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Review

The benefits of pesticides to mankind and the environment

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Abstract

Most published material relating to pesticides focuses on negative attributes and outcomes. This fact probably partly explains the public's inaccurate perception of the hazard they represent, and the low level of appreciation of the benefits they bring. This paper explores and analyses the many benefits of using pesticides, in order to inform a more balanced view. It does not attempt to quantify or rank these benefits, nor to weigh them against any negative consequences of pesticide use. Twenty-six primary benefits are identified that are immediate and incontrovertible, and 31 secondary benefits that are longer term, less intuitive and for which it is harder to establish causality. These benefits include increased crop and livestock yields, improved food safety, human health, quality of life and longevity, and reduced drudgery, energy use and environmental degradation. A complex matrix of benefit interactions are explored for a range of beneficiaries at three main levels—local, national and global, and in three main domains—social, economic and environmental.

Keywords: Pesticide; Application; Effect; Primary benefit; Secondary benefit; Risk; Beneficiary; Agriculture; Public health; Economy; Pests; Diseases

Contents

1. Introduction . . . 1337
2. Perceived versus real risk . . . 1338
3. Types of positive outcome from pesticide use . . . 1339
   3.1. Effects . . . 1339
   3.2. Primary benefits . . . 1339
   3.3. Secondary benefits . . . 1339
4. Beneficiaries and the domains and dimensions of benefit . . . 1339
   4.1. The benefits of effect 1—controlling pests and plant disease vectors . . . 1339
   4.2. Benefits of effect 2—controlling human/livestock disease vectors and nuisance organisms . . . 1342
   4.3. Benefits of effect 3—preventing or controlling organisms that harm other activities or damage structures . . . 1345
5. Categorisation of benefits by domain and dimension . . . 1345
6. Discussion and conclusions . . . 1347
   References . . . 1347

1. Introduction

The hazards of pesticides are well documented, but their benefits are largely ignored in published literature and the mass media. A recent brief poll of pesticide-related articles in published literature, conducted by the authors, revealed a ratio of over 40 negative articles for each one that took a more positive view. Many point to health or environmental problems from accidental or deliberate exposure to pesticides, particularly pesticides with high mammalian toxicity or those that persist in the environment. These risks should not be ignored, and efforts must be made to

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minimise them through rigorous regulation and proper training for users, but we should not overlook the positive impacts of pesticide use. When pesticides are used rationally and carefully, in conjunction with other technologies in integrated pest management systems, it is more likely that their use will be justifiable.

Part of the explanation for the scarcity of articles highlighting the benefits of pesticides may be that when a product does exactly what the manufacturer says it does, it is not 'newsworthy'. We do not read about the wonders of gloss paint, but it remains a good way to protect exterior woodwork. Sometimes, it takes an accident or evidence of harm to stir the popular media into action and this applies to some extent to scientific literature too.

There are some exceptions to the predominantly negative view of pesticides—Lomborg and Bjorn (2001) wrote "If pesticides were abolished, the lives saved would be outnumbered by a factor of around 1000 by the lives lost due to poorer diets. Secondary penalties would be massive environmental damage due to the land needs of less productive farming, and a financial cost of around 20 billion US Dollars".

This paper does not attempt to quantify or rank the benefits, nor to balance the benefits from pesticide use against any negative consequences. Rather it focuses on the positive outcomes delivered by judiciously used pesticides, in order to inform a more objective assessment of costs and benefits. It arises from an extensive literature search, the preparation of a comprehensive review report and the compilation of an electronic database of pesticide benefits for CropLife International. The key 100 or so articles will be available in the database, which will be publicly accessible via the CropLife website, as well as the full review report and bibliography of all 360 references (http://www.croplife.org/).

2. Perceived versus real risk

Like many technological developments that improve the quality of our lives, pesticides can pose risks if they are not used judiciously. In this they are not unique. Cars kill over 40,000 people each year in the US alone (Anon, 2003a). Their emissions contribute to greenhouse gases (Anon, 2006a) and they are inefficient users of energy compared with alternatives, such as buses or trains (Anon, 2006c). However, the convenience of being able to go from place to place independently is compelling, so many of us buy and drive cars. To reduce the risks and negative impact of car ownership, we legislate to make them safer (Likanen, 2001), and less polluting (EPA, 2000) and require drivers to pass a proficiency test to drive them. Likewise mains electricity brings irresistible benefits but there are some negatives too. Its production pollutes the atmosphere and causes 33% of greenhouse gases (Anon, 2006b) and there were 411 deaths in the US from accidental electrocution in 2001 according to the Product Safety Commission (2006). Similarly, few people would deny that medicines can reduce disease and preserve life, but if they are used without care they can be extremely hazardous. Berry (1991) pointed out that we accept the risks associated with selling the analgesic drug paracetamol over the counter in packets of five lethal doses, due to the benefits of easy access to pain relief and the improvement in life quality that it brings. These examples provide parallels with pesticides, being technologies that make our lives better, provided they are regulated and used in such a way that the benefits significantly outweigh the risks.

The potential benefits are particularly important in developing countries, where pests cost billions of dollars in national income (Anon, 2004b) and farm and post-harvest losses contribute to hunger and malnutrition, which kills between 12 million (UNICEF undated) and 15 million children annually (Anon, 2005a). According to the United Nations Children's Fund (UNICEF) malnutrition is: "largely a silent and invisible emergency, exacting a terrible toll on children and their families" (Bellamy, 1998).

Weighing the risks against the benefits of pesticide use is not only hampered by the paucity of information on benefits, but also by the fact that most people are poor judges of the relative hazard that pesticides represent. Based on earlier US data by Upton (1982), Hibbitt (1990) ranked 30 hazards on the criterion of number of deaths per year, with number 1 being the largest number of deaths and number 30 being the smallest. Pesticides were ranked very low at number 28 behind food preservatives (ranked 27), home appliances (ranked 15), swimming (ranked 7) and smoking and alcohol (ranked 1 and 2, respectively). But public perceptions were very different. Women voters thought that pesticides ranked number 9 in the list, and college students put them at number 4. Both groups performed poorly at estimating the relative risks posed by a list of hazards, perhaps due to the predominantly negative publicity that pesticides receive.

Moreover, food safety and health concerns in the general public have increased in Europe following serious incidents such as Salmonella poisoning, Bovine Spongiform Encephalopathy (BSE), Foot and Mouth and *Escherichia coli* infections. Pesticide residues in food, detected at ever-lower levels due to increasingly sensitive laboratory equipment, are perceived to be associated with these issues and are lumped together with them as another of the evils of agricultural intensification. However, the evidence does not support the popular view that pesticide residues represent a significant health risk in Europe and the US.

Statutory maximum residue levels (MRLs) are the highest concentration of pesticide (expressed in mg/kg) legally permitted in or on food commodities and animal feed. They are set by measuring the residue levels on harvested produce after it has been grown using Good Agricultural Practice and in accordance with pesticide label instructions, provided this level does not constitute a hazard to consumers. In fact, contrary to public perception, MRLs are far below any level that would be hazardous to consumers—they are usually not approved unless they are a factor of at least 100 below the no observable adverse effect level (NOAEL). The UK Pesticide Residue Committee annual report (2002) found