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Symposium Report

MODERN AGRICULTURE AND THE HEALTH OF MAN, PLANT AND ANIMAL

Under the above title a symposium was held in Wageningen (The Netherlands) on May 3, 1972. The organizers were the Royal Society of Agricultural Science and the Netherlands Society of Graduates in Agricultural Science. Lectures were given by C.T. de Wit, C.M.J. Sluysmans, S. Iwema, L.P. Flipse and C. Engel; and a forum discussion followed. Many important things were said, and to summarize these in a brief report would be impossible. An integrated series of notes made at the symposium is therefore given in this report.

In present-day society the use of chemical fertilizers and biocides in agriculture is increasingly subject to criticism. Strikingly, an analysis of the reasons why these chemicals are used often fails to turn up. In order to keep discussion on a rational level it is important that these reasons be made clear. From the lectures at the Wageningen meeting the following motives were evident:

(1) Modern agriculture needs to produce as much food as possible for many, many millions of people.

(2) Agriculture is forced to obey strong rational-economical principles and to possess sufficient competitive power.

(3) Under the present circumstances, maintaining the profitability of the farming business requires keeping investments relatively low and increasing the productivity per man-hour of labour.

(4) As a consequence, modern agriculture is characterized, among other things, by intensive use of land, a limited number of crops and large areas with one and the same crop (monocultures), the absence of extensive crop rotations and the practical exclusion of years of rest for land.

(5) There is a striving toward increased productivity from stable quantities of agricultural raw materials. The volume of sowing seed needed per unit of product decreases with increasing yield per hectare. The higher the level of the yield, the more the preceding phenomenon holds for other factors also. To reach a moderate yield it is necessary to maintain the pH of the soil at about 5.5. Higher yields do not demand a higher pH nor appreciably higher liming to maintain the pH. The phosphate level suitable for obtaining moderate yields is also satisfactory for reaching higher yields, and the phosphate intake by the crop is very small in comparison to the total quantity of phosphate that needs to be added to soils.

(6) A different situation arises in the case of nitrogen. In regions such as The Netherlands this element is pre-eminent in promoting increased growth. As a consequence, for instance, the use of nitrogen on grassland has been approximately quadrupled over a period of twenty years.

(7) Modern agriculture needs a large flow of energy. This not only includes energy required for sowing, ploughing, weeding and harvesting; but also the energy needed for reclamation and conservation of land; manufacturing of tools and machinery, fertilizers and biocides; breeding of new varieties; and research. As in the case of agricultural raw materials, the aim is to minimize the use of energy per unit of product.

(8) For several types of soil it has been established that fewer raw materials and less energy are needed to attain a high production level from a moderate one than to raise production from a low to a medium level. As a consequence, it is cheaper to increase production on good agricultural land than to keep marginal land under cultivation.

(9) Partly as a consequence of the above, modern agriculture is frequently in a position where land is transferred to other kinds of use. In several countries there is a great need for land for other uses. This is related to the extension of urban areas and road systems, the need for more space for outdoor recreation and the increased appreciation of nature reserves.

(10) The present system of intensive agriculture is in general linked automatically to a strongly one-sided composition of parasite populations. Insufficient natural means and methods are available to control diseases and pests.

(11) The micro-climatological conditions of a high-productivity crop, moreover, are often particularly favourable to the development of moulds. Because of the great ability of adaptation of moulds the results of breeding for resistance are disappointing. This stimulates the use of chemical fungicides.

(12) From the point of view of saving labour costs, the use of chemical herbicides is considered all but inevitable in the growing of several crops. Economic considerations of individual farmers and gardeners are often the primary factors here.

Much thinking and discussion is going on in the world of agriculture with respect to the situation sketched above and to the possible consequences, although these are from different points of view and reach different conclusions. I realize that generalization always contains an element of danger. However, the symposium confirmed an earlier impression which may be of significance. This is that in the spheres of policy making and research those who graduated from an agricultural-science faculty often seem to be inclined to defend the present situation and to modify current developments only in detail. In contrast, biologists who have found employment in the world of agriculture usually tend to be much more critical with regard to the situation that has arisen and are inclined to strive for fundamental changes. This may lead to agriculturists reproaching biologists for lack of sufficient understanding of every-day agricultural practices while biologists reproach agriculturists for a professionally narrow point of view. It seems of the utmost importance that this disagreement be not enhanced, but that it be transformed into more intensive interdisciplinary discussion, joint research and practical collaboration. The Wageningen symposium produced ample suggestions for topics to be considered or reconsidered. To mention a selection:

(1) The question may be asked whether striving for maximum productivity is always and under all circumstances necessary or desirable. To answer this question thorough study is required.

(2) Despite the inherent consequences of higher labour intensity and a possible lower level of productivity, an increasing number of farmers and gardeners are prepared to work along more biological lines, provided consumers are prepared to pay the extra costs entailed.

(3) It is questionable whether business-economical considerations, which in the short run lead to high chemical-fertilizer dressings and the application of chemical herbicides and many pesticides, can remain the standard for agricultural practices in the long run, even as far as the durability of high productivity is concerned. Thorough reflection and study on this problem is most desirable.

(4) The importance given to the present-day economical exigencies will have to be reduced and that given to biological requirements increased, in particular with a view to the long-term conditions for environmental health. This requires changes in agro-economical thinking and theory.

(5) Attempts towards a modification of the economic structure of agriculture and limitations on the use of materials which affect environmental health will lead to optimum results only if these are accepted and coordinated on an international level. In view of the urgency of the problems and the slow adaptability of international political structures there is reason for concern. Coordinated pressure from the agricultural field might help.

(6) High nitrogen dressings on agricultural land increase the chances of percolation to groundwater and of washing out and, as a result, of eutrophication of surface waters, although as a direct danger these are probably less serious than is sometimes feared. However, there are also indirect consequences. The nitrogen not used by the growing plants may be stored in the rhizosphere. The efficiency of crop plants in the use of nitrogen and its accumulation as nitrate varies widely. Genetic variation is notable; e.g., the chenopods – beets, spinach, and the like – are notable accumulators. On highly productive meadows more cattle can be kept and more manure is produced; in autumn and winter part of the nitrogen in this manure is washed out. Increased use of fodder concentrates causes extra nitrogen enrichment in stable and stale manure.

(7) There are indications that phosphate dressings which exceed the small amounts extracted by the crops in the long run lead to significant washing out.

(8) Environmental pollution with nitrogen and phosphate can be restricted by using these materials at the correct times and in quantities carefully calculated in advance (e.g., maize can be dressed in summer along the rows).

(9) Environmental factors are known to influence plant metabolism. Some which impair metabolism may reduce the processing of nitrate into protein. The major factor is sudden drought during the growth season. Then the plant accumulates high amounts of nitrate, which may threaten the health of man and animals. Another factor is reduced light. This may cause higher nitrate concentrations in leaves and stems. High fertilizing and reduced light in dense crop stands may lead towards increasing the nitrate concentra-

tion. Soil characteristics and phosphate deficiency are further factors which affect the nitrate concentration in plants. Such factors may also occur in various combinations with strengthened effects.

(10) Botanical investigations have revealed that high nitrogen dressings in combination with careful maintenance of grasslands lead to a modified and more uniform composition of the grassland flora. In this way, the chemical composition of the forage is altered rather considerably. So far, however, no significant influences have been detected on the health of cattle. But as with any other strong deviation from natural conditions it is desirable that this be kept under careful control.

(11) More attention needs to be paid to ever-lengthening chains of causes and effects. There is the phenomenon that the application of one chemical expedient induces the use of still another. A typical illustration of this can be found in cereal growing, in which high fertilizer dressing sometimes makes it necessary to slow down growth again in a later stage by means of a chemical growth regulator; a crop thus grown may appear to be more vulnerable to certain fungal diseases, against which in its turn chemical fungicides are applied. The question needs to be studied whether perhaps similar final results can also be reached by means of fewer interventions, which might imply a lesser need to use chemical expedients.

(12) Dressing with organic manure implies a stronger stimulus to soil organisms than chemical-fertilizer dressing with similar effects on plant nutrition. What are the consequences of this difference, particularly in the long run?

(13) More research is urgently needed into the development of biological means and methods which may replace chemical biocides. When chemical biocides are used, it is desirable that those which are the least poisonous and least persistent are selected. The quantities used should always be kept as small as possible. Reaching more individual decisions on whether a certain spraying is to be executed or can be omitted may be supported by further perfection in the prediction of expected diseases and pests and a subsequent more local tuning of the predictions.

(14) Persistent biocides still in use need to be replaced as soon as possible by means which put lesser loads on the environment. Also less persistent means need to be regularly reevaluated, with ever more critical testing, particularly according to ecological criteria.

(15) Integrated programmes for the prevention of pests and diseases need to be designed separately for each crop and often even on regional scales. The development of such programmes can, however, well be taken up in close international collaboration. It is recommended that simultaneously with such studies the possibilities of making agricultural systems more stable be explored.

(16) Observations in practice suggest that there may be a relationship between the susceptibility of crops for diseases and pests and certain external conditions, such as site, soil structure, state of fertilization, ground cover, etc. More detailed investigations of the factors which are of influence in the occurrence of pests and diseases may well lead to beneficial results. It may well appear that these will contribute to a decreasing need for spraying.

(17) More research is desirable on the question as to what degree certain infestations could be tolerated with a view to expected harm. There are examples of clearly visible infestations which in fact have little or no effect on yield (e.g., beet fly). There are also indications that it is really unnecessary always to remove all weeds (e.g., certain weeds in between cereals on light soils).

(18) The development of chemical biocides and the execution of extensive tests with these implies ever-rising costs. For certain industries keeping development costs of new biocides economically acceptable has reached a critical level. This may cause a negative impact on the development of more selective means and methods which are so much needed for future integrated control programmes.

(19) Much time may pass before detrimental side effects of chemical materials are detected. In man it may well be some decades before these are noticed. It is even possible that certain side effects may completely escape attention. This necessitates the utmost care, not the least of which is for the sake of generations yet unborn.

A.A. MANTEN (Utrecht)