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Trends in Agrochemicals Used To Grow Cotton

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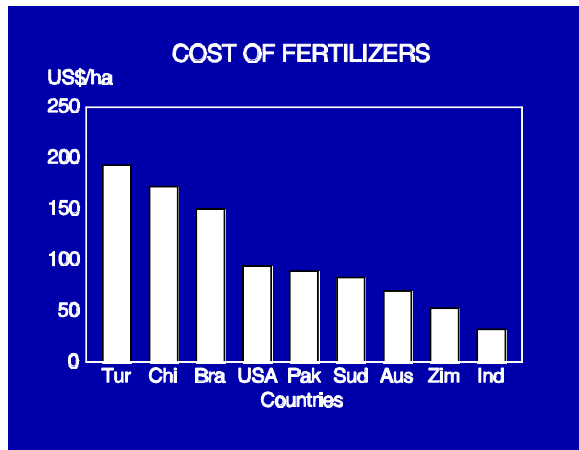
Last year the International Cotton Advisory Committee undertook an extensive study of agrochemicals used to grow cotton in various countries. The report based on the latest data for the year 1994/95 was published in October 1995. The report is available from the ICAC Secretariat and results of the same report along with our conclusions from this study are presented here. Agrochemicals have become an integral part of cotton production practices in the last few decades and knowledge on use of agrochemicals is considered to be a crucial factor in realizing an optimum yield under any set of agroclimatic conditions and production practices. For optimum utilization of production technology and inputs, it is important to avoid misuse of agrochemicals. This paper covers the current status of agrochemicals used to grow cotton and their possible future trends. The agrochemicals covered in this paper are fertilizers, insecticides, herbicides, growth regulators and to some extent defoliant.

Fertilizers

Fertilizers form the bulk of agrochemicals used to grow cotton. Like all other agricultural crops, nitrogen, phosphorous and potassium are the major elements needed to grow cotton. Nitrogen has to be applied under all set of growing conditions because plant needs for nitrogen are drastically different at various stages of development. But, it is still not used on all the cotton area in the world. Nitrogen is not applied in Uganda and it is applied to only about 2% of total area in Argentina. Almost all or more than 90% of the total cotton area is treated with nitrogen in China (Mainland), Colombia, Greece, Israel, Pakistan, Senegal, Spain, Syria and Togo. In the USA, nitrogen is applied to about 85% of the total cotton area. Phosphorous and potassium are used more extensively in Brazil, Colombia, Israel, Sénégal, Spain (100%), Syria, Togo and the USA. Micronutrients are applied in small quantities to some area in Colombia, Greece, Sénégal, South Africa, Spain, Thailand, Togo and the USA.

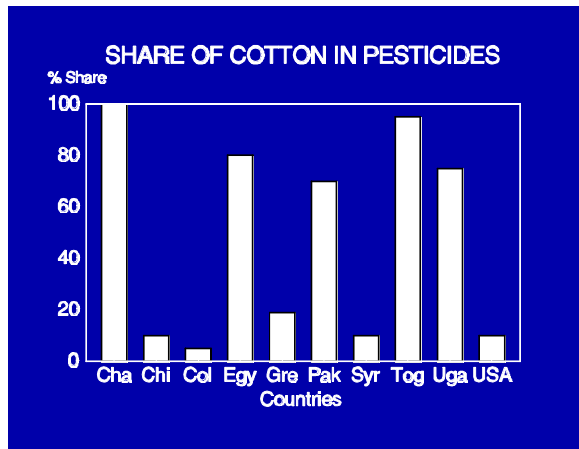
| Country | FERTILIZERS | | |
|-----------|----------------------------------|---------|---------|
| | Kg Nutrients/ha (% Area Treated) | | |
| | N | P | K |
| Argentina | 40(2) | | |
| Australia | 150(100) | 8(100) | |
| Brazil | 25(50) | 50(50) | 30(50) |
| China | 100(90) | (40) | (50) |
| India | 40(80) | 20 | 20 |
| Pakistan | 112(100) | 45 | |
| Spain | 200(100) | 75(100) | 75(100) |
| Turkey | 200 | 50 | |
| USA | 100(85) | 52(54) | 65(36) |
| Zimbabwe | 20(50) | 20 | 30 |

Cost of fertilizers is a major part of production cost but it is still less than the cost of insecticides. Almost US\$ 200 are spent on fertilizers and their application in Turkey, over US\$ 170 in China and close to US\$ 100 in the USA, Pakistan and Sudan.

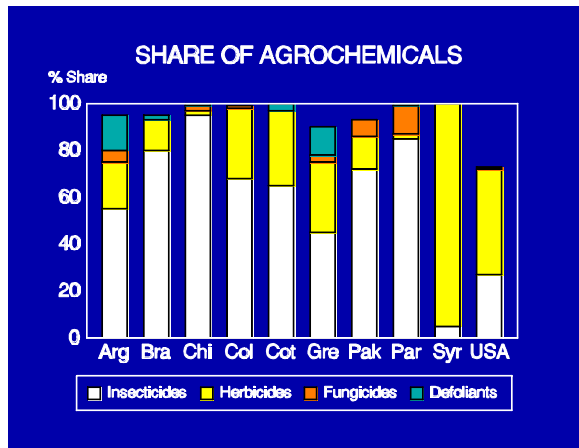


Pesticides

Insecticides and herbicides are the main components of pesticides used on cotton. Chad is the only country where all pesticides imported in the country are used on cotton. Togo is an almost similar situation. In India and Pakistan, 53% and 70% of total pesticides are consumed by cotton respectively. In China and the USA, which together produce about 40% of world production of cotton, cotton uses only 10% of the total pesticides used in these countries.

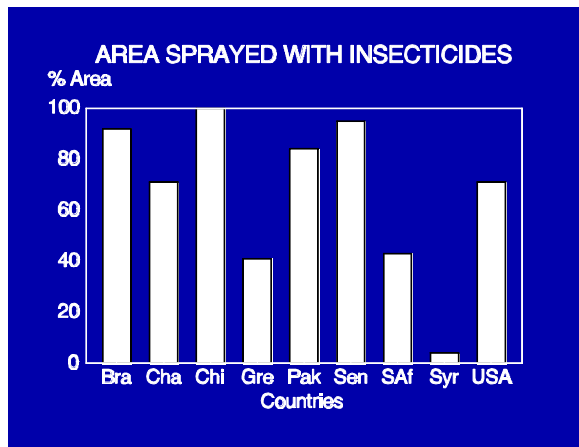


Among pesticides and other chemicals used to grow cotton, other than fertilizers, insecticides form major component of these chemicals. In Syria, 95% of the total chemicals (without fertilizers) used to grow cotton are herbicides. In the USA, insecticides and herbicides are 27% and 45% of total chemicals respectively. Fungicides are used at the most on 12% of the total area in Paraguay, which has the highest rate of their application in the world. Pheromones –a special group of chemicals used to control insects –are commonly used in Egypt.

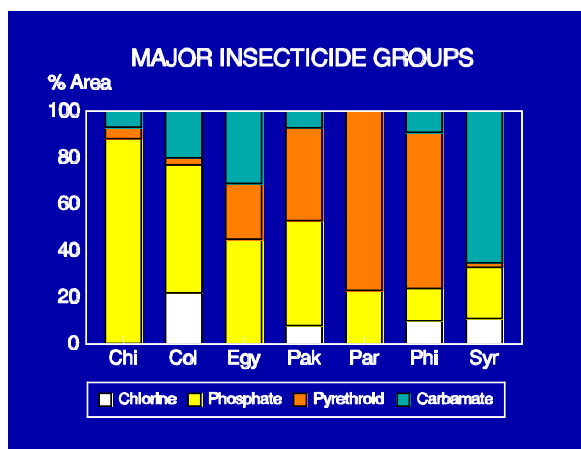


Insecticides

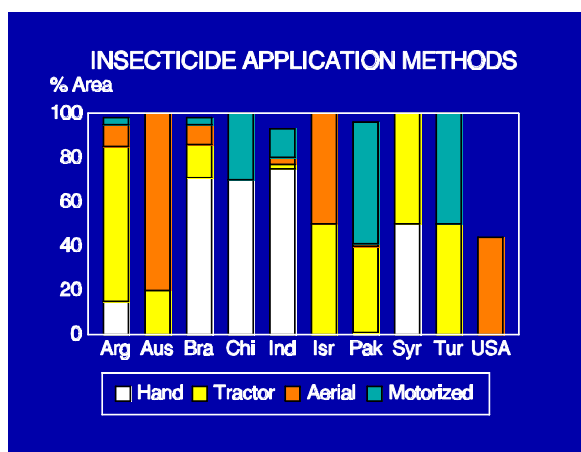
100% of planted cotton area is not sprayed in many countries, nor is there a need to do so. Currently, 100% of the cotton area is sprayed at least once a season in Argentina, China (Mainland), Colombia, Côte d'Ivoire, Egypt, Iran, Israel, Paraguay, the Philippines and Spain. More than 80 but less than 100% of the total cotton area is sprayed with insecticides in Brazil, Pakistan, Sénégal, Thailand and Togo. Among these countries, in the last ten years, significant changes have occurred in China (Mainland). During 1985, only 70% of the total cotton area was treated with insecticides, increasing to 100% by 1991. China (Mainland) had to extend insecticide application to a larger area because of widespread losses due to bollworms and aphids. Brazil has also significantly increased the area sprayed with insecticides. Syria and South Africa are the only countries where insecticide use in terms of sprayed area has been reduced in the last ten years. In Syria, raising of the economic threshold and IPM have reduced the area sprayed from 25% in 1985 to only 4% during 1994. In Egypt, implementation of plans to spray only infested areas, not to use insecticides against early season insects, to use pheromones (since 1991) and to practice IPM methods extensively is expected to eliminate the need for spraying some areas. Israel, Pakistan and the USA are also giving high priority to IPM methods and treated area is not expected to increase. In the USA, sprayed area is stagnant at around 70%, but the USDA target is to raise the total area under IPM to 75% by the year 2000.



Organochlorines, organophosphates, pyrethroids and carbamates are major insecticide groups used on cotton to control insects. However, organophosphates and pyrethroids are the only two insecticide groups used in almost all countries. Organophosphates are very popular in China, Colombia and Pakistan in addition to Chad, Côte d'Ivoire, Sénégal and Togo. Pyrethroids form more than 50% of the total insecticides in Greece, Paraguay, the Philippines and Syria. Use of pyrethroids, a group of chemicals notorious for resistance, has decreased in Colombia and China mainly due to resistance problem.

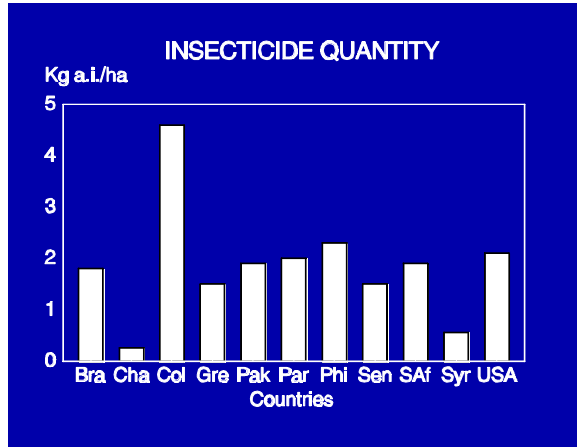


Four main methods to spray insecticides are back mounted hand operated sprayers, motorized sprayers, tractor mounted sprays and aerial application. Hand spraying is more popular in China, Brazil, India, Paraguay, Philippines, Syria, Thailand, Uganda and Zimbabwe. In Argentina, Israel and Syria at least 50% of spraying is done by tractor mounted sprayers. In Greece, all insecticides are applied with tractor mounted sprayers. 80% of spraying is done with airplanes in Australia. In Colombia and the USA, 50% of spraying is done with airplanes.

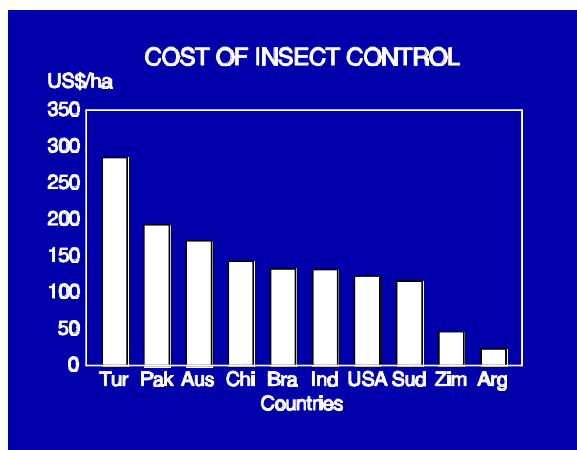


In Colombia, the need for a high quantity of insecticides has rendered cotton production an uneconomical business thus affecting cotton area. The quantity of insecticides applied on per unit area does not significantly differ among Brazil, Pakistan, Paraguay, Philippines and the USA. Comparable data were not available from Australia, China and India but it is learned that insecticide use has been reduced in Australia while it has increased in China and India. The smallest quantity of insecticides is used in Chad and Syria because of limited supply and

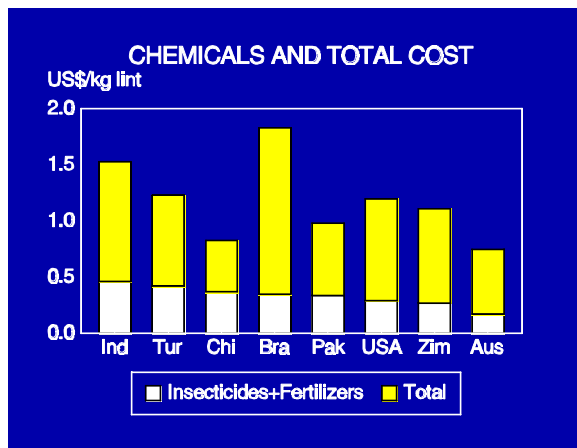
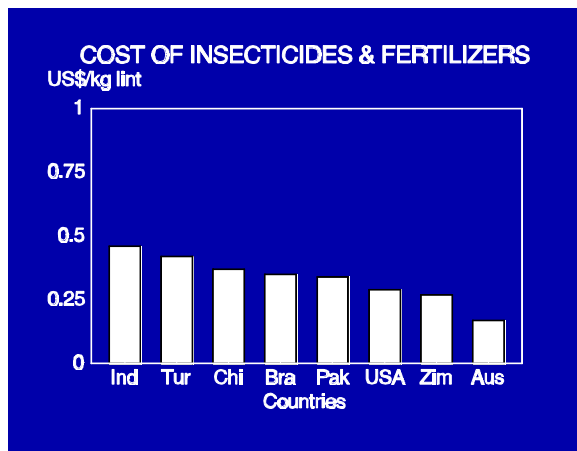
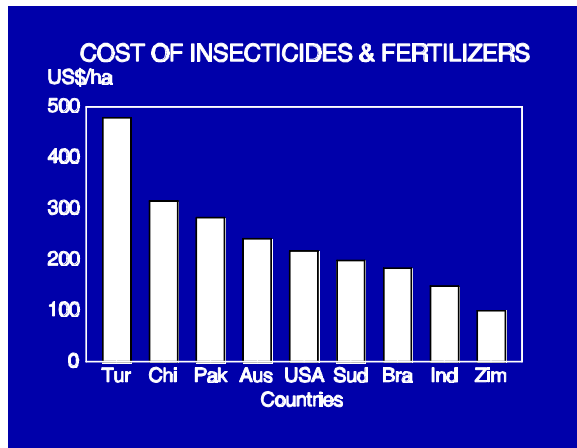
minimum need for insecticides respectively.



Among ten main cotton producing countries of the world, the highest dollar amount is spent on insecticides and their application in Turkey (US\$ 285/ha). In Pakistan, widespread losses due to leaf curl virus disease since 1992 have increased the cost of insect control significantly, and during 1994/95 about US\$ 200 were spent to grow one hectare of cotton. In Australia, a resistance management program has reduced the average number of sprays from 13 to 9 in the last few years but still about US\$ 170 was spent to grow one hectare during 1994/95. In China, due to bollworm resistance, the cost of insecticides and their application has increased to US\$ 143 per hectare in the last few years. Damage due to boll weevil may increase the cost of insect control in Argentina in the next few years.



The cost of the two major agrochemicals, i.e. fertilizers and insecticides, for producing one hectare of cotton among major cotton producing countries is the highest in Turkey (US\$ 478) followed by China (US\$ 315), Pakistan (US\$ 282), Australia (US\$ 241) and the USA (US\$ 217). The cost of fertilizers and insecticides per kilogram of lint was the highest in India due to low lint yield. Among ten main cotton producing countries excluding Uzbekistan, the cost of fertilizers and insecticides per kilogram of lint was the minimum in Australia due to high lint yield/ha.



Over 75% or all insecticides used on cotton are imported in Brazil, Chad, Egypt, Greece, Iran, Paraguay, Syria, Togo and Uganda. Similarly, 3/4 or all insecticides used in China, Côte d'Ivoire, Israel, Sénégal, South Africa, Spain, Thailand and the USA are locally produced. However, all new insecticides are registered only after thorough testing and an evaluation of the test results by government authorities in all countries. In many countries, label language

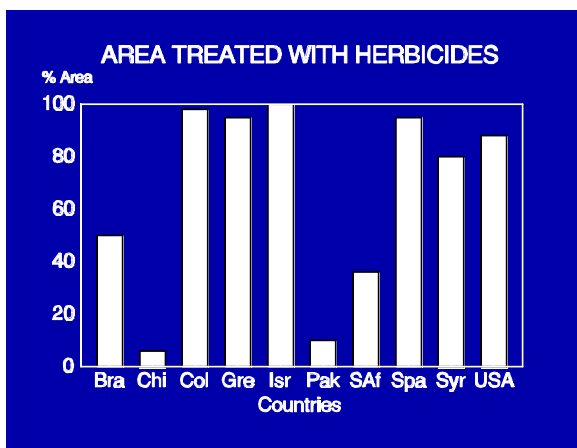
is also approved for safe use of products. Toxic effects, effect on the environment and effect of non active substances on mammal and non mammal species is rarely given on the labels. Our study has also observed that farmers' understanding of insecticide use has improved significantly and farmers are becoming more conscious of using environmentally safe products. It has also been observed that spraymen often do not wear proper clothing at the time of spraying or while handling toxic compounds. However, intoxication is very rare. If registered insecticides do not conform to the claims made by pesticide companies or cause serious effects on non-target species and the environment, they are deregistered in all countries.

Farmers usually judge products from their field performance which is affected by spray machinery and many other factors. If any of these factors goes wrong and the insecticide does not show the desired effect, the purity of the product is blamed. Adulteration of pesticides is a critical issue often raised by farmers. Quality control is in effect in almost all countries. Resistance to various groups of insecticides is another important issue of concern to many countries and requires long term planning.

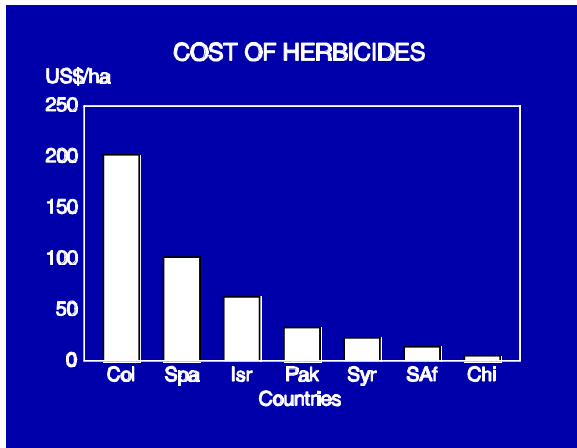
Currently, many choices for non-chemical, more safe means of insect control are not available to farmers. Among biological control agents, Bt is used in some countries but on a limited area. Cost, comparability with insecticides, and control of more than one species of insects are some of the issues which will determine its future use. On the other hand genetically engineered Bollgard and BXN cotton tolerant to lepidopteran insects and broad leaf herbicide respectively will be planted on larger scale in the USA during 1996/97. The impact of genetically engineered Bollgard cotton on reducing the use of insecticides is still to be seen. However, IPM approaches have been designed and implemented in many countries. The Food and Agriculture Organization of the United Nations has organized a number of regional meetings in various countries to promote IPM. To some extent, IPM has already shown an impact on the quantity of insecticides used to control insects.

Herbicides

Herbicides are used extensively only in Colombia, Greece, Israel, Spain, Syria and the USA. Alternate methods of eliminating weeds in the form of cheap labor and mechanical eradication are available and used in other cotton producing countries.

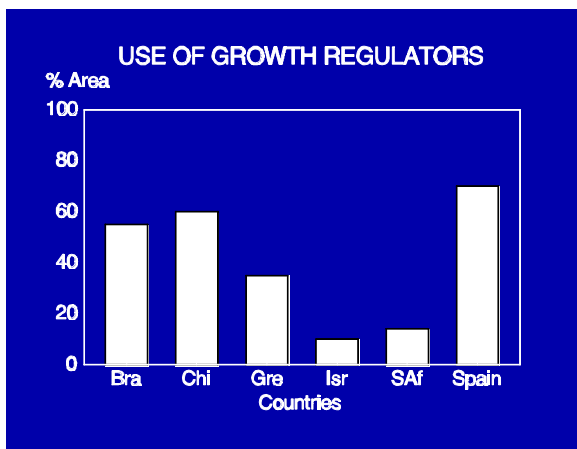


In the last ten years, herbicide use has decreased in S negal and South Africa. The general trend, however, is increased use of herbicides because of better awareness of the ill effects of weeds which compete with the cotton plant for water and nutrients, harbor insects, hinder cultivation operations and affect lint quality. In the USA, although it is intended to reduce herbicide applications, the release of genetically engineered BXN cotton tolerant to broad leaf herbicide might encourage the use of post-emergence herbicides. Syria has stabilized herbicide use at 70-80% of the total area. Cost of herbicides is the highest in Colombia followed by Spain and Israel although all the cotton area is treated with pre or post emergence herbicides in these countries.



Growth Regulators

Growth regulators are used only on a small scale with the exception of Brazil and China (Mainland) where currently 55% and 60% of the total cotton area is treated with growth regulators, respectively. The use of growth regulators is expected to increase in these countries. In Greece and Guatemala, the portion of the area treated with growth regulators fluctuates around 35%, depending on planting conditions.



10-14% of the total cotton area is treated with growth regulators in Argentina, Bulgaria, Ecuador, Israel and South Africa. In the last few years, the use of growth regulators has

increased significantly in Spain, and now about 70% of the total area is sprayed with growth regulators. In the USA, 35-40% area is treated with growth regulators. Growth regulators have shown no significant effect on yield in many countries like Egypt, Pakistan, Philippines and Turkey. With the continuous selection pressure on the plant for short and early maturing plant types, a stage might come when growth stimulants may have a positive effect on yield.

Defoliants

Chemical defoliation is a prerequisite for machine picking. But, in some countries defoliants are used to enhance crop maturity and also to improve uniformity. Sometimes cold temperatures also serve as a natural defoliant and help in natural shedding of leaves and consequently improve crop maturity. 100% of the cotton crop is chemically defoliated only in Australia and Israel. In the USA, almost all cotton is defoliated in the West but only 20% of the production area is defoliated in the Southeast.

