Agricultural Research in Natal.

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IN spite of the abnormal climatic conditions, excellent progress was made during the past season. Reasonably good rains fell during September and October, but November and December were dry, hot during the day and on some nights abnormally cool. Conditions commenced to improve early in the new year, and the season closed with a total rainfall of 26·5 inches.

With the first rains a considerable portion of the maize-breeding experiment was planted, and the drought following provided an excellent opportunity of eliminating breeding lines susceptible to drought. By contrast the rainy, sultry weather from February to March was responsible for a serious outbreak of plant diseases, as a result of which hundreds of highly susceptible breeding lines had to be eliminated from the experiment. Fortunately, the lines most drought-resistant were on the whole also less susceptible to disease. The first experimental crossings for determining the breeding capacity of approximately 800 lines was carried out. More than 100 hybrids from these crossings will be included in a yield test during the coming season.

A development of signal importance in studying problems of soil fertility is the use of radio-active phosphate. Although this work has hardly begun, interesting results have already been obtained. Yields in the ordinary fertiliser experiments show that the correct fertilising practice is not such a simple matter as has been supposed. It appears that nitrogen, potash and lime deficiencies, although not as important as the general shortage of available phosphorus are aspects not to be ignored.

The erection of farm buildings at the Ukulinga experiment station was continued, and at last one department, viz.; Poultry Husbandry, disposes of fairly adequate facilities. A commencement has also been made with the erection of additional buildings for the Department of Animal Husbandry.

As regards educational work, the student numbers continue to grow and the present enrolment is as follows:— First year, 72; second year, 41; third year, 25 and fourth year, 19. There are also 3 candidates for the M.Sc. (Agric.) degree and 4 for the Ph.D. (Agric.).

The following degrees were awarded in March, 1952: M.Sc. (Agric.), 2; and B.Sc. (Agric.), 27.

Research.

Agronomy.

The statistical calculations of the agronomic experiments for the seasons 1949/50 and 1950/51 have been completed and reports on the findings are at present being drafted.

Preliminary indications of experimental data are as follows:—

(1) Rotational cropping and greenmanure experiments give no indication that greenmanure can be profitably applied in the case of maize, and that a legume crop every fourth year is sufficient for raising maize yields.

(2) The effect of phosphate is both economically as well as scientifically significant.

(3) For this region, Babala appears to be a better fodder crop than Japanese millet.

(4) Espacement of 3 ft. × 2 ft. again furnished the highest maize grain yield, but the market value of a mixture of maize (a foot apart in the rows) and soybeans planted in alternate pairs of rows, was the highest. Further confirmation of this finding will place the problem of economic cropping methods in the foreground.

(5) The production of foxtail millet or of Japanese millet mixed with teff did not raise the yields but kept the teff in the mixed stand sufficiently erect to admit of the use of a mower, while a pure stand of teff lodged and could not be so harvested. Development has now reached the stage where the research programme can be carried out regularly.

Biometry.

Apart from teaching and ever-increasing advisory work, data of the Institute's research work were analysed. Research in connection with the interaction between quantity and quality in factorial tests was undertaken.

Entomology.

Army Worm (Laphygma exempta).—Towards the end of January and the beginning of February, 1952, the army worm was a serious pest in a large part of Natal. In the beginning of February a brief visit was made to the districts of Newcastle, Utrecht and Dundee in order to guage the extent of the pest and to assess the resultant damage. The infestation by the army worm was particularly noticeable along the banks of spruits, rivers, vleis and cultivated lands, although the area actually infested was trifling. The damage to crops like maize, established pastures, etc., was not conspicuous.

Achaea Sp. on Soybeans.

During March a species of caterpillar was noticed to attack and defoliate the soybean plants at Ukulinga. Full-grown moths, reared afterwards from this collection, were identified as belonging to the genus *Achaea* (fruit-stinging moths). It should be stated that this plant is normally fairly free from insect pests.

Genetics and Plant Breeding.

(1) *Genetics.*—Research in the genetic constitution of local *Drosophila* populations is being continued. If circumstances permit, this work will later on include the heterotic aspect of polygene groups from various localities.

Cytocological research in respect of the karyological relationship of *Ornithogalum* species was focussed on the species found in Natal. Five species not from Natal were, however, also included.

Various kinds of cowpeas, including wild types, were cytologically examined. Hybrids among most of the wild types have been identified and will be grown during the coming season.

(2) *Plant Breeding.*—During the year, which must be considered to have been particularly successful from the point of view of maize breeding, good progress was made in developing lines which are blight (*Helminthosporium turcicum*) and drought resistant.

A new technique in artificially infecting plants with *Helminthosporium* was evolved, and approximately 1,100 inbred lines, as well as 11,000 open-pollinated plants were artificially infected. It was accordingly possible to isolate 40 lines of Potchefstroom Pearl and Hickory King which show resistance to leaf blight as well as to drought. These lines will now be utilised in two separate syntheses.

Apart from the more conventional method of maize breeding the method of recurrent reciprocal selection is also being applied and a large number of white lines, some derived from Potchefstroom Pearl, others from Hickory King, were used in top crosses with open-pollinated plants of opposite groups. In order to obtain more seed, all top crosses in which drought-resistant lines were concerned, were repeated.

Altogether, approximately 15,000 plants were self-pollinated in the course of the season, and 2,655 ears were selected for further breeding.

Agricultural Chemistry and Biochemistry.

Investigation, now entering its fourth year, was confined to a comprehensive fertiliser experiment with maize. Both rock phosphate and superphosphate treatments and certain mixtures of phosphate and lime thus far appear to be best.

Research was confined principally to an experiment in which radio-active phosphorus in the form of superphosphate was used. With teff as the test crop, the effect of lime, organic material and nitrogen on the availability of phosphorus was measured in two different soil types in Natal, one type of which is that of the acid, iron-rich soils of the mist belt. Treatments were applied 42, 28, 14 and 0 days before sowing respectively, with the object of measuring the effect of the interval on the rate at which phosphorus became available in the soil.

The department has a Geiger Counter and the experiment was carried out in 80 large earthenware pots, each containing 50 lb. of soil. The first results are very promising.

In 1951, in collaboration with the department of Poultry Breeding, an investigation in connection with diluents of fowl semen was begun, but was discontinued after four months owing to a shortage of staff. Further, assistance in analytical work was given to various Departments during the year under review.

Agricultural Economics.

During December, 1951, for the second year in succession, the survey of the management and production costs of sugar was carried out. Data were collected from 81 of a possible 596 European sugar farmers in Natal and Zululand who produced between 1,000 and 15,000 tons of sugar cane per farm. The data were collected in far greater detail than in the first year of the study. Special attention, for example, was paid to determining the value of the growing sugar cane and the costs involved in reaping it.

Further, in collaboration with the Division of Economics and Markets, a survey of production costs was commenced in connection with pig farming and egg production in the vicinity of Pietermaritzburg. During the year the above-mentioned Division was also assisted in a study of production costs of factory milk in East Griqualand.

On behalf of the Division of Soil Conservation and Extention costings were compiled and the data are being collated for the demonstration farm, Spitzkop, near Wartburg.

Agricultural Engineering.

A commencement has been made with the establishment of an agricultural engineering workshop which will be fully developed when the new building for the Faculty is occupied. The purpose of the workshop is to make the necessary implements and machines available for instruction in the major subject and for research in the mechanical sphere of agricultural engineering, as well as to assist other Departments in making their own apparatus. A drawing room for drafting purposes has been properly furnished with the essential instruments, drawing tables, plan cabinets, etc.

The existing four-year degree course which had certain defects has been drastically changed and will now be a five-year course, the students being required to follow the courses of the Engineering Faculty in Durban for three years. The final two years will be devoted to specialised and applied training in the Agriculture Faculty.

The engineering department is also concerned in the development on the two experiment stations, viz.; Ukulinga, and Springfontein in East Griqualand.

Plant Pathology and Microbiology.

At the commencement of the academic year, the degree of B.Sc. (Agric.) with Plant Pathology as the major subject was awarded to the first students trained by this department.

The collection of pathological specimens has been systematically arranged and added to. A store-room and a laboratory have been equipped, principally by the personnel, to cope with the most urgent needs.

The investigation undertaken in 1951 in connection with the so-called black spot and brown spot in pine-apples had unfortunately to be discontinued owing to the great distance between Alexandria and Pietermaritzburg. A *Fusarium* species, presumably *F.moniliforme,* was repeatedly isolated from infected tissue. In a subsequent consignment of diseased fruit, the appearance of an unidentified *Penicillium* species was also common. From the nature of things no deductions could be drawn.

Approximately 1,500 flasks of culture medium for breeding soybean nodular bacteria (*Rhizobium japonicum*) were prepared for the Agricultural College, Cedara.

Dairying.

One dairy factory was visited for the purpose of investigating certain difficulties there in determining the acidity of milk. It was found that the strength and quality of the indicator as well as the light on the titration basin had an important effect on the final result. Seldom do these factors receive the necessary attention in factories. The acidity and pH values of more than 400 cans of milk were determined during the visit.

The analysis of milk produced on the experiment station continues but is now confined to fat and solids-not-fat.

Data obtained from the analysis of more than 1,600 samples during the last two years are being statistically analysed. Experiments have been initiated in connection with the manufacture of ice cream and the selection of suitable flavourings. The first comprehensive report on the composition of cheese was drawn up for the Dairy Control Board and an extract from it was published.

Horticulture.

Preliminary results of experiments and observations in general indicate that there are possibilities of expansion in fruit production in Natal. Where, generally speaking, conditions of summer rains, misty weather and hail in the Natal Highveld are not very suitable for the production of deciduous fruits, certain isolated and sheltered parts in this area appear to hold possibilities for the production of these fruits.

Suitable soil along the coast has very largely been planted to sugar cane and owing to the adverse effect of sea winds on most sub-tropical fruits, the inner coastal belt, extending approximately 10 to 50 miles inland and varying in altitude from 500 to 2,500 feet, seems to be most promising. Preliminary tests and observations indicate that these areas are especially suitable for pineapples, pecun nuts, citrus, Fuerte avocados, bananas and papaws.

Citrus.—"Greening" of citrus fruit as has appeared in the Transvaal Lowveld for the past twenty years, has made its appearance at Ukulinga. The cause of this "disease" is as yet unknown.

Grapes.—Vines seem to thrive except that the incessant misty rains which are peculiar to this area in summer and promotive of anthracnose, cause much damage. Efforts to control the disease by using fungicides appear to be unsatisfactory under the prevailing conditions. In view of the excellent demand for table grapes in Natal, preliminary experiments are being laid down for further testing of various grape varieties.

Pineapples.—In co-operation with certain farmers preliminary tests with both "Smooth Cayenne" and "Queen" pineapples at Ukulinga furnish promising results. Arrangements are being made for a proper pineapple experiment which will be commenced this year at Ukulinga.

Carrot-espacement Experiment.—The results show that at both a high and a low standard of soil fertility, the relatively wide espacements, viz; 6×3 and 3×3 inches, furnished the highest yield of marketable carrots. In the case of the comparatively close espacement, viz; $6 \times \frac{3}{4}$ and $3 \times \frac{3}{4}$ inches, the total yield was equally large, though *that* of marketable carrots was lower.

Animal Husbandry.

The Jersey bull, Els. Martini has given excellent results but, because his heifers are now sexually mature, he is being replaced by a young bull from the Grootfontein College of Agriculture.

The Friesland herd has been augumented by the addition of eight cows from the Stellenbosch-Elsenburg College of Agriculture, and the pig herd by the addition of three Large White gilts from the Agricultural Research Institute, Pretoria.

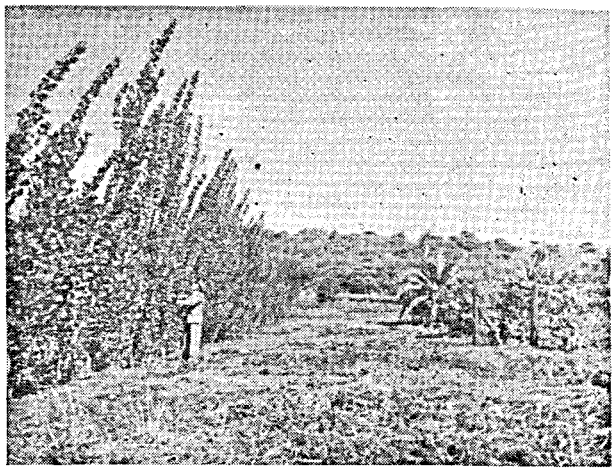
In both these herds infertility troubles, as mentioned in the previous report, were solved by introducing a Friesland bull, Univers Staatsman 20044, and a large White, Univers 1988, both from the Research Institute, Pretoria.

The calf crop from the small group of Africander and Hereford heifers was 10 per cent, and the Africander bull which was used, has been returned to stud at the Mara Research Station.

Four open stables have been erected for the housing and care of calves and dry cattle. A cattle scale has been installed and the entire herd is weighed monthly. In this way it is hoped to obtain interesting data in connection with the growth and milk production of the herd.

A very successful short course on Jerseys, attended by 25 breeders and 3 officers was held in July, 1952.

Research, largely by way of work done by final-year students for their theses, was focussed principally on certain aspects of milk and butter-fat secretion, the feeding of cow dung to baconers, the history and breeding value of the Jersey herd and the mineral feed required for growing beef cattle. For the present, observations of the effect of suckling on mastitis are also being taken.



Chilian poplar avenue at Ukulinga. The trees are 18 months old.

Poultry Husbandry.

The main building of the poultry section has been completed. Little research could be done owing to the shortage of staff, and projects already commenced had perforce to be discontinued.

Natal does, however, offer a very fertile field of labour in the sphere of poultry research.

The Experimental Farm.

Animal Diseases.

Except for mastitis, which is still a problem in the herd, the animals on the experimental farm have been particularly free from disease during the year under review.

As regards mastitis, trouble was experienced not only as a result of *Streptococcus* infection, but also because a number of cows, some of them dry, contracted *Staphylococcus infection.* In the latter case particularly good results were obtained with aureomycin.

The tuberculin test was again applied but no reactors were found. Tho cows were regularly examined for pregnancy and very little difficulty was experienced as a result of infecundity.

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Farming Problems in the Winter-Rainfall Area.

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FARMING conditions in summer were less favourable than in the previous year. Till the end of 1951 the rainfall was adequate, but from January to April exceptionally warm and dry conditions prevailed. Consequently the wine crop was considerably smaller than in previous years. The grain crop of 1951 was fair and loss from take-all in wheat and barley less severe than expected. Much damage, however, was caused by rust, especially to rye, with the result that the rye crop was a total failure in the Sandveld. So far the grain crops for 1952 are promising exceptionally well in the Swartland and Rûens areas. In the south-western districts no rain fell during early winter, but there have been good precipitations since. It is too early, however, to make any predictions as to the prospects of crops. In the North-West the rain came a little late but during July and August the precipitation was above normal. The prospects of stock-farmers for a good season are particularly promising.

Owing to the lateness of the winter rains the lupin crop, which is playing such an important part in the sheep industry at present, is less promising in the Swartland area this year. In the Piquetberg area the burr clover crop is good.

Education.

(1) As usual, the maximum number of 56 students were admitted to the diploma course, and numerous applicants had to be refused. Diplomas were awarded to 26 students.

(2) Short courses in wine-making, viticulture, dairy and pig farming, poultry, grain grading and domestic science were held and, as usual, very well attended.

(3) The degree courses were well attended in spite of the high cost of academic training. In 1952, 225 degree students were enrolled, 73 of whom in the first year, 51 in the second year, 33 in the third year and 46 in the fourth year of the B.Sc. degree course; there are 18 post-graduate and 4 special students. In forestry there are 23 and in domestic science 79 students. During the past year university degrees were awarded as follows:—

M.Sc. (Agriculture), 1; B.Sc. (Agriculture), 41; M.Sc. Forestry), 1; B.Sc. (Forestry), 11; and B.Sc. and B.Ed. (Domestic Science), 11.

Extension Work.

Extension work is being continued by way of farmers' days at the experiment stations and also by visits of farmers in groups. Special extension work in connection with viticulture, wine-making, the control of plant diseases and of insects, etc. was also undertaken and conducted by visiting farms and holding special meetings.

Apart from providing the public as usual with winter cereal and vegetable seeds and with vine-propagation material, a large quantity of sweet lupin seed of two excellent varieties that were selected and tested here, was supplied to seed growers during the past year. It is hoped that the sweet variety will provide protein concentrates and high-grade silage for the live-stock industry.

Research.

Agro-chemistry.

Three fertiliser experiments with vegetables were undertaken and four with winter cereals and lupins. The chemical examination of the soil in the crop-rotation and soil-cultivation experiments with regard to carbon, nitrogen and phosphate, was continued. For fuller data representative specimens of young cereals in various stages were taken and analysed in all the above experiments.

The soil-cultivation experiments clearly indicate that more nitrogen is mobilised by fallowing late in spring and cultivating in autumn than by other methods of cultivation.

In the crop-rotation experiments, where lucerne is grown in rotation with wheat as compared with fallowing, the old lands are invaded by volunteer burr clover and the advantage of lucerne over fallowing disappears—an indication that burr clover can play the same role as lucerne.

Analyses of young cereals show that wheat following on lucerne has a lower nitrogen content than wheat following on green manuring with lupins. It has also been proved that green lupins nitrify exceptionally rapidily, the entire process being completed in three months.

Another interesting result is that oats not treated with fertiliser but following on lupins treated with phosphate has been found to have a low phosphate content. It seems as if it would be much more profitable to treat the oats with phosphate fertiliser and to let the lupins manage on the residual effect of phosphate applied to the oats crop.

On sandy soils it has also been found that the removal of heavy lupin crops (green material) from the soil results in poor grain yields the following year. According to indications this phenomenon is due to lack of potash.

As regards the fertilising of lupins interesting results were obtained. The application of agricultural lime—both the ordinary and the dolomitic types—entailed neither advantages nor disadvantages. Heavy applications of phosphates in the first year sufficiently accounted for heavy lupin crops in the second year. So far rock phosphate has been the most economic phosphatic fertiliser for lupins.

In the Hermon area phosphatic fertiliser has induced very favourable crop increases. Superphosphate is the best form of phosphate for winter grain but where lupins follow on winter grain rockphosphate and superphosphate mixtures show a superior phosphatic residual effect.

The fertiliser experiments on the experiment farm of the Cape Flats which were laid out for determining the most economical applications of manganese and copper failed because of climatic conditions.

The vine fertiliser experiments showed that heavy applications of nitrogen resulted in better vegetative

43 bacterial cultures which secrete pectin enzymes were collected and identified.

Engineering.

Apart from rendering the services previously mentioned under "Technical Assistance", a humidifying apparatus for maintaining a specific atmospheric humidity was designed and constructed. For this apparatus a switch was designed which automatically cuts off the current as soon as the water falls below a certain level, whereby damage to the element is prevented. Equipment for experiments on the control of frost damage to orchards has also been designed.

Statutory inspection was carried out at 193 cold storage plants.

Agricultural Research in Natal:—

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The death rate amongst poultry was also particularly low. From time to time there were losses resulting from tumours, but *Neurolymphomatosis* did not appear. The number of deaths amongst certain chicks after inoculation for Newcastle Disease was fairly serious. The chicks showed symptoms typical of Newcastle Disease, but the actual cause was *Coccidiosis*, contracted before facilities for hygienic housing of the chicks were available. The deaths ceased immediately after treatment for Coccidiosis.

Pasture Management and Soil Conservation.

In addition to academic tuition, attention was also devoted to giving instruction and advice to farmers. In co-operation with the Division of Soil Conservation, active part was taken in the functions of certain soil conservation committees and in the planning of certain areas.

Four different experiments were continued. An experiment on large-scale veld burning and grass cutting is now in its third season. It has been found that usually autumn burning in this area does not take place sufficiently early to ensure growth before winter. Since but light frost occurs, the veld dies off mainly as a result of drought, and consequently autumn burning in this area differs entirely from that in the highveld areas.

Last season's finding that the time of cutting hay on veld, burned before or after the spring rains, did not synchronise with that on veld which had been cleared with a mower, was again confirmed. It was again found that the hay yield from veld which had been cleared with a mower was much higher than that from veld which had been burned. In the third season undesirable weeds are already appearing in some plots which are subjected to burning.

The field-fertilisation experiment has supplied very interesting data. Particularly striking is the interaction of nitrogen and phosphate. Up to the present phosphate alone has given practically no increase in the yield; nitrogen, on the other hand, has raised the yield considerably, and a combination of nitrogen and phosphate has so far proved the most promising in respect of yield only. Interference with the natural water relationships and ecological equilibrium in the grassveld is apparently a very serious problem created by field fertilisation.

Unfortunately the co-operative experiment on veld fertilisation had to be discontinued for a season because the concentration of game on that portion of the veld was such that enclosure became imperative.

Root studies under different veld-cutting conditions have been continued. Remarkable differences were noticed between the structure and distribution of the roots of various grasses.

A veld-cutting experiment was also continued.

Botanical analyses were made of all experiments, dry weights taken and samples chemically analysed, so that quantity, quality and effect at any time may be compared.

A grass nursery is being maintained, especially for demonstration purposes. Varieties of an indigenous grass have been colected for purposes of further selection and breeding.

Apart from recording the ordinary meteorological observations, considerable time has been devoted to the collection and collation of data for drawing up a detailed meteorological chart of Natal later on.

Farming Problems in the Winter-Rainfall Area:—

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The lucerne-breeding programme includes about 2,000 single plants, which are being checked and are evaluated in respect of all qualities which are regarded as important; their self-fertility and cross fertility are also being determined. In an effort to find a selection-criterion, it was found that leaf area is an indication of drought resistance.

In the tomato breeding experiment success was ultimately attained in establishing a genetic bridge between the ordinary tomato and one of the Peruvian species which is resistant to spotted wilt and eelworm, is drought-resistant, is tolerant to low temperatures, and is high in vitamin content.

Poultry Breeding.

Observations on the relative merits of the battery and other systems of poultry keeping indicate—

(1) that food consumption in respect of these systems differs very little;
(2) that egg production with the battery system is better;
(3) that there is no significant difference between the systems as far as mortality is concerned;
(4) that the calcium requirements for laying hens in battery systems are higher than otherwise; and
(5) that in a closed unit the air requirements of the hens in battery systems have to be carefully studied.

In the feeding experiments it was determined that growth in chickens are no better stimulated by fish solubles than by the ordinary three per cent brewers yeast. An extensive experiment is under way for testing sweet and bitter lupins as a source of vegetable proteins.

Sex determination in Black Australorp day-old chickens, according to possibly sex-linked factors, is still under way as are also studies in connection with the slaughter qualities of American broad-breasted turkeys.