Drought effects on the synchrony of above and belowground phenology in potato

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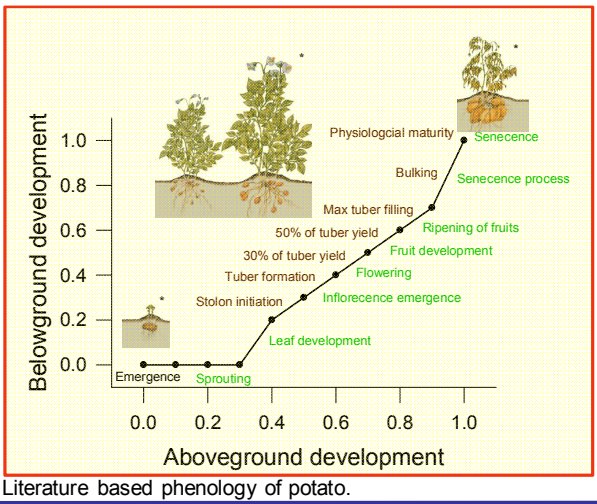
Introduction

In literature the below- and aboveground development of potato is described to be quasi-linearly related. Many agronomic studies in potato use non-destructive above-ground phenology to assess below-ground development. In order to assess the effects of drought on the synchrony, it is important to know how the above and belowground development is maintained or broken.



Literature based phenology of potato.

Conclusions

- The sychrony between above and belowground development is changed under drought.
- Under early drought, aboveground development is accelerated and below-ground development delayed. Under late drought belowground development is hastened.
- It is important to investigate the above-ground development separately from the belowground development for each treatment and genotype.

Results and Discussion

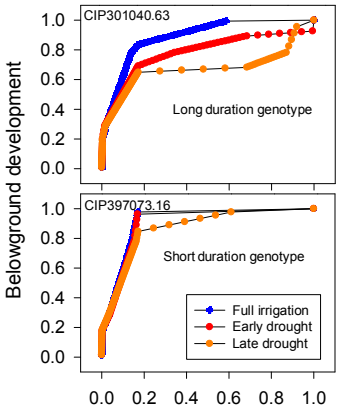
Genotypic response on drought

	Full irrigation				
	CIP392797.22	CIP301040.63	CIP392025.7	CIP397073.16	CIP397078.12
	ID	LD	ID	SD	LD
Tuber yield (g pl^{-1})	627 ± 101	365 ± 79	584 ± 155	708 ± 153	684 ± 89
Tubers physiological maturity (DAP)	81	99	81	69	89
Senescence (DAP)	100	115	100	85	112
	Early drought				
Tuber yield (g pl^{-1})	171 ± 26	13 ± 5	212 ± 35	273 ± 100	184 ± 26
Tubers physiological maturity (DAP)	70	118	100	69	79
Senescence (DAP)	86	105	80	84	93
	Late drought				
Tuber yield (g pl^{-1})	875 ± 170	398 ± 41	722 ± 161	666 ± 190	635 ± 134
Tubers physiological maturity (DAP)	84	104	79	79	79
Senescence (DAP)	85	109	84	85	90

Days after planting (DAP)
LD: long duration genotype, ID: intermediate duration genotype,
SD: short duration genotype

- Under early drought smallest tuber yields in combination with early above-ground senescence were analysed.
- Under drought physiological maturity of tubers is indenpendent of aboveground senecence processes.
  - Phenological responses and yield levels varied between treatments and genotypes.

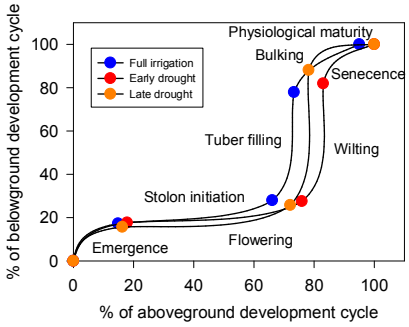
Duration effect on drought response



Aboveground development: 0-0.1; Emergence, 0.1-0.2 ; Flower, 0.2-0.65; Wilting, 0.66-1.0; Senescence.
Belowground development: 0-0.1; Emergence, 0.1-0.3; Stolon initiation, 0.3-0.75; Tuber filling, 0.76-1.0; Tuber bulking/physiological maturity.

- Genotypic disparity between aboveground and below ground development.
  - Shifting development pattern caused by drought.

Drought effects on synchrony



Relative development phases of five genotypes

- Stolon initiation accounted for 11%, tuber filling for 50% and bulking for 22% of the time to physiological maturity under full irrigation. Under drought, tuber filling phase was prolonged and bulking phase was shortened.
  - The sychrony between above and belowground development is shifted under drought.

Materials and Methods

Field trials were conducted between July 2013 and August 2014. Five potato genotypes were planted in a randomized split plot design with three replications. The genotypes tested were: CIP 392797.22, CIP 301040.63, CIP 392025.7, CIP 397073.16 and CIP 397078.12. Three irrigation treatments were applied: fully watered (340mm/4 month), early terminal drought initiated at 50 days after plating (DAP) and late drought where irrigation was withheld at 80 DAP. Soil moisture were measured in 3-5 day intervals. Aboveground phenological development was evaluated in 5 day intervals. Tubers were harvested in 10 day intervals to determine belowground development und tuber weight.

*Pictures from www.agrar.basf.de

Phenological assessment at 70 days after planting

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