

Trophobiosis Theory: A Pest Starves on a Healthy Plant

By John Paull

Fenner School of Environment & Society, Australian National University, Canberra

Pests shun healthy plants. Pesticides weaken plants. Weakened plants open the door to pests and disease. Hence pesticides precipitate pest attack and disease susceptibility, and thus they induce a cycle of further pesticide use.

This is the essence of Trophobiosis Theory, a thesis presented by Francis Chaboussou, an agronomist of the France's National Institute of Agricultural Research (INRA), in *"Healthy Crops: A New Agricultural Revolution"*. After two decades, this important book is finally available in English.

Trophobiosis has been characterised by the former Minister for the Environment in Brazil, Jose Lutzenberger, as: "a pest starves on a healthy plant" (1995). It is "a revolution in plant pathology and is a mortal blow to agrochemistry as commonly practised in modern agriculture" (Lutzenberger, 2000, p. 2). He laments that: "Chaboussou is still unknown to most workers in agriculture, even in organic agriculture" (2000, p. 2). Lutzenberger puts the case bluntly: "the more poisons we apply, the more diseases and pests we get" (p. 3). It is certainly the case that agribusiness continues its focus, not on the health of the crop, but rather on the demise of the pest, and so continues to develop novel pesticides, genetically modified organisms that produce pesticides or can withstand heavy pesticide dosages, and most recently the coupling of nanotechnology and pesticides.

Lutzenberger writes that: "I knew that pests shunned healthy plants, as most observant organic farmers knew. But I didn't know how and why. Chaboussou was a revelation to me ... I dare say that Chaboussou's work is the most important discovery in agricultural chemistry since Liebig" (p. 5).

If Chaboussou is correct then the premises of the so-called green revolution are false. There is the common experience that pesticides used on crops lose their efficacy after so many applications, the pests return and the pesticide dose, or the frequency of application needs to be stepped up, and/or new pesticides need to be introduced into the spraying regime. The green revolution explanation of this is that the pest develops

resistance. Chaboussou's explanation is that the plants are weakened, and progressively more so, as they are repeatedly assaulted by this chemical warfare. Because they are progressively weakened ever more chemical intervention is required - hence the pesticide treadmill experienced in chemical farming.

Chaboussou's alternative approach is to focus on the health of the crop. According to Chaboussou *"we need to overcome the idea of 'a battle'; that is we must not try to annihilate the parasite with toxins that have been shown to have harmful effects on the plant, yielding the opposite effect to the one desired. We need, instead, to stimulate resistance by dissuading the parasite from attacking. This implies a revolution in attitude, followed by a complete change in the nature of research"* (p. 209).

In taking a non-military approach to farming, Chaboussou is taking a position in solidarity with proponents of organic agriculture including the earliest, Steiner (1924), Pfeiffer (1934), and Northbourne (1940). *"And so with the biological-dynamic methods we work not against Nature but with Nature* (Pfeiffer, 1934, p.16).

Pfeiffer put it this way: *"When the biological balance is upset, degeneration follows; pests and diseases make their appearance. Nature herself liquidates weaklings. Pests are therefore to be regarded as nature's warning that ... the balance [has been] sinned against"* (1958, p.16).

Northbourne wrote that: *"There can be no quarrel between ourselves and nature any more than there can be between a man's head and his feet ... We have invented or imagined a fight between ourselves and nature; so of course the whole of nature, which includes ourselves as well as the soil, suffers ... We have tried to conquer nature by force and by intellect. It is now for us to try the way of love"* (1940, p. 191, 192).

From the outset of organic agriculture, Northbourne had nailed the escalation problem of chemical farming: *"True, plants continue to grow on the ground, but why is it that more and more spraying is necessary? What answer can there be but that diseases and pests are more and more rampant; in spite of the fact that far more is being done, far more skill is being lavished on the combating of disease than was ever dreamed of in the past ... It is liability to disease and not disease itself which indicates ill-health"* (1940, 101). This is the issue that Chaboussou addresses with trophobiosis theory.

Trophobiosis is derived from two Greek roots - *trophikos* (nourishment) and *biosis* (life): *"the relationships between plant and parasite are primarily nutritional"*

(Chaboussou, p. 206). According to the trophobiosis theory, it is nutrient deficiencies and imbalances that lead to pest and disease outbreaks, and that synthetic pesticides and fertilisers can cause such deficiencies and imbalances.

The trophobiosis theory has been summed up by Dr. Ulrich Loening of the University of Edinburgh as follows: *“most pest and disease organisms depend for their growth on free amino acids, and reducing sugars in solution in the plant’s cell sap. Every farmer has experienced the increase in diseases after heavy fertilisation with nitrogen; the Green revolution varieties are good examples in which rich fertilisation creates susceptibility to pests, requiring more pesticides to control. Chaboussou explains why. Almost all conventional chemical agricultural technologies create favourable conditions for the growth of pest and disease organisms ... the susceptibility of the crop is increased: when offered free nutrients, pests grow better and multiply faster. In this sense therefore, agro-chemicals and poisons cause pests and diseases”* (2004, p. x, xi).

Under Chaboussou’s theory, an excess, within the plant, of less complex biochemical molecules, such as amino acids (rather than proteins that they build to) and/or simpler (reducing) sugars such as glucose (rather than the more complex carbohydrates such as glucose polymers - starches - and other polysaccharides) offers an attractive milieu for pests and disease.

Chaboussou’s book *Healthy Crops* is presented in three sections: *Pesticides and Biological Imbalances; Deficiencies and Parasitic Diseases; and Agriculture Techniques and the Health of Crops*. He documents his case citing a wide variety of research, including his own.

Chaboussou acknowledges that there are multiple environmental factors in the relationship between plants and pests, including “genetic factors, ... the physiological cycle of the plant, photoperiodism, climate, nature of the soil, fertilisation, nature of the stock” and the one central to the trophobiosis theory, “the effect of pesticides on the plants physiology” (p. 7).

The trophobiosis argument is that resistance and susceptibility to attack are a function of the nutritional state of a plant - when proteins are being synthesised, the plant is resistant, and when proteins are being broken down, the plant is at risk. “Organophosphates inhibit protein synthesis ... this is the cause of the plant’s increased susceptibility, not only to sucking insects such as mites, aphids, aleurodes [aphids] and (so it seems) psyllids but also to diseases, fungal and otherwise” (p. 55).

Chaboussou states that “all herbicides are toxic for all plants” (p. 57). He reports “ a parallel between the effects of herbicides and those of nitrogen fertilisers ... the pesticides that contain nitrogen - practically all chemical pesticides - are cations. They can replace cations such as Ca, Mg, and Zn from the exchange complex” (p.156). And hence applications of herbicides and synthetic fertilisers can lead to deficiencies in the treated plant.

Chaboussou states that “artificial organo-chemicals have a very special affinity for plant tissues” (p. 39) and pesticides applied to the leaves - foliar application - find their way into the body of the plant. This can be through the cuticle and through the stomata - since light promotes the maximum opening of the stomata, penetration of pesticides will be greater where the poison is applied in daylight. Penetration of pesticides into the body of the plant can be *via* the leaves, and also the roots, the seeds and the branches. Having penetrated the plant, Chaboussou identifies that pesticides can be transported through the plant via both apoplastic (extracellular) pathways and symplastic (intracellular and intercellular exchange - within a cell and from cell to cell - via the cytoplasm) pathways. The plant, so weakened, is thus susceptible to pests and disease.

Francis Chaboussou’s book “*Healthy Crops: A New Agricultural Revolution*” first appeared in French, published by Flammarion, Paris in 1985. He died the same year. The book has been translated and published in German (1987 & 1996), Portuguese (1987 & 1999 2nd edition) and Japanese (2003), and now English.

Plant pathologist Francis Chaboussou (b.1908 - d.1985) saw with a clear eye that just as there are iatrogenic, doctor-caused, medical problems, likewise there are agrogenic, farmer-caused, agricultural problems. Chaboussou offers a lifetime’s insight into his vision for an agriculture without pesticides, and in so doing he provides a scientific underpinning for organic and bio-dynamic agriculture.

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