Improving Water Use Efficiency of Crops for Sustainable Agriculture in Dry Lands

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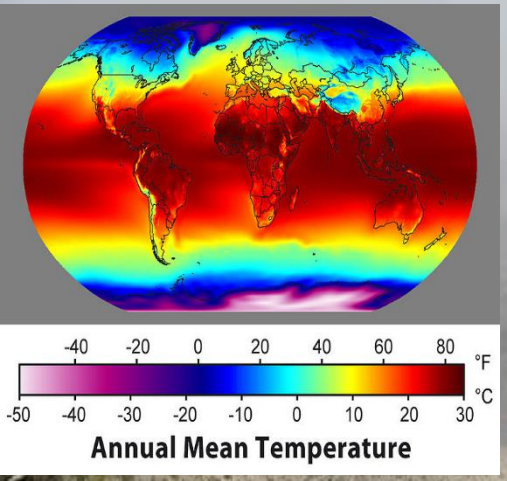
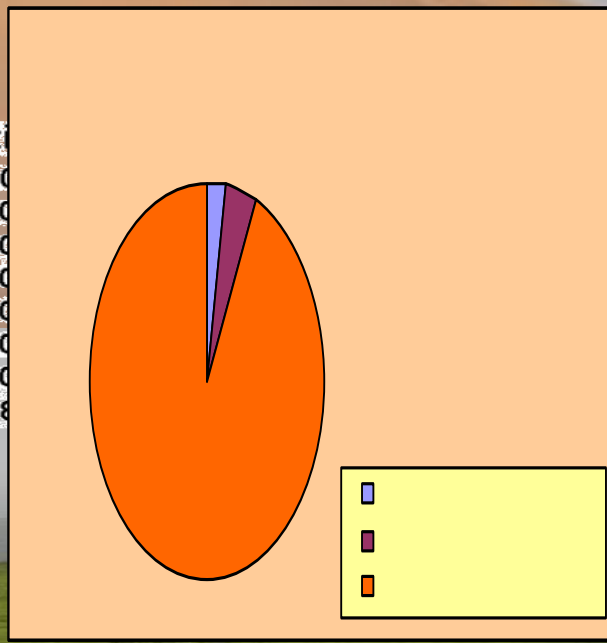


***Arid Country with annual rainfall of 100 mm**

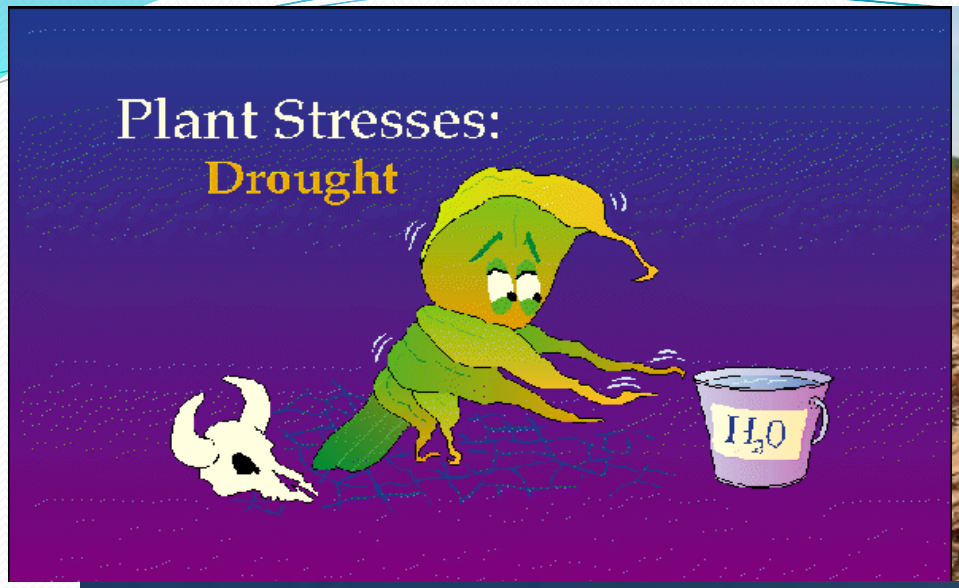
*** Annual Evaporation 7,714 MCM**

*** Groundwater is the main source of water**

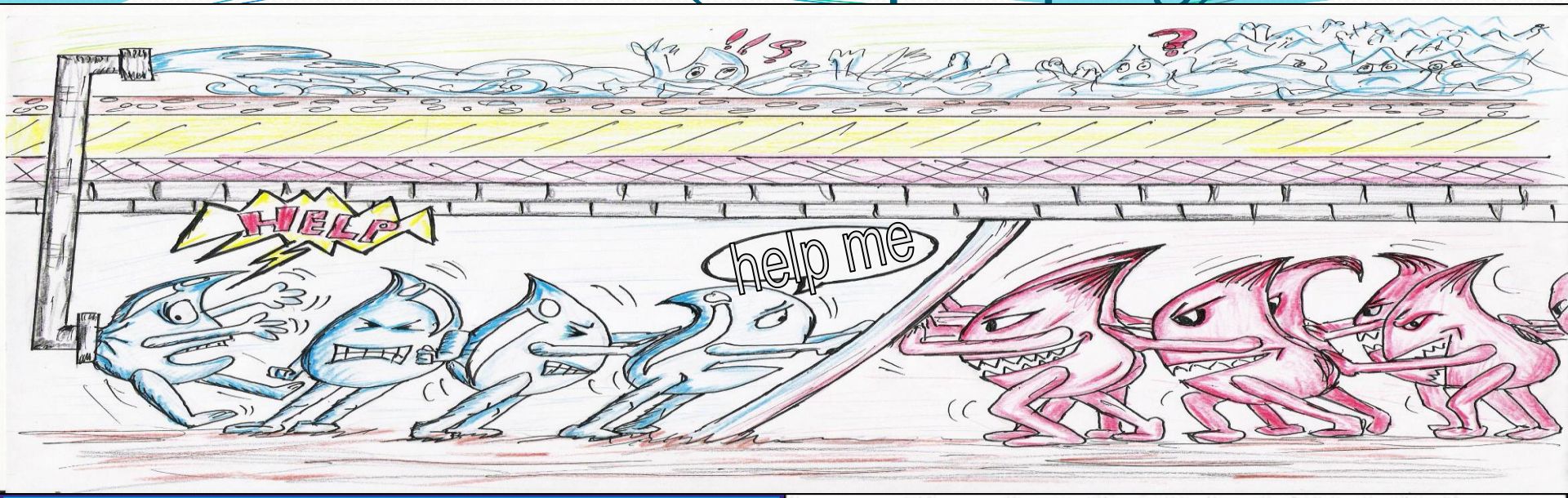
Musandam
Batinah
Muscat
Dhahira
Sharqia
Dakhilia
Wusta
Dhofar
Elevati
<40
400
800
120
160
200
240
>28
100 0 100 200 300 400 Kilometers

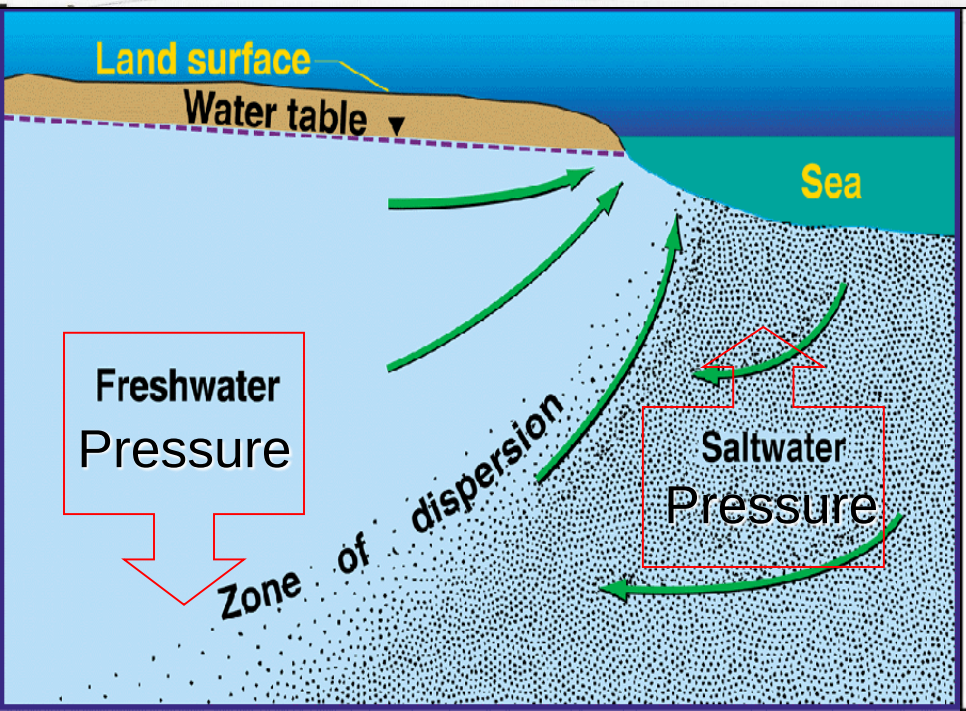


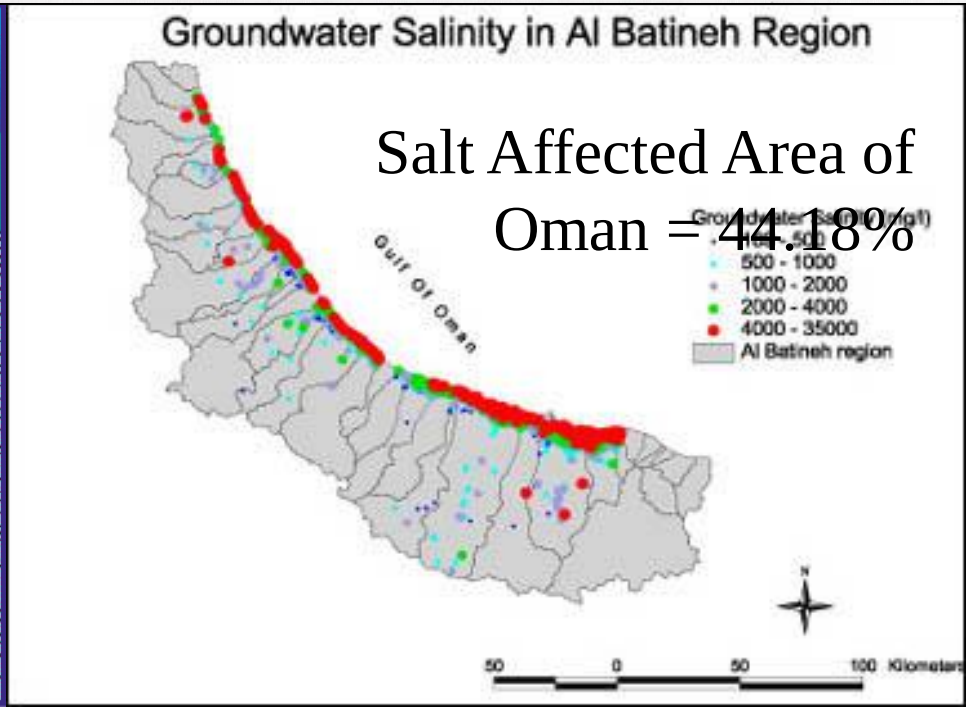
Challenge 1: Water Shortage



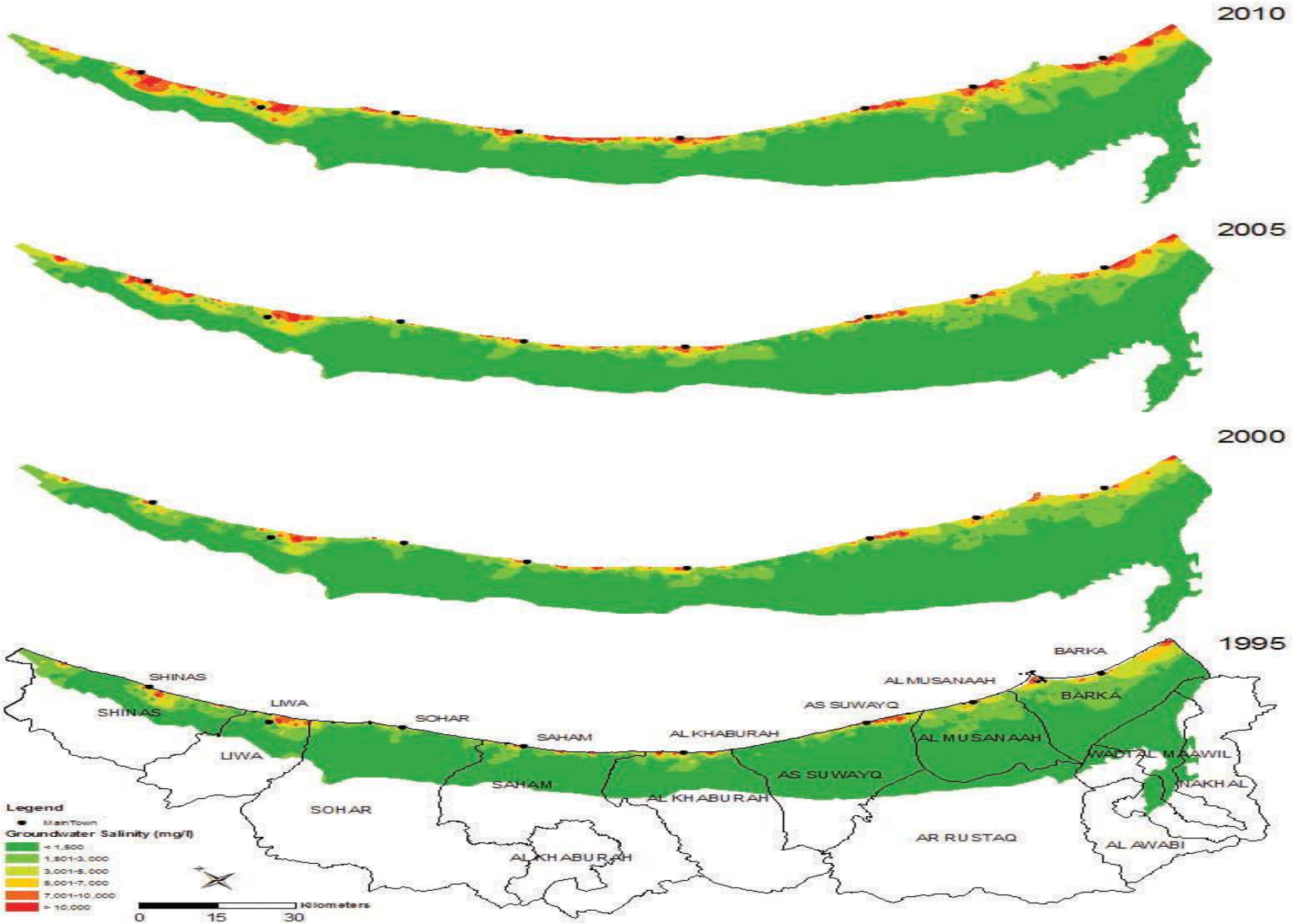
Seawater Intrusion (over pumping)







Growth of sea water intrusion



Challenge 2: Soil Salinity

Municipal Wastes Management

3R Approach

Wastewater Treatment and Reuse

"3R" Approach from Solid Waste Management Applied to Wastewater Treatment and Reuse

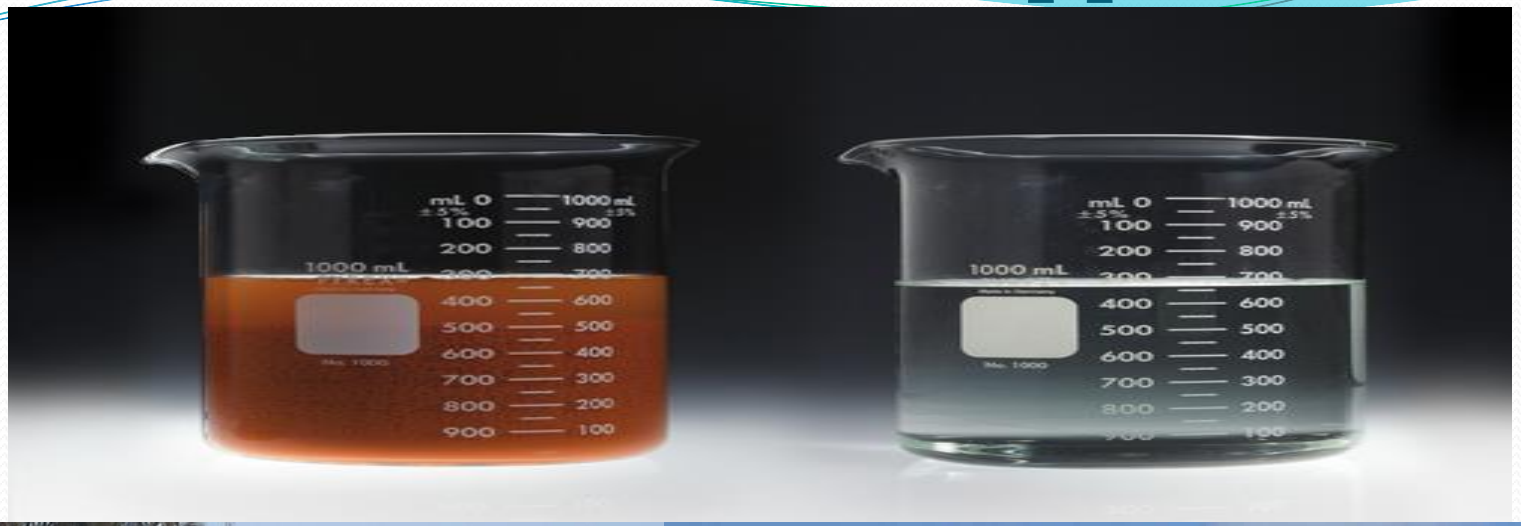
Reduce

Reuse

Recycle

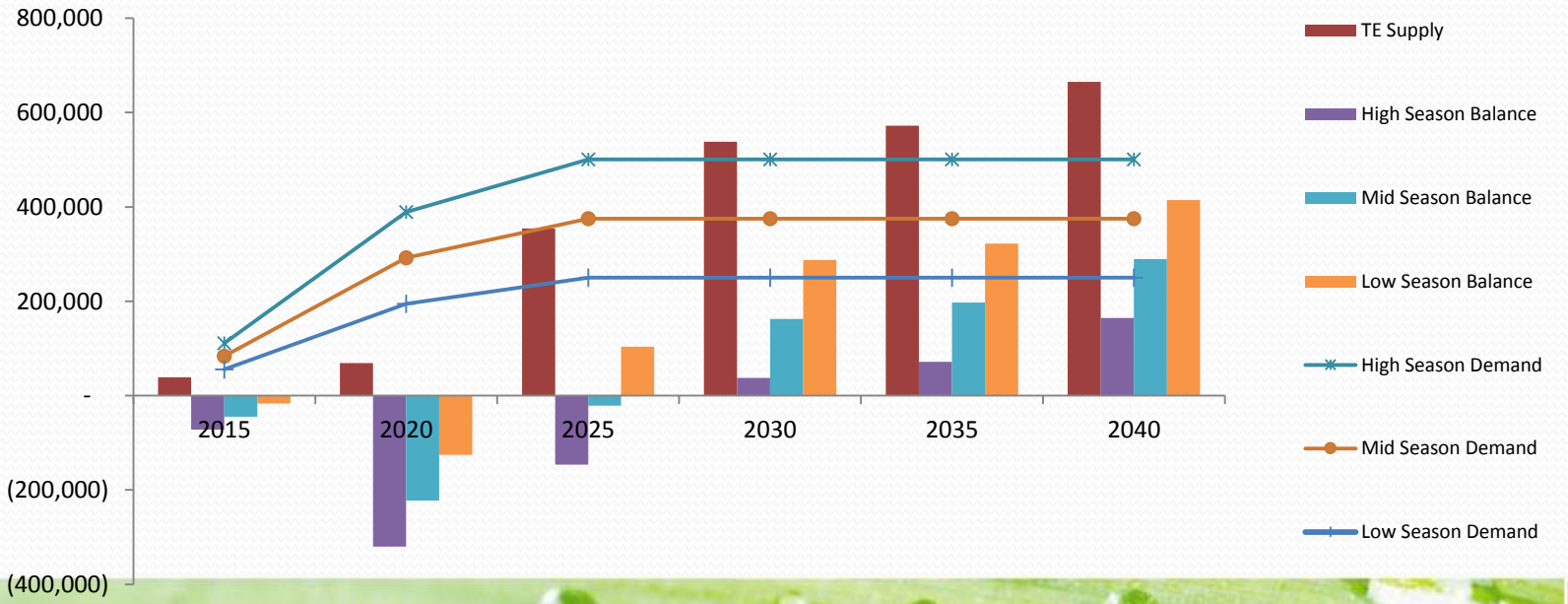
Option1: Treated Wastewater

1. Treated Wastewater Application

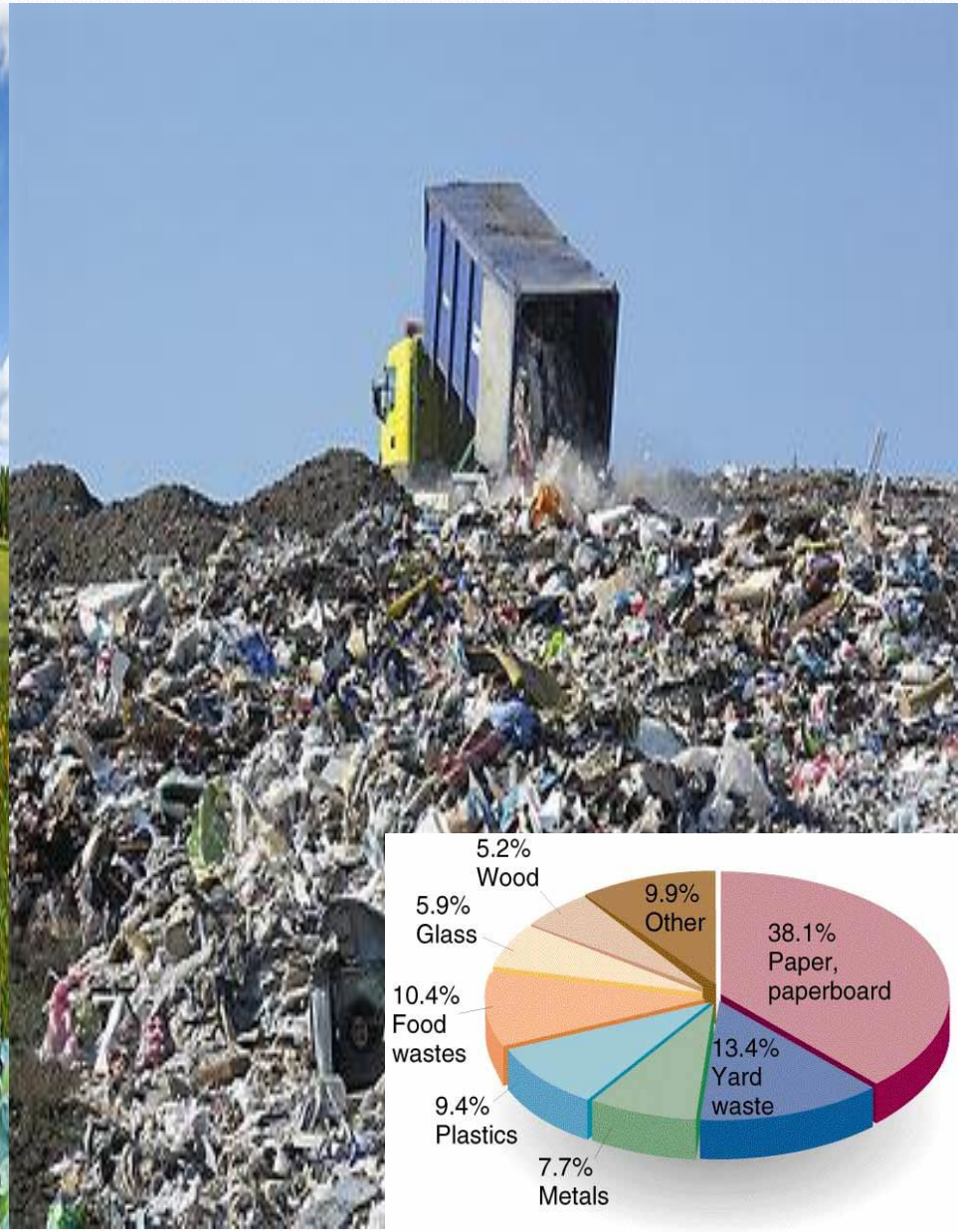


1. Treated Wastewater outside Muscat

العام / الإنتاج اليومي (متر مكعب /اليوم)	2015	2020	2025	2030	2035	2040
Total production الإنتاج السنوي(m3/day)	38,861	69,129	353,998	537,773	572,137	664,706



Option 2: Municipal Wastes Management



Solid Waste Management
(Haya Water Company)

Municipal Wastes: Application and Assessment

(Solid Waste)

Municipal Wastes: Application and Assessment

(Solid Waste)

Quantity of Materials Treated in 2014

Biosolids

S.N	LOCATION	Jan	Feb	Mar	Apr	May	Jun	Jul	Age	Sep	Oct	Nov	Dec	TRIPS	Total Weight Ton.
1	Al Ansab STP	208	213	301	277									999	12,804
2	Darsait STP	27	44	50	47									168	1,827
3	Quriyat STP	10	8	9	5									32	182
	Total														**14,813**

Bulking Agents

Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Age	Sep	Oct	Nov	Dec	TRIPS	Total Weight Ton
Green Waste	81	58	48	53									240	481
Horse Bedding	6	7	10	13									36	248
Scrap Wood	1	1	14	7									23	67
Total														**796**

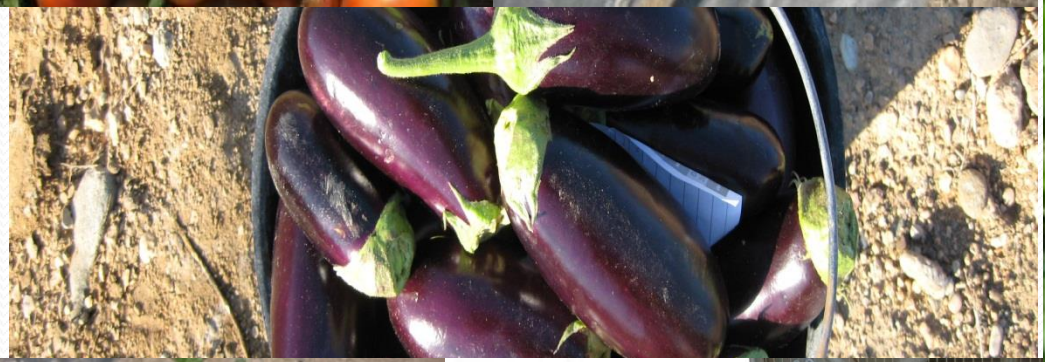
Kala Compost Production

Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Age	Sep	Oct	Nov	Dec	Total
Bags 50 liters	11,256	27,065	25,165	19,573									**83,059**

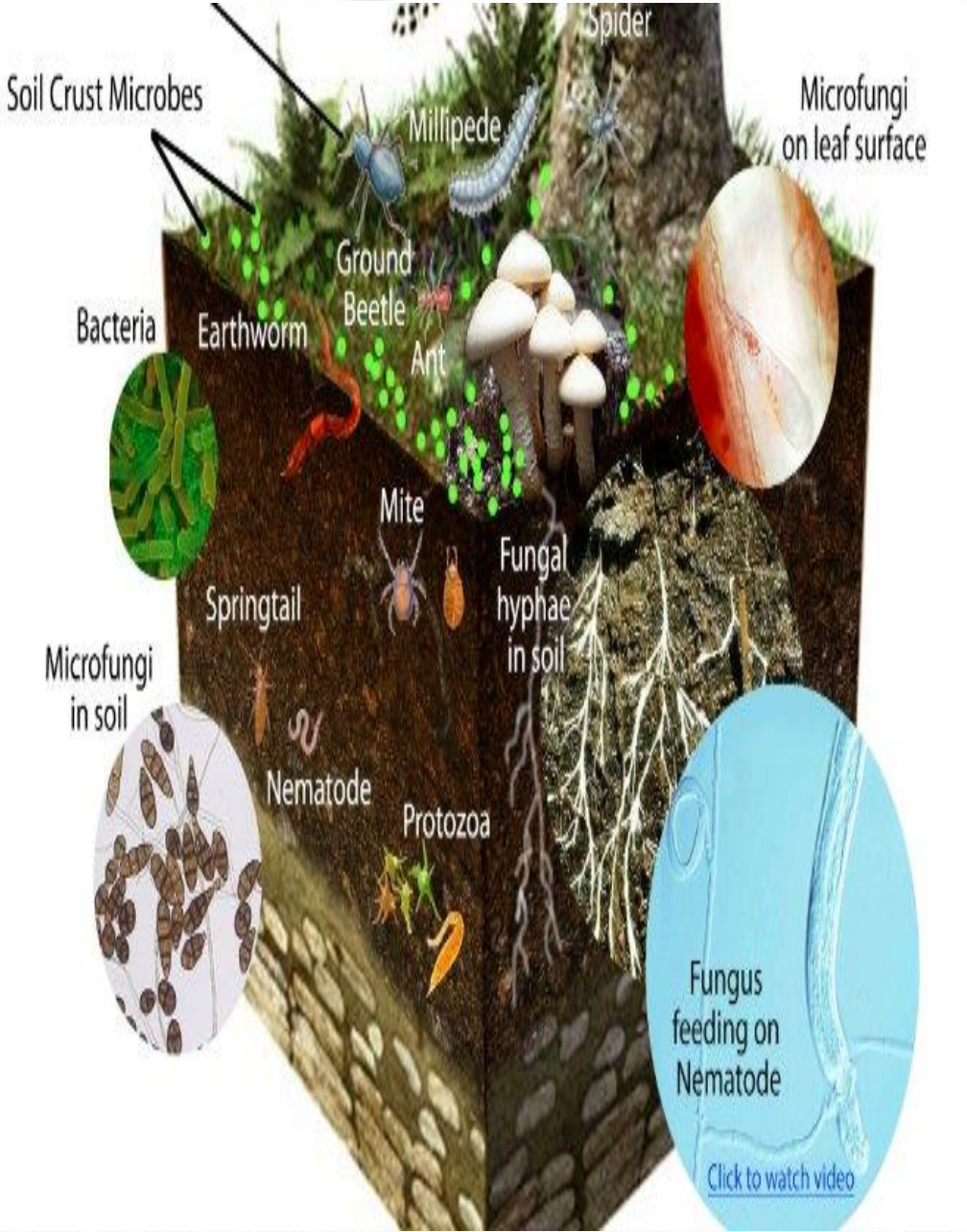

REOTEMP
°C
0
10
20
30
40
50
60
70
80
90
100

Solid Waste Converted to Compost (Kala)

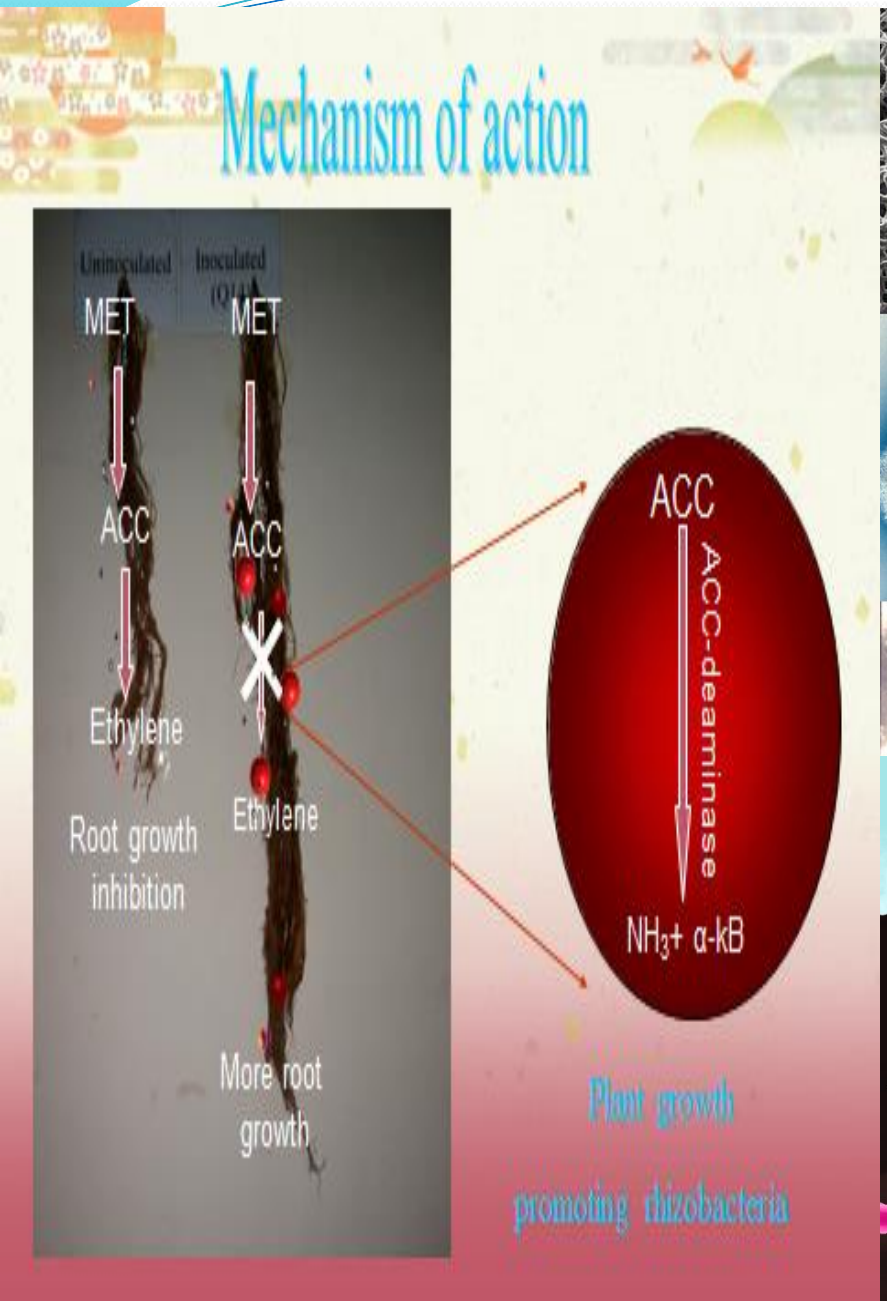
Kala Compost

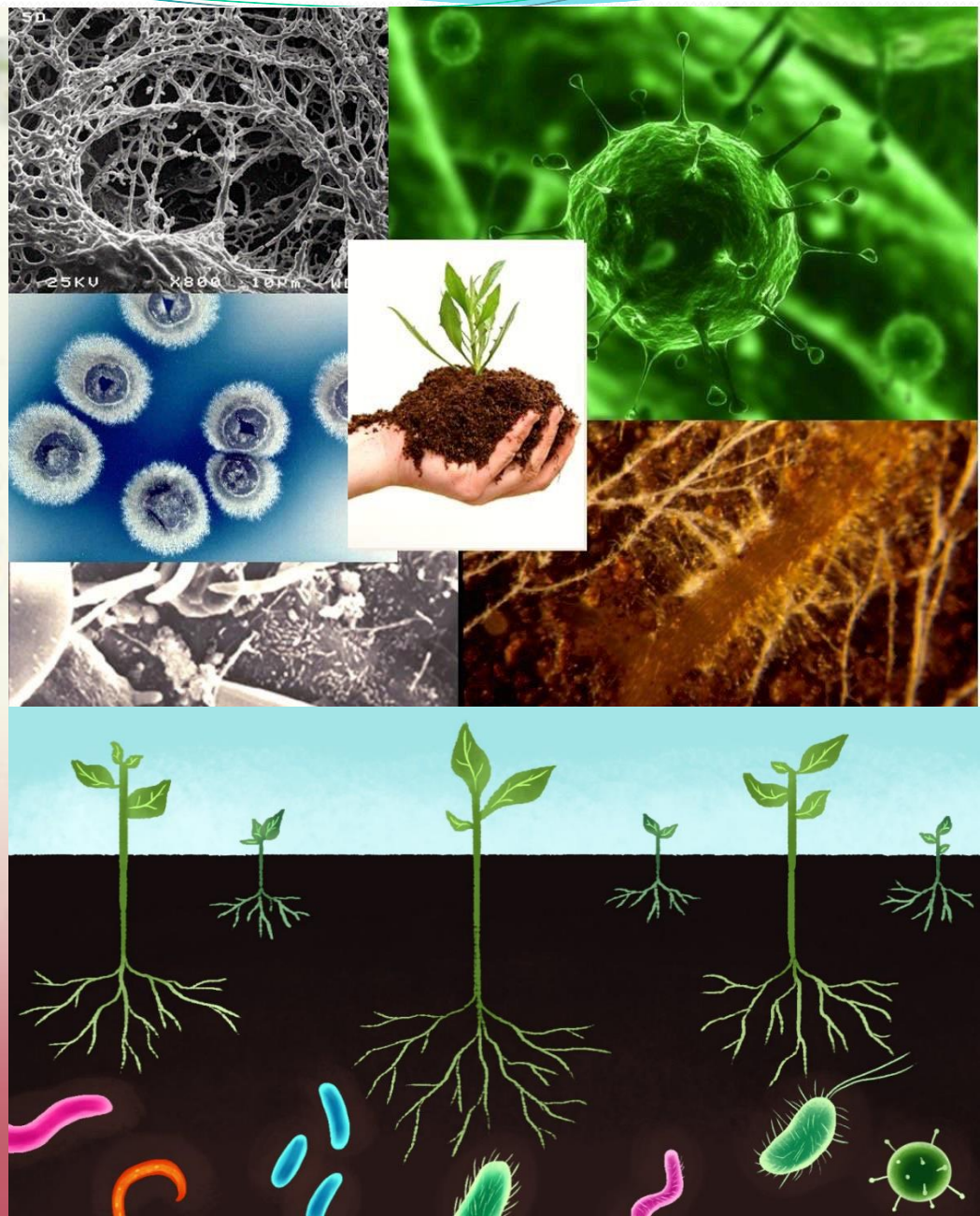


Option 3: Soil Microbes

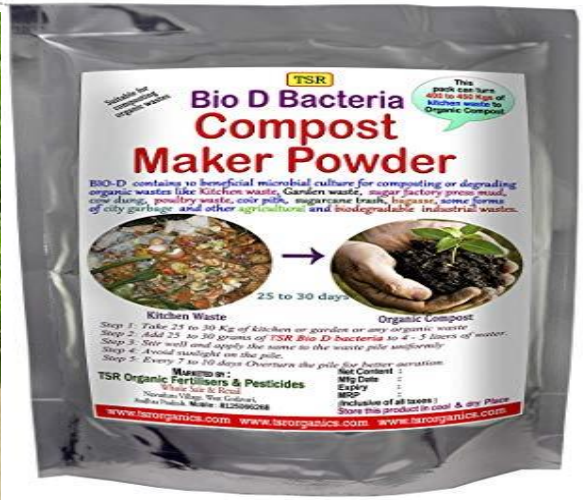


Soil-Water-Plant (Bio-Compost)

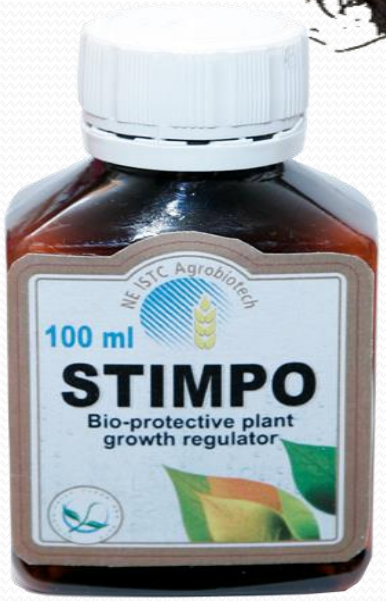




Soil-Water-Plant (Bio-Compost)



Soil-Water-Plant (Stimpo and regoplant)



stimpo-i-regoplant

Objectives

- Evaluate all three options (TWW, Recycled Compost, Soil Microbes) in improving plant growth

Methodology

- Bacteria were isolated from saline soils.
- The best bacteria that gave better growth in saline media were selected.

- The best two bacteria were reproduced and used for field trials.

- They were compared with two bio-stimulants (Stimpo and regoplant) and grown in three different composts.

Greenhouse

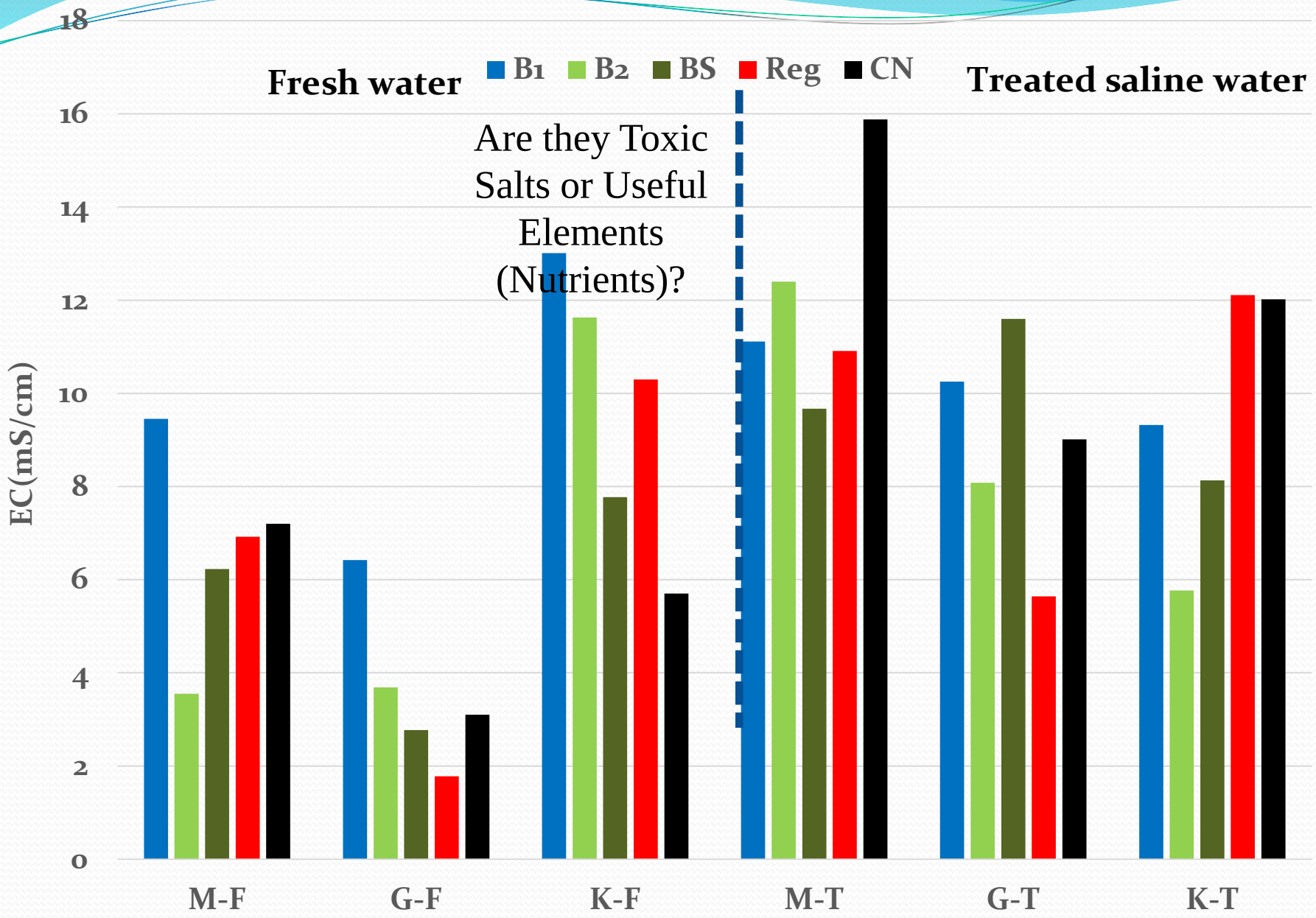
Fresh & Saline (TWW) Waters

Radish and Okra plants

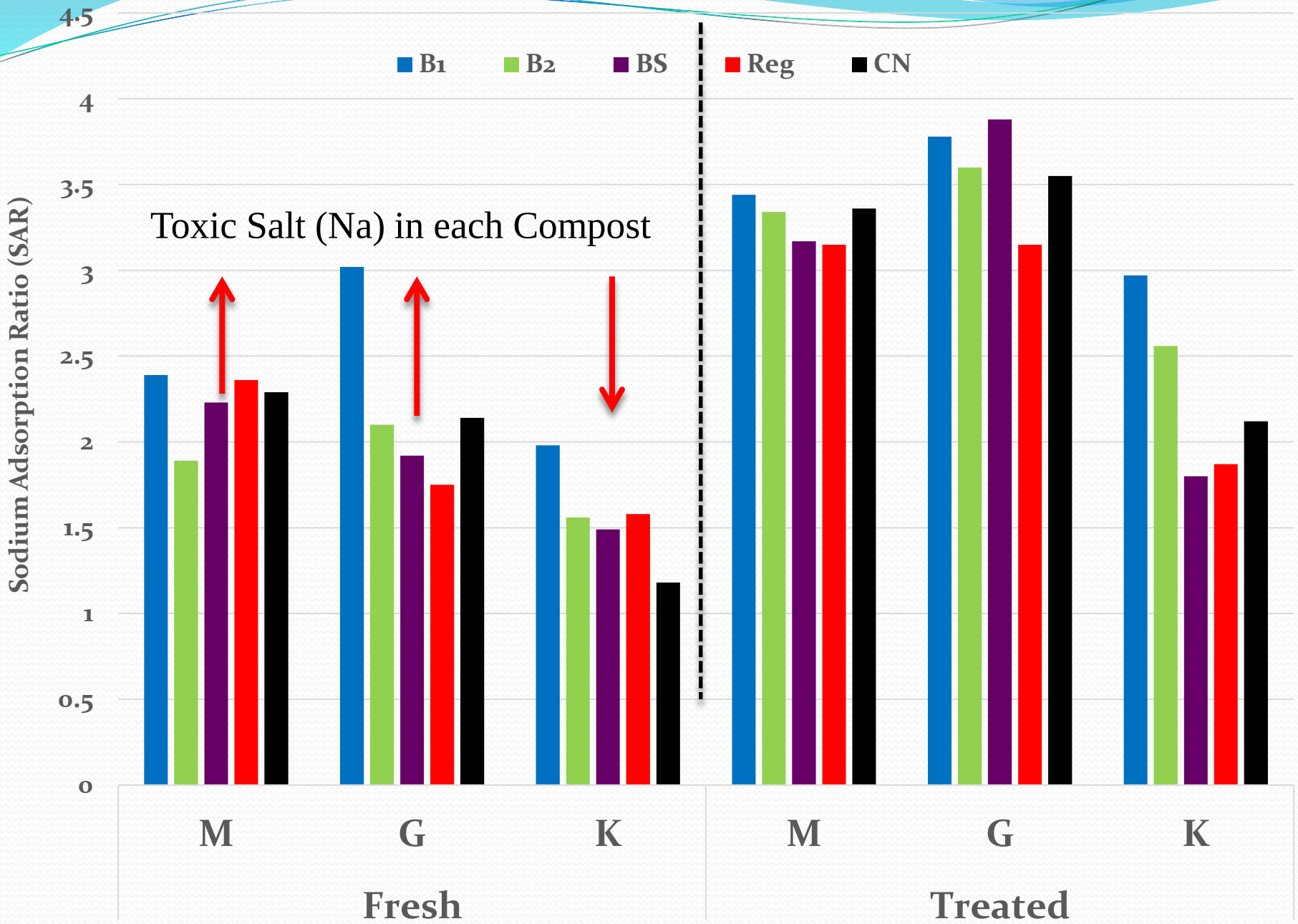
M

G

Soil Salinity (dS/m)



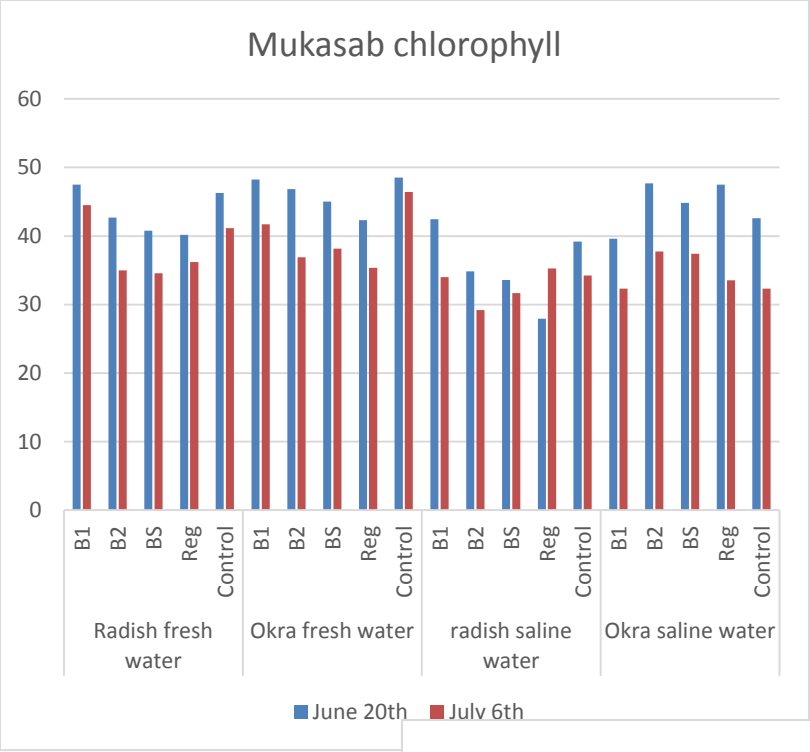
Sodium Adsorption Ratio (SAR) = Na/(Ca+Mg)

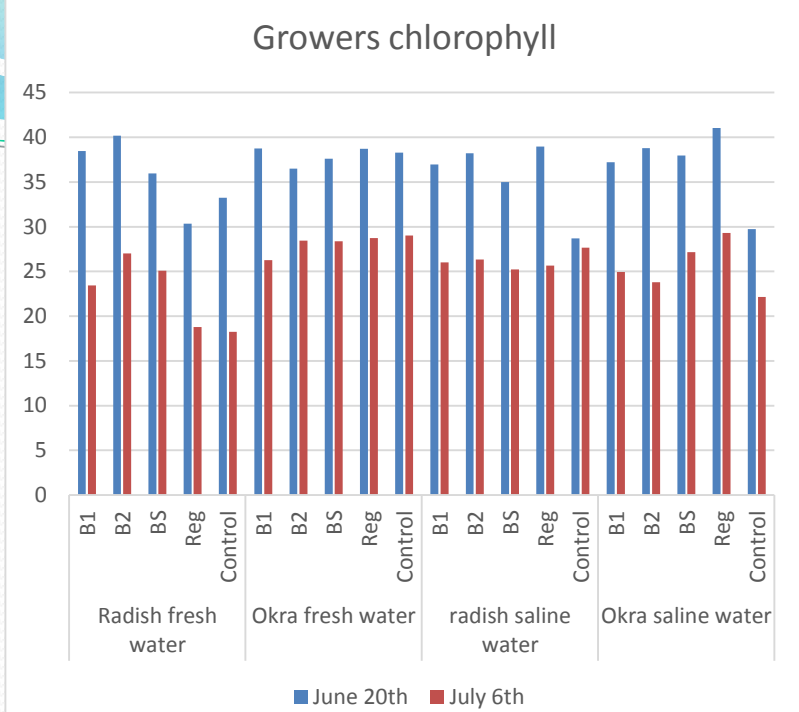


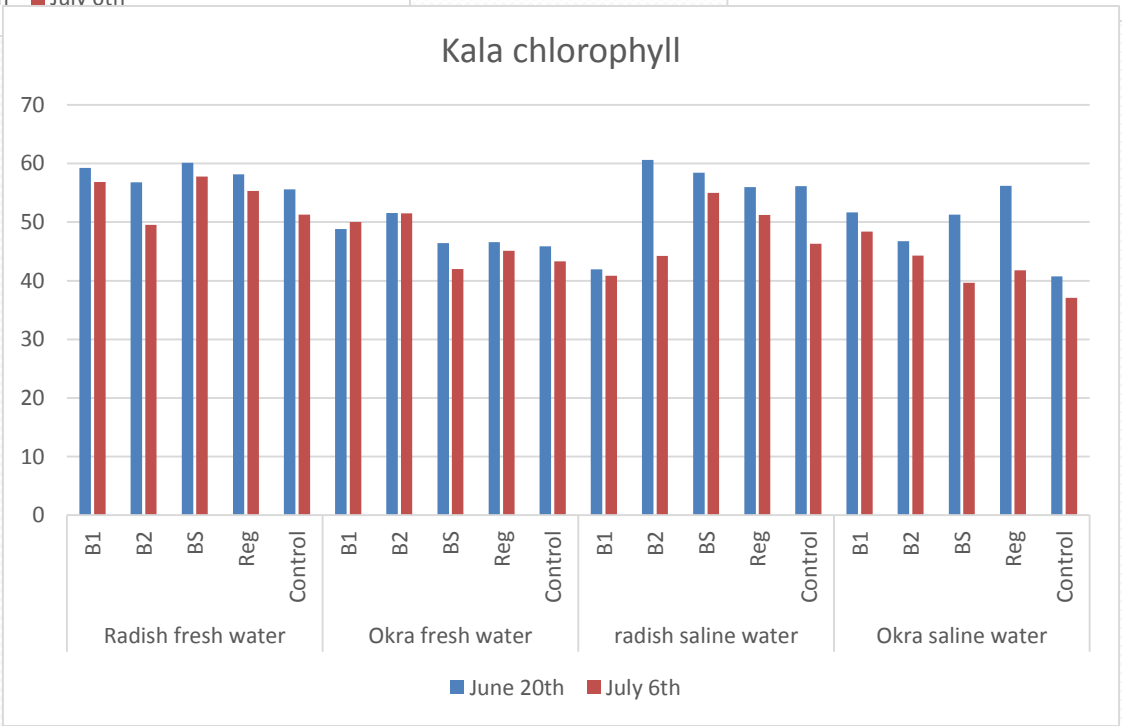
Soil Heavy Metals (mg/kg)

			Zn	Cu	Ni	B
Fresh	M	B1	0.446594	0.020545	0.082641	0.541482
		B2	0.146817	0	0.015704	0.561189
		BS	0.184886	0.009058	0.062574	0.599271
		Reg	0.350061	0.057719	0.228333	0.596983
		CN	0.4509	0.019956	0.157597	0.52329
	G	B1	0.516351	0.110617	0.206098	1.16396
		B2	0.604416	0.010015	0.011367	0.902885
		BS	0.773653	0.020908	0.018044	0.870885
		Reg	0.636462	0	0	0.617329
		CN	0.997149	0.00441	0	0.812974
	K	B1	0.71936	0.115376	0.013617	2.10371
		B2	0.579191	0.126172	0.015361	1.96602
		BS	0.846753	0.095925	0.007005	1.83614
		Reg	0.844826	0.181122	0.039552	2.20178
		CN	0.87137	0.103584	0.007672	1.14987
Treated	M	B1	1.86267	0	0.020944	0.656322
		B2	0.713977	0	0.047596	0.488791
		BS	0.865632	0.029747	0.070735	0.564869
		Reg	0.234201	0	0.098653	0.532513
		CN	0.88519	0.005745	0.252747	0.621568
	G	B1	0.521842	0	0	0.895054
		B2	0.402837	0.00378	0.019648	0.988861
		BS	0.285909	0.01261	0.049903	1.18189
		Reg	0.698188	0.020455	0.04045	0.802778
		CN	0.799443	0.013596	0.041431	0.806882
	K	B1	0.875127	0.112728	0	1.4395
		B2	0.588233	0.113951	0.006005	1.32392
		BS	0.555066	0.080875	0	1.52134

Chlorophyll content







Higher values with Kala

↓

Supplying more Nitrogen

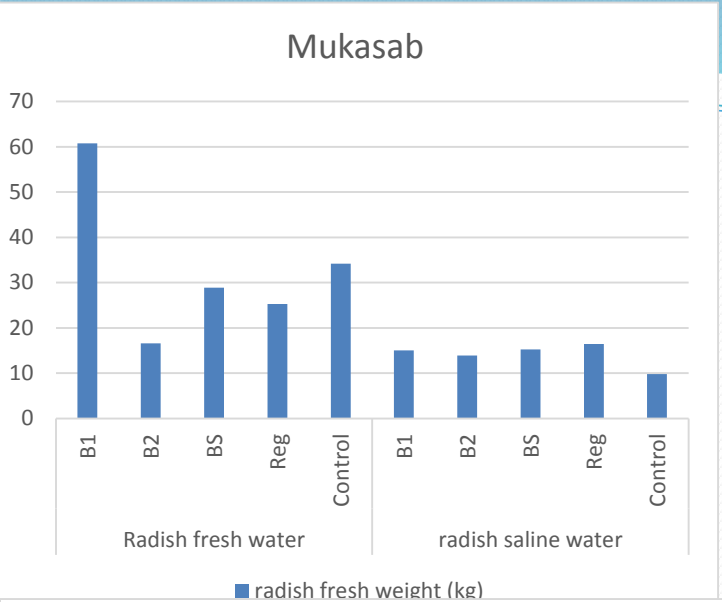
Radish Chlorophyll Content

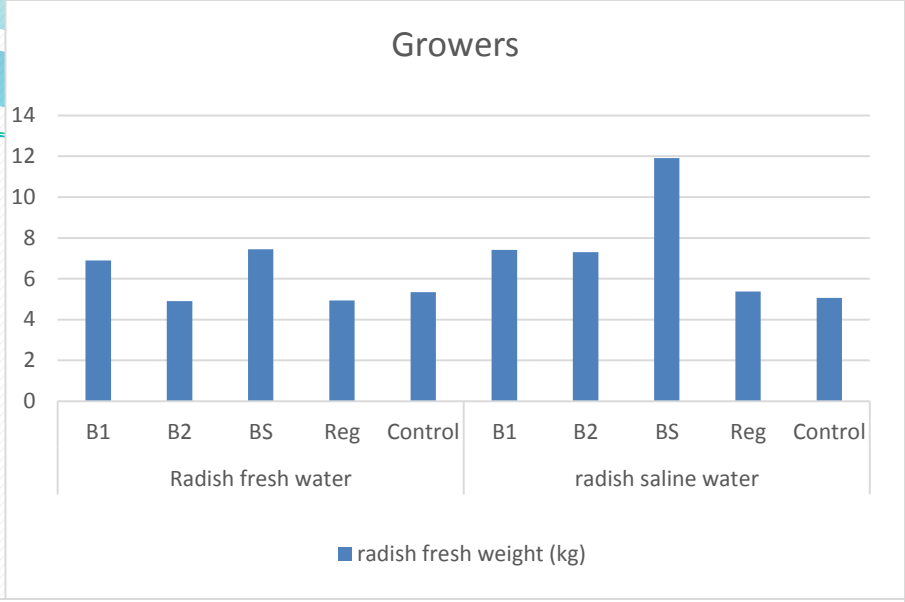
G compost

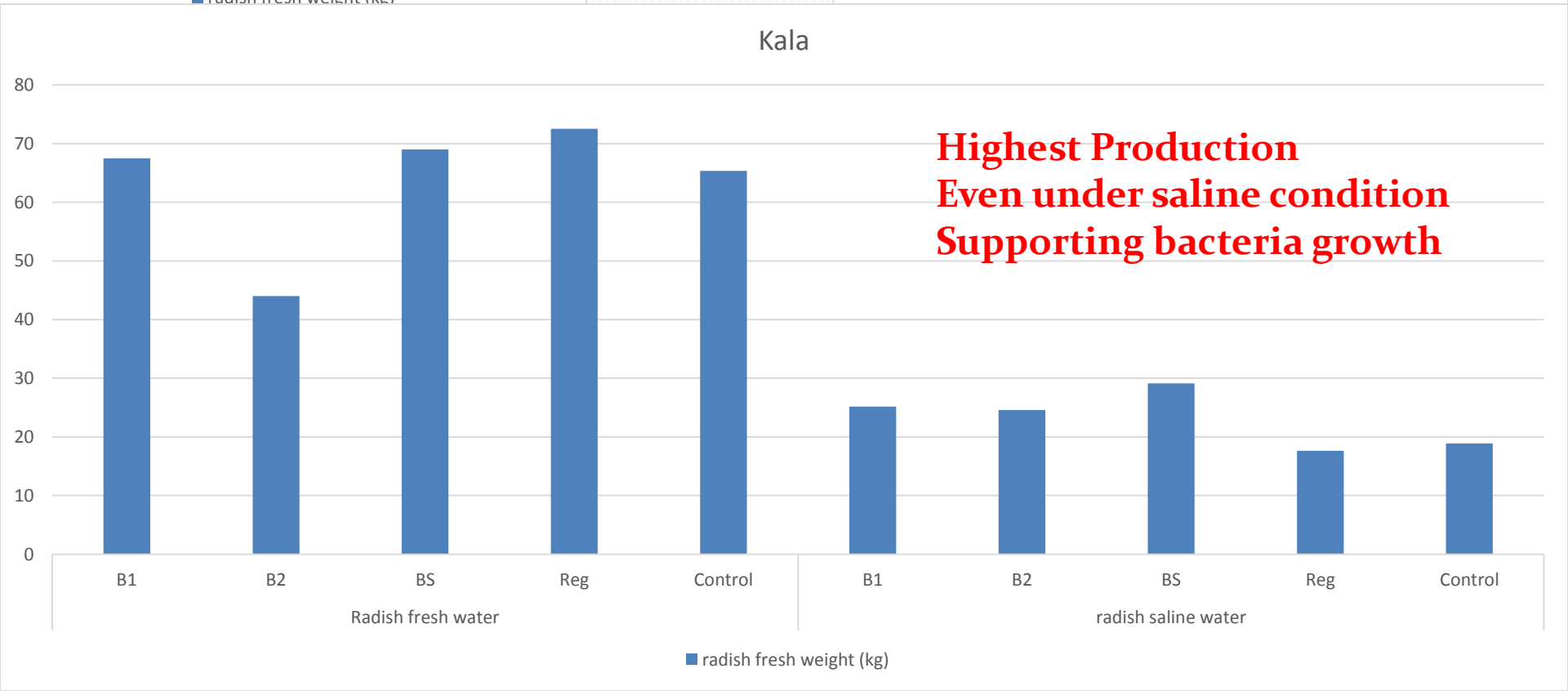
Kala compost with soil Bacteria

Compost with Water Quality

Radish fresh weight

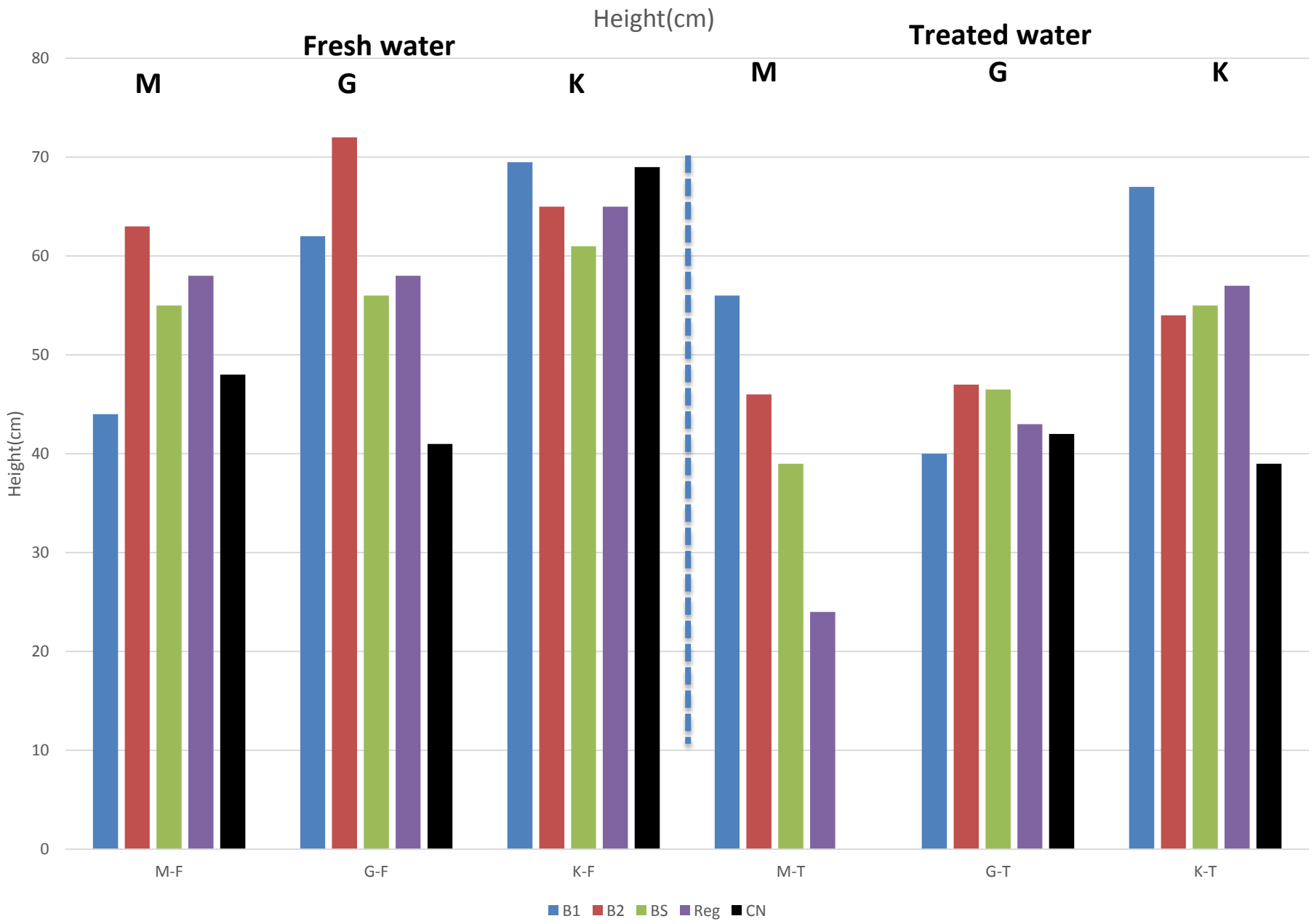






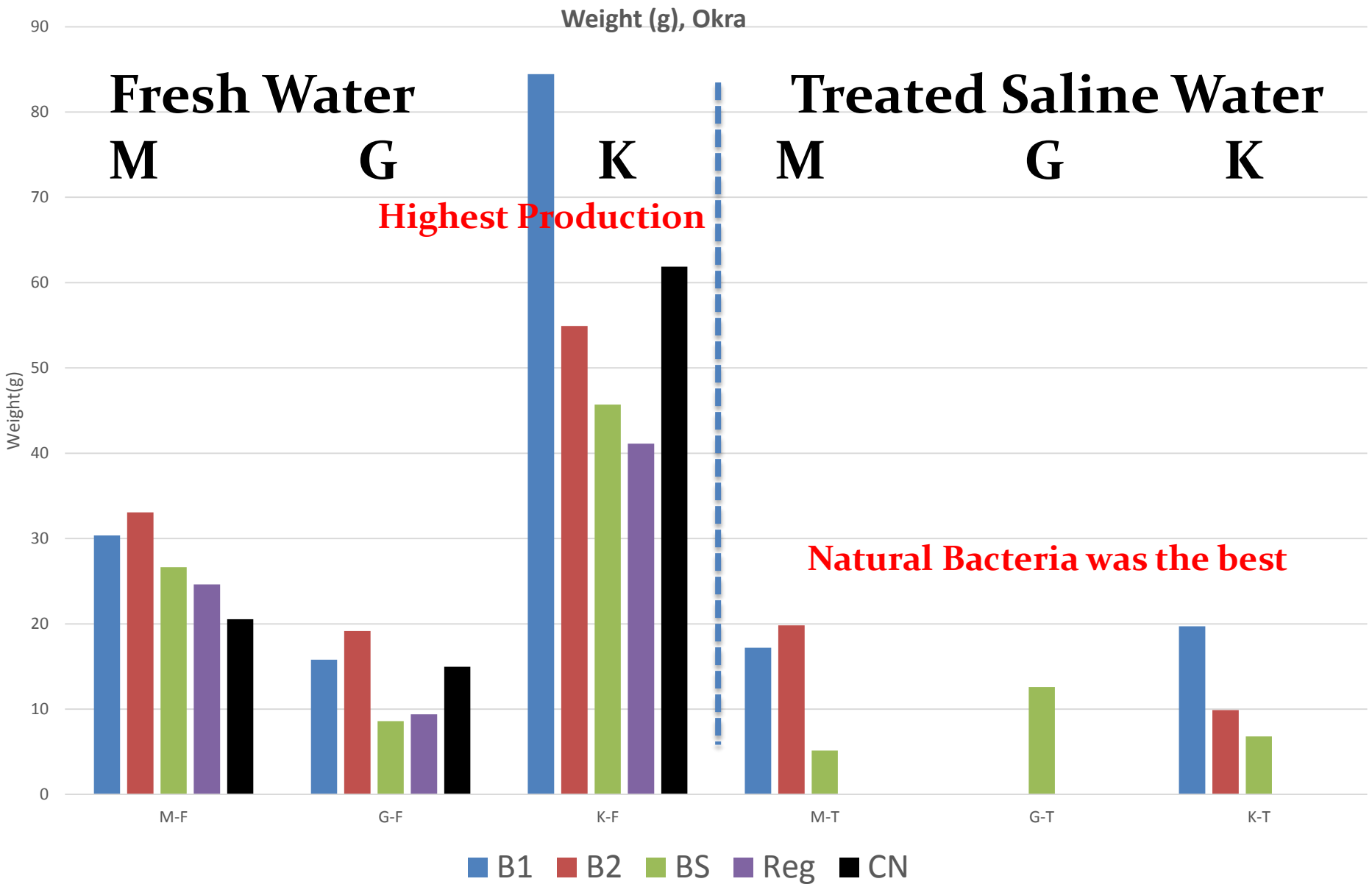
Highest Production
Even under saline condition
Supporting bacteria growth

Okra Height


Height(cm)
Fresh water
Treated water
M
G
K
M
G
K
80
70
60
50
40
30
20
10
0
Height(cm)
M-F
G-F
K-F
M-T
G-T
K-T
B1
B2
BS
Reg
CN

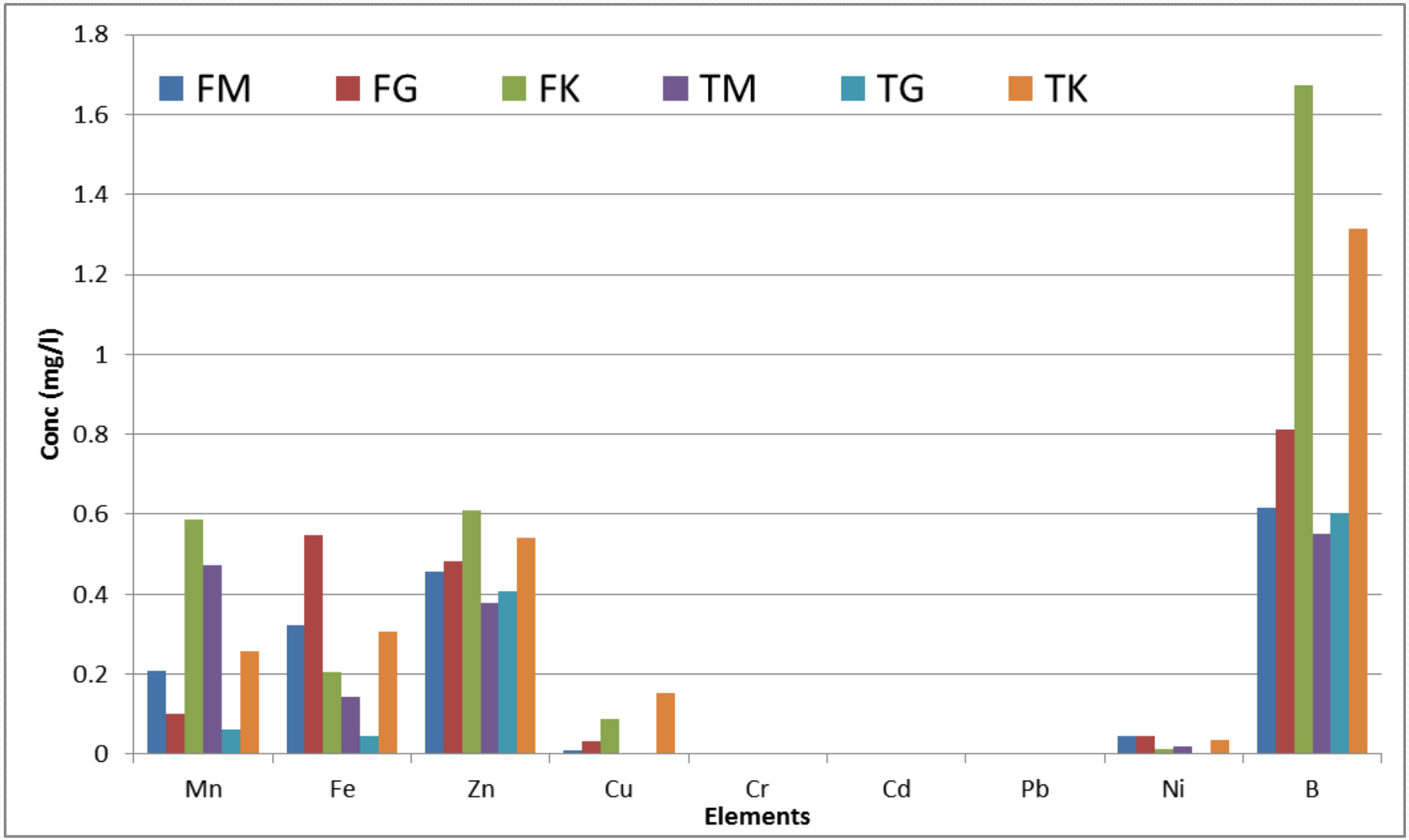

Kala compost

Okra Fruit Weight



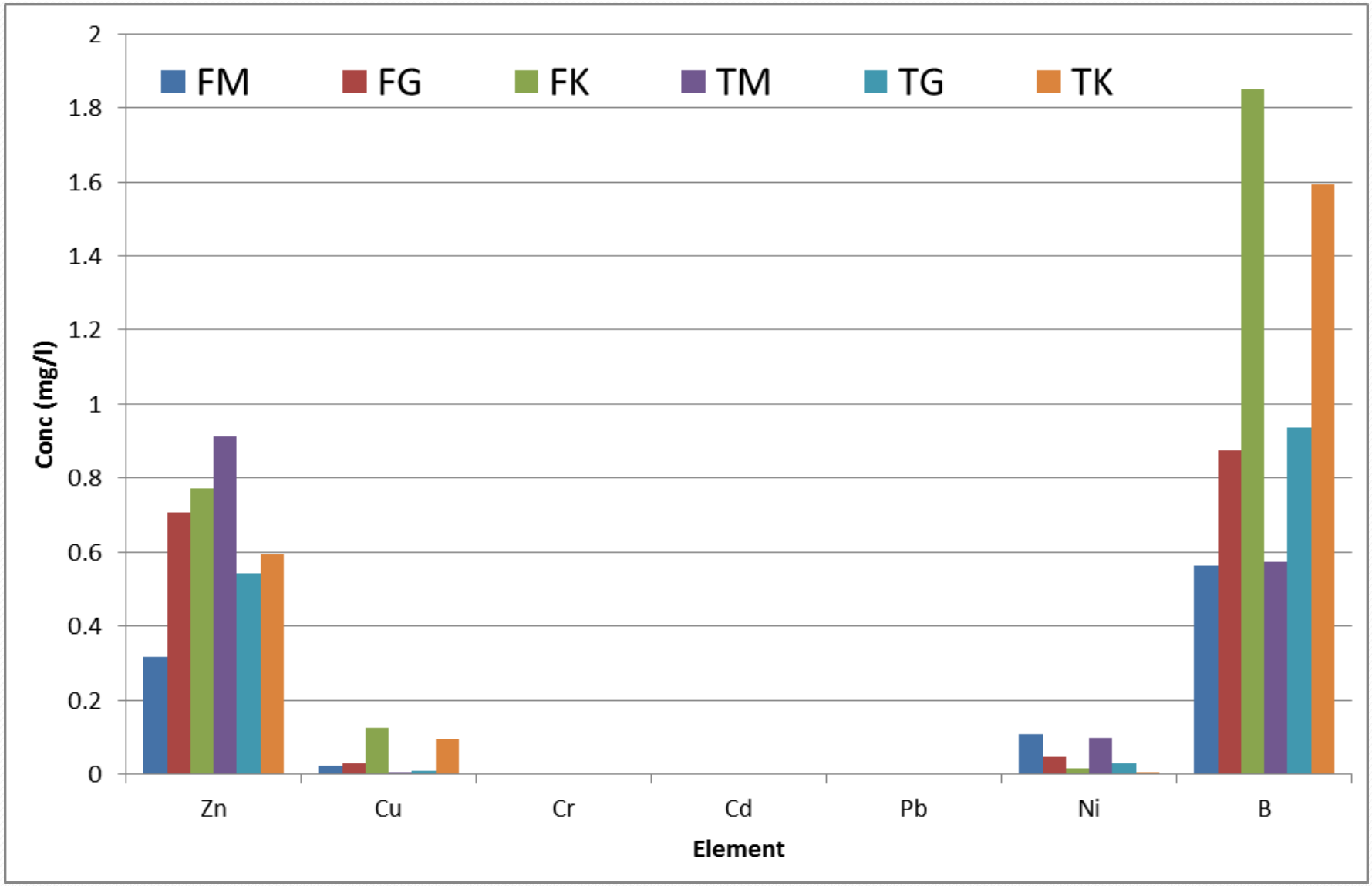
Elements Concentrations (Radish)

Zn	Cu	Cr	Cd	Pb	Ni	B
1-400	5.0-20	0.03-14	0.1-2.4	0.2-20	0.02-5	-



Elements Concentrations (Okra)

Zn	Cu	Cr	Cd	Pb	Ni	B
1-400	5.0-20	0.03-14	0.1-2.4	0.2-20	0.02-5	-



Conclusion

- Application of different composts and bacteria had a role in supporting plant growth and it productivity.
- For the composts application, it was found that Kala compost was the best compost in creating good environment for plant growth by providing more water and nutrients in root zones compared to M and G composts.
- In addition it was enhancing bacteria growth by providing almost all needed parameters for better bacteria growth.
- However, the study should be repeated so clear conclusion can be achieved.

Second Experiment (In Progress)