

Healthy crops during drought  
season in 10 easy steps

# Drought Guide

SEEDING  
THE FUTURE  
SINCE 1856





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easy to say, hard to define
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# Drought tolerance – easy to say, hard to define

## **Drought never comes alone. It is always just one important element, within a package.**

Drought alone would mean having a lack of water, but keeping all other factors on a comfortable level: soil and air temperature, air moisture, radiation intensity, nutrient status, and the activity of adversary organisms like insects, fungi and weeds. As this never happens, drought is an imbalance with many faces.

## **How do we encounter Drought Stress?**

On the playground are, listed in order of declining size, and increasing accessibility: climate; soil, agricultural practice, but also farming practice will act on soil and crop (while agriculture as an entirety acts on climate). Crop rotation affects practice and soil. Within the crop, man has created a level of complexity called variety.

KWS continuously improves the genetic quality of its own hybrids, that contribute to a better performance under various drought stresses.





## What this Drought Guide is about

Actually, drought guide is about how to optimize the relevant set- screws accessible by agricultural practice and crop, through the 11 most important points, from the drought oriented soil and field preparation until the walk through the physiological life of the crop through the 3 phases: before, at and after flowering.

As a result of breeding and genetic improvement, and of our KWS drought tolerance research related to the 3 phases mentioned, let us present you the hybrids that have the right properties to suffer less from drought, such as root development, assimilation efficiency, Anthesis – Silking – interval, efficient grainfill, and more. We call them Climate **CONTROL**<sup>3</sup>. Discover more, in this Drought guide.

# What happens when high temperatures and drought become a daily thing?

## Based on the data so far, it can be said that the following effects of climate change are expected by 2034:

- Average annual temperatures on land in Europe have increased by ~ 2°C since pre-industrial times.
- Drought-affected regions will expand across Europe (from 13% to 19-26% of land area).
- Droughts will last 3-4 times longer than in the past (exception: Northern Europe).
- A decrease in precipitation is expected across southern Europe during the summer months and an increase in precipitation in northern Europe during the winter months.
- A continuous increase in the frequency and duration of extreme weather events (heavy rains, heat waves, floods) is expected.



## How to prepare?

- From germination, through vegetative development, flowering, grain formation and filling, until the maturity of the corn plant, the process of growing corn is complicated and the speed and duration of each phase depends on the characteristics of the hybrid and the length of the growing season.
- The external environment is often a significant factor and, although it can be stimulating, it can often have an unfavorable influence.
- Some stages of corn development occur during high air temperatures and drought, resulting in insufficient amounts of available water in the soil for plants. Basically, when water is hard to come by, the plant uses more energy to stay hydrated. This stress, due to lack of water and nutrients, seriously affects yields.
- Climate change represents a major challenge for agricultural production due to the increasing presence of high temperatures, longer periods of drought and other unfavorable weather conditions every year. But now, you can be ready to face that challenge!

## What solutions do we offer?

- The company KWS continuously improves the genetic quality of corn hybrids. Within the KWS lineage pools, we identify genes that contribute to stress tolerance.

## What methodology do we use?

- A classical approach of crossing well-characterized but highly divergent lines, as well as examining their segregating progeny. This approach is followed by modern engineering methods and observation of the breeding process in KWS's test network.
- In order to bring you our best solutions, hundreds of test sites have been set up across Europe. Also, 4 drought platforms were built to test drought stress at different stages of the life cycle.

## What is our solution?

**ClimaCONTROL<sup>3</sup>** is a special group of hybrids that is tolerant to stressful conditions.

## How?

Through a series of adaptations, such as rapid growth in early stages of maturity, a large number of kernel rows, a higher number of kernels on the cob, greater and more stable kernel mass, and many others. But the secret lies in a holistic approach, so we offer education and support. And, in the end, all of this will help the crops, increase profit, and save season. But what is most important to us is that it will give farmers something to rely on, especially when drought comes.



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# 1

## Drought oriented soil and field preparation



### Target

- Establish a maximum of usable soil volume for the crop n Maximize usable water capacity, support organic matter content
- Accumulate winter rainfalls
- Minimize evaporation losses before and during vegetation



### Measures

1. Deep parts of soil preparation work must be done in autumn.
2. No till or soil preparation when conditions are wet, use broad low pressure tires.
3. Apply vertical tillage by paraplough or subsoiler or deep chisel - in very heavy soils, include a vibration equipment.
4. Minimize the number of tillage and/or plough passes.



Roots from light soil  
Source: Andreas Groß



Roots from heavy soil  
Source: Andreas Groß

# 2

## Drought oriented fertilizing



### Target for N

- Corn yield needs Nitrogen: provide for the needs expected
- Offer N close to demand, in time, place, and quantity
- Avoid losses, protect water quality and support N efficiency

### Target for K

- Keep K availability on a good level



### Measures

1. Make a soil sample analysis, close to sowing, to estimate what comes from soil.
2. Make a balance of stocks and needs, based on realistic yield expectations.
3. Set up a fertilizer tactics. Do not just look for the cheapest kg of N. Deploy the different types, by using their solubility properties, like urea (slow), stabilized ammonium (slow), ammonium (medium), and nitrate (fast) fertilizers.
4. Apply K before sowing
5. Apply Nitrogen fertilizer short before, and at sowing. Only plan for N at 7/8 leaves stage, when you are able to combine it with a cultivator pass.
6. If you give late N around 7/8 leaves stage, use the PSNT at 4/6 leaves.



Source: Andreas Groß

Important for strong water tubes in the plant: K

# 3

## Drought oriented maturity strategy



### Target

- Spread the risk
- Avoid coincidence of highest drought risk, and flowering period

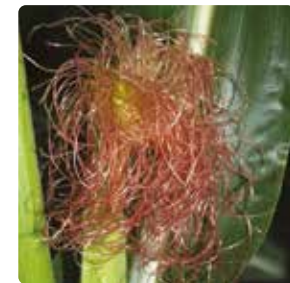


### Measures

1. MIX IT! Choose at least 2 different FAO groups to spread the climatic risk.
2. Go Early! Choose more early hybrids, and plant them earliest possible.



It gets hard for the pollen when it gets hot  
Source: Andreas Groß



Most sensitive to water shortages: flowering  
Source: Andreas Groß

# 4

## When a cold spring is followed by a period of drought



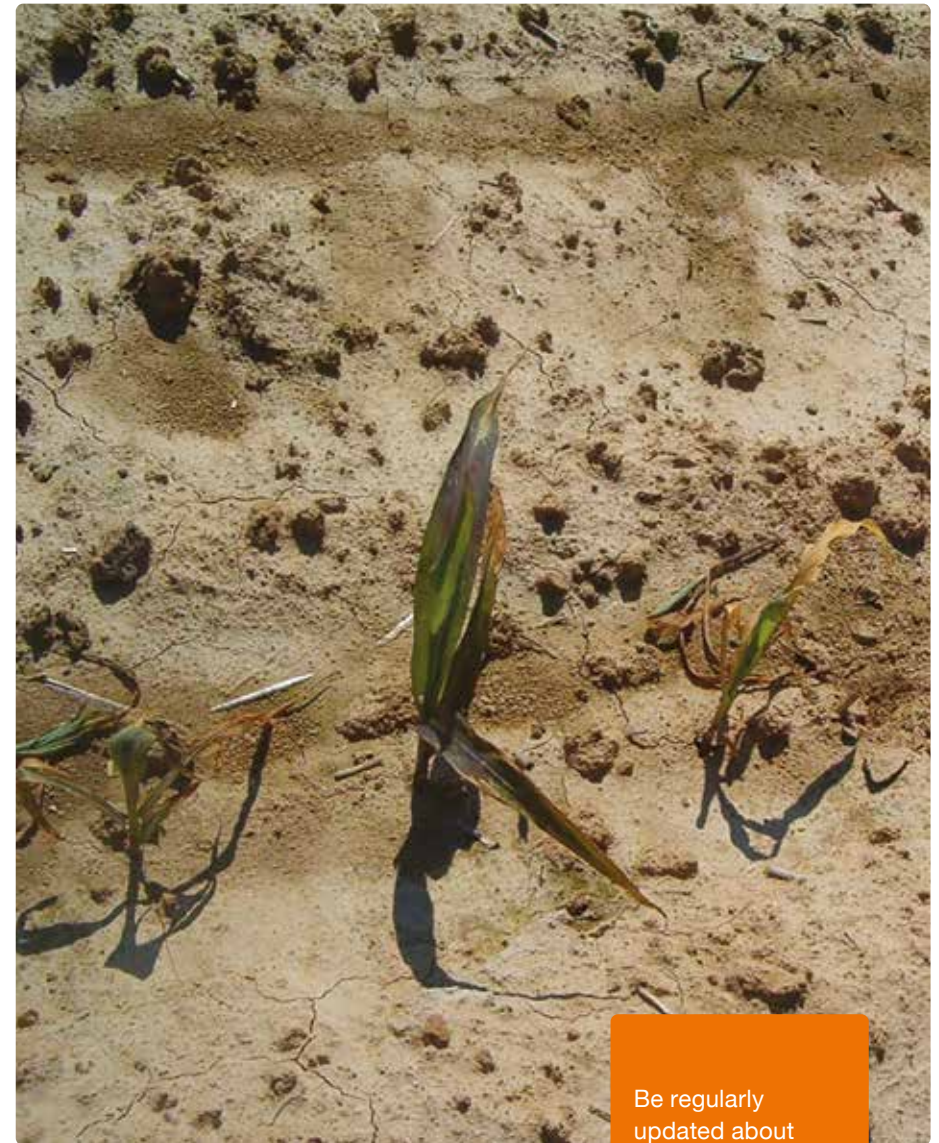
### Target

- Improve the resilience of your crop, against weather hazards



### Measure

1. Choose more early hybrids, as their cold tolerance is usually better. Plant them early, and rather flat than deep.
2. Use P and N starter fertilizer.



Be regularly updated about weather forecast of the season

Source: Andreas Groß

# 5

## Drought oriented planting time



### Target

- Avoid drought stress at flowering, by moving earlier the flowering period



### Measures

1. Anticipate planting operations, by using a hybrid tolerant to early planting.
2. Check density and sowing depth modifications.
3. Monitor the soil temperature at sowing depth. Take action at 8-10°C.



Happens at very early planting, helps to make big roots: tillering  
Source: Andreas Groß

# 6

## Drought oriented planting density



### Target

- Improve resilience of the crop, by implementing higher securities



### Measures

1. Check thoroughly the planter: it has to provide for a perfect placement.
2. Check the planting density when sowing starts: It should be 10% lower than you need for reaching best yield, under best condition. This is the same for early planting!



Source: Csaba Kiss

# 7

## Drought oriented sowing depth



### Target

- Create close contact between soil moisture, and seed
- Enable a rapid and powerful emergence



### Measures

1. If your strategy is to speed up, you must not go too deep.
2. Very sandy soil, high drought risk: 10cm. Heavy soil, not much air supply: 4cm.
3. Check it right behind the planter!



Source: Csaba Kiss



Source: Andreas Groß

... and down it goes

# 8

## European corn borer control



### Target

- Limit corn borer population in long term, to an acceptable level



### Measures

1. Crop rotation with rapeseed, sunflower, cereals. Regional coordination is more effective.
2. Do not leave intact pieces of stover, as refuge, on field during winter.
3. Whether you apply insecticides, or Trichogramma larvae, correct timing is the key.

# 9

## Drought oriented weed control



### Target

- Keep the cornfield weed free, from 3/4 leaves stage onwards
- Keep weed seed infestation of the soil, on low levels



### Measures

1. Crop rotation with non-cereals.
2. Stubble management, of the precedent crop.
3. Early herbicide application (at 3 leaves!).
4. Cultivator pass, in knee-high corn, when the upper 5-10 cm of soil are dry.



Source: Csaba Kiss

# 10 Drought oriented harvest time



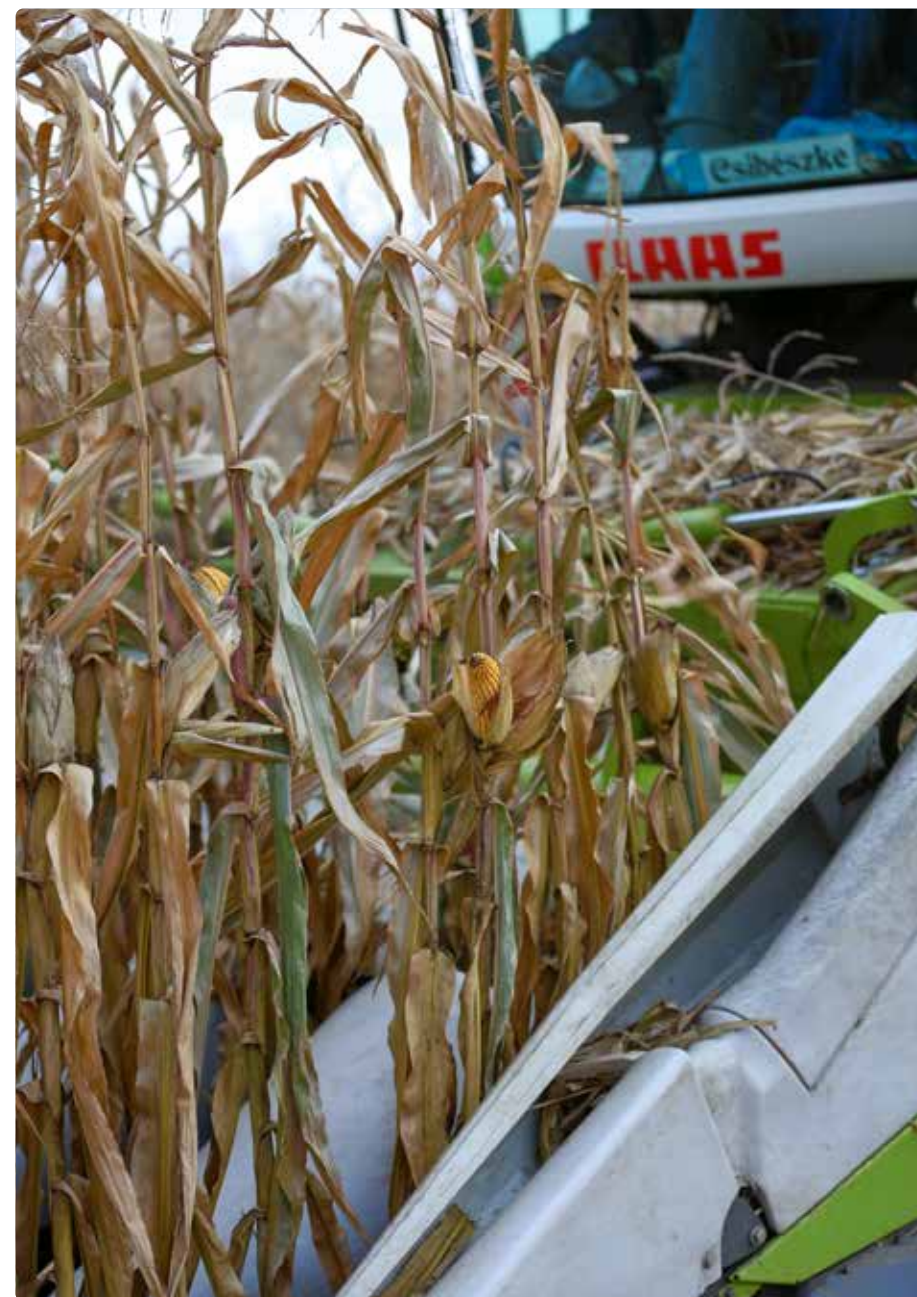
## Target

- Avoid breakdown of the crop
- Avoid mycotoxine pollution of the harvest
- Achieve low levels of grain moisture (<18%)



## Measures

1. Find the best compromise. Consider to antedate harvest, when ear moulds are present in the field.
2. Avoid harvest under wet field conditions, to prevent from soil damage, and ear mould explosion.



Source: Csaba Kiss

# ClimaCONTROL<sup>3</sup>

Profit from stable yields using our highly drought-tolerant hybrids



1. Before flowering

2. During flowering

3. After flowering

1



## Early robustness

against cold, heat and herbicide stress ensures flowering fertility and kernel row number

2



## Secure flowering

Synchronized pollination and silking under drought and heat stress secures kernel development

3



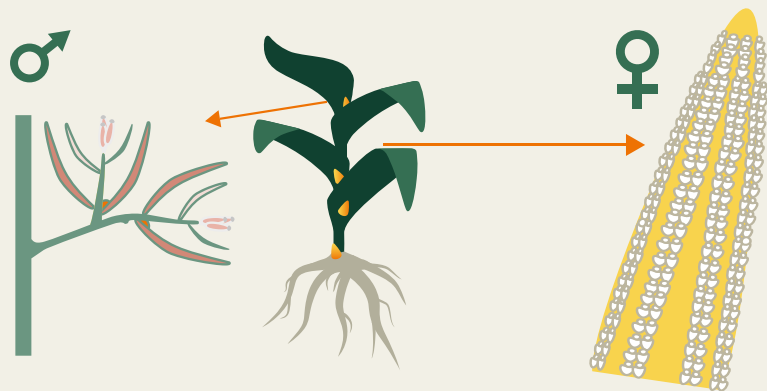
## Resolute grainfill

preserves TKW from stress effects, staygreen supports grain filling until black layer

# 11 Drought oriented physiology

## 1. Before flowering

### Determination of inflorescences



Drought stress during the growth phase before flowering, can impair fertility, of the male (tassel) and the female (ear) inflorescence. The phase of 7 to 10 leaves is the time, when inflorescences are shaped, and determined.

- Other stresses during this time, such as weed competition, herbicide damage, frost, and others, bear a similar risk.



### Vertical root orientation

The full fecundation potential, and yield potential, need to arrive at flowering, even when facing early periods of drought

- A drought tolerant hybrid will have its tassel well filled by fertile and productive spikelets.
- It will show less reductions in kernel row number, and total kernel number, than others.

The early development of a deep reaching root system can help improve water uptake efficiency, in later phases of drought

- Well adapted hybrids respond to early drought stress, by making deep reaching, longer roots. It is often connected to reduced near-surface roots, and interacting with N presence in the soil.

## 2. Flowering

### Pollen Shed and Silk Elongation Fecundation Success

Flowering is the time of highest water is consumption, by the plant. Energy demand is at its maximum, as the plant needs to finalize vegetative growth, produce pollen, grow silk, and develop embryos.

Glume opening and pollen shed, and even more, silk elongation, consume lots of moisture

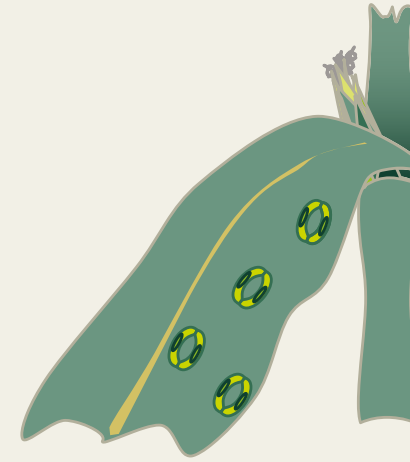
- Drought tolerant hybrids realize flowering in a short, effective timespan, and in perfect synchronicity.
- No secondary ear prolongates flowering, impairing synchronicity.
- Early flowering may help by establishing a timing, where soil water is still better available, and drought risk is lower.

Pollination must work, even at wind speed close to zero

- Drought tolerant hybrids show a tassel that fully emerges from the uppermost leaf, in the course of flowering.



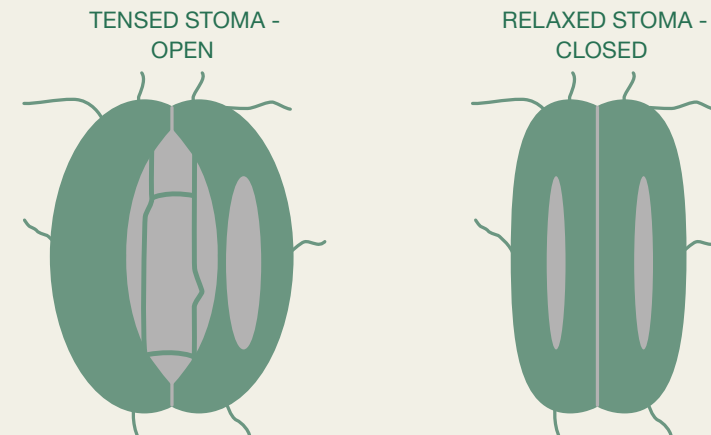
♀



### Maximal Assimilation

Assimilation, each breath of CO<sub>2</sub> costs humidity.

- Drought tolerant hybrids limit their gas exchange, by effective stomata control, closing tightly during the hottest hours of the day, assimilating powerfully in the mild morning hours.



### 3. After flowering

#### Determination of Actual Kernel Weight

Starch formation needs CO<sub>2</sub> assimilation. Staygreen keeps it empowered by a core part of plant, until physiological maturity is reached.

- Drought tolerant hybrids show a certain staygreen, from flowering, to black layer stage.

Grainfill must start immediately after fecundation

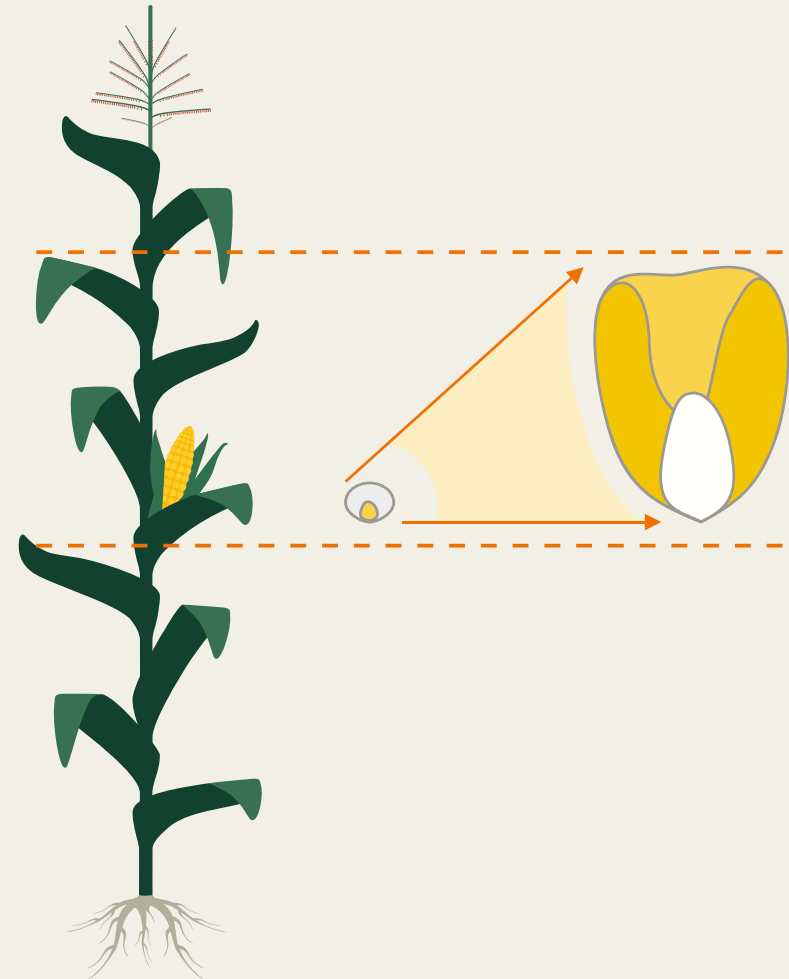
- Drought tolerant hybrids don't waste time, and show a short lag phase, from fecundation, to start of grainfill.

Moisture losses from the growing ear must be minimized

- Drought tolerant hybrids cover their ear well by husks, opening at black layer stage.

At terminal drought stress, kernel weight as the last yield component, needs to be enforced

- Drought tolerant hybrids show less differences in kernel weight, with or without drought stress.





ClimaCONTROL<sup>3</sup>

## KWS LAURO

FAO 290



- Visok potencijal prinosa za grupu ranih hibrida
- Veoma dobra stabilnost prinosa
- U uslovima stresa ima sinhronizovano prašenje, svilanje i početak cvetanja
- U stresnim uslovima pokazuje odličnu stabilnost broja redova zrna i mase zrna

## KWS HYPOLITO

FAO 390



- Visok potencijal za prinos u dobrim uslovima proizvodnje, a odlične rezultate postiže u stresnim uslovima
- Dobro podnosi niže temperature u proleće
- Velika i razgranata metlica je jedan od važnih faktora koji utiču na visoku stabilnost u uslovima stresa
- Ima kompaktan klip sa velikom, ali i stabilnom masom zrna
- Tolerantan na fuzarijum stabla i klipa

## KWS DONJUAN

FAO 440



- Izražen rani porast
- Tolerantan na niske temperature u proleće (pogodan za raniju setvu)
- Rano cvetanje obezbeđuje izbegavanje perioda sa visokim temperaturama
- Razvijena metlica omogućava sigurniju oplodnju
- Tolerantan na lom i poleganje stabla
- Dobro završen klip sa 16-18 redova zrna

## KWS GIRO

FAO 480



- Veoma snažan ClimaCONTROL<sup>3</sup> hibrid u kasnoj FAO 400 grupi
- Izražena stabilnost tokom godina, visoke performanse u suši
- Veoma rano cvetanje utiče na izraženiju toleranciju na visoke temperature i sušu
- Kompaktan tip biljke, bez velike lisne mase, sposobnost duge asimilacije
- Visoka hektolitarska masa i veliki broj redova zrna

## KWS ADVISIO

FAO 500



- Izražena stabilnost u razčitim agroekološkim uslovima
- Stablo srednje visine, srednje visoko postavljen klip
- Izražen staygreen, široki tamni listovi
- Kraći, dobro popunjeni klipovi sa stabilnim brojem redova zrna
- Izražena stabilnost mase 1000 zrna

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