POTASSIUM MANAGEMENT IN VEGETABLES, SPICES AND FRUIT CROPS

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INTRODUCTION

- India is the second largest producer of vegetables and fruits but largest producer of spices in the world, next to China.
- Fruit crops in general remove much higher quantities of potassium and usually carry high amount of K in the marketable parts.
- Most crops absorb as much or more K than they absorb N from the soil.
- Nutrient removal continues to exceed nutrient addition.
- Many Indian soils are deficient in K and the area is increasing.
- Orissa has a tremendous potential for cultivation of varieties of vegetable crops almost round the year, taking the advantages of the agro-ecological flexibility that the state experiences.
- Although the potassium content of the soils of orissa is medium, many vegetable crops have been found to give good response to application of potassium.
- The vegetable crops such as potato, sweet potato, radish, brinjal, tomato, turnip, carrot, onion and chilli are the principal vegetable crops cultivated in Orissa which need care with regard to potassic fertilizer for getting higher yields of good quality.

Systematic outlay of steps involved in executing nutrient management program

MARKET DEMAND	MONITORING Visual, Leaf tissue analysis, Soil analysis, Irrigation &drainage, Water analysis		MARKET DESTINATION Fresh or processed fruit
FERTILIZER SOURCES Economic situation Application method Tree age Soil pH Soil type(vulnerability to leaching) Salinity	FERTILIZER RATES Tree age Production history Variety fruit stock Soil type(organic matter) Organic soil arrangement Destination of fruit Economic situation Diagnostic information	FERTILIZER TIMING AND FREQUENCY Climatic cycles Tree age Soil type(vulnerability to leaching) Fertilizer nutrients and source Time of year Irrigation method	FERTILIZER PLACEMENT Root zone location Application methods
INTERACTIONS Water management Weather variations Grove floor management Tree size control	FERTILIZER APPLICATION Economics, Fertilization timing and frequency Availability of equipment & lab our, Type of irrigation system Timing of other groove operations, Environmental considerations		METHODOLOGY Broadcast dry fertilizer Fluid suspension (under tree boom) Fertigation Foliar
EVALUATION Fruit yield and quality(fresh vs. processed), Tree size, foliage cover, canopy density, growth habit, Leaf tissue and soil analysis(visual & laboratory), Economics			

Functions and role of potassium

- Photosynthesis,
- Transportation of photosynthates
- Formation and translocation of sugars
- Production of protein
- Stress conditions
- Resistant to lodging.
- Absorption of water
- Healthy root system
- Quality of crops
- Size and colour
- Oil in plants
- Biological N fixation.

Deficiency symptoms

- Growth rate and vigor
- Darkening of leaves
- Chlorotic appearance
- Necrotic
- Hidden hunger
- Resistance
- Roots
- Disease and pest incidence
- Quality of produce

Fertilizer schedule for some important vegetable crops suitable for Orissa

Sl.No.	Crop	FYM(cartload /ha)	N(kg/ha)	P_2O_5(kg/ha)	K_2O(kg/ha)
1	Brinjal	25	125	75	125
2	Tomato	25	125	70	75
3	Chilli	25	110	70	75
4	Okra	25	110	60	75
5	Cabbage	25	120	40	60
6	Cauliflower	25	125	40	60
7	Knolkhol	10	75	50	50
8	Beans	20	25	50	25
9	Country bean	25	25	50	50
10	Parwal	25	25	40	112
11	Radish	25	50	50	100
12	Onion	25	62	50	90
13	Sweetpotato	15	120	60	75
14	Colocasia	20	50	50	80
15	Yam	15	80	60	80
16	Pumpkin	25	50	60	75
17	Snake gourd	25	50	30	75
18	Ridge gourd	20	50	30	75
19	Cucumber	20	50	30	75
20	Bitter gourd	25	50	30	50
21	Watermelon	25	55	55	55

Potash removal relative to N and P for different crops

Sl.No.	Crop	Produce	Removal Kg/ton of produce N	P_2O_5	K_2O	Ratio of K_2O and P_2O_5 removal relative to N		
						N	P_2O_5	K_2O
1	Potato	Tuber	3.9	1.4	4.9	100	35.9	125.6
2	Cassava	Tuber	7.8	1.2	5.1	100	15.4	65.4
3	Cowpea	Fodder	13.8	6.6	17.6	100	47.8	127.5
4	Tomato	Fruit	4.1	1.5	5.9	100	36.6	393.9
5	Coconut	1000nuts	7.1	3.5	10.7	100	49.3	150.7
6	Cardamom	Pods	122.0	14.0	200.0	100	11.5	163.9
7	Cashew nut	Nuts	88.0	25.0	42.0	100	28.4	47.7
8	Mango	Fruit	6.7	1.7	7.4	100	25.0	110.0
9	Banana	Fruit	5.6	1.3	20.5	100	22.7	366.5
10	Citrus	Fruit	1.1	0.6	2.9	100	54.6	259.1
11	Pineapple	Fruit	1.8	0.5	6.3	100	30.0	353.3
12	Papaya	Fruit	2.8	0.8	2.3	100	26.7	80.0
13	Grape	Fruit	8.0	2.0	9.0	100	25.0	112.5
14	Lichi	Fruit	22.0	3.5	29.0	100	15.9	131.0

Removal of Potassium from the soil by some vegetable crops

Sl. No.	Crop	Yield(t/ha)	Removal of K_2O(kg/ha)
1	Potato	40	310
2	Tomato	50	190
3	Brinjal	50	300
4	Cabbage	70	480
5	Cauliflower	50	350
6	Knolkhol	20	170
7	Carrot	30	200
8	Radish	20	120
9	Beet	25	112
10	Onion	35	160
11	Leek	30	240
12	Cucumber	40	120
13	Pumpkin	50	160
14	Muskmelon	15	97
15	Pea	9	88
16	Beans	15	160
17	Okra	20	90
18	Celery	30	300
19	Lettuce	30	160
20	Spinach	25	200
21	Asparagus	5	150
22	Cassava	40	350
23	Sweet potato	40	340
24	Elephant-foot yam	50	245
25	Yam	14	86

Effect of K with N application on yield of tomato(t/ha)

Rate of K_2O(kg/ha)	Rate of	N	(kg/ha)
	132	198	264
0	15.6(41)	16.5(56)	20.5(55)
330	38.7(80)	45.8(85)	58.7(85)

Figures in parenthesis indicate % marketable

Fertigation scheduling and uptake of potassium

Crop	Total K(kg/ha)	Crop development stage	Crop development week	K application Rate (kg/ha/day)
Cucumber	112	1	1	0.9
		2	2	1.5
		3	6	1.9
		4	1	1.5
Tomato	149	1	2	0.9
		2	3	1.5
		3	7	1.9
		4	1	1.5
		5	1	0.9
Pepper	112	1	2	0.9
		2	3	1.5

Effect of different levels of K on yield of Cabbage

Treatments (kg/ha)	Yield (q/ha)
K-0	66.95
K-75	67.80
K-150	83.10
C.D.(0.05)	2.87

Effect of K application on Chilli (cv.pant)

Doses of K_2O(kg/ha)	Yield of green chilli(q/ha)
K-0	17.51
K-40	18.28
K-80	19.70
C.D.(0.05)	9.25

Effect of different doses of Potassium on bulb yield of Onion(cv.Nasik red)

TreatmentsK_2O(kg/ha)	Bulb Yield(q/ha)
K-0	50.00
K-50	72.83
K-100	72.67
C,D.(0.05)	6.82

Accumulation of potassium at different stages of potato growth in the plains

Plant part	Days after planting					
	30	40	50	60	70	80
	K_2O(Kg/ha)					
Leaves	29	49	35	37	29	28
Stems	13	9	6	8	8	6
Tubers	1	25	62	82	98	121
Roots	6	4	2	2	2	2
Total(K_2O)	49	87	105	129	137	157

Accumulation of potassium(K_2O kg/ha) at different stages of potato growth in the hills

Plant part	Days after planting		
	65	85	105
Tops	108	89	64
Tubers	29	121	160
Roots	15	9	-
Total K_2O	152	219	224

Response rates of potato to K application in different soils

Rate (kg/ha)	Response, kg tuber /kg Nutrient applied			
	Alluvial	Hill	Black	Red
29	76	72	21	48
59	64	59	15	42
88	55	49	13	38
118	44	31	8	31
146	34	27	6	25

Doses of K for top dressing potato on the basis of tissue testing

Potato cultivar	Petiole K%	Kg K_2O /ha to be top dressed	Response to top Dressing , t/ha
Kufri jyoti	10.0	105	4.2
	10-11	80	3.2
	11-12	43	2.3
	12.0	43	1.8

Removal of potassium by some of the fruit crops

Crop	Yield(t/ha)	Uptake of K(kg/ha)
Mango	15	100
Banana	58	1180
Guava	20	150
Pineapple	85	530
Papaya	80	175

Uptake of Potassium from some important fruit crops

Sl. No.	Crop	Yield (t/ha)	Total K uptake (Kg/ha)
1	Banana	38	1053
2	Pineapple	84	440
3	Papaya	150	415

Effect of K application on yield attributing characters and yield of banana

K_2O applied (g/plant)	Yield	components		
	Kg/ bunch	Hands/ bunch	Fruit/ bunch	Fruit length (cm.)
0	4.4	7.5	114	18.3
150	6.6	8.1	130	19.0
450	7.2	8.9	140	19.5
600	7.9	9.2	164	20.0

Effect of potash on banana yield and quality

Quality parameters

K_2O applied (g/plant)	Total yield (t/ha)	Fruit weight (g)	Total soluble solids(Brix)	Total sugar (%)	Ascorbic acid (mg/100 g pulp)
200	37.0	115.2	18.4	12.6	5.69
400	50.7	132.7	19.3	14.2	7.45
600	55.9	138.8	20.1	16.7	9.86
CD(5%)	0.87	4.45	0.18	0.15	0.50

Vegetative growth, yield and fruit quality of micro propagated 'Robusta' banana at different K doses

K dose (g/plant)	Plant ht. at Shooting (cm.)	Pseudostem Circum-ference at shooting (cm.)	Leaf length (cm.)	Leaf Width (cm.)	Canopy spread at Shooting (cm.)	Days to shooting
0	143.72	50.28	126.39	111.39	26.31	277.00
100	144.86	54.17	127.50	119.72	28.14	292.00
200	144.97	55.42	132.64	124.86	30.14	275.00
300	145.81	58.06	135.143	128.19	31.33	282.00
CD at5%	4.59	3.82	3.64	6.52	1.00	NS

Vegetative growth, yield and fruit quality of micro propagated 'Robusta' Banana at different K doses

K dose (g/plant)	Days to maturity	Days from Shooting to maturity	Bunch wt. (kg)	Finger wt. (g)	TSS (%)	Pulp/Peel ratio
0	373.0	96.0	8.2	135.3	22.9	3.53
100	377.0	98.0	11.1	170.6	23.1	3.61
200	374.0	99.0	12.2	181.5	23.3	3.65
300	383.0	101.0	13.5	186.0	23.4	3.67
CD(0.05)	11.6	6.8	2.3	21.1	0.07	-

Critical concentration of K(%) in the dry matter of leaf parts of banana

Lamina-3	Mid-rib-3	Petiole-7
3.0	3.0	2.1

Table 20. Effects of N and K levels on bunch weight (kg) of banana(cv.Champa)

Levels	K_2O-150	K_2O-300	K_2O-450	K_2O-600	Mean
N-75	6.5	6.8	6.9	7.2	6.85
N-150	6.7	6.9	7.2	7.3	7.03
N-225	6.8	7.0	7.5	7.8	7.28
Mean	6.67	6.9	7.2	7.43	
Treatment			C.D.(0.05)		
N			0.316		
K			0.274		
NxK			0.547		

Effect of levels of K on growth, yield and quality of ratoon banana

K_2Olevel (g/plant)	Full bunch wt.(kg)	No. of Hands/bunch	No. of fingers/bunch	Wt. of Finger (g)	Fruit Yield (t/ha)	Total soluble Solids (%)	Pulp :Peel ratio
50	5.1	6	56	90.5	15.6	20.4	2.1
100	6.3	6	61	104.3	19.5	21.5	2.4
200	10.7	7	86	123.7	33.0	22.3	2.7
300	12.0	8	94	128.8	37.1	22.7	2.9
400	19.6	10	137	143.3	60.3	24.3	3.4
500	9.6	7	80	119.5	29.5	23.2	2.3
CD(0.05)	0.41	0.68	5.11	7.08	1.22	0.60	0.25

Effect of NPK application on yield and quality of banana

Treatments Doses (g/plant/yr)			Quality Parameters					
N	P_2O_5	K_2O	TSS (%)	Reducing Sugar (%)	Acidity (%)	Starch (%)	Yield (kg/plant)	No. of Fingers / bunch
0	0	0	15.90	6.36	0.176	3.23	19.66	191.6
75	90	300	17.03	7.63	0.166	2.10	33.93	240.6
150	90	400	17.33	7.80	0.183	1.96	40.43	246.1
CD (0.05)		0.50	0.76	NS	0.310	1.90	2.30	

Yield attributes of coleus as influenced by potash

	K levels(kg/ha)				
	25	**50**	**75**	**100**	**SE/CD (0.05)**
No. of tubers/plant	11.42	14.35	12.81	11.33	1.185/NS
Mean tuber Wt.(g)	9.78	10.00	12.57	9.72	0.664/1.917
Tuber yield (t/ha)	8.15	9.11	8.88	8.58	0.486/NS

Potassium budgeting in 'Nagpur' mandarin orchards (A case study of K mining in central India)

Requirement (kg/ha)	-	83
Added by growers (kg/ha)	-	27
Added through annual leaf fall (kg/ha)	-	20
Deficit(kg/ha)	-	36
One orchard cycle	-	25years

Effect of K on flowering, yield and quality of Mango(cv.Amrapalli)

Treatments	Male flower /plant	Hermophrodite/ plant	Sex ratio	No. of Fruits/ plant	Yield/ Plant (kg)	Fruit wt.(g)	Pulp Wt.(g)
K-0	181	68	1:2.63	79	13.26	169.00	103.25
K-100	190	72	1:3.03	84	15.18	181.50	103.75
K-150	220	94	1:1.92	86	16.24	183.75	109.00

Effect of K on quality of Guava

K levels (g/plant)	Fruit weight	TSS	Total sugar (%)	Reducing sugar (%)	Acidity (%)	Vit.C (mg/100g.)
K-0	136.7	8.8	8.01	4.89	0.27	190.4
K-130	141.5	8.8	8.22	5.11	0.29	193.2
K-260	146.4	8.9	8.38	6.04	0.30	196.0

Effect of potassium on growth and yield of Papaya(cv.Pusa magesty)

K_2O (g/plant)	Plant ht cm.)	Stem girth (cm)	Days to 1st fruiting	No. of fruits /plant	Fruit wt. (gm.)
0	119	22.6	278	2	472
90	128	24.9	268	3	697
180	133	26.3	256	5	767
360	150	28.9	252	7	925
540	158	30.3	249	8	969
720	146	27.5	260	5	719
900	141	26.5	264	5	688
CD(0.05)	11.6	1.2	8.8	1.3	68.4

Effect of nutrients on tuber yield of arrowroot

Treatments K2O/N (kg/ha)	Tuber yield (t/ha) 0	25	50	75	Mean
0	5.34	12.30	9.17	10.50	9.33
25	7.71	10.67	8.96	7.30	8.66
50	12.54	8.84	11.00	9.96	10.59
75	8.55	10.96	13.37	12.30	11.29
Mean	8.54	10.69	10.62	10.02	

CD N-1.468, K-1.468, NxK-2.93

Fertilizer (K) application in Acid lime crop

The plants need 2-3 fertilizer applications each year.

(i) Pre rainy season
(ii) Middle of the rainy seasons
(iii) Rainy season is about to end .

The fertilizer is applied in the following manner

Age of the plant	K_2O(g/plant)
1st year	200
2nd year	400
3rd year	600
4th year	800
5th year and above	800

Food sources of K

Vegetables	Portion	K content(mg)
Asparagus	½ cup	279
Avocado	½ medium	530
Broccoli, cooked	1 cup	456
Cucumber, sliced	½ cup	80
Green beans, cooked	1 cup	373
Mushrooms	1 cup	550
Tomato	1 each	273
Tomato juice	1 cup	537
Fruits		
Banana	1 medium	451
Orange	1 medium	273
Grape fruit, white	½ grape fruit	175
Orange juice	1 cup	474
Watermelon slice	1 cup	186

Potassium requirement of spices

Crop	K_2O(kg/ha)
Ginger	45
Turmeric	60
Chilli	30
Onion	113
Garlic	53
Coriander	19
Fenugreek	19
Black cumin	15
Ajwanseed (Bishop weed)	53

Application of potassium phosphate (0.3%) In Pepper :

- Resulted in highest values of
- Sprouting-90.33%
- Plant height-19 cm.
- Number of leaves/plant -20.67
- Oleoresin-8.8-11.95%
- Peperine-3.6-4.5%
- Disease incidence-17.67%
- Fungi population-15x102 cfu/g of soil
- Tricoderma population- 5.33x102 cfu/g of soil
- Bacterial population-153x104 cfu/g of soil
- Contain highest amount of minimum disease incidence

Potassium requirement of Cardamom

Age of plant	Kg/ha –Rain fed areas
2nd year planting	70 (2 applications)
3rd year planting	70 (3 applications)

Effect of K on growth and yield of turmeric

K (kg/ha)	Plant ht. (cm.)	Tiller/ Clump	Rhizome Yield (t/ha)	Additional Cost due to K_2O (Rs)	Cost of additional produce due to K_2O (Rs)	Additional benefit Over control (Rs)
0	2.7	57.5	8.14	437	6320	5883
45	3.1	64.3	9.72	873	8360	7487
90	3.1	64.9	10.23	1310	7520	6210
135	3.1	63.8	10.02	-	-	-

N.B: Cost of MOP-Rs.580.00/q

Role of potassium on growth and yield of Ginger:

For ginger the recommended dose of K_2O is 100 kg/ha, which is to be applied at the time of planting and at the time of second top dressing(90 days after planting).

Effect of graded doses of K on the yield of ginger

K_2O (kg/ha)	Rhizome yield(q/ha)
K-0	81.7
K-50	86.8
K-100	91.7
K-150	91.7

Recommended doses of K for Chilli, Garlic and Coriander

Crop	K(kg/ha)
Chilli	75
Garlic	50
Coriander	20

Conclusion

Efficient use of Fertilizer potassium

- Soil
- Crop
- Stress Situations
- Disease incidence
- Time of application
- Intensity of farming


THANK YOU


GOD BLESS ALL