WHEAT DEVELOPMENT IN THE ORANGE FREE STATE: SOME RECOLLECTIONS

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Introduction

Wheat growing in the summer rainfall area of the Republic of South Africa has increased rapidly in recent years. In the Orange Free State for example, production has increased five-fold in the past 25 to 30 years, although most of this increase has taken place in the last 10 years or so. This rate of growth is quite a lot faster than for maize, which in itself has been impressive. The maize increase is largely due to better and heavier fertilization, and to hybrid seed. Agricultural research played a vital role in improving fertilization and producing hybrid seed. Research was also very much involved in the chemical control of weeds, insects and disease – to mention only some production factors.

The increase in wheat production on the other hand is due mainly to two factors viz

(i) improved soil preparation and

(ii) improved cultivars.

For the introduction of new cultivars with their improved adaptability to the summer rainfall conditions, credit goes to research and specifically, plant-breeding research. The changes and advances in soil preparation have been almost entirely due to farmer initiative and agricultural extension and it is this aspect which I want to stress today. In doing so I shall be mentioning quite a few names but I have no hesitation in paying tribute to what I believe, was very necessary developmental work as far as dryland wheat production is concerned.

When Kenneth Clarke's "Civilisation" series was recently screened on SABC-TV, he made it quite clear that his was a personal viewpoint. Since then I have noticed that a number of speakers have used the same tactic. Now I claim a similar prerogative. What I am going to say about wheat production in the Free State is a personal account. It is as I have seen it.

After the 1933 drought, the three natural resources of soil, water and veld, were very much in the public eye. C J J van Rensburg with his flair for the dramatic, had done much to publicise the effects of soil erosion and of course the Soil Conservation Act of 1936 had been passed by Parliament. Van Rensburg, was a protege of Dr I B Pole Evans, one-time Chief of Plant Industry, Department of Agriculture and Director of Botanical Survey.

At the end of World War II there were many ex-servicemen who had no desire to return to office work and city life. Overall there was a strong feeling of wanting to work on the land. Professor John Phillips initiated two graduate conservation courses at the University of the Witwatersrand. Dr T D Hall, Agricultural Adviser to AECI Limited, appointed a number of Soil Conservation Officers who provided a free service to farmers by way of surveying contour-banks and dams and drawing up farm plans. P A Bydendyk was the first of these officers and I was the second. We were both based in the Eastern Free State. J P van der Merwe, the Extension Officer at Ficksburg had at the time taken a countrywide lead in soil conservation activities. Between the Public and Private Sectors therefore, the Eastern Free State was relatively well served as far as conservation went.

Summer fallowing

Bydendyk was at heart a pasture officer. He read a great deal and he was also a prolific letter writer who corresponded with scientists all over the world in connection with pastures.

Enclosed in one letter which he received from America in 1947 was a pamphlet entitled "The miracle of production on summer fallow". This described how summer rain could be stored in the soil by mechanical means and then used to produce winter crops like dryland wheat. Bydendyk showed the pamplet to Sam Bairstow, a Tweespruit farmer, who with his wife Marge was farming along traditional mixed lines which included dairying, maize and wheat. They were intrigued by what the pamphlet promised and decided to test the fallowing idea on a small area.

The Eastern Orange Free State is the oldest wheat growing area in the summer rainfall region. Yet in the 1940's average dryland yields were only 300 to 400 kg of grain to the hectare. Only two satisfactory crops were expected in five years. Soil preparation for dryland wheat was in many cases limited to an autumn ploughing – perhaps even after a summer crop had been taken – followed by a discing and maybe a harrowing. Opposed to this, fallowing meant working the soil repeatedly with shallow implements throughout the summer in order to store up rainfall.

Holding moisture in the soil – and the need to do so – appeared to be a new idea to the Free State farmers and the concept was not easily accepted. Yet at a Wheat Breeders' Conference held at Potchefstroom in 1958, H J Maree quoted Colonel H S du Toit on moisture conservation. Du Toit was in charge of the Lichtenburg Dryland Research Station more than 70 years ago when he wrote "Let the irrigation farmer conserve his rain water in dams and reservoirs and let the dryland farmer conserve his in the soil".

It would seem that this very valuable observation had not got through to the farmers of the time and even those later. For a number of years dryland wheat production was investigated at the Lichtenburg station and other sites in the Western Transvaal and North-western Free State. The annual report of the Potchefstroom College of Agriculture for 1921–22 recorded yields of up to four metric tons of grain per hectare. Then the investigation was stopped.

In the summer of 1947/48 on the farm Jevington, Bairstow fallowed for the first time, using discs and working shallow. No ploughing was done. The most popular cultivar of the time was Scheepers and this was seeded at the normal 35 kg per hectare in 180 mm rows. No fertilizer was used. The crop grew beautifully with plenty of dark-green leaf but it fired at the end of winter, the leaves died and nothing was reaped. However, the Bairstows had seen enough to be convinced and encouraged by Bydendyk, 300 hectare were fallowed for the 1949 season. Another Tweespruit farmer, Don Holmes, joined in the fallowing experiments on his own farm.

For the 1949 seeding, every other row in the seed-drill was blocked off so that the rows were now 360 mm apart. Furthermore the seeding rate was reduced to 5 kg per hectare which was almost *one-seventh* the normal seeding rate. This crop turned out to be the first successful summer-fallowed wheat in the South-eastern Free State. It was also possibly a first in the whole of the summer rainfall area. After this crop, Jevington was reorganised on specialised lines. Only wheat was grown and all other enterprises were dropped.

An all-important breakthrough had been made. It had been shown that by mechanical means, summer moisture could be stored for winter usage. What the Americans had long accepted, had been shown to apply in our country as well. Incidentally the soils at Jevington are not top agricultural soils but mostly Westleigh, Estcourt and Kroonstad, with a little Avalon. But if it was a major achievement, very few South Africans would believe it and accept it at the time. I cannot emphasise enough how difficult it was for so many farmers and others to accept the concept of fallowing and the method used for moisture storage. The mouldboard plough was an entrenched farming implement and it was farming heresay to say that it was possible to farm successfully without it. At least two University professors, one an agronomist and the other a soil scientist, expressed their doubts. Mobilisation of nitrogen through mechanical soil disturbance which was probably very destructive — yes. Leaf response to this nitrogen — yes. But the physical conservation of moisture and its retention over such a long period of time ... this was questioned.

Non-agreement between academics and the practical farmer focussed on two aspects viz

(i) Was the limiting factor soil fertility or moisture?

(ii) Would monoculture wheat lead to soil deterioration and finally to breakdown?

The United States dustbowl was still very fresh in memory and monoculture was a long dirty word. Nevertheless when one of the professors asked what crop rotation plans he had in mind, Sam laughed and said "Wheat for the next 99 years". That was almost 30 years ago and Jevington is still a wheat farm. However wild oats has become such a problem that summer crops like sunflowers have been brought in so as to reduce the oats. Had it been possible to control oats chemically and economically, the monoculture would have continued.

Only a small handful of people was concerned with this initial fallowing investigation. The approach was essentially practical. There was always argument and much discussion — not always scientific — but I do remember the strong belief that we were on the right lines. There was never any doubt about this, but the method and the means were thrown repeatedly back and forth. I remember too the disbelief when the results which had been achieved — and they were there to be seen — were not generally accepted. In retrospect one realises that everything was in fact all too practical and lacked proper scientific back-up. At the time, the mouldboard plough played no part in fallowing and was in fact not wanted. Today we know that moisture conservation is largely a matter of weed absence and a soil surface receptive to rain. To put the situation in correct perspective, perhaps the points should be made that firstly, the fallowing was not a success just because the mouldboard plough was not used. Secondly, although the cultivations were shallow, the moisture was stored more in the subsoil than in the surface soil.

After the successful fallow crop of 1949, more and more individuals became involved in the Tweespruit developments and each made a contribution. What follows is a somewhat brief recall of the different aspects in which advancement and change took place.

Tractors

At the time under discussion all wheel tractors were powered by paraffin. Dieseline was considerably cheaper than paraffin but only crawler tractors were powered by dieseline. The whole process of production which was being put into practice was basically mechanical and the cheaper that it could be done the better. The switch to crawler tractors and dieseline was logical. As a result, the agents for Caterpillar tractors, Barlows, took an active interest in the production of wheat. In the early 1950's Al Elias was particularly helpful. Today the pendulum has swung again and very few tracks are now used.

Cultivation Implements

Once the decision had been taken to discard the plough, a number of different implements became alternatives.

One-way discs were popular on contoured lands because they could be used to move soil up or down as the farmer desired. The main disadvantage of the one-way was that if it was used too often on the sandy Free State soils, it powdered the soil into too fine a condition. A shallow hardpan could also develop in a relatively short time.

The offset-disc soon replaced the one-way in most fallowing situations. It did not move the soil and its weeding action was good because it threw weeds on to the surface of the soil where they dried out and died. The one-way often covered weeds in such a way that they were not killed.

In the fallowing process, it was noticed quite early on that discs mobilised more nitrogen – in shorter time – than tines. In other words, the disc action was more effective than tine action. This also meant that it was more destructive as far as the soil was concerned. The breakdown action of discs was understandably criticized by all those who thought in the long term. However the farmer was farming for the day and in this instance, discs became more popular than tines and so won the day. Specifically the offset was the disc of choice.

At this stage, the fallow was strictly only a summer fallow ie the fallowing period began after one wheat crop had been reaped and ended when the next was sown. This lasted about five months. The sooner that the fallow began, the better, and one could do not better than to start on the day that the land was combined. I learned to judge a wheat farmer by the time he took between combining and discing. If the discs were literally following the combine that put him in the lead. Then the aim right through the summer was, as the Americans put it "to keep the land black". In other words the land should not be allowed to green up because of weeds.

In the very dry areas of America, a full fallow was practised. By this was meant fallowing through two summers (15 months) and taking a crop only every other year. We wondered what the effect of a longer fallow would be on moisture storage and crop yield and so this was next investigated. With a long fallow however, discs worked the Free State soils down too finely and so tines came back into favour.

Now came a period of continuous change and modification. The width of the toolbar. The spacing of the tines. The depth of the working. Tractor speed. To sweep or not to sweep. The size of the sweeps. Ideas were changed as often as womens' fashions changed. In 1956/57 Theo Roeloftz of Bloemfontein Engineering played a leading role in the development of an implement that came to be called "Dorsland Dora". This was a 30 foot flexible toolbar with tines and spring shanks. The main purpose of this implement was to work extremely shallow (maximum of 75 mm) over a wide width at minimum cost. For this very shallow working, sweeps were used.

L van den Aardweg of Kynoch Limited was probably the first to point out that sweeps were liable to develop a hardpan. However, when yields began to drop, the cause was a mystery. At this time Bairstow was working almost exclusively with the Fertilizer Companies, Kynoch and Fison's, as well as implement companies. Ironically he was using no fertilizer and it was logical to suspect that lack of fertility was the reason for the drop in yield. The young wheat plants also showed very poor root development and root disease was suspected. It was thought too that insufficient phosphorus might be a contributory factor. Fertilizer trials were being carried out by Van den Aardweg and before him J A Stofberg, also of Kynoch. The whole mechanical process of production was based on shallow, low-cost working. In the Stofberg/Van den Aardweg trials it was natural therefore for the fertilizer to be applied shallow. A number of years later, C A Hamman of Fison's went one better. He investigated the deep placement of phosphate viz 250 mm and obtained an immediate yield response. Hamman's trials were well designed. His control treatment was a deep ripping without any fertilizer and here he also recorded a yield increase. This was an important breakthrough because it pointed to soil compaction as the prime reason for the drop in yields.

It looked as though the whole mechanical production system was back to square one because even a single deep mouldboard ploughing responded on the shallowly compacted soil. At the Bethlehem Research Station, the plough had never been completely discarded. Their view was that an initial deep ploughing and subsequent shallow cultivations gave as good a fallow as shallow working only. The Killifer system followed this principle and this was Bairstow's next step. This is how the land is still being prepared at Jevington today viz an early deep working – but not with the plough – and subsequent shallow workings.

There was at least one further problem which came up before Hamman pinpointed compaction. This was the failure of some plants to develop a strong primary ie main root system. It was crisis time again but after a long discussion with Ernst Pieper at the Bethlehem Research Station, it was decided that moisture was critical to the development of these roots.

A S van Jaarsveld at the time, a Kynoch agronomist, but later with Fedmis (Pty) Limited, recorded this problem with solutions and recommendations in the Landbouweekblad in September 1962. D S Purchase, also of Kynoch, in a Farmers' Weekly in September 1964 wrote about the problem relative to spring wheat. Moisture in the top surface of the soil was necessary for primary root development. A good and healthy primary root system was in turn essential before deeper moisture could be used effectively.

The importance of this early root growth was taken a step further by Van Jaarsveld. In the drier central Free State he gave a cut-off date for planting because of diminishing surface moisture. At that time crop failures west

of Bloemfontein were fairly commonplace. Van Jaarsveld concentrated his studies in this area and in the Fertilizer Society Journal of 1973 he published a number of clear leads specifically for the drier areas. Today for example there are wheat silos at Petrusburg. Figuratively their foundations had been laid quite a number of years previously. Perhaps I should mention that Van Jaarsveld had also been closely associated with developments in the Eastern Free State.

He now took fallowing a step further by developing a 10-month fallow. This ran from maize to wheat and *vice versa.* Toward the end of the sixties, he was able to show a four-fold increase in wheat yields on a 10-month fallow, compared with conventional methods of soil preparation. With the 10-month fallow, two crops (one summer, one winter) were reaped in three years.

H ten Cate of the Senekal Co-operative followed up Van Jaarsveld's work with a series of 10-month fallow trials in 1971–72. With both maize and wheat, he showed significant increases in yield compared with conventional maize to maize and wheat to wheat. He concluded that it was possible to double the net profit margin under a 10-month fallow system.

When Paraquat and the concept of minimum tillage was introduced to South Africa, D Suckling of AECI Limited, laid down trials at Jevington. However, because of soil compaction, moisture storage was poor and minimum tillage was not successful.

Planters

At the start of this story, conventional drills were in universal use. Discs, coulters and 180 mm rows were standard. The first change was to block off every other row thus reducing the seeding rate by half. The first major switch in planters was to the Press-wheel planter. This was a tine planter which obtained its name from the wheel which followed the tine and which compacted the plant row. Today the name is a misnomer because the press-wheel actually caused compaction. W Bramley of Lifa developed the Guage-wheel planter which was more accurately a depth-control planter. A further modification was a double disc opener for planting through straw. Just as the drill was used by most wheat farmers 30 years ago, so is the gauge-wheel planter used today. In Australia, wheat farmers have followed these South African developments and have given credit to "the moisture-seeking tine with the press-wheel".

Fertilization

Bairstow used no fertilizer until 1962 – a period of 14 years. Today for winter wheat he still uses only 60 kg single superphosphate or ammoniated supers to the hectare. His long-term yield is slightly less than one metric ton of grain per hectare. At present prices, this gives an extremely good grain to fertilizer ratio.

Research data on the fertilization of winter wheat in the summer rainfall area are hard to come by and the published data are almost non-existent – at least this is my experience. Mr Bairstow has several reports in his possession of fertilizer trials carried out on his farm and I shall begin by quoting from these. The earliest is dated 1954 and records a non-replicated trial carried out by J A Stofberg of Kynoch Limited. He used four different standard fertilizer grades at different rates and at two planting thicknesses. He also attempted to measure moisture utilisation. He concluded that fertilization did not increase yields and that no treatment appeared to use more moisture than another.

In 1958 L van den Aardweg also of Kynoch carried out an unreplicated trial with super- and raw phosphate, broadcast and deep-placed, with and without lime. The cultivar was Scheepers. Despite the fact that the soil level of phosphorus was very low, Van den Aardweg concluded that there was no response to phosphorus or to lime or to deep placement.

It should be borne in mind that both Stofberg and Van den Aardweg were field agronomists and not research officers. However I mention their work to highlight the lack of properly conducted research.

In 1963–64 A S van Jaarsveld and D S Purchase both of Kynoch put down replicated fertilizer trials on several sites in the South-eastern Free State. Although their work was never published, yield responses were obtained to phosphorus although they were only just economic. This work was done on both winter and spring wheat.

Some half-a-dozen years later, C A Hamman of Fison's Limited, was responsible for a series of statistically designed trials on wheat in the Free State, mostly in the eastern part of the province. Within the limits of the conditions of his trials, he showed that the later the planting, the thicker should the seeding rate be and the heavier the fertilization. Where soil P levels were good, there was little or no response to fertilizer. Writing in the Fertilizer Society Journal in 1969, Hamman referred to the confusion regarding the fertilization of dryland wheat in the summer rainfall area due to the fact that so little research had been done. He pointed out that fertilization was only one of four main factors that contributed to the efficiency with which wheat plants utilized available moisture. When a fertilizer recommendation was made, information should also be given on cultivar, planting date and seeding rate. Incidentally Hamman was the first worker to record nitrogen response on late winter and spring plantings.

Still later work on fertilization was done by C D Koch and H R Steyn, both of Fedmis (Pty) Limited. This led to further clarification on cultivars, planting dates and rates of nitrogen.

Despite the scarcity of critical data on wheat fertilization – nitrogen in particular – the recent wet years have moved farmers toward heavier fertilization. Many farmers have

recently been planting winter wheat with up to 200 kg 3:2:1 (25) per hectare. Yields of 2 000 to 3 000 kg per hectare have been reaped.

Economics

In 1958 Kynoch Limited initiated a costed unit on the farm of Mr J G Craven in the Lindley district. The production costs of maize, spring wheat and *Eragrostis curvula* were diligently costed out for a number of years. A great deal of valuable information came out of this unit not the least of which was the promising economic returns from spring wheat. After four seasons' results, I wrote optimistically about spring wheat in the Farmers' Weekly, September 1962 ... provided lands were properly fallowed and moisture conserved.

Extension of Knowledge

By the early 1950's a number of farmers in the Tweespruit, Westminster and Ladybrand districts were farming on successful and economic summer fallow production systems. What these farmers were doing then, is being done now, with modifications for spring and summer wheat, by most dryland wheat farmers in the Free State and the Transvaal, including the Springbok Flats. There should always be pace-setters and in this instance, the pace was set in the South-eastern Free State.

It has been said that knowledge takes some 10 to 15 years to be applied generally. In this case, it has taken all of that time and more. J P Wales who farms at Petrus Steyn, also combines crops under contract. He has reaped the crops at Jevington for many years and so was in touch with the Tweespruit action from the beginning. It was natural therefore for him to introduce summer fallowing into his own farming at Petrus Steyn.

It is my impression that Petrus Steyn was one of the first districts in the Northern Free State to show a marked swing toward wheat in recent years. If I am correct in this, then the Wales connection played a direct part in this change.

From Sannieshof in the Western Transvaal, L van Wyk, a local farmer visited Tweespruit in the early 1950's. As a result he and his brother introduced summer fallow wheat as a rotation crop with maize. Yields were relatively low but they were economic. With today's new cultivars, wheat growing in that part of the Transvaal appears to be on the increase.

In the recent wheat explosion in the Springbok Flats, the principles of soil preparation are much the same as developed at Tweespruit. However, to the best of my memory, the Dykema family at Settlers showed many years ago that ploughing the turf soils was unnecessary and in fact, undesirable. Their farming was aimed at summer production but I believe that their switch from ploughs to discs and tines was significant and links up with the present wheat production.

There have been many critics of the Flats' developments, but possibly fewer today than a year or so ago. The criticisms ring familiar. Perhaps a parallel can be drawn between wheat in the Flats and the Tweespruit experience. If so, then it is likely that the wheat in the Springbok Flats is here to stay. In some years, yields will be lower than in others but this must be expected. Disease and weed problems will no doubt build up too and when they do, it will be for research to find ways and means of overcoming them.

Cultivars

Correct working of the soil so as to conserve moisture was one thing. But as good a wheat as Scheepers is, its production potential was — and is — limited. It has long been recognised that it uses up too much moisture during the vegetative growth phase and leaves too little for the reproductive phase.

W R M E Pieper the wheat breeder at the Bethlehem Research Station of Agricultural Technical Services, saw the positive yield advantages of summer wheat as opposed to winter wheat. Regent had been grown in 1952/53 on a small scale in Vrede and in Bethlehem and Fouriesburg some farmers were growing Sonop. Pieper began research on summer wheat in 1954 using cultivars like Daeraad, Goudveld, Maluti, Penkop and Wit Spitzkop. The three Manitoba 'R's viz Regent, Reward and Renown were also under test. He concentrated on cultivar selection relative to planting date, planting thickness, nitrogen and phosphorus.

Today we live in a very quick-moving world but the research worker 20 to 25 years ago did not always have the means of moving around. Pieper was very appreciative of the arrangements made for him to visit Tweespruit. No-one could fail to be impressed and influenced by the Bairstow enthusiasm and this and subsequent visits gave Pieper the opportunity of keeping abreast of the most up to date practical side of wheat growing. From their side, the farmers were quick to assess the worth of a man like Ernst Pieper to wheat in the Eastern Free State. His influence on the growing industry cannot be stressed enough. His selections and his breeding were not only highly productive but were also widely accepted by farmers.

By 1958 at a Wheat Breeders' Conference held in Potchefstroom, Pieper was able to record his views on winter wheat. He gave it a reasonable chance of success provided

(i) moisture was conserved

(ii) autumn planting was delayed so as not to withdraw too much moisture too early

(iii) planting rate was thinner than generally accepted

(iv) the correct cultivar was planted.

These points were very much in line with what the Tweespruit and other Eastern Free State farmers were doing. Pieper was confident that wheat production could be increased considerably, and he cited poor production methods as *the* limiting factor to increased production.

Conclusion

Looking back, I believe that improvement in production methods – as called for by Pieper – has been the most important single factor in which most wheat farmers have made the most progress. In saying this, I do not detract from the role which cultivars have played.

The private sector is active in a variety of ways in South African agriculture. My story has largely concentrated on only one small part of this activity. I sometimes feel that sufficient credit has not always been given to the contribution made by commercial organisations to the progress of which the country can boast in agriculture.

If one looks back into the past to find improvement in the present, then I would say that the present good relationship existing between the public and private sectors in agriculture, has never been better. An understanding of working together has developed very positively during recent years. One hopes that this will continue for a long time to come because after all, it is the farmer who ultimately benefits.

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