CHAPTER-II

GENERAL
HOST

Common Name

Bengal gram (Indian), Chickpea (English), Garbanzo (Latin America)

Scientific Name

Species: *Cicer arietinum* L.

Family: Leguminosae

Origin

The specific name *aritinum* is derived from the Greek term 'Karios' which means the head of a horned ram the shape of which the seed resembles. Van der Maesen (1972) believed that the species originated in the southern Caucasus and northern Persia. However, Ladizinsky (1975) reported the center of origin to be southeastern Turkey. Van der Maesen (1987) recognized the southeastern part of Turkey adjoining Syria as the possible center of origin of chickpea based on the presence of the closely related annual species, *C. reticulatum* Ladizinsky and *C. echinospermum* Davis. Wild *C. reticulatum* is inter fertile with the cultivated pulse and morphologically closely resembles with cultivated *C. arietinum*. It is regarded as the wild progenitor of chickpea (Ladizinsky, 1975). "Botanical and archeological evidences showed that chickpeas were first domesticated in the Middle East and widely cultivated in India. It is an important crop of Mexico, Argentina, Chile, Peru and the U.S. and Australia. It is grown as a cold weather crop both in north and south India.

Ecology

Chickpea is a self-pollinated crop. Cross-pollination (0-1%) is rare (Smithson *et al.*, 1985; Singh, 1987). It is grown usually as a rainfed cool-weather crop or as a dry climate crop in semi-arid regions. Optimum conditions include 18-26°C day and 21-29°C
Chapter II

General

night temperatures with annual rainfall of 600-1000 mm (Duke, 1981; Smithson et al., 1985). The crop is generally grown on heavy black or red soils (pH 5.5 - 8.6). Relative humidity of 21-41% is optimum for seed setting. In virgin sandy soils or for the first planting in heavier soils, inoculation is said to increase yield by 10-62% (Duke, 1981).

Taxonomy, Morphology and Floral Biology

The Genus includes 9 annuals and 34 perennial herbs (Van der Maesen, 1972; Muehlbauer, 1996). Cross ability and fertility of hybrids in inter specific crosses have been used as a basis to classify the annuals into 4 cross ability groups. The first group includes the cultivated (Cicer arietinum L.) chickpea (Ladizinsky et al., 1988) and C. reticulatum. Chickpea plants can be described as "Herbaceous annual, branching from the base, mostly erect and with a few diffuse spreading branches; all parts of the plant are covered with viscid glandular hairs; stem generally greish in appearance; leaves pinnately compound with leaflets small, hairy, serrated; flowers axillary, solitary, pedicels jointed; the colour of flower varies from white, greenish white, or bluish, and is papilionaceous; stamens diadelphous, (9+1); ovary superior with one or two ovules; fruit a turgid pod, normally containing one or two seeds; seeds vary in size and shape their colour ranging from white, light fawn, orange-yellowish, brown, brownish dark brown and with little bluish tinge; the seed coat may be smooth or puckered and wrinkled or roughly granulate or tuberculate; cotyledons thick and yellowish (Sundararaj and Thulasidas, 1976).

Chemistry

Chickpea seed has 38-59% carbohydrate, 3% fiber, 4.8-5.5% oil, 3% ash, 0.2% calcium, and 0.3% phosphorus. Digestibility of protein varies from 76-78% and its carbohydrate from 57-60%. (Hulse 1991; Huisman and Van der Poel, 1994). Raw whole seeds contain per 100 g: 357 calories, 4.5-15.69% moisture, 14.9-24.6 g protein, 0.8-6.4
Chapter II

% fat, 2.1-11.7 g fiber, 2-4.8 g ash, 140-440 mg Ca, 190-382 mg P, 5.0-23, 9 mg Fe, 0-225 mg b-carotene equivalent, 0.21-1.1 mg thiamin, 0.12-0.33 mg riboflavin, and 1.3-2.9 mg niacin (Duke, 1981; Huisman and Van der Poel, 1994). Sprouting is said to increase the proportionate amounts of ascorbic acid, niacin, available iron, choline, tocopherol, pantothenic acid, biotin, pyridoxine, inositol, and vitamin K. The limiting amino acid concentrations are 0.52 for methionine, 1.45 for lysine and cystine, 0.71 for threonine and 0.16 for tryptophan (Williams et al., 1994). The amino acid (g) composition of seeds with 19.5% protein, 5.5% oil is (per 16 g N): 7.2 lysine, 1.4 methionine, 8.8 arginine, 4.0 glycine, 2.3 histidine, 4.4 isoleucine, 7.6 leucine, 6.6 phenylalanine, 3.3 tyrosine, 3.5 threonine, 4.6 valine, 4.1 alanine, 11.7 aspartic acid, 16.0 glutamic acid, 0.0 hydroxyproline, 4.3 proline, and 5.2 serine (Duke, 1981; Huisman and Van der Poel, 1994; Williams et al., 1994). Percent fatty acid compositions are: 'Desi': oleic 52.1, linoleic 38.0, myristic 2.74, pactic 5.11, and steatic 2.05; 'Kabuli': oleic 50.3, linoleic 40.0, myristic 2.28, palmitic 5.74, stearic 1.61, and arachidic 0.07%. The leaves contain 4-8% protein (Duke, 1981).

Use

Chickpea is valued for its nutritive seeds with high protein content, 25.3-28.9 %, after dehulling (Hulse, 1991). Chickpea seeds are eaten fresh as green vegetables, parched, fried, roasted, and boiled; as snack food, sweet and condiments; seeds are ground and the flour can be used as soup, dhal, and to make bread; prepared with pepper, salt and lemon it is served as a side dish (Saxena, 1990). Seeds average about 20% protein, 5% fat and 55% carbohydrate.. Young plants and green pods are eaten like spinach. A small proportion of canned chickpea is also used in Turkey and Latin America, and to produce fermented food. Animal feed is another use of chickpea in many developing countries. An adhesive may also be prepared; although not water-resistant, it

Department of Botany, Dr. H. S. Gour Vishwavidyalaya Sagar, M. P.
is suitable for plywood. Gram husks, and green or dried stems and leaves are used for
stock feed; whole seeds may be milled directly for feed. Leaves are said to yield an
indigolike dye. Acid exudates from the leaves can be applied medicinally or used as
vinegar. In Chile, a cooked chickpea-milk (4:1) mixture is good for feeding infants,
effectively controlling diarrhea. Chickpeas yield 21% starch suitable for textile sizing,
giving a light finish to silk, wool, and cotton cloth (Duke, 1981).

Medicinal Use

Among the food legumes, chickpea is the most hypocholesteremic agent;
germinated chickpea was reported to be effective in controlling cholesterol level in rats
(Geervani, 1991). Glandular secretion of the leaves, stems, and pods consists of malic and
oxalic acids, giving a sour taste. In India these acids used to be harvested by spreading
thin muslin cloth over the crop during the night. In the morning the soaked cloth is wrung
out, and the acids are collected in bottles. Medicinal applications include use for
aphrodisiac, bronchitis, catarrh, cutamenia, cholera, constipation, diarrhea, dyspepsia,
flatulence, snakebite, sunstroke, and warts. Acids are supposed to lower the blood
cholesterol levels, while seeds are considered antibilious (Duke, 1981).

Yield and Economics

A greater and more stable yield is the major goal of plant breeding programs.
Chickpea yields usually average 400-600 kg/ha, but can surpass 2,000 kg/ha, and in
experiments have attained 5,200 kg/ha. Yields from irrigated crops are 20-28% higher
than yields from rainfed crops. Two types of chickpea are recognized (i) desi (colored,
small seeded, angular and fibrous) and (ii) kabuli (beige, large seeded, rams-head shaped
with lower fiber content) types (Malhotra et al., 1987). In a 3-cultivar trial in India, dry
matter yields ranged from 9,400 to 12,000 kg/ha. In India, chickpea or gram ranks 5th.
among grain crops, and is the most important pulse crop (Smithson et al., 1985). In India and Pakistan, chickpeas are consumed locally, and about 56% of the crop is retained by growers (Duke, 1981). In United States and Europe, chickpeas are marketed dried, canned, or in various vegetable mixtures. In Europe, mashed chickpeas from the Mediterranean are sold canned. In 1975 to 1994, on the average, Asia produced 5-6,000,000 MT, yields ranging from 570-766 kg/ha, led by India, which produced 4-5,000,000 MT, ranging from 500-900 kg/ha; Africa produced 250-364,000 MT, with yields ranging from 600-660 kg/ha. North and Central America produced 180-260,000 MT, while averaging 1,600 kg/ha. Europe produced 50-118,000 MT, while averaging 750 kg/ha (FAO, 1976, 1994). The major chickpea growing countries are India, Pakistan, and Turkey in Asia, Ethiopia in Africa, California and Washington State in the U.S., Mexico and Australia (FAO, 1994). Chickpea production increased from 1980 to 1990 by about a million tons (at 1.8 % annually), and there was a 5.6 % increase in yield over the decade (Oram and Agcaoili, 1994). Further increases in yield could be attained from the use of germplasm/wild relatives, for identification of new genes, and from new combinations of favorable genes already existing (Muehlbauer et al., 1988).

**DISEASES OF CHICKPEA**

Chickpea is attacked by a diver’s spectrum of pathogens. Out of 42 diseases reported on chickpea (Nene et al., 1985), 30 diseases have been reported from India. The main fungi which cause diseases of chickpea are *Fusarium oxysporum* Schle.:Fr. f. sp. *ciceris* (Padwick) Matuo and Sato, causing the plant to wilt and Ascochyta blight caused by *Ascochyta rabiei*. Other fungi known to attack chickpea include leaf spot (*Alternaria* sp.), *Ascochyta pisi*, rust (*Uromyces ciceris-orientini*), gray mould (*Botrytis cinera*), powdery mildew (*Levillula taurica*), *Pythium debaryanum*, *P. ultimum*, dry root rot (*Rhizoctonia bataticola*), *R. solani*, foot rot (*Sclerotium rolfsii*), *Sclerotinia sclerotiorum*,
wilt (*Verticillium albo-atrum*). Some of these fungi may become of economic importance. Viruses isolated from chickpea include alfalfa mosaic, pea leaf roll, pea streak, bean yellow mosaic, and cucumber mosaic (Duke, 1981; Smithson *et al.*, 1985; Kaiser *et al.*, 1988). Chickpea wilt was first reported from India by Butler (1910) from North-West Frontier Province of Undivided India during 1906-1907. He observed the association of *Cephalosporium*, *Neocosmospora* and *Fusarium* with the diseased specimen and called it "typical wilt" in nature. In 1918, Butler stated that the organism associated with chickpea wilt might be closely allied to the *Fusarium* causing wilt in pigeon pea. Narasimhan (1929) reported an association of *Fusarium* sp. and *Rhizoctonia* sp. with wilted plants. McRae (1932) and Prasad and Padwick (1939) observed it to be caused by *Fusarium* species. In the studies of Dasture (1935), *Rhizoctonia bataticola* produced wilted plants, which he called it "Rhizoctonia wilt".

In 1940, the fungus causing chickpea wilt was named as *Fusarium cathoceras var. ciceri*. Erwin (1958) and Bhatti *et al.*, (1983) observed a association of *Verticillium albo-atrum*. Esbin (1958) reported *F. lateritium f. sp. ciceri* to be the cause and questioned the name *F. orthoceras var. ciceri*. Following the classification of Synder and Hansen (1940), Chattopadhyay and Gupta (1967) renamed *F. orthoceras var. ciceri* as *Fusarium oxysporum f. sp. ciceri* which is now widely accepted (Booth, 1971).

In addition to other fungi reportedly found associated with wilt, high temperature at the time of sowing and flowering, deficient soil moisture and "bad soil" were also considered to be the cause (Bedi and Fracer, 1952). The wilt disease which is mainly caused by *Fusarium oxysporum f. sp. ciceri* is the most important disease of chickpea.