Ecological Aspects of Plant Protection in the Middle East

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Abstract

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The introduction of modern plant protection technologies into the Middle East may upset traditional production systems. Research in the region itself must determine the priorities. In **dryland cereals** nutrient deficiencies are widespread and need correction. Chemical weed control seems to be only economic, when yield levels have been markedly raised. Resistance breeding is, for the present time, the most appropriate method of disease control. Work on chemical seed treatment is urgently needed. Rape seed, as well adapted oil crop, may improve the negative effect of cereal monoculturing. **Sugar beets** under irrigation should be cultivated with the highest possible intensity and careful plant protection, including weed control. New projects can be analysed beforehand for the probability of disease and pest occurrence through geopathological methods. In **fruitcrops** spray programs, based on weather data and pathogen or pest observation, are most promising. In **vegetable crops** many problems can be solved by integrated control programs including resistance breeding and planting time; Winter-planted chickpeas are a good example.

Introduction:

The Middle East has been known in history as the «cradle of civilization» - the Fertile Crescent. Until today, wild wheat and barley, the ancestors of our present cultivated forms, are found here. Hordeum spontaneum may even form dense stands with acceptable yields, competing well with our cultivated forms. Near Rosafa, in the North Syrian steppe area, we measured 1.3 t/ha. In the Middle East we have also located some major gene and domestication-centers for crop plants and animals. This includes cereals except rice and maize, some improtant legumes, vegetables and fruits, together with most of todays farm animals. If today we, as agricultural scientists, try to introduce scientific methods into the agricultural production systems of this region, with its evolution period of about 10,000 years, we must expect severe difficulties. They may come from farming people, who are caught in old traditional production processes, honored by time and experience, or from unexpected reactions of the ecosystem. This system is characterized by different survival strategies of its members, exposed to highly variable and unreliable physical living conditions. The unpredictable variations in rainfall-temperature patterns need our special attention. They are important, if we try to transfer technology from other production systems to the Middle East. They certainly need careful adaption and are preferably replaced by technologies especially developed for, and within, this region.

Plant Production:

Considering plant production, we must be aware, that we face, in most cases, fully integrated production systems. They are certainly in many different stages of transfer from empirical to scientific production systems. One may think about the controlled environment vegetable production in the Jordan valley, the terraced fruit culture in Mount Lebanon, the irrigated agriculture in the Ghaab valley in Syria, the dryland cereal farmer, or the migrating shepherd in the steppe. It is obviously impossible to make general statements for all of them, and I will therefore consider some examples, which may deserve our special attention.

Cereals:

They are the classical dryland crops of the region and it's major food source, covering almost 60% of the arable land area. Yields, as calculated from international and national statistics, are in the range of 1 t/ha, and seem not to differ much between wheat and barley. If it is one of the objectives of plant protection to ensure healthy plants that produce a large fraction of their physiological yield potential, limited only by climatic constraints, we must try to determine this actual yield potential in the region itself. Mexican wheat varieties have shown that the yield level may be raised considerably. But, the old land races of barley can also perform well. High fertility spots can be seen in many fields between March and May, caused by underground ant colonies. These spots were used for a survey on local barley yield potential in Syria. Their yields were wbove 5 t/ha, being usually 2 to 3 times more than the yield on the surrounding field. First analytical data on the causes of this yield increase revealed a much higher P and N content of the soil profile. There are indications that this may not fully account for the observed effect. Diagnosis of non-parasitic deficiency symptons and appropriate action to increase soil fertility and water use efficiency is therefore one important contribution of plant protection to the region, with significant ecological side effects.

Chemical plant protection has, in recent years, caused a revolution of cereal cultivation in Europe. Yield developments during the past 500 years reveal this very clearly. Weed, pest, and disease control accounted largely for the doubling of yields in the past 15 years. Will this success story be repeated in the summer-dry climates? Certainly weed control needs special consideration. Experimental data are still rare. The traditional system is based on low soil fertility, the use of fallow, no fertilizer inputs, and handweeding for feeding of farm animals. Weeds yielded often more than 1 t/ha dry matter in the Aleppo region, reflecting cereal plant density and fertilizer application. Barley was always a better competitor than wheat. Preliminary calculations indicated, that a net profit could be made from harvesting the weeds. One must also realize that the responses to chemical weed control were very inconsistent; while some experiments showed high increases, others were without effect.

Chemical control was never significantly more effective than hand-weeding. Considering the very different social structure, plot sizes, and values of weeds for food and feed in Middle East agriculture, one should be wary of centralized, large-scale application of herbicides. Farmers will have to make their own decision when to turn from hand-weeding to herbicides, as their soil fertility, yields, and market orientation increase. Certainly, much more experimental data on yield responses from many locations and years are needed to assist the farmer in his decision-making on this difficult subject.

Leaf diseases have been mostly considered insignificant in dryland cereals. Higher yielding plots, however, showed alarming symptoms of leaf blotch (*Rhynchosporium secalis*), net blotch (*Helminthosporium teres*), *Septoria tritici* and *S. nodorum*, powder mildew (*Erysiphe graminis*), rusts (*Puccinia* spp.) and bacterial blight (*Xanthomonas* spp.), depending on location and year. There are no data on the yield responses to leaf application of fungicides; their high efficiency in European cereal cultivation may or may not hold true in this region. One may expect economic returns only if higher yield levels than the present average are reached. Resistance-breeding may, in the meantime, breach the gap.

Seed application of fungicides and its efficiency should attract more attention in the future. The dangerous mercury-containing chemicals are now banned in many countries, and should no longer be promoted. The recorded cases of mercury poisoning of animals and man, resulting from consumption of treated seeds, should never occur again. The newly developed chemicals are certainly much safer. They are more expensive, too! Their systemic action is also effective against leaf diseases in early growth stages. In spring barley, this effect remained stable throughout the growing season in Germany. I believe, that intensive experimentation with this new generation of seed-treatment chemicals is urgently called for. side-effects, such as delayed emergence and increased drought and salt resistance, have been observed and deserve further studies. We may also recall, that seed-treatment has frequently been the vehicle to introduce modern technologies into traditional agricultural systems.

Insect control in cereals is already practised in the region with the soony bug (*Eurygaster integriceps)* as the main target organism. Certainly no such application meets the demand of modern, ecology-oriented plant protection if not based on well determined economic threshold values.

Other considerations, that I may only touch upon, are the development of cereal-legum rotations, which may improve soil fertility, land-use intensity and rural income through an increase of animal products. Also, rape seed proved very successfull at ICARDA/Aleppo and may offer new possibilities for food, and as an oil crop to many growers. It is certainly too early to elaborate on the plant protection problems that may evolve from such new cereal systems. We must conclude that many new considerations in plant protection call for our attention to the dryland cereal crops wich seem to be at the beginning of a new step in their evolution as agricultural crop plants.

Sugar beets:

This crop may be briefly dealt with as an example of irrigated cash crops, wich are so important to the national economies of many countries in the region. Water supply is, or should, be assured and all varieties are newly bred and imported. No traditional system exists, and such a crop should offer itself as a test case for the functioning of a scientifically-based extension network. However, in plant protection, the situation is quite different. The product is chemically processed and pesticide residues are not likely to remain on it. Only long-lasting residues in the soil must be avoided. Otherwise, we are guided by mainly economic considerations. It is in such a crop-environment relation that the concept of ecologically-planned plant protection may be used with profit to plan and stabilize new sugar beet unexpected pest and disease problems, in the region.

Seedling problems need much attention since germination is slow and damping-off diseases as well as insect pests such as *Cassida* spp. may cause total crop failure. However, the salt resistance of the beet is remarkable. We have successfully grown beets in Bahrain with irrigation water of 3.95 mmho/cm (i. e. 2528 ppm soluble salt). Thus beet offers it self as a highly adapted crop to saline soils, which is certainly one of the major problems in the region.

Leaf diseases are of special importance, and differ markedly from the ones of temperate climates. It was, during the study of their problems, that the concept of geophyto-pathology was developed. A so-called «main damage area» is one where the major climatic factors favoring a pathogen's infection occur together within the growth range of the host plant, constituting an area with regular epidemics and economics losses. Most sugar beet-growing areas in the Middle East seem to fall into this category for the sugar beet powdery mildew (*Erysiphe betae*). Yield increases between 20 and 30% can almost certainly be expected if an apropiate control scheme is applied. Here large scale, centralized spraying can be practised with advantage. The different geographic distribution of the powder mildew and the leaf spot disease, caused by *Cercospora beticola* can be explained by various epidemiological parameters. Temperature optima for conidia germination are not widely different, but well explain why downy mildew (*Peronospora schachtii*) has only a poor chance when beets are cultivated during winter in the region. However, conidia formation, in relation to relative humidity shows the high adaption of *E. betae* to dry climates. We have tried to summarize our findings on this diseases in a map, using climatic zoning as guideline for expected disease intensity. We seem to find the «Fertile Crescent» here again; this time, however, fertile for a plant pathogen.

Fruit crops:

It is tempting to also go through some of the plant protection problems of selected fruit crops but time does not allow me to do so. Apple scab control, for example is of the main disease problems in Lebanon, and offers itself to plantation-based prediction models, followed by curative sprays, using a refined system of Mill's Tables and locally produced temperature-leaf wetness recorders. A network of more than 20 stations was installed in 1973 and operated successfully. Other problems, that offer themselves for ecology-oriented plant protection, are integrated systems for citrus orchards, for olive fly and fruit fly control, and for prediction of stigmatomycosis of pistachio nuts.

Vegetables:

In vegetable crops we have been studying the *Ascochyta* blight of chickpeas (*Ascochyta rabiei*), and now seem to understand its epidemiology. We are in the planning stage for an integrated control system, including the available resistance sources and considering the biological variability. Many other problems could be mentioned.

Conclusions:

There is no doubt that all principles of modern plant protection, such as effective and economic control, maximum safety for user, consummer and environment, and minimum distur-

bance of existing biological equilibria, are also valid for pest and disease control systems in the Middle East. However, direct data transfer does not seem to be possible; most of the research must be out in the region itself to arrive at reliable control systems. It was, therfore, with great pleasure that I have addressed you, at this first meeting of the Arab Society for Plant Protection whose members will have the duty and the chance to work for this rewarding goal.

الملخص

ان ادخال الطرق الحديثة في وقاية النبات في منطقة الشرق الاوسط قد يسبب خللاً للانتاج بالوسائل التقليدية. ان الابحاث التي تجري محليا هي التي ستحدد الاولويات. فزراعة الحبوب مثلاً، في المناطق الجافة تعاني من نقص في العناصر الغذائية بشكل واسع وتحتاج الى تصحيح. كما ان مقاومة الاعشاب الضارة بالمبيدات الكيماوية سيكون اقتصادي فقط عندما نتمكن من زيادة الانتاج الحالي زيادة محسوسة. في الوقت الحاضر يعتبر التحسين النباتي في محاصيل الحبوب بهدف الحصول على اصناف مقاومة هو افضل الطرق لمكافحة الامراض. كما ان القيام بابحاث لمعالجة البذور كيماويا هو ضروري جدا. ان استعمال بذور بعض محاصيل العائلة الصليبية الزيتية (Rape seed) قد يصحح النتائج السلبية لزراعة الحبوب بشكل متواصل. ان الشمندر السكري في الاراضي المروية يجب ان يزرع باكثر كثافة ممكنة مع العناية بالوقاية من الآفات بما فيها الاعشاب. يمكن تقييم احتمال الاصابة بالآفات في المشاريع الجديدة مسبقا باستعمال دراسات جغرافية الامراض (Geopathology) . وفي اشجار الفاكهة فان برامج الرش التي تعتمد على البيانات المناخية ومراقبة الآفات هي الاكثر نجاحا. في محاصيل الخضر فان كثير من المشاكل يمكن حلها بتكامل طرق المكافحة بما في ذلك تكوين اصناف مقاومة ووقت الزراعة والحمص الشتوي هو مثال جيد لذلك.