10 Application techniques for agrochemicals
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The majority of pesticide formulations are diluted in water and applied under pressure through hydraulic nozzles, while some specialized formulations are used with a petrochemical diluent, undiluted as ultra-low volume sprays, or dry as granule or dust treatments. In this chapter the different types of nozzles and the portable, tractor-drawn and aerial equipment are described, followed by information on alternative methods of application. More detailed description of application techniques is given by Matthews (1992). A recent trend in the developed countries has been the health and safety legislation leading towards linking packaging of pesticides, described in the previous chapter, with the application equipment to provide a closed transfer system minimizing operator exposure. With the trend towards adoption of integrated pest management (IPM) to minimize the use of pesticides, more accurate and timely application is of increasing importance (van Emden and Peakall, 1996). In particular, training is needed to ensure better choice of equipment, especially the nozzles, and calibration to ensure the correct dosage is applied.

10.1 Hydraulic nozzles

The key part of the atomization of liquid sprays into droplets is the nozzle. Liquid passing through a small orifice in the nozzle tip forms a sheet, which subsequently breaks into droplets. The process of break-up includes rim disintegration where droplets are thrown from the edge of the sheet, but most droplets are formed by perforated sheet disintegration. An increasing number of holes develop in the sheet, separated by thin ligaments of liquid that are unstable. These ligaments break up into droplets and smaller ligaments, which ultimately produce smaller satellite droplets. In some cases under turbulent conditions, wavy sheet disintegration occurs where sections of the sheet may break away. The break-up of the sheet is also influenced by the physical properties of the formulation, including dynamic surface tension and viscosity of the liquid. If the sheet disintegrates closer to the nozzle, larger droplets are formed, whereas if the sheet remains coherent and stretches to form a very thin film before break-up, smaller droplets are produced (Butler Ellis et al., 1997; Figure 10.1). Irrespective of the mode of break-up, hydraulic nozzles produce droplets of a wide range of sizes.
Figure 10.1 Spray from 110 degree 04 nozzle hydraulic nozzle to show effect of pressure and addition of certain surfactants. (a) Water sprayed at 1 bar pressure; (b) as (a) at 3 bar pressure; (c) water plus 0.5% LI-700 at 1 bar pressure; (d) as (c) at 3 bar pressure; (e) water plus 0.5% Ethokem at 1 bar pressure; (f) as (e) at 3 bar pressure. (Photographs supplied by P. Miller, Silsoe Research Institute.)