CONFERENCE ON "GREENING" DISEASE OF CITRUS

On the 16th of last November there was held at the Pretoria Headquarters of the Division of Agriculture, a conference on the above disease of marked importance to both growers and scientists. Since the meeting was purely internal, new growers were present, but otherwise it was a fully representative of all directly and indirectly concerned with the problem. For in addition to the Officers of the Division (Dr. Andersen, Chief of the Division, and Messrs. J. C. Le Roux, A. J., van der Merwe, A. C. Bathurst, L. C. Marris, J. W. Pont, H. van Elen, H. J. Kriel and P. F. Malan), representatives were present from the African Reality Trust (A. Mathew and J. I. de Villiers), the Botany Division (P. C. Loest), the Chemical Division (U. Schmidt), the Citrus Exchange (P. Crous, J. M. Hector, O. T. van Nierkerk), the Crocodile Valley Estate (D. J. Esselen), the Pretoria Agricultural Research Institute (J. J. Theron, P. C. J. Oberholzer and J. D. J. Hofmeyr) and the University of Pretoria (M. G. Mes).

Under the chairmanship of Dr. F. G. Andersen, the meeting got down to the business in hand with commendable promptitude. No time was wasted; briefly indeed was in evidence throughout and all the speakers, almost without exception, outlined their opinions concisely. There were no "heated" discussions. The procedure was simplified by the fact that the Division of Agriculture had summarised in advance the work already done, and a copy of this was in front of every member. In rotation, the officers, wholly or partly concerned, reported on their work and supplemented the evidence as requested. In this manner, a bird's eye view of the problem and the work already carried out, was obtained. Your reporter has here neither the time nor the space to deal with the evidence in detail nor to cite those responsible for the work done. A precis for the press must suffice.

Early in the discussion, it became clear that the so-called "symptoms" of greening are very difficult to define, partly because odd fruits may occur which present at least a "greened" appearance and partly because there is no method at present known by which a tree affected by greening can be recognised when the fruit is immature or "off." The appearance of the fruit, however, in clearly defined cases, is fairly definite. Such fruit is in general considerably smaller than the normal, somewhat flattened on one side, with the same or a larger area remaining green in colour. In other words, the fruit is lopsided, suggesting that growth over a considerable area, varying in size, has been arrested. On the tree, the more exposed areas of outside fruit are invariably less affected than the less exposed areas. As regards inside fruit, malformation or lop-sidedness tends to be absent; a general arrest in development of the whole fruit occurs; the colour remains a pale green over the entire surface. On an affected tree, such fruit may occur only as individual fruits scattered over the whole tree; on isolated branches to a greater or lesser extent; and finally, as a large percentage of the crop over the whole tree. The severity of the condition varied markedly, ranging from 1% to 70% of the trees in an orchard. Unaffected trees, however, may be found well distributed even in a highly infected orchard. The badly affected trees or portions of the trees are usually stunted and badly mottled. These symptoms,

KONFERENSIE OOR "VERGROENING" VAN SITRUS

Op 16 November, 1943, is daar by die Pretoria Hoofkantoor van die Afdeling Tuinbou, 'n konferensie gehou wat van groot belang vir beide groeiers en wetenskaplikes was. Aangesien die vergadering binnenuur was, was geen groeiers teenwoordig nie, maar orgens was dit volledig verteenwoordig van almal direk en indirek in die probleem betrokke want, buiten die amptenare van die Tuinbou Afdeling (Dr. Andersen, Hoof van die afdeling en Mr. J. C. le Roux, A. J. van der Merwe, A. C. Bathurst, L. C. Marris, J. W. Pont, H. van Elen, H. J. Kriel en P. F. Malan), was verteenwoordigers teenwoordig van die African Reality Trust (A. Mathew en J. I. de Villiers), die Plantkundige Afdeling (P. C. Loest), die Skielundkundige Afdeling (U. Schmidt), die Streuebeurs (P. Crous, J. M. Hector, O. T. van Nierkerk), die Crocodile Valley Estate (D. J. Esselen), die Pretoria Landboukundige Navorings Instituut (J. J. Theron, P. C. J. Oberholzer en J. D. J. Hofmeyr) en die Universiteit van Pretoria (M. G. Mes).

Onder die voorzitterskap van Dr. F. G. Andersen, het die vergadering aanvang gemaak met die saak op hande met prysenwaardige proefheid. Geen tyd was verwys nie; kortheid, inderdaad, was bewys dwarsdeur en die sprekers, amper sonder uitskakeling, het hulle opinies saaklik beskryf. Daar was geen "warm" redenerings nie. Die procedure was vergemaklik deur die feit dat die Afdeling Tuinbou die werk alredges gedoen het en op sy tyd, opgesamol het, en 'n skrif hiervan was voor elke lid. In agtergrondvolging het die amptenare, geheel en gedeeltelik betrokke, oor hulle werk verslag en die getuigismes gelewer soos verskyn. Op hierdie wyse was 'n duidele beginstelling verkry van die probleem en was die werk alredges gedoen. U verslaggawe het hier nie die tyd, nie die spase, om bredewoordig te handel met die getuigismes nie, of om te neem wie die werk gedoen het nie. 'n Oopnoming moet vir tyd en wyl voltooi word.

Vroeg in die bespreking het dit duidelik geword dat die sogenaamde "sleptome" van vergroening baie swaar is om te ontlust, gedeeltelik omdat in sommige gevalle vrugte gevind word wat teminste 'n "vergroende" voorkoms en gedeeltelik omdat daar op die oomblik geen methode is waardeur 'n boom geaffekteer deur "vergroening" uitgeken kan word as die vrugte ontvolks of "af" is nie. Die voorkoms van die vrugte egter, in duidelike bepaalde gevalle, is taamlik definitief. Sulke vrugte is oor die algemeen aangeteken as die normale vrugte, iets wat plaas aan die eentuig, met die vrugte of 'n groter ontwikkeling van groen in kleur. Met ander woorde, die vrugte is misvorm wat aanbied dat groei, en wat in soek om ontwikkeling, afwisselend in groene, gestrem is.

Op die boom is die meer blootgestelde dele van buitevrugte sonder uitsondering, minder geaffekteer dan die minder blootgestelde dele. Wat vrugte aan die binnekant betref, is misvorming geneig om afwesig te wees; 'n algemene strooming in die ontwikkeling van die vrug kom voor, die kleur by 'n lagte oor die hele oppervlak. Op 'n geaffekteerde boom mag sulke vrugte net as afsonderlike vrugte voorkom, verspreid oor die hele boom; op geisoelde takke, tot 'n groter of minder mate; uiteindelik, as 'n groot persentasie van die oor die hele boom. Die oors van die kondisie verskil grootskaals, en varieer van 1% tot 70% van die boom in 'n boord. Ongeskeerde boome egter, kan gevind word versprei in 'n hoog geaffekteerde boord. Die swaar geaffekteerde boome of gedeeltelike boome is gewoonlik heerlik in groei en vol bontblad. Hierdie ver-

FOR BETTER TREES — AMANZI ESTATE, UITENHAGE.
however, are not peculiar to the disease, and as a consequence, it is difficult to say whether a tree exhibiting these symptoms and bearing an immature crop, will or will not produce greened fruit. Affected trees do not die off but remain standing. Young trees appear to be more susceptible than old—a deduction from the fact that even in the badly affected sections of the area, only young trees, many of the older orchards have grown satisfactorily. Where replacements have taken place, however, the young trees are often badly stunted and bear greened fruit. As regards species and varieties, it would appear that the susceptible ones in sequence read: Valencia, Tangerines, Tangels and Navels. No greening or very slight greenening has been noted on midseason types—Lemons, Mandarines, Grapefruit, Limes, Sevillanas and Kumquats.

The above disease (or condition) was first reported from a point near Pretoria in 1928, and thereafter (about 1929) from the Eastern Transvaal, where from 1929 to 1933 the central section of one part of the area became badly affected. In certain orchards of this section plus-minus 25% of the fruit was greened. Individual trees might even carry over 50% of such fruit. From 1933 onwards, though the greening position in the area did not deteriorate, other areas became infected in the Eastern Transvaal, though on the whole the percentage of fruit affected remained low. In the remainder of the areas growing areas—the Western Transvaal, Northern Transvaal, Natal, the Eastern and Western Cape, as well as certain sections in the Eastern Transvaal—"greening" is unknown or insignificantly small.

The description of the condition known as greening has been given at some length because the writer's personal opinion is that the key to the solution of this problem is to be found in an analysis of the symptoms, the susceptibilities and the distribution. Other evidences there are—very negative at first sight and at present somewhat contradictory and unco-ordinated. These evidences were laid before the meeting.

From the soil chemist's viewpoint, it must be conceded that many soils in the Eastern Transvaal are unsatisfactory in several respects. They tend to be acid or under certain treatments tend to become acid very rapidly. At the same time groves exhibiting greening may be heavy, medium or light in texture, but the same may be said of non-affected groves. Generally speaking, however, the soils, where greening is severe, have been found to be acid. This suggests a relation between greening and acidity. On the other hand, certain soil treatments and pot experiments indicate that the relationship cannot be regarded as a deciding factor. It must also not be forgotten that beans and potatoes, etc., grow excellently on the above soils. Cultural practices in affected orchards vary markedly and parallel experimental tests proved equally negative. All the irrigation and fertilisation experiments had no influence in reducing the malady.

Very extensive nutritional studies were carried out not only in the soil but in the sand and water cultures. They gave no positive results. Attempts to correlate the conditions with minor elements such as Barium, Magnesium, Boron, Copper, Zinc, Iron, Aluminum, etc., in deficiency and in excess, also gave no clue to the solution of the problem. A limited trial with growth substances failed equally. On the roots of citrus trees a specific nematode, with a world-wide distribution, may occur. During 1936, it was found that badly stunted trees carrying greened fruit were heavily infected with this organism. A comprehensive survey in the citrus growing areas of the Transvaal and also in the Eastern Cape Province showed that this parasite was distributed throughout, and that its presence could not be skiesvol, egter is nie kenmerkende eieskappe van die siekte nie, en as 'n gevolg is dit nooitlik om te sê of 'n boom wat hierdie verskynsels vertoon en 'n onvolwesende oes dra, wel, of nie. "vergroening" vrugte sal produceer. Geaffekteerde bome gaan nie dood nie, maar hoo klein. Jong boom skyn meer vatbaar te wees dan ou bome—'n gevolgtrekking van die feit dat selfs in die swaar geaffekteerde dele van die area meer betrokke, baie van die area boore bevordering gegaan het. Wat betref geslagte en soorte, wil dit dalk dat die swaarste toepas in volgorde lees: Valencias, Nartijes (Tangerines), Tangelos en Navulas. Geen vergroening of baie gevoelige vergroening is gevind op Middeldeinoeseen, suurlemoe, Mandaryne, Pomelos, Spaanse suurlemoe, Sevilles en Kumquats.

Die bogenoemde siekte (of kondisie) was vir die eerste keer gerapporteer vanuit 'n deel naby Pretoria in 1928 en daarna (op 'n treintjie 1929) vanuit die Ooselijke Transvaal, waarvan 1929 tot 1933 die sentrale sektor van een deel van die area swaar geaffekteer geword het. "Vergroening" boore van hierdie sektor was min of meer 25% van die vrugte vergroen. Afsonderlike bome mag selfs 50% sulke vrugte dra. Vanaf 1933 al naar eind is die vergroening swaar in die area nie versleg nie, en in ander areas geaffekteer geraak in die Ooselijke Transvaal, tog oor die gehele het die persentasie geaffekteerde vrugte laag gebly.

Die oorsake van die kondisie bekend as vergroening is breedvoerig aangegee, want die skrywer se persoonlike opinie is dat die skadelikheid van die vrugte te vinde is in die onvolwassenheid van die verskynsels, die vorming van die vrugte en die distribusie. Ander getuens is daar—baie negatief met die eerste oogopslag en die oomblik iswat ontevreden en ongelukkig. Hierdie bewysie was voor die vergadering gelaat.

Uit die oogpunt van die grond skakulering moet dit toegenee word dat baie grootskale in die Ooselijke Transvaal onbepaald is in sekere opsigte. Die grond is geneig om suur te wees, of onder sekere behandelingen geneig om baie suur in te word. Geselselfriedt het boore wat vergroening vertoon, swaar medielman of lig in te trek, swart, waar dieselfde kan gesê word van nie-geaffekteerde boore. Oor die algemeen egter, is gronde, waar vergroening straf is, gevind om van 'n suur oes te wees. Dit stel 'n verbindeling tussen vergroening en suurgraad voor. Aan die anderhand het die sektor grondbestand en pot-experimente aangedui dat die verwantskap nie as 'n beslissende faktor beskou kon word nie. Dit moet ook nie vergeet word nie, dat avokado-plantes uitstekend groei in die genoemde gronde.

Kwekingsmetodes in geaffekteerde boore verskyn opvallend en gelyke eksperimente toon met sy negatiewe bewys. Al die besproeiing en bemesting eksperimente het geïnvoel oor die vermindering van die moeilikheid gehad nie.

Baie uitgebreide voedinge studies was uitgevoer, nie alleen in die grond nie, maar in suur en water kultuur. Hulle het geen beslissende resultate gelever nie. Pogings om die kondisies in verwantekap te bring met geringe elemente soos Barium, Magnesium, Boron, Koper, Sink, Ister, Aluminium, en, in gebrek en oormaat, het ook geen weerkom toegedie tot die oplossing van die probleem nie. 'n Beperkte probeering met groeiings-bestanddele het ook misluk. Op die wortels van citrus home magn spesifieke aardwarm voor oor 'n wereldwyd verspreiding. Gedierte
correlated with the incidence of greening. Field experiments and controlled experiments in greenhouses conclusively proved that greening could occur on the nematodes infested and non-infested trees. There remains the possibility that the condition may be due to the presence of either a virus, a bacterial organism or a fungus. Here the evidence seems somewhat unsatisfactory. Up to the present no organism whatsoever has been found that can produce the malady. In most instances, the roots of affected trees appear healthy, thus rendering it unlikely that any causal organism could be present in the roots. Cultures of all organisms so far found have produced no results. As regards the possibility of a virus being responsible, the evidence against seems to rest mainly on the fact that no one has yet been able to artificially transmit the disease. Many viruses, however, are notoriously difficult, until all the conditions are known, to transmit experimentally.

After considerable discussion of the situation outlined above, the conference was of the opinion that not only should the above investigations be continued but that further work should be initiated along the following lines:

1. To define the symptoms of the malady more precisely, and to correlate the microscopic structure of the affected fruit and the appearance of the trees with the greening condition of the fruit.

2. To obtain a more accurate survey of the distribution of the affected areas as a whole and in individual orchards, the data so obtained to be correlated with the soil conditions.

3. To study in more detail the oxidation of organic matter and ammonium nitrogen in these soils.

4. To increase the fertility of these soils, their buffer capacity, to trace elements present and the microflora generally.

5. To continue and extend the nutritional work, utilizing trees produced from both non-infected and affected stocks and selections.

6. To study the effect of different root stocks on the incidence of the malady.

7. To ascertain whether the condition is due to a virus or any other organism and to establish whether or not it can be transmitted in any way whatsoever.

Commenting on the above, the writer is of the opinion that the first, second and seventh items mentioned are of basic importance. Without being in any way dogmatic, he would argue that the evidence so far available indicates two main possibilities. These are that the greening condition is either due to a virus; or alternatively, that the soil conditions in many areas of the Eastern Transvaal are such that they tend to inhibit, perhaps seasonally, the absorption of one or more of the soil solutes. This inhibition may well be an indirect one, affecting in the first instance the fungus flora of the roots. In other words, he considers that there is a symbiotic relationship between this flora and the roots of the citrus tree. Together they constitute a "mycorrhiza" of a somewhat loose nature, the capacity of a citrus tree to absorb solutes being in either measure due to this relationship. To establish either of these possibilities will demand exhaustive research.

As regards the conference as a whole, the writer considers that it served its purpose. It brought all the investigators together; it enabled them to measure their own personal ideas against those of others; it stimulated interest;
and it resulted in the formulation of a research programme with new and modified concepts. Naturally, the conference came to no final conclusions. The so-called “greening” condition is an exceedingly complex one, and many lines of approach were possible. So the grower, reading the above, must neither be too optimistic nor too critical. A solution of the problem will not be found in the immediate future. Whether that solution will be an economic one, none can at present say. As for criticism, one must keep in the foreground the fact that, although the results so far obtained have proved to be negative, they are negative only in reaction to the “greening” problem. They are not negative in relation to the fundamental problem of the growth of citrus trees. So far as that is concerned, all the experiments conducted have contributed in a very marked manner to our knowledge. Let us not forget that it was the famous “null experiment” that was responsible for the foundation of modern physics.

J.M.H.

CHEMISTS IN CONVENTION

What U.S. chemists mainly talked about, at their annual convention in Pittsburgh recently, was food, oil and rubber. But the chemists also got around to some sex talk about roosters.

Roosters. A new way to produce fatter, tastier cockerels, to make even tough old roosters succulent, had been discovered by Biochemist Frederick W. Lorenz of the University of California. His method: the injection of a synthetic sex hormone. Lorenz had begun by wondering why a hen grows fat when it starts laying eggs. He proved it was because the female sex hormone, estrogen, increases the amount of fat in the blood. Lorenz then hit on the idea of giving estrogen (available in a cheap, synthetic form called diethylstilbestrol) to fatten up male fowl.

Feeding them the hormone did not work (they eliminated it too fast). So Lorenz injected pellets of the substance under their skin, let them absorb it slowly. The results were startling. In two to six weeks the roosters’ red combs paled and shrank; they grew female feathers and a layer of fat; their pubic bones spread; they lolled around like capons. After roasting, they tasted much better than ordinary cockerels. When Lorenz treated stringy, dark-fleshed old roosters, their meat also became light and tender. Lorenz has tried his discovery only on chickens and turkeys, but biochemists do not expect it to stop there; some even envision the production of sweet-tempered bulls like the fictional Ferdinand.

Offering his discovery to U.S. poultrymen, Lorenz had a word of warning: if the consumer should swallow an unconsumed hormone pellet with his chicken, it might make him sick. To avoid this, he suggested that the pellets be implanted in a part not usually eaten, i.e., the neck.

Other convention highlights:

Mosquitoes. A new mosquito repeller, more effective and four to six times as lasting as citronella, was announced by a group of chemists from hard-bitten New Jersey. A military secret known only as “Formula No. 612,” it is an inexpensive, colourless liquid without unpleasant odour.

van mening dat daar ‘n simbiotiese verantskaps is tussen hierdie plantgroei en die velkore van die citrus boom. Tansame vorm hulle ‘n “micohiza” met ‘n ietwat los soort en die kapasiteit van die citrus boom om oplossings te absorbeer is to’n groot mate betwyse aan hierdie verhouding. Om enige van hierdie moontlikhede van te stel sal uitgebreide onderzoekingswerk vereis.

Wet die konferensie as ‘n geheel betrek, dink die skrywer dat dit die doel beantwoord het. Dit het al die navorsers bymekaar gebring; dit het hulle in staat gestel om hulle eie persoonlike idees te meet met daardie van andere; dit het belangstelling opgewek; en dit het gelei tot die formulering van ‘n navorsings-program met nuwe en veranderde ontwerpe. Natuurlik het die konferensie tot geen finale gevolgtrekking gekom nie. Die sogenoemde “vergroeiing” toestand is uitsig ingewikkeld en baie maniere van nadering was moontlik. Dis moet die grooier wat bestaande lees, nie te optimisties wees nie, maar die resultate skyn vir die toekom nie. Die oplossing van die probleem sal nie gevind word as long as the nabye toekoms nie. Of die oplossing ekonomies gaan wees kan niemand vir tyd en wyl sê nie. Wat kritiek betref moet ‘n mens die feit on die voorspraak hou dat, al het die resultate sover verky berus om negatief te wees, hulle net negatief is in realiteit met die “vergroeiing” probleem. Hulle is nie negatief in verhouding met die fondamentele probleem oor die groei van citrus home nie. Soever dit nagaan, het al die eksperimenter wat aangevoer is op opvallende wyse bygedra tot ons kennis. Laat ons nie vergeet nie dat dit die herkoms “mul-eksempel” was wat verantwoordelik was vir die grondal van moderne fisika.

J.M.H.

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