Tropica Seeds

Technical Guide on Nutritional recommendations for

SWEETPEPPER

For Open-field, Nethouse, Tunnels and Polyhouse

Tropica Seeds

SWEETPEPPER:
Botanical name: *Capsicum annuum L.*

Synonyms: Capsicum, bell-pepper, paprika

1. <u>General growing conditions</u>

1.1 Growing method
Open-field, Nethouse, tunnels and polyhouse. Preferred culture is with drip irrigation and mulching.

1.2 Soil type
Better results will be obtained by growing in light soil such as sandy loam or loams, well drained, rich in organic matter. The preferable pH of the soil should be between 6.5 and 7.5.

1.3 Specific sensitivities

Sensitivity to soil-borne diseases
Peppers are prone to soil-borne diseases caused by fungi, viruses or bacteria. Therefore it is recommended to avoid growing peppers on plots that used for other sensitive crops (tomatoes, eggplants, potatoes, sweet potatoes, cotton, soybeans etc.,). Practice of 3-year rotation between small grains and pepper is recommended.

Sensitivity to salinity
We strongly recommend soil test before taking up Sweetpepper cultivation. If the pH is higher than 7.5, sodium cations will compete with the Potassium cations for the uptake sites in the roots and chloride competes for the uptake of nitrate-nitrogen and will reduce the yield. This will also result in a potassium deficiency in the pepper plants, leading to a low fruit number per plant. Corrective measures under such conditions must include the following steps:

- Abundant application of potassium, as this specific cation can successfully compete with the sodium, and considerably reduce its uptake and negative effects.

- Abundant application of nitrate, as this specific anion can successfully compete with chloride, and markedly reduce its uptake and adverse effects.

 Also, calcium may help to suppress the uptake of sodium. When sufficient calcium is available, the roots prefer uptake of potassium to sodium, and sodium uptake will be suppressed.

Zinc nutrition in plants seems to play a major role in the resistance to salt in pepper and other crops. Adequate zinc (Zn) nutritional status improves salt stress tolerance, possibly, by affecting the structural integrity and controlling the permeability of root cell membranes. Adequate Zn nutrition reduces excessive uptake of sodium (Na^+) by roots in saline conditions.

The methods of implementing these measures are discussed later.

Sensitivity to calcium deficiency
Peppers are highly sensitive to calcium deficiency, which is manifested in the Blossom-end rot (BER) symptom on the fruits. Salinity conditions severely enhance BER intensity. But manganese (Mn) was recently found to serve as antioxidant in pepper fruit hence the addition of manganese to peppers grown under salinity may alleviate BER symptoms in the fruits. Special care must be taken to avoid growing conditions, which enhance BER phenomenon.

1.4 Desirable temperatures

Table 1. Optimal temperatures for pepper plants by growth stage.		**Temperature (°C)**	
Growth stage	Minimum	Maximum	Optimum
Germination	13	40	20-25
Vegetative growth	15	32	20-25 (day) 16-18 (night)
Flowering and fruiting	18	35	26-28 (day) 18-20 (night)

1.5. Irrigation
Greenhouse grown peppers enjoy a longer growing season. They consume, therefore, a larger amount of water than open-field grown peppers during their respective growing season. Water stress affects pepper growth by reducing the number of leaves and the leaf area, resulting in less transpiration and photosynthesis. Root density is reduced by approximately 20% under water stress conditions, compared to sufficiently irrigated plants.

Excessive irrigation will cause water-logging, root death due to anaerobic soil conditions, delayed flowering and fruit disorders.
The root system consists of a deep taproot with laterally spread branches about 50cm long, and adventitious roots. Therefore a drip irrigation system equipped with fertigation device is advisable.

1.6 Growth stages

Growth stages of plants consists of four general periods, having unique nutritional needs of the plants, consequently requiring different fertilization regimes;

- Vegetative growth from sowing to first flowering
- From flowering to fruit set
- Fruit set to first harvest
- From first to last harvest

The duration of each stage vary according to growing method, variety and climatic conditions.

Table 2. Various growth stages duration for Sweetpepper F1 Spinx

Location: Hosur, Tamil Nadu, India
Growing method: Open-field, under drip irrigation and mulching
Number of days of flowering: 20-25 days from Transplanting
Number of days to first harvest: 55 days from Transplanting

Growth Stage	Plant age(Days from TPL)
Planting	1
Vegetative	20
Flowering	20-25
Fruit set	35
First harvest	60
First harvest to Last harvest	130

2. Nutritional requirements

2.1 Main functions of plant nutrients

Table 3. Summary of main functions of plant nutrients:

Nutrient	Functions
Nitrogen (N)	Synthesis of proteins leading to plant growth and yield
Phosphorus (P)	Cellular division and formation of energetic structures
Potassium (K)	Transport of sugars, stomata control, cofactor of many enzymes, reduces susceptibility to plant diseases and abiotic stresses, counteracts salinity
Calcium (Ca)	A major building block in cell walls and reduces susceptibility to diseases.
Sulphur (S)	Synthesis of essential amino acids cysteine and methionine
Magnesium (Mg)	Central part of chlorophyll molecule
Iron (Fe)	Chlorophyll synthesis
Manganese (Mn)	Necessary in the photosynthesis process
Boron (B)	Formation of cell wall, germination and elongation of pollen tube, Participates in the metabolism and transport of sugars
Zinc (Zn)	Auxin synthesis
Copper (Cu)	Influences in the metabolism of nitrogen and carbohydrates
Molybdenum (Mo)	Component of nitrate-reductase and nitrogenase enzymes

The greatest uptake of nutrients occurs in the first 60 days of growth, and another peak takes place after the first fruit removal. Therefore, the plant requires high nitrogen application early in the growing season and supplemental applications after the fruit initiation stage. Improved nitrogen use efficiency and greater yields are achieved when the nitrogen is applied under polythene mulches and with 12 weekly N applications in a drip irrigation system through fertigation. At least 50 to 90% of the total nitrogen should be applied in nitrate (No3) form.

2.2 N-P-K functions in Pepper

Nitrogen (N) contributes to the vegetative growth of the pepper plant. It is important that the plant, when reaching the flowering stage, will be well developed vegetatively, otherwise it will have a low yielding potential. Pepper plants were found to positively respond (by increasing number of flowers and fruits) to higher concentrations than the usual norms for other crops.

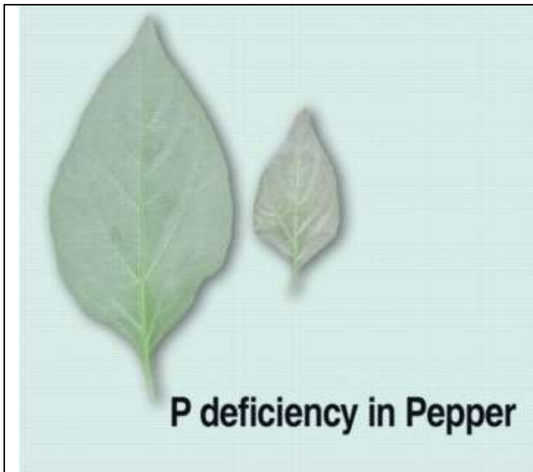
Phosphorus (P) is essential for the normal development of the roots and reproductive organs (flowers, fruit, and seeds). Highly available phosphorus is needed for the establishment of the transplant. Phosphorus shortage in the soil will result in development of too small and short branches, many underdeveloped buds and less fruit in general. Adequate phosphorus enhances early fruit ripening.

Potassium (K) adequate levels enhance the accumulation of carbohydrates and the resistance to low temperatures and diseases. Potassium deficiency slows down the growth rate of pepper plants. Potassium deficiency symptoms are; brown spots at the edges of the leaves and fruits and sometimes there is curling and drying of the leaves. Severe potassium deficiency will retard the transportation of sugars within the plant, leading to starch accumulation in the lower leaves.

2.3 Nutritional disorders in Pepper

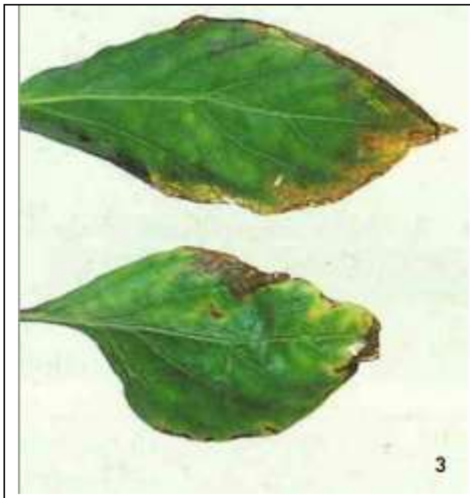
Table 4: Visual symptoms exhibited by pepper plants under nutritional disorders

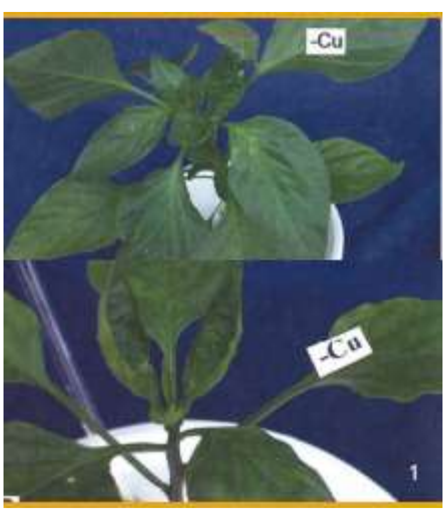
Nutrient	Deficiency symptoms	Excess/Toxicity symptoms
Nitrogen  Nitrogen deficiency symptom	Plant development gradually slows down. Gradual drying, beginning at leaf margins, of the area between the lower leaf veins. The petioles bend and hang downwards, parallel to the stem. The plant develops few flowers and fruit setting is poor. The fruit receptacle is thin, and the ovary is small. Sometimes there is no fruit development on the plant at all, and on those plants that bear fruits, the fruit is deformed.	Plants are usually dark green in color, have abundant foliage, but usually with restricted root system. Flowering and seed production can be retarded.
Phosphorus	The plants display limited growth. The leaves are hard and brittle to the touch. Flower formation is	No typical primary symptoms. Copper and zinc deficiencies may occur due to excessive phosphorus.

	defective. Few flowers develop, only one in every four or five develops a fruit. The fruit is underdeveloped with a thin receptacle, and very few seeds. The root system is underdeveloped.	
Potassium  **Potassium deficiency symptom**	Yellow chlorosis spots appear between leaf veins, firstly in the lower leaves. The veins and the areas adjacent to these spots do not change their color. Later, the chlorotic spots become lighter. (this can be seen mainly in the upper parts of the plant). There is less and small fruits setting	

Sulfur  **Sulfur deficiency symptom**	Causes leaves to become yellowish	Reduction in growth and leaf size. Leaf symptoms often absent or poorly defined. Sometimes interveinal yellowing or leaf burning
Magnesium  **Magnesium deficiency symptom**	It is common on pepper plants. Yellowing of the leaves is apparent in the interveinal areas and veins remain green. The oldest leaves are affected first. Sometimes magnesium deficiency occurs when excessive application of potassium have been made. It may also show up under extremely hot dry weather	
Calcium	The most common reason of blossom end rot of the fruit. This may be	No consistent visible symptoms. Usually associated with excessive soil carbonate

 **Blossom end rot**  **Bubbly crinkly leaves**	corrected by foliar spray of calcium chloride or calcium nitrate.	
Iron 	Symptoms show at the later stages of growth. The young leaves fade and then become yellow in the areas between the veins. The veins remain green	Rarely evident in natural conditions. Has been observed after foliar iron sprays manifested as necrotic spots
Chloride	Wilted leaves, which then become chlorotic bronze, and necrotic. Roots become stunted	Burning or firing of leaf tips or margins. Bronzing, yellowing and leaf abscission and sometimes chlorosis. Reduced leaf size and lower growth rate.

 chloride toxicity	and thickened near tips.	
Manganese  Manganese deficiency symptom	Chlorotic spots between the upper leaf veins	Sometimes chlorosis, uneven chlorophyll distribution. Reduction in growth. Lesions and leaf shedding may develop later
Boron  Boron deficiency	The deficiency manifests itself very quickly. The lower leaves curl upwards. Growth is stunted. The plant develops a thick, short stem. The apex withers and the leaves become yellow from bottom to top of	Yellowing of leaf tip followed by progressive necrosis of the leaf beginning at tip or margins and proceeding toward midrib.

 Excess boron symptoms on leaves	the plant. There is a reduced production of flowers and fruit setting is poor	Excess boron symptom on fruit 
Zinc 	The leaves become narrow and small	Excessive zinc commonly produces iron chlorosis
Copper 	Appear late in the vegetative stage. The leaf margins curl and dry up. The leaves and the fruit become narrow and rectangular	Reduced growth followed by symptoms of iron chlorosis, stunting, reduced branching, thickening and abnormal darkening of rootlets

Molybdenum 	The foliage turns yellow-green and growth is somewhat restricted. The deficiency occurs most commonly on acidic soil. Resembles N deficiency symptom but shows on younger leaves	Rarely observed. Sometimes leaves turn golden yellow

Blossom end rot: (BER)
Occurs mainly during hot weather conditions. Fruits are affected in their early stages of development (10-15 days after fruit set). The cause is related to the rate of calcium supply to the fruit, which is lower than the rate of the fruit growth. This results in the collapse of certain tissues in the fruit, resulting in BER. Factors that favor BER are directly related to limited calcium uptake and supply to the fruit, like high salinity, high temperatures, high growing intensity and water shortage.

Pepper spots:
Black spots or strip is appears on the fruit as grey or black spots, which develop under the skin in the fruit wall, at the time fruit attains a diameter of 8cm or more. As the fruits ripen, the spots slightly enlarge and turn green or yellow. Strip is a calcium disorder, caused by excessive Nitrogen in Ammonia form and Potash rates.

2.4 Plant Nutrient Requirements

Table 5: Nutritional requirements of pepper in greenhouse/Nethouse (Kg/Ac)

Expected yield (Tons/ac)	N	P	K	Ca	Mg
40	153.6	40.4	234.0	97.6	32.4
50	186.4	49.2	284.8	116.0	38.8
60	218.8	58.0	336.4	134.4	45.6
70	251.6	66.8	387.2	152.4	51.6
80	284.0	75.6	438.4	170.8	58.4

Table 6: Nutritional requirements of pepper in Open-field (Kg/Ac)

Expected yield (Tons/ac)	N	P	K	Ca	Mg
40	160.8	42.0	243.2	105.2	34.4
48	188.8	49.6	286.4	122.0	40.0
56	220.8	56.8	330.0	138.8	46.0
64	255.4	69.0	389.0	156.2	52.0
80	286.0	77.2	441.2	175.6	59.2

3. Fertigation recommendations

The recommendations appearing in this document should be regarded as a general guide only. The exact fertigation program should be determined according to the soil type and the exact quantification of macro and micro nutrients present in the soil known through soil test report one month before planting.

3.1 Open field cultivation:

Table 7: Daily Fertigation schedule recommendation for open-field cultivated Sweetpepper (Kg/Ac)

Crop Stage	Fertilizer	Quantity in Kg
Basal Application	DAP	150.0
	10:26:26	150.0
	Magnesium Sulphate	50.0
	Bio-Zyme (Granule)	16.0
	Carbofuran	6.0
1-15 Days after TPL	19:19:19	3.0
	Micro nutrient	1.0
	Calcium	1.0
	Boron	1.0
16-30 days	Calcium nitrate	1.5
	Potassium nitrate	1.5
31-45 days	Calcium nitrate	1.5
	Potassium nitrate	2.0
46-60 days	Calcium nitrate	2.0
	Potassium nitrate	2.0
61-75 days	Calcium nitrate	2.0
	Potassium nitrate	2.0
	0:00:50	1.0
76-90 days	Calcium nitrate	2.0
	Potassium nitrate	2.0
	0:00:50	1.0
91 -105 days	Calcium nitrate	2.5
	Potassium nitrate	2.5
	0:00:50	1.5
106-125 days	Calcium nitrate	2.5
	Potassium nitrate	2.5
	0:00:50	1.5
126-145 days	Calcium nitrate	2.5
	Potassium nitrate	2.5
	0:00:50	1.5

Note: the fertigation schedule is daily or alternate days depending on the crop condition.

3.2 Nethouse/Polyhouse cultivation:

Table 8: Daily Fertigation schedule recommendation for open-field cultivated Sweetpepper (Kg/Ac)

Crop Stage	Fertilizer	Quantity in Kg
Basal Application	DAP	135.00
	10:26:26	135.00
	Magnesium Sulphate	45.00
	Bio-Zyme (Granule)	14.40
	Carbofuran	5.40
1-15 Days after TPL	19:19:19	2.70
	Micro nutrient	0.90
	Calcium	0.90
	Boron	0.90
16-30 days	Calcium nitrate	1.35
	Potassium nitrate	1.35
31-45 days	Calcium nitrate	1.35
	Potassium nitrate	1.80
46-60 days	Calcium nitrate	1.80
	Potassium nitrate	1.80
61-75 days	Calcium nitrate	1.80
	Potassium nitrate	1.80
	0:00:50	0.90
76-90 days	Calcium nitrate	1.80
	Potassium nitrate	1.80
	0:00:50	0.90
91 -105 days	Calcium nitrate	2.25
	Potassium nitrate	2.25
	0:00:50	1.35
106-125 days	Calcium nitrate	2.25
	Potassium nitrate	2.25
	0:00:50	1.35
126-145 days	Calcium nitrate	2.25
	Potassium nitrate	2.25
	0:00:50	1.35

Note: the fertigation schedule is daily or alternate days depending on the crop condition.

Table 9: Micronutrient, Calcium and Boron fertigation schedule recommendation for open-field/nethouse/polyhouse cultivated Sweetpepper (Kg/Ac) for thickening of cell wall and pericarp

Time of Application days from transplanting	Micronutrient	Calcium	Boron
10	0.5	1.0	1.0
20	0.5	1.0	1.0
30	0.5	1.0	1.0
40	0.5	1.0	1.0
50	0.5	1.0	1.0
60	0.5	1.0	1.0
70	0.5	1.0	1.0
80	0.5	1.0	1.0
90	0.5	1.0	1.0
100	0.5	1.0	1.0
110	0.5	1.0	1.0
120	0.5	1.0	1.0
130	0.5	1.0	1.0
140	0.5	1.0	1.0
150	0.5	1.0	1.0

Include Potassium Nitrate (KNo3) and Calcium Nitrate(CN) alternate along with every spray of pesticide @ 3gm/liter of water.

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