BELANGRIK

Resultate van 'n kultivarproef by 'n enkele lokaliteit in enige jaar, of selfs 'n beperkte aantal lokaliteite in 'n enkele jaar, kan as gevolg van die kenmerkende seisoenale variasie in die RSA hoogs misleidend wees en kan sodoende onregverdiglik teen die beste genotipes vir daardie omgewing diskrimineer. **'n ERNSTIGE BEROEP WORD OP ALLE BETROKKENES GEDOEN OM NIE HUL GENOTIPEADVIES OP SO 'N HOOGS ONBETROUBARE METODE TE BASEER NIE.** Produsente word veral versoek om nougeset daar teen te waak dat hulle nie ook foutiewe genotipe uitsprake op dieselfde wyse doen nie, of op hierdie wyse mislei word nie.

Hierdie meerjarige resultate van die Nasionale Kultivarproewe, wat deur die LNR-IGG uitgevoer is en gepubliseer word, geskied in belang van produsente, adviesdienste en die teeltbedryf. Die resultate mag derhalwe vryelik gebruik word, mits dit wetenskaplik korrek vertolk word. Vrye gebruik van die resultate word ook met 'n verdere voorwaarde toegelaat, naamlik dat die nodige erkenning aan die bron van die inligting verleen word.

LNR - Instituut vir Graangewasse

Privaatsak X1251

POTCHEFSTROOM B/I

2520

DANKBETUIGINGS

Die sukses van hierdie navorsingsprojek is toe te skryf aan die goeie samewerking en medewerking tussen die private, koöperatiewe en openbare sektore asook boere by wie genotipeproewe geplant is (Tabel 2). Die verantwoordelike navorsers betuig hiermee hul grootste waardering vir die besondere samewerking en ondersteuning wat hul van al die betrokkenes ontvang het.

Medewerkende instansies en persone

SAADFIRMAS

Agricol (Edms) Bpk

Capstone Seeds South Africa (Edms) BPK

Pannar Saad (Edms) Bpk

LNR – INSTITUUT VIR GRAANGEWASSE

Hierdie verslag se samestelling,voorbereiding en vermeerdering het bydraes deur verskeie kollegas en beamptes geverg. Spesiale vermelding moet egter gemaak word van die insette deur Mnr. D J. Muller vir sy beplanning en bestuur van die proewe, Me T. Mathobisa-Manyokole vir data voorbereiding.

SORGHUM TRUST

Die LNR-IGG wil hiermee ook sy dank uitspreek teenoor die Sorghum Trust vir finansiële ondersteuning wat die uitvoer van die proewe moontlik gemaak het.

IMPORTANT

Due to typical seasonal variations in the RSA, results of a cultivar trial at a single locality in any year, or even at a limited number of localities in a single year can be highly misleading and can discriminate unfairly against genotypes, which may in reality be the best for certain areas. **ALL THOSE INVOLVED ARE STRONGLY URGED NOT TO BASE THEIR GENOTYPE RECOMMENDATIONS ON A HIGHLY UNRELIABLE METHOD SUCH AS THIS.** Producers, especially, are requested to guard against letting themselves be misled in this way and against making incorrect genotype judgments.

Results of these National Cultivar Trials, carried out by the ARC-GCI, are published by the Institute in the interest of producers, advisory services and the breeding industry. These results may thus be freely used, as long as they are used in a scientifically correct manner, incorporating the whole spectrum of localities and observations. The source of the information should also be awarded the necessary recognition when using these results.

ARC – Grain Crops Institute

Private Bag X1251

POTCHEFSTROOM

2520

ACKNOWLEGEMENTS

The success of this research project is due to the good co-operation between the private, co-operative and public sectors as well as farmers on whose farms genotype trials were planted (Table 2). The researchers wish to express their utmost appreciation for the exceptional co-operation and support received from all those involved.

Co-working authorities and persons

SEED COMPANIES

Agricol (Pty) Ltd

Capstone Seeds South Africa (Pty) Ltd

Pannar Seed (Pty) Ltd

GRAIN CROPS INSTITUTE

The compilation of this report was made possible by the efforts of many colleagues and officials. Special thanks go to Mr. D J. Muller for his planning and management of the trials, Ms. T. Mathobisa-Manyokole for data preparation.

SORGHUM TRUST

The ARC-GCI would like to thank the Sorghum Trust for financial support that made these trials possible.

INHOUDSOPGAWE / CONTENTS

TABELLE / TABLES

FIGURE / FIGURES

AANHANGSEL A /APPENDIX A

INLEIDING

Resultate van die 2012/2013 Nasionale Kultivar Proewe met Sorghum, is in hierdie verslag saamgevat. Die doelwit van die navorsing is om die stabiliteit van verskillende genotipes te evalueer ten opsigte van verskillende opbrengspotensiale asook die agronomiese en industriële waarde van nuwe genotipes. Genotipe inskrywings bestaan uit die GM, GL en GH graderingsklasse.

NAVORSINGSPROSEDURE

Standaard en wetenskaplik erkende prosedures en waarnemings wat vir die navorsingsprogram voorgeskryf is, word in die jaarverslae beskryf. Medewerkers is „n vry hand gegee in die implimentering van mees geskikte produksie praktyke in hulle spesifieke areas. Dit word gedoen om opbrengste te optimaliseer en om toestande te skep van varieërende potensiaaltoestande deur plantdatums en/of besproeiingsfrekwensies te manipuleer.

Proef ontwerp

„n Volledige roosterontwerp met 3 herhalings by elke lokaliteit, is deurgaans gebruik om die 20 genotipes te akkommodeer. Aan elke lokaliteit is „n spesifieke proefrandomisasie toegeken, en die uitleg word jaarliks verander.

Genotipe inskrywings

Dieselfde 20 genotipes word gebruik in al die proewe. Saadmaatskappye nomineer al die genotipes wat ingeskryf word. Saadmaatskappy inskrywings geskied volgens prioriteit. Indien te veel inskrywings ontvang is, word die finale genotipelys met betrokke saadmaatskappye beding.

Perseel grootte en spasiëring

A bruto perseel grootte van twee plantrye van 6 m elk en „n netto perseel grootte met rylengtes van 5m is voorgeskryf vir alle proewe. „n Rywydte van 1.0m en binne-ry spasiëring van 7.5cm is ook aanbeveel vir proewe. Genoegsame saad is verskaf om „n goeie stand te verseker.

Sodra saailinge sterk genoeg was, is dit uitgedun om te voldoen aan die aanbevole binne-ry spasiëring.

Grond en bemesting

Gronde wat normaalweg geskik is vir sorghumproduksie, is gebruik waar moontlik. Keuse van spesifieke grondkondisies en tipes verseker ook verskille in produksiepotensiaal. Waar moontlik, is proewe geplant onder nette of in kommersiële aanplantings ten einde voëlskade te minimiseer aan voëlvatbare genotipes. Bemestingsriglyne is nie voorgeskryf nie, maar is toegedien volgens grondvoedingstatus en opbrengspotensiaal van die relevante areas.

Plantdatum

Aanvaarbare plantdatums vir suksesvolle sorghum produksie in spesifieke areas is voorgestel. Dit is verwag dat die plantdatums voor 1 Desember sal wees.

Plant en oesmetodes

Proewe is met die hand of meganies geplant en geoes. Die oesproses het plaasgevind sodra die graan se vogpersentasie laer was as 22.1%. Na die oesproses is alle sorgum plante gedors met dieselfde dorsmasjien.

Onkruid en plaagbeheer

Die gebruik van onkruiddoders en plaagbeheermiddels is vrylik toegelaat omdat effektiewe beheer van onkruid en plae verwag is. Die gebruik van sistemiese plaagbeheermiddels vir gronde is ook toegelaat. Die gebruik van plaagbeheermiddels moes gerapporteer word.

Siektes

Medewerkers is gevra om te rapporteer sodra enige siektes waargeneem word sodat nodige opvolgstappe betyds geneem kan word. Natuurlike infestasie van enige siekte behoort van so „n aard te wees dat genotipe reaksies waargeneem kan word.

Waarnemings

Die volgende informasie en waarnemings word elke jaar verwag:

- … Bemestingformulasie, tyd en metode van toediening
- … Siektebeheermiddels, tyd en metode van toediening

- ... Plant, opkoms en oesdatums
- ... Spasiëring, bruto en netto perseelgroottes
- ... Maandelikse reënval (en besproeiing waar van toepassing)
- ... Aantal dae vanaf plant tot 50% stuifmeelstort (waar moontlik)
- ... Aarsteellengte (lengte tussen kraag van boonste blaar en die onderpunt van die aar)
- ... Aantal koppe geoes (slegs waar omval voorkom)
- ... Aantal koppe wat omgeval het
- ... Gedorsde graanmassa
- ... Persentasie graanvog per genotipes
- ... Enige addisionele betekenisvolle waarnemings (Bv. enige aspek wat variansie kan verklaar).

Statistiese verwerking

Graanopbrengs was die enigste parameter wat statisties ontleed is. In die algemeen is „n AMMI analise gebruik om die aanpasbaarheid en stabiliteit van genotipes aan te dui vir verskillende omgewings. Die gekombineerde variansieanalise volgens die "Additive Mean Effective and Multiplicative Interaction (AMMI) model is uitgevoer met die GENSTAT program (Tabel 1). Om grafies die Genotipe – Omgewings – Interaksie (GOI) en aanpasbaarheid van genotipes ten opsigte van omgewings te beskryf is, in die GGO 2 XY-grafiek gebruik waar „n IPCA 1-waarde geplot is teen die IPCA 2-waards (Figuur 1). Die "Principle Component Interaction Analysis (IPCA) van genotipes in die AMMI analise gee „n aanduiding van die genotipe se stabiliteit oor verskillende omgewings. Hoe groter die IPCA-waarde, beide negatief of positief, hoe meer is „n genotipe aangepas vir „n spesifieke omgewing. Hoe nader die IPCA-waardes aan nul kom hoe meer stabiel is die genotipes vir al die omgewings waarin dit getoets is. AMMI Stabiliteits-Waardes (ASW) is die afstand vanaf nul in „n tweedimensionele verspreidingsgrafiek van IPCA 1-waardes teenoor IPCA 2-waardes. Soos die ASW-waarde nader kom aan nul kan „n spesifieke genotipe as meer stabiel geklassifiseer word vir omgewings. Addisionele beskrywings en informasie oor AMMI is beskikbaar in Aanhangsel A.

Statistiese prosedures wat normaalweg gebruik word om uitskieterproewe te identifiseer, is vir doeleindes van hierdie verslag wel toegepas. Sekere statistiese parameters is egter ook vir diagnostiese doeleindes gebruik aan die hand waarvan besluit is watter proewe liefs weggelaat moes word.

Diagnostiese parameters:

KV- Die Koëffisient van Variasie verwys na die fout van enkel persele en gee 'n aanduiding van die grootte van die variasie tussen perseelwaardes wat vanaf verskeie bronne afkomstig is. Die KV gee dus 'n aanduiding van die akkuraatheid van die perseelwaardes (grootte van die waarde). Bronne van variasie is byvoorbeeld grondvariasie (vrugbaarheid, diepte, grondvog, kleipersentasie, ongelykheid, ens) en plantvariasie (bevolkingsgrootte, oneweredige groei ens). Stremmingstoestande (vog, temperatuur, siektes, ens) het so dikwels tot gevolg dat normaalweg aanvaarbare grond- en plantvariasie baie sterker in die proefdata tot uiting kan kom en die KV vergroot. 'n Relatief hoë KV, wat aan hand van bekende bronne van variasie verklaar kan word, kan nie as die enigste parameter gebruik word om onbetroubare proefdata te identifiseer nie.

GKV- Die Genetiese Koëffisient van Variasie verwys na die verskille in kultivar-opbrengs. Die GKV is dus 'n aanduiding van die variasiegrootte wat aan verskille in genetiese samestelling tussen kultivarinskrywings toegeskryf kan word. Hoë waardes kan die gevolg wees van siektevatbaarheid, groot verskille in rypwordingstadium, temperatuurgevoeligheid en soortgelyke afwykings. Dit word ook gebruik om uitskieterproewe te identifiseer.

tn- Kultivarherhaalbaarheid verwys na die herhaalbaarheid van kultivargemiddeldes en kan gedefinieer word as die verwantskap tussen die genotipe variansie en die totale variansie. Hierdie parameter is eintlik van waarde vir proewe waarvan die aantal herhalings nie dieselfde is nie.

t- Die Intraklas Korrelasie verwys na die herhaalbaarheid van perseelwaardes oor herhalings. Hoe groter die ooreenstemming tussen perseelwaardes oor herhalings vir elke kultivarinskrywing is, hoe nader sal "t" na 1.0 neig.

SF(t)- Die Standaard Fout van die Intraklas Korrelasie (t) gee 'n aanduiding van hoe akkuraat die skatting van "t" is.

t/SF(t)- Hierdie verhouding word as 'n belangrike parameter beskou daar die Intraklas Korrelasie (t) verkieslik minstens drie keer groter as sy foutterm moet wees. 'n Verhouding van kleiner as 3.0 dui aan dat die betrokke stel proefdata as minder betroubaar beskou kan word.

EENJARIGE RESULTATE

Proeflokaliteite

Lokaliteite, proefplasings en medewerker inligting vir die 2012/2013 se proewe word weergegee in Tabel 2.

Lokaliteitsbeskrywing

Beskikbare inligting oor bemesting en ander relevante genotipe inligting verskyn in Tabel 3. Al 10 genotipe proewe wat aan medewerkers in verskeie lokaliteite versprei is, is terug ontvang.

Groeitoestande

Groeitoestande het gewissel tussen omgewings en moet dus in aanmerking geneem word by die interpretasie van resultate. Bo-gemiddelde reënval het voorgekom gedurende Oktober 2012 oor die oostelike en suidelike gedeeltes van die land. Reënval in die groot dele van die Noordwes Provinsie, die sentrale- tot die noordwestelike Vrystaat en die noordelike dele van die Noordkaap was egter ondergemiddeld. Gedurende September en Oktober is 'n bo-normale plantegroei indeks waargeneem oor die grootste dele van die Limpopo, Mpumalanga, Gauteng en KwaZulu-Natal – dit word toegeskryf aan relatief hoë reënval. Plantegroei was onder-normaal oor groot dele van Noordwes Provinsie en sentraal Vrystaat omdat reënval baie laag was. Die tydperk tussen Desember 2012 tot Februarie 2013 / Maart 2013, dus ongeveer in die middel van die somerreënvalseisoen, was die reënval in groot gedeeltes van die somerreënvalgebied onder-normaal. Oor die grootste gedeelte van die somerreënvalgebied het goeie reënval egter voorgekom gedurende April 2013, reënval sedert Julie 2012 was byna normaal, maar onder-normale reënval en selfs droë toestande het ontwikkel in die grootste gedeeltes van Noordwes, noordoostelike gedeeltes van die Noord-Kaap en die westelike gedeeltes van die Vrystaat

Standaard van proefuitvoering

Besoeke aan proewe het beaam dat voorgeskrewe prosedures nagekom is en dat proewe bevredigend uitgevoer is. Verwerking van data is vertraag omdat sommige van die inligting nie volgens die voorgeskrewe formaat was nie, en die addisionele inligting dus aangevra moes word. Waardevolle tyd het verstryk aangesien medewerkers gekontak moes word om onvolledige data aan te vul, en waarna data gekondoneer moes word, om dit in „n werkbare vorm in die verslae te kon insluit.

Proefmislukkings

Al die proewe was suksesvol die afgelope seisoen.

Statistiese diagnostiek

Volgens die statistiese parameters in Tabel 4 was al die proewe „n sukses.

Dae tot stuifmeelstort

Aantal groeidae tot 50% stuifmeelstorting is nog altyd as 'n ruwe hulpmiddel met 'n lae betroubaarheid beskou, maar moet behou word totdat 'n betroubaarder hulpmiddel beskikbaar is. Beskikbare data van een lokaliteit word in Tabel 5 aangebied.

Aarsteellengte

Die vermoë van genotipes om hul are vêr genoeg bokant die boonste blaar uit te stoot om die stroopproses te vergemaklik, word as 'n goeie eienskap beskou. Hierdie eienskap se belangrikheid kom in werklikheid eers tydens stremmingstoestande na vore as genotipes hul are steeds vêr genoeg bokant die blare kan uitdra. Aarsteellengte word die meeste benadeel wanneer droogtestremming tydens aarsteelverlenging voorkom en betroubare afleidings is nie altyd moontlik nie. Die verskil in aarsteellengte van genotipes kan veroorsaak word deur vogstremmings wat op verskillende groeistadiums voorgekom het.

Genotipes met verskille in dae tot stuifmeelstorting toon verskillende reaksies op vogstremmings wat op verskillende tye gedurende die groeiseisoen voorkom. Dit is dus belangrik dat die klimaattoestande (reënval, vog en hittestremming) sowel as die groeiseisoen van die genotipes in aanmerking geneem word by die interpretasie van die data. Vanweë droogte en hoë temperature gedurende die seisoen is geen betroubare resultate beskikbaar. Beskikbare data van een lokaliteit word in Tabel 6 aangebied.

Planthoogte

Planthoogte was gemeet by twee lokaliteite (Tabel 7) en dui verskille aan tussen genotipes. Vanweë droogte en onvoldoende water is geen planthoogtes gedurende die seisoen gemeet. Beskikbaarheid van water gedurende „n seisoen kan planthoogte betekenisvol beïnvloed.

Graanvog

Die gemiddelde persentasie vog van die graan tydens oestyd, word in Tabel 8 weergegee. Verskille in vogpersentasie tussen lokaliteite en genotipes was gemeet. Die graanvog saam met die groeiseisoenlengte van 'n genotipe kan 'n aanduiding gee van die pitvullings- en afdrogingstempo van spesifieke genotipes.

Graanopbrengs

Die opbrengspotensiaal en aanpassingsvermoë van genotipes in spesifieke omgewings bly die belangrikste maatstaf om genotipeprestasie te vergelyk. Omgewingstoestande verskil van jaar tot jaar asook van lokaliteit tot lokaliteit, en afleidings van genotipesprestasie vanaf een jaar se data is nie so betroubaar soos vanaf meerjarige data nie. Die gekombineerde variansieanalise (ANOVA) van die 20 genotipes oor 10 lokaliteite volgens die AMMI 2 model word weergegee in Tabel 1. Die ANOVA dui op hoogs betekenisvolle verskille tussen lokaliteite, genotipes en genotipe x omgewingsinteraksies. Die IPCA 1 en IPCA 2-waardes was ook hoogs betekenisvol.

Tabel 9 verteenwoordig die gemiddelde graanopbrengs van die 20 genotipes soos getoets oor 10 omgewings (lokaliteite).

Tabel 10 dui die AMMI analise aan met die IPCA 1 en IPCA 2 waardes vir die lokaliteite. 'n Genotipe en genotipe x omgewingsinteraksie (GGO) grafiek is gebruik om die prestasie van verskillende genotipes by 'n omgewing te vergelyk, om die beste presteerders in verskillende mega-omgewings te identifiseer en om ideale kultivars en toets lokaliteite te identifiseer. Die grafiek wat weergegee word in die verslag is gegenereer met die GENSTAT sagteware pakket. Figuur 1 verteenwoordig 'n sorghum GGO grafiek vir die 2012/2013 seisoen. Toppresterende genotipes wat die beste reageer kan visueel in die grafiek waargeneem word. Die kultivars is of die beste of swakste genotipes by sommige of al die lokaliteite en kan gebruik word om potensiële mega-omgewings te identifiseer. Genotipes wat die beste reageer vir 2012/2013 was PAN 8926, PAN 8625, PAN 8906, AVENGER en CAP. Deur konneksie van die merkers van genotipes word 'n poligoon gevorm en deur loodregte lyne dan na elke kant van die poligoon te trek en wat deur die oorsprong gaan word lokaliteite verdeel in verskillende sektore, elk met 'n verskillende hoek genotipe. Four of the four sectors contained localities, and these were identified as the four mega-environments.

Tabel 11 verteenwoordig die AMMI stabiliteitswaardes vir elke genotipe.

Tabel 12 dui die beste AMMI seleksies van genotipe per omgewing aan.

TWEE SEISOENALE PROEWE

Omdat daar slegs „n paar kultivars getoets is oor die laaste drie jaar is slegs die laaste twee jaar (2011/2012 en 2012/2013) se resultate in die verslag ingesluit. Die twee seisoene gee „n aanduiding van kultivar prestasies by spesifieke omgewingstoestande wat ondervind is gedurende die spesifieke seisoene. Kultivaraanbevelings sal geldig wees vir ooreenstemmende groeikondisies.

NAVORSINGSPROSEDURES

Standaard en wetenskaplik aanvaarbare prosedures is voorgeskryf vir die navorsingsprogram en word beskryf in die jaarverslag. Slegs prosedures wat aangeneem of wat spesifiek van toepassing is op die verslag, word hier bespreek.

Genotipesvergelykings

Om „n onbevooroordeelde vergelyking tussen genotipes te verseker, is slegs genotipes wat ingeskryf is vir die Nasionale Sorghum Genotipes Proewe vanaf 2011/2012 ingesluit in die verslag. Nuwe genotipes wat goeie potensiaal toon en ander genotipes wat ingesluit was vir slegs een of twee seisoene van die drie jaar is nie ingesluit in die verslag nie. Multiseisoenale resultate van 12 genotipes word weergegee. Die gemiddeld van proewe is gebruik as standaard vir vergelyking in die AMMI model.

Statistiese analise en diagnostiek

Die graanopbrengsdata is statisties verwerk en word aangebied in die vorm van die AMMI model en AMMI opbrengstabiliteits-waardes. Slegs daardie proewe wat aan die vereistes van diagnostiese parameters en die uitskieterprogram voldoen het, in die twee afsonderlike jare, is vir hierdie meerjarige genotipesvergelyking gebruik. Alle ander proewe is dus ten opsigte van al die genotipe eienskappe as onaanvaarbare proewe beskou en is dus nie gebruik nie.

RESULTATE

Groeitoestande

Dit is belangrik dat die groeitoestande wat gedurende die 2011/2012 tot 2012/2013 seisoene geheers het, deeglik in ag geneem word by die interpretasie van die resultate. Dit sal verhoed dat onregverdige genotipe uitsprake gemaak word.

Groeiseisoenlengte

Die groeiseisoenlengte van die betrokke genotipes in die verslag, verskyn in Tabel 13. Die sleutel wat aangegee word, wys relatiewe verskille uit en daar moet onthou word dat die presiese aantal dae tot blomstadium deur omgewingstoestande verander kan word. Die inligting in Tabel 13 is slegs 'n aanduiding van die verwagte groeiseisoenlengte van genotipes.

Graanopbrengs

Die opbrengspotensiaal en stabiliteit van genotipes in spesifieke omgewings bly die belangrikste maatstaf om genotipesprestasie te vergelyk. Omgewingstoestande verskil van jaar tot jaar asook van lokaliteit tot lokaliteit, en afleidings van genotipesprestasie vanaf een jaar se data is nie so betroubaar soos vanaf meerjarige data nie. Die gekombineerde variansieanalise (ANOVA) van die 12 genotipes oor 23 lokaliteite en twee jaar, volgens die AMMI 2 model, word aangedui in Tabel 14 Die ANOVA dui op hoogs betekenisvolle verskille vir omgewings, genotipes en genotipe x omgewingsinteraksies; die IPCA 1 en IPCA 2 – waardes was ook hoogs betekenisvol. Multiseisoenale prestasie van spesifieke genotipes ten opsigte van graan opbrengs word aangedui in Tabel 15

AMMI opbrengs stabiliteits-waardes

Tabel 16 verteenwoordig die AMMI analise data met die IPCA1 and IPCA2 waardes vir die omgewings. Om aanvaarbare gevolgtrekkings oor genotipeprestasies te maak is die AMMI opbrengstabiliteits-waarde bereken. Die waardes word weergegee in Tabel 17 Met die IPCA 1 en IPCA 2 – waardes bekend vir genotipes, kan die beste vier genotipes vir spesifieke omgewings gekies word (Tabel 18).

In die meerjarige data vanaf 2011/012 - 2012/13 was die toppresteerders PAN 8816 PAN 8625, PAN 8919, NS 5511, CAP 1002 en CAP 1004. Die lokaliteite val in drie. PAN 8816, PAN 8625 en PAN 8919 was die beste presteerder in omgewing een, NS 5511 en CAP 1002 in omgewing twee , CAP 1004 in drie (Figuur 2). Mega-omgewings wat gedefinieer word deur verskillende presteerders stel die bestaan van drie mega-omgewings in die sorghum produksiegebied.

Inligting oor die interpretasie van die resultate vir die doel van genotipes aanbevelings word verduidelik in Aanhangsel A.

Vrywaring

Die opsteller van die dokument en enige ander bron/instansie/persoon verantwoordelik vir enige inligting genoem in hierdie dokument is na die beste wete van die opstellers korrek met druktyd. Die inligting is ontwikkel deur wetenskaplike prosesse en word in goeder trou aangebied. Enige persoon/instansie wat hierdie inligting gebruik doen dit op eie risiko en die opstellers of enige ander party sal onder geen omstandighede verantwoordelik gehou kan word vir enige verliese gelei deur enige persoon/instansie wat die inligting in hierdie dokument gebruik nie.

INTRODUCTION

This report deals with the 2012/2013 National Sorghum Cultivar Trials. The aim of this research is to evaluate the stability of commercial genotypes to different yield potentials as well as the agronomic and industrial value of new genotypes. Genotype entries consist of commercial genotypes in the GM, GL and GH grading classes.

Research procedure

Standard and scientifically acceptable procedures were prescribed for the execution of this research programme. Co-workers were given a free hand to implement the most suitable cultivation practices in their areas in order to optimise the yield and to create condition of varying yield potentials by manipulation date and /or irrigation frequency.

Trial design

A randomized complete block design with three replicates and consisting of 20 genotype entries were used at all localities. Each locality was allocated its own trial randomization that differs annually.

Genotype entries

The same 20 genotypes were used in all the trials. Seed companies nominated all the genotypes entered in the trials. Seed company entries are in order of priority. Where too many entries were received, the final genotype choice was made through negotiation with each seed company.

Plot size and spacing

A gross plot size of two plant rows with a row length of 6.0 m and a net plot size with a row length of 5.0 m were prescribed for all the trials. Row widths of 1.0 m and in-row spacing of 7.5 cm were recommended for all trials. Sufficient seed was supplied to ensure a good stand. When seedlings were strong enough, they were thinned out to comply with the recommended in-row spacing.

Soil and fertilization

Soil types normally used for sorghum production were used where possible. Choosing specific soil conditions and types also incorporated differences in production potentials. Where possible, trials were planted in wire cages or under commercial conditions in sorghum fields in order to minimize bird damage to non-bird proof types. Fertilizer applications were not prescribed, but were applied according to soil fertility and yield potential of the relevant area.

Planting date

Accepted planting dates for successful sorghum production in the area involved, were recommended. The planting date was expected to be before 1 December.

Planting and harvesting methods

Trials were planted and harvested by hand or mechanical. Harvesting occurred as soon as the grain moisture percentage was lower than 22.1 %.

Pest control

The use of suitable herbicides and insecticides were freely allowed, as effective weed and pest control were required. Use of suitable systemic soil insecticides was also allowed. The use of pesticides had to be reported.

Diseases

Co-workers were requested to report the incidence of any disease immediately to ensure that the necessary follow-up action could be done. Natural infection of any disease should be severe enough to give genotype reaction and differences.

Observations

The following information and observations are requested each year:

- Fertilizer quantity, time and method of application.
- Pesticide quantity, time and method of application.
- Planting, plant emergence and harvesting dates.
- Spacing, gross and netto plot size.
- Monthly rainfall (and irrigation where applicable).
- Number of days from planting to 50 % pollen shed (where possible).

- Peduncle length (length between the collar of top leaf and bottom of the head).
- Number of heads harvested (only where lodging has occurred).
- Number of heads that had lodged.
- Threshed grain mass.
- Percentage grain moisture per genotype.
- Any additional meaningful observations (e.g. any aspect denotes variance differences).

Statistical analysis

Grain yield was the only parameter statistically analysed. In general, an AMMI analysis was used to indicate the adaptability and stability of genotypes for different environments. The combined analysis of variance according to the Additive Mean Effects, and Multiplicative Interaction (AMMI) model was performed using the GENSTAT Package (Table 1). To graphically explain the Genotype, Environment Interaction (GEI) and adaptation of the genotypes to the environments, the GGE bi-plot was used where the IPCA 1 scores were plotted against the IPCA 2 (Figure 1). The Principle Component Interaction Analysis (IPCA) of genotypes in the AMMI analysis is an indication of the stability of a genotype over environments.

The greater the IPCA scores, either negative or positive, the more specifically adapted a genotype is, to a certain environment.

The closer IPCA scores approach zero the more stable the genotype is over all environments sampled. AMMI Stability Value (ASV) is the distance from zero in a two dimensional scatter-gram of IPCA 1 scores against IPCA 2 scores. As the ASV nearing zero the genotype can be considered more stable for the environments. Additional explanations and information about AMMI are available in Appendix A

Statistical procedures normally used to identify and exclude outlier trials from the AMMI model were used for the purposes of this report. Certain statistical parameters (diagnostic parameters) were also used to help in the selection of trials for presentation.

The diagnostic parameters were as follows:

CV- The coefficient of variation - this parameter relates to the error of a single plot, and as such relates to the variability as induced by soil variation or plant population i.e. the larger the variation the larger the CV. Stress conditions (moisture, temperature, diseases, etc.) result in acceptable soil variation to be more pronounced in trials and a higher CV is recorded. The CV on its own cannot be used as a parameter to discard trials.

GCV- The genetic coefficient of variation - this parameter relates to the yield differential between the highest and lowest entry yield, relative to the trial mean i.e. the greater the difference between the extreme values, the larger the GCV. High values are indicative of disease sensitivity, differences in maturity stage, temperature sensitivity and like problems.

tn- Repeatability of genotype mean yield - relates to the repeatability of entry means, and can be defined as the relationship of genetic variance of observed means. In genotype trials this parameter is useful only when the number of replications between trials varies, otherwise the t-value is sufficient.

t- The repeatability of plot yield or intra class correlation coefficient - relates to the repeatability of plot means over replications, and is interpreted as is the normal correlation coefficient, i.e. the greater the concurrence of plot values per entry over replications the closer "t" will strive towards unity. The standard error calculated for a particular t-value indicates the accuracy of the estimate of "t"

SE(t)- Standard Error of the Intraclass Correlation (t) denotes how accurate the estimation of "t" is.

t/SE(t)- This relationship is considered an important parameter as the Intraclass Correlation (t) should be at least three times greater than it's error term. A relationship of less than 3.0 denotes low reliability.

SINGLE SEASONAL RESULTS

Trial localities

Localities, trial placements and co-worker particulars for the 2012/2013 trial series appear in Table 2.

Locality descriptions

Available information on fertilization and other relevant cultivation information appear in Table 3. All of 10 genotype trials that have been distributed to co-workers at different localities in the sorghum production areas were received.

Growing conditions

Growing conditions differed between localities and this must be taken into consideration when interpreting results. Above-normal rainfall occurred during October 2012 over much of the eastern and southern parts of the country while most of North West, the central to northwestern Free State and the northern parts of the Northern Cape received below-normal rainfall. During September and October above normal vegetation index was observed over most of Limpopo, Mpumalanga, Gauteng and KwaZuluNatal due to the relatively high rainfall. Vegetation activity is below normal over much of the North West and central Free State, where very little precipitation has occurred. During December 2012 to February 2013, this period constitutes an important part of the summer rainfall season, clearly showed a large area of below-normal rainfall. Good amount of rain occurred over much of the summer rainfall region during April 2013, after relatively dry conditions over much of the region during especially February and March. Most of the summer rainy region received normal to above-normal rainfall since July 2012. However, below normal rainfall and even associated with drought conditions developed over most of the North West, northeastern Northern Cape and western Free State

Standard of trial execution

Visits to the planted trials confirmed that prescribed procedures were followed and that trials were satisfactorily carried out.

Trial failures

All the trials were successful this growing season.

Statistical diagnostics

According to the statistical parameters in Table 4 the grain yields of all tested trials were successful.

Days to pollen shed

The number of days to 50 % pollen shed is considered a rough aid with low reliability, but must be retained until a more reliable aid is available. Available data of one locality is presented in Table 5.

Peduncle length

The ability of genotypes to carry their heads high enough above the top leaf and thus facilitate harvesting is considered a desirable character. The importance of this character is realized during conditions of drought stress.

Peduncle length is adversely affected when drought stress occurs during elongation, thus reliable assumptions are not always possible. The difference in peduncle length of genotypes can be caused by moisture stress occurring at different times during the growing season. Genotypes that differ in number of days to pollen shed react differently to moisture stress occurring at different growth stages. It is thus always important to take climatic conditions as well as length of growing season into consideration when interpreting this data. Available data of one locality is presented in Table 6.

Plant height

Plant height was recorded in two localities (Table 7) and indicates differences between genotypes. The availability of moisture during the season can influence plant height significantly.

Grain moisture

The mean percentage grain moisture at harvest is presented in Table 8. Differences in moisture percentage between localities and genotypes were measured. The grain moisture percentage and length of growing season of a genotype can give an indication of the rate of drying.

Grain yield

The yield potential and adaptability of genotypes in specific environments are the most important criteria for measuring genotypes performance. Environmental conditions differ between years and localities, thus reliable and meaningful conclusions cannot be drawn from a single year"s yield data alone. Conclusions on genotypes performance made from the interpretation of multi-seasonal data are more reliable than those drawn from just a single season. The combined analysis of variance (ANOVA) of the 20 genotypes over 10 environments according to AMMI 2 model are presented in Table 1. The ANOVA indicated highly significant differences for environments, genotypes and importantly genotype x environment interaction. The IPCA 1 and IPCA 2 were also highly significant

Table 9 shows the mean grain yield of 20 sorghum genotypes tested at 10 environments.

Table 10 presents the AMMI analysis data with the IPCA1 and IPCA 2 scores for the environments. Genotype and genotype x environment interaction (GGE) biplots were used to compare the performance of different genotypes at an environment, identify the highest yielding genotypes at the different mega environments, and identify ideal cultivars and test locations. The biplot presented in this report was generated using the GENSTAT software biplot package. Figure 1 represents GGE biplots for 2012/2013 season of sorghum cultivar trials. In the biplot, vertex genotypes, which are the most responsive ones, can be visually identified. These are either the best or the poorest genotypes at some or all locations and can be used to identify possible mega-environments. The most responsive genotypes were: PAN 8926, PAN 8625, PAN 8906, AVENGER and CAP 1004. By connecting the markers of the corner genotypes a polygon is formed. By drawing perpendiculars to each side of the polygon passing through the origin, the locations are divided among several sectors, each with a different corner genotype. Four of the four sectors contained localities, and these were identified as the four mega-environments.

Table 11 represents the AMMI stability values for each genotype

Table 12 indicates the best AMMI selections of genotype per environment.

TWO SEASONAL TRIALS

Due to the fact that a few numbers of genotypes had been tested in the last three seasons only the results for the last two seasons (2011/2012 and 2012/2013) are included in this report. These two season"s genotype results are indicative of genotype performance under specific environmental conditions experienced during the relevant two years. Genotype recommendations will be valid for similar growing conditions.

RESEARCH PROCEDURE

Standard and scientifically acceptable procedures were prescribed for this research programme and are described in the annual reports. Only those procedures, which were adapted or are specifically applicable to this report, are mentioned.

Genotype comparison

To obtain a fair genotype comparison only genotypes, which were entered into the National Sorghum Genotype Trials since 2011/2012, were included in this report. Promising new genotypes and other genotypes that were included in one of the two years could not be included in this report. Multi-seasonal results of 12 genotypes are presented. The averages of trials were used as standard for comparison in the AMMI model.

Statistical analysis and diagnostics

The grain yield data were statistically analyzed and is presented in the form of the AMMI model- and AMMI yield stability values. The only trials, which are used for this multi-seasonal comparison, are those, which fulfilled the requirements of the diagnostic parameters and the test for outliers during each of the three years. All the other trials are unacceptable in respect of genotype characteristics and were thus not used.

RESULTS

Growing conditions

It is most important that the growing conditions, which prevailed during the 2011/2012 to 2012/2013 seasons, are taken into consideration with the interpretation of the results. This will prevent incorrect genotypes comparisons.

Length of growing season

The length of growing season for the genotypes has been evaluated for the last two years and is presented in Table 13. It is most important to note that the specific number of days from plant to flowering is influenced by environmental conditions. The information in Table 13 is merely an indication of the expected length of the growing season of genotypes.

Grain yield

The yield potential and stability of genotypes in specific situations are the most important criteria for measuring genotype performance. Environmental conditions differ between years and localities, thus conclusions that are more reliable can be drawn from multi-seasonal data than from one year's data. The combined analysis of variance (ANOVA) of the 12 genotypes over 23 environments, and two years, according to the AMMI 2 model, are presented in Table 14.

The ANOVA indicated highly significant differences for environments, genotypes and importantly genotype x environment interaction; the IPCA 1 and IPCA 2 scores were also highly significant. Multi-seasonal performance of specific genotypes in regard to grain yield is presented in Table 15.

AMMI Yield stability values

Table 16 presents the AMMI analysis data with the IPCA1 and IPCA 2 scores for the environments. To enable reliable conclusions on genotype performance, AMMI yield stability values were calculated. These values are presented in Table 17 with the IPCA1 and IPCA 2 scores for the genotypes. Selection for the best four genotypes at specific environments is presented in Table 18

In the two seasons data from 2011/12-2012/13 the vertex genotypes were PAN 8816 PAN 8625, PAN 8919, NS 5511, CAP 1002 and CAP 1004. The locations fell into three PAN 8816, PAN 8625 and PAN 8919 was the best performing genotype for environment one, NS 5511 and CAP 1002 for environment two, CAP 1004 for environment (Fig.2). Therefore, mega-environments defined by different vertex genotypes suggest the existence of three mega-environments for the sorghum producing area.

Information regarding the interpretation of these results for the purpose of genotype recommendations is presented in Appendix A.

Indemnity

The composer of this document and any other source/institution/person responsible for any information contained in this document is to the best knowledge of the composers correct at printing. The information was developed using sound scientific procedures and is presented in good faith. Institutions or people use this information at own risk and the composers or any other parties will under no circumstances be under any legal obligation regarding any losses occurring by using the information contained in this document.

Tabelle/Tables

Tabel 1 ANOVA analise van die sorghum genotipe evaluasie proewe met die gebruikvan die AMMI 2 model vir die 2012-2013 seisoen.

Table 1 ANOVA analysis of the sorghum genotypes evaluation trials, using the AMMI 2 model for the 2012-2013 season

Bron Source	df	SS	MS	F	F_prob
Totaal/Total	599	4062	6.78	*	*
Behandeling/Treatment	199	3819	19.19	33.24	0
Genotipe/Genotype	19	109	5.73	9.92	0
Omgewing/Environment	9	3373	374.76	316.71	0
Blok/Block*	20	24	1.18	2.05	0.00523
Interaksie/Interaction	171	337	1.97	3.41	0
IPCA 1	27	131	4.84	8.39	0
IPCA 2	25	93	3.72	6.44	0
Res/Residual	119	113	0.95	1.65	0.00021
Fout/Error	380	219	0.58	*	*

* Blocks within environments

Table 2 Proeflokaliteite en medewerkers 2012/2013

Table 2 Trial localities and co-workers 2012/2013

LOKALITEIT/ LOCALITY	ADRES/ADDRESS	MEDEWERKER/ CO - WORKER
POTCHEFSTROOM	POTCHEFSTROOM	AGRICOL
POTCHEFSTROOM B/I	ARC-GCI, PRIVATE BAG X1251, POTCHEFSTROOM	D. MULLER
VREDEFORT	VREDEFORT	BARRY STEENKAMP/CAPSTONE SEED
PLATRAND	STANDERTON - MPUMALANGA	PANNAR RESEARCH SERVICES
PERDEKOP	VOLKSRUST - MPUMALANGA	PANNAR RESEARCH SERVICES
HOLMDENE	STANDERTON - MPUMALANGA	PANNAR RESEARCH SERVICES
WEIVELD	PARYS - FREE STATE	PANNAR RESEARCH SERVICES
KLERKSDORP	KLERKSDORP - NORTH WEST	PANNAR RESEARCH SERVICES
AMERSFOORT	AMERSFOORT - MPUMALANGA	PANNAR RESEARCH SERVICES
LEEUWKRAAL	STANDERTON - MPUMALANGA	PANNAR RESEARCH SERVICES

Tabel 3 Bemesting, plantdatum, spasiering en plantbevolking vir elke proeflokaliteit
Table 3 Fertilisation, planting date, row width and plant population for localities

LOKALITEIT LOCALITY	Bemesting voor/ met planttyd Fertilisation before/at planting Kg/ha	Bemesting na planttyd Fertilisation after planting	Plant- datum planting date	Oes- datum Harvest date	Rywydte Row width cm
POTCHEFSTROOM	210 KG 3N:3P:1K (34) 450 Kg/ha 9N:0P:2K (24)	400 Kg/ha 9N:0P:2K (24)	20-Nov-12		0.91
POTCHEFSTROOM B/I	250 KG 3N: 2P: 1K (25)	150 KG LAN (28)	06-Nov-12	08-Apr-13	1.15
VREDEFORT	220 kg/ha 4:2:1 (27) 110 kg/ha ANO		22-Dec-12	06-Jun-13	0.91
PLATRAND			26-Oct-12	30-Apr-13	0.90
PERDEKOP			30-Oct-12	01-May-13	0.90
HOLMDENE			23-Oct-12	29-Apr-13	0.90
WEIVELD			19-Nov-12	07-May-13	0.90
KLERKSDORP	300 KG 15: 8: 4 (29)	350 KG (301)	07-Nov-12	12-Apr-13	0.90
AMERSFOORT			06-Nov-12	01-May-13	0.90
LEEUWKRAAL			30-Oct-12	01-May-13	0.90

Tabel 4 Dignostiese parameters vir die statistiese aanvaarbaarheid van prowe vir betroubare opbrengsanalises

Table 4 Diagnostic parameters for the statistical acceptability of trials for reliable yield analysis

Lokaliteit locality	Proefgemiddeld Trial mean	KV CV %	GKV GCV %	tn %	t	SF(t) SE(t)	t/Sf(t) t/Se(t)	H
Amersfoort	5.08	8.20	20.92	59.05	0.23	0.08	4.19	0.89
Dleeuwkraal	6.86	10.80	5.60	44.53	0.61	0.06	3.59	0.42
Holmdene	4.21	11.30	9.82	69.15	0.43	0.09	4.94	0.66
Klerksdorp	10.08	11.10	8.86	65.58	0.39	0.08	4.62	0.62
Perdkop	5.90	11.10	8,87	65.58	0.39	0.08	11.10	0.62
Platrand	4.50	9.00	12.00	84.33	0.64	0.08	7.90	0.80
Potchefstroom	6.41	15.10	19.07	82.66	0.61	0.08	7.32	0.79
Taaiboschbult	10.00	11.10	9.56	68.88	0.09	0.09	4.92	0.65
Vredefort	1.90	18.70	25.86	85.26	0.66	0.08	8.28	0.81
Weiveld	5.54	12.80	12.11	72.86	0.47	0.09	5.36	0.69

B/ I = Besproeiing / Irrigation

Tabel 5 Dae tot 50% blom vir verskillende sorghum genotipes by Potchefstroom B gedurende 2012-2013 seisoen

Table 5 Days to 50 % flowering for different sorghum genotypes at Potchefstroom I during 2012-2013 season

Genotipe Genotypes	Potchefstroom B/I	Gem Mean
AVENGER	99.70	99.70
CAP1002	133.00	133.00
CAP1003	98.00	98.00
CAP1004	126.00	126.00
ENFORCER	94.00	94.00
NS5511	98.70	98.70
NS5655	97.00	97.00
PAN8625	94.70	94.70
PAN8816	93.30	93.30
PAN8906	95.30	95.30
PAN8911	99.70	99.70
PAN8919	92.30	92.30
PAN8920	133.30	133.30
PAN8921	92.70	92.70
PAN8923	121.70	121.70
PAN8925	94.70	94.70
PAN8926	94.70	94.70
PAN8927	96.00	96.00
PAN8928	95.00	95.00
PAN8929	127.30	127.30
Gem/Mean	103.86	103.86

B/I = Besproeiing / Irrigation

Tabel 6 Aarsteellengte (cm) vir verskillende sorghum genotipes by gedurende 2012-2013 seisoen

Table 6 Peduncle length (cm) for different sorghum genotypes during 2012-2013 season

Genotipe Genotypes	Potchefstroom B/I	Gem Mean
AVENGER	12.33	12.33
CAP1002	14.00	14.00
CAP1003	8.67	8.67
CAP1004	14.00	14.00
ENFORCER	15.00	15.00
NS5511	10.67	10.67
NS5655	12.67	12.67
PAN8625	17.67	17.67
PAN8816	13.00	13.00
PAN8906	10.00	10.00
PAN8911	11.00	11.00
PAN8919	11.67	11.67
PAN8920	8.33	8.33
PAN8921	18.00	18.00
PAN8923	11.00	11.00
PAN8925	16.33	16.33
PAN8926	9.67	9.67
PAN8927	11.00	11.00
PAN8928	19.00	19.00
PAN8929	8.00	8.00
Gem/Mean	12.60	12.60

B/I = Besproeiing / Irrigation

Tabel 7 Plant hoogte (cm) vir verskillende sorghum genotipes by gedurende 2012-2013 seisoen

Table 7 Plant height (cm) for different sorghum genotypes during 2012-2013 season

Genotipe Genotypes	Potchefstroom B/I	Vredefort	Gem Mean
AVENGER	153.30	105.00	129.15
CAP1002	201.70	130.00	165.85
CAP1003	158.30	130.00	144.15
CAP1004	198.30	155.00	176.65
ENFORCER	138.30	105.00	121.65
NS5511	163.30	115.00	139.15
NS5655	151.70	80.00	115.85
PAN8625	155.00	95.00	125.00
PAN8816	145.00	105.00	125.00
PAN8906	126.70	95.00	110.85
PAN8911	125.00	105.00	115.00
PAN8919	126.70	80.00	103.35
PAN8920	133.30	100.00	116.65
PAN8921	135.00	90.00	112.50
PAN8923	123.30	80.00	101.65
PAN8925	138.30	115.00	126.65
PAN8926	136.70	80.00	108.35
PAN8927	125.00	85.00	105.00
PAN8928	123.30	80.00	101.65
PAN8929	128.30	80.00	104.15
Gem/Mean	144.33	100.50	122.41

Table 8 Gemiddelde graanvogpersentasie met Oestyd 2012-2013 seisoen

Table 8 Mean percentage grain moisture at harvest 2012-2013 season

Genotipes Genotypes	Perdkop	Plantrand	Vredefort	Potchefstroom B/I	Dleeuwkraal	Amersfoort	Taaiboschbult B/I	Klerksdrop B/I	Weiveld	Holmden	Gem Mean
AVENGER	14.30	16.00	10.60	13.34	13.70	16.80	18.60	14.30	12.30	13.90	14.38
CAP1002	16.10	11.00	9.13	16.86	16.50	23.00	21.33	16.10	13.30	13.20	15.65
CAP1003	15.10	15.40	9.40	15.10	13.90	16.10	14.90	15.10	11.90	13.40	14.03
CAP1004	17.60	18.00	8.60	12.90	17.70	20.00	18.73	17.60	13.40	13.40	15.79
ENFORCER	14.10	14.10	7.93	13.23	13.60	15.90	16.33	14.10	11.80	12.80	13.39
NS5511	14.70	18.40	9.60	13.23	15.70	19.30	19.80	14.70	12.70	13.90	15.20
NS5655	15.70	14.00	8.97	13.01	14.20	14.60	16.60	15.70	11.70	12.60	13.71
PAN8625	15.40	13.50	8.90	13.01	12.90	13.90	14.93	15.40	11.60	12.30	13.18
PAN8816	16.70	14.50	9.33	12.46	14.40	16.00	16.83	16.70	12.20	12.90	14.20
PAN8906	15.00	13.20	7.53	13.12	14.40	15.40	16.37	15.00	12.10	12.60	13.47
PAN8911	16.20	13.90	7.80	13.78	13.90	15.90	16.27	16.20	11.30	13.50	13.88
PAN8919	14.50	15.60	9.50	13.34	13.70	15.70	17.17	14.50	12.20	12.50	13.87
PAN8920	14.50	14.00	9.33	13.56	13.10	16.00	18.33	14.50	12.30	13.10	13.87
PAN8921	14.20	14.10	6.90	13.89	13.10	14.00	16.73	14.20	12.10	11.00	13.02
PAN8923	14.30	14.80	7.63	13.78	14.60	16.70	18.10	14.30	12.00	13.50	13.97
PAN8925	14.60	13.40	6.97	12.90	14.80	15.90	15.40	14.60	12.60	12.80	13.40
PAN8926	14.50	14.10	8.60	12.46	13.60	16.90	18.73	14.50	11.20	12.70	13.73
PAN8927	14.20	15.40	8.67	13.12	13.80	14.90	16.80	14.20	12.10	13.70	13.69
PAN8928	15.20	15.70	9.23	13.67	13.40	14.50	16.83	15.20	12.30	12.90	13.89
PAN8929	13.90	15.30	7.80	14.36	14.00	16.00	19.97	13.90	12.20	12.50	13.99
Gem/Mean	15.04	14.72	8.62	13.56	14.25	16.38	17.44	15.04	12.17	12.96	14.02

B/I = Besproeiing / Irrigation

Tabel 9 Gemiddelde graanopbrengs (t. ha^{-1}) vir sorghum genotipes by verskillende omgewings gedurende 2012-2013 seison
Table 9 Mean yield (t. ha^{-1}) for different sorghum genotypes under different environments during the 2012-2013 season

Genotipes Genotypes	Amersfoort	Dleeuwkraal	Holmdene	Klerksdorp B/I	Perdkop	Plantrand	Potchefstroom B/I	Taaiboschbult B/I	Vredefort	Weiveld	Gem Mean
AVENGER	4.73	6.58	4.14	9.11	5.34	4.42	4.81	10.75	2.79	6.10	5.88
CAP1002	5.52	6.44	4.25	8.79	5.15	3.07	4.14	11.20	2.07	4.90	5.55
CAP1003	5.71	6.56	2.99	8.72	5.11	4.22	5.52	9.06	2.25	5.59	5.57
CAP1004	3.17	5.25	3.04	8.81	5.16	4.02	9.89	8.85	0.99	3.14	5.23
ENFORCER	4.98	6.35	4.25	9.36	5.48	4.60	7.03	9.78	2.15	5.89	5.99
NS5511	4.71	6.73	4.27	8.50	4.98	4.22	8.15	12.43	2.54	5.60	6.21
NS5655	4.73	6.10	4.10	8.44	4.95	4.25	6.18	11.03	2.29	5.05	5.71
PAN8625	6.40	6.93	4.80	11.31	6.63	4.55	7.55	9.87	2.45	6.44	6.69
PAN8816	5.94	7.27	4.71	10.28	6.02	4.85	6.24	9.87	1.55	6.64	6.34
PAN8906	5.76	7.40	4.55	11.36	6.66	5.87	6.79	10.92	2.44	5.82	6.75
PAN8911	6.43	6.87	4.24	10.60	6.21	5.00	6.41	9.55	1.33	6.57	6.32
PAN8919	7.01	7.07	4.58	10.73	6.28	4.48	6.23	10.61	1.54	5.79	6.43
PAN8920	8.18	7.67	4.13	10.90	6.39	4.06	7.86	11.07	1.59	5.33	6.72
PAN8921	6.53	6.62	4.68	10.28	6.02	5.34	6.78	10.39	1.02	5.69	6.33
PAN8923	4.61	7.26	4.47	10.97	6.43	4.64	6.55	8.69	2.43	6.04	6.21
PAN8925	6.38	7.26	4.06	10.27	6.02	5.03	5.15	10.23	1.35	4.68	6.04
PAN8926	6.71	7.55	4.94	12.40	7.26	4.17	6.94	10.27	2.19	5.42	6.78
PAN8927	6.56	7.25	4.10	10.32	6.04	4.18	5.91	9.37	1.63	5.69	6.10
PAN8928	6.05	7.41	4.16	9.72	5.69	4.97	5.53	6.92	1.89	5.60	5.79
PAN8929	6.04	6.71	3.92	10.67	6.25	4.07	4.52	9.93	1.44	4.78	5.83
Gem/Mean	5.81	6.86	4.22	10.08	5.90	4.50	6.41	10.04	1.90	5.54	6.12
CV%	8.20	10.80	11.30	11.10	11.10	9.00	15.10	11.10	18.20	12.80	12.7
$LSD_{T\ (0.05)}$	0.786	1.226	0.790	1.850	1.084	0.665	1.600	1.843	0.584	1.171	1.250

B/ I = Besproeiing / Irrigation

Tabel 10 Die IPCA 1 en IPCA 2 waardes vir 10 omgewings gesorteer volgens omgewings-gemiddelde opbrengs

Table 10 The IPCA 1 and IPCA2 scores for 10 environments, sorted on environmental mean yield

Omgewing Environment	Omg/Env. No	Gem Mean	IPCA1 Waarde/Score	IPCA2 Waarde/Score
Amersfoort	1	5.81	1.048	0.089
Dleeuwkraal	2	6.86	0.447	0.025
Holmdene	3	4.22	0.086	-0.183
Klerksdorp B/I	4	10.08	0.726	0.898
Perdkop	5	5.90	0.334	0.455
Plantrand	6	4.50	-0.057	0.206
Potchefstroom B/I	7	6.41	-1.989	1.071
Taaiboschbult	8	10.04	-0.702	-1.705
Vredefort	9	1.90	-0.263	-0.584
Weiveld	10	5.54	0.370	-0.273

B/I = Besproeiing / Irrigation

Tabel 11 Gemiddelde opbrengs (t. ha-1), orde, IPCA1 en IPCA2 waardes en AMMI stabiliteits waarde (ASW) vir sorghum genotipes geanaliseer volgens die AMMI 1model oor 10 omgewings vir die 2012-2013 seisoen

Table 11 Mean yield (t. ha^{-1}), rank, IPCA1 and IPCA2 scores and AMMI stability value (ASV) of sorghum genotypes analysed according to the AMMI model over 10 environments during the 2012-2013 season

Genotipes* Genotypes	Gen.No. Gen.No.	Gem/Mean Opb/yield	Ord Rank	IPCA1 Score	IPCA2 Score	ASW ASV	Ord Rank
PAN8906	10	6.76	2	-0.014	0.045	0.046	1
PAN8921	14	6.34	7	0.017	0.116	0.116	2
PAN8816	9	6.34	6	0.226	0.044	0.146	3
CAP1003	3	5.57	18	0.122	-0.166	0.196	4
PAN8920	13	6.72	3	0.004	0.207	0.207	5
PAN8919	12	6.43	5	0.321	-0.042	0.247	6
ENFORCER	5	5.99	13	-0.418	-0.008	0.354	7
PAN8625	8	6.69	4	-0.018	0.420	0.420	8
PAN8911	11	6.32	8	0.301	0.296	0.476	9
PAN8923	15	6.21	10	0.071	0.525	0.535	10
PAN8927	18	6.10	11	0.422	0.185	0.539	11
PAN8925	16	6.04	12	0.470	-0.125	0.563	12
PAN8926	17	6.79	1	0.324	0.475	0.683	13
AVENGER	1	5.88	14	0.076	-0.867	0.879	14
PAN8929	20	5.83	15	0.66655	-0.12472	1.006	15
CAP1002	2	5.55	19	0.278	-1.107	1.260	16
NS5655	7	5.71	17	-0.530	-0.733	1.291	17
PAN8928	19	5.79	16	0.621	0.735	1.500	18
NS5511	6	6.21	9	-1.201	-0.827	3.691	19
CAP1004	4	5.23	20	-1.738	0.953	6.946	20

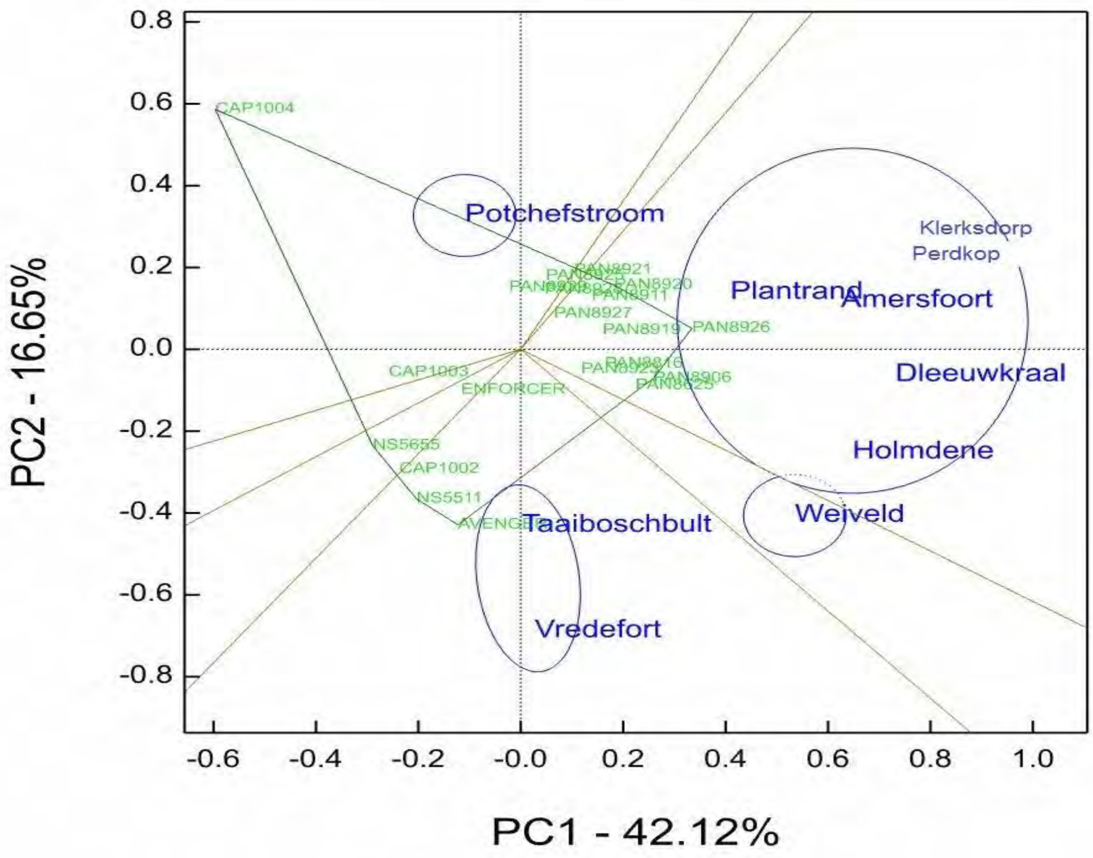
genotype ranking according to ASV values

Tabe 12 Die AMMI model seleksie vir die beste genotipes se gemiddelde opbrengste in verhouding tot die omgewings geëvalueer gedurende 2012-2013 seison

Table 12 The AMMI models best four genotypes selections for mean yield in relation to the environments evaluated during 2012-2013 season

Omgewings Environment	Gem Mean	IPCA 1 waarde/Score	AMMI seleksies/selection			
Amersfoort	5.81	1.048	PAN8926	PAN8919	PAN8906	PAN8920
Klerksdorp B/I	10.08	0.726	PAN8926	PAN8625	PAN8920	PAN8928
Dleeuwkraal	6.86	0.447	PAN8926	PAN8906	PAN8920	PAN8625
Weiveld	5.54	0.370	PAN8926	PAN8906	PAN8920	PAN8625
Perdkop	5.90	0.334	PAN8926	PAN8625	PAN8920	PAN8906
Holmdene	4.22	0.086	PAN8906	PAN8926	PAN8920	PAN8625
Plantrand	4.50	-0.057	PAN8926	PAN8625	PAN8906	PAN8920
Vredefort	1.90	-0.263	NS5511	PAN8906	PAN8920	PAN8625
Taaiboschbult B/I	10.04	-0.702	NS5511	NS5655	AVENGER	CAP1002
Potchefstroom B/I	6.41	-1.989	CAP1004	NS5511	PAN8625	PAN8920

B/I = Besproeiing / Irrigation



Figuur 1 Die GGO XY grafiek vir 20 sorghum genotipes en 10 omgewings vir die tydperk 2012-2013

Figure1 The GGE biplot for 20 sorghum genotypes and 10 environments for the duration 2012-2013

Tabel 13 Groeiseisoenlengte vir spesifieke genotipes wat getoets is gedurende 2011/2012 & 2012/2013

Table 13 Length of growing season for specific genotype tested during 2011/2012 & 2012/2013 season

Genotipes Genotypes	Groeiseisoenlengte Length of growing season		
CAP1002	S		
CAP1003	S		
CAP1004	M		
ENFORCER	M		
NS5511	L		
NS5655	M		
PAN8625	L		
PAN8816	M-L		
PAN8911	S-M		
PAN8919	M		
PAN8920	M		
PAN8923	M		
Dae tot Blom/ Days to flowering	Kort(k)/Short(S)	Medium(M)	Lank(L)Long
Warm streke/ hot areas	70-75	75-80	80-85

T**abel 14** Die gekombineerde variansie analise (ANOVA) van 12 genotipes oor 23 omgewing Volgens die AMMI 2 model

Table 14 The combined analysis of variance (ANOVA) of 12 genotype over 23 environments according to AMMI 2 model

Bron / Source	df	SS	MS	F	F_prob
Totaal/Total	827	5592	6.76	*	*
Behandeling/Treatment	275	5222	18.99	31.23	0
Genotipe/Genotype	11	145	13.18	21.67	0
Omgewing/Environment	22	4465	202.96	150.02	0
Blok/Block *	46	62	1.35	2.23	0.00002
Interaksie/Interaction	242	612	2.53	4.16	0
IPCA 1	32	188	5.88	9.67	0
IPCA 2	30	116	3.86	6.35	0
Res/Residual	180	308	1.71	2.81	0
Fout/Error	506	308	0.61	*	*

* Blocks within environments

Tabel 15 Gemiddelde graanopbrengs (ton. ha^{-1}) vir sorghum genotipes by verskillende omgewings gedurende 2011/2012 & 2012/2013 seisoene

Table 15 Mean yield (t. ha^{-1}) for different sorghum genotypes under different environments during the 2011/2012 & 2012/2013 seasons

Omgewings Environment	CAP1002	CAP1003	CAP1004	ENFORCER	NS5511	NS5655
Taaiboschbult13	11.20	9.06	8.85	9.78	12.43	11.03
Klerksdorp13	8.79	8.72	8.81	9.36	8.50	8.44
Platrand A12	8.47	8.20	6.81	8.57	9.07	8.58
Potchefstroom Early12	7.60	7.39	10.09	9.60	6.49	8.64
Potchefstroom12	9.37	7.18	9.32	8.19	7.52	5.98
Potchefstroom13	4.14	5.52	9.89	7.03	8.15	6.18
Dleeuwkraal13	6.44	6.56	5.25	6.35	6.73	6.10
Potchefstroom Late12	4.01	6.94	5.06	9.26	6.68	6.71
Klerksdorp12	5.15	5.19	5.63	5.58	6.11	5.76
Perdkop13	5.15	5.11	5.16	5.48	4.98	4.95
Amersfoort13	5.52	5.71	3.17	4.98	4.71	4.73
Weiveld13	4.90	5.59	3.14	5.89	5.60	5.05
Weiveld12	4.59	4.60	4.14	4.55	4.81	4.78
Perdkop12	4.55	4.36	4.64	4.46	4.41	4.32
Bethlehem12	2.26	5.58	1.64	5.52	3.96	5.61
Plantrand13	3.07	4.22	4.02	4.60	4.22	4.25
Parys12	4.84	3.63	3.78	4.00	6.63	3.04
Holmdene13	4.25	2.99	3.04	4.25	4.27	4.10
Holmdene12	3.27	2.85	3.34	3.43	3.84	4.06
Platrand E12	2.23	1.94	2.96	3.38	2.64	2.95
Senekal-Steynsrus12	3.05	3.37	2.88	2.18	1.85	2.51
Vredefort13	2.07	2.25	0.99	2.15	2.54	2.29
Villiers12	1.15	1.85	2.44	2.24	1.37	1.69
Mean	5.05	5.17	5.00	5.69	5.54	5.29
LSD $_{T(0.05)}$						
CV %						

Tabel 15 Vervolg

Tabel 15 Continued

Omgewings Environment	PAN8625	PAN8816	PAN8911	PAN8919	PAN8920	PAN8923	Gem Mean
Taaiboschbult13	9.87	9.87	9.55	10.61	11.08	8.69	10.17
Klerksdorp13	11.31	10.28	10.60	10.73	10.90	10.97	9.78
Platrand A12	11.31	10.44	10.65	10.16	11.50	9.49	9.44
Potchefstroom Early12	9.45	9.87	7.03	6.27	10.83	8.72	8.50
Potchefstroom12	8.35	9.12	6.85	6.96	9.67	7.67	8.01
Potchefstroom13	7.55	6.24	6.41	6.23	7.86	6.55	6.81
Dleeuwkraal13	6.93	7.27	6.87	7.07	7.67	7.26	6.71
Potchefstroom Late12	4.34	8.25	6.64	6.48	7.42	6.31	6.51
Klerksdorp12	7.04	7.28	6.55	7.04	5.85	7.30	6.21
Perdkop13	6.63	6.02	6.21	6.28	6.39	6.43	5.73
Amersfoort13	6.40	5.94	6.43	7.01	8.18	4.61	5.62
Weiveld13	6.44	6.64	6.57	5.79	5.33	6.04	5.58
Weiveld12	5.82	5.24	5.59	5.89	5.67	5.59	5.11
Perdkop12	5.21	5.38	5.14	5.92	5.50	5.99	4.99
Bethlehem12	6.27	5.08	5.62	5.44	2.83	3.80	4.47
Plantrand13	4.55	4.85	5.00	4.48	4.06	4.64	4.33
Parys12	5.47	3.00	3.16	4.41	4.72	3.70	4.20
Holmdene13	4.80	4.71	4.24	4.58	4.13	4.47	4.15
Holmdene12	4.27	4.34	4.19	3.28	3.83	3.04	3.65
Platrand E12	4.10	3.99	4.23	3.67	3.51	3.44	3.25
Senekal-Steynsrus12	2.68	3.10	3.47	2.20	3.09	3.27	2.80
Vredefort13	2.45	1.55	1.33	1.54	1.59	2.43	1.93
Villiers12	1.35	2.53	1.69	1.50	1.89	1.56	1.77
Mean	6.20	6.13	5.83	5.81	6.24	5.74	5.64
LSD $_{T(0.05)}$							1.314
CV %							14.5

12 & 13 = 2012 & 2013 seisoene, Platrand (A & E) on site with two different localities

Tabel 16 Die IPCA 1 en IPCA 2 waardes vir 23 omgewings gesorteer volgens omgewings-gemiddelde opbrengs.

Table 16 The IPCA 1 and IPCA2 scores for 23 environments, sorted on environmental mean yield.

Omgewing Environment	Omg/Env. No	Gem Mean	IPCA1 Waarde/Score	IPCA2 Waarde/Score
Taaiboschbult13	19	10.17	-0.0431	0.9065
Klerksdorp13	8	9.78	0.2484	0.1094
Platrand A12	2	9.44	0.6653	0.4370
Potchefstroom Early12	16	8.50	-1.2467	-0.6965
Potchefstroom12	14	8.01	-1.1119	0.4045
Potchefstroom13	15	6.81	-1.2737	-0.2826
Dleeuwkraal13	4	6.71	0.2168	0.1955
Potchefstroom Late12	17	6.51	0.1730	-1.3680
Klerksdorp12	7	6.21	0.1856	-0.0472
Perdkop13	11	5.73	0.0692	0.0706
Amersfoort13	1	5.62	0.6092	0.5307
Weiveld13	23	5.58	0.7174	-0.1174
Weiveld12	22	5.11	0.2273	0.1965
Perdkop12	10	4.99	0.0072	0.0990
Bethlehem12	3	4.47	1.2649	-0.7620
Plantrand13	12	4.33	0.0809	-0.3971
Parys12	9	4.20	-0.3340	1.0807
Holmdene13	6	4.15	0.1488	0.2051
Holmdene12	5	3.65	-0.0804	0.0024
Platrand E12	13	3.25	0.0532	-0.1866
Senekal-Steynsrus12	18	2.80	-0.1780	-0.0758
Vredefort13	21	1.93	0.0081	0.1326
Villiers12	20	1.77	-0.4075	-0.4375

12 & 13 = 2012 & 2013 seisoene

12 & 13 = 2012 & 2013 seasons

Platrand (A & E) on site with two different localities

Tabel 17 Gemiddelde opbrengs (t.ha^{-1}), orde, IPCA1 en IPCA2 waardes AMMI stabiliteits waarde (ASW) vir sorghum genotipes geanaliseer volgens die AMMI model oor 23 lokaliteite vir die 2011/2012 & 2012/2013 seisoene

Table 17 Mean yield (t.ha^{-1}), rank, IPCA1 And IPCA2 scores and AMMI stability values (ASV) of sorghum genotypes analysed according to the AMMI model over 23 environments during the 2011/2012 & 2012/2013 seasons

Genotipes* Genotypes	Gen.No. Gen.No.	Gem/Mean Opb/yield	Ord Rank	IPCA1 Score	IPCA2 Score	ASW ASV	Ord Rank
PAN8923	12	5.74	6	0.05929	-0.22821	0.237	1
PAN8816	8	6.13	3	0.14569	-0.75812	0.814	2
NS5655	6	5.29	9	0.32428	-0.54442	0.821	3
PAN8625	7	6.20	2	0.30917	0.58975	0.841	4
NS5511	5	5.54	8	-0.14205	0.83914	0.892	5
CAP1003	2	5.17	10	0.50008	-0.49084	1.148	6
ENFORCER	4	5.69	7	-0.14839	-1.15041	1.208	7
PAN8920	11	6.24	1	-0.62947	0.46544	1.506	8
CAP1002	1	5.05	11	-0.28059	1.43988	1.647	9
PAN8911	9	5.83	4	1.0018	-0.2433	2.879	10
PAN8919	10	5.81	5	1.05396	0.44054	3.358	11
CAP1004	3	5.00	12	-2.19378	-0.35945	13.001	12
Mean		5.64					
LSD $_{T(0.05)}$		1.314					
CV %		14.5					

*genotype ranking according to ASV values

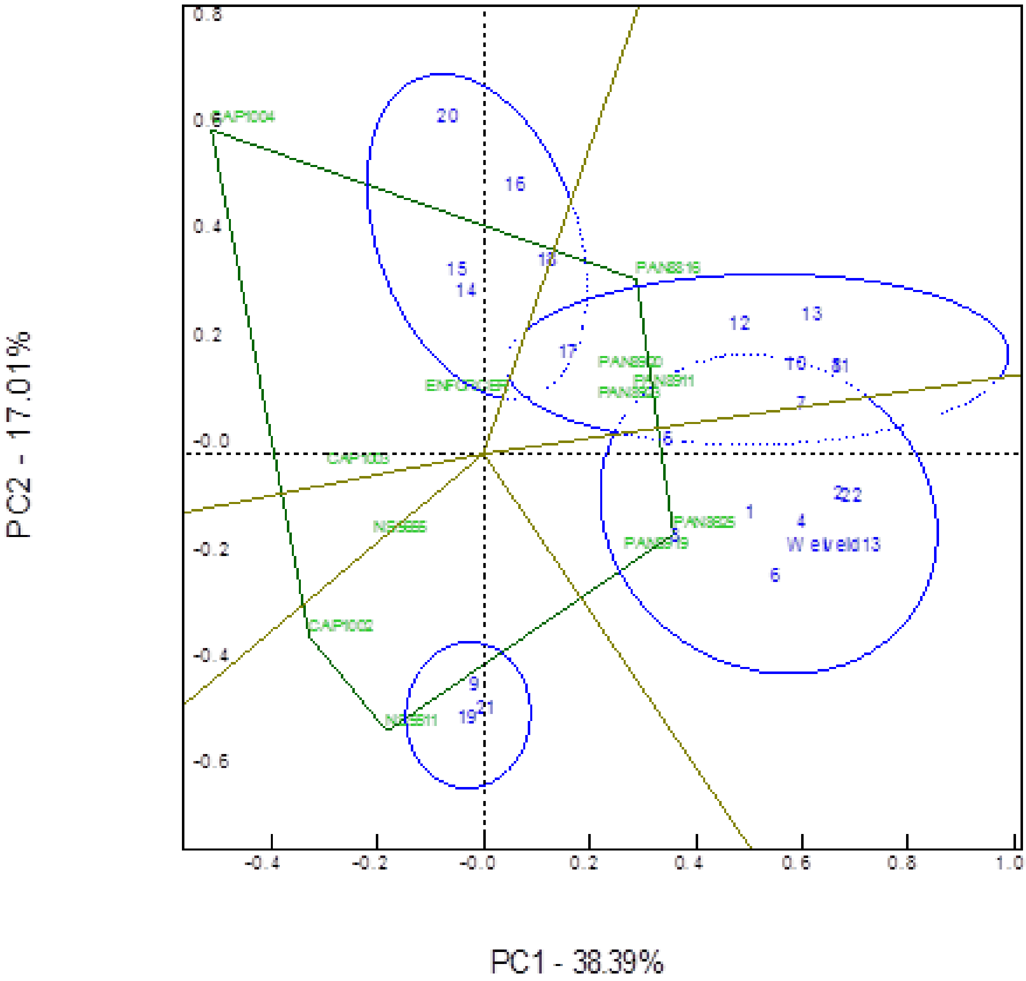
Tabel 18 Die AMMI model seleksie vir die beste genotipes se gemiddelde opbrengste in verhouding tot die 23 omgewings geëvalueer gedurende 2011/2012 & 2012/2013 seisoene

Table 18 The AMMI models best genotypes selections for mean yield in relation to the 23 environments evaluated during 2011/2012 & 2012/2013 seasons

Omgewings Environment	Gem Mean	IPCA 1 Waarde/Score	AMMI seleksies/selection			
Taaiboschbult13	10.17	-0.043	PAN8625	PAN8920	CAP1002	NS5511
Klerksdorp13	9.78	0.248	PAN8625	PAN8920	PAN8919	PAN8816
Platrand A12	9.44	0.665	PAN8919	PAN8625	PAN8911	PAN8920
Potchefstroom Early12	8.50	-1.247	CAP1004	PAN8920	ENFORCER	PAN8816
Potchefstroom12	8.01	-1.112	CAP1004	PAN8920	PAN8625	NS5511
Potchefstroom13	6.81	-1.274	CAP1004	PAN8920	ENFORCER	PAN8816
Dleeuwkraal13	6.71	0.217	PAN8625	PAN8920	PAN8919	PAN8816
Potchefstroom Late12	6.51	0.173	ENFORCER	PAN8816	PAN8911	NS5655
Klerksdorp12	6.21	0.186	PAN8625	PAN8816	PAN8920	PAN8911
Perdkop13	5.73	0.069	PAN8625	PAN8920	PAN8816	PAN8919
Amersfoort13	5.62	0.609	PAN8625	PAN8919	PAN8911	PAN8920
Weiveld13	5.58	0.717	PAN8911	PAN8919	PAN8625	PAN8816
Weiveld12	5.11	0.227	PAN8625	PAN8920	PAN8919	PAN8816
Perdkop12	4.99	0.007	PAN8920	PAN8625	PAN8816	PAN8919
Bethlehem12	4.47	1.265	PAN8911	PAN8816	PAN8919	ENFORCER
Plantrand13	4.33	0.081	PAN8816	ENFORCER	PAN8911	PAN8920
Parys12	4.20	-0.334	PAN8920	PAN8625	CAP1002	NS5511
Holmdene13	4.15	0.149	PAN8625	PAN8920	PAN8919	PAN8816
Holmdene12	3.65	-0.080	PAN8920	PAN8625	PAN8816	PAN8911
Platrand E12	3.25	0.053	PAN8816	PAN8920	PAN8625	PAN8911
Senekal-Steynsrus12	2.80	-0.178	PAN8920	PAN8816	PAN8625	ENFORCER
Vredefort13	1.93	0.008	PAN8920	PAN8625	PAN8816	PAN8919
Villiers12	1.77	-0.408	PAN8816	PAN8920	ENFORCER	CAP1004

12 & 13 = 2012 & 2013 seisoene

12 & 13 = 2012 & 2013 seasons
Platrand (A & E) on site with two different localities



Figuur 2 Die GGO XY grafiek vir 12 sorghum genotipes en 23 omgewings vir die tydperk 2010-2012

Figure 2 The GGE biplot for 12 sorghum genotypes and 23 environments for the duration 2010-2012

Die nommers verteenwoording omgewing/ The number represent environments in Table 16

AANHANGSEL A / APPENDIX A

Die interpretasie van die " Additive Main Effects and Multiplicative Interactions (AMMI)" model en opbrengstabiliteit.

Die effek van genotipe en omgewing (G x O) interaksies in die interpretasie van resultate van opbrengste is welbekend. „n Gekombineerde variansie-analise kan die interaksie kwantifiseer maar beskryf slegs die hoof effekte. Die klassieke ANOVA help nie veel om die interaksies te verstaan of te interpreteer nie. Dit is dan ook die rede hoekom stabiliteits-analises, verskeie vorme van liniêre regressies en afgeleide G x O prosedures tekort skiet in definiëring van hoofeffekte, betekenisvolle interaksies of te min verklaar van interaksievariasies. AMMI bied „n baie beter alternatiewe statistiese benadering vir veldproewe waar „n G x O interaksie relevant kan wees. Multivariasie-analises het drie hoof doelwitte:

a) Om die akkuraatheid van analises en datapatrone te verbeter
b) Om die data op te som.
c) Om die genotipe – omgewingsinteraksie te kwalifiseer.

Met behulp van multivariansie-analise kan genotipes met ooreenstemmende reaksies gekombineer word waardeur analises makliker uitgevoer kan word. Die doel van verskillende multivariansie metodes is om genotipes in te deel in kwalitatiewe homogene en stabiele subgroepe. Binne sulke subgroepe bestaan daar geen betekenisvolle G x O interaksies nie, terwyl daar wel verskille tussen subgroepe bestaan. „n XY- grafiek help baie vir modellering of om genotipes, omgewing of die interaksie te verstaan. Die basiese prinsiep van so „n AMMI XY – grafiek is dat die punte op die X-as die hoof effekte aandui terwyl die Y-as die interaksie aandui. „n Genotipe en omgewingskombinasie met beide negatiewe of positiewe waardes het „n positiewe interaksie en andersins „n negatiewe interaksie. Genotipes naby die bopunt van „n XY – grafiek presteer goed in dienooreenkomstige omgewings en dieselfde geld vir genotipes aan die onderkant. Genotipes of omgewings naby die nul lyn op die Y – as het klein interaksies en is dus relatief stabiel. Genotipes met hoë opbrengspotensiale lê aan die regterkant van so „n grafiek.

DEFINISIES

Interaksie Prinsiep Komponent Analise (IPCA)

IPCA van genotipes in die AMMI analise gee „n aanduiding van die stabiliteit daarvan oor omgewings. Hoe groter die waarde, beide positief en negatief, hoe meer is „n genotipe aangepas vir „n spesifieke omgewing. Hoe nader die IPCA-waarde aan nul kom hoe meer stabiel is „n genotipe oor alle gemete omgewings.

AMMI Stabiliteits Waarde (ASW)

Figuur 3a is „n voorbeeld van die AMMI model se klassifikasie vir genotipes se aanpasbaarheid en stabiliteitskarakteristieke. Indien die letters A tot E verskillende genotipes verteenwoordig kan die volgende afleidings gemaak word. Genotipe A is baie goed aangepas vir hoë potensiaal toestande maar is nie baie stabiel nie. Onder swak heersende toestande kan die genotipe swak presteer. Genotipes B en C is stabiel vir die meeste omgewings alhoewel hulle opbrengste laer kan wees as A onder hoë potensiaal kondisies. Genotipe C is meer stabiel as Genotipe B omdat dit nader aan die nul waarde van IPCA lê. Genotipe D word ook as relatief stabiel geklassifiseer, maar slegs vir lae potensiaal omgewings. Genotipe E is onstabiel en slegs aangepas vir lae potensiaal omgewings. In die algemeen word genotipes wat geleë is tussen IPCA-waardes van 1 en –1 gereken as stabiel maar hulle aanpasbaarheids-karakteristieke kan wissel tussen hoë en lae potensiaal omgewings.

The interpretation of the Additive Main Effects And Multiplicative Interactions (AMMI) model and yield stability

The effect of genotype and environment (GxE) interactions in the interpretation of results of yield trials, are well known. A combined analysis of variance can quantify the interactions, but as an additive statistical model describes only the main effects. The classical ANOVA does little to help understand or interpret the interactions. That is why stability analysis, various forms of joint linear regression, and related GxE statistical procedures can be deficient in defining main effects, incorrectly declaring interactions insignificantly, or explaining too little of the interaction variance. AMMI offers a more appropriate first statistical analysis of yield trials that may have a GxE interaction.

Multivariate analysis has three main purposes:

a) To increase the accuracy of data patterns and analysis
b) To summarize the data
c) To clarify the genotype–environment interactions.

Through multivariate analysis, genotypes with similar responses can be clustered, and the data can be summarized and analysed more easily. The aim of various multivariate classification methods are therefore to allocate genotypes to qualitatively homogeneous stability subsets. Within subsets, no significant GxE interactions occur, while differences among subsets are due to GxE interactions. A bi-plot is helpful for modelling or understanding the genotypes, the environments, and the interaction. The basic interpretive principle for such bi-plots is that bi-plots points displaced along the X-axis differ in main effects, whereas points displaced along the Y-axis differ in interaction. The joint structure of genotype and environment points in a bi-plot show the interaction. A genotype and environment combination with both negative scores or both positive scores, has a positive interaction, and otherwise a negative interaction. Hence genotypes near the top of a bi-plot do especially well in environments near the top, and likewise for the bottom genotypes and environments. Genotypes or environments near zero on the Y-axis have small interactions – they are relatively stable. Genotypes with high yield over the growing region of the trial are located to the right.

DEFINITIONS

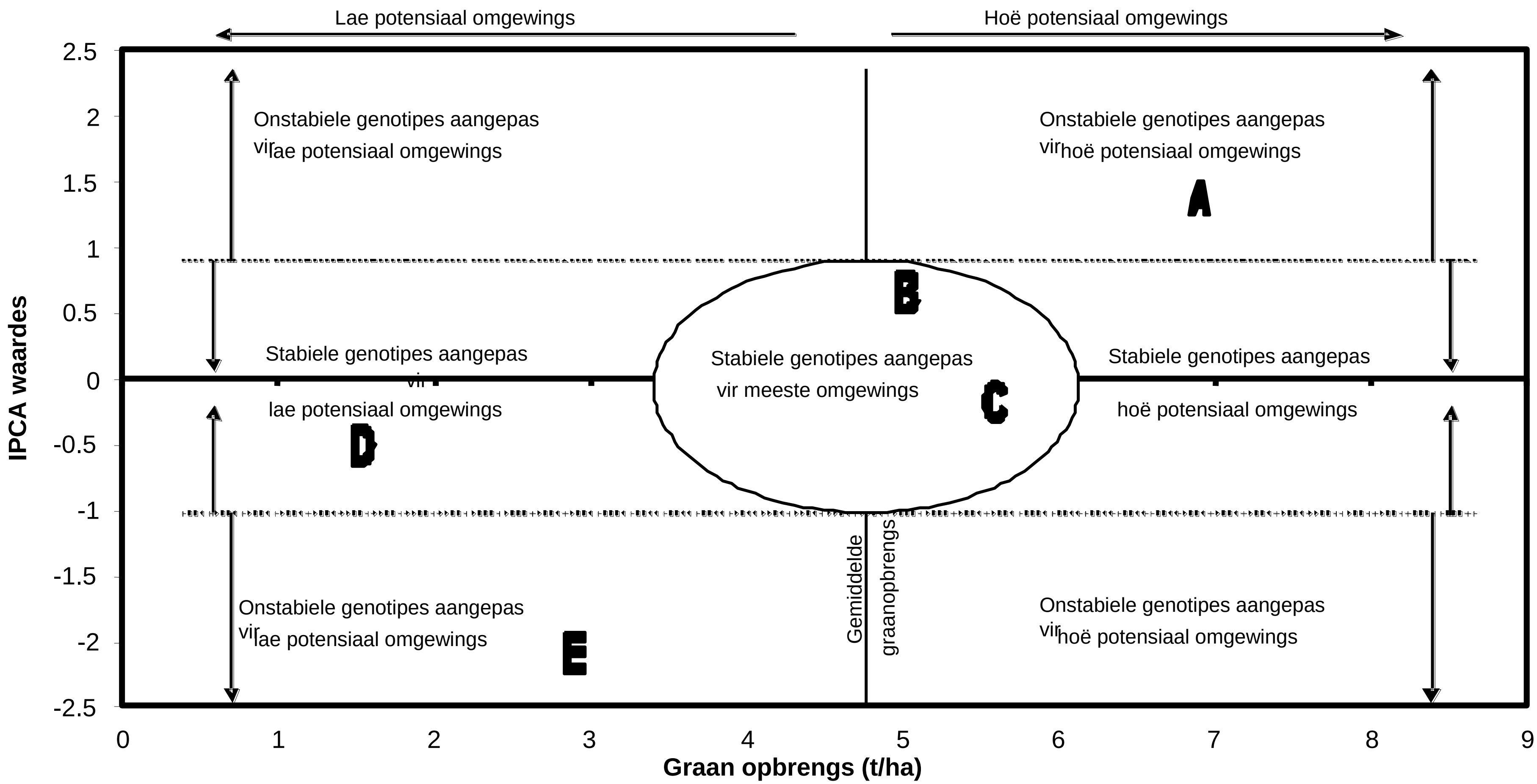
Interaction Principle Component analysis (IPCA)

The Principle Component Interaction Analysis (IPCA) of genotypes in the AMMI analysis is an indication of the stability of a genotype over environments. The greater the IPCA scores, either negative or positive, the more specifically adapted a genotype is to a certain environment. The closer IPCA scores approach zero the more stable the genotype is over all environments sampled.

AMMI Stability Value (ASV)

AMMI Stability Value (ASV) is the distance from zero in a two dimensional scatter gram of IPCA 1 scores against IPCA 2 scores. As the ASV nearing zero the genotype can be considered more stable for most of the environments.

Figure 3b is an example of the AMMI model‟s classification of genotypes adaptability and stability characteristics. If the letters A to E represent genotypes the following conclusions could be made. Genotype A is very good adapted towards high potential conditions but is not stable. Therefore, under poor prevailing conditions this genotype may yield poorly. Genotypes B and C are stable for most environmental potential conditions although their yields will be lower compared to genotype A under high potential conditions. Genotype C is more stable than genotype B because it is lying closer to the IPCA value of zero. Genotype D is also considered stable, but only for low potential environments. Genotype E is unstable and only adapted to low potential environments. In general, genotypes that are falling between IPCA values of 1 and –1 are considered stable, but their adaptabilities can range between low and high potential environments.



Figuur 3a. AMMI model dui die stabiliteit aan van genotipes by verskillende omgewings

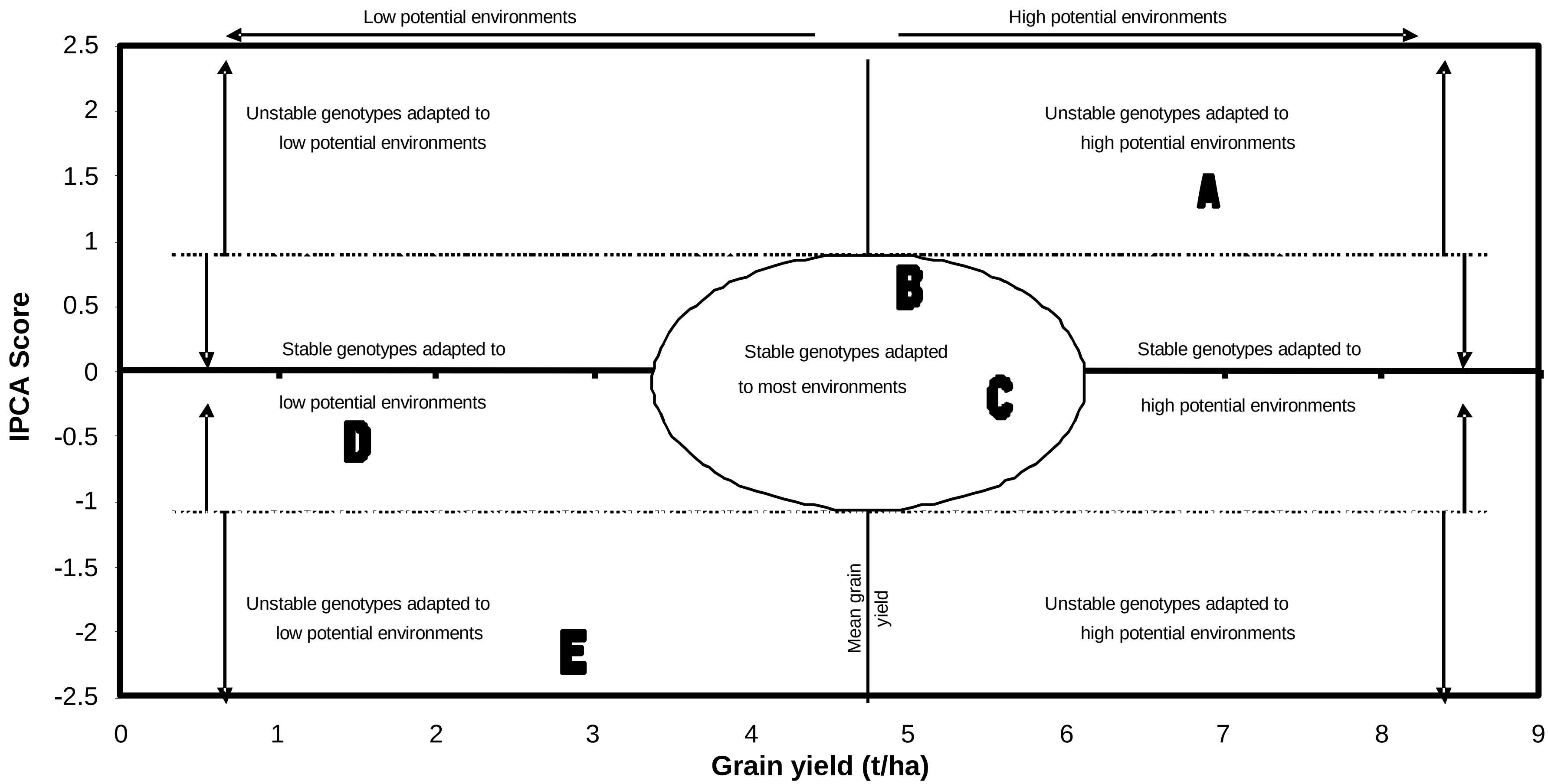


Figure 3b AMMI model indicate the stability of genotypes at different environments