MAIZE COMPLAINT INVESTIGATION PANNAR PAN 5R-891BR

Jeremy Munton-Jackson

Executive Summary

I was requested by Corne Louw of GrainSA to investigate a complaint of poor pollination over a wide farming area, stretching form Ventersdorp through Wolmaransstad, Bothaville, Hoopstad to Hertzogville. This request had arisen from a large group of farmers who had, apparently, not accepted the explanation given by the supplying company, which was that the "silk-balling" and pollination problems were weather/chemical/fertilization programmes etc.

Corne had selected the farmers that I should visit.

These were:

Petrie Geldenhuys (Potchefstroom)

Magnus Theunissen (Ottosdal/Sannieshof)

Koos (Ottosdal)

Eric Kruger (Ottosdal/Wollies)

Christo van Wyk (Ottosdal/Wollies)

JP van der Merwe (Ottosdal/Wollies)

Willem Kirsten

Johan (Vierfontein & Viljoenskroon)

Jaco Erasmus (Vierfontein)

Petrus Steyn (Bothaville)

Izak (Bothaville)

HW Viljoen (Hoopstad/Herzogville)

Conclusions:

Having visited each of the above farmers on their individual farms, it appears that the PANNAR information, as relayed to the farmers separately, is correct. The weather data certain indicates that there were cool nights, as does some of the symptoms observed on the plants during the investigation. These symptoms appear to correlate with planting dates from 23rd to the 30th November.

However, despite the fact that there were 3 cool nights in February which may have contributed to the silk-balling episodes seen, there were other hybrids planted immediately next to PAN 5R-891BR, and within a 24-hour period, which would have been subject to exactly the same growing conditions, at the same stage of flowering, as PAN 5R-891BR. Four of these hybrids, also from the PANNAR stables, are of the same family as - PAN 5R-891BR. Accordingly, their time to flowering/50% tassel should be identical.

These hybrids were:

PAN 5A-291 (Non-GMO)

PAN 5B-491B (BT Only)

PAN 5R-591R (Roundup Ready only planted as the required "Refuge area")

PAN 5R 791BR (1^{st} generation stack with Bt 1 gene)

These hybrids showed none or very little sign of the silk-balling issues under investigation.

Along with the above hybrids, many of the farmers in the area visited, had also planted DKC 76-77BR both prior to, as well as after the PAN 5R-891BR planting dates. In the areas visited, the Dekalb hybrids did not show any indication of the silk-balling seen in PAN 5R-891BR.

It is very easy to blame these issues on the weather however, with the direct comparisons of the above-mentioned hybrids to PAN 5R-891BR, it must be concluded that the PAN 5R-891BR is a hybrid with a hyper-sensitivity to growing conditions (including a sensitivity to certain chemicals not shown by competitive hybrids) and specifically cool night temperatures during silk elongation.

Having said all of the above, it would be very difficult to do an estimation on yield loss because of the sporadic nature of the silk-balling within each land.

In some of the cases, it was difficult to find the issues, even though the silk-balling had been obvious during pollination

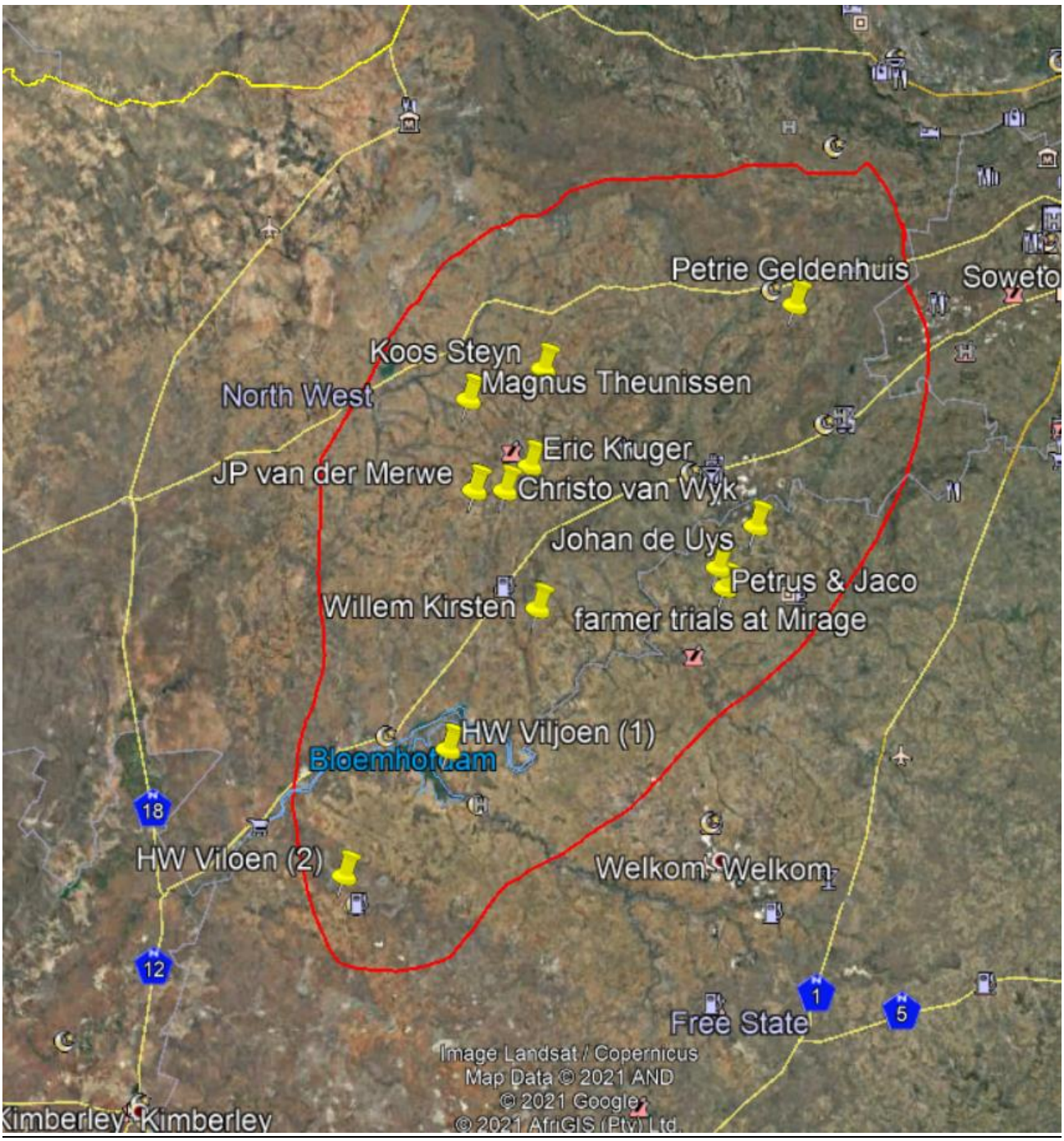
Recommendations

Farming is an inherently difficult occupation where weather conditions play the biggest controlling factor. With the size of areas which farmers plant under a single hybrid, a selected hybrid cannot be seen as too sensitive to relatively small changes in conditions. Obviously, this type of risk is true with any business adventure, but this is exacerbated in farming by the current unstable nature of weather patterns.

It is therefore, recommended that any trialling of new hybrids is done on a very limited scale for the first couple of years, and thereafter expanding the area planted if results are satisfactory under the specific growing conditions and planting times.

Main Report

Map of the area visited , with the farmers locations



Grower visits

Petrie Geldenhuis

Having looked around Mr.Geldenhuis' farm with his son, it was difficult to link any of the symptoms directly to weather related factors. Although there could have been weather issues affecting the pollination through silkballing, the sensitivity of PAN 5R-891BR to Flumetsulam (contained in "SURESTART") virtually masked most other indicators.

Photo 1(left) showing an unopened cob with the elongated cob leaves tangled from chemical damage. Photo 2 (right) showing the silk-balling effect from the leaf opening being too tight. This could be either chemical or weather related.

Photos showing the extreme elongated cob leaves and shanks. Indications of probable hormonal chemical damage.

Magnus Theunissen

Mr. Theunissen plants PANNAR trials on his farm for new upcoming hybrids (referred to as R3 trials). These are compared directly to existing hybrids to make final decisions on the release of new hybrids onto the market.

Although I was not at liberty to know which the hybrids were, PAN 5R-891BR was marked on the trial. In going through the trial, observing symptoms of silk-balling, none of the hybrids exhibited this tendance apart from PAN 5R-891BR. This was the same indications as seen in the fields.

Once again, PAN 5R-891BR showed a hybrid specific sensitivity to growing conditions.

Above photos showing the effect of conditions on PAN 5R- 891BR in the R3 trials.

Photo below in DKC 76-77 showing potential cool weather damage on husks, which are starting to show a tightness around the cob. This can lead to silk-balling/balling, although none were found

Competitive hybrid *5R-PAN 5R-*

Mr. Theunissen showing silk-balling/jamming (and diplodia) on PAN 5R-891BRBR on the right, with a competitive hybrid on the left. All hybrids in these trials were planted on the same day.

Koos Steyn

At Mr. Steyn's farm, there was silk-balling as well as fair amount of seed aborting on PAN 5R-891BR. In his lands it is difficult to say whether these symptoms are weather related or not. An interesting indicator with the silk-balling is that the plants that had the worst silk-balling, were still green, as opposed to the rest of the field that was drying down.
Once again, this farmer had planted DKC 76-77BR literally along side the PAN, which showed none of the above symptoms.


Above photos (left)showing the many green plants that had the worst silk-balling incidents as shown(right)


Classic silk-balling found in the fields.


Extreme chemical damage showing the same type of symptoms as seen at Mr. Geldenhuis

Eric Kruger

Here, the issues were much the same as with previous farms, apart from some of the plants that indicated a “Choking” on the cobs, where the husks had very definitely tightened around the cobs. At that point pollination stopped, and the silks balled at the tip of the cob.

Photos above and below showing (left) cobs prior to opening right cobs with husks removed. Note the very tight husks around the cobs.

Diplodia stalkrot coming in on PAN 5R-891BRBR

Christo van Wyk

2 sets of lands were visited with Mr. van Wyk.

The first lands were in the Bamboesspruit area. Here we found the silk

Balling issues found in other lands of PAN 5R-891BR.

Along side this planting of PAN 5R-891BR, was DKC 76-77BR, also planted within a day of each other on the adjoining rows. Once again, there were no indications of Silk-balling using a direct comparison on the DKC row directly next to the PAN.

The second set of lands visited were lands to the west of Strydpoort silos. These they referred to as the Bloegom, Boorgat and Pepperboom lands.

The Bloegom and Boorgat lands are directly opposite each other and planted within one day of each other. On the Boorgat land PAN 5A-291 (non-GMO) was planted, and directly opposite on the Bloegom land PAN PAN 5R-891BR was planted.

On the Pepperboom land, PAN 5R-785BR was planted directly opposite PAN 5R-891BR. The distances between these lands was approximately 35 meters.

Once again, only the PAN 5R-891BR showed signs of silk-balling.

In this area, DKC 76-77BR showed a high percentage of diplodia, as did the PAN 5R-785BR.

JP van der Merwe.

JP's first land we visited was PAN 5R-891BR, opposite to this was 75-76. Not many issues were found here.

The next land we visited, one of the PANNAR yellow hybrids had been planted next to PAN 5R-891BR. Here we found some of the problems in PAN 5R-891BR, but no issues in the yellow hybrid.

One of the lands closer to his house was checked. Here we found a percentage of "Bar-bell" cobs. This is something unusual, and there are some research that indicates that this could be caused by very early damage. (V5 stage)

Willem Kirsten

Mr. Kirsten planted PAN 5R-791BR, which is a previous generation hybrid of PAN 5R-891BR. At his home farm, we did not see any real problems, although the 2nd cobs were very poorly developed.

At his Leeudoriningstad land we found a few cobs with some symptoms. At this point the weather closed in with lightning and rain, so this was left at that.

Johan deUys

Mr deUys farm was one of the ones where the were no real issues. Some of the 2nd cobs showed some minor issues.

Petrus Steyn and Jaco Erasmus

We visited their 1st land at "Tarantaalbos" showed some extreme silk-balling in a section of the land. A PANNAR trial was visited to ascertain if there was anything showing in that situation. In these trials the PAN 5R-891BR looked good, even when compared against other PANNAR and opposition hybrids.

We then visited a "farm trial" planted by the farmer himself, just a couple of weeks later than the "Tarantaalbos" land. In this trial, the PAN 5R-891BR looked excellent. Once again, PAN 5R-891BR showed specific sensitivity to environmental factors.

Cobs from the "Tarantaalbos" land, laid out plant by plant. Main cob at the front, with 2nd cob behind.

Izaak

After discussions at his house, we visited a couple of his fields planted with PAN 5R-891BR. A comparison against the “refuge area” PAN 5R-591R showed silk-balling in the PAN 5R-891BR, which was absent in the “refuge area”.

HW Viljoen

We first visited lands planted with PAN 5R-891BR near Hoopstad. We did not find much in terms of silk-balling. However, we found some yellow contamination within the planting that appears to come from within the seed. A further observation was, what appeared to be “inbred” plants. This, however would need to be tested electrophoretically.

The second land was at his home farm close to Hertzogville. Here, there was evidence of silk-balling.

Extract from:

Silk Development and Emergence in Corn

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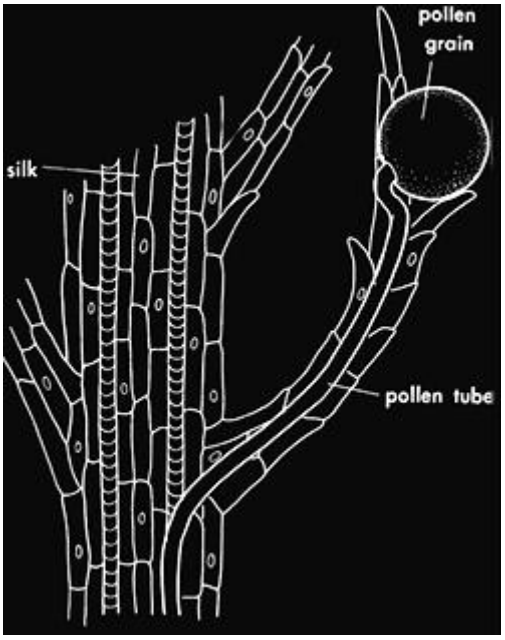
Pollination and Fertilization

For those of you who are anal about semantics, let's review two definitions relevant to sex in the cornfield. Pollination is the act of transferring the pollen grains to the silks by wind or insects. Fertilization is the union of the male gametes from the pollen with the female gametes from the ovule. Technically, pollination is almost always successful (i.e., the pollen reaches the silks), but unsuccessful fertilization (i.e., pollen tube failure, silk failure, pollen death) will result in poor kernel set and yield losses.



Pollen grain germination occurs within minutes after a pollen grain lands on a receptive silk. A pollen tube, containing the male genetic material, develops and grows inside the silk, and fertilizes the ovule within 24 hours. Pollen grains can land and germinate anywhere along the length of an exposed receptive silk. Many pollen grains may germinate on a receptive silk, but typically only one will successfully fertilize the ovule.

Silk Responses to Severe Stress

Severe Drought Stress. The most common cause of incomplete silk emergence is severe drought stress. Silks have the greatest water content of any corn plant tissue and thus are most sensitive to moisture levels in the plant. Severe moisture deficits will slow silk elongation, causing a delay or failure of silks to emerge from the ear shoot. If the delay is long enough, pollen shed may be almost or completely finished before receptive silks are available; resulting in nearly blank or totally blank cobs.

In addition to causing silk emergence failure, severe drought stress, especially accompanied by high temperatures and low relative humidity, can also desiccate exposed silks and render them non-receptive to pollen germination. In the Eastern Corn Belt, this effect of drought stress on silk receptivity is likely more common than effects on pollen availability or viability.

The severity of drought stress required for significant silk emergence delay or desiccation can probably be characterized by severe leaf rolling that begins early in the morning and continues into the early evening hours. Such severe leaf rolling is often accompanied by an initial change in leaf colour from “healthy” green to a grayish-tinged green, before the leaves eventually die.

Silk Clipping by Insects. Severe silk clipping by insects such as corn rootworm beetle or Japanese beetle can interfere with the success of pollination by decreasing or eliminating viable or receptive exposed silk tissue. Fortunately, unless the beetle activity is nonstop for days, continued elongation of silks from inside the husk will expose undamaged and receptive silk tissue at the rate of about one inch or more per day.

Silk "Balling". Occasionally, silks fail to emerge successfully because they fail to elongate in their usual straight "path" from the ovules toward the end of the husk leaves. Instead, silk elongation becomes convoluted (twisted, coiled, scrambled) inside the husk leaves. This silk "balling" phenomenon is not well-understood and

hybrids tend to vary in their vulnerability to this type of silk emergence failure. Two different pieces of circumstantial evidence are often associated with the problem. One is a physical restriction imposed on silk elongation caused by unusually "tight" or long husk leaves in certain hybrids. The other circumstance often correlated with silk "balling" is the occurrence of unusually cool nights during the time silk elongation is occurring, but prior to silk emergence. The physiological effect of such cool nights on silk elongation is not understood. It has been years since I last saw a field with a significant level of silk "balling" (Nielsen, 2000).

Silkballing

Source: Dewey Lee, Univ. of Georgia

Source: Dewey Lee, Univ. of

Symptoms:

Ears exhibiting "silkballing" usually produce ears of normal length with kernel set only near the base of the ear. "Silkballed" ears often contain a mass of silks inside the husks. The key to distinguishing "silkballing" and blunt ears ("beer can ears") is to determine if silks are still present in the husk. The environmental stress that causes "beer can ears" produces either short ears or ears with long cobs and kernel set only near the base of the ears. However, very few or no silks are present inside the husks of these ears. The environmental stress that causes "silkballing" may also produce long ears with kernel set only near the base of the ear. The difference is "silkballed" ears will usually contain a mass of silks inside the husks. Silks remain attached to developing ovules until these ovules are successfully fertilized. These ovules degrade if they are not fertilized. However, the silks can often remain in the husk until the ear is mature.

Cause:

"Silkballing" occurs when the silks lose orientation during the pollination process and begin to grow in many different directions inside the husk. Causes are uncertain. The problem has been attributed to a combination of a brief interval of cold stress or drought stress sometime during the silk growth cycle and certain corn genetics.

Management:
Avoid hybrids sensitive to such injury.

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Barbell Ears or Dumb Bell Ears

Chilling injury during ear formation. Source: Dr. Pat Lipps, Ohio State University Plant Pathology

Chilling injury during ear formation. Source Dr. Pat State University Plant Pathology

Barbell ears from plants that root lodged at VT Source: P. Thomison, OSU

Barbell ears from plants that root lodged at VT Source: P. Thomison, OSU

Poor kernel development where ears pinched Source: P. Thomison, OSU

Poor kernel development where ears pinched Source: P. Thomison, OSU

Sweet corn ears exhibiting barbell deformity. Source: Kevin Black, 2019

Sweet corn ears exhibiting barbell deformity. Source: Kevin Black, 2019

Ear from a non-GMO hybrid sprayed with a low level of glyphosate in spray tank contamination at V5. Source: Kevin Michem, 2017

Symptoms:

With the "Bar Bell" deformity, kernel formation is normal at the base and tip of the ear but absent from the middle of the ear.

Causes:

This problem is associated with chilling injury during ear formation and more evident in certain sweet corn genetic backgrounds. Low temperatures disrupt normal kernel development resulting in anomalous ear growth.

Barbell ears have been observed when non-GMO corn hybrids are sprayed with a low level of glyphosate in spray tank contamination at V5.

Management:

Avoid planting hybrids susceptible to this abnormality especially under conditions where cold temperatures during ear formation is likely.

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Arrested Ears (also referred to as "Remnant Ears" and "Hollow Husk")

Source: P. Thomison, OSU

Symptoms:

Arrested ears exhibit varying degrees of stunting with limited kernel formation. In a moderately arrested ear, the base may appear normal, but have abnormal development between the base and tip of the ear – pollination and kernel development still occur, but at a significantly reduced amount. In severely arrested ears, cob and ovule development cease completely at an early stage of development. Some ear shoots carry either no ear or only the short remnant of an ear. Often silks are

absent or limited. Severity of symptoms differs among hybrids. Corn plants with arrested ears generally appear healthy, ie. exhibited normal plant height and color.

Causes:

Applying a nonionic surfactant (NIS) prior to tasseling (VT growth stage) may result in arrested ear development. Some portion of the cob along with ovule development at the tip end of the ear, appears to prematurely cease shortly after a foliar NIS application. The risk appears to be greatest from growth stages V12 to V14 (12 to 14 exposed leaf collars), one or two weeks prior to pollination. Symptoms are evident as early as a week after foliar NIS applications, but are more pronounced three weeks after application.

According to Dr. R.L. Nielsen, given the fact that an affected plant appears otherwise normal indicates that the cause of the arrested ear is not a lingering or cumulative type of stress (e.g., compaction, drought stress, nutrient deficiency), but rather a single stress event that directly affected the developing ear.

Management:

Avoid foliar application of surfactants from the V12 to VT stages.

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