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Advances in crop improvement of Cucumber

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Introduction:

Cucumber (*Cucumis sativus* L. 2n=2x=14) is an important vine species of the Cucurbitaceae family Probably originated from India. Cucumber is the fourth most important vegetable crop worldwide and is a model system for other Cucurbitaceae family which is used for studying several significant biological processes . Cucumber is originated from India, particularly southern foot-hills of Himalayan region. It was domesticated in India from its wild relative, *Cucumis sativus* var. *hardwickii* 3000 years ago. It is commercially grown in the tropical and subtropical regions of the world. The fruits are widely consumed as salad at immature stage. Cucumber is high in water content and low in calories, fat, cholesterol, and sodium and good source of mineral nutrients (Ca, Mg, P & K) and medicinal properties such as antioxidant, anti-inflammatory,anti-cancer benefits. Cucumbers are also used for digestive benefits and mood stability when modulating stress. Cucumbers fortify cells so they may retain hydrated and work at the highest levels, and may slow age-related cellular deteriorations. The available genetic diversity within the cultivated cucumber is very low which is the major impediment in the genetic improvement of various cucumber market classes . Thus, increasing the genetic diversity of cultivated cucumber is an important task for public sector research. Earliness, high yield, uniform fruit shape, size, color and better quality are prerequisites for the release of the cucumber varieties and F1 hybrids for open field condition. In addition to these characters, gynoecious and parthenocarpic traits are desirable for green house cucumber production.

Popular Varieties of Cucumber

Straight Eight – An American variety introduced in India by the Regional Station of IARI in Kullu Valley.

Japanese Long Green – Released by Regional Station of IARI, Kullu Valley.

Poinsette – An American variety introduced by National Seeds Corporation of

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India. It is resistant to anthracnose, powdery mildew, downy mildew, and angular leaf spot.

Pusa Sanyog – An F1 hybrid between Green Long Naples and Japanese gynoecious line, released by IARI, Kullu Valley. Unfortunately, this cucumber could not reach the market due to the absence of seed production.

Pant Khira 1 or PCUC 28 – This contains indigenous germplasm from Pantnagar.

Pant Sankar Khira 1 – This is a hybrid created at Pantnagar by a cross of PCUC 8 X PCUC 28.

Floral biology and crop behavior

Cucumber is an annual and day neutral plant. Within C sativus staminate, pistillate and hermaphroditic flowers occur in various arrangements. Cucumbers are primarily monoecious ie bearing separate staminate and pistillate flowers on the same plant. Male flowers occur in clusters with each flower on a slender stem and having three stamens. Female flowers are usually solitary with stout and short pedicel and have an inferior distinguishable large ovary. Anthesis takes place around 5.00 AM to 7.30 AM. The dehiscence of anther takes place around 4.00 AM to 5.00 AM. Pollen remains fertile 7 to 8 hours after anthesis. Honeybees are the major pollinating agents of cucumber. The optimum time for pollination is between 6:00 AM to 9:00 am. Cucumber pollen is sticky and not actively collected by bees. To ensure adequate pollination bees should visit the flowers at least 12 to 15 times for normal fruit development.

Breeding Objectives

- High Yield
- Reduced number of nodes to first female flower
- High female: male ratio
- More Flesh thickness
- Desirable flesh colour
- Low Cucurbitacin
- Less Seed
- Resistance to pest and diseases
- Good Transport quality
- More number of Lateral Branches
- Stress tolerance (temperature extremes, water deficiency).

Breeding methods

Several breeding methods have been employed for the genetic improvement of cucumber depending on the specific breeding objectives. Single plant selection, single seed descent method, mass selection, simple backcross breeding, pedigree selection, hybridization, use of sex inheritance and chemicals in breeding, and population improvement and extraction of inbred lines are the most common methods used. In recent time, marker assisted selection derived lines have been developed for the improvement of

quantitative and qualitative traits in different cucumber market classes.

Simple backcross breeding is quite useful for transferring characters governed by single genes e.g. disease resistance or quality traits from donor lines to more stable recurrent parents. Backcross is a cross between a hybrid and one of its parents. Hybrid and the progenies in the successive generation are repeatedly backcrossed to one of the parents. This method is commonly utilized in desirable gene transfers for resistance to diseases Often, six generations of selection and backcrossing to the recurrent parent are required to recover the desired genotypes recurrent parent + additional trait.

Heterosis breeding can exploit the genetic diversity present in cucumber for various growth and yield characters. In Western countries almost 90% of the area of cucumber is under F1 hybrids.Cucumber is a monoecious and cross pollinated crop, there is a great scope for exploitation of heterosis. High level of hybrid vigor could be obtained with the involvement of diverse parents. Several studies have been conducted to identify the best heterotic combination for earliness, yield and quality traits in cucumber. Appreciable heterosis was observed over better parent and top parent for many economic traits like node number of first female flowers, number of fruits per plant, days to fruit set, days to first fruit harvest, yield per plant. Significant heterosis has also been reported for earliness characters using gynoecious lines and quality characters Singh *et.al*. The hybrid combinations of gynoecious × gynoecious and gynoecious × monoecious showed maximsum heterosis followed by monoecious × monoecious hybrids for earliness and yield per plant Jat *et.al*. . Therefore yield of the cucumber can be enhanced by using gynoecious line as one of the parent in future breeding programme.

Introduction: Many varieties have been introduced which are high yielding and have quality traits fruit and resistance to diseases.eg; Japanese long green.

Mass selection: involves selection of a large number of phenotypically superior plants. Harvesting and bulking the produce of the selected plants together for sowing the next generation. This process of harvesting and bulking is repeated till the desired characters are obtained. The original population from where the superior plants are selected would have been a mixture of several purelines, and the plants selected would be homozygous. The final population which is obtained from the selected plants would be more uniform than that of the original population for easily observable characters.

Pedigree Method: Pedigree may be defines as a description of the ancestors of an

individual and it generally goes back to some distant ancestor or ancestors in the past. This is the most favourite method of breeders as it tells the changes that occur from earlier time till now. It is useful by finding out if 2 individuals are related by descent, whether they have a common parent in their ancestor and some genes in common. Pedigree would describe the parents, Grand parents, Great grand parents and so on. This method make a controlled crosses followed by single plant selection. Single plant selection is initiated in F2 and is continued through successive generations till F6.

Mutation breeding: Mutation breeding now days is used as an important tool to develop a variety in a very short time by the breeders. When the mutation is induced by using various chemicals for crop improvement is called mutation breeding.

Biotechnological approaches

Various biotechnological approaches have been utilized to ameliorate vegetable quality and quantity. Scientists are successful in isolating target gene of interest, its transfer and integration into the host species based on the knowledge of DNA. Plant biotechnology enables amelioration that are not possible with traditional crossing of related species alone. Some Biotechnological approaches like Genetic engineering, Tissue culture, Molecular markers, Cryopreservation.

Conclusion

Classical genetics and traditional breeding techniques have made great contribution in better understanding and genetic improvement of cucumber crop for several qualitative and quantitative traits, understanding of phylogenetic relationship and taxonomy. Using traditional breeding methods, cucumber breeder have identified a number of genes associated with economic traits and used this information to develop early and high yielding cultivars. Advancement of some quantitative characters using traditional methodology is difficult and time consuming process. Therefore molecular markers technology offers an avenue to overcome the hurdles associated with traditional breeding. Molecular breeding has played a significant role in better understanding of cucumber genetics, and has been directly responsible for some of the improvement made in modern cucumber cultivars in different market classes. Classical breeders have said “Anything is possible using traditional approaches; it is just that the world is not large enough to hold the populations needed to find the variation required for some traits. As we move forward with molecular breeding in cucumber, it is important that we understand the need to maintain traditional breeding.

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