Wongan Hills

Research Station

1924 – 73

Department of Agriculture.
INFORMATION SERVICE

HISTORY

Light textured, infertile soils are scattered throughout nearly every district of Western Australia's agricultural area. Estimates place their area at 38 million acres, over half of the 65 to 70 million acres which receive 11 inches or more annual rainfall.

Large areas were taken up in association with the better class soils of the wheatbelt. In 1921 it was estimated that 8 million acres of light land were already alienated in areas of reliable rainfall but were not economical to farm with existing methods. By 1938, with the spread of farming in the wheatbelt, there were 12 million acres of light land available for selection within 25 miles of existing railways. This land could be used to a limited extent in association with better class land. Vast, almost continuous, sandplains north of Perth and along the south coast between Albany and Esperance were regarded as agriculturally worthless.

A conference held in Perth in 1921 to discuss methods of utilizing the large tracts of light land resolved to establish an experimental farm on a typical area of wheatbelt light land.

Sites at Lomos, Tammin, Goomalling and Bruce Rock were suggested, and the Government appointed a committee consisting of the Hon. H.K. Maley, Minister for Agriculture, Mr. G.L. Sutton, Director of Agriculture, and Mr. J.P. Camm, Surveyor General, to consider the various sites. At this stage, Mr. R.R.B. Ackland of Lake Ninan, near Wongan Hills, reminded the Government that an area of wheatbelt light land near Wongan Hills had been reserved for the establishment of an experiment farm. The committee inspected the site, having arrived at Elphin Siding by special train in the winter of 1922.

The committee recommended the site, which contained soils corresponding to much of the wheatbelt light land, except for the poorest types usually termed "wodjil". Work commenced with water boring in the winter of 1923, and 1000 acres of scrub was rolled and burnt in the summer of 1923/24.

The entrance gates to the station commemorate the endeavours of Mr. Ackland, who was instrumental in having the research station established. As Chairman of the Wongan Hills Progress Association he made representations to the Minister of Agriculture which resulted in 1600 acres being placed under temporary reserve for a State Farm in 1914. (The area became part of paddocks 3-5 Home, 1-3 West, and the undeveloped area in the south-west corner of the property, and also an area to the east of this which was finally not included in the farm). Mr. G.L. Sutton, then Commissioner for the Wheatbelt, wisely suggested that a much greater area would be required to make the property an economical unit and the area now occupied by the paddocks 1,2,3, 6 and 7 Home and part of the uncleared area west of these was added. An additional area on the west, at present largely undeveloped and adjacent to Elphin Siding, was added to the temporary reserve at the request of Mr. Ackland in 1916. Mr. Ackland was largely responsible for the reserve being maintained against considerable pressure for the release of the area for farming.

The area now occupied by paddocks 1-3 East was added following the decision to establish the Wongan Hills Light Lands

Farm making the total area 6,032 acres in 1923. The Farm was to become unique in Australia and was to pave the way for the successful development of light lands for agriculture.

EARLY DEVELOPMENT 1924-45

The initial clearing (Paddocks 1-5 Home) was sown in 1924 to wheat and oats for pedigree seed, 153 acres of fodder crops and 28 acres of experiments. The wheat crop, on tussock and smokebush sandplain yielded 16.8 bushels per acre with 11.2 lb. superphosphate per acre. These soils were 9 to 18 inches of sand over a gravelly cement subsoil. The Manager of Chapman Experiment Farm, Mr. I. Thomas, travelled by motorcycle to Wongan to supervise the initial development.

Two teamsters' cottages, an implement shed, stables, workshop, single men's quarters, Manager's residence, and boundary and subdivisional fences of the homestead block were completed or under way at the time of the official opening in 1925 by the Hon. M.F. Troy, Minister for Agriculture.

The Director of Agriculture, Mr. G.L. Sutton, and Mr. I. Thomas, who had become Superintendent of Wheat Farms, planned a rapid development of the farm. Most of the work was supervised by the Manager, Mr. A.R. Venton, who held the position from mid 1926 to the early 40's. By 1929, 2,770 acres were under cultivation, most on a four year rotation of fallow-crop-stubble-volunteer pasture. The four land units in the rotation were the "Home" paddocks and the three East paddocks. The eastern parts of paddocks 2E and 3E were uncleared and there was an area of scrub in 2 Home uncleared.

A small flock of wethers was purchased to run on the stubble of the first crops and 220 ewes in lamb were added to these in 1927. In 1931 a small Border Liecester stud was established to provide Border Liecester x Merino ewes for fat lamb experiments at Avondale. Some fat lamb trials were also conducted at Wongan. There were about 800 sheep on the farm by the late 1930's. About 15 working horses were used in cropping 650 to 800 acres each year. Sown fodders in the form of cereals, lupins and peas were essential for livestock maintenance because the self-regenerating natural pastures were unproductive.

Experimental Work

During the early years the major work on the station was to test, on light land, the cereal production methods developed for more fertile soils at Merredin and Chapman Experiment Farms. The main aspects were depth of ploughing, time of fallowing, time of planting, rate of seeding, variety tests and rates and times of application of superphosphate. In many cases the practices for heavy land were successful on lighter soils although, perhaps, for different reasons.

Seeding as early as possible after allowing for weed control proved to be the best on both heavy and light soils. On heavy soils this may have been necessary to avoid boggy winter conditions, while on light land the object was to get the crop established before the onset of cold, wet conditions and before there was leaching of the already low soil nitrogen supply. Mid-season and late varieties had to be used for the earliest plantings at Wongan to avoid disease injury to the maturing ear.

No advantage was gained from seeding rates higher than 45 to 60 lb per acre.

Most cultivation techniques affected cereal yields only through the degree of weed control achieved. A period of long fallow preceding the crop was essential for reasonable cereal yields on the light soils.

Rate of superphosphate trials with treatments of 0, 75, 150, 225 and 300 lb per acre superphosphate (22-23 per cent) were started in each of the four main paddocks during a crop year, and then cropped on the same rotation as the main paddock. Paddocks 2E and 3E were new land at the start of the trials, 4 Home had had one previous crop (150 lb super) and 1E two crops (total 262 lb super per acre). Nil plots on new land gave no yield. Responses were obtained with the highest rates but low wheat prices in the 1930's meant that rates above 120 pound were rarely economical.

The time of application of the 112 to 150 pound of super per acre for the cereal crop was tested with the hope of reducing the amount of work at seeding, but yields were best when the whole dressing was applied at seeding.

Cereal variety testing, initially using imported types but later an increasing number of locally-bred varieties, was always a major part of the experimental work. Plant breeding started at the station in the early 1930's with the transfer of operations from the Chapman Experiment Farm and the achievements in this work are given in a later section.

Seed fungicide treatments were tested at Wongan as well as the other wheatbelt experiment farms.

In addition there were tests of fertilisers other than superphosphate, rotation experiments, and tests of fodder and pasture varieties. Most experiments were repeated on at least one other wheatbelt experiment farm. (NOTE: Experiment Farms became Research Stations in 1936).

Trials with additional potash as, or equivalent to, 56 lb of muriate did not increase wheat yields with 150 lb superphosphate.

Nitrogenous fertiliser experiments began in 1929 and substantial yield responses were obtained with 1 cwt sulphate of ammonia at seeding with wheat on fallowed ground with 120 lb per acre superphosphate. The low nitrogen status of the light soils was obvious, even on fallowed land, but, at the time, the high cost of nitrogenous fertilisers made their use uneconomical.

In 1932 a trial with nitrogen and potash combined gave no increase in yield above nitrogen alone. In 1931 an experiment with manganese on wheat resulted in slight, non-economic yield increases. Phosphate sources, such as Rhenania Phosphate, proved to be inferior to superphosphate for wheat.

A minor element trial conducted by the Plant Nutrition Branch (later, the Plant Research Division) in 1938 suggested that no deficiency, other than superphosphate, was likely to occur.

Pasture establishment experiments began in 1934, with a range of grasses and legumes. By 1938 the plants which showed promise were snail clover, lupins, early subterranean clover (Dwalganup), veldt grass, Phalaris tuberosa, trivicata lucerne and creeping saltbush. It was found that lupins gave very good bulk when autumn rains were satisfactory, and once well established produced sufficient hard seeds to re-establish after the fallow-wheat phase of the rotation. Lucerne over-summered quite well and came away with the autumn rains. Barrel medic set a reasonable amount of seed, but did not grow as quickly in the early stages as Dwalganup subterranean clover. Phalaris and perennial veldt appeared to be the best of the perennial grasses.

The initial plantings of rotation experiments were made in 1926. One experiment ran from 1932 to 1961 with the four treatments: continuous wheat, fallow-wheat, stubble-fallow-wheat, lupins-lupins-fallow-wheat (lupins replaced by clover in late 1940's). Superphosphate at 112 lb per acre, was the only fertiliser used and was applied with the cereal crop. Plots in each rotation were cropped each year, and the wheat yields obtained were as follows:

	Wheat Yield, Bush. per acre.				
	1933	1936	1939	1942	1945
Variety	Totadgin	Totadgin	Totadgin	Merredin	Koorda
Cont. Wheat	21.7	7.9	6.9	2.2	2.1
F - W	21.6	15.6	5.9	14.7	14.1
St - F - W	21.8	17.1	10.9	24.2	17.6
L(2)-F - W	21.7	19.2	9.3	25.6	29.1

In the early 1940's it was concluded that lupins were the most satisfactory pasture plant and that early subterranean clover was not yet proven on a large scale. The lupins were only suited to summer grazing and it was hoped, by selection, to produce a grazing type which could be utilized the year round. Pasture establishment was hampered by the largeness of the main paddocks, four larger than 500 acres each covering two thirds of the cultivated area; subdivision was hampered by the lack of finance for capital improvements during the war years.

The war forced some changes in the experimental programme on the station. The supply of rock phosphate from Nauru was cut off and other sources, including guano from the Abrolhos Islands, were inferior and limited. In the later war years superphosphate dressings were limited to 30 and 40 pound per acre of cereal sown, but trials showed that 90 per cent. of maximum yield could be obtained with 40 lb per acre on previously well-supered land.

Beside the rate of superphosphate trials, residual superphosphate trials had been carried out since the inception of the station. In 1941 rates of 0, 56 and 112 lb per acre were used on wheat on two sites of moderate (270 lb) and heavy (747 lb) super histories. Both sites proved to be similar, yields with no super being 70 per cent and 56 lb being 95 per cent of yield with the higher rate.

Safflower crops sown in 1941 and 1942 yielded poorly because growth was confined to the drier, warmer spring months. Plantings of Guayule rubber survived the summer conditions but, at the end of the war, the work was not continued.

PASTURE IMPROVEMENT PHASE 1946-50

Pasture and fodder problems were the main interests of visitors to all the wheatbelt research stations in the 1940's.

It was evident that sheep numbers in the wheatbelt could be very profitably increased if pastures were more productive. At Wongan, the establishment of pasture legumes was essential to improve fertility after 20 years of exploitation. Wheat yields had maintained a reasonable average of about 15 bushels per acre up to 1940, but thereafter steadily declined. Soil erosion by wind and water increased with the loss of soil organic matter and poorer cover of volunteer pasture. Fallowed paddocks, essential to maintain yields, were badly eroded. Erosion control experiments and the system of contour banks on the station date from this time.

After initial setbacks, small areas of subterranean clover and ryegrass pastures were successfully established in 1942 and 1943. In 1946, the first large paddock (1 East) was sown with 6 lb of Dwalganup Early subterranean clover and 2 lb of Wimmera ryegrass under a cover crop of 20 lb of oats with 56 lb of superphosphate per acre. Successful establishment was achieved and in the following years practically the whole of the available cleared area was sown to this strain of clover.

In 1947-48 the West Paddocks (Nos. 1-3) were cleared and developed according to the present recommended techniques for light land. After the whole area was rolled and burnt in the early part of 1948, paddock number 1W was cultivated, without fallow, and sown to wheat and oats in the winter. Paddocks 2 and 3W were fallowed in July and August, and all three paddocks were cropped in 1949. The resultant crop was an excellent one and the stubble was burnt in March 1950 to control sucker regrowth.

Number 1W was sown to 6 lb Dwalganup sub clover and 150 lb zinc-super per acre in 1950. The other two West paddocks were sown with 8 lb sub clover and 150 lb zinc-super in 1951, after a second cereal crop. Successful sub clover establishment on new land followed the use of innoculated seed and liberal annual superphosphate applications after 1 or 2 pioneer cereal crops. On older land the important aspects of establishment were weed control and, again, liberal use of superphosphate.

Experimental work

The rate of superphosphate experiments, 1929 series and 1941 series, and the rotation experiment begun in 1932 were continued. The evaluation of cereal varieties also continued.

The Plant Nutrition Branch conducted several trials on the economical development of light land during this period, using wheat as a pioneer crop. The trials employed different rates of super, copper, zinc and molybdenum, with some emphasis on obtaining a heavy stubble. The Wongan soils proved to be not as deficient in minor elements as the sandy soils at Eneabba and on the south coast which were being developed at this time. Minor element contaminants in superphosphate were sufficient for reasonable cereal yields over many years and tended to mask the fact that marginal deficiencies existed. Better crop and pasture growth on new land followed the use of copper, zinc and molybdenum.

A large rotational grazing experiment, conducted in association with C.S.I.R.O. (P71) was started in 1946. The trial occupied 96 acres, on Wongan loamy sand in the centre of paddock 3E. The aim was to compare the effect of various pasture associations on the carrying capacity and wool production of merino wethers, and yields of subsequent crops. The trial ran through two cycles of 3 years pasture, 1 year crop until 1953.

The pasture phases, with duration in brackets, were: volunteer pasture (3 yrs), oats (3), sub clover and Wimmera rye grass (3), oats (2)-peas(1), oats (1)-peas(2), oats, rye grass and lupins (3). The pastures were resown annually, and were not grazed from April 15 until the oats were 6 inches high. Stocking rates were adjusted to completely eat out the pasture in the grazing period of about nine months. Results after the first three years' pasture are shown below.

	Vol. Pasture	Oats	Sub Clover	Peas & Oats		Lupins
				Peas 2	Peas 1	
Soil N increase cwt. S/A per acre	4.5	1.4	10.8	1.4	1.4	8.1
Wheat yield bus. per acre	14.0	6.1	19.7	8.9	8.2	11.9
Total Dry Matter Pasture cwt/acre	18.9	10.6	25.5	16.1	13.7	20.7
Wool Yield lb/acre/annum	10.7	27.5	17.8	28.0		23.7

DEVELOPMENT OF CLOVER LEY FARMING 1951-60

The success of the pasture establishment programme was seen in the elimination of soil erosion hazards, the reduction of long fallow, and the spectacular increase in crop yields and stock production.

Crop yields in 1 East before clover establishment ranged from 10.5 to 17.9 bushels for an average of 11.1 bushels per acre for the seven wheat crops. In contrast, the first crop after clover in 1951 yielded 22 bushels per acre. In 1953 2 East was cropped for the first time after five years of clover and yielded an average of 25.7 bushels per acre. Previous yields in this paddock averaged 14.2 bushels with a range of 10.2 to 17.3 for six crops. Taking these two paddocks together, the average yield for the first crop after clover was 22.9 bushels compared to 11.8 bushels for the previous crop.

Adult sheep numbers doubled to about 2,500 over the period 1951-55, with increases of 1.6 lb. in the amount of wool cut per Merino sheep compared to 1945.

Experimental work was mainly concerned with the <u>treatment</u>

of clover land before and after the cropping phase. Long fallow periods were discontinued because of the greater overall gains in stock carrying capacity, soil fertility and erosion control without reducing cereal yields. It was found that sub clover did not re-establish satisfactorily after the cereal crop, and re-seeding was necessary. Clover establishment under a cereal grain crop proved to be unsuccessful in 1956.

A large scale cultural trial, which compared discs, mouldboard, scarifier and chisel plough, was started in 1955. There were no differences in cereal yield provided there was equivalent weed control with the various implements. The weed control effect was demonstrated by using herbicides. Generally the plough was superior to the scarifier for weed control.

New land at the eastern end of 2 and 3 East, which was rolled and burnt in 1955/56, provided sites for the investigation of clover seedling mortality following poor or ineffective nodulation. Soil fumigation treatments suggested that this was due to microbial antagonism in the soil. The value to clover establishment of leaving the clearing as bare fallow for 12 months or using a cereal pioneer crop was clearly demonstrated. Thorough destruction of the natural vegetation by burning and ploughing helped to minimise seedling mortality.

Trials with superphosphate showed that where wheat was grown on old clover land which had received more than 1000 lb. per acre of superphosphate, no yield responses were recorded to more than 56 lb. of super sown with the crop. Soil sampling of the 1933 residual phosphate experiment showed that, for all rates of application, at least two thirds of the phosphorus applied could be accounted for in the top 12 inches of soil.

The advent of cheaper inorganic nitrogen fertilisers led to further trials with cereals on new land. These fertilisers gave economical yield increases, and were particularly useful where two successive crops were grown and where a good stubble was required for burning. Where several crops were grown it was found that yields were improved and less supplementary nitrogen was required where the stubble was burnt before seeding.

W O N G A N   H I L L S   R E S E A

S O I L   M A

SOIL SERIES

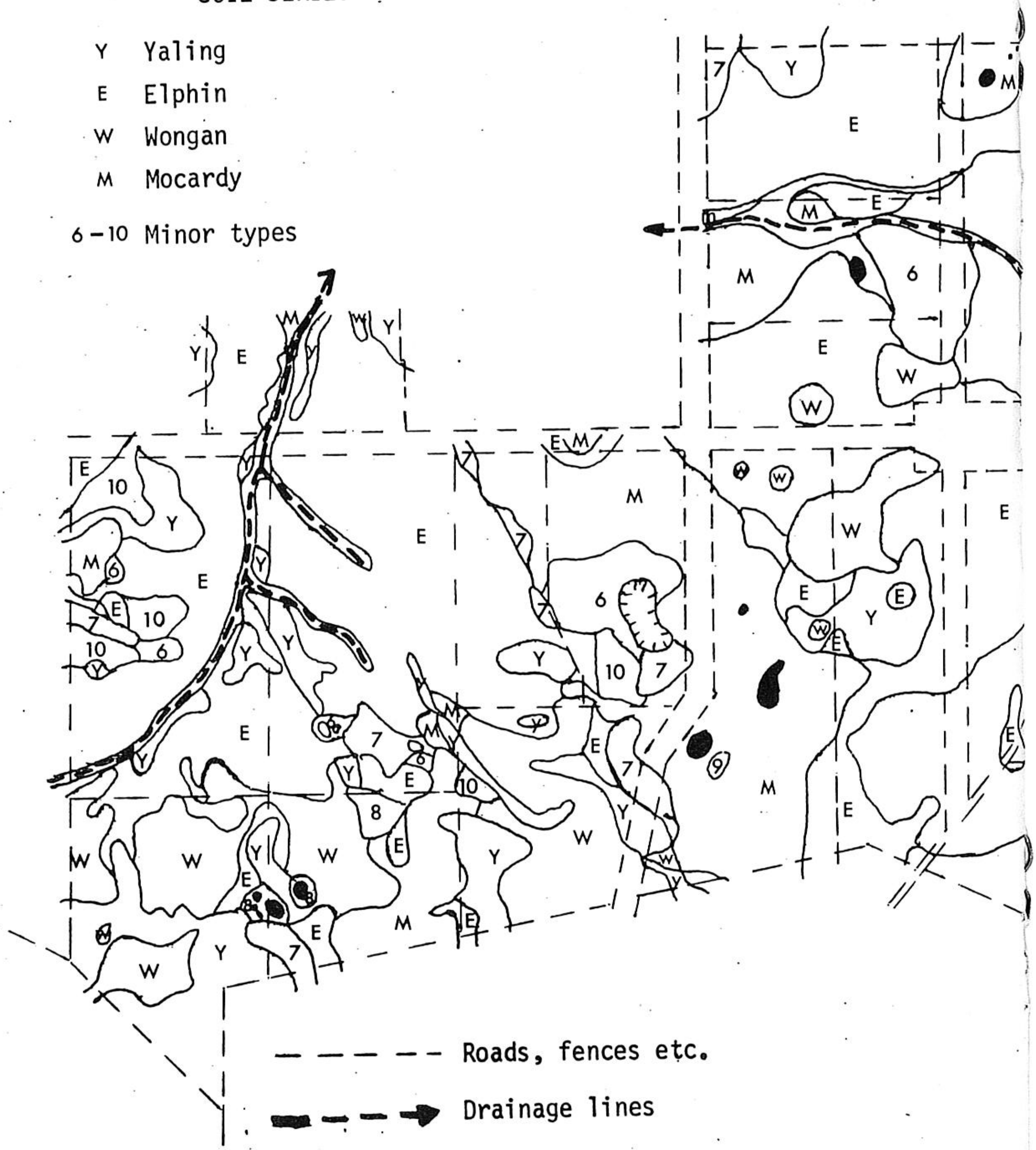
Y Yaling

E Elphin

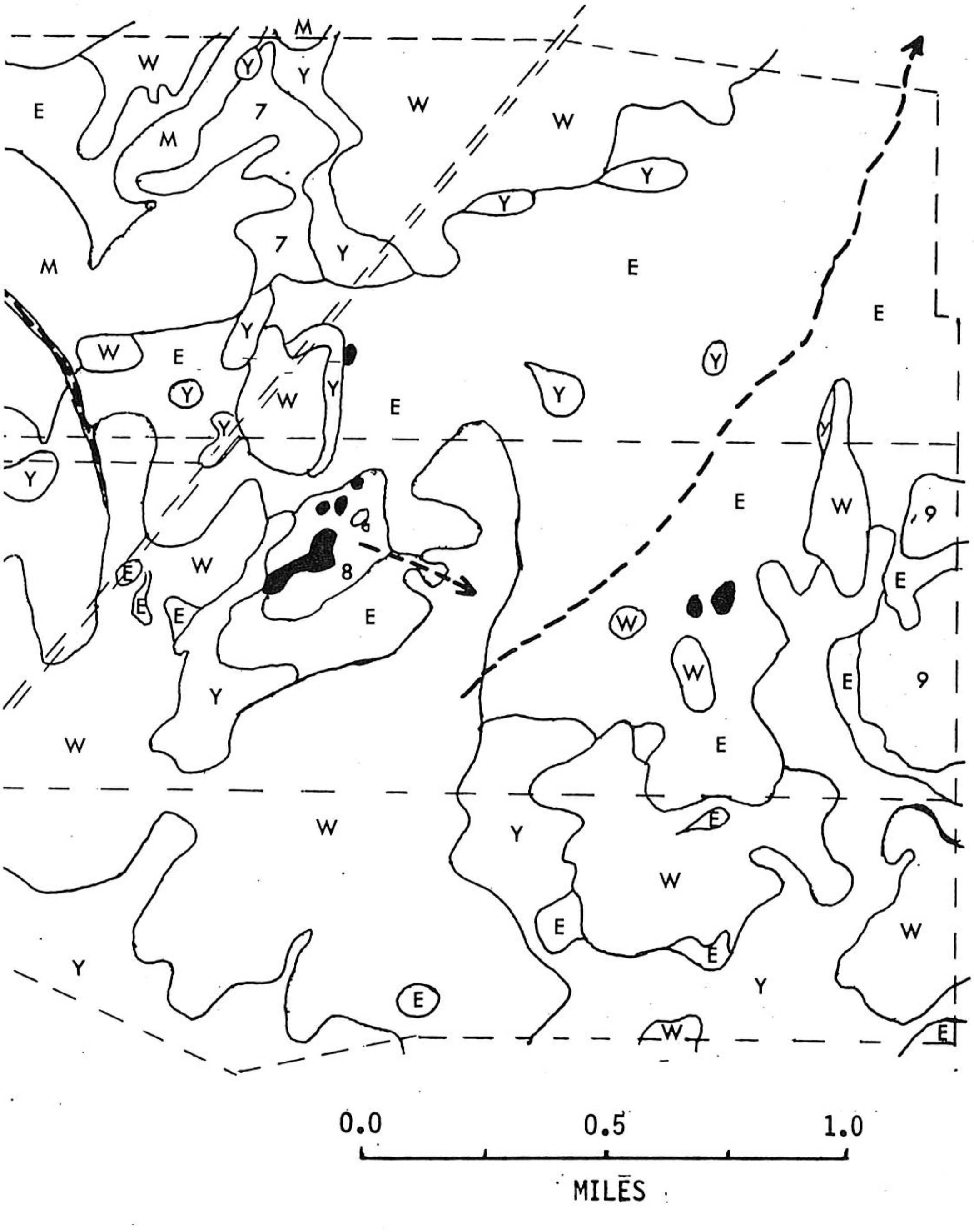
W Wongan

M Mocardy

6–10 Minor types



RCH STATION



A long term trial was commenced to determine the length of the pasture phase necessary to promote maximum crop yields, and also how short the phase could be before there were substantial effects of yield. This trial is still in progress in paddock 2EE.

The incidence of "takeall" in wheat increased in crops sown on old clover land, and detailed experiments on the problem began in the mid 1950's.

THE PAST DECADE

Sheep numbers increased rapidly during the 1960's as farmers sought to utilize their increasing areas of improved pasture. Higher stocking rates and later lambing led to more efficient use of pastures. The fertility of ewes and rams became important in exploiting the favourable market for sheep.

A "flushing" experiment at Wongan Hills Research Station in 1960 showed that a temporary liveweight gain in ewes at mating time increased lambing percentage. Hand feeding to make ewes five pounds heavier at mating increased lamb drop by 12 per cent.

Time of lambing trials at Wongan showed the value of matching the ewe's feed requirements with the natural cycle of pasture growth. The rising plane of nutrition required by the ewe in the last two months of pregnancy and the first six weeks of lactation was supplied by green pasture with July-August lambing, whereas costly supplements were necessary for April-May lambing. Later lambed ewes had a higher conception rate and there was less spread of lambing because a greater proportion of ewes were in oestrus in February-March than in October-November.

Results from the 1964-69 time of lambing experiments showed the effect of liveweight at the time of mating on lambing performance of ewes. At both lambing times, the percentage lambs born increased with increased liveweight at mating, and the increases were greatest with later lambing. To reap the full benefits of later lambing, body weights must be maintained until the ewes are mated.

One stocking rate trial started in 1961 showed that 1½ wethers per acre could be carried at Wongan without detriment to pasture or stock when compared to previous rates of less than 1 sheep per acre. Another trial, which began in 1962, examined both stocking rate and autumn versus spring shearing. At the time, the trend towards later lambing, the availability of shearers and buyer interest tended to favour autumn shearing. Autumn-shorn fleeces tended to be infested with grass seeds, but this could be influenced by management because grassy pastures were a feature of low stocking rates. On the other hand, autumn-shorn wool from heavily grazed pastures was inclined to be dusty.

Hand feeding was necessary to carry three sheep per acre at Wongan but, at that time, the cost of supplementation was economically justified. It was found that the clean wool yield of fleeces and the staple length fell as stocking rate increased, but wool fineness increased so that final wool prices were only slightly in favour of lower stocking rates. It was clearly established that wool production per acre increased up to 2.5 sheep per acre, although production per head declined.

Ram fertility investigations began with a series of trials started in 1963, partly as a result of a suggestion that high temperatures during February-March mating might affect the rams' fertility. There were less dry ewes and more twins with 2½ per cent. rams than with 1 per cent. rams, and the cost of the additional rams was easily justified by the much better lambing results.

Further work showed that 2-tooth rams were less fertile than mature rams when both were joined at 2 per cent., but of equal fertility when both were joined at 4 per cent. rams to ewes. With an eight-week joining period there was no advantage in joining more than 2 to 2½ per cent. mature rams. The use of 4 per cent. mature rams resulted in higher fertility during the first three weeks of joining, and therefore in a more concentrated lamb drop. Future work will test the suggestions that the higher fertility of mature rams is due to better semen quality and also to greater mating experience.

Another aspect of flock management during mating studied in trials at Wongan, was the intensity of management during joining. Ewes in small paddocks had the same lambing results with 1 or 4 per cent. rams, while ewes in large paddocks had fewer lambs with the lower ram percentage.

Wongan was included in a survey of lamb mortality on research stations. Combining all breeds and all stations over the period 1964-66, losses were 14 per cent. of all lambs born. The major causes of death were failure to suckle and difficult or prolonged birth. Lamb death rates in July-August and April-May were similar and lamb deaths were not higher at higher stocking rates. Twinning gave useful increases in numbers of lambs reared despite higher lamb mortality rates.

Clover disease has not been severe at Wongan Hills, even in ewes grazing pastures dominated by a potent strain of sub clover. An experiment is in progress comparing ewes on clover and non-clover pasture during the green period.

Trials were conducted to detect oestrus in lactating ewes, having in mind the possibility of mating ewes to lamb twice each year or three times every two years. Oestrus varied from 10 to 90 days after lambing, and best results were obtained by introducing rams shortly after instead of shortly before lambing.

The 1960's saw a large number of crop and pasture experiments at Wongan. In the ten growing seasons 1961-70 more than 180 separate experiments were conducted on cereal and pasture agronomy, and more than 60 experiments on weed control, as well as experiments on crop and pasture diseases. Many of these experiments are still in progress.

Experiments with 2,4-D for the control of wild radish, turnip, mustard and doublegee in cereal crops showed the importance of confining the sprays to the tillering stage of the crop. Earlier or later spraying was almost certain to reduce yields. Other work showed that earlier application at the 2 to 6 leaf stage of the crop was best for Afalon, Linuron, Brominil and Buctril.

Trials showed that the replacement of a cultivation by a herbicide treatment was practical and could be used to advantage. Work is proceeding on the economical selective control of wild oats and rye grass.

Soil fertility investigations showed that four or five years of clover pasture could be followed by two or three successive high-yielding wheat crops. Nitrogen fertilisers equivalent to 25-50 lb urea per acre were likely to give payable increases in yield of the second and third successive crops.

Burning the previous year's stubble during a cropping sequence helped to control grass weeds and increased crop yields.

Results from the long term rotation trial, and other trials on the station, made it clear that a farmer could vary the length of the pasture phase to suit his particular situation. Where quite high wheat yields were possible, and only a low stocking rate could be maintained, the rotation selected could contain a shorter pasture phase. In the long term rotation trial, yields after two years of clover averaged 23 bushels per acre compared to about 12 bushels for the first crop on new land. Five or seven years of clover resulted in an average yield of 24 bushels per acre for three successive wheat crops. Soil nitrogen in the top three inches of soil increased at the rate of about 50 pound per year of clover.

In a continuous wheat cropping trial, started in 1961, quite high yields were obtained for a number of years without nitrogen fertiliser. The trial is still in progress on Wongan loamy sand in paddock 2Ec. Before the trial began this paddock had two periods of five and seven years continuous pasture with one cereal crop between the pasture periods in 1953. Yields of the nil plots are still over 20 bushels in a normal season, with maximum yields of 27-30 bushels obtained with 50 or 100 lb. urea or equivalent per acre. In recent years, yields have been reduced on plots receiving 3 cwt sulphate of ammonia per annum, and further work will be done to identify the causes.

Comparisons of drilled and top-dressed superphosphate showed that maximum cereal yields with the least super were always obtained by drilling. For example, where previously applied super totals 1000 lb., maximum yields were obtained with 90 lb. super per acre drilled or 200 lb. per acre top-dressed.

Work on new pasture species for wheatbelt light land is in progress, with some emphasis on low-oestrogen strains of sub clover as possible replacements for Dwalganup and Geraldton. The low-oestrogen strain Daliak has been sown in several paddocks and is making satisfactory growth. Other leguminous species are generally inferior to sub clover in pasture production at Wongan. The rose clovers and cherleris make successful growth but do not persist under continuous heavy stocking.

Cattle

The initial herd of poll hereford cross cattle was established at Wongan in April 1964. Trials in subsequent years showed the potential of beef production in the 14 inch rainfall area. The main breeding herd of 30 animals was set-stocked on 100 acres of Dwalganup sub clover pasture. Results showed that good quality baby beef could be produced if calves were born in March-April. Hand feeding was necessary to maintain the cows in reasonable condition, but this did not have to exceed 1000 lb. of cereal hay a head in a normal season. Selling of calves at the baby beef stage allowed the breeders to improve in condition before summer.

Plant breeding

Plant breeding work at Wongan Hills began in 1932 with the complete transfer of the material from the Chapman Experiment Farm. Work on wheat and oats, begun at Chapman, was continued and barley breeding started.

Selections from the oat cross Mulga x Burt's Early, made at Chapman in 1928, were observed over a number of years at Wongan and resulted in the release of three new varieties which were to be prominent for many years. These had a range of maturities from the early Wongan, released in 1937, to Ballidu and Dale, both released in 1942. Besides offering a range of maturities, the varieties were higher yielding, stronger strawed and less prone to shedding than the other varieties in use at the time.

Kondut wheat, released in 1943, was produced at Wongan from the cross Wilfred x Sutton made at Chapman in 1930. Although not outstanding, the variety made a solid contribution in the wetter districts where it offered some escape from septoria disease and where it is still grown on a significant area. The alternative varieties for drier areas were Bencubbin and Bungulla, both bred at Merredin Research Station.

Further success with oats came with the release of Avon in 1955 and Kent in 1956. Both were from the cross Ballidu x (Mulga x Laggan) made at Wongan in 1942. Avon, later maturing than Ballidu, became widely grown in the wetter areas, and is still a leading variety here and in the Eastern States. Kent was not as widely grown as Avon, but was a useful early-maturing grazing oat.

Early maturing selections of the cross Kent x Ballidu, made at Wongan in 1949, were transferred to Merredin and resulted in the new oat varieties Irwin, released in 1965, and Swan, released in 1967.

The early barley breeding programme concentrated on 2-row varieties and the present leading variety, Dampier was produced at Wongan and released in 1967. The emphasis remains on producing two-rows but six-row varieties are used in breeding.

Wongan Hills became a major plant breeding centre in 1971 with the transfer of the wheat programmes from Merredin and Avondale research stations and the linseed programme from Avondale. All rows and initial yield tests (stage 1) are carried out at Wongan. High yielders from the initial trials are then retested in stage 2 trials at Kalannie or Merredin (representing low rainfall conditions), again at Wongan Hills (medium rainfall), and also at Mt. Barker (high rainfall).

High yielding, good quality survivors are either retested at the same three sites or included in stage 3 variety trials on 9 wheat-belt research stations.

Since 1966 Wongan has been the centre for producing and distributing seed supplies for the final stage (stage 4) variety trials conducted at approximately 45 sites throughout the cereal growing areas of the State.

In years to come, Wongan Hills Research Station will become the initial testing centre for early-maturing lupin crossbreds and for bulk production of pedigreed Unicrop lupin seed.

SOILS

Physiography and geology

The research station consists of relatively high country and includes two important drainage divides. The south boundary, east and west of the main Wongan-Ballidu road, roughly coincides with the divide between drainage to the north and to the south. The north drainage goes past Korraling, and then west past the north end of the Wongan Hills to the flats and channels of the Mortlock River (North branch). The south drainage passes west of Wongan Hills township and joins the Mortlock River south of the Wongan Hills in the vicinity of Lake Ninan.

There is a ridge which roughly bisects the station from north to south. West of this ridge, drainage is via a gully system in No. 2 Home paddock running east and north of the Research Station buildings and passing west through the uncleared area and across the Korraling road. Levels taken during the soil survey show a fall of 180 feet from the Wongan-Ballidu road at the south boundary of the station to the creek bed on the Korraling road.

East of the north-south ridge a broad, shallow valley extends towards Mocardy Hill, about three miles away. A creek bed originates in the central part of No. 2 East paddock and runs north-east through No. 1 East, leaving the developed area of the station near the north-east corner where it has become waterlogged and salt affected. A low rise along the east portions of these paddocks divides this gully from a similar broad gully in the adjoining property.

A depression on the fence between No. 2 and 3 East paddocks is surrounded by deep sandy soils of the Wongan series, and is separated by a low rise from the head of the gully draining north-east. This depression sometimes forms a winter swamp and a shallow well at the edge was sunk in 1937. These paddocks had been cleared and cultivated for eight years before free water became apparent. The higher water table is due to the altered relationships between rainfall, transpiration and evaporation since the natural vegetation was removed. Tree plantings in No. 3 East about 1947 have somewhat altered the ground water levels.

Except for laterite, the chief outcropping rocks are of a granitic type. The fact that the area is underlain by granite, was shown by the numerous bores sunk in the 1920's, all of which bottomed on hard granite at depths of 6 to 114 feet. The outcrops may not be quite typical as they have been more resistant to weathering and are now exposed through the dissection and removal of the laterite. More basic rocks, either from small dykes or basic segregations, occur in the north-west of No. 1 Home and south of the breakaways in No. 2 Home. Brown soils (Type 7) in these vicinities have resulted from the weathering of these rocks, and similar soil is found on small areas in the south-west of No. 5 Home. Limestone nodules are found in some profiles of these soils. In the vicinity of the laterite breakaways, in No. 2 Home, lumps of limestone sometimes include ironstone gravel from the laterite.

It seems almost certain that the whole of the area was covered with ironstone gravel, or laterite, formed in the soils under much wetter climatic conditions than at present. The dissection, transport and deposition of the various components of the laterite profile has produced the variety of soils on the Research Station.

The original laterite is common along the north-south ridge, and along the south boundary of the station and in other places associated with the soils grouped as the Yaling series. Small breakaways occur in several places, the steepest and biggest in the uncleared area in the north of No. 2 Home.

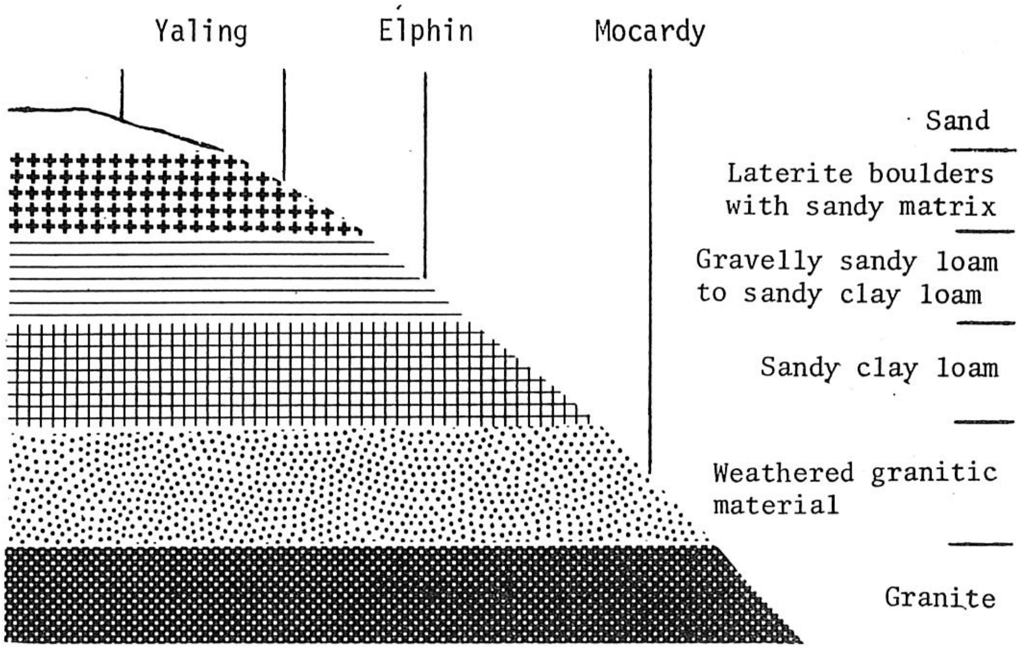
The hardpan phases of the soils of the Elphin series have a layer of hard laterite usually starting between 12 and 24 inches from the surface. This becomes less hard with depth; it represents part of the original laterite profile, or it may be a younger ironstone formation. Much of the Elphin soils occur on slopes which may be up to 150 feet below the highest laterite ridges, showing that the ground surface when the laterite formed was not very level. As previously suggested all the ironstone may not be of the same age.

Soils

The long period of leaching, during which the laterite was formed, left the profile very low in plant foods. In fact, Pendleton (1941), speaking of the laterite soils in Thailand, says, "The presence of laterite in the soil warns that the soil is worn out and is not likely to be able to produce satisfactory crops". The soils over the greater part of the station are formed on and from the residual products of the old laterite profile, and have very low inherent fertility. Superphosphate trace elements and subterranean clover have greatly improved soil fertility.

The four main soil series, Yaling, Wongan, Elphin, and Mocardy, are shown on the map on pages 12 and 13. In addition there are five minor soil types numbered 6 to 10 on the map. The relationship of the soil series to the old laterite profile is shown in the following diagram.

The Yaling series embraces the very gravelly and shallow sandy soils associated with massive laterite or laterite boulders.



The Elphin series has grey sands and loamy sands with increasing clay in the subsurface and subsoil. The subsoil below one to two feet has hard laterite or more weakly cemented remnants of the old laterite profile.

The Wongan series soils are deep and relatively sandy throughout the profile, with bright yellow colours beneath the surface humus layer. They are probably formed on wind-transported products of the old laterite profiles.

The Mocardy sand has a light grey sandy surface, covered with coarse quartz sand. Its mottled gritty sandy clay subsoil in most places seems weathered from the underlying granite but may represent the deepest parts of a well truncated laterite profile.

Type 6, which occurs on the slope of a broad gully and adjoins a large area of the Mocardy sand, has a york gum mallee vegetation (north of the homestead). Its grey sandy loam surface and tough sandy clay subsoil are apparently formed from the underlying granite rock. The subsoil contains calcium carbonate. This type might be extensive in this locality under the present climatic conditions, but for the extensive occurrence of laterite and the residuals of the old laterite profile.

Type 7 includes somewhat variable brown and grey-brown soils with brown clay subsoils, formed directly on, or influenced by, the weathering products from basic rocks. These rocks are probably small dykes or basic segregations of very limited extent.

Type 8 is a brown immature gritty soil on shallow granite around some of the granite outcrops in No. 2 East.

Type 9 is associated with mallee and teatree vegetation on the east boundary of the station. It has a grey or grey-brown sandy surface, generally 4 to 18 inches deep, resting abruptly on grey mottled tough sandy clay, generally free of lime. Below 3 feet there is weathered rock, probably of a granitic type.

Type 10 is a grey gravelly sandy loam 4 to 6 inches deep, over a yellow brown tough gritty clay.

CLIMATE

The research station has an annual rainfall of about 14 inches of which nearly 11 inches falls in the growing period from May to October. The highly reliable May to August rainfall of over 9 inches is one of the main features of the climate. The driest June on record is 81 points in 1955, and seeding is nearly always completed by mid-June.

Nearly 17 inches fell during the 1963 growing season and the total rainfall for that year, 2128 points, is only 2 points short of the highest total recorded in 1939. The wettest month on record is July 1958, when 702 points fell. This is 45 points more than the total for the driest growing season, 1969.

The average monthly rainfall and a sample of the records from 1932-70 is given in the table.

Monthly temperatures vary from an average minimum of about 41.5 deg. F. in July to an average maximum of 94 deg. F. in January. There are usually about 87 days each year when the temperature is 90 deg. F. or more and about 27 days when it is 100 deg. F. or more. At the other extreme frosts may occur in June to August.

Rainfall

Year	Jan	Feb	Mar	Apr	Growing Period: May	Jun	Jul	Aug	Sep	Oct	Total	Nov	Dec	Total Annual	
1932	50	13	119	95	292	134	393	554	76	178	1627	6	24	1934	Wettest August
1934	79	15	187	320	102	184	291	206	98	45	926	37	16	1580	Wettest April
1937	-	9	56	90	347	222	52	214	93	37	992	203	-	1350	Wettest November, Driest July
1939	119	343	-	61	348	353	416	237	18	109	1481	120	6	2130	Wettest year, Equal Driest September
1940	59	6	5	2	90	202	237	29	77	95	730	5	98	905	Driest August
1941	-	24	-	190	231	344	188	137	136	41	1077	34	207	1532	Wettest December
1942	28	-	491	91	428	191	173	243	153	45	1233	5	85	1933	Wettest March, May
1946	-	33	21	201	244	444	447	197	18	2	1352	106	-	1713	Driest October, Equal Driest September
1947	46	9	44	91	273	324	224	81	77	212	1191	41	4	1426	Wettest October
1948	1	5	140	187	-	175	290	370	104	19	958	83	8	1382	Driest May
1955	153	381	27	99	204	81	161	406	196	98	1146	3	23	1832	Driest June
1957	97	-	38	55	164	643	81	202	46	41	1177	-	-	1367	Wettest June
1958	3	-	10	25	366	160	702	167	158	39	1592	56	53	1739	Wettest July, Wettest month
1961	237	18	63	309	28	286	256	167	44	18	799	-	31	1457	Wettest January
1963	110	157	54	95	414	392	329	479	56	26	1696	8	8	2128	Wettest Growing Season
1967	62	-	2	28	244	210	203	127	18	44	846	6	23	967	Equal Driest September
1969	19	154	58	60	104	249	97	86	108	13	657	34	7	989	Driest Growing Season
1972	-	5	6	48	58	223	157	239	43	38	758	3	2	822	Driest Year
1973	36	17	4	47	78	271	281	225	347						Wettest September
Average 45 years to 1970	46	55	75	85	190	273	264	186	90	68	1049	40	32	1404	