Section 16.2

MAIZE YIELD ESTIMATION

R.E. Schulze and N.J. Walker

Background Information

- Maize, *Zea mays L*., is South Africa's most important field and grain crop.
- Approximately 10 - 16 kg of grain are produced for every mm of water "consumed" through the maize plant, and in the absence of any soil water stress, each maize plant will have consumed around 250 litre of water by maturity (NDA, 2005).
- No other crop utilises sunlight more effectively than maize, and its yield/ha is the highest of all grain crops. By way of analogy, the total energy used by one maize plant at maturity is equivalent to that of nearly 8 300 electric globes of 15 W each burning for one hour (NDA, 2005).
- Each tonne of maize produced removes 15 - 18 kg of nitrogen, 25 - 30 kg of phosphorus and 3 - 4 kg of potassium from the soil and at maturity the uptake of a single maize plant is 8.7 gram N, 5.1 g P and 4 g K (NDA, 2005).
- Especially while maize provides the staple diet to the majority of South Africa's population, and where it is produced by subsistence and emerging farmers it provides for their basic household requirements, with any excess production sold to supplement household income (NDA, 2005).
- The maize industry is also an important foreign exchange earner through exports of maize and maize products.
- The local consumption requirement of maize for South Africa is around 8.7 million tonnes per annum, of which ~ 4.8 million tonnes is the demand for white maize and ~ 3.9 million tonnes is for yellow maize, which is the most important ingredient for feed rations in the beef, dairy and poultry industries (Trends in Agriculture, 2005).
- Maize in South Africa is produced by ~ 9 000 farmers who produce direct employment to a workforce of ~ 130 000.
- In addition, tens of thousands of people are employed in the various industries relying on maize as a raw material (mainly milling and stockfeeds).
- **Figure 16.2.1** shows that over the past 40 years an increasing trend in yield/ha has taken place. This, according to Trends in Agriculture (2005), is attributable to
  - a decrease in plantings (cf. **Figure 16.2.1**), in climatically and edaphically marginal areas;
  - the impact of technology, e.g.
    - higher yielding cultivars
    - improved seeds
    - more affordable precision farming technologies and
    - improved herbicides, pesticides and fertilizers;
  - improved soil management practices, e.g.
    - greater use of crop rotation systems and fallow land practices
    - better fertilizer and seed placement and
    - better timing of optimal plant dates; and
  - the area planted under irrigation which, for white maize is ~ 5% and for yellow maize ~ 10% (Trends in Agriculture, 2005).

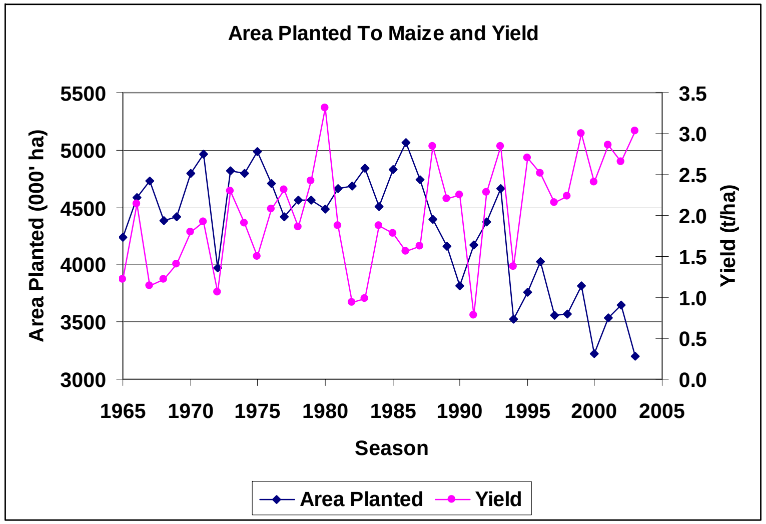


Figure 16.2.1 Time trends of area of maize planted and yields (Source data: NDA, 2005)

Photo 1

Site Requirements for Maize

- Maize in South Africa is generally planted from October to December, depending on regional and seasonal rainfall and temperature patterns, for example,
  - as soon as sufficient soil moisture has accumulated (~ 25 mm over a 5 day period)
  - once soil temperatures are high enough for germination, i.e. when minimum temperatures of 10 - 15°C have been maintained for a week (NDA, 2005).
- Being a warm weather crop, daily mean temperatures > 22°C are required with a January mean > 19°C and < 24°C being ideal.
- The critical upper temperature affecting yield reductions is ~ 32°C.
- Frost can damage maize at all growth stages and generally a frost-free period of 120 - 140 days is required to prevent damage (NDA, 2005).
- While maize can be produced when *MAP* > 350 mm, ideally 450 - 600 mm is needed during the growing season (NDA, 2005).
- Sustained production is dependent on an even distribution of rainfall throughout the growing season (NDA, 2005), but is critical particularly during the flowering season when soil water stress reduces yields more during other growth phases.
- Maize prefers a relatively deep (< 750 mm) well drained soil, with both light and heavy textured soils reducing yields, particularly in drier areas.

Maize Production in South Africa

- South Africa's maize industry, deregulated in 1007, operates in a free market environment of demand and supply (NDA, 2005).
- The total area planted to maize in the recent past (2000/1 - 2004/5) is ~ 3.5 million ha, of which 2.7 - 3.2 million ha is for commercial production (cf. **Figure 16.2.1**) and 350 000 - 500 000 ha in the developing sector mainly for household use.
- Fluctuations in the area planted depend on the carryover of stocks from previous years, the strength of the Rand and the going price of maize (Trends in Agriculture, 2005).
- Dryland production is mainly in the Free State (34%), North West (32%) and Mpumalanga (24%), with KwaZulu-Natal producing 3%.
- Total production in the 10 years 1995/6 - 2004/5 has fluctuated between 7.7 and 10.2 million tonnes, of which around 95% is from commercial production.
- A swing to white maize production in more recent years now sees the ratio of white to yellow maize at ~ 65% : 35%.
- Maize yields in South Africa are low. In the decade 1995/6 to 2004/5 they have fluctuated between 2.16 and 3.04 t/ha (cf. **Figure 16.2.1**), depending primarily on in-season climatic conditions (NDA, 2005). Yields from the commercial sector are somewhat higher (2.7 - 3.3 t/ha; Trends in Agriculture, 2005) with highest dryland yields attained in KwaZulu-Natal (3.93 t/ha) and Mpumalanga (3.42 t/ha; Statistics SA, 2002) while those of the developing sector are only ~ 0.8 t/ha for white and 1.4 t/ha for yellow maize (Trends in Agriculture, 2005). Yields under irrigation average at 6.05 t/ha, with highest yields in the Northern Cape (6.76 t/ha), Free State (6.31 t/ha) and Mpumalanga (6.27 t/ha; Statistics SA, 2002).
- However, as shown in **Figure 16.2.1**, yields are increasing over time, for reasons already discussed under *Background Information*.

Photo 2

Approaches to Modelling Maize Yields

Crop yield models may be of differing complexity.

- Some are simple rule based climate driven models with yields modified for variations in soil properties and management level, such as the Smith (1994; 1998) models applied extensively in this Atlas.
- Other models, such as the *ACRU* maize yield model (Schulze *et al*., 1995) are of intermediate complexity and simulate yield by daily soil water budgeting coupled with crop phenology, approximating the crop's response to environmental conditions, while sacrificing certain details of physiological processes such as photosynthesis and respiration.
- Others are complex physiology and genetics based growth models, such as CERES-Maize model (Jones and Kiniri, 1986; Jones *et al*., 1998).

In this Atlas the CERES-Maize model was used yield simulations.

Background to the CERES-Maize Yield Model: From IBSNAT to DSSAT to CERES-Maize

The International Benchmark Sites Network for Agrotechnology Transfer (IBSNAT) Project, involving multiple institutions and organisations (Hoogenboom *et al.,* 1994), had as its overall aim the application of systems analysis to problems faced by resource-poor farmers in the tropics and sub-tropics, specifically in the area of evaluating new and untried agricultural technologies. One of the outcomes of the IBSNAT Project was the release of the Decision Support System for Agrotechnology Transfer (DSSAT) in 1989 (Hoogenboom *et al.,* 1994).

The DSSAT was designed to allow the user to:

- Input, organise and store data;
- Retrieve, analyse and display data;
- Calibrate and evaluate crop growth models; and
- Evaluate different management practices at a site (Jones *et al.,* 1998).

CERES Suite of Models: General Structure

One of the crop model options in DSSAT is the CERES-Cereal model. This is a suite of models which operates on a daily time step and simulates the main physiological processes for barley, maize, millet, rice, sorghum and wheat. The main processes that CERES simulates are:

- Photosynthesis,
- Respiration,
- Accumulation and partitioning of biomass,
- Phenology,
- Extension growth of leaves, stems and roots,
- Soil water extraction,
- Evapotranspiration, and
- Nitrogen transformation processes (Wu *et al.,* 1989).

Potential dry matter production is determined by using a function of solar radiation, leaf area index and reduction factors for temperature and moisture stress. Six phenological stages of leaf and stem growth are replicated, based primarily on thermal time. Accessible photosynthate is at first partitioned to leaves and stems, and later for ear and grain growth. Any residual photosynthate is assigned to root growth unless the dry matter available for root growth is below a minimum limit, whereupon grain, leaf and stem allocations are reduced and the minimum level of root growth occurs (CIESIN, 1997).

CERES-Maize

CERES-Maize (Jones and Kiniry, 1986) is one of the options within the CERES-Cereal model.

In version DSSAT v3, which was used in this study, the crop simulation modules require information from the DSSAT database. The association between the modules and input files is shown schematically in **Figure 16.2.2**. The experiment detail file is referred to

CERES-Maize (continued)

as FILEX and contains information to document field experiments or farm management. The soil profile data are stored in a file that is accessed by the module with the profile data selected using a soil number from FILEX. Daily climate data are stored in yearly files. For the seasonal modelling the IBSNAT30.INP file (**Figure 16.2.2**) is created outside the DSSAT shell and run consecutively for all Quaternary Catchments with the use of a batch file. The sequential modelling using CERES-Maize and the creation of input files within the DSSAT shell is discussed in detail by Walker (2005). Cultivar information is read from crop-specific files and FILEX specifies which cultivar to select from this file. Outputs files are from the crop model depend on the options selected in a simulation control in FILEX (Jones *et al.,* 1998).

The schematic relationships of the crop model driver program, the crop model input program, the temporary files read by the crop model modules and the crop simulation model modules (Jones *et al*., 1998) are illustrated in **Figure 16.2.3**.The model driver controls entry to the input module and to the correct crop model. It is performed every time a crop is to be simulated (Jones *et al*., 1998).

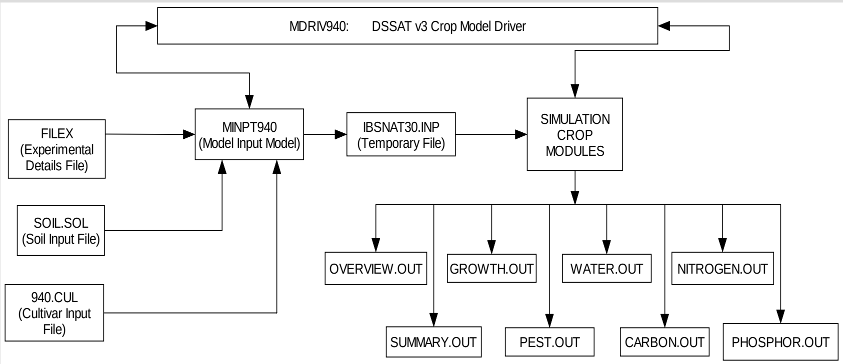


Figure 16.2.2 Schematic of relationships between the crop model driver program, crop model input program, temporary files read by the crop model modules and the crop simulation model modules (After Jones *et al*., 1998)

CERES-Maize (continued)

Cultivar information is read from crop-specific files and FILEX specifies which cultivar to select from this file. Outputs files are from the crop model depend on the options selected in a simulation control in FILEX (Jones *et al.,* 1998).

The schematic relationships of the crop model driver program, the crop model input program, the temporary files read by the crop model modules and the crop simulation model modules (Jones *et al*., 1998) are illustrated in **Figure 16.2.3**.The model driver controls entry to the input module and to the correct crop model. It is performed every time a crop is to be simulated (Jones *et al*., 1998).

The DSSAT v3 crop models were originally developed for simulating the growth of annual crops during a single season. The various crop models have a similar structure, which has allowed their use for long-term simulation of cropping sequences.

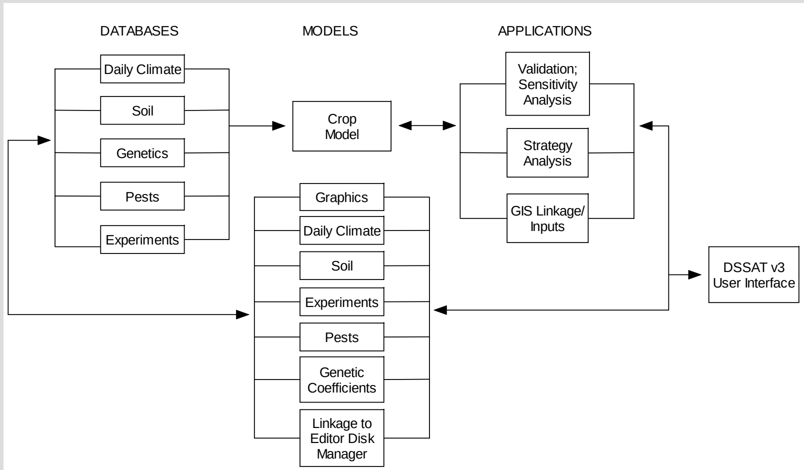


Figure 16.2.3 DSSAT v3 database components and linkages for crop model applications (After Jones *et al*., 1998)

CERES-Maize (continued)

The term sequence in DSSAT models refers to the growing of a crop in continuous succession or a rotation of different crops for a stated length of time. Since DSSAT operates on a daily time step, the simulation of cropping in sequence necessitates continuous calculations of soil and water process on daily basis, which will include those days when no crop is growing. A temporary file named 'TMP.DAT', which contains the relevant variables to pass from one model to the next, assists the running of the models in sequence. Consequently, the majority of variables in the temporary file which are passed on from season to season are those that are required for the simulation of soil water, C and N processes). Links between the model driver and crop simulation models are shown in **Figure 16.2.4**.

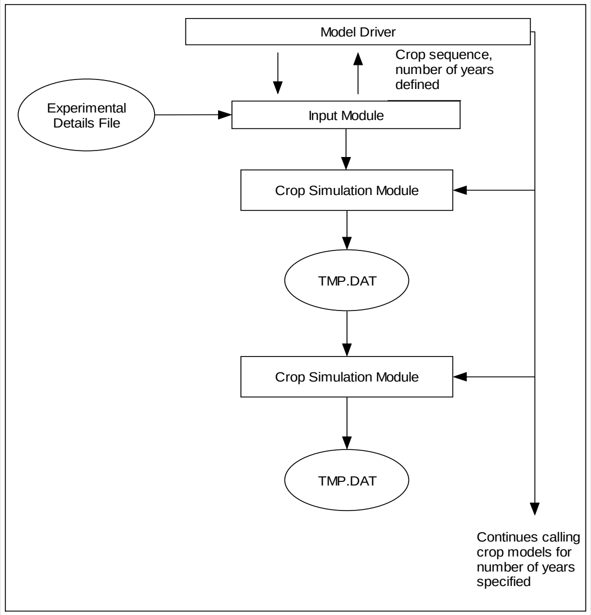


Figure 16.2.4 Linkages between the model driver and crop simulation models to simulate continuous cropping sequences in DSSAT v3 (After Bowen *et al*., 1998)

CERES-Maize (continued)

At the beginning of the simulation the driver program reads the order of the cropping sequence from an experimental details file. The driver then continues running the respective models for the number of years specified in the same experimental details file (Bowen *et al*., 1998).

CERES-Maize in South Africa: Some Examples of Applications and Improvements

The results presented in this Atlas build on a long history of applications of, and improvements to, the CERES-Maize model in South Africa. Selected examples are discussed below.

1. Applications

Various studies have been carried out in South Africa using the CERES-Maize model:

- Du Pisani (1987) developed a methodology in which CERES-Maize was employed to assess drought impacts on maize at an early stage in the season. Excellent correlations were found between yield predictions based on observed early season data in combination with median data for the remainder of the season, and yield predictions based on observed data over the entire season.
- Schulze *et al*. (1993) used the CERES-Maize model tool to investigate agricultural productivity in southern Africa and its response to climatic changes. The study revealed a large dependence of production and crop yield on the intra-seasonal and inter-annual variation of rainfall.
- CERES-Maize simulations were used with seasonal weather predictions and climatic data for historic El Niño years to simulate production practices so that management options could be ascertained that could help to reduce the negative impacts on yield of an El Niño year (du Toit and Prinsloo, 1998).
- Using daily climate and soils databases, a Geographic Information System (GIS) in combination with the CERES-Maize and Putu

CERES-Maize in South Africa: Some Examples of Applications and Improvements (continued)

Maize models, de Jager *et al.* (1998) developed a framework for drought assessment in the Free State. Drought hazard in maize was quantified and mapped by employing climate characteristics of the Southern Oscillation Index and running crop models in a GIS.

- Using a calibrated version of the CERES-Maize v3.0 model, du Toit *et al.* (1999) investigated maize yield responses to climate change. Four potential scenarios were tested at 19 individual sites representing most of the current maize production areas in South Africa. The results showed that maize yields would either remain at more or less current levels or decrease by between 10 and 20%, depending on which GCM scenario was used. In some of the marginal areas of the Free State and North West Province maize production would not be economically sustainable under certain future climate scenarios.
- Jones and Thornton (2003) modelled the possible impacts of climate change on smallholder maize production in Africa and Latin America using a third order Markov rainfall model, the CERES-Maize model and output from a GCM (HadCM2). The results showed an overall 10% reduction in maize production to 2055. On a regional scale large variability in yields occurred, and Jones and Thornton's conclusion was that climate change needed to be assessed at the household level so that the people who would be most vulnerable to its impacts could be targeted with appropriate research and development. The results for South Africa showed that the simulated baseline yield for smallholders was 1 310 kg/ha compared with the FAO yield figure for 2000 of 2 029 kg/ha, with the simulated yield for the year 2055 being 1 061 kg/ha for smallholder rainfed production systems.
- Lumsden and Schulze (2004) studied management strategies for small-scale farmers producing maize under conditions of climate variability, using the CERES-Maize model. An analysis was made

CERES-Maize in South Africa: Some Examples of Applications and Improvements (continued)

of the accuracy of yield forecasts based on rainfall forecasts, and to ascertain whether these forecasts could be valuable to the small-scale farmer when planning crop management strategies.

- Walker (2005) applied CERES-Maize in a major sustainability study on maize production at different spatial scales and different climate scenarios in South Africa, with scales ranging from the entire Highveld region to subsistence farmer level.

2. Improvements

- Du Toit *et al*. (1994a), upon finding that significant differences existed between observed and optimised genetic coefficients, calibrated genetic parameters in the subroutines of CERES-Maize to South African growing conditions.
- CERES-Maize was furthermore evaluated in regard to optimising the planting date of cultivars. Different stages of the plant growth were calibrated in CERES-Maize to improve phenological predictions and as a result of modifications made by du Toit *et al*. (1994b) systematic errors were reduced.
- A field trial was carried out by du Toit *et al.* (1998) to improve the prediction of the silking date of maize by CERES-Maize, which has been linked to the problem the model has in simulation of the kernel number. The modifications made improved the simulation of the silking date (du Toit *et al.,* 1998; du Toit and Prinsloo, 2000).
- The inability of CERES-Maize v3.0 to simulate a fluctuating shallow water table, important under irrigated conditions, was rectified by du Toit *et al.* (2002) by addition of a waterlogging sub-routine which facilitates the simulation of a fluctuation of the water table without the need for additional soil inputs. That research now also allows the quantification of the influence of oxygen stress on maize under waterlogged conditions.

Objectives of this Study

Numerous studies have thus been carried out using the CERES-Maize model in South Africa and significant local improvements/adaptations have been made. This particular study builds on the above and, additionally, was linked to the South African Quaternary Catchments Database (cf. **Section 2.3)**. Many of the maps presented were first produced for the Swiss Reinsurance company, whose support is hereby acknowledged.

The objectives of this study were as follows:

- To simulate maize yields, and their inter-annual, at a spatial resolution of Quaternary Catchments for 12 different combinations of
  - three plant dates, *viz*. 15 October, 15 November and 15 December representing early, mid and late plantings (with a range of three dates given since plantings for optimum yields should be scheduled that the most heat and moisture sensitive growth stage at flowering should not coincide with mid-summer droughts which often occur in South Africa); and
  - four cultivars, *viz*. an ultra-short season hybrid maturing in <115 days, a short season (115 - 130 days), medium (130 - 145 days) and a long season hybrid maturing in >145 days (with hybrids selected to consider *inter alia* stable high yields, non-susceptibility to certain diseases, resistance to lodging and length of growing season);
- in order to evaluate
  - which hybrid lengths give the highest yields, irrespective of plant dates
  - which plant dates give the highest yields, irrespective of hybrid lengths and
  - the overall highest yields which should be attained, irrespective of the combination of plant date and hybrid length,
- as well as
  - which hybrid lengths give the lowest CVs (%), irrespective of plant dates
  - which plant dates give the lowest CVs (%), irrespective of hybrid lengths and
  - which combination of plant date and hybrid length would yield the lowest CVs (%).

Distribution Patterns over South Africa of Statistics Relating to Potential Maize Production

1. Yields vs Plant Dates and Hybrid Lengths

- For *ultra-short season hybrids* the overall best plant date with respect to yield is 15 November, while 15 October displays the widest range of yields. These hybrids generally tend to produce very low yields.
- *Short season hybrids* display similar spatial patterns to the ultra-short ones, but yields are higher along the eastern seaboard in the Eastern Cape, KwaZulu-Natal and Mpumalanga.
- Both *medium* and *long season hybrids* are similar to the above.

2. Coefficients of Variation vs Plant Dates and Hybrid Lengths

- The highest inter-annual variability of yields is for the *ultra-short season* hybrids.
- *CV*s (%) are slightly lower for *short*, *medium* and *long season* hybrids.

3. Hybrid Lengths Producing the Highest Yields, Irrespective of Plant Date

- Neither *long season* nor *ultra-short season hybrids* produce highest yields anywhere.
- *Short season hybrids* tend to produce the highest yields in the northern parts of South Africa, while the central and southerly regions of the country attain their best yields with *medium length hybrids*.

4. Plant Dates Producing the Highest Yields, Irrespective of Hybrid Lengths

- Highest yields across most of KwaZulu-Natal, Mpumalanga, Gauteng and the eastern Free State are achieved with early season planting around *15 October*.
- Surrounding the above area in the east, north and west is an arc where best yields are attained from plantings around *15 November*.
- Late planting, around *15 December*, produces highest yields along the northeast coastal area of KwaZulu-Natal, the southern parts of the Eastern Cape, the far west of the Free State and the western half of

North West province.

5. Hybrid Lengths Producing the Lowest Variability of Maize Yields

Overall, *ultra-short season hybrids* display the lowest inter-annual variability of maize yields (although yields are low), and only in patches would *short* and *medium season hybrids* produce less variable yields.

6. Plant Dates Producing the Lowest Variability of Maize Yields

- Generally a planting around *15 November* would produce the most consistent yields year-by-year.
- Exceptions are northern KwaZulu-Natal, Mpumalanga and the southwest of Limpopo province, where *October 15* plantings display least inter-annual variability in yields.
- Further exceptions are the southern areas of production where, in patches, lowest variability is achieved with plantings around *15 December*.

References (In the sequence in which they appear in this Section, with the full references given in Section 22)

1. NDA (2005)
2. Trends in Agriculture (2005)
3. Statistics SA (2002)
4. Smith, J.M.B. (1994)
5. Smith, J.M.B. (1998)
6. Schulze, R.E., Domleo, F.B., Furniss, P.W. and Lecler, N.L. (1995)
7. Jones, C.A. and Kiniry, J.R. (1986)
8. Jones, J.W., Tsuji, G.Y., Hoogenboom, G., Hunt, L.A., Thornton, P.K., Wilkens, P.W., Imamura, D.T., Bowen, W.T. and Singh, U. (1998)
9. Hoogenboom, G., Jones, J.W., Hunt, L.A., Thornton, P.K. and Tsuji, G.Y. (1994)
10. Wu, Y., Sakamoto, C.M. and Botner, D.M. (1989)
11. CIESIN (1997)
12. Walker, N.J. (2005)
13. Bowen, W.T., Thornton, P.K. and Hoogenboom, G. (1998)
14. Du Pisani, A.L. (1987)
15. Schulze, R.E., Kiker, G.A. and Kunz, R.P. (1993)
16. Du Toit, A.S. and Prinsloo, M.A. (1998)
17. De Jager, J.M., Potgieter, A.B. and van den Berg, W.J. (1998)
18. Du Toit, A.S., Prinsloo, M.A., Durand, W. and Kiker, G.A. (1999)
19. Jones, P.G. and Thornton, P.K. (2003)
20. Lumsden, T.G. and Schulze, R.E. (2004)
21. Du Toit, A.S., van Rooyen, P.J. and Human, J.J. (1994a)
22. Du Toit, A.S., Booysen, J. and Human, J.J. (1994b)
23. Du Toit, A.S., Booysen, J. and Human, J.J. (1994c)
24. Du Toit, A.S., Booysen, J. and Human, J.J. (1997)
25. Du Toit, A.S. and Prinsloo, M.A. (1998)
26. Du Toit, A.S., Prinsloo, M.A., Wafula, B.M. and Thornton, P.K. (2002)
Photo 1 - Schulze, R.E.
Photo 2 - Schulze, R.E.

Citing from this Section of the Atlas

When making reference to this Section of the Atlas, please cite as follows:

Schulze, R.E. and Walker, N.J. 2007. Maize Yield Estimation. *In:* Schulze, R.E. (Ed). 2007. **South African Atlas of Climatology and Agrohydrology**. Water Research Commission, Pretoria, RSA, WRC Report 1489/1/06, Section 16.2.

Mean Maize Yield (t/ha/season), Ultra Short Hybrid, Plant Date 15 October							
Province / Country	Mean Value	CV (%)	Maximum Value	Minimum Value	Exceedence Probability		
					20%	50%	80%
Limpopo	2.5	42.4	5.4	0.2	1.8	2.2	3.1
Mpumalanga	1.5	78.9	5.1	0.1	0.4	1.0	2.3
North West	2.4	219.6	4.8	0.8	1.6	2.1	3.0
Northern Cape	2.4	51.9	5.3	0.0	1.2	2.3	3.3
Gauteng	2.7	144.0	4.9	0.9	1.4	2.4	3.7
Free State	3.0	184.4	5.2	0.7	2.2	2.7	4.0
KwaZulu-Natal	0.8	95.8	3.9	0.1	0.3	0.6	0.9
Eastern Cape	1.7	77.6	5.0	0.1	0.6	1.1	3.3
Western Cape	2.4	298.6	5.4	0.0	1.0	2.1	3.9
Swaziland	0.8	939.9	2.9	0.1	0.2	0.6	1.2
Lesotho	2.7	147.4	5.4	0.9	1.9	2.2	3.7

Mean Maize Yield (t/ha/season), Ultra Short Hybrid, Plant Date 15 November							
Province / Country	Mean Value	CV (%)	Maximum Value	Minimum Value	Exceedence Probability		
					20%	50%	80%
Limpopo	2.5	38.5	5.3	0.3	2.0	2.3	3.1
Mpumalanga	1.6	65.4	5.0	0.2	0.6	1.4	2.4
North West	2.4	213.4	4.6	1.1	1.8	2.2	3.0
Northern Cape	2.4	47.3	5.1	0.0	1.4	2.2	3.3
Gauteng	2.7	142.1	4.7	1.2	1.6	2.4	3.5
Free State	2.9	192.1	5.2	1.1	2.0	2.6	3.7
KwaZulu-Natal	1.0	79.4	4.1	0.1	0.4	0.8	1.3
Eastern Cape	1.9	68.3	5.0	0.2	0.8	1.4	3.4
Western Cape	2.4	295.5	5.2	0.0	1.1	2.2	3.7
Swaziland	1.0	730.0	3.2	0.2	0.4	0.8	1.5
Lesotho	2.5	157.0	5.1	1.2	1.9	2.2	3.3

Mean Maize Yield (t/ha/season), Ultra Short Hybrid, Plant Date 15 December							
Province / Country	Mean Value	CV (%)	Maximum Value	Minimum Value	Exceedence Probability		
					20%	50%	80%
Limpopo	2.2	41.1	4.9	0.6	1.7	2.0	2.7
Mpumalanga	1.6	56.1	4.7	0.2	0.8	1.5	2.1
North West	2.1	246.4	4.4	1.1	1.5	1.9	2.7
Northern Cape	1.9	49.2	4.6	0.0	1.2	1.8	2.6
Gauteng	2.3	167.6	4.2	1.2	1.4	1.9	2.8
Free State	2.4	229.3	4.9	1.1	1.7	2.0	3.1
KwaZulu-Natal	1.0	78.1	3.9	0.0	0.4	0.8	1.5
Eastern Cape	1.6	70.7	4.6	0.2	0.7	1.1	3.0
Western Cape	2.0	355.9	4.5	0.0	0.9	1.7	3.1
Swaziland	1.2	629.2	3.2	0.2	0.5	0.9	1.7
Lesotho	2.0	195.9	3.9	1.2	1.4	1.8	2.4

Inter-Annual CV (%) of Maize Yield, Ultra Short Hybrid, Plant Date 15 October							
Province / Country	Mean Value	CV (%)	Maximum Value	Minimum Value	Exceedence Probability		
					20%	50%	80%
Limpopo	45.8	36.1	106.0	6.0	36.0	46.0	55.0
Mpumalanga	65.6	37.8	131.0	10.0	45.0	62.0	88.0
North West	48.2	26.2	69.0	9.0	39.0	49.0	59.0
Northern Cape	52.9	87.5	538.0	0.0	33.0	47.0	59.0
Gauteng	42.6	35.3	73.0	17.0	25.0	43.0	52.0
Free State	43.7	35.6	73.0	4.0	28.0	47.0	57.0
KwaZulu-Natal	92.2	32.7	196.0	31.0	65.0	90.0	117.0
Eastern Cape	71.3	43.3	182.0	11.0	43.0	71.0	95.0
Western Cape	51.6	58.4	194.0	0.0	29.0	47.0	68.0
Swaziland	90.5	31.2	161.0	50.0	66.0	81.0	113.0
Lesotho	49.6	28.2	93.0	7.0	36.0	49.0	59.0

Inter-Annual CV (%) of Maize Yield, Ultra Short Hybrid, Plant Date 15 November							
Province / Country	Mean Value	CV (%)	Maximum Value	Minimum Value	Exceedence Probability		
					20%	50%	80%
Limpopo	45.7	35.4	117.0	7.0	35.0	46.0	55.0
Mpumalanga	63.7	38.4	170.0	13.0	44.0	59.0	83.0
North West	46.7	23.4	71.0	13.0	39.0	46.0	57.0
Northern Cape	53.5	110.3	663.0	0.0	35.0	47.0	58.0
Gauteng	43.3	31.3	68.0	18.0	25.0	44.0	54.0
Free State	45.5	32.7	72.0	6.0	32.0	48.0	58.0
KwaZulu-Natal	81.1	40.0	219.0	20.0	50.0	74.0	107.0
Eastern Cape	62.5	41.1	187.0	12.0	40.0	63.0	81.0
Western Cape	51.0	77.2	447.0	0.0	29.0	45.0	61.0
Swaziland	80.9	32.9	151.0	45.0	56.0	74.0	104.0
Lesotho	50.0	23.2	75.0	15.0	38.0	52.0	60.0

Inter-Annual CV (%) of Maize Yield, Ultra Short Hybrid, Plant Date 15 December							
Province / Country	Mean Value	CV (%)	Maximum Value	Minimum Value	Exceedence Probability		
					20%	50%	80%
Limpopo	51.0	33.2	140.0	11.0	39.0	51.0	62.0
Mpumalanga	67.5	35.4	136.0	12.0	50.0	62.0	84.0
North West	50.5	24.2	78.0	15.0	41.0	50.0	60.0
Northern Cape	54.8	87.9	665.0	0.0	40.0	51.0	63.0
Gauteng	45.9	32.8	73.0	21.0	30.0	41.0	62.0
Free State	49.9	29.5	77.0	13.0	37.0	52.0	62.0
KwaZulu-Natal	85.0	48.0	556.0	26.0	59.0	80.0	103.0
Eastern Cape	67.0	39.8	173.0	18.0	41.0	67.0	86.0
Western Cape	57.4	90.0	610.0	0.0	34.0	49.0	64.0
Swaziland	79.1	27.9	131.0	46.0	58.0	74.0	97.0
Lesotho	55.2	21.0	80.0	27.0	45.0	55.0	65.0

Mean Maize Yield (t/ha/season), Short Hybrid, Plant Date 15 October							
Province / Country	Mean Value	CV (%)	Maximum Value	Minimum Value	Exceedence Probability		
					20%	50%	80%
Limpopo	3.1	56.0	8.0	0.3	1.9	2.4	4.0
Mpumalanga	1.9	84.4	7.4	0.2	0.5	1.2	2.8
North West	3.0	186.7	7.1	0.8	1.7	2.4	3.9
Northern Cape	3.2	60.8	7.9	0.0	1.2	3.0	4.8
Gauteng	3.4	138.0	7.2	0.9	1.4	3.1	4.5
Free State	4.2	134.0	7.7	0.7	2.8	3.9	5.8
KwaZulu-Natal	1.0	103.6	5.5	0.1	0.4	0.7	1.2
Eastern Cape	2.3	82.6	7.1	0.0	0.6	1.5	4.5
Western Cape	3.1	217.8	8.0	0.0	0.8	2.9	5.5
Swaziland	1.1	677.7	3.9	0.2	0.3	0.8	1.7
Lesotho	3.7	124.2	8.2	0.9	2.2	3.3	5.4

Inter-Annual CV (%) of Maize Yield, Short Hybrid, Plant Date 15 October							
Province / Country	Mean Value	CV (%)	Maximum Value	Minimum Value	Exceedence Probability		
					20%	50%	80%
Limpopo	49.7	34.6	117.0	8.0	38.0	50.0	62.0
Mpumalanga	65.9	35.0	137.0	16.0	48.0	62.0	87.0
North West	51.4	25.5	75.0	19.0	41.0	52.0	62.0
Northern Cape	56.5	94.2	678.0	0.0	36.0	51.0	63.0
Gauteng	46.7	37.7	92.0	20.0	27.0	46.0	59.0
Free State	46.8	34.6	79.0	6.0	30.0	50.0	61.0
KwaZulu-Natal	89.0	33.7	193.0	29.0	62.0	87.0	113.0
Eastern Cape	70.0	40.6	172.0	17.0	43.0	71.0	93.0
Western Cape	53.1	54.4	215.0	11.0	32.0	49.0	69.0
Swaziland	87.4	33.8	173.0	45.0	64.0	78.0	105.0
Lesotho	53.4	29.1	103.0	9.0	40.0	51.0	66.0

Mean Maize Yield (t/ha/season), Short Hybrid, Plant Date 15 November							
Province / Country	Mean Value	CV (%)	Maximum Value	Minimum Value	Exceedence Probability		
					20%	50%	80%
Limpopo	3.1	46.2	7.3	0.4	2.1	2.6	3.7
Mpumalanga	2.0	66.9	6.6	0.2	0.8	1.6	2.9
North West	3.0	183.4	6.1	1.1	2.0	2.7	3.7
Northern Cape	3.1	52.6	7.2	0.0	1.5	2.9	4.4
Gauteng	3.3	138.7	7.0	1.2	1.7	2.8	4.4
Free State	3.8	144.2	7.2	1.1	2.8	3.4	5.0
KwaZulu-Natal	1.2	84.5	5.3	0.0	0.5	0.9	1.6
Eastern Cape	2.4	70.2	6.8	0.2	0.9	1.8	4.2
Western Cape	3.1	218.1	7.4	0.0	1.1	3.0	5.0
Swaziland	1.4	539.7	4.3	0.2	0.6	1.1	2.1
Lesotho	3.4	133.2	7.5	1.3	2.4	2.9	4.6

Inter-Annual CV (%) of Maize Yield, Short Hybrid, Plant Date 15 November							
Province / Country	Mean Value	CV (%)	Maximum Value	Minimum Value	Exceedence Probability		
					20%	50%	80%
Limpopo	49.9	34.6	118.0	13.0	36.0	50.0	62.0
Mpumalanga	64.3	35.7	168.0	15.0	47.0	62.0	81.0
North West	49.9	23.9	74.0	20.0	40.0	49.0	60.0
Northern Cape	57.2	114.7	656.0	0.0	36.0	49.0	60.0
Gauteng	46.9	33.0	84.0	19.0	29.0	48.0	60.0
Free State	47.3	31.4	78.0	12.0	33.0	50.0	60.0
KwaZulu-Natal	79.9	42.2	239.0	19.0	52.0	74.0	103.0
Eastern Cape	63.2	41.5	204.0	18.0	38.0	64.0	83.0
Western Cape	53.7	64.8	425.0	13.0	30.0	47.0	67.0
Swaziland	78.2	34.0	149.0	45.0	55.0	71.0	98.0
Lesotho	52.2	25.2	93.0	16.0	41.0	51.0	63.0

Mean Maize Yield (t/ha/season), Short Hybrid, Plant Date 15 December							
Province / Country	Mean Value	CV (%)	Maximum Value	Minimum Value	Exceedence Probability		
					20%	50%	80%
Limpopo	2.7	49.7	7.0	0.9	1.9	2.3	3.1
Mpumalanga	2.0	56.4	6.7	0.2	1.1	1.9	2.6
North West	2.6	208.3	5.4	1.2	1.6	2.3	3.4
Northern Cape	2.6	51.5	6.6	0.0	1.6	2.3	3.5
Gauteng	2.9	158.6	6.4	1.3	1.6	2.4	4.1
Free State	3.3	167.3	6.9	1.2	2.4	2.9	4.2
KwaZulu-Natal	1.3	80.2	5.3	0.0	0.5	1.0	1.9
Eastern Cape	2.2	70.0	6.5	0.3	0.9	1.6	4.0
Western Cape	2.7	250.9	6.5	0.0	1.1	2.5	4.1
Swaziland	1.6	446.8	4.4	0.3	0.6	1.4	2.5
Lesotho	2.8	162.1	5.8	1.3	2.0	2.3	3.6

Inter-Annual CV (%) of Maize Yield, Short Hybrid, Plant Date 15 December							
Province / Country	Mean Value	CV (%)	Maximum Value	Minimum Value	Exceedence Probability		
					20%	50%	80%
Limpopo	54.9	32.6	140.0	13.0	41.0	55.0	68.0
Mpumalanga	69.5	34.2	145.0	17.0	51.0	67.0	86.0
North West	53.9	24.3	85.0	23.0	42.0	54.0	64.0
Northern Cape	56.8	72.7	530.0	0.0	41.0	52.0	65.0
Gauteng	49.5	34.5	81.0	22.0	31.0	43.0	66.0
Free State	52.0	29.4	83.0	12.0	37.0	55.0	65.0
KwaZulu-Natal	86.0	51.5	603.0	28.0	61.0	80.0	106.0
Eastern Cape	69.0	40.3	179.0	20.0	42.0	70.0	90.0
Western Cape	60.4	85.9	520.0	0.0	34.0	50.0	71.0
Swaziland	80.0	30.5	148.0	45.0	56.0	76.0	101.0
Lesotho	58.0	22.8	86.0	26.0	46.0	57.0	71.0

Mean Maize Yield (t/ha/season), Medium Hybrid, Plant Date 15 October

Province / Country	Mean Value	CV (%)	Maximum Value	Minimum Value	Exceedence Probability 20%	50%	80%
Limpopo	3.2	58.7	8.5	0.3	1.9	2.4	4.0
Mpumalanga	1.9	85.6	7.9	0.2	0.5	1.4	2.8
North West	3.0	215.7	7.3	0.8	1.7	2.6	3.9
Northern Cape	3.3	62.1	8.5	0.0	1.3	3.1	4.9
Gauteng	3.6	124.9	7.7	0.9	1.4	3.3	5.0
Free State	4.3	121.7	8.2	0.6	2.8	4.0	6.0
KwaZulu-Natal	1.0	105.7	5.5	0.1	0.4	0.7	1.2
Eastern Cape	2.4	83.7	7.6	0.1	0.6	1.6	4.7
Western Cape	3.3	235.6	8.6	0.0	0.9	3.1	5.9
Swaziland	1.2	607.5	4.2	0.2	0.4	0.9	2.0
Lesotho	3.8	117.7	8.8	0.9	2.2	3.4	5.6

Mean Maize Yield (t/ha/season), Medium Hybrid, Plant Date 15 November

Province / Country	Mean Value	CV (%)	Maximum Value	Minimum Value	Exceedence Probability 20%	50%	80%
Limpopo	3.1	51.7	7.9	0.4	2.0	2.5	3.9
Mpumalanga	2.0	69.4	7.6	0.2	0.8	1.7	2.8
North West	3.0	213.5	6.7	1.0	1.9	2.7	3.9
Northern Cape	3.1	55.5	7.7	0.0	1.5	2.9	4.6
Gauteng	3.4	127.3	7.4	1.3	1.6	3.1	5.0
Free State	4.0	129.6	8.1	1.0	2.8	3.5	5.3
KwaZulu-Natal	1.3	87.6	5.7	0.0	0.5	0.9	1.6
Eastern Cape	2.5	72.9	7.3	0.3	0.8	1.9	4.5
Western Cape	3.2	244.9	8.0	0.0	1.1	3.0	5.1
Swaziland	1.5	490.7	4.8	0.2	0.5	1.2	2.2
Lesotho	3.5	128.0	7.9	1.2	2.5	2.9	4.6

Mean Maize Yield (t/ha/season), Medium Hybrid, Plant Date 15 December

Province / Country	Mean Value	CV (%)	Maximum Value	Minimum Value	Exceedence Probability 20%	50%	80%
Limpopo	2.7	55.5	7.6	0.9	1.8	2.2	3.2
Mpumalanga	2.1	59.4	7.4	0.2	1.1	1.9	2.7
North West	2.6	249.1	5.7	1.0	1.5	2.4	3.3
Northern Cape	2.6	56.0	7.4	0.0	1.5	2.4	3.6
Gauteng	2.9	149.0	6.7	1.1	1.5	2.3	3.8
Free State	3.4	152.9	7.6	1.0	2.4	3.0	4.4
KwaZulu-Natal	1.4	85.0	5.6	0.0	0.5	0.9	2.0
Eastern Cape	2.3	75.2	6.9	0.2	0.8	1.6	4.2
Western Cape	2.6	299.8	6.9	0.0	0.9	2.3	4.0
Swaziland	1.8	405.3	5.0	0.2	0.7	1.5	2.8
Lesotho	2.8	156.7	5.6	1.2	2.0	2.3	3.6

Inter-Annual CV (%) of Maize Yield, Medium Hybrid, Plant Date 15 October

Province / Country	Mean Value	CV (%)	Maximum Value	Minimum Value	Exceedence Probability 20%	50%	80%
Limpopo	54.6	33.6	137.0	9.0	42.0	55.0	66.0
Mpumalanga	71.7	36.6	170.0	19.0	52.0	66.0	94.0
North West	55.8	24.3	85.0	23.0	45.0	56.0	69.0
Northern Cape	59.3	106.3	686.0	0.0	38.0	53.0	66.0
Gauteng	50.2	32.3	89.0	25.0	31.0	52.0	61.0
Free State	49.7	32.5	84.0	8.0	35.0	53.0	64.0
KwaZulu-Natal	94.9	35.6	262.0	29.0	66.0	91.0	122.0
Eastern Cape	72.9	42.0	183.0	17.0	44.0	73.0	95.0
Western Cape	55.4	60.6	315.0	0.0	33.0	50.0	71.0
Swaziland	93.6	35.6	174.0	43.0	66.0	85.0	118.0
Lesotho	55.3	26.4	98.0	12.0	42.0	53.0	67.0

Inter-Annual CV (%) of Maize Yield, Medium Hybrid, Plant Date 15 November

Province / Country	Mean Value	CV (%)	Maximum Value	Minimum Value	Exceedence Probability 20%	50%	80%
Limpopo	55.6	31.8	118.0	12.0	42.0	58.0	68.0
Mpumalanga	67.4	33.2	184.0	17.0	51.0	65.0	83.0
North West	54.3	22.1	79.0	22.0	44.0	55.0	63.0
Northern Cape	54.9	73.0	516.0	0.0	38.0	51.0	63.0
Gauteng	51.8	35.1	95.0	23.0	33.0	53.0	64.0
Free State	50.4	30.7	84.0	10.0	37.0	53.0	63.0
KwaZulu-Natal	84.0	42.1	285.0	18.0	54.0	76.0	109.0
Eastern Cape	66.2	40.9	215.0	17.0	41.0	67.0	85.0
Western Cape	58.8	89.8	693.0	15.0	32.0	51.0	69.0
Swaziland	81.1	36.8	163.0	44.0	56.0	71.0	103.0
Lesotho	54.7	24.6	101.0	19.0	41.0	55.0	65.0

Inter-Annual CV (%) of Maize Yield, Medium Hybrid, Plant Date 15 December

Province / Country	Mean Value	CV (%)	Maximum Value	Minimum Value	Exceedence Probability 20%	50%	80%
Limpopo	59.9	31.2	146.0	12.0	46.0	62.0	73.0
Mpumalanga	72.5	32.5	147.0	18.0	53.0	69.0	90.0
North West	57.3	22.4	84.0	23.0	47.0	57.0	70.0
Northern Cape	59.4	71.7	520.0	0.0	44.0	54.0	66.0
Gauteng	52.5	31.6	82.0	23.0	35.0	51.0	69.0
Free State	53.1	27.6	93.0	15.0	40.0	54.0	65.0
KwaZulu-Natal	92.4	53.9	619.0	30.0	64.0	86.0	112.0
Eastern Cape	74.5	41.5	194.0	22.0	44.0	74.0	99.0
Western Cape	70.0	105.0	693.0	0.0	38.0	55.0	78.0
Swaziland	81.4	32.3	141.0	41.0	56.0	80.0	111.0
Lesotho	58.6	23.9	93.0	26.0	46.0	56.0	68.0

Mean Maize Yield (t/ha/season), Long Hybrid, Plant Date 15 October							
Province / Country	Mean Value	CV (%)	Maximum Value	Minimum Value	Exceedence Probability		
					20%	50%	80%
Limpopo	2.8	62.2	7.7	0.2	1.6	2.1	3.8
Mpumalanga	1.7	90.1	7.2	0.1	0.4	1.1	2.5
North West	2.7	255.0	6.7	0.7	1.4	2.2	3.6
Northern Cape	3.0	64.4	7.8	0.0	1.1	2.8	4.6
Gauteng	3.2	158.9	6.9	0.6	1.1	2.9	4.6
Free State	3.9	140.7	7.5	0.5	2.5	3.7	5.6
KwaZulu-Natal	0.9	112.6	5.1	0.1	0.3	0.6	1.0
Eastern Cape	2.1	85.4	7.0	0.0	0.5	1.4	4.2
Western Cape	2.9	283.1	8.1	0.0	0.7	2.7	5.3
Swaziland	1.0	744.0	3.8	0.1	0.3	0.7	1.7
Lesotho	3.5	132.8	8.3	0.7	1.9	3.0	5.2

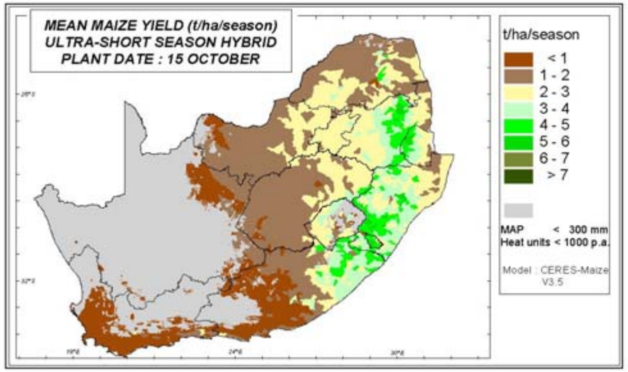
Inter-Annual CV (%) of Maize Yield, Long Hybrid, Plant Date 15 October							
Province / Country	Mean Value	CV (%)	Maximum Value	Minimum Value	Exceedence Probability		
					20%	50%	80%
Limpopo	58.8	37.3	187.0	12.0	43.0	59.0	72.0
Mpumalanga	78.3	39.6	207.0	18.0	55.0	71.0	100.0
North West	58.7	24.9	87.0	22.0	46.0	60.0	70.0
Northern Cape	56.4	39.6	149.0	0.0	40.0	57.0	71.0
Gauteng	53.8	38.5	118.0	25.0	31.0	53.0	66.0
Free State	54.0	33.4	94.0	12.0	36.0	57.0	69.0
KwaZulu-Natal	102.0	37.2	225.0	24.0	69.0	96.0	134.0
Eastern Cape	77.3	44.3	242.0	12.0	46.0	76.0	102.0
Western Cape	59.6	69.4	456.0	0.0	35.0	52.0	76.0
Swaziland	105.1	41.3	224.0	47.0	70.0	89.0	137.0
Lesotho	60.4	28.7	113.0	14.0	46.0	58.0	74.0

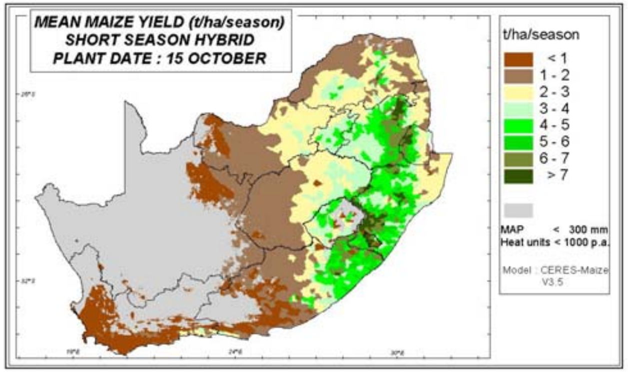
Mean Maize Yield (t/ha/season), Long Hybrid, Plant Date 15 November							
Province / Country	Mean Value	CV (%)	Maximum Value	Minimum Value	Exceedence Probability		
					20%	50%	80%
Limpopo	2.8	53.3	7.5	0.3	1.8	2.3	3.4
Mpumalanga	1.8	72.2	6.6	0.1	0.6	1.5	2.5
North West	2.7	254.0	6.1	0.9	1.7	2.4	3.6
Northern Cape	2.8	57.8	7.0	0.0	1.3	2.5	4.1
Gauteng	3.0	164.0	6.8	1.1	1.5	2.7	4.2
Free State	3.5	154.3	7.4	0.9	2.5	3.1	4.7
KwaZulu-Natal	1.1	93.4	5.0	0.0	0.4	0.8	1.4
Eastern Cape	2.2	75.2	6.5	0.2	0.7	1.6	4.0
Western Cape	2.8	292.9	7.3	0.0	0.9	2.6	4.8
Swaziland	1.2	613.7	4.0	0.2	0.4	1.0	1.7
Lesotho	3.1	149.5	7.3	1.1	2.1	2.5	4.2

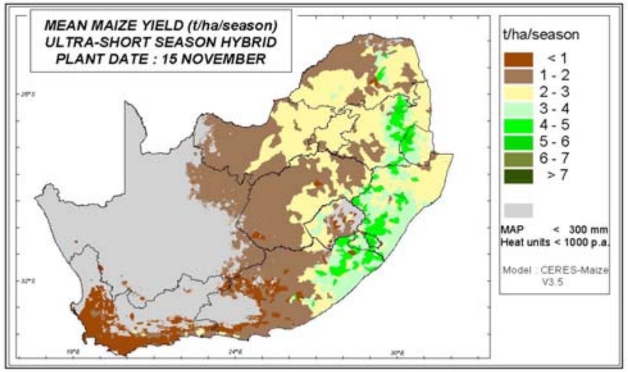
Inter-Annual CV (%) of Maize Yield, Long Hybrid, Plant Date 15 November							
Province / Country	Mean Value	CV (%)	Maximum Value	Minimum Value	Exceedence Probability		
					20%	50%	80%
Limpopo	60.1	32.7	124.0	17.0	45.0	62.0	76.0
Mpumalanga	73.0	35.0	205.0	16.0	54.0	70.0	86.0
North West	59.6	23.2	87.0	21.0	49.0	60.0	70.0
Northern Cape	58.0	64.7	493.0	0.0	39.0	55.0	70.0
Gauteng	56.3	34.1	98.0	26.0	33.0	56.0	68.0
Free State	54.3	31.4	95.0	16.0	39.0	58.0	69.0
KwaZulu-Natal	91.0	47.4	450.0	23.0	59.0	82.0	123.0
Eastern Cape	70.7	42.5	229.0	20.0	42.0	70.0	92.0
Western Cape	65.3	100.9	693.0	17.0	33.0	55.0	74.0
Swaziland	87.4	37.5	188.0	46.0	61.0	79.0	106.0
Lesotho	59.9	24.2	112.0	22.0	46.0	62.0	71.0

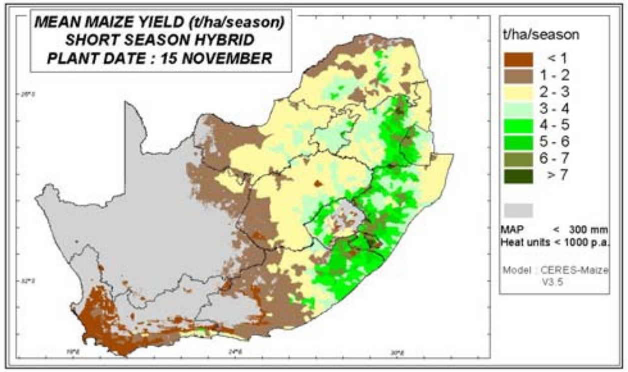
Mean Maize Yield (t/ha/season), Long Hybrid, Plant Date 15 December							
Province / Country	Mean Value	CV (%)	Maximum Value	Minimum Value	Exceedence Probability		
					20%	50%	80%
Limpopo	2.6	54.9	7.2	0.5	1.7	2.1	3.2
Mpumalanga	1.8	67.6	7.1	0.1	0.8	1.5	2.4
North West	2.5	270.2	5.7	0.9	1.5	2.3	3.3
Northern Cape	2.6	58.1	6.6	0.0	1.3	2.2	3.7
Gauteng	2.8	175.0	6.2	1.0	1.5	2.3	4.0
Free State	3.3	168.4	7.3	0.9	2.2	2.8	4.2
KwaZulu-Natal	1.1	92.4	5.1	0.0	0.4	0.8	1.6
Eastern Cape	2.1	76.6	6.5	0.2	0.7	1.5	3.9
Western Cape	2.6	317.5	6.9	0.0	0.8	2.5	4.1
Swaziland	1.3	551.3	4.2	0.2	0.5	1.1	2.0
Lesotho	2.7	166.3	6.3	1.1	1.9	2.3	3.6

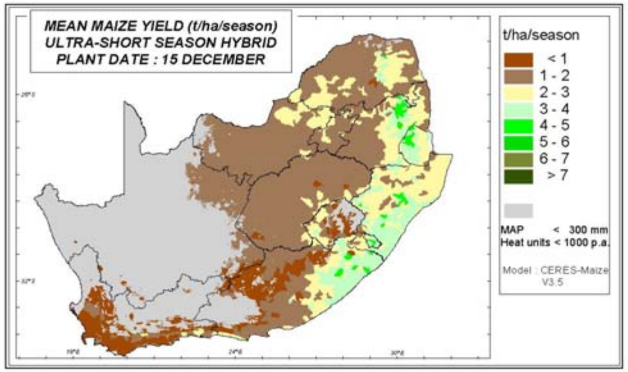
Inter-Annual CV (%) of Maize Yield, Long Hybrid, Plant Date 15 December							
Province / Country	Mean Value	CV (%)	Maximum Value	Minimum Value	Exceedence Probability		
					20%	50%	80%
Limpopo	64.2	33.5	186.0	16.0	49.0	66.0	80.0
Mpumalanga	77.1	34.6	165.0	20.0	57.0	73.0	94.0
North West	61.9	24.3	97.0	23.0	49.0	60.0	75.0
Northern Cape	63.6	80.8	693.0	0.0	46.0	59.0	73.0
Gauteng	56.6	35.3	100.0	22.0	36.0	50.0	74.0
Free State	58.8	29.6	97.0	13.0	43.0	62.0	74.0
KwaZulu-Natal	94.9	43.7	360.0	25.0	62.0	88.0	123.0
Eastern Cape	75.6	42.5	210.0	18.0	44.0	76.0	99.0
Western Cape	71.6	105.9	693.0	0.0	37.0	60.0	80.0
Swaziland	88.5	33.5	171.0	44.0	62.0	78.0	109.0
Lesotho	65.0	22.7	99.0	29.0	49.0	67.0	75.0

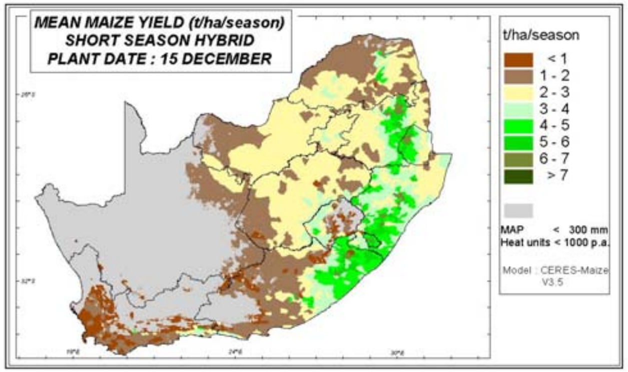

MEAN MAIZE YIELD (t/ha/season)
ULTRA-SHORT SEASON HYBRID
PLANT DATE : 15 OCTOBER
t/ha/season
< 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
> 7
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5

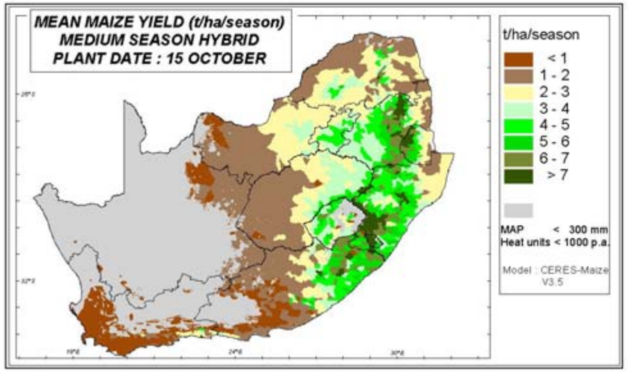

MEAN MAIZE YIELD (t/ha/season)
SHORT SEASON HYBRID
PLANT DATE : 15 OCTOBER
t/ha/season
< 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
> 7
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5

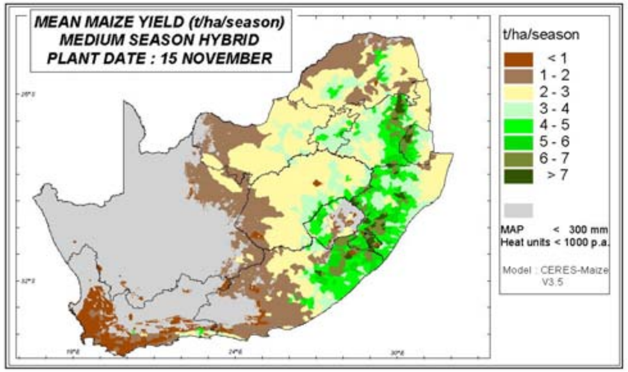

MEAN MAIZE YIELD (t/ha/season)
ULTRA-SHORT SEASON HYBRID
PLANT DATE : 15 NOVEMBER
t/ha/season
< 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
> 7
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5

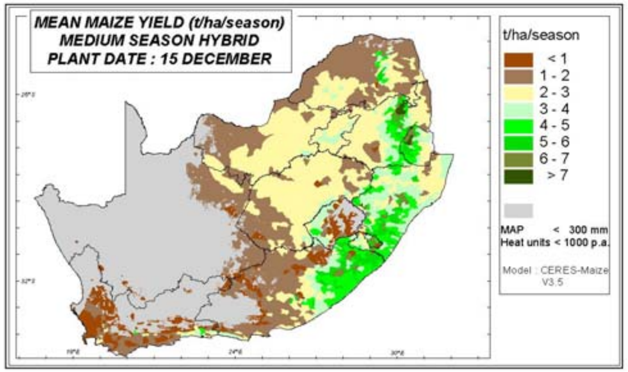

MEAN MAIZE YIELD (t/ha/season)
SHORT SEASON HYBRID
PLANT DATE : 15 NOVEMBER
t/ha/season
< 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
> 7
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5

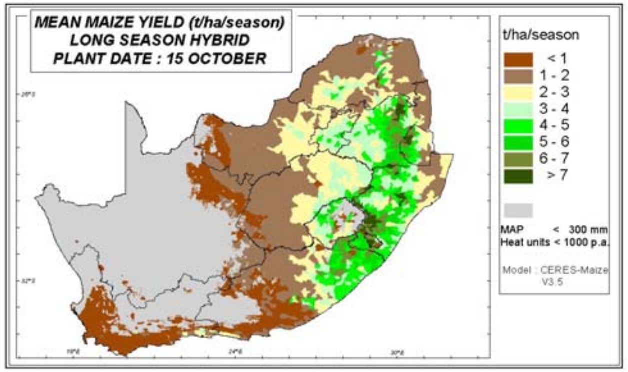

MEAN MAIZE YIELD (t/ha/season)
ULTRA-SHORT SEASON HYBRID
PLANT DATE : 15 DECEMBER
t/ha/season
< 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
> 7
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5

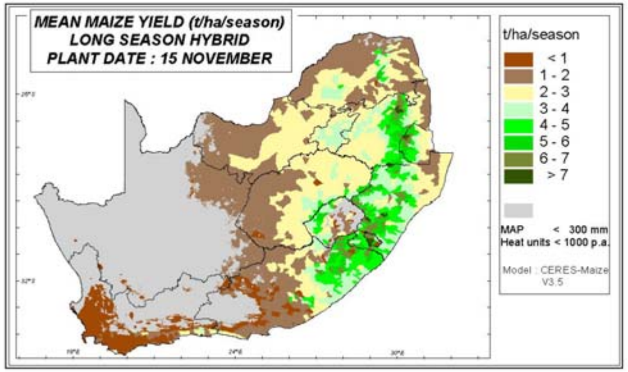

MEAN MAIZE YIELD (t/ha/season)
SHORT SEASON HYBRID
PLANT DATE : 15 DECEMBER
t/ha/season
< 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
> 7
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5

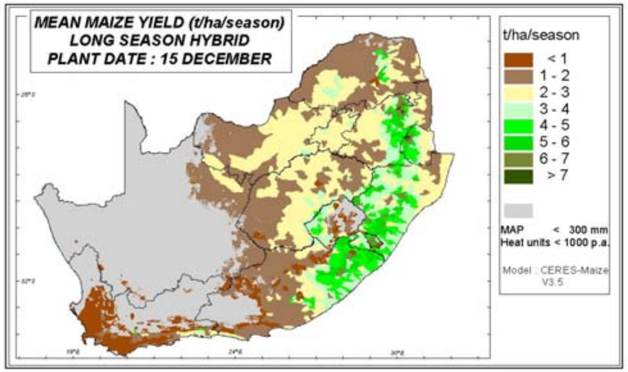

MEAN MAIZE YIELD (t/ha/season)
MEDIUM SEASON HYBRID
PLANT DATE : 15 OCTOBER
t/ha/season
< 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
> 7
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5

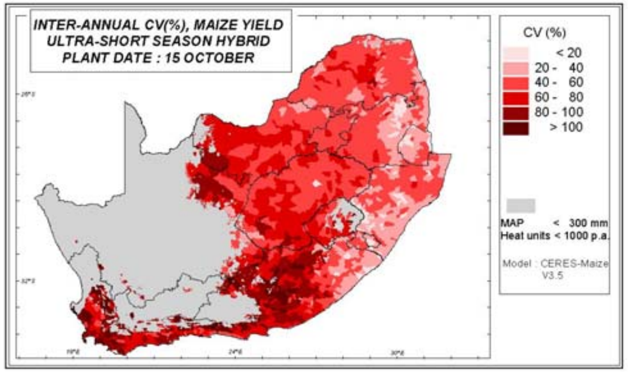

MEAN MAIZE YIELD (t/ha/season)
MEDIUM SEASON HYBRID
PLANT DATE : 15 NOVEMBER
t/ha/season
< 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
> 7
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5

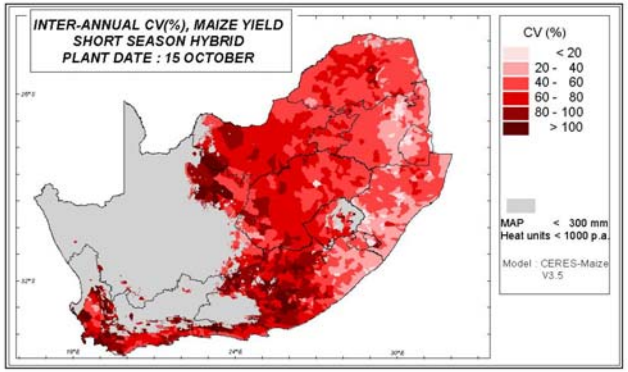

MEAN MAIZE YIELD (t/ha/season)
MEDIUM SEASON HYBRID
PLANT DATE : 15 DECEMBER
t/ha/season
< 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
> 7
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5

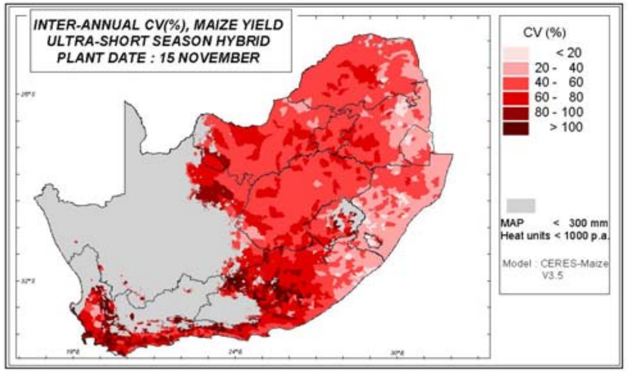

MEAN MAIZE YIELD (t/ha/season)
LONG SEASON HYBRID
PLANT DATE : 15 OCTOBER
t/ha/season
< 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
> 7
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5

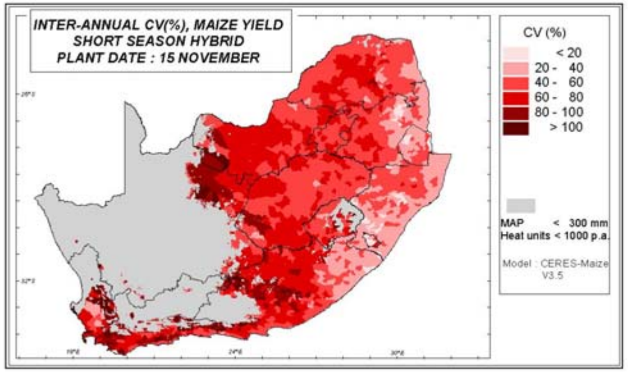

MEAN MAIZE YIELD (t/ha/season)
LONG SEASON HYBRID
PLANT DATE : 15 NOVEMBER
t/ha/season
< 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
> 7
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5

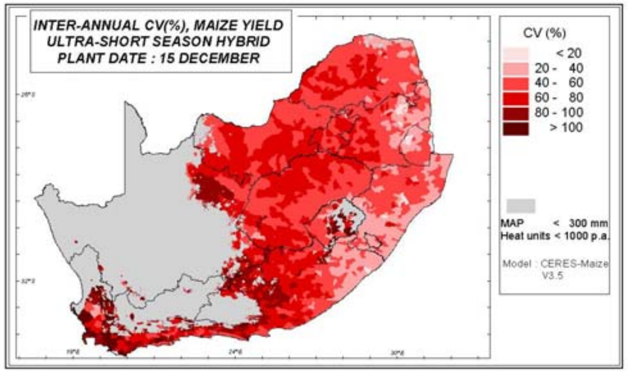

MEAN MAIZE YIELD (t/ha/season)
LONG SEASON HYBRID
PLANT DATE : 15 DECEMBER
t/ha/season
< 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
> 7
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5

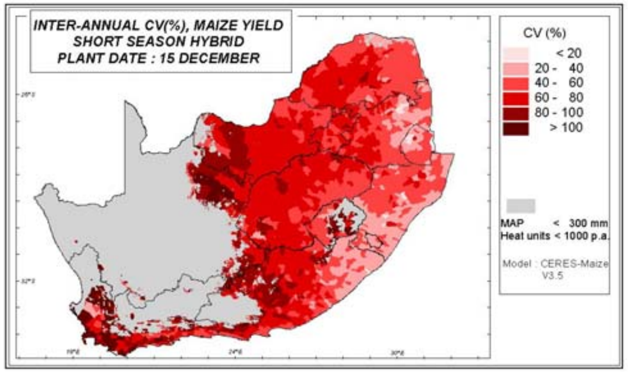

INTER-ANNUAL CV(%), MAIZE YIELD
ULTRA-SHORT SEASON HYBRID
PLANT DATE : 15 OCTOBER
CV (%)
< 20
20 - 40
40 - 60
60 - 80
80 - 100
> 100
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5

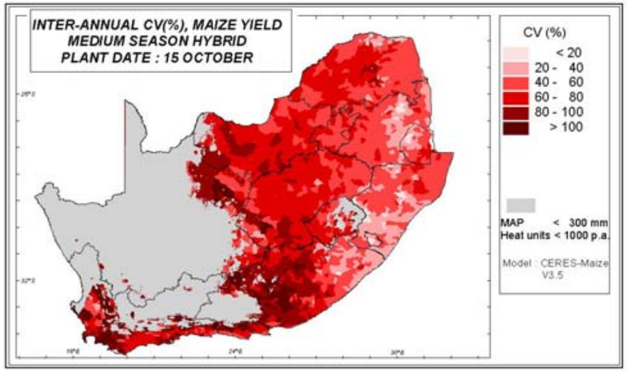

INTER-ANNUAL CV(%), MAIZE YIELD
SHORT SEASON HYBRID
PLANT DATE : 15 OCTOBER
CV (%)
< 20
20 - 40
40 - 60
60 - 80
80 - 100
> 100
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5

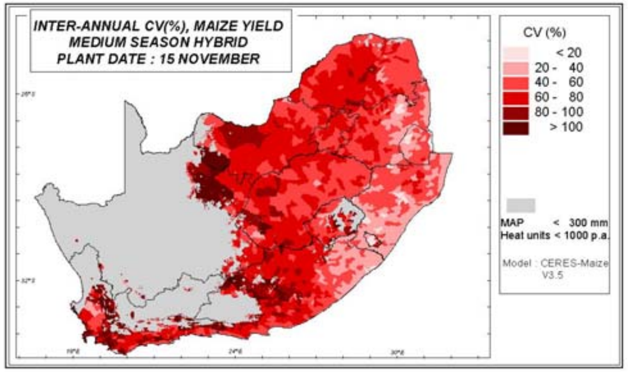

INTER-ANNUAL CV(%), MAIZE YIELD
ULTRA-SHORT SEASON HYBRID
PLANT DATE : 15 NOVEMBER
CV (%)
< 20
20 - 40
40 - 60
60 - 80
80 - 100
> 100
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5

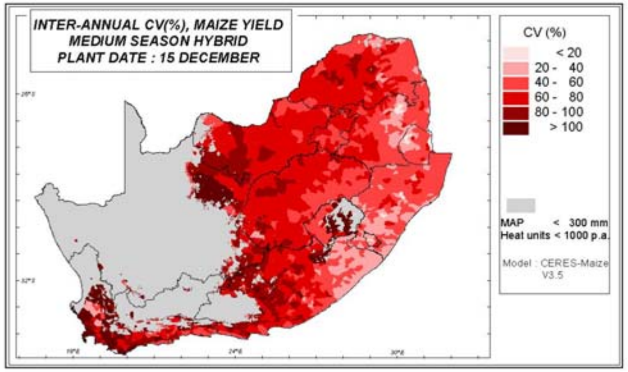

INTER-ANNUAL CV(%), MAIZE YIELD
SHORT SEASON HYBRID
PLANT DATE : 15 NOVEMBER
CV (%)
< 20
20 - 40
40 - 60
60 - 80
80 - 100
> 100
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5

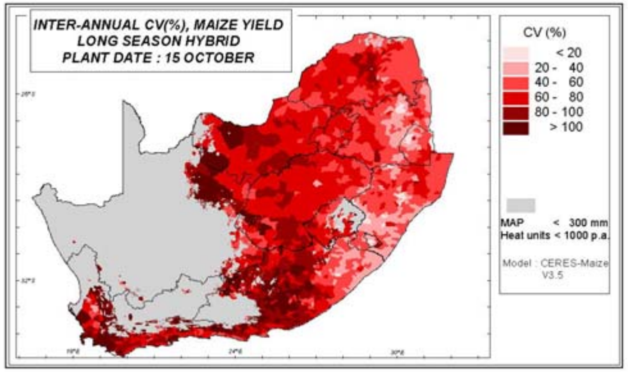

INTER-ANNUAL CV(%), MAIZE YIELD
ULTRA-SHORT SEASON HYBRID
PLANT DATE : 15 DECEMBER
CV (%)
< 20
20 - 40
40 - 60
60 - 80
80 - 100
> 100
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5

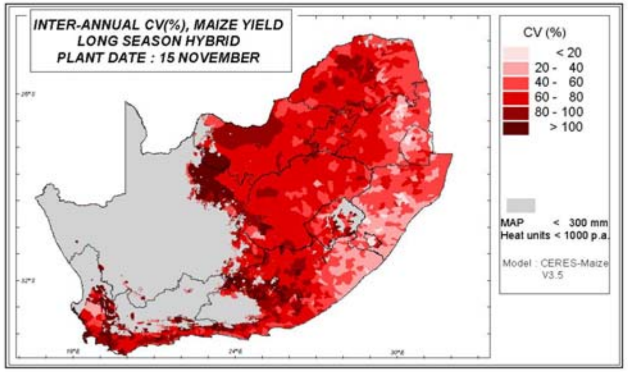

INTER-ANNUAL CV(%), MAIZE YIELD
SHORT SEASON HYBRID
PLANT DATE : 15 DECEMBER
CV (%)
< 20
20 - 40
40 - 60
60 - 80
80 - 100
> 100
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5

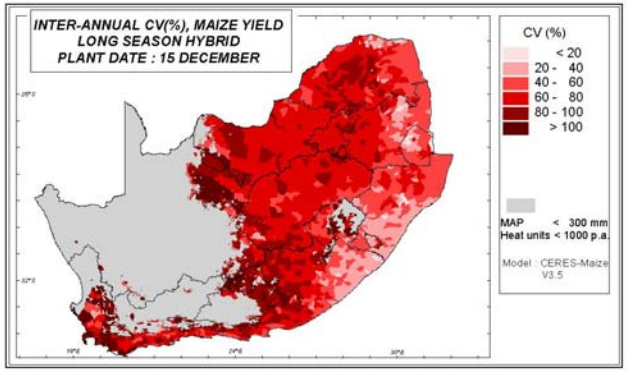

INTER-ANNUAL CV(%), MAIZE YIELD
MEDIUM SEASON HYBRID
PLANT DATE : 15 OCTOBER
CV (%)
< 20
20 - 40
40 - 60
60 - 80
80 - 100
> 100
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5

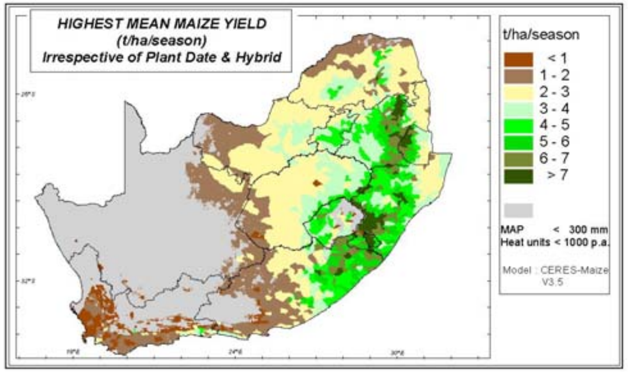

INTER-ANNUAL CV(%), MAIZE YIELD
MEDIUM SEASON HYBRID
PLANT DATE : 15 NOVEMBER
CV (%)
< 20
20 - 40
40 - 60
60 - 80
80 - 100
> 100
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5

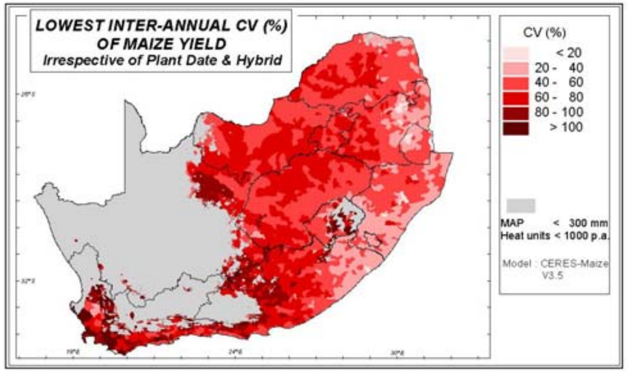

INTER-ANNUAL CV(%), MAIZE YIELD
MEDIUM SEASON HYBRID
PLANT DATE : 15 DECEMBER
CV (%)
< 20
20 - 40
40 - 60
60 - 80
80 - 100
> 100
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5

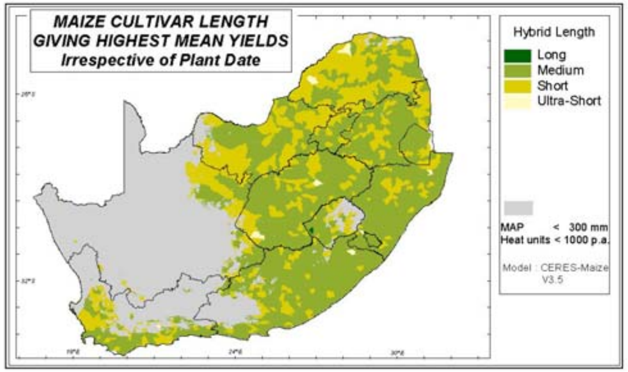

INTER-ANNUAL CV(%), MAIZE YIELD
LONG SEASON HYBRID
PLANT DATE : 15 OCTOBER
CV (%)
< 20
20 - 40
40 - 60
60 - 80
80 - 100
> 100
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5

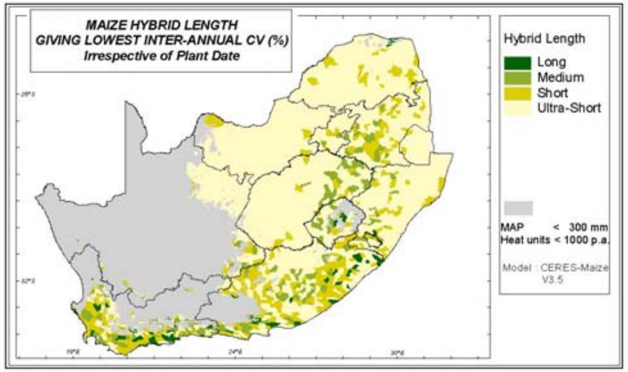

INTER-ANNUAL CV(%), MAIZE YIELD
LONG SEASON HYBRID
PLANT DATE : 15 NOVEMBER
CV (%)
< 20
20 - 40
40 - 60
60 - 80
80 - 100
> 100
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5

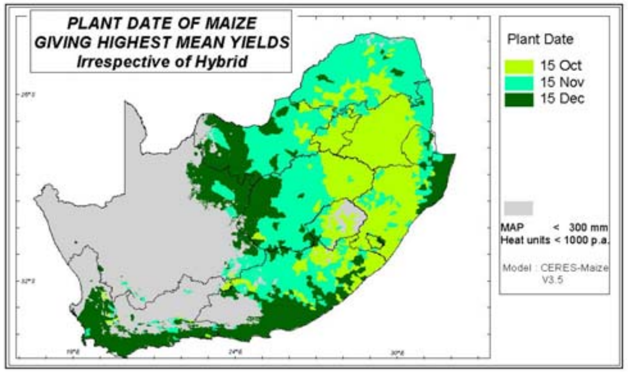

INTER-ANNUAL CV(%), MAIZE YIELD
LONG SEASON HYBRID
PLANT DATE : 15 DECEMBER
CV (%)
< 20
20 - 40
40 - 60
60 - 80
80 - 100
> 100
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5

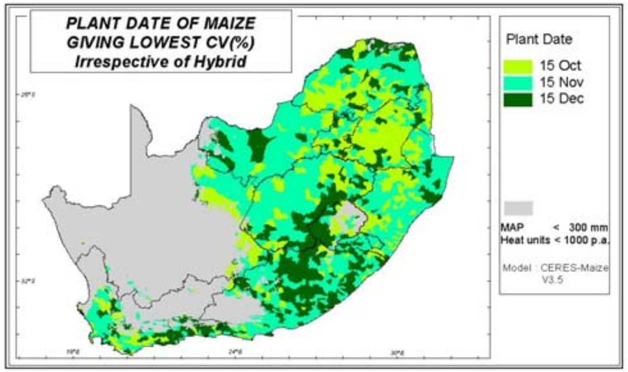

HIGHEST MEAN MAIZE YIELD
(t/ha/season)
Irrespective of Plant Date & Hybrid
t/ha/season
< 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
> 7
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5


LOWEST INTER-ANNUAL CV (%)
OF MAIZE YIELD
Irrespective of Plant Date & Hybrid
CV (%)
< 20
20 - 40
40 - 60
60 - 80
80 - 100
> 100
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5


MAIZE CULTIVAR LENGTH
GIVING HIGHEST MEAN YIELDS
Irrespective of Plant Date
Hybrid Length
Long
Medium
Short
Ultra-Short
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5


MAIZE HYBRID LENGTH
GIVING LOWEST INTER-ANNUAL CV (%)
Irrespective of Plant Date
Hybrid Length
Long
Medium
Short
Ultra-Short
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5


PLANT DATE OF MAIZE
GIVING HIGHEST MEAN YIELDS
Irrespective of Hybrid
Plant Date
15 Oct
15 Nov
15 Dec
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5


PLANT DATE OF MAIZE
GIVING LOWEST CV(%)
Irrespective of Hybrid
Plant Date
15 Oct
15 Nov
15 Dec
MAP < 300 mm
Heat units < 1000 p.a.
Model : CERES-Maize V3.5