Pengairan dan pembajaan dalam Fertigasi

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SKOP PEMBENTANGAN

- PENGENALAN
- KONSEP PEMBAJAAN (4R)
- KUALITI AIR
- *PEMBAJAAN FERTIGASI*
- BIOSTIMULAN
- RUMUSAN

Fertigasi

01 Pengagihan Air dan Nutrien

02 Pada Zon Pengakaran

03 Menggunakan Baja 100% larut air

04 Dos dan masa yang sesuai.

4R Concept

- ✓ RIGHT **source**
- ✓ RIGHT **rate**
- ✓ RIGHT **time**
- ✓ RIGHT **place**

40%

Pengurusan Nutrien

Pengurusan Tanaman

40%

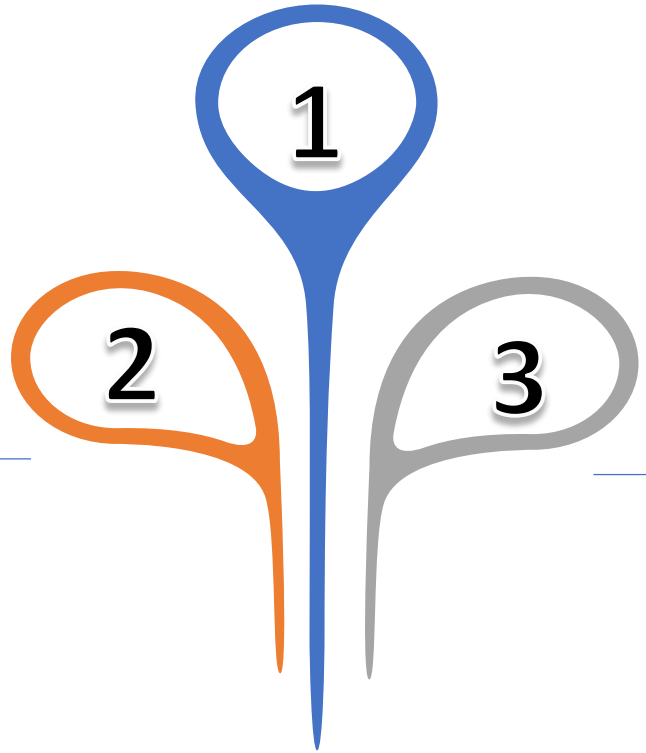
20%

Lain-Lain
(Cuaca, P&D, Pengairan dan Infrastruktur)

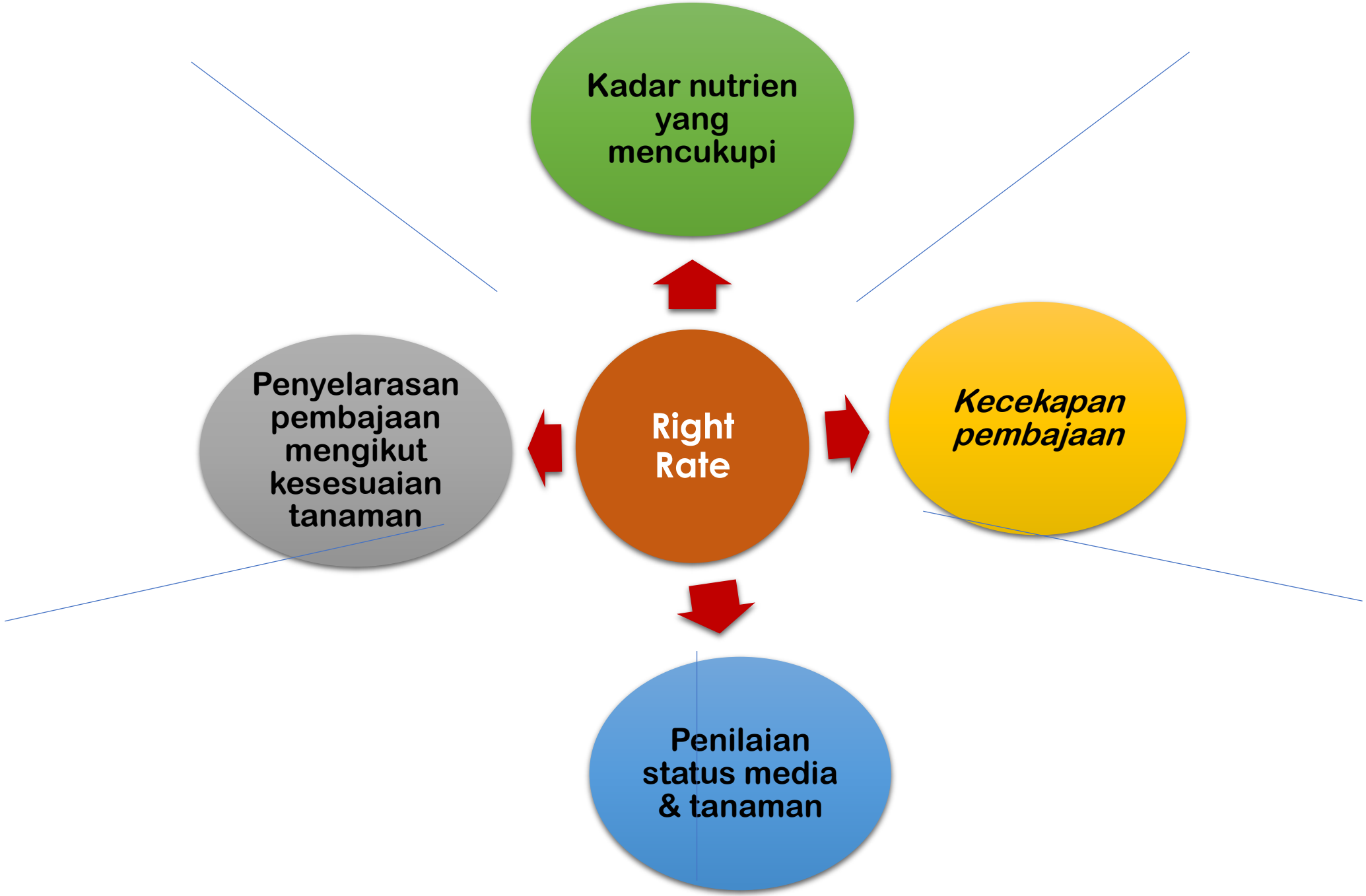
Right Source

Sumber nutrien yang spesifik

Baja Yang Tepat mengikut keadaan semasa tanaman



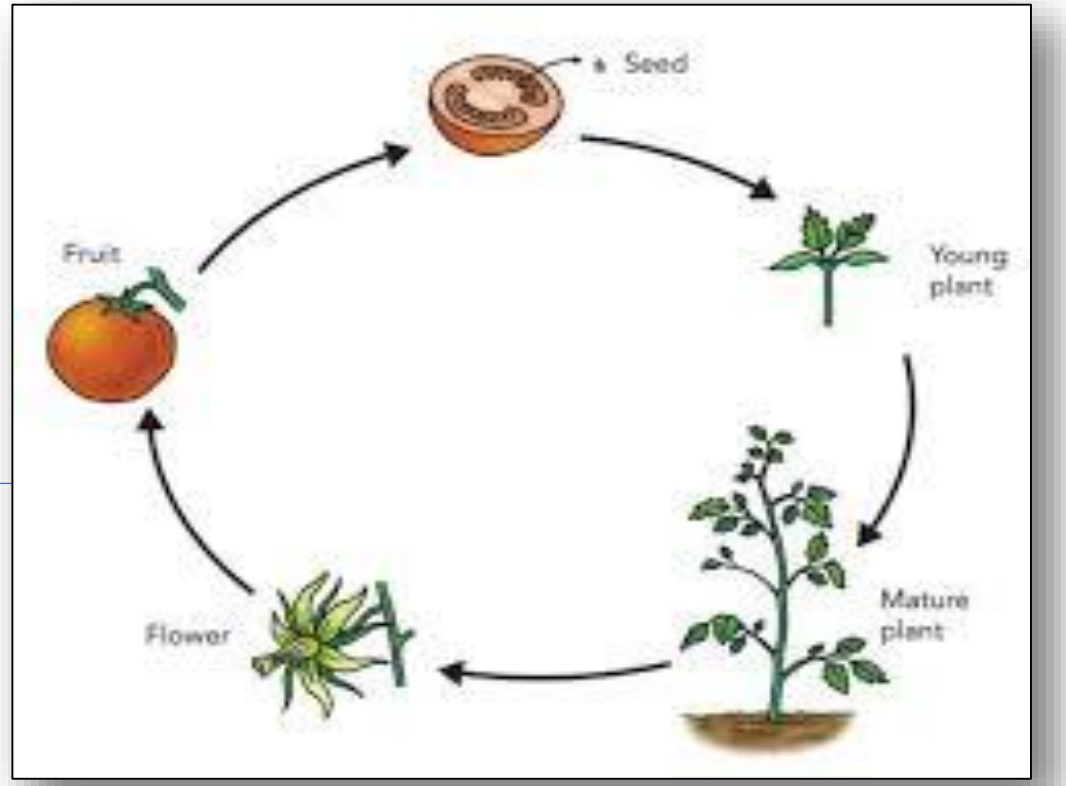
Ketahui Interaksi nutrien dan keserasian


Kadar nutrien yang mencukupi
Penyelarasan pembajaan mengikut kesesuaian tanaman
Right Rate
Kecekapan pembajaan
Penilaian status media & tanaman

Right Time

Aplikasi perlu mengambilkira ketersediaan nutrient dan keperluan semasa.

Fahami *life cycle* tanaman.



Pelbagai Teknik pembajaan mengikut kesesuaian tanaman

Zon Pengakaran

Rujuk sifat media, pola pengakaran dan teknologi digunakan

Right Place

Faktor-faktor yang berkaitan

Pelbagai Kaedah aplikasi samaada melalui titis, foliar, basahan dll

SUMBER BEKALAN AIR

Sumber Bekalan Air

Paip JBA

- Ph 6.8-7.2 (Kebiasaan).
- Oksigen tinggi.
- Berklorin
- Kos tinggi.

Air Bukit

- pH mudah berubah.
- Sejuk / tinggi kandungan oksigen.
- Tercemar akibat aktiviti pembalakan.

Air kolam/tasik/ sungai

- Mudah tercemar dgn logam berat.
- pH rendah.

Telaga Tiub

- Mineral tinggi
- O_2 terlarut rendah.
- Terdapat pencemaran Ferrous atau Hidrogen Sulfida.
- Berasid / alkali.

*** LAKUKAN ANALISIS TERHADAP SUMBER AIR*

HARD WATER

- Mengandungi **magnesium & calcium** yang tinggi.

HIGH *FERROUS*.

Mengandungi kandungan Fe^{2+} yang tinggi melebihi tahap optimum:-
> 5.0 mg/L.

KESAN ANTAGONISTIK :

Fosforus, Kalsium, Mangan, Kuprum, Zink

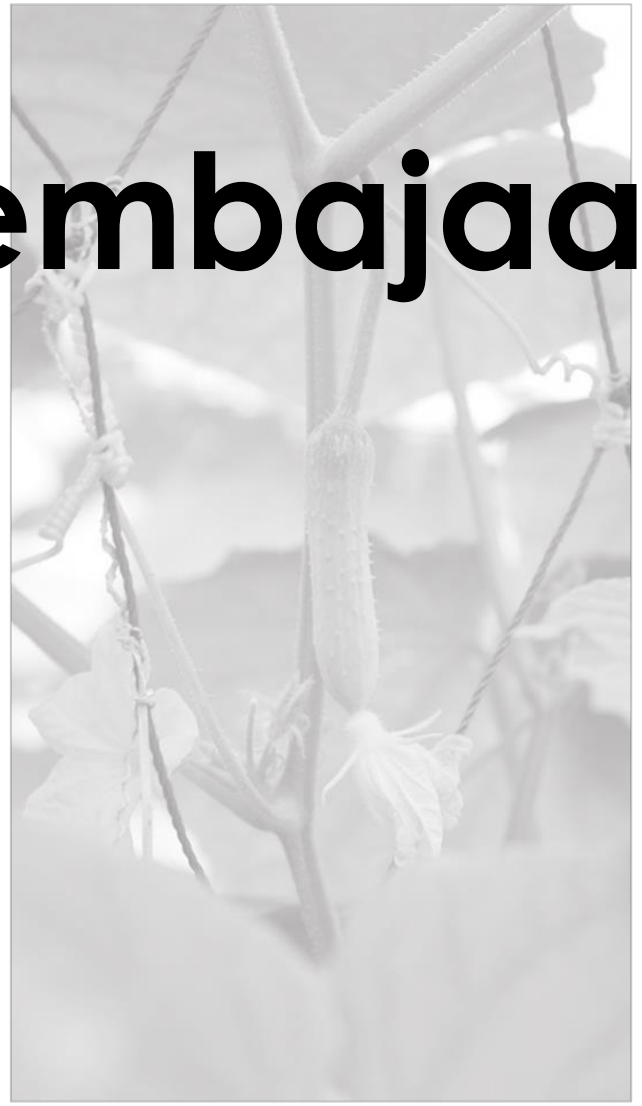
KAEDAH PENINGKATAN KUALITI AIR

- Penapis -120 mesh
- Baiki pH air - 6.0-7.5 (Asid atau Alkali)
- Tingkatkan oksigen - > 5ppm (pengudaraan)
- Rawatan – Takung dan rawat / jalankan Pengudaraan turunkan $Fe^{2+} \rightarrow Fe^{3+}$
- Guna arang aktif utk bersihkan air.
- RO – Reverse Osmosis.

STANDARD KUALITI AIR PERTANIAN

Ciri	Nilai
Electrical Conductivity (EC)	a. Umum :≤ 700 µS/cm Sederhana Sesuai : 700 - 3000µS/cm Tidak Sesuai : ≥3000µS/cm b. Fertigasi ≤ 1000 µS/cm c. Tanaman Padi/sayur berdaun / peringkat Tumbesaran ≤2000 µS/cm
Merkuri (Hg)	2.0-3.5
Plumbum (Pb)	≤5.0 ppm
Arsenik (As)	≤0.1ppm
Kadmium (Cd)	≤0.01 ppm
Nikel (Ni)	≤0.2 ppm
Ferum (Fe)	<1.0 ppm (Sayur berdaun) <5.0 ppm (lain-lain)

Pembajaan Fertigasi



FAKTOR YANG PERLU DIAMBIL KIRA DALAM PEMBAJAAN FERTIGASI

- JENIS TANAMAN
- KEPERLUAN AIR TANAMAN
- MEDIUM TANAMAN YANG DIGUNAKAN

JENIS TANAMAN

- Setiap jenis tanaman mempunyai keperluan nutrien yang berbeza.
- Olahan formulasi baja mestilah mengikut keperluan tanaman.
- CTH: Bagi tanaman timun :

- 150-200 ppm N
- 25-50 ppm P
- 150-200 ppm K
- 150-200 ppm Ca
- 30 ppm Mg
- 20-200 ppm S
- 0.3 ppm Mn
- 2-3 ppm Fe
- 0.3 ppm B
- 0.1-0.5 ppm Zn

- Baja AB mikronutrien dan makronutrien disatukan dalam pembajaan.
- Faktor pH, keseimbangan nutrien, nisbah unsur perlu diambil perhatian.
- Pembajaan boleh dibahagikan kepada makro dan mikro.
- Gubahan biasa dibuat pada kandungan Makro,
- Sentiasa berhati-hati dengan aras mikronutrien dalam larutan baja.

  Cth:Mangan antagonistik dengan Ferum krn keduanya bersaing untuk pengangkutan protien melalui membran plasma.

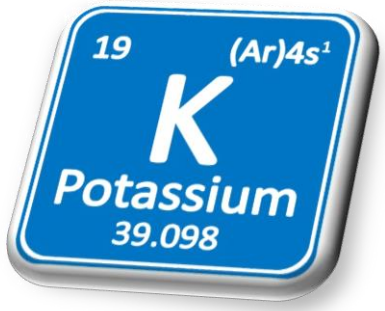
Aras mikronutrien dalam larutan nutrien

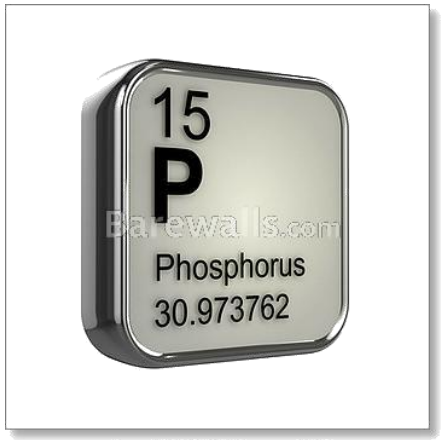
Tanaman	Fe	B	Cu	Zn	Mn	Mo
Tomato	1.12 - 1.39	0.324	0.064	0.327	0.549	0.048
Cucumber	0.84 – 1.12	0.270	0.064	0.327	0.549	0.048
Eggplant	0.84 – 1.12	0.324	0.064	0.327	0.549	0.048
Pepper	1.12 - 1.39	0.324	0.064	0.458	0.549	0.048
Strawberry	1.12 - 1.39	0.162	0.064	0.458	0.549	0.048
Melon	0.56 - 0.84	0.270	0.064	0.327	0.549	0.048

Rujukan: Pardossi A, Carmassi G., Diara C., IncrocciL., Maggini R., Massa D (2011) Fertigation and Subsrate Management in Close Soiless Culture

Pemahaman tentang fungsi nutrien

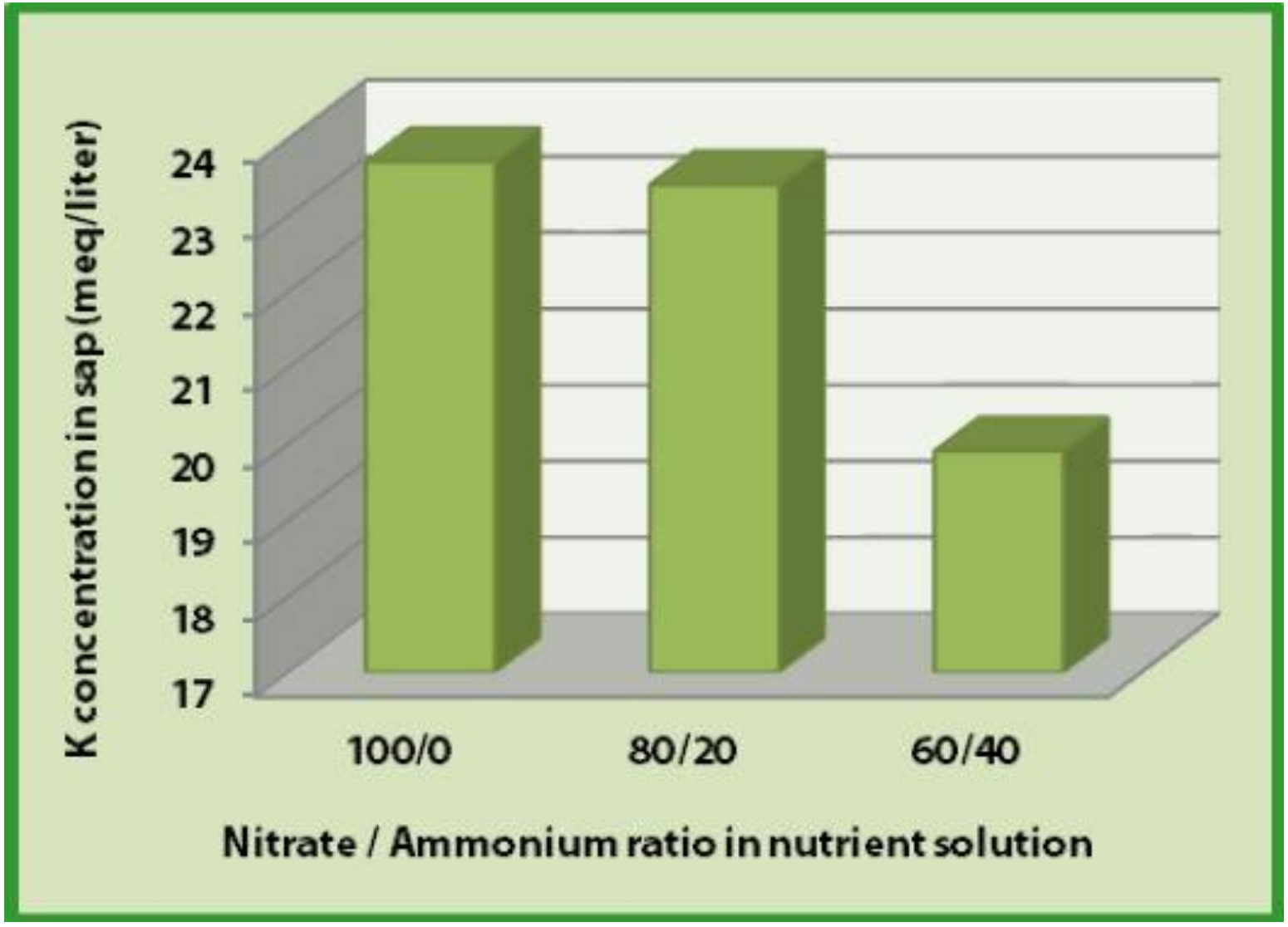
- **N** • GROWH ELEMENT
- **P** • ENERGY ELEMENT
- **K** • HEALTH ELEMENT





Pemilihan baja: Nitrogen

The effect of $NO3^-$ /$NH4^+$ ratio in the soilless nutrient solution on the concentration of K in the sap of cucumber (cv. *Hyclos*) seedlings (*Zornoza and Carpena*, 1992).



Kadar Pengambilan nutrien oleh tanaman

GROUP 1: Active uptake, fast removal	**N, P, K Mn**
GROUP 2: Intermediate uptake	**Mg, S, Fe, Zn, Cu, Mo, Cl**
GROUP 3: Passive uptake, slow removal	**Ca, B**

KEPERLUAN AIR TANAMAN

Chili actual evapotranspiration, ETa (mm/day)

Sum of transpiration by crop and evapotranspiration from the soil surface.

Jadual 1: Average crop water use (mm/day) of different Growth Stages

Growth Stage	Days	Crop Coefficient, Kc	ETa, mm/day	Canopy Diameter, cm	Irrigation Requirement, mL/day
Initial Stage	0-12	0.30	-	-	450
Development	13-42	0.3 - 0.62	4.96	10 - 30	
Flowering 0-50%	43 - 55	0.62 - 0.83	5.00 - 7.72	30 - 70	450 - 2970
Flowering > 50%	56 - 63				
Fruit Setting	64 - 109				
Late Stage	> 110	0.71	7.72	70	2970

Afifah, 2015 & A. Katimon, 1985

Keupayaan Media Tanaman

Water Retention:

Capability of growing media to retain water.

- **100% cocopeat:**
- 8x relative to its weight (Chanthai)

- **70% Cocopeat : 30% Perlite**
  - 912% of dry weight (W.Fazilah)

Optimal Growing Condition

- 45% of water must held in root media (Available water); best at 65% to 70% available water.

Kesan EC kepada pengeluaran hasil cili

Table.3 Yield variation of capsicum during growing period

No. of treatment	EC in dS/m	R1			R2			R3			Yield in kg
		1st harvest	**2nd harvest**	**3rd harvest**	**1st harvest**	**2nd harvest**	**3rd harvest**	**1st harvest**	**2nd harvest**	**3rd harvest**	
		27/2/2016	16/3/2016	14/4/2016	27/2/2016	16/3/2016	14/4/2016	27/2/2016	16/3/2016	14/4/2016	
T1	2.4, 2.6, 2.8	13.4	14.6	10.4	14.15	16.75	12.45	14	15	12.7	41.15
T2	2.3, 2.5, 3	12.89	13.73	10.58	13.68	15.74	10.57	9.8	12.9	9.1	36.3
T3	2.7, 3, 3.2	4.06	7.43	7.7	5.8	7.3	6.7	6.2	8.6	6.8	20.05
T4	2.5, 2.5, 2.5	9.87	8.86	9.61	12	12	9	10.3	11.6	7.8	28.34
Total											**125.84**

The effect of Electrical Conductivity of Irrigation Water on Water Uptake by Capsicum in Soiless Media – S.Ahirwar and M. Hasan*

Fig.2 Water uptake by capsicum through different treatments in vegetative stage

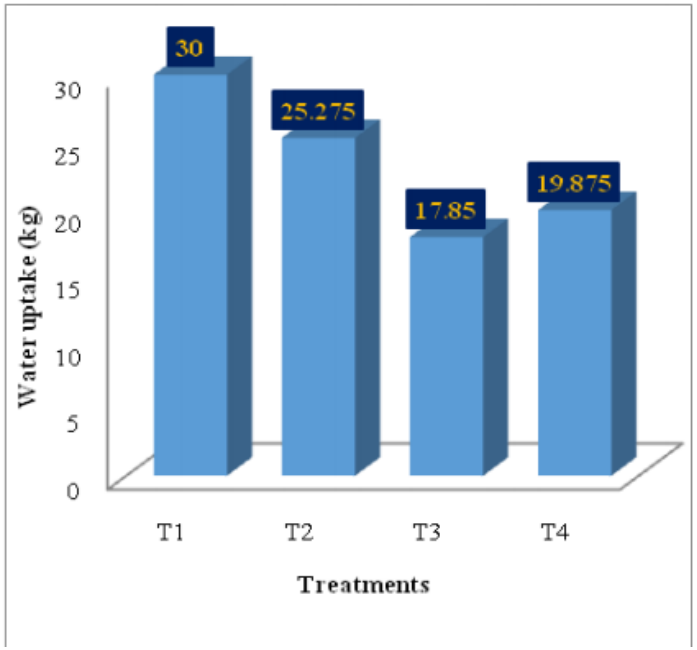


Fig.3 Water uptake by capsicum through each treatment in flowering stage

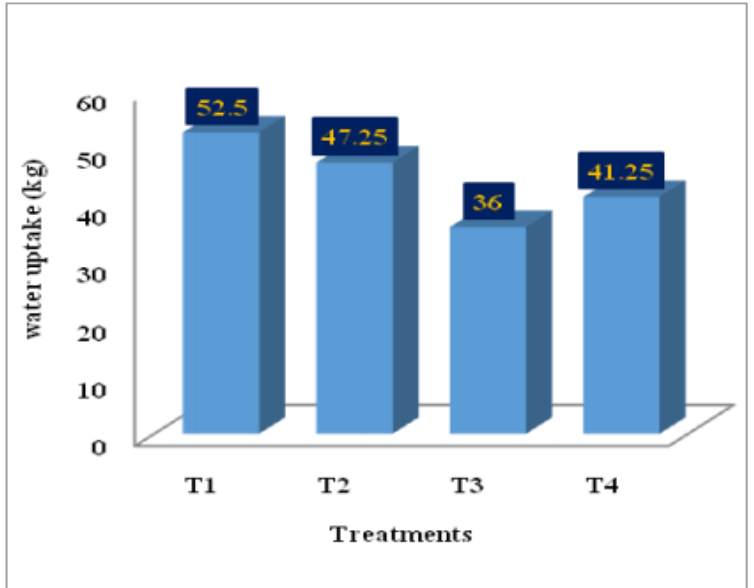


Fig.4 Water uptake by capsicum through each treatment in fruiting stage

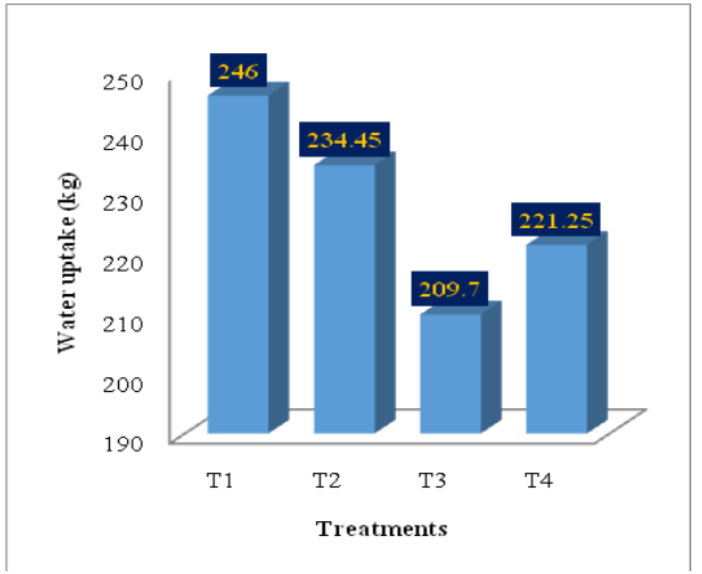
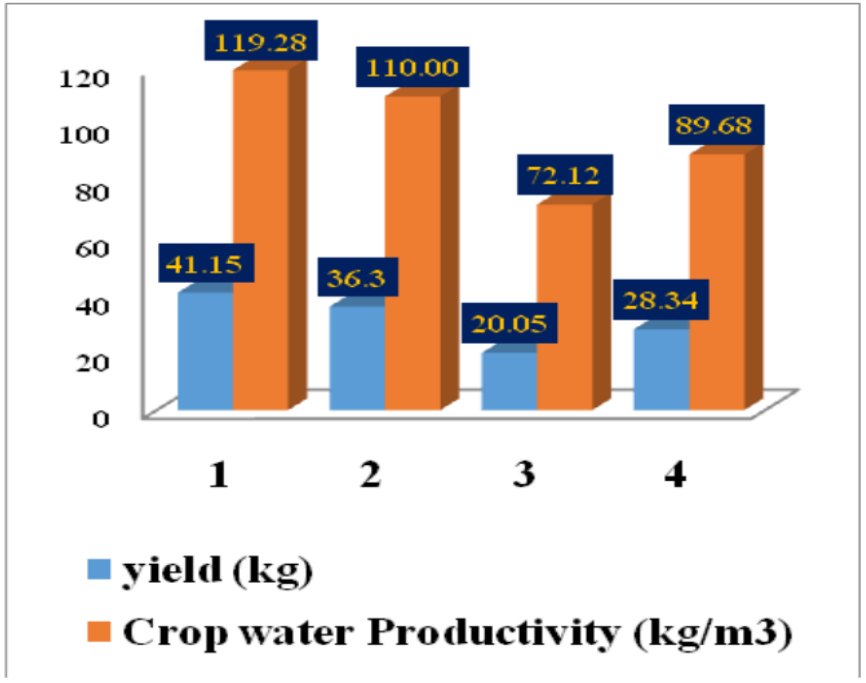


Fig.7 Relation between yield and crop water productivity



CADANGAN JADUAL PEMBERIAN BAJA FERTIGASI CILI

MINGGU	KEKERAPAN	MASA	JUMLAH AIR/POLIBAG	EC BAJA (mS/cm)
1-3	3 Kali	8pg, 12 tgh, 4.30 ptg	0.9 Liter	1.8
4-5	5 Kali	8pg,11tgh, 1tgh, 3ptg, 4.30ptg	1.5 Liter	2.0
6-7	5 Kali	8pg, 10pg, 12tgh, 2ptg, 4.30ptg	1.75 Liter	2.2
8-9	6 Kali	8pg, 10pg, 11.30tgh, 1tgh, 2.30ptg, 4.30ptg	2.10	2.5
10-11	7 Kali	8pg, 10pg, 11.30 pg1 tgh, 2.30ptg, 4.30 ptg	2.45 Liter	2.7
12-13	7 Kali	7.30pg, 9.30 pg, 11pg, 12.30tgh, 2.30ptg, 3.30 ptg, 4.30ptg	2.5 Liter	2.8
SETERUSNYA	7 Kali	7.30pg, 9.30 pg, 11pg, 12.30tgh, 2.30ptg, 3.30 ptg, 4.30ptg	2.7 Liter	3.0

FORMULASI CILI 1

Unsur	ppm
N	249.79
P	49.94
K	315.04
Ca	201.02
Mg	39.9
Fe	2.51
Mn	0.22
B	0.48
Cu	0.03
Zn	0.42
Mo	0.06
S	128.96

JENIS BAJA	Berat (gm)
KALSIUM NITRAT	21,160.00
FERUM EDTA	380.00
JUMLAH SET A	*21,540.00*
KALIUM NITRAT	13,200.00
MKP	4,400.00
MGSO4	8,060.00
MANGAN EDTA 13%	34.00
HIBOR 60	52.00
KUPRUM EDTA 14%	3.80
ZINK EDTA 15%	29.00
AM.MOLYBDATE	2.40
JUMLAH SET B	*25,781.20*

FORMULASI CILI 2

Unsur	ppm
N	237.88
P	46
K	358
Ca	175.75
Mg	45
Fe	1.32
Mn	0.73
B	1.28
Cu	0.07
Zn	0.58
Mo	0.14

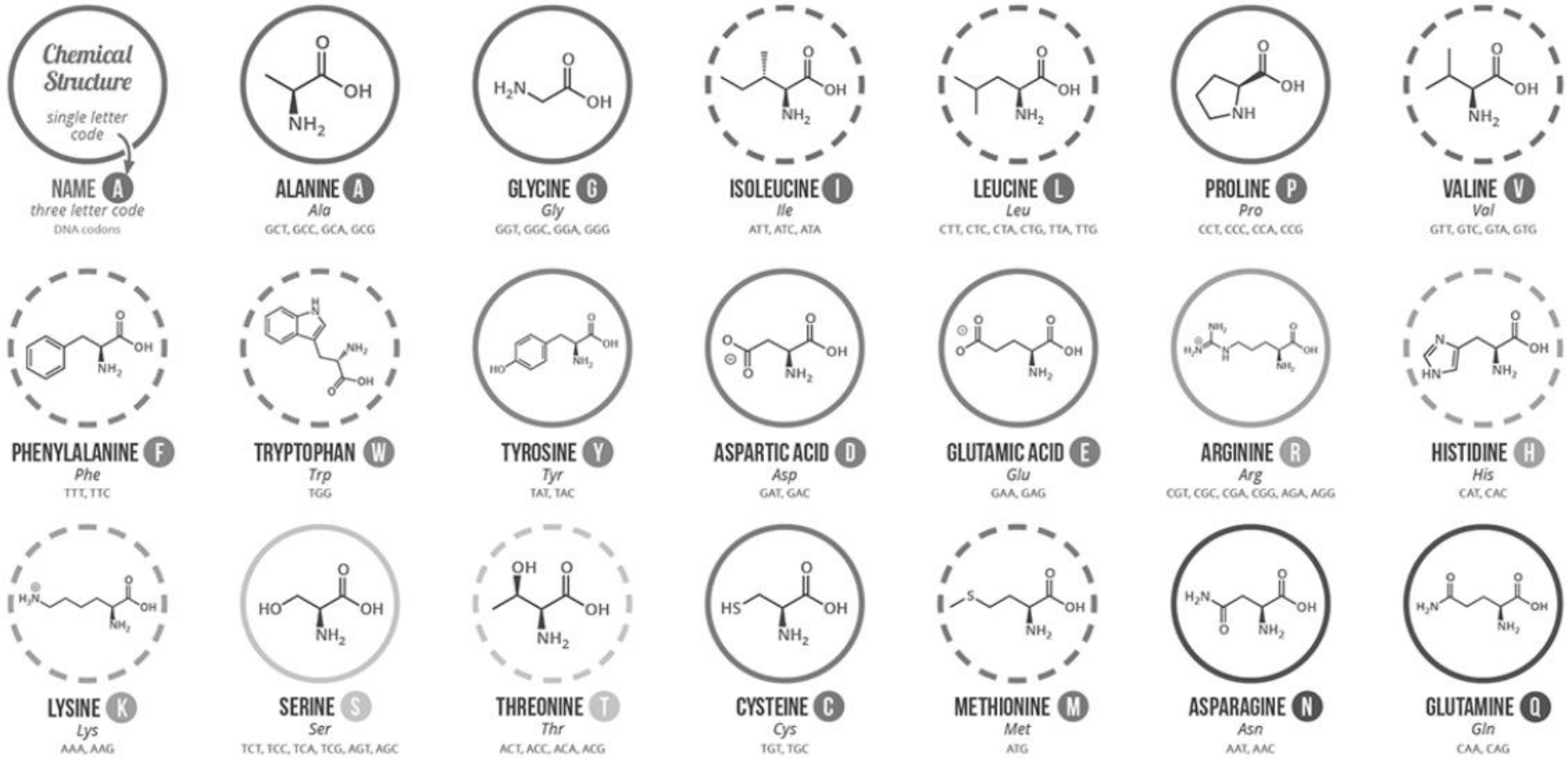
Jenis Baja	*Berat (gm)*
KALSIUM NITRAT	18,500
KALIUM NITRAT	3,000.00
AMMONIUM NITRAT (33%)	1000.00
FERUM EDTA	200.00
JUMLAH SET A	***22,700***
KALIUM NITRAT	9,000.00
KALIUM SULFAT (52%)	1,000.00
MKP	4,000.00
MGSO4	9,000.00
MANGAN EDTA 13%	45.00
HIBOR 60	150.00
KUPRUM EDTA 14%	10.00
ZINK EDTA 15%	50.00
AM.MOLYBDATE	5.00
JUMLAH SET B	***23,260***

JADUAL PEMBERIAN BAJA TANAMAN TERPILIH

ROCK MELON		
MINGGU LEPAS TANAM	EC BAJA	KADAR SIRAMAN (ml)
1	1.6	500
2	1.8	700
3	2.0	900
4	2.2	1400
5	2.4	1600
6	2.6	1800
7	2.8	2000
8	3.4	2200
9	3.8	1000

TIMUN		
MINGGU LEPAS TANAM	EC BAJA	KADAR SIRAMAN (ml)
1	1.2-1.5	500
2	2.0	600
3	2.5	1200
4	2.7	1500
5	2.8	1800
6	2.8	2200-2500

TERUNG		
MINGGU LEPAS TANAM	EC BAJA	KADAR SIRAMAN (ml)
1	1.8	700
2	2.3	700
3	2.5	800
4	2.6	1000
5	2.8	1100
6	3.0	1200
7	3.2	1200
8	3.2	1400
9	3.4	1600
10	3.4	1800
11	3.4	2200-2800



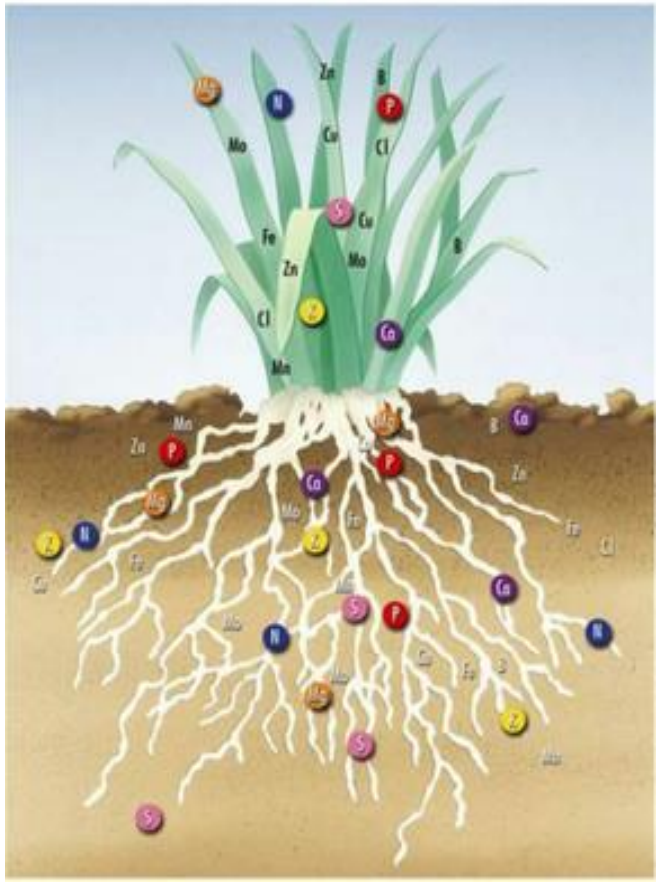
BIOSTIMULANT

BIOSTIMULANT

Biostimulants are compounds that influence physiological processes in plants, producing better growth and enhancing stress tolerance – Phytopathol mediterr. (2009)

1. AMINO ASID
2. EKSTAK RUMPAI LAUT
3. Asid Humik
4. Asid Fulvik

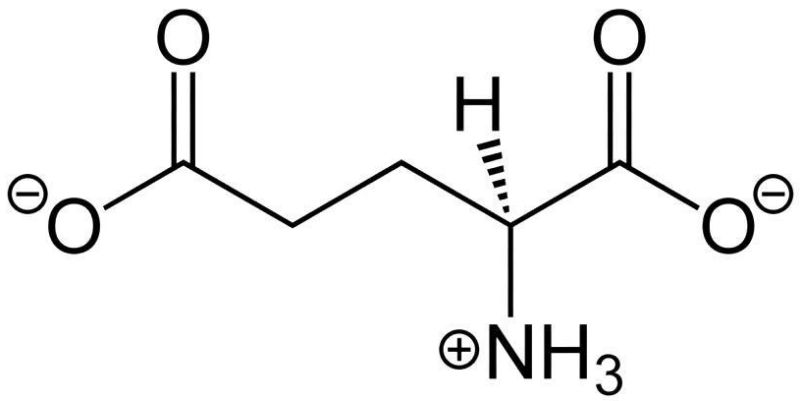
BIOSTIMULANT

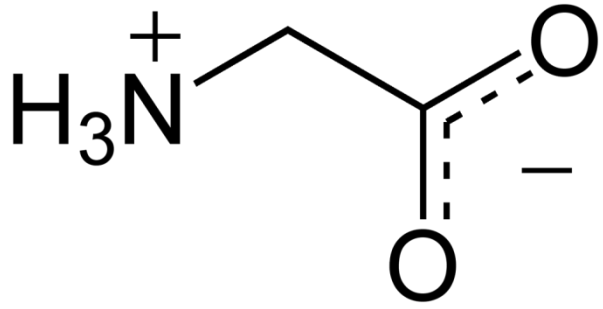


- Molekul organik yang dapat meningkatkan respon fisiologi tanaman
- Meningkatkan pengambilan nutrien dan juga air *(open ion channel)*
- Merangsang antibodi bagi pertahanan tanaman.
- Jimatkan penggunaan baja (penyerapan lebih efisyen).
- *Plant biostimulants are natural compounds that trigger physiological and molecular processes modulating crop yield and quality, though their primary function is neither to supply nutrients (fertilizers) nor to protect plants against soilborne or foliar pests and pathogens (Plant Protection Products) (du Jardin, 2015).*

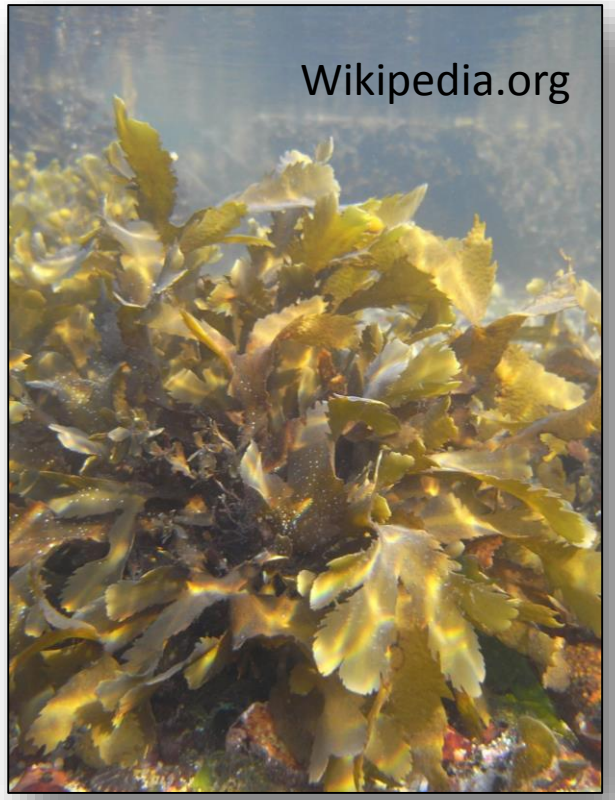
Amino Asid

- Merangsang akar tanaman untuk penyerapan Calcium
- Acid glutamic dan glycine membantu penyerapan calcium
- chelate semulajadi
- Agen pelindungan tanaman





Ekstrak rumpai laut



Mengandungi hormon pertumbuhan semulajadi dan *trace element* yang bermanfaat

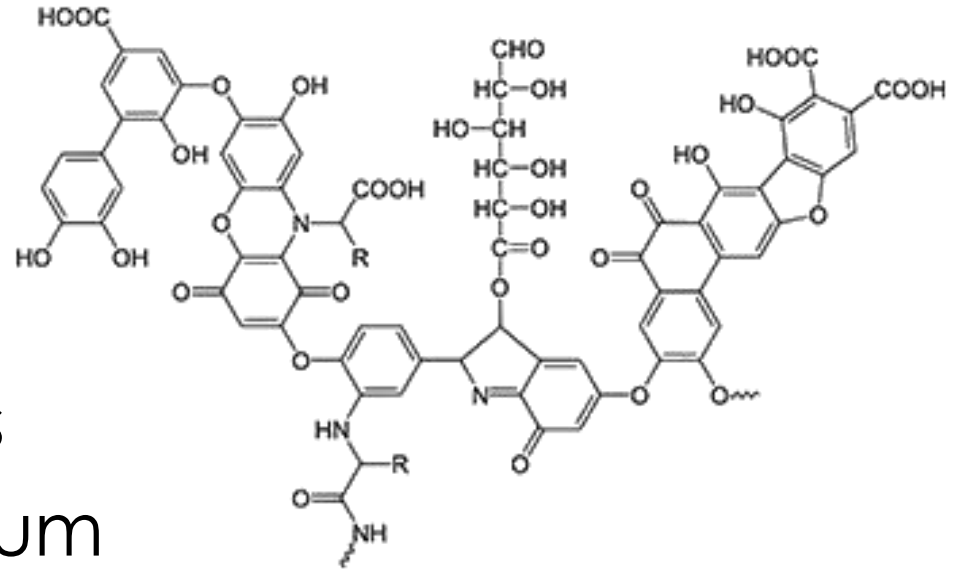
Mengaktifkan enzim

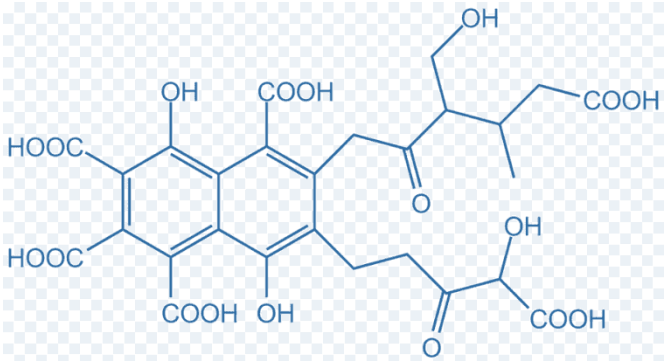
Mengandungin auksin, sitokinin dan giberelin bagi pertumbuhan keseluruhan tanaman

- The major components of commercial SWE are polysaccharides, followed by phenolics, vitamins precursors, osmolytes (mannitol), phytohormones, and hormone-like compounds (Battacharyya et al., 2015).

Humik acid dan Fulvic acid

- Agen Chelate
- Pengaktifan enzim
- Buffer pH (media)
- Meningkatkan toleran kepada stress
- Meningkatkan pengambilan Ion Ferum
- Merangsang membran sel utk pam proton semasa aktiviti fotosintesis
- Meningkatkan kualiti hasil / rasa / warna.





Rumusan

- Pengurusan pembajaan yang tepat melalui konsep 4R, dapat memastikan keseluruhan sistem ladang berjalan dengan baik dan lebih effisyen.
- Kemahiran dalam mengenalpasti sifat dan keperluan tanaman pada setiap fasa, serta pengetahuan berkaitan fungsi nutrisi dapat memastikan pengurusan pembajaan dan penjagaan tanaman dapat dilakukan dengan sempurna.

Rujukan

Schmidt, R.E., Ervin E.H. and Zhang X. 2002. Questions and Answers About Biostimulants. Turfgrass Society of America 2002 Research Notes.

Fertigation an subtrate management in Close Soiless Culture – Pardossi A, Carmassi G., Diara C., Incrocci L., Maggini R., Massa D.

International Fertrilizer Industry Association - U. Kafkafi and J. Tarchitzky.

Guide to Fertilizer Use in Peninsular Malaysia – by Kanapathy.


TERIMA
KASIH