



Smartfertilizationday

November 25th 2016
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Facts on N-uptake:

- Grain yield is predetermined by N-uptake in early stages(*)
- 25-50% of N-uptake after silking(**)

Activ'N	Urea	NH ₄ ⁺	P ₂ O ₅	K ₂ O	SO ₃	CaO	MgO	Na ₂ O	Npro
18	8%	10%			25%	8%	4%	4%	✓
20	10%	10%			35%	5%	3%		✓
23	8%	15%			43%	5%			✓
24	12%	12%			35%	5%	5%		✓
26	20%	6%			25%	4,5%	3%		✓
30	25%	5%			20%	2%	3%		✓
32	26%	6%			18%	3%			✓
13-0-17	4%	9%		17%	25%	3%	3%		✓
13-5-17	4%	9%	5%	17%	20%	4%	3%		✓
16-5-8	3%	13%	5%	8%	30%	2%	3%		✓



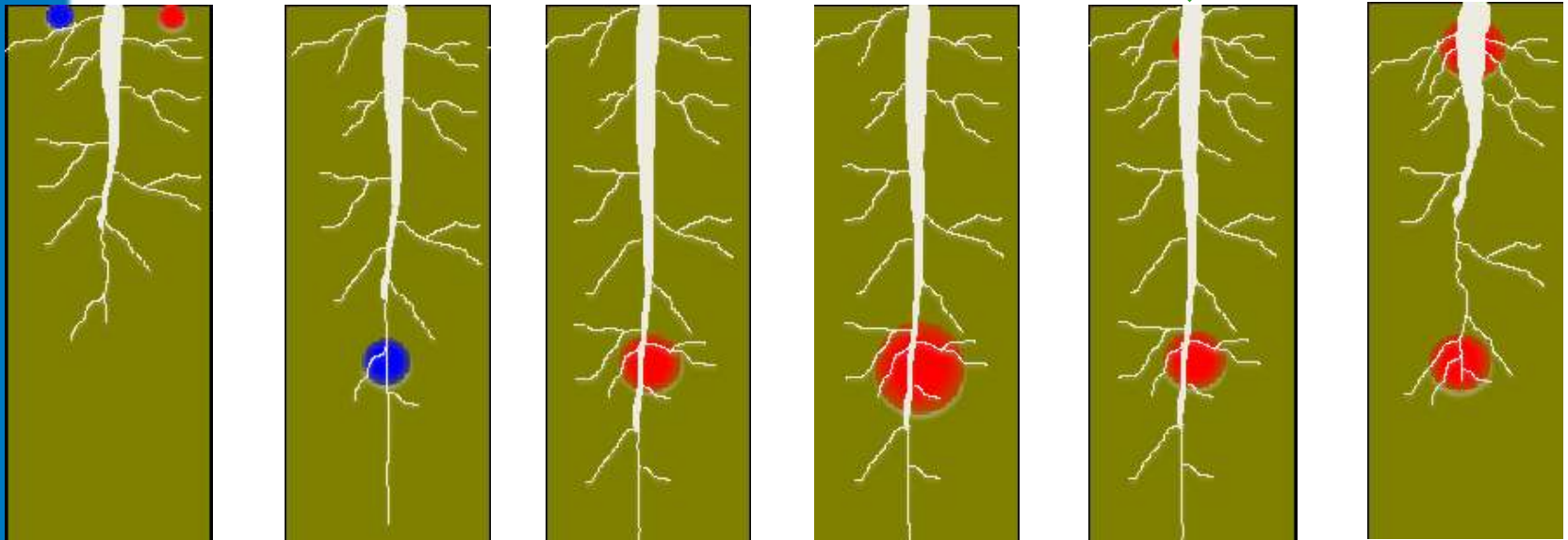


Small quantities placed on the right place promotes and attracts root growth

Placement of elements shapes root architecture.

A starter application of N+P in combination with basic N+P placed on distance, gives maximum root development.

SMART choice





P starter has a positive effect on early plant development and root growth and root architecture

Timac Agro introduced a NK micro-granular (Physiostart NK) in 2010 for farmers with no P surplus from slurry and average to high Pw-soils

Results from NK precision fertilization were fair-good... but low soil P and cold temperatures make effectiveness less.



Facts on Low Temperature:

- Low soil temp inhibits root growth (1)
- Lower P-uptake(1)
- Lower P-availability to plants, slower diffusion(2, 6)
- Lower P-available quantity(2)
- Shoot/Root growth is retarded, but P is still taken-up and stored(3)
- Lower P solubility (6)
- **Rate of root growth determines P-uptake mostly(4)**

Facts on Low P:

- Inhibits shoot+root growth(5)
- Lower photosynthesis capacity (5)
- Smaller axillary meristem, smaller ears(6)
- Changes root architecture



Facts on P-fertilization at low temp and/or low soil P

- Yield improvement when P is applied in patches⁽⁴⁾
- Yield improvement when P is applied together with (little) NH_4^+ ^(5,6, 7): $\text{NH}_4^+ > \text{NO}_3^-$
(solubility of $\text{CaP} + \text{H}_2\text{PO}_4^-/\text{HPO}_4^{2-}$ shift to H_2PO_4^-)
- Improves P-influx/root length⁽⁵⁾
- Increases N+P uptake in early growth ⁽⁸⁾
- Acid Growth Principle increases P-uptake
- $\text{NH}_4^+ + \text{P} > \text{NO}_3^- + \text{P}$ or Urea+P⁽⁹⁾
- **P starter application can off-set the adverse effect of low temp on P-uptake** ^(1,2,3)

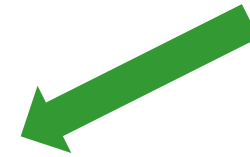
What "Product" are we suppose to feed?



Many laterals on shallow roots



Ideotype



Many laterals on deep roots

Deep+Steep
related traits

		Day 12				
Principal Component #		PC1	PC2	PC3	PC4	PC5
Variation Explained (%)		35.99	23.49	15.37	10.83	7.33
Vector Loadings	Bushiness	0.08	-0.61	-0.11	0.62	0.36
	Surface Area	0.75	0.60	0.06	0.11	0.17
	Perimeter	0.90	0.24	0.21	0.23	-0.11
	Major Ellipse Axes	0.59	-0.45	0.30	-0.45	0.30
	Network Area	0.82	0.52	0.06	0.07	0.08
	Total Length	0.88	0.30	0.21	0.26	-0.06
	Minor Ellipse Axes	0.84	-0.08	-0.37	-0.32	-0.07
	Width-Depth Ratio	-0.34	-0.06	0.86	-0.21	0.14
	Median Number of Roots	-0.07	0.72	0.49	-0.17	-0.33
	Depth	0.81	-0.15	-0.50	-0.10	0.00
	Max Width	0.59	-0.29	0.57	-0.35	0.24
	Length Distribution	0.15	-0.60	-0.08	0.61	0.39
	Average Root Width	-0.42	0.59	-0.33	-0.28	0.43
	Network Convex Area	0.91	-0.19	0.03	-0.29	0.07
	Ellipse Axes Aspect Ratio	0.44	0.34	-0.69	0.06	-0.29
	Volume	0.29	0.79	-0.09	0.07	0.46
	Solidity	-0.49	0.75	-0.01	0.34	-0.01
	Specific Root Length	0.43	-0.58	0.18	0.20	-0.54
	Maximum Number of Roots	0.33	0.31	0.63	0.57	-0.06

Shallow
related
traits

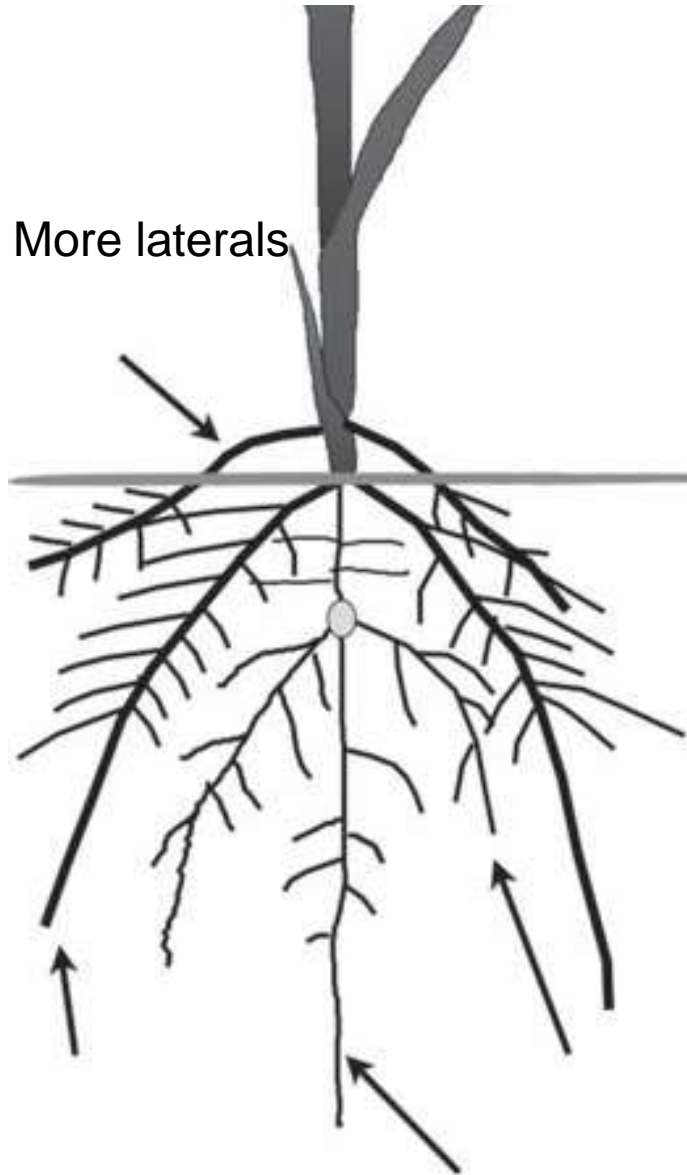


Modern corn varieties:

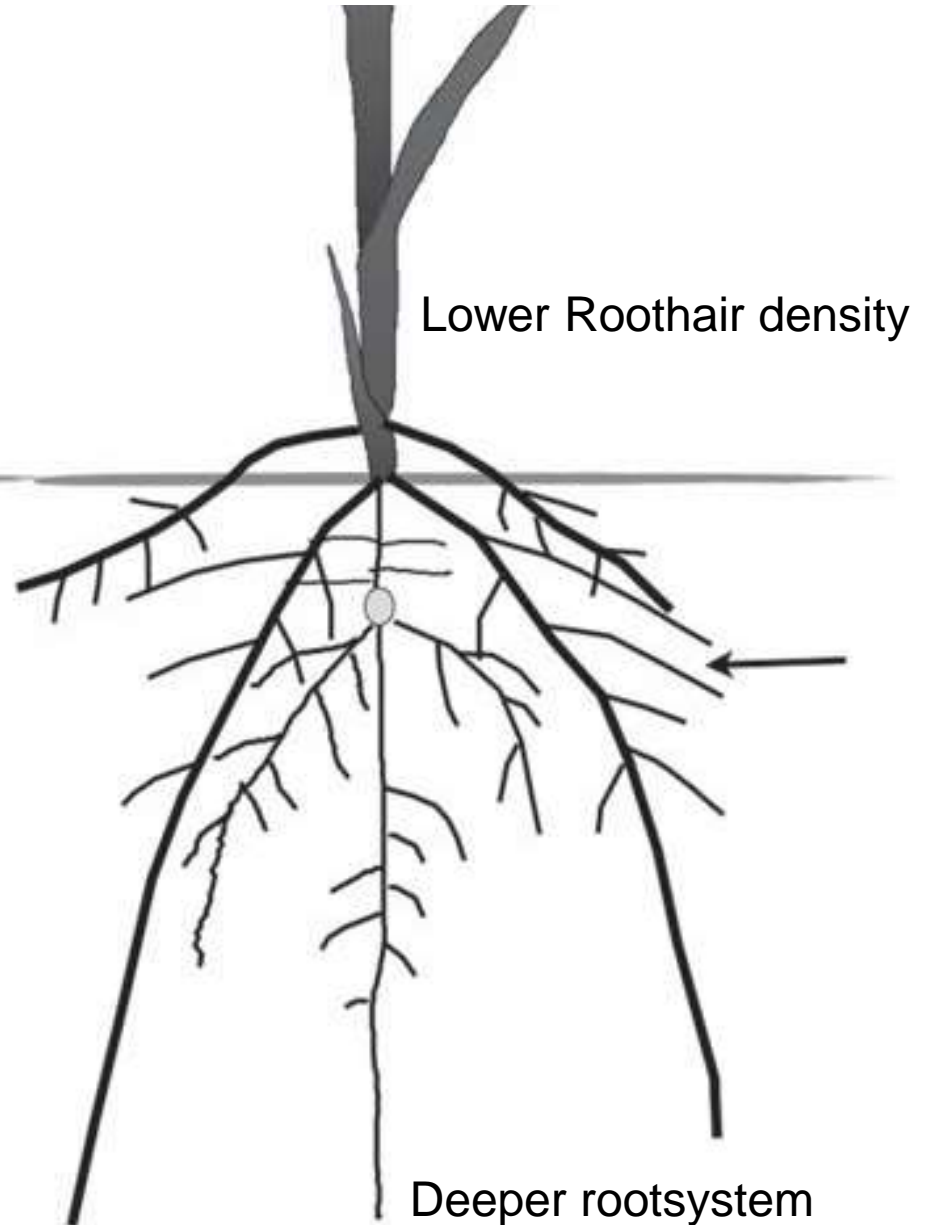
- Fewer crown/axial roots
- Less laterals on seminal roots
- Greater distance between laterals
- Deeper roots
- Steeper roots

Modern Root Architecture not optimal for P acquisition

Root architecture under high P



Root architecture under low P



Early Phosphorous + Aminopurines (Physio⁺) promotes root cluster formation



=Basic concept for mode of action on micro-granular starter P fertilization

2016 Field trials

Object	Meststof	Versopbrengst	Droge-stofgehalte	Droge-stofopbrengst
		(ton/ha)	(%)	(ton/ha)
A	Onbehandeld (geen microgranulaat)	22,8 a .	34,9 a	7,97 a .
B	Physiostart 8-28	41,6 . b	35,8 a	14,97 . b
C	Physiostart P Plus 5-24	37,1 . b	35,6 a	13,21 . b
D	Physiostart P Plus 6-16	45,4 . b	36,4 a	16,56 . b
Lsd5%		13,0	2,2	5,1
F-prob. Object		0,018	n.s.	0,021





2016 spring greenhouse pot trial

2016 Treatment	Plant Dry yield (*)	Root Dry yield (*)	Dry yield total plant	mgPup PLANT	mgPup ROOT	mgPup Total
No-P fertilizer	4.30 a	1.72 a	6.02 a	13.0 a	2.93 a	16.0 a
Physiostart NP	5.96 b	2.33 ab	8.29 b	16.4 b	3.79 ab	20.2 b
Physiostart P-Plus	6.51 b	3.25 c	9.76 b	17.8 b	5.07 c	22.8 b
LSD	1.032	0.825	1.580	2.886	1.240	3.669
F pr.	0.002	0.016	<.001	0.038	0.032	0.014

Significantly as good as mineral P

*=Grs/pot



At the left Physiostart P-Plus. At the right Physiostart NK



P- start fertilization: Proof of Concept

- 1- “SMART” precision fertilization in close proximity of roots
- 2- addition of biostimulant Physio+⁺
- 3- addition of NH₄⁺ (local low acidification)
- 4- processing enhancement of raw struvite
- 5- “Deep, Cheap and Steep”, keep plants lean and mean





Roots matter!
Nitrogen matters!

(renewable) Phosphorus matters!

Thanks for your attention, any
questions?