

SOYBEAN YIELDS AND YIELD GAP ANALYSIS IN THE PAMPAS REGION OF ARGENTINA

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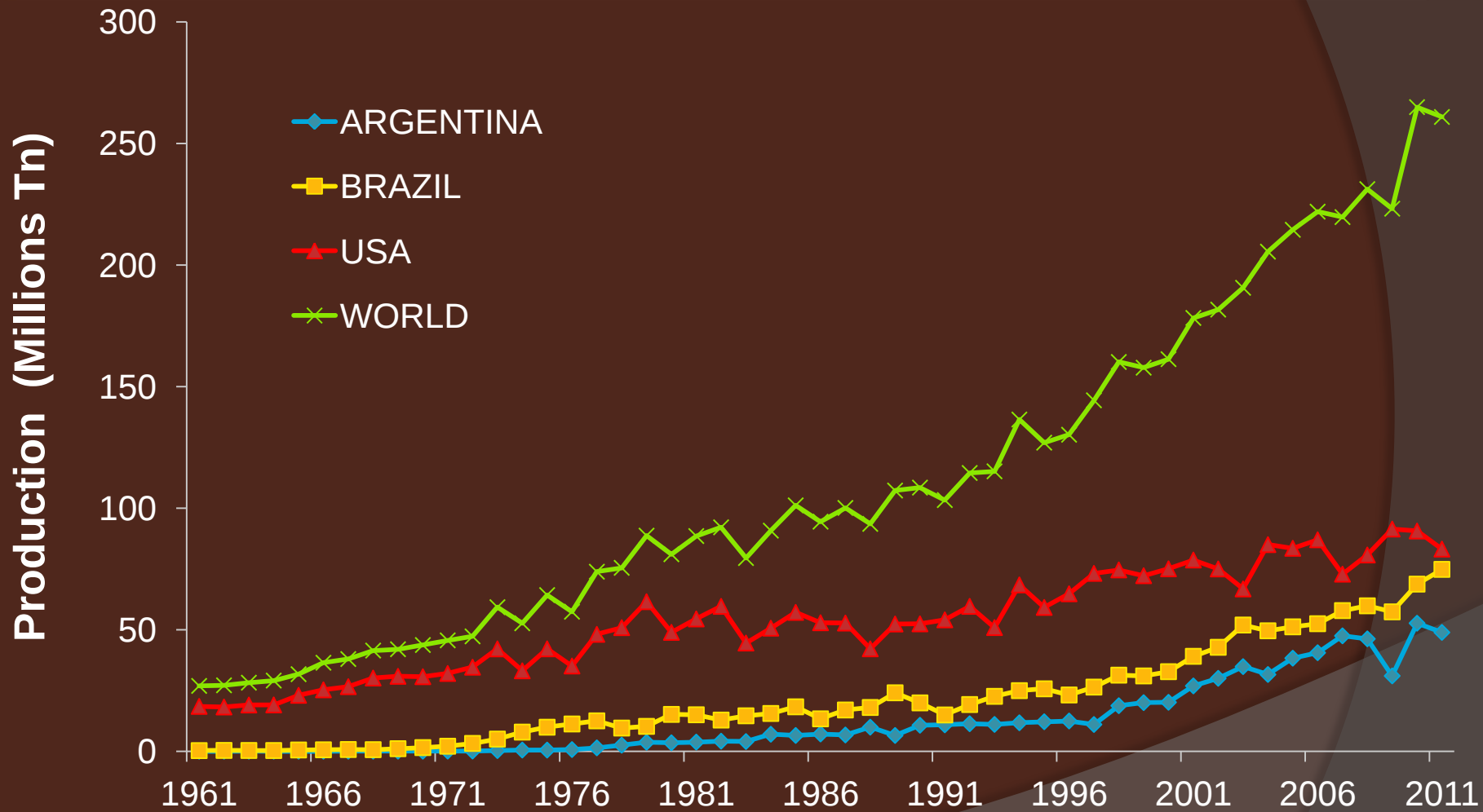
In Argentina, the third largest soybean producer in the world, increases in cropped land area face ecological issues. Thus, agricultural intensification is expected to happen in order to increase soybean production. Narrowing the yield gap (YG) must involve both increasing inputs and production efficiency. Climatic conditions in the Pampas region of Argentina allow a wide choice of planting dates x genotypes combinations. These combinations may generate different seed yield potentials (YP) and yield gaps, but there are no specific studies that acknowledge this issue. The objective of the present study was to evaluate YP, water-limited yield potential (WLYP) and the YG between them as affected by planting date and genotype in the Pampas region of Argentina. During the 2009 and 2011 seasons, field experiments were performed at INTA Oliveros Research Station (32°33'S, 60°51'W), Argentina, testing three genotypes, i.e., MG III (NA 3731), MG IV (DM 4670) and MG V (DM 5.5) planted at three planting dates from the end of October to the beginning of January (E1, E2 and E3) under rain-fed (i.e. WLYP) and irrigated conditions (i.e. YP). Treatments were arranged in a RCBD with three replications. Cumulated radiation and rainfall were calculated for the periods R1-R5 and R5-R7 for the different genotypes. At harvest, seed yield (SY), pod number per square meter (PNm²), pod number per plant (PNpl) and individual seed weight (SW) were measured. In 2009, SY was higher than in 2011 and in both seasons the largest SY was observed in E1. In 2009, YP in E1 was 4391, 6004 and 4383 kg ha⁻¹ for NA3731, DM460 and DM5.5, respectively. In 2011, soybean yield was 3657, 4027 and 4442 kg ha⁻¹, respectively, for E1, E2 and E3. The YG was 259, 194 and 616 kg ha⁻¹ for E1, E2 and E3, respectively in 2009 and 386, 43 and 308 kg ha⁻¹, respectively in 2011. Both WLYP and YP decreased as planting date was delayed. In 2009, YP in NA3731, DM460 and DM5.5 decreased at a rate of 7, 16 and 5.5 kg per delayed day, respectively. However, WLYP decreased at a higher rate, showing a reduction of 11, 19 and 12 kg per delayed day for NA3731, DM460 and DM5.5, respectively. In 2011 differences in this rate between YP and WLYP were similar (23 and 24 kg per delayed day) with no differences between genotypes. Hence, a delay in planting date reduced YP between 5-23% in 2009 and 31% in 2011 for all genotypes. Likewise, WLYP decreased between 20-28% in 2009 and 29-37% in 2011. In 2009, the delay in planting date showed a reduction in PNm² of 16-41% in irrigated treatments averaging all genotypes, with similar relative reductions under rain-fed conditions. In 2011, there were no changes in PNm² in response to later planting dates for all genotypes. The same trend was observed when analyzing PNpl, but the relative decrease in PNpl in 2009 ranged from 41-64% between genotypes without differences between rain-fed and irrigated treatments. In 2011, there was a larger proportion of under-developed pods. SW did not show a clear trend. In 2011, there were reductions of 10-17% when planting date was delayed, but there were no changes in 2009. In summary, early planting dates showed the highest YP and WLYP, but the lowest YG was detected in the intermediate planting date (in November), suggesting that YG is more likely to be reduced at this planting date. PNm² and PNpl were more sensitive to changes in planting date, as opposed to SW which showed a lower relative impact on yield determination.

“SOYBEAN YIELDS AND YIELD GAP ANALYSIS IN THE PAMPAS REGION OF ARGENTINA”

***Amalia Manlla & Fernando Salvagiotti
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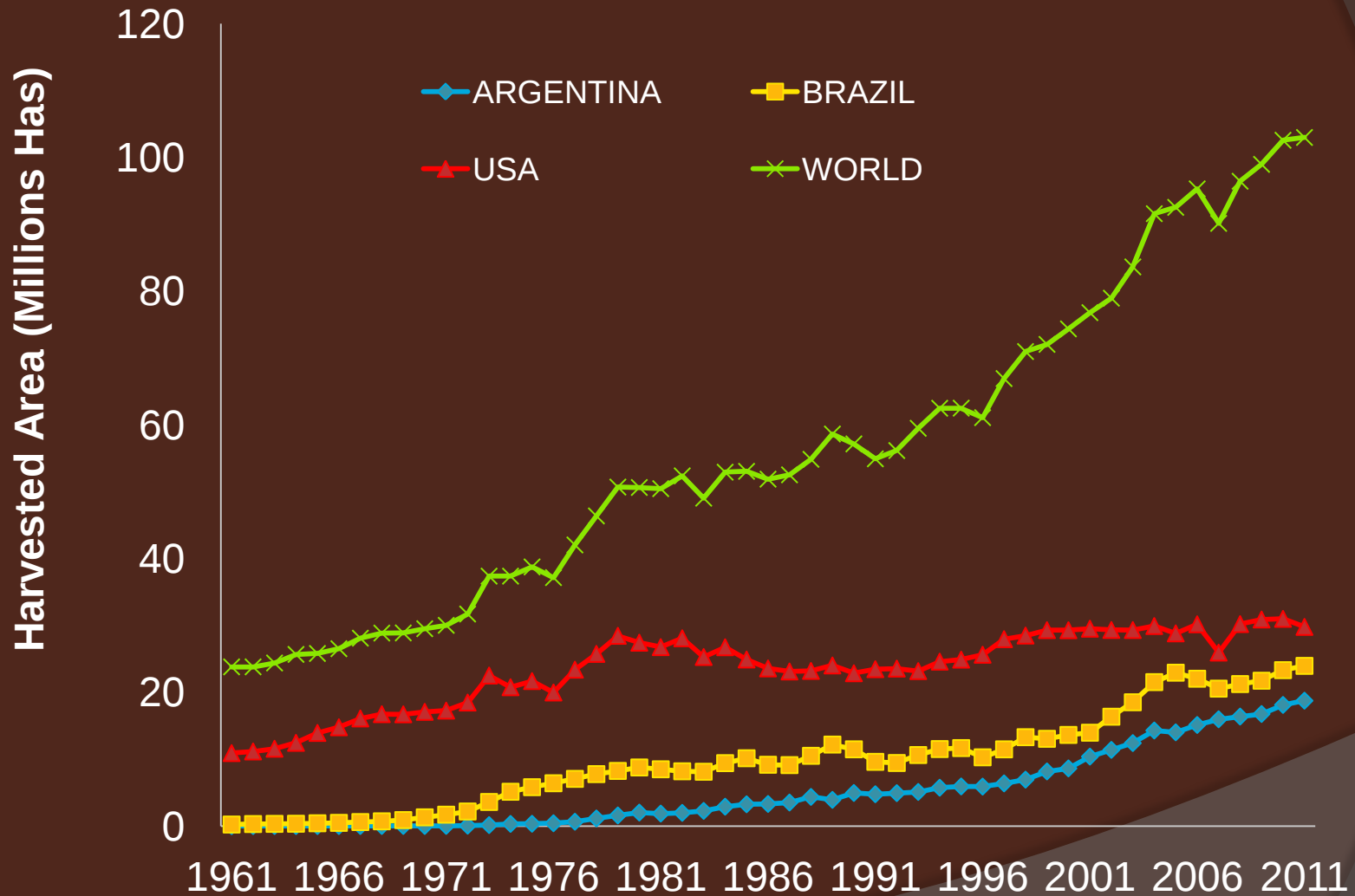


SOYBEAN PRODUCTION



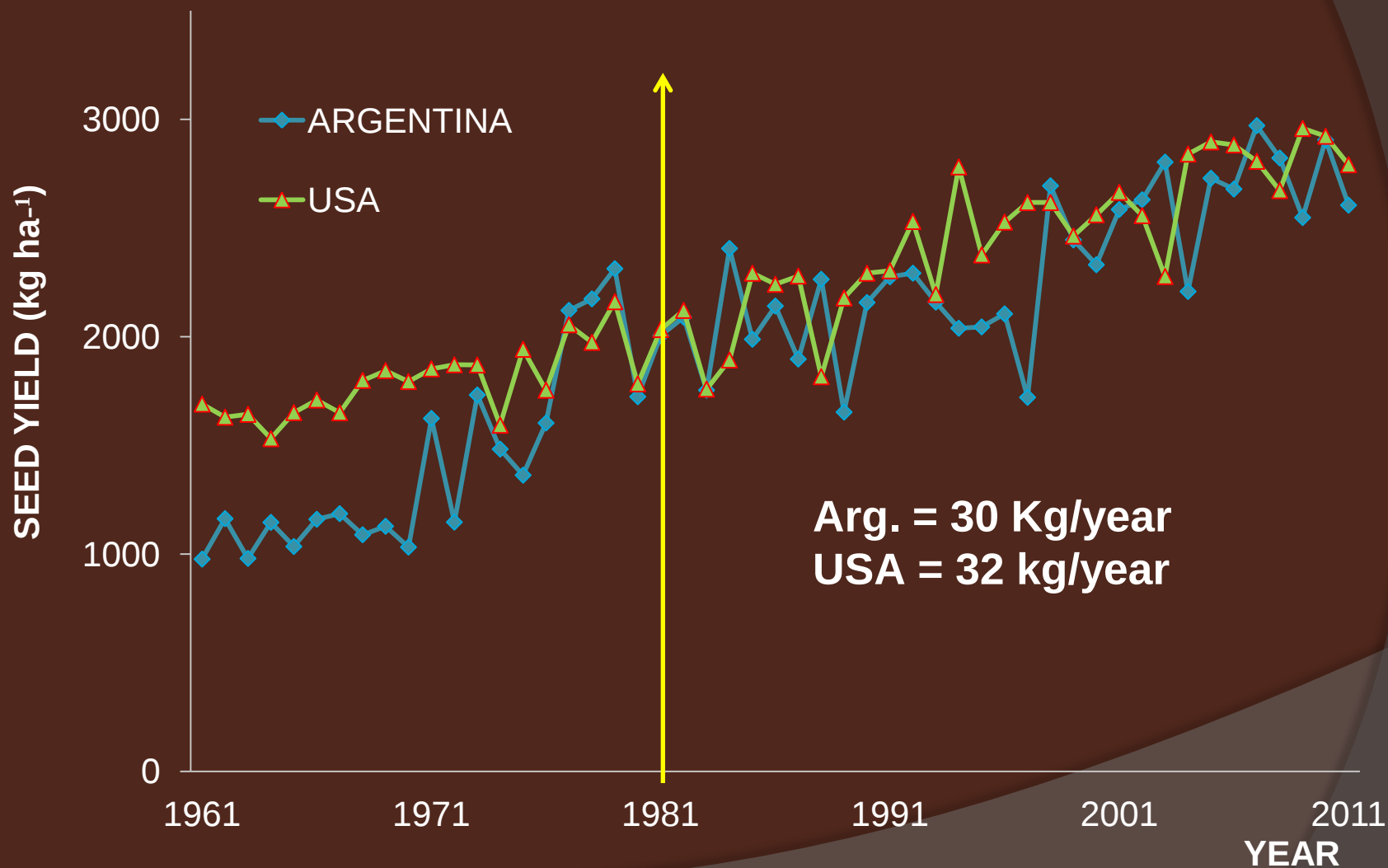
Source: FAOSTAT

HARVESTED AREA



Source: FAOSTAT

Argentina average Soybean yield 1961-2011



Soybean Production in Argentina



Santa Fe

US Dept of State Geographer

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Data SIO, NOAA, U.S. Navy, NGA, GEBCO

21°53'32.53" S 69°18'51.62" O elevación 2074 m

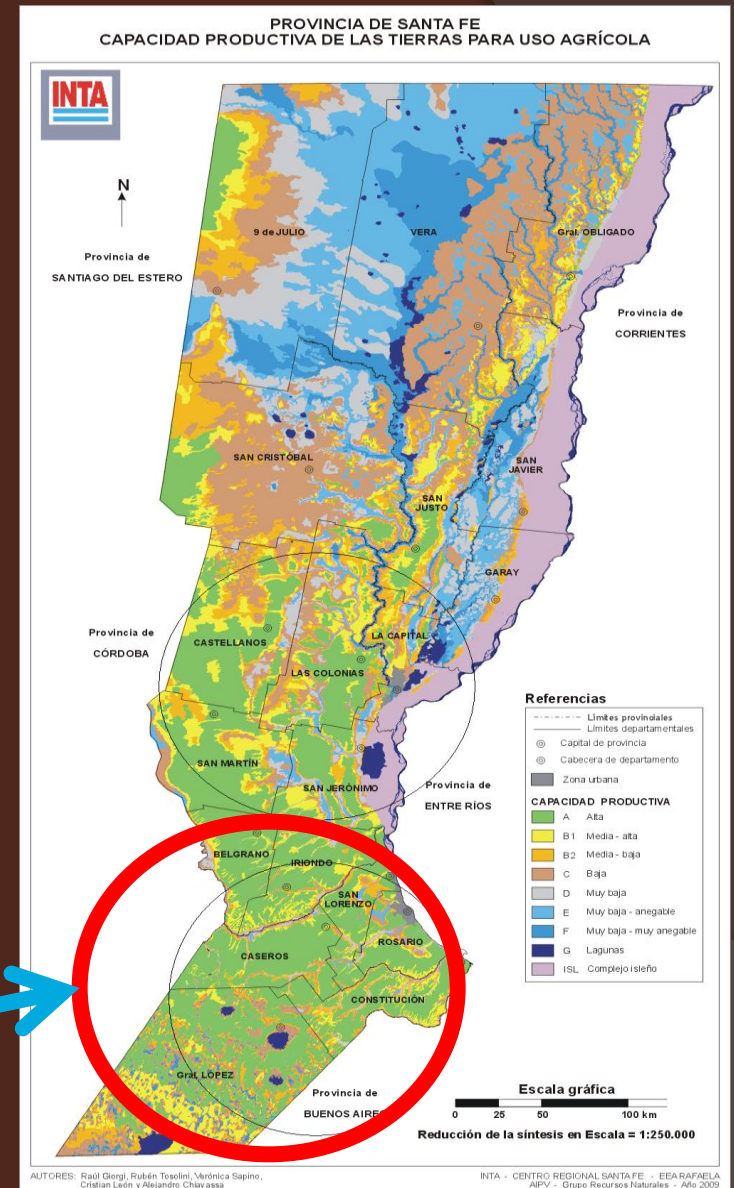
Google earth

Alt. ojo 22984.66 km

In 2011, Argentina produced 48 million tons of soybeans.

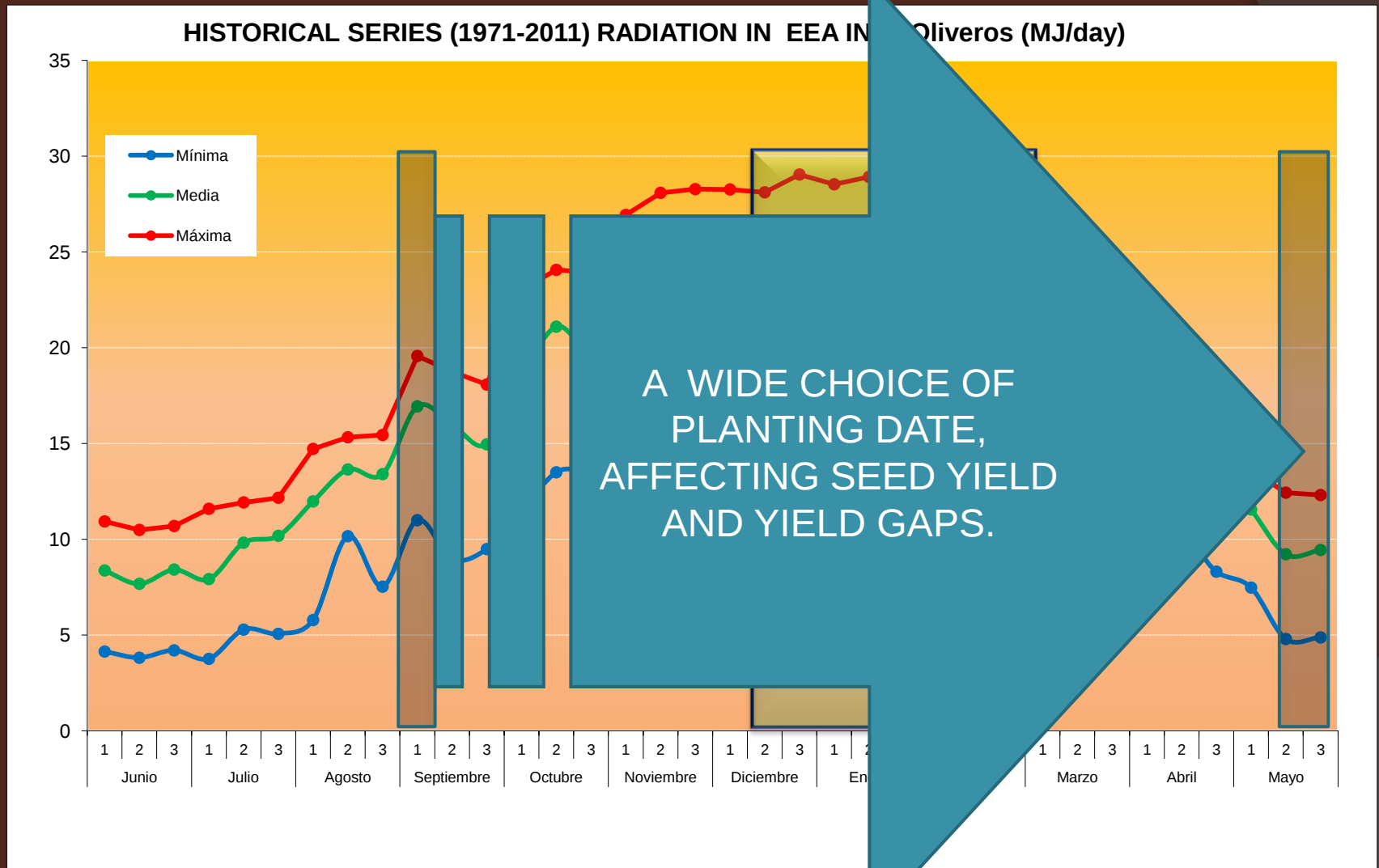
- Santa Fe contributed 20% of nacional production

typical Argiudol predominates
And further south the
Hapludols does.

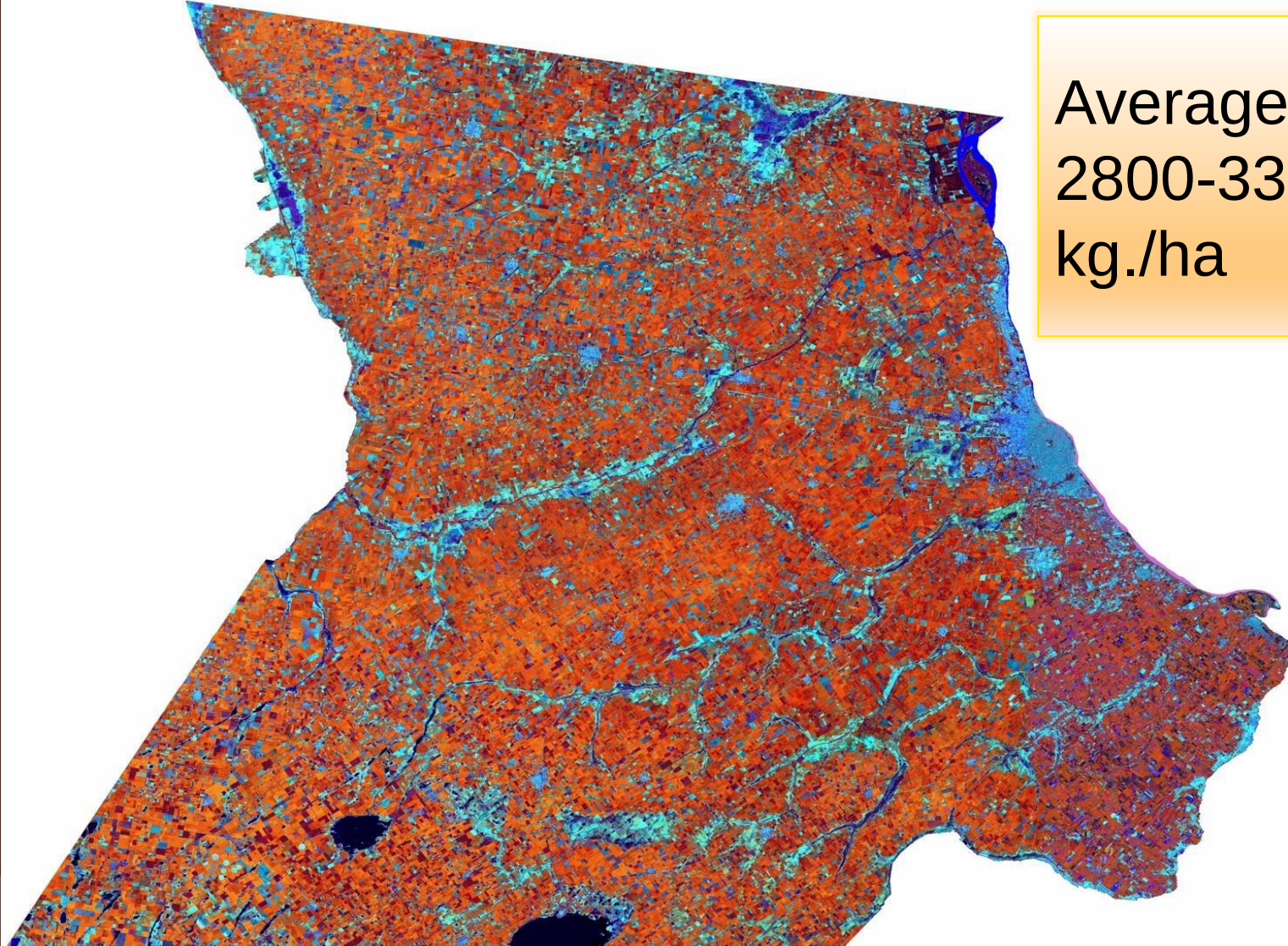


CLIMATE OF PAMPAS REGION

Distribution of radiation and the frost free periods.



70% of the south central area of Santa Fe is devoted to soybean (Source: RIAN)



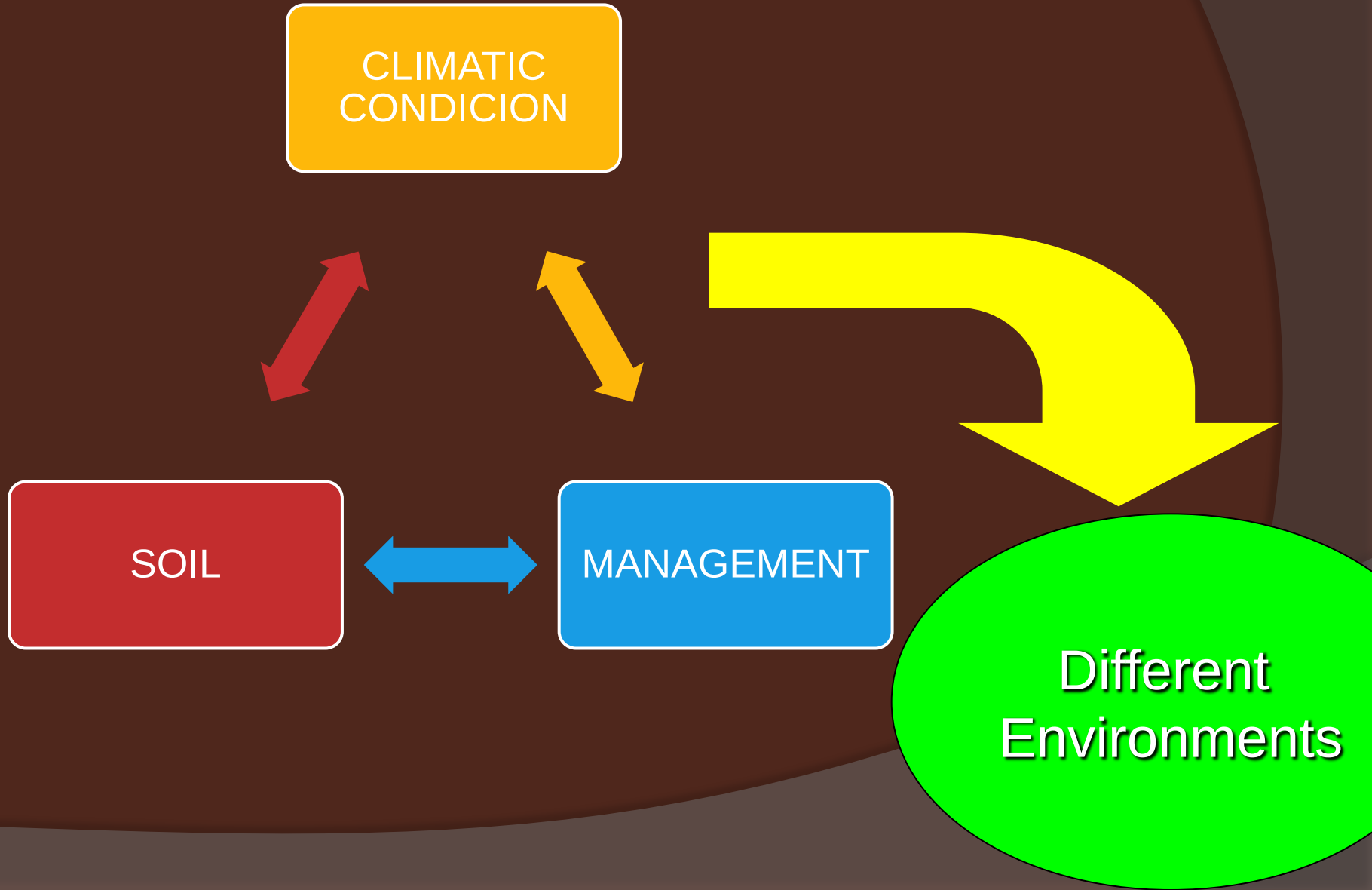
Average yield:
2800-3300
kg./ha



Production per ha

It is IMPORTANT to make
efficient use of the natural
resources and inputs
**PRESERVING THE
ENVIRONMENT!!!**

PRODUCTIVE POTENTIAL OF A REGION



Potential Yield

Water Limited Yield

Actual Yield

YIELD GAP
Temporal
and
spatial variations

Defining Factors:
CO₂
Radiation
Temperature
Genotype

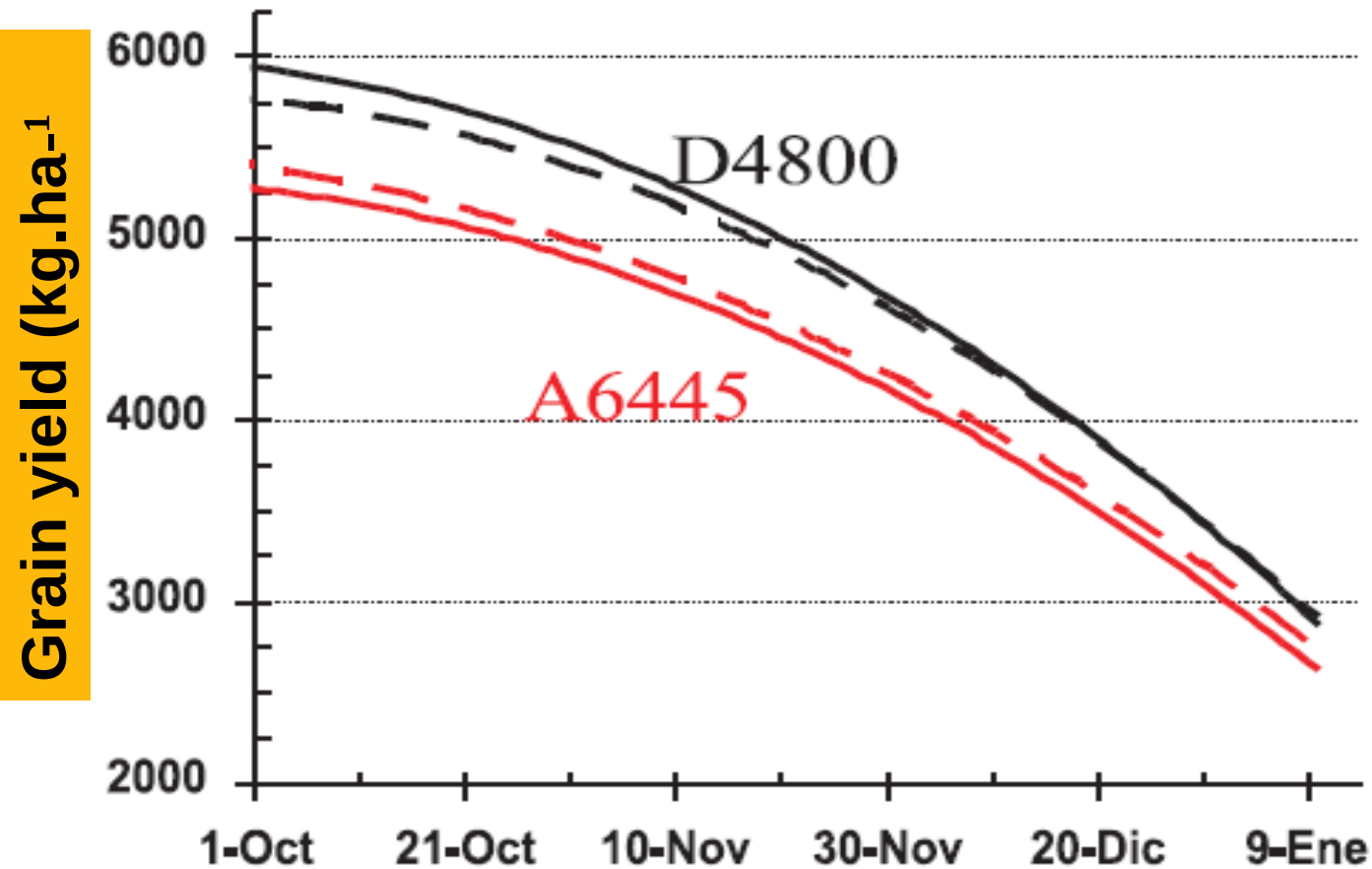
Limiting Factor:
Water

Reducing Factors:
Diseases
Pest
Weeds

MAXIMUM ATTAINABLE YIELD

Place	Sites/years	Yields (kg/ha)	Reference
Experimental Field in Research station			
USA	1 (1980-1983)	6203-7911	Flanery (1984)
USA	1 (1982/85/98/99)	6050-6817	Cooper (2003)
AUSTRALIA	1 (1984)	8004-8604	Lawn et al (1984)
USA	1 (1982/85/98/99)	4642-6603	Cooper (2003)
USA	1 (1999-2005)	4280-5900	Setiyono et al (2007)
Yield Contests			
USA	15 (1966-1969)	5009-7310	Cooper (2003)
ARGENTINA	SEVERAL SITES (1997-2001)	5315-6376	AIANBA

Potential yields according to planting date in Oliveros (solid line) and Santa Isabel (dashed line) for two soybean cultivars



Santa Fe has no recording of the yield gaps in its own area

- ✓ *The aims* of the present study were to
- evaluate Yield Potential
 - water-limited yield potential (WLYP) and
 - Yield Gap between them as affected by planting date and genotype in the Pampas region of Argentina.

MATERIALS AND METHODS

- Field experiments were performed at INTA Oliveros Research Station (32°33'S, 60°51'W), Argentina in 2009 and 2011 seasons.
- Testing 3 genotypes and 3 planting dates under rainfed (R) and irrigated conditions (I):
 - MG III (NA 3731)
 - MG IV (DM 4670)
 - MG V (DM 5.5)

Season	2009	2011
S 1	26/10/2009	01/11/2011
S 2	24/11/2009	25/11/2011
S 3	08/01/2010	27/12/2011

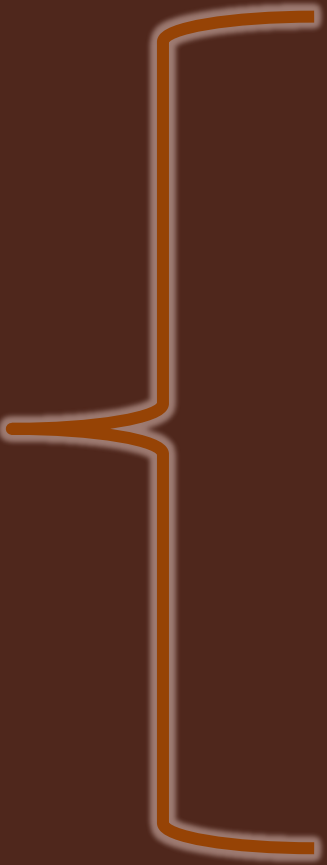
- Treatments were arranged in a RCBD with 3 replications.
- The water treatment was carried out without limitations by means of a drip irrigation system, maintaining soil moisture above 60% of useful water.
- The plots were kept free of weeds, pests and diseases.

- Cumulated radiation
 - Cumulated rainfall
- were calculated for the periods E-R1, R1-R5 and R5-R7 for the different genotypes.

At harvest were measured :

- seed yield (SY)
- pod number per square meter (PNm²)
- pod number per plant (PNpl)
- individual seed weight (SW)

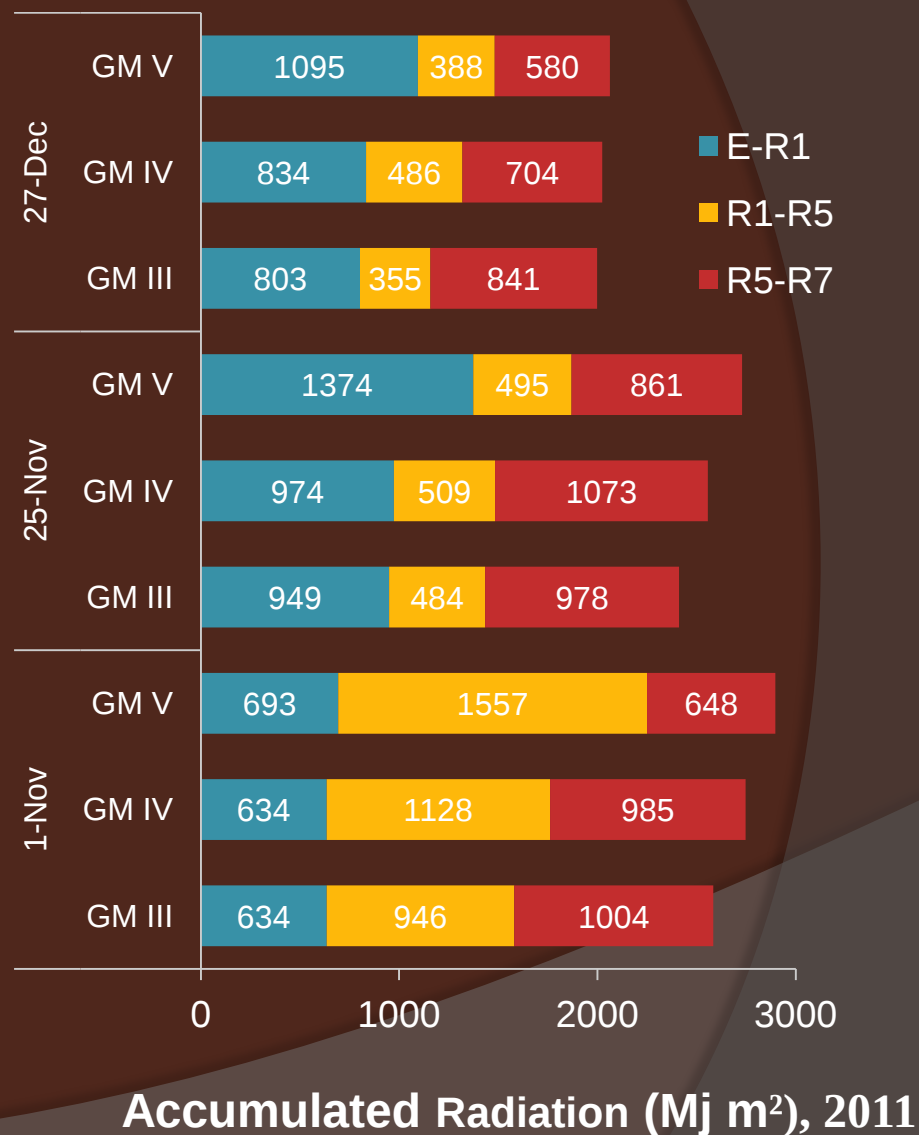
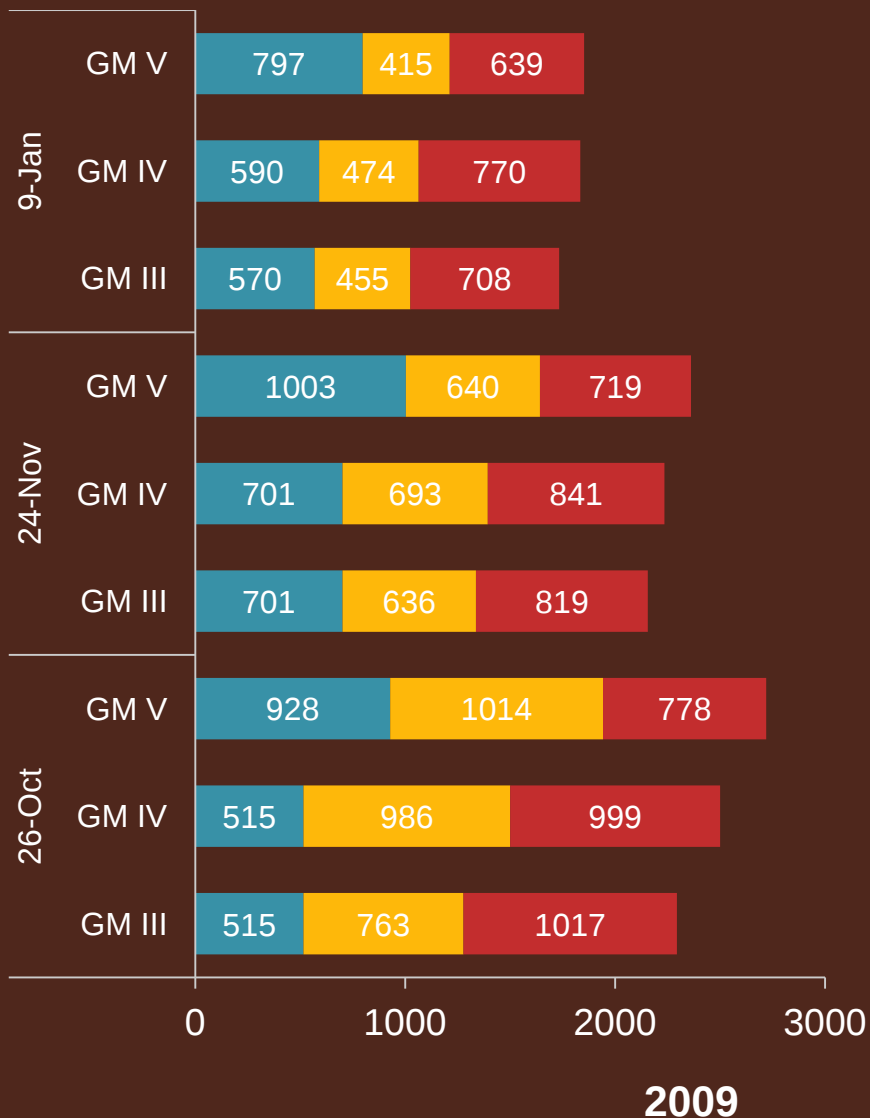
RESULTS:



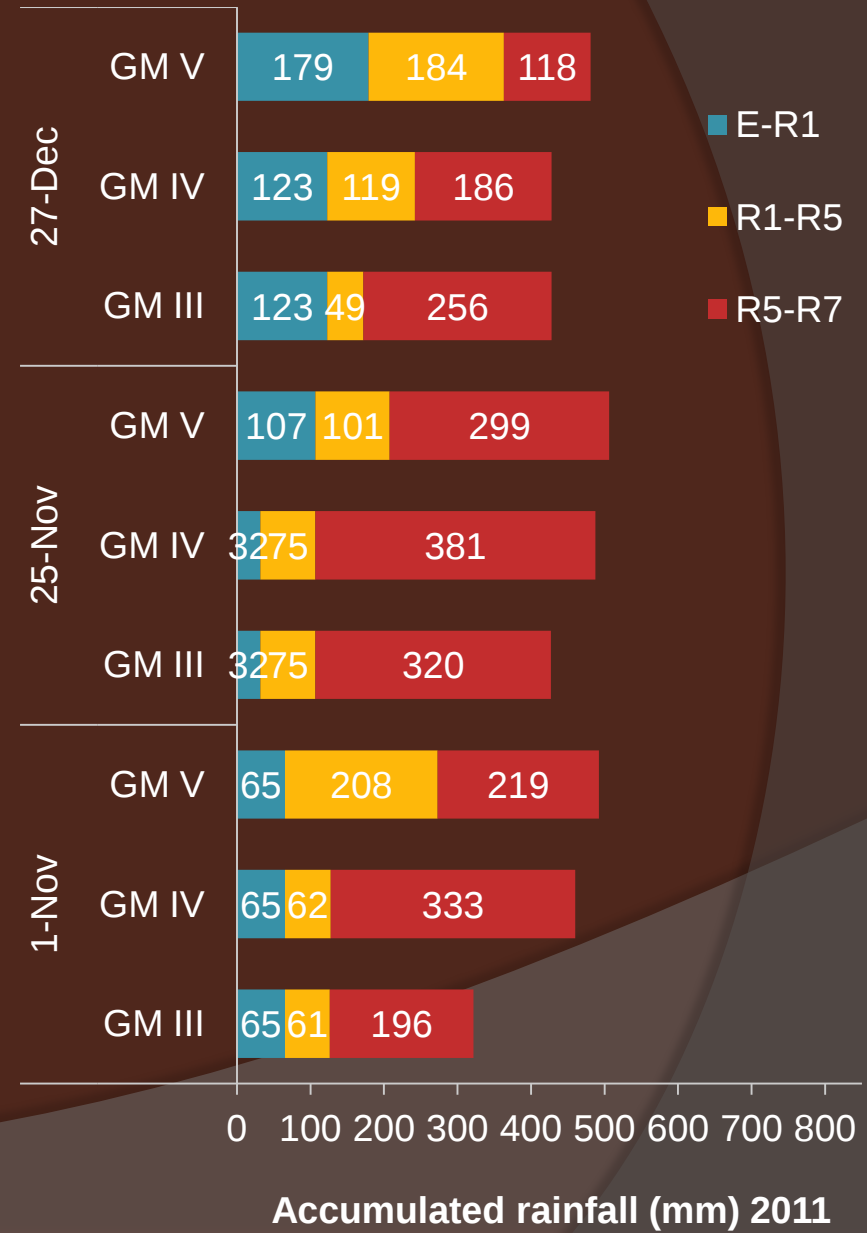
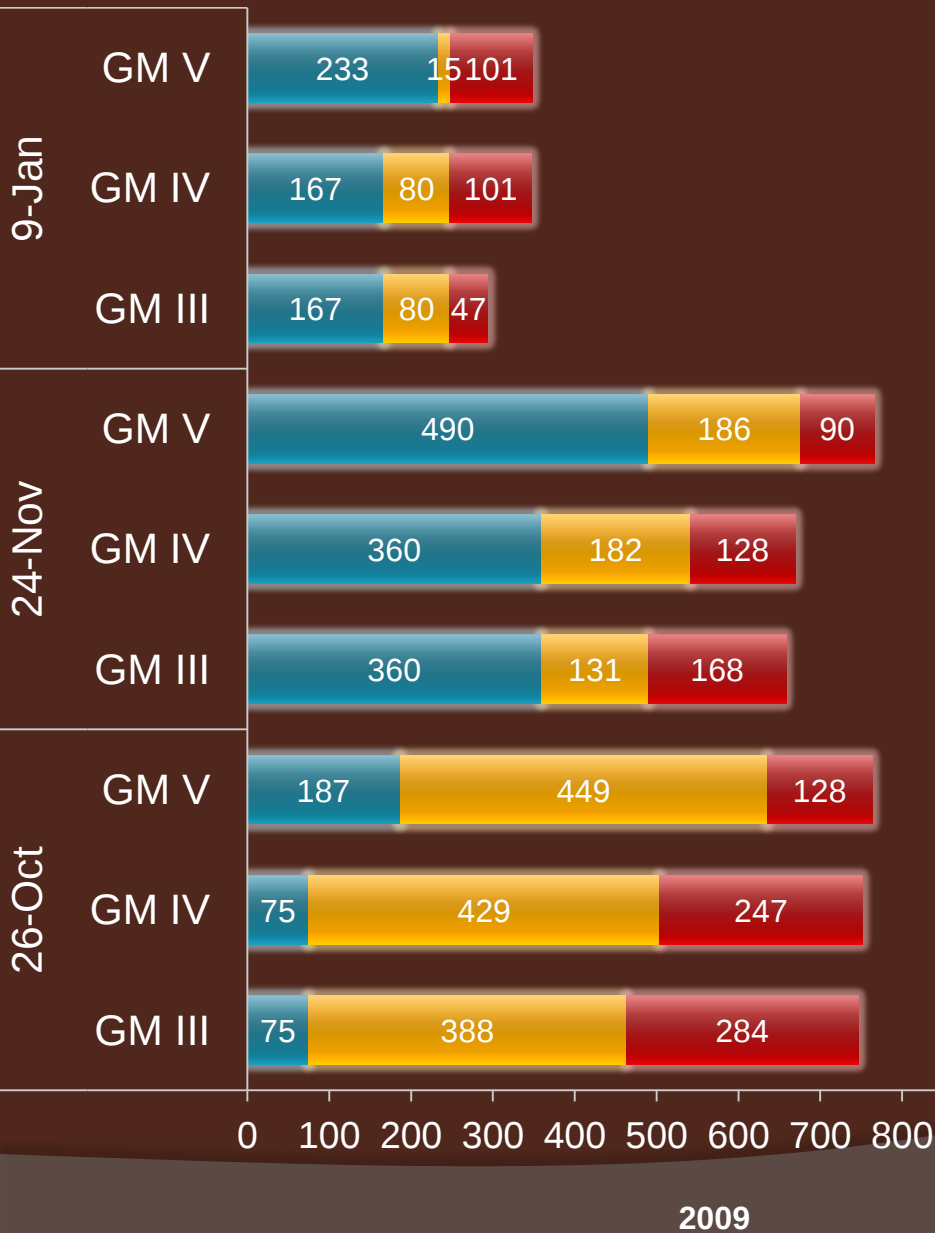
» *AVAILABLE RESOURCES*

» *MAXIMUM ATTAINABLE YIELD*

AVAILABLE RESOURCES: Accumulated Radiation



AVAILABLE RESOURCES: Accumulated Rainfall



MAXIMUM ATTAINABLE YIELD

Trial	IRRIGATED			RAINFED		
Planting date	S 1°	S 2°	S 3°	S 1°	S 2°	S 3°
09-10	6004	4778	4649	5434	4565	3917
11-12	4442	4304	3009	4222	4184	2824

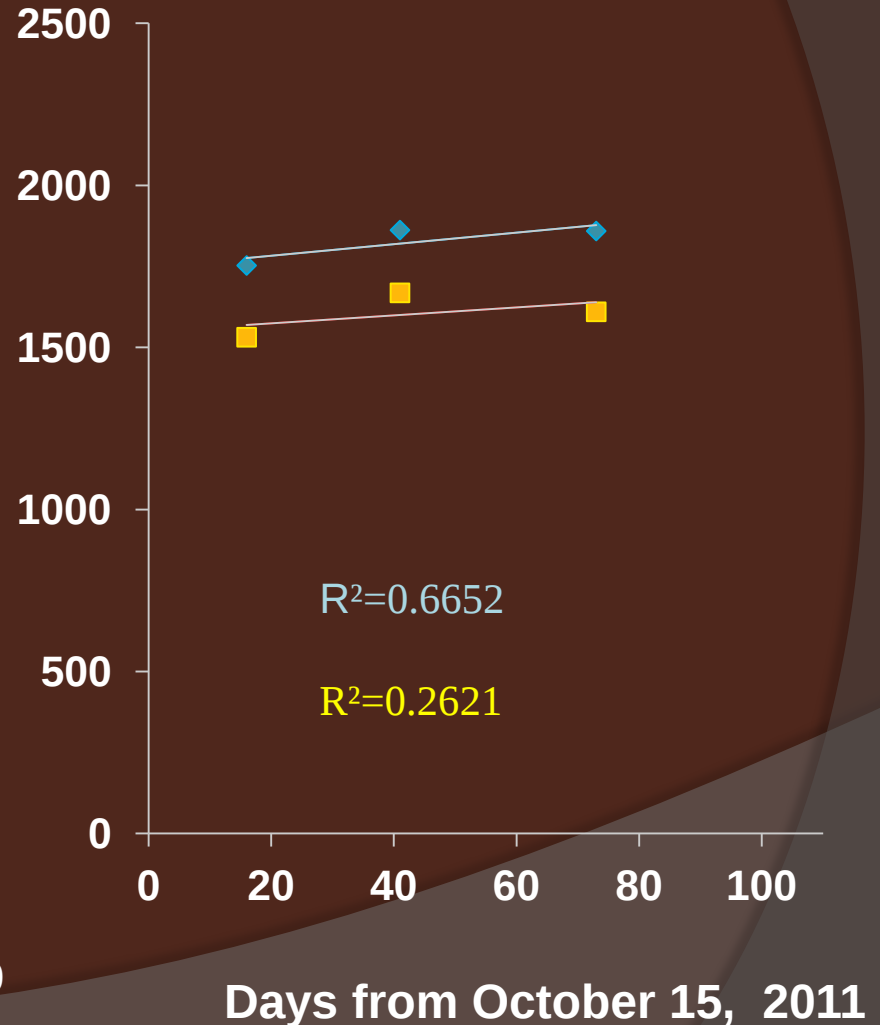
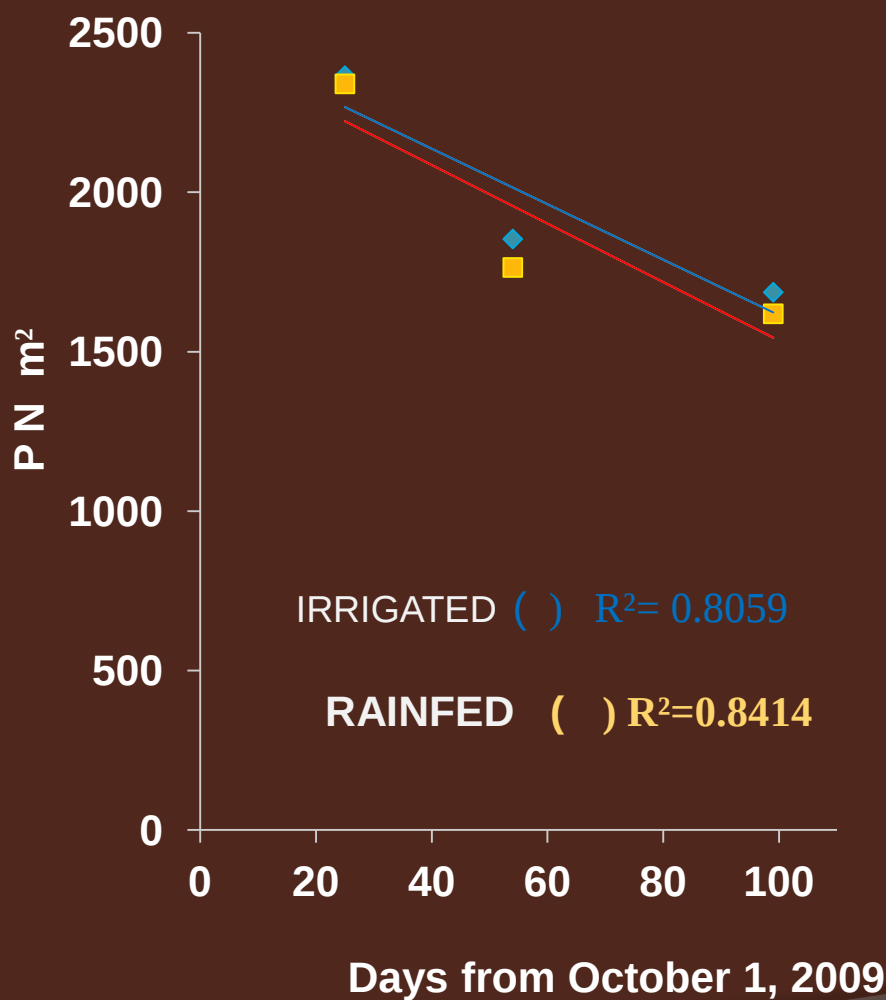
	Yield decrease rate (kg. dia ⁻¹)	
	IRRIGATED	RAINFED
09-10	16	19
11-12	25	24

YIELD GAPS

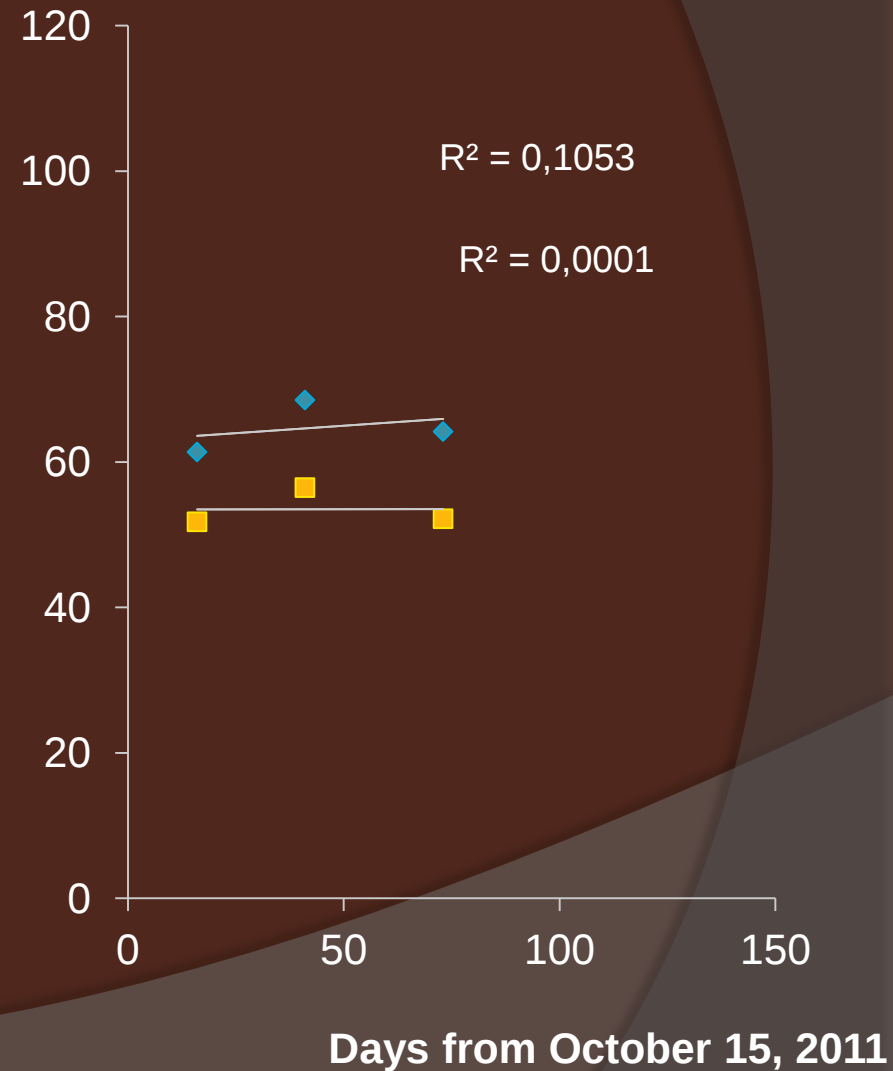
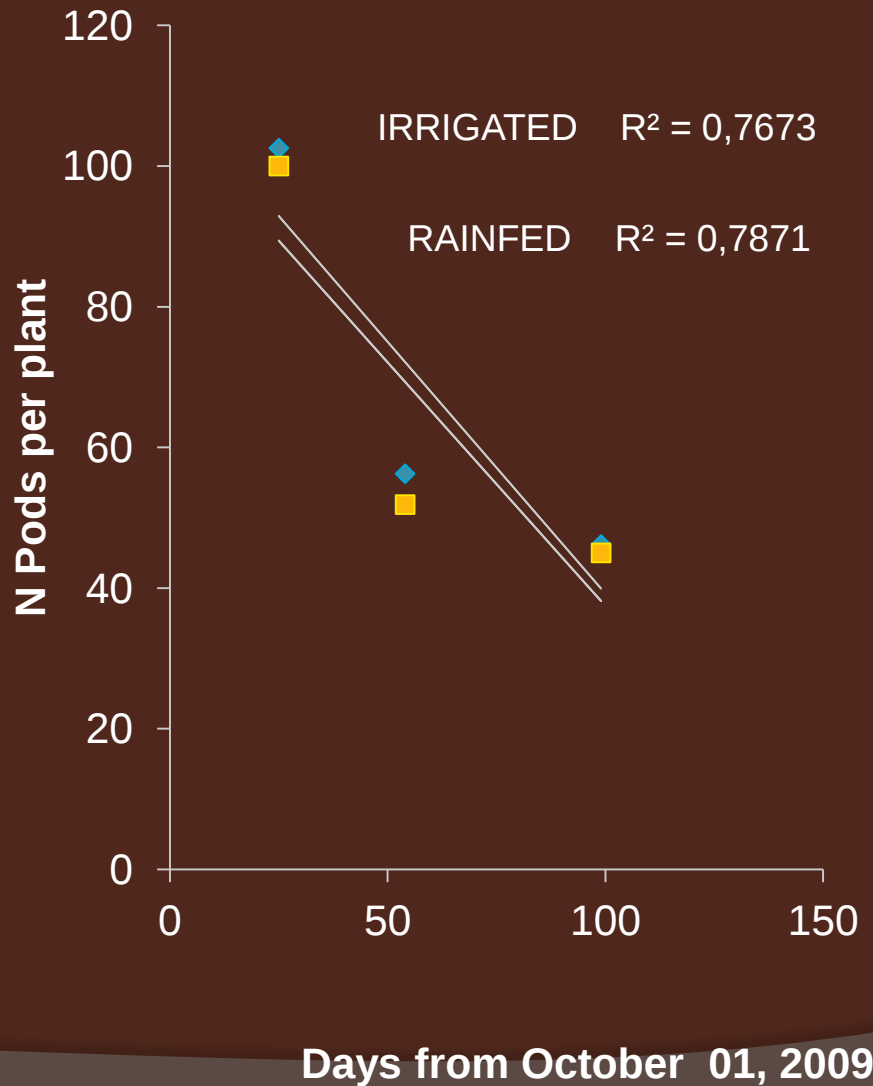
Production Potential trials EEA Oliveros
(2009/10- 2011-2012)



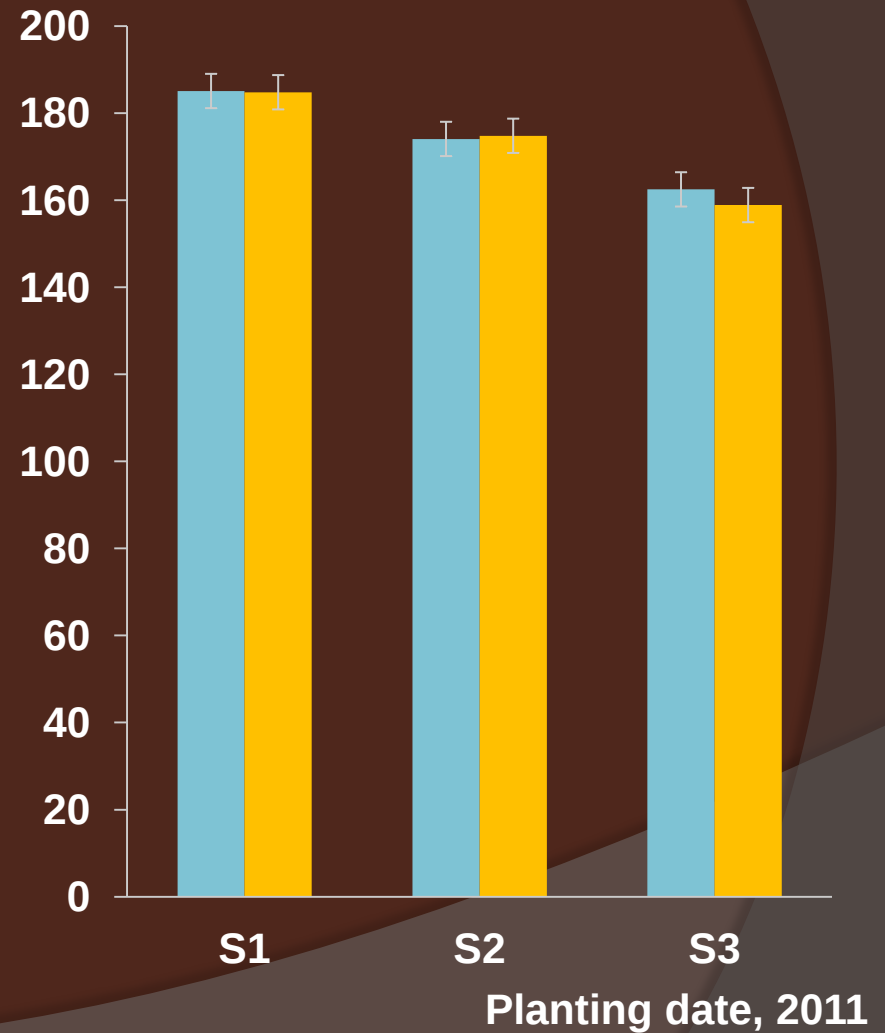
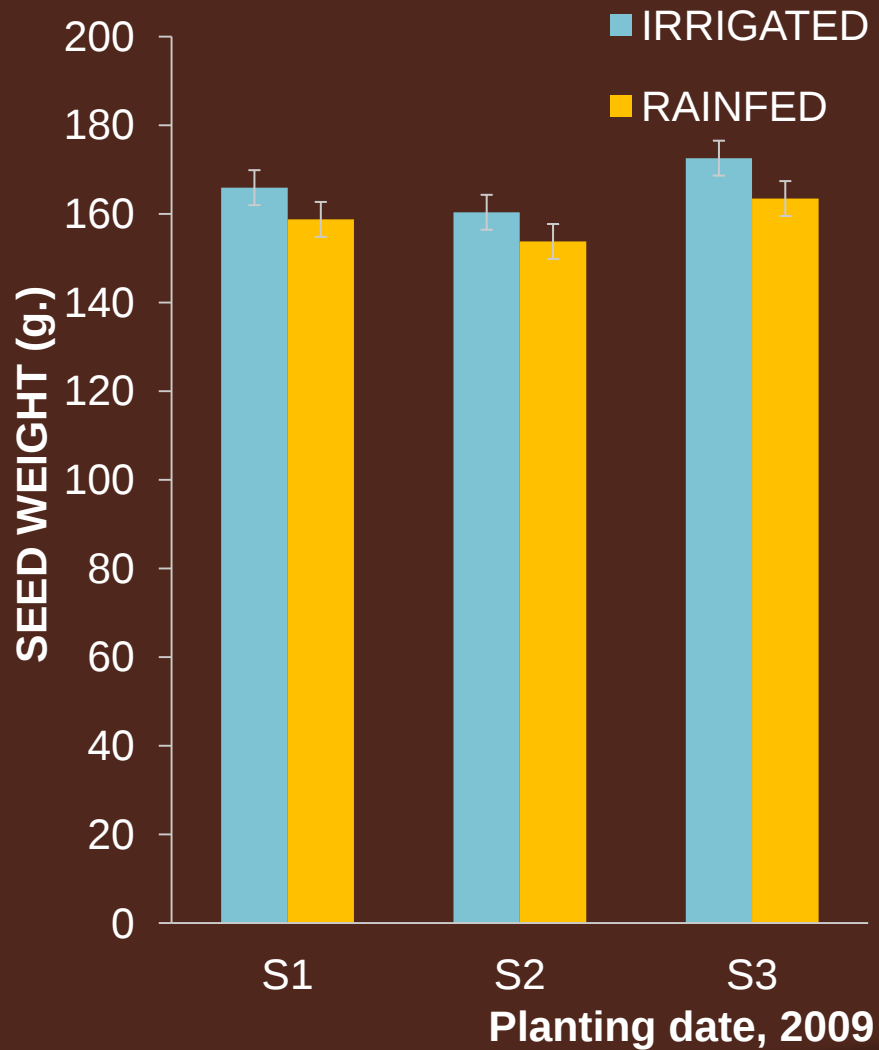
Pods Number (m²)



Pods Number per Plant



Seed Weight (g)



Field experiments season 2009 in Oliveros.

GM V (Rainfed)



GM V (Irrigated)



CONCLUSION

- ❖ Early planting dates showed the highest YP and WLYP.
- ❖ The shortest Yield Gap were detected in intermediate planting dates (in November)

***YIELD GAP IS MORE LIKELY TO BE
REDUCED BY INTERMEDIATE
PLANTING DATES.***

CONCLUSION

- ❖ The number of pods per square meters and plant were affected by the late planting
- ❖ While the seed weight was not affected by the delay in planting.

Thank You!!!



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