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FACULTY OF AGRICULTURAL SCIENCES AND ALLIED INDUSTRIES

Chilli and Capsicum

Botanical Name : *Capsicum annum var.annum*

Capsicum annum var.grossum

Family : *Solanaceae*

Chromosome number : *2n=24.*

Origin : *Central and South America*

Common name : *Chilli (Hot pepper), Capsicum (Sweet pepper & Bell pepper)*

Area and production

- At present chilies and capsicums grown all most all states of the country. The major chilli growing states are Andra pradesh, Karnataka, Maharastra, Orissa, Tamil Nadu, Madhya Pradesh, West Bengal and Rajasthan. Within a span of over four centuries, it has spread to an area of around 0.8 million ha. The area and production keeps varying depending on price fluctuations and the weather conditions.

Economic importance and uses

- Chilli is mainly used in culinary purpose for adding flavour, colour, and pungency. Dry chilli, powdered or ground into a paste and even green chillies are used for curries, sambars, rasam and other savory dishes to impart pungency, colour and flavour to food items. It is widely used in the manufacture of curry powder, curry paste and all kinds of pickles and preparing sauce, soups, salads etc.
- In food and beverage industries chilli is being used in the form of oleoresin which permits better distribution of colour, flavour in food. Capsaicin, the pungent principle, is used in the preparation of balms, whereas the colour extracts

(caratenoids pigments) find use as colour additives in food industry, poultry and prawn feed industry. Raw green as well as fried one are used as such for eating.

Varieties of chilli

K-1:

- It is a selection from Assam type chilli i.e. B72A. Plants are tall compact. The fruits are 6.6cm long and are shiny red with a capsaicin content of 0.35 mg/g. It yields 1900 kg of dry pods per ha in a crop duration of 215 days which is 20 per cent higher than local varieties.

K-2:

- It is released from TNAU. This is a hybrid derivation of K1 and sathur samba. Plants are tall, compact, fruits measure 7.3 cm long with a capsaicin content of 0.49 mg/g. Fruits are bright red and crop matures in 210 days. It yields about 1500kg of dry pod per ha.

Co-1:

- Developed at TNAU, Coimbatore. It is a selection from a Samba type from sathur Samba. The plants are erect, medium tall and compact. Fruits measure 7.3 cm long with a capsicin content of 0.72 mg/g. It yields 2100 kg of dry chilli /ha in a duration of 210 days.

Co-3:

- Released by TNAU, Coimbatore. It is a selection from Sri Lankan introduction. Plants are dwarf less spreading. Suitable for very close planting. It yields about 15-18 tonnes of green or 3.5 tonnes of dry pod/ha.

PMK 1:

- Developed at TNAU, Coimbatore. It is a cross between CO2 X Ramanathapuram gundu. Suitable for rainfed condition, yields about 2.3 t/ha of dry chilli. Capsaicin content 0.36 mg/g.

G-4 (Bagyalaxmi):

- This variety known for its high yielding potentiality. Plants are tall, dense and fruits are 8.8 cm long. Fruits are bright red and contain 0.52 mg capsaicin per gm of fruit.

G-5 (Andra Jyothi):

- It is a cross between G-2 and Bihar variety (1331) which is tolerant to thrips. Plants are tall, dense and the fruits are red measuring 5.1 cm length and 6.3 cm in girth. The capsaicin content is 0.65 mg/g of fruit.

NP 46A:

- This variety is evolved at IARI. Plants are dwarf, dense, spreading type. The cultivar is less seeded and contains 0.53 mg capsaicn per gm of fruit.

Pusa Jwala:

- Released at IARI, New Delhi. This is derived from a cross of NP 46A and puri red. The plants are dwarf and spreading in habit. Fruits are long red and contain capsaicin of 0.48 mg/g of fruits.

Pant C-1: GBPUAT:

- It is evolved from a cross between NP46A X Kandhari. It is tolerant to leaf curl and mosaic virus. The plants are erect and 50-60 cm tall. Fruits are green when immature and red when ripe. Fruits are erect, 6-7 cm long and are highly pungent.

Pant C-2:

- It is a selection from cross involving the same parents as that of pant C-1 plants are tolerant to leaf curl & mosaic and yields about 1400 kg dry chilli/ha.

Arka Abir:

- released through pure lime selection. It is suitable for colour extraction.

Sindhur:

- It is selected from CA960. The fruits have deep red thick pericarp. They measure 8.2 cm in length with capsaicin content of 0.81 mg/g fruit.

JCA154:

- This is pickling cultivar from JNKV Madhya Pradesh. Fruits are dark green when unripe and bright red when ripe. Fruits mature in 115-120 days.

Pusa Sadabahar:

- This is a multipurpose chilli cultivar. It can be consumed green and used for preparation of red powder and manufacture of oleoresin. Fruits bear in cluster of 6 to14 that facilitate bunch harvesting. It is developed through the cross between Pusa jwala X IC 31339 (C.Frutescense). Fresh fruit yield 75-100 q/ha and dry yield 15-20q/ha.

X-235:

- It is cross between G4 X Anther mutants. Early maturing plant spreading with short internodes. Leaves small dark green. Flowers with yellow anthers as markers. Fruits are 5-6 cm long and pointed tip.

Arka Lohit:

- released by IIHR, Bangalore. It is a selection from IHR 324, plants are tall, spreading, foliage light green. Tolerant to moisture stress, suitable for rainfed condition. Fruits are dark green with a capsaicin content of 0.21 per cent fruits are highly pungent , yield potential is 3.5 t/ha of dry or 20 to 25 t/ha of green chilli in 180 days.

Arka Harita:

- High yielding chilli F1 hybrid developed by using MS line. Plants tall (1m) & spreading (90cm.). Fruits medium long (10 cm) with width 1 cm. Fresh yield 31 t/ hectare and dry yield 6 t/ ha in 150-160 days. Fruits are dark green and turn red. Tolerant to powdery mildew and viruses.

Arka Meghana:

- High yielding chilli F1 hybrid developed by using MS line. Plants medium tall (81.3 cm) & spreading 69.5 cm. Fruits long (10.6 cm) with width of 1.2 cm. Very early, taking 24 days for 50% flowering. Fresh yield of 33.5 t/ ha and dry yield of 5 t/ ha in 140-150 days. Fruits are dark green and turn deep red.Tolerant to powdery mildew and viruses.

Arka Suphal PMR 57:

- Indeterminate with a plant height of 80-90 cm Dark green Foliage Fruits straight, smooth with pointed tip, 7-9 cm long Fruit colour green changing to deep red Yield: 25t green and 3 t dry chilli/ ha Resistant to powdery mildew and field tolerant to viruses.

Arka Sweta:

- High yielding chilli F1 hybrid developed by using MS line. Plants medium tall(95cm)&spreading(82.5cm). Fruits long (13.2 cm) with 1.3 cm width. Fresh yield 38.4t/ ha and dry yield of 6 t/ ha in 140-150 days. Fruits are light green, turns red.

Samrudhi:

- Released by UAS, Bangalore suitable for growing under rainfed conditions.

Jwala Sakhi:

- It is evolved by cross involving vellanotchi X Pusa jwala. Fruits sulphary green, long, succulent yields 19.6 t green chilli in 125 days. Tolerant to little leaf and leaf spot.

Jwala Mukhi:

- It is developed at KAU, vellayani by using same parents of Jwala sakhi. Plants dwarf, fruits long (9.6cm) succulent, dark green with light pungency yield 22.5 t/ha of green chilli in 137 days, tolerant to little leaf and leaf spot.

Bell pepper varieties

California Wonder:

- It is an introduction from USA. Plants vigorous, upright, prolific, fruits are 3-4 lobbed smooth with medium thick sweet flesh.

Chinese Giant:

- plants are vigorous and prolific bearer, fruits are 3-4 lobbed sweet flesh and skin is dark green in colour.

World Beater:

- Plants are upright, productive, fruits 3-4 lobbed flesh thick mild and sweet.

Yolo Wonder:

- Large fruit, 3-4 lobbed, medium thick flesh mild & sweet.

Bharat:

- This is F1 hybrid released by IAHS Bangalore. Plants are vigorous, fruit dark green, 4 lobed yields 20-25t/ha. It is resistant to TMV.

Arka Gaurav:

- Selection from golden California wonder of USA. Plants indeterminate with upright bearing habit, thick flesh, 70 to 80 g fruit weight, tolerant to bacterial wilt, yield 20t/ha.

Arka Basant:

- Indeterminate plant habit with yellow green foliage.Thick fleshed, 2-3 lobed conical fruits Average fruit weight 50-80 g Fruits erect, cream coloured, which turn orange red on ripening.Yield potential of 16 t/ha Duration of 150 days

Arka Mohini:

- Determinate plant habit with dark green foliage. Thick fleshed, 3-4 lobed dark green blocky fruits. Average fruit weight 180-200 gms Fruits pendent, which turn red on ripening. Yield potential of 20 t/ha Duration of 160 days

Pusa Deepti:

- IARI, katrain. It is a F1 hybrid, high yielding, resistant to anthracnose and fruit rot.

KT 1:

- It is evolved at IARI sub station katrain. It is high yielding F1 hybrid resistant to anthracnose and fruit rot disease.

Climate and soil

Climate

- Chilli performs well in warm humid tropical and subtropical regions. It is being cultivated from sea level to almost 1000 m above MSL.Optimum temperature range of 15-350C is requires for chilli cultivation. Comparatively milder climate conditions are preferred for sweet or bell pepper. A soil temperature of 100C or less retards crop growth. Prevalence of low temperature during fruit ripening is likely to delay colour development of fruits.
- Temperature beyond 400C result in poor fruit set as well as severe fruit drop. As a rainfed crop, chilli performs well in regions receiving rainfall of 600-1200 mm spread over four to five months. Areas receiving < 600mm of rainfall require a few protective irrigation for better crop yields. Successful crop of bell pepper can be raised only under irrigated condition providing shade to sweet or bell peppers through poly or net houses during summer and only shade nets and open during other seasons is beneficial.

Soil

- Chilli can be grown in wide range of soils but well drained loam soil rich in organic matter is best suited for chilli cultivars. As a rainfed crop chilli can be grown successfully in medium to heavy textured soils like clay loams provided proper drainage to prevent water stagnation. Chilli crop will not withstand water logged conditions for more than a day. A good crop of chilli can be raised on red sandy and sandy loam soils, as an irrigated crop, with copious amount of organic manuring and fertilizer application is necessary to get optimum growth of the plant.
- Though chilli is grown on soils with as pH range of < 5.0 like the acid laterite soils of coastal areas and heavy rainfall (mountain) regions to soils of > 8.0 pH like the Alluvial soils of north India and black cotton soils of the Deccan plateau, it performs best at a soil pH of about 6.5. Saline and sodic soils hinder crop growth

and fruit development. Most extensive cultivation of Chilli can be seen on vertisols covering the states of Andra Pradesh , Karnataka, Maharashtra and Tamil Nadu. Bell pepper performs best on red and alluvial soil with slightly acidic pH and having good drainage and aeration.

Preparation of field

- The soil is brought to fine tilth by repeated ploughing and harrowing. Tillage consists of breaking up the hard, compact soil to certain depth by tillage operations like ploughing, hand digging to bring the soil to pulverized mass known as tilth. Twenty five tonnes of FYM/ha can be incorporated into the soil.

Spacing and transplanting

- Seedlings are transplanted 4-6 weeks after sowing. Chilli planting at a closer spacing gives higher yield and a spacing of 20X20cm gave higher yields in Uttar Pradesh. A closer spacing of 30X30 cm was found good in Tamil Nadu. In Karnataka 75 X 45 cm distance between rows and plants is being practiced to get higher yields. Bell pepper plant population appears to be the most important single factor for getting higher yields. Maximum fruit yields are got at a spacing of 45 X 45cm. A spacing of 60X30 with 55,000 plants/ha gave highest yields of 12.3t/ha in capsicum cv. California Wonder. In Karnataka 60 X 45cm spacing is recommended for higher yields.

Nutrition

- Chilli and capsicum respond well to application of fertilizers both under irrigation and rainfed condition. The nutrient requirements are mentioned below.

	Chilli		Capsicum
Nutrients	**Irrigated (kg/ha)**	**Rainfed (kg/ha)**	**Irrigated (kg/ha)**

N	175	100	150
P	75	50	75
K	75	50	50

- Good fertile soils with humus are most desirable for growing capsicum. Heavy application of N fertilizers may increase vegetative growth and delay maturity. For rainfed crop 50% of Nitrogen and full dose of P & K applied as basal dose and remaining 50% should be applied 4 weeks after transplanting. While under irrigation nitrogen should be split into three split equal doses and applied at an interval of three weeks. Nitrate form of nitrogen is preferred by capsicum hence it is suggested that for bell pepper nitrate should be supplied at least at double the rate of ammonical nit rogen.
- During cooler seasons higher ratios of ammonia to nitrate and in summer almost equal ratio of these two forms was found to favour capsicum production. Pepper plants grown under nutrient film techniques (NFT) and exposed to solar radiation preferred NO3 as the source of nitrogen while imposing shade made the plants to perform well with ammonical and nitrate forms 1:4 ratio. Capsicums were found to respond to inoculation with VAM fungus Glomus irraradices. Azospirillum as a seed treatment and soil application increased vegetative growth in capsicums.

Irrigation

- Since chilli is largely cultivated as a rainfed crop, the crop suffers during its various growth phases by moisture stress due to drought spell. Soil moisture stress affects the plant growth and production of chilles. Decreased nitrogen utilization and decreased yield were observed at lower irrigation regions. Phosphorus uptake was severely affected by soil water stress. Moisture stress also resulted in severe flower drop in chilli. The soils with available water holding

capacity of 100 to 160 mm per metre depth of soil are ideal for cultivation of chillies.

- The crop raised in kharif season is mainly for ripe red chilli purpose. In semi arid regions of the tropics, it is observed that providing supplemental irrigation whenever dry spell exceeds 8 to10 days period almost doubles the chilli yields on red loam soils. Irrigation requirement depends on season of cultivars and soil type. Capsicums are mostly grown during rainy and winter seasons although as it not common to see them being cultivated during summer season. Even during monsoon season whenever dry spell exceeds 7-8 days providing supplemental irrigations are necessary. When the capsicums are grown as irrigated crops, normally furrow method of irrigation is followed.

Weed control

- Weed intensity is generally more in red soils than in black soils in the same locality. Weed intensity is high when the crop is grown during kharif season than in Rabi or summer months. Though cultural methods of weed control is widely followed, with the increase in labour wage and scarcity of laborers and some times increased rains preventing these operations, using herbicides or combination of both herbicide and cultural operations are becoming more popular.
- A large number of herbicides have been tried, both for transplanted and direct sown chilli crop. Among the herbicides tried, dephenamide, trifluralin, EPTC, Nitrofen had given good results in chilli crop. Various mulches such as saw dust, gravels, crop residues, plastic films etc are used to control weed population.

Physiological disorders/constraints

Physiological disorders/constraints

Blossom end rot:

- A disorder of sweet pepper where water soaked spots first appears on the blossom end of fruit. The spots soon become light brown and papery as the lesions dry out. The causes and control measures are similar to tomato. i.e. for controlling the disorder we should follow judicious and timely irrigation and the crop should be grown in the soil having good water holding capacity.

Sun scald:

- A disorder of sweet pepper, it occurs when the fruits are exposed to scorching sunlight. This disorder arises as a soft, light coloured area in fruit that becomes slightly wrinkled. Plants having enough foliage are less prone to this disorder.

Skin cracking:

- A disorder of sweet pepper where cracking occurs around the shoulder of fruits. It is often associated with fluctuations in temperature and humidity. High day temperature and average RH increases the incidence of cracking.

Flower and fruit drop:

- It is one of the major constraints in chilli cultivation.
- Flower and fruit drop may occur due to

(1) Low humidity and high temperature condition which result in excessive transpiration and water deficit in the plant and cause abscission of buds, flowers and small fruits
(2) decreasing light intensity
(3) Short day and high temperature and
(4) High temperature during early flowering stages.

Control

1. Irrigation at flowering and fruit set stage helps in reducing blossom end rot and fruit drop.

2. Foliar application of 50 ppm NAA at full bloom set stage effectively controls the drop.

3. Foliar application of 20 ppm NAA at first flower opening followed by two sprays at an interval of 30 days increases fruit set.

4. Application of Triacontanol (vipul 1ml/ 2 litre of water) also markedly reduces flowers and fruit drop.

Harvesting and yield

- The crop is harvested for either green fruits or red ripe fruits by hand picking. The picking of green fruits continues for about 2 months at an internal of 10-12 days and they will be five to six pickings for green chillies and 3-4 for red ripe fruits. Drying of red ripe fruits for about 5-7 days in bright sun light is necessary before marketing or storage. When there is a good demand for green chillies one or two picking of green fruits can be done even of the crop is grown for red chillies.

- The yield may be about 7 to 16 tonnes per hectare of green chillies and 12-20t/ha of non pungent sweet capsicums or bell peppers. In case of dry chillies the yield may be 0.5-1.0t/ha of rain fed & 1.5-2.5t/ha in irrigated crop. The yield of fresh green chillies is 3-4 times higher than that of fresh red ripe chillies and 6 to 10 times that of dry chillies. However the proportion of dry to fresh ripe chillies depends upon quality of seeds and the thickness of the inner wall, the pericarp of the fruit.

Seed production

- Chilli is a self pollinated crop but cross pollution also takes place to some extent. The isolation distance between two cultivars may be kept 250-400 m

apart to avoid cross pollination. Good healthy and well developed fruits should be selected for producing seeds. The off types and disease affected plants are taken out atleast thrice during crop period. First before flowering on the basis of flowers of external plant characters.

- Second at the time of flowering on the basis of flower characters and finally at the time of pod maturity on the basis of pod characters. Complete ripe pods are harvested and dried properly for 15-20 days in sunlight or 2-3 days in drier at 550C. Later on, the seeds can be extracted from the dry chillies. Simple mechanical seed extractor also used for extraction of seeds. Siever is used for separation of seeds fitted with wire mesh. This procedure brings down the extraction cost by 50 per cent and enhances germination per cent to 90 per cent.
- The capsicum plant is generally cross-pollinated crop. The isolation distance between two cultivars should be kept 200m for foundation seed and 100 m for certified seed. Off types are removed as soon as these are observed. 3 to 4 rougings depending on the purity of the seed desired. Field inspections should be done at least twice or thrice. The fruit should be picked when red ripe and cut and crushed or macerated by machines. Seed is to be washed to make it free from and skin. After washing it should be dried and used for sowing. The seed yield is 105 to 225 kg/ha.