farmers can obtain information on pesticides from three sources: literature put out by the manufacturers, material issued by the departments and agricultural universities, and what is published by formulators. Literature from the first two sources was compared for their structure and contents. The objective was to know the prevailing cost to farmers and the substitutive products available to them. Another objective incidental to the main

objective of the study, was to ascertain the sizes of packing for various types of formulations, and the comparative unit cost of active ingredient in each formulation.

For the insecticides/miticides marketed as dusting powder and wettable powder, the price per kilogram of active ingredient was higher by 9.5 per cent in wettable powders than for the dusting powder. The price per kilogram of active ingredient in emulsion was 43 per cent higher than in dusting powder. There was a greater difference in the organo phosphorus group of insecticides.

Liquid formulations are marketed in five sizes of containers. The price indices for a kilogram of active ingredient were: 1 litre 104.1, 0.5 litre 109.7, 0.25 litre 112.7 and 0.1 litre 121.4 where 5 litres = 100. The price index for the smallest packing was found higher in products of large companies than the rest of the products. Prices of the same chemical marketed by different companies showed a variation of +12/-10 per cent over the average price. This, however, was not uniform across the four chemicals studied for this purpose. In one case the price was higher by 27.5 per cent and in another, lower by 4.6 per cent than the average price.

The dissimilarities between the literature of the manufacturers and six agricultural institutions were identified, in respect of their general structure, and for the recommendations for cotton pest

control in particular. These findings reinforced the need to rationalize the way recommendations are made and to achieve uniformity among them. Following suggestions were made to achieve these goals.

Recommending pesticides for groups of pests should be the predominant practice; allowing such variations as found advantageous.

The practice should be to give the amount of formulation to be used in unit area while stating the quantity needed as it is easy to understand. The quantity of spray required should be indicated as well.If repeat applications are required, it should be indicated.

When recommendations for cotton pest control from the manufacturers and agricultural institutions are compared, the need to differentiate between pest status of various insects in the manufacturers' literature is felt. The list of insecticides for cotton pest control given by the companies needs to be rationalized, keeping in view the techno-economic data. The list of chemicals recommended by agricultural institutions, on the other hand, needs to be enlarged and the comparable effectiveness and costs of these chemicals should also be given. The manufacturers recommend higher dosages than the institutions; this discrepancy should be eliminated. Research should be carried out to determine if less expensive chemicals can effectively substitute the more expensive ones.