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Stem Growth Habit in Chickpea *(Cicer Arietinum* L.)

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Introduction

Pulses historically have been one of the most importantcomponents of Indian cultivation and consumption patterns and for a long time they were considered “the poor man's meat” as it is one of thecheapest sources of protein (Mohanty and Satyasai, 2015). Among them, chickpea (*Cicer arietinum*) is preferred to food legumes due to its diverse uses for a growing population around the world.It is aself-pollinating cool-season annual food legume with a diploid set of chromosomes 2n=2x=16 and an estimated genome size of 738 Mb with about 28,269 genes (Varshney et al.,2013). It belongs to the family Fabaceae, sub-family Papilionaceae, tribe Cicereae, and the genus *Cicer*. Its different types are variously known as gram, Bengal gram, garbanzo, garbanzo bean, Egyptian pea, chana or chole. Chickpea is believed to be originated from Turkey in the South East (Ladizinsky, 1975).Cicer is a Latin name derived from the Greek word "kikus," which means "power" or "force."The word *arietinum* is also of Latin origin, translated from the Greek 'krios' another name for ram. Chickpea is an indirect reference to the seed shape that resembles a ram's head (Aries) (van der Maesen, 1987).

Production and Distribution

Globally, chickpea ranks second in area and production only after common bean. Currently the world’s chickpea production is 17.4 million tons with an area of 17.5 million ha (FAO,2020). India is the largest chickpea producing country globally where chickpea production increased six-fold (from 1.29 million tons to 8.25 million tons) in central and southern India due to a threefold (2.43 million ha to 7.8 million ha) increase in area and doubling of productivity (530 kg/ha to 1058 kg/ha) from 1981 to 2018. Central and southern India is now a major chickpea-producing region of the world. Among the chickpea producing countries, India ranked top with the production of 10.9 million tons which is cultivated area in an area of 11.5 million ha with an average productivity of 920kg/ha followed by Australia,

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Turkey, Pakistan, Mexico, Unites states of America and Canada. Despite pandemic constraints, effective collaborations with National Agricultural Research Systems in Africa and Asia resulted in the release of 10 new varieties (6 desi and 4 kabuli) in 2020.In central and southern India, Myanmar, Ethiopia, and Tanzania, these varieties will significantly increase chickpea area, productivity, and production.

Types of Chickpea

Based on seed size and colour, chickpea is classified into two diverse forms, commonly known as desi (*Cicer arietinum*) and kabuli (*Cicerkabulium*) types (Cubero 1975). Desi chickpeas are usually brown in colour and small sized with rough surface, pink flowers, anthocyanin pigmentation on the stems and either semi-erect or semi spreading growth habit, traditionally cultivated in warmer climates of South Asia and East Africa while kabuli chickpeas are typicallywhitish to light tan in colour however, there are new varieties that are black or green in colour and are generally larger than desi, with no anthocyanin pigmentation on stem, semi spreading growth habit and used in salads and as vegetable. Among the two, desi chickpea is predominantly cultivated in India and occupied larger area than kabuli.

Health Benefits:

Chickpea is an important pulse crop and a sustained source of human nutrition, as it is an important component of production systems that are resilient to climate change. Its grain is an excellent source of high-quality protein with a wide range of essential amino acids like aromatic amino acids, tryptophan, lysine, and isoleucine and make an excellent replacement for meat in vegetarian and vegan diets. Starch is the major storage carbohydrate followed by dietary fibre, oligosaccharides and simple sugars such as glucose and sucrose. Although lipids are present in low amounts, chickpea is rich in nutritionally important unsaturated fatty acids such as linoleic and oleic acids. β-Sitosterol, campesterol and stigmasterol are important sterols present in chickpea oil. Ca, Mg, P and, especially, K are also present in chickpea seeds. Chickpea is a good source of important vitamins such as riboflavin, niacin, thiamin, folate and the vitamin A precursor β-carotene.

Chickpea helps to control blood sugar as canned and dried chickpea have a low glycemic index so that body absorbs and digests them slowly and it has a type of starch that digests slowly, called amylose. As a rich source of vitamins, minerals and fiber, chickpeas may offer a variety of health benefits, such as improving digestion as it is high in dietary

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fiber, especially a soluble fiber called raffinose. It helps to lower total cholesterol and LDL cholesterol thus, lowers risk of heart disease. It is a rich source calcium, iron, magnesium, fiber and other nutrients which helps to give stronger bones. It aids in weight management and reducing the risk of several diseases.

Stem growth habit in Chickpea:

Chickpea (*Cicer arietinum* L.) is an indeterminate plant that produces vegetative growth when soil moisture, temperature, and other environmental circumstances are favorable (Williams and Saxena, 1991). There was no determinate chickpea plant accessible at first, but one was generated by mutation breeding (van Rheenen*et al.* 1994). However, the determinate plant produced no pods due to female sterility. Hegde (2011) was the first to report the segregating generation of an inter-varietal hybrid containing a viable true breeding determinate chickpea, BGD 9971. Determinate chickpea, BGD 9971 generates more seeds per pod (1-4 seeds) and seeds per plant, which are important components of chickpea seed output. In the chickpea, he identified three types of stem development habits: indeterminate, semi-determinate, and determinate. It was also observed that a determinate stem growth habit might be combined with early flowering and maturity, plant height, and seed size (Hegde 2011).

Stem growth habit in other legumes:

In most of the legume crops, indeterminacy is found to be predominant. But reports of determinate type was also found in other plants like Arabidopsis (Alvarez *et al.* 1992), soybean (Bernard, 1972), common bean (Tulmann and Alberini, 1989), cowpea (Steele *et al.*, 1985), broad bean (Filippetti, 1986) and pigeonpea (Waldia and Singh 1987).

Stem growth habit and its significance:

Depending on whether the terminal meristems are vegetative or reproductive, flowering plants are categorized as determinate, semi-determinate, or indeterminate. Determinate plants have dwarf bushy and compact with short primary and secondary branches, and the apical bud grows into a flower bud or fully opened flower; semi-determinate plants have elongated flowering branches but do not end with a flower bud or fully opened flower; and those plants with elongated flowering branches and ends with vegetative bud are considered as indeterminate plants. Chickpea is primarily an indeterminate crop, meaning it grows vegetatively whenever soil moisture, temperature, and other

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environmental factors are favourable (Williams and Saxena, 1991). Chickpea is mostly cultivated in low-productivity, drought-prone rain-fed environments because of its indeterminate growth habit and poor response to high fertility and irrigation.

Stem growth habit is essential in determining plant form or architecture, which is important in terms of agronomy because it determines the plant's adaptability to cultivation and potential grain yield (Reinhardt and Kuhlemeier 2002). Due to the prolonged growth cycle, indeterminacy induces excessive vegetative growth, resulting in intense competition within the plant for assimilate partitioning between reproductive and vegetative growth (Huyghe, 1998). Excess water triggers vegetative development, which acts as a competitive sink for developing pods, resulting in reduced fruit set due to its indeterminate growth habit.

Conclusion:

As a result of the indeterminate growth behaviour of all released chickpea varieties, cultivars grown in long-term conditions, particularly in northern India, are prone to lodging due to excessive vegetative growth. Because to its unpredictable growth pattern, pods mature at different times, compromising seed quality (seed size and color).

The currently available indeterminate cultivars are not suitable for irrigation because they prolong maturity, resulting in uneven seed size after harvest and, as a result, a low market price for farmers. As a result, high-yielding types with a predictable growth pattern must be bred and developed. The determinate growth habit of chickpea is thought to result in consistent maturity, seed size, and a higher harvest index by eliminating excessive vegetative growth.

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