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Webinar

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General info

- Università degli studi di Perugia

Dipartimento di Scienze agrarie, Alimentari e Ambientali	
BSc	Scienze Agrarie e Ambientali (curriculum: biotecnologie agrarie)
MSc	Biotecnologie Agrarie e Ambientali

- Research thesis:

Phenotyping of agronomic traits in a pre-breeding tomato (*Solanum lycopersicum L.)* population

- Supervisor: Massimiliano Beretta

- ISI Academy internship: 22/07/2019 – 20/09/2019

Introduction and Objectives

- **Topic area**: phenotyping of a NAM (Nested Association Mapping) population inside a processing tomato breeding project.
- **Questions**:
  - are there correlations between detected traits?
  - observation of heterosis between lines and hybrids: are there lines that increase heterosis?
- **Answer**: hybrid seed production has a higher cost which can be compensated by the high production achieved compared to traditional lines.
- **Objective**: Identify the female lines with the best specific combination attitude (ACS).

Methodology

NAM population: 25 Lines and 25 hybrids, produced crossing the female lines with the pollinating “Heinz 1706-BG”.

Type of study: 17 traits

Physiological findings:

CHL – SPAD – TotCH (µg/cm²)

10 measurements for plot

Qualitative findings:
- Weight and Volume 10 fruits
- Weight of pericarp, placenta and centrifugate
- °Brix and pH

Quantitative findings:
- Weight of the epigean part
- Number and weight of ripe and immature fruits

Methodology

The collected data were processed using the statistical software R

```
NAM<-read.csv("C:\\Users\\user\\Documents\\Francesco\\TESI\\NAM_def.txt", sep = "\t", head=T)


TOTALE_COR <- matrix(NA, 17, 17)
TOTALE_PVAL <- matrix(NA, 17, 17)

for(ii in 5:21) {
  for(jj in 5:21) {

    RES_COR <- cor.test(nam[,ii], nam[,jj])

    TOTALE_PVAL[ii-4,jj-4] <- RES_COR$p.value
    TOTALE_COR[ii-4,jj-4] <- RES_COR$estimate
  }
}

write.table(TOTALE_COR, "TOTALE_COR.txt", sep = "\t")
write.table(TOTALE_PVAL, "TOTALE_PVAL.txt", sep = "\t")
```

Results

Correlations (*r*)

TRAITS		*r*	*P*
Peso 10 frutti (g)	Volume (ml)	0,995	***
Peso 10 frutti (g)	**Peso placenta (g)**	**0,713**	***
Peso 10 frutti (g)	Peso centrifugato (g)	0,980	***
Peso 10 frutti (g)	Peso pericarpo (g)	0,995	***
Peso pericarpo (g)	Volume (ml)	0,991	***
Peso pericarpo (g)	Peso centrifugato (g)	0,984	***
Peso centrifugato (g)	Volume (ml)	0,975	***
SPAD	CHL	0,994	***
TotCH(ug cm)	CHL	0,999	***
TotCH(ug cm)	SPAD	0,992	***

TRAITS		*r*	*P*
Kg frutti verdi	n.frutti verdi	0,663	**
pH centrifugato	pH placenta	0,697	***
Peso placenta (g)	**Volume**	**0,691**	***
Peso placenta (g)	**Peso pericarpo (g)**	**0,675**	***
Brix pericarpo	Brix placenta	0,689	***

***: $P<0,005$ **: $P<0,05$

- Fruit growth is strongly associated with placental development

Results

Test t-Student ⟶ comparison between lines and hybrids for the three traits of greatest commercial importance:

- Total production (kg/plant)
- Soluble solids content (°Brix)
- pH

Comparison between individual genotypes:

all female lines were compared with the respective hybrid, to check whether or not a heterotic effect had occurred.

Heterosis (H) was measured as the difference between the average of the F1 progeny and that of the two parental lines (P), according to the formula:

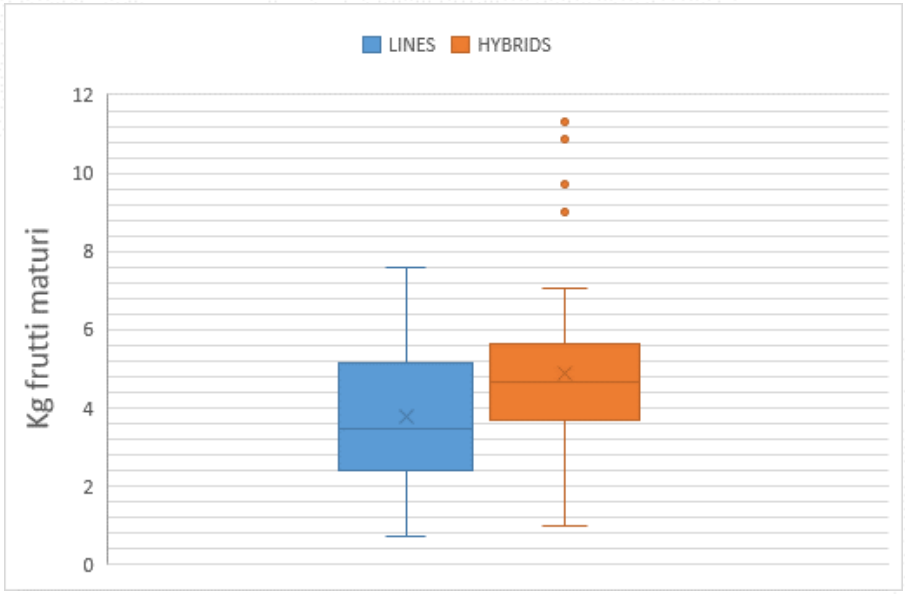
$$H = F1 - P$$

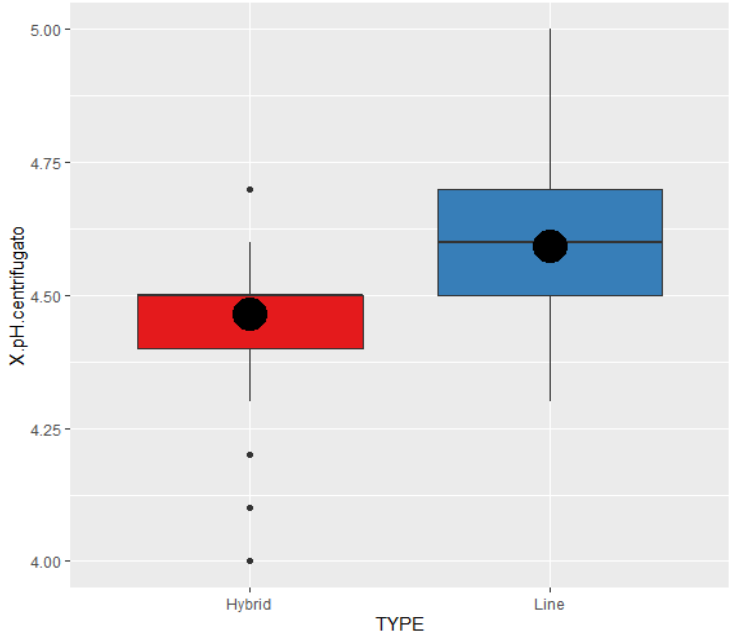
Discussion

Kg frutti maturi	LINES	3,77	*a (*)*
	HYBRIDS	**4,89**	
°Brix	LINES	4,45	*b*
	HYBRIDS	4,38	
pH	LINES	4,59	*a (***)*
	HYBRIDS	**4,47**	

*: $P < 0,05$

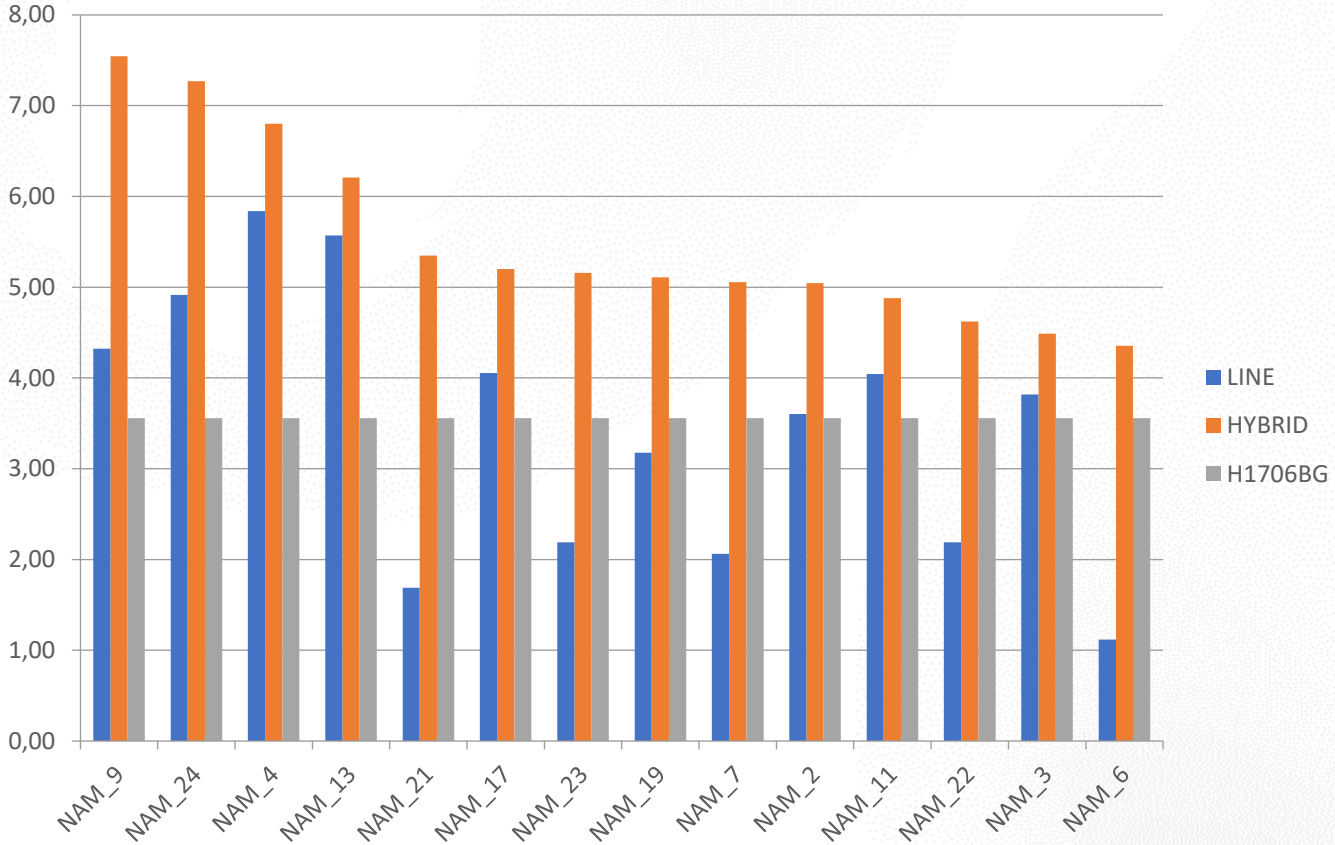
***: $P < 0,001$





Discussion

Weight of ripe and marketable fruits

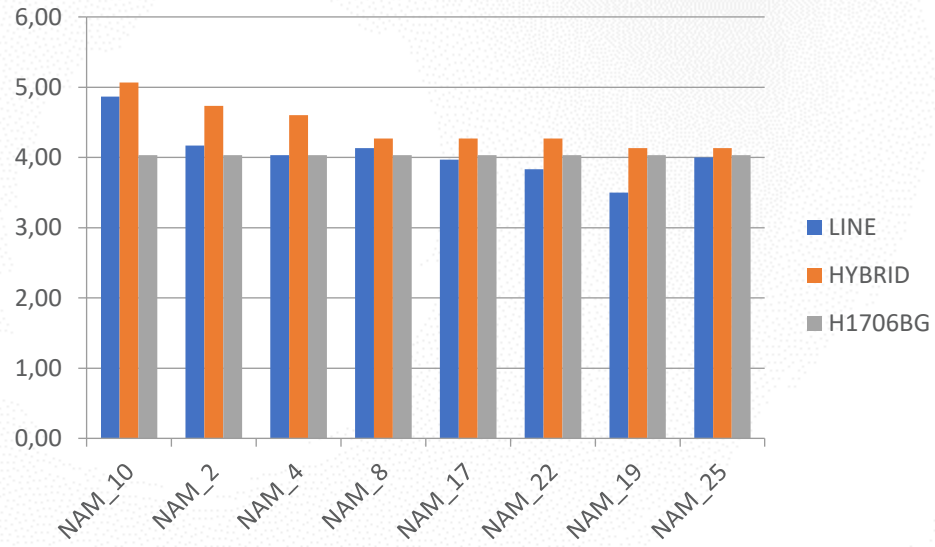


	Mean (kg)	*h*
NAM_9	7,55	3,61
NAM_24	7,27	3,03
NAM_21	5,35	2,72
NAM_23	5,16	2,29
NAM_7	5,05	2,25
NAM_4	6,80	2,1
NAM_6	4,35	2,02
NAM_22	4,62	1,75
NAM_19	5,11	1,74
NAM_13	6,21	1,64
NAM_2	5,04	1,47
NAM_17	5,20	1,39
NAM_11	4,88	1,08
NAM_3	4,49	0,8

✓ 14 female lines with good ACS were identified

Soluble solids content (°Brix)

➢ 8 lines increased heterosis for °Brix

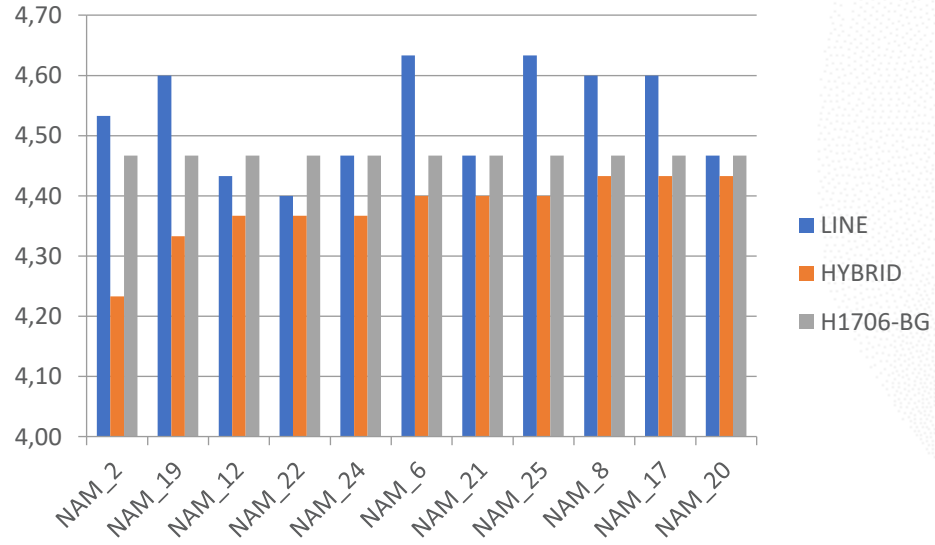


✓ The lines that showed the best ACS with the pollinator were the first three

	Mean	h
NAM_10	5,07	0,63
NAM_2	4,73	0,62
NAM_4	4,60	0,57
NAM_8	4,27	0,37
NAM_17	4,27	0,33
NAM_22	4,27	0,27
NAM_19	4,13	0,18
NAM_25	4,13	0,12

pH

➢ 11 lines increased heterosis for pH



✓ The lines that showed the best ACS with the pollinator were 5

	Mean	h
NAM_2	4,23	-0,27
NAM_19	4,33	-0,2
NAM_6	4,4	-0,15
NAM_25	4,4	-0,15
NAM_8	4,43	-0,1
NAM_17	4,43	-0,1
NAM_24	4,37	-0,1
NAM_12	4,37	-0,08
NAM_21	4,4	-0,07
NAM_22	4,37	-0,07
NAM_20	4,43	-0,03

Conclusions

The work carried out has made it possible to evaluate the ACS of the FEMALE lines, in view of further crossings between lines aimed at the production of commercial hybrids

The F2 seed was collected from hybrid genotypes to develop the real second generation NAM population which will undergo a new phenotyping work.