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Advancement and Efficacy of Plant Growth Regulators in Ber (*Ziziphus mauritiana* Lamk)

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Ber (*Ziziphus mauritiana* Lamk.) is an important arid fruit crop that belongs to the family Rhamnaceae. The crop is originated in India but one of its related species Z. *jujube* is widely cultivated in the hills of Himalayas. It is well known for its specificity on hardiness and adaptive capacity in the adverse soil and climatic condition. It is one of the fruit crops which can give good returns even under rainfed conditions and can be grown in a variety of soils and climatic conditions. This fruit crop is commonly grown in India and also in other countries i.e., China, Afghanistan, Iran, Russia, Syria, Myanmar, Australia and USA. In India, ber is cultivated in various part of the country particularly in arid and semi-arid regions comprising of 50000 ha area producing 5.13 lakh MT of fruits. The major growing regions are Rajasthan, Madhya Pradesh, Uttar Pradesh, Haryana, Punjab, Gujarat, Bihar, Maharashtra, Andhra Pradesh and Tamil Nadu. Ber is a nutritious and delicious table fruit. The fruit is a rich source of ascorbic acid, vitamin B- complex and minerals and the root, stem bark, flower and seed are used in Ayurveda to treat indigestion, headache, cough etc. The leaves are good fodder for animals, especially goats and ships. The ber is a hardy plant and shows summer-deciduous nature and can grow under low-inputs which makes the plant sustain salinity and drought and becomes a popular fruit crop of arid and semi-arid regions. In spite of having vast potential, the ber fruit has limited cultivation, unlike the other fruit crops as for commercial production. It needs proper care and adequate plant management. Generally, ber growers faced various problems like low and inferior quality yield, flower and fruit drops and poor fruit setting. These problems occur due to various factors, i.e. improper nutrition management, inadequate cultivation practices and changes in environment variables. Plant nutrition's help in the production of raw materials that require the plant to sustained normal growth. However, the hormones help in translocation of raw materials and regulate the normal physiological process in plants. Imbalance of hormones in the plant altered normal physiological processes that directly affects on the reproductive response of the plants.

Plant growth regulators

Plant growth regulators are the non-naturally occurring synthetic compounds requires in minute quantity to promote or inhibit the plant physiological process. PGRs regulate the growth and development of plants by regulating the internal processes. An exogenous application of these substances modifies the growth responses. Auxins were the first group of growth regulators discovered during 19th to early 20th century. Subsequently, during the middle of the 20th century, the other growth regulators i.e. abscisic acid, cytokinins, gibberellins and ethylene were also identified as synthetic plant hormones. Since then marked experiments has done to identify their efficacy in the regulation of plant physiological process. Discovery of plant hormones and identification of their efficacy in the improvement of yield and qualitative parameters had a great impact on the fruit production.

Effect of growth regulators on propagation: The ber is propagated sexually by seed as well vegetatively using the budding technique. The germination responses of ber seed are not adequate due to its stony endocarp present in the fruit that makes the seed impermeable to water and air and normally takes about 3 -4 weeks for germination. Among the many cultural practices higher seed germination (76%) by sowing the kernels as compared to that by sowing the whole seed (54%). Whereas the high percentage of germination (65%) were obtained with the treatment of scarification with sandpaper and the treatment of sulphuric acid for 10 min (46%). However, among the growth regulators, gibberellic acid and benzyladenine widely used to break dormancy in ber.

Response of growth regulators with pruning intensities: Pruning is an important operation for better flowering and fruiting in ber fruit. In India flowering period of ber varies from early June to late November in different varieties and under different agroclimatic conditions. Flowering can, however, be regulated to some extent by timing the pruning operation. In India, after the fruit harvesting, the branches of the ber tree are heavily pruned just keeping the main stem which also coincides with the summer at many places when the plant naturally shed their leaves and enter into dormancy. The flower buds in ber are borne on both mature as well as current season's growth, and the inflorescence is an axillary cyme. The newly emerged healthy shoots produce better flowers and fruits. The intensities of pruning affect the flowering and fruiting in ber. Application of growth regulators after pruning improves shoots health resulting in better yield and quality of fruit.

Effect of PGRs on flowering and fruit set: The flowering and fruiting process is the most important and periodic phenomenon of the plants. Duration of flowering in ber is prolonged and the time of blossoming largely depends on climatic conditions. However, flowering and fruiting is a complex network where more than one plant hormone is involved in controlling various aspects of fruit development. Flower formation and development are known to be influenced by hormones, especially by cytokinin, gibberellins, and auxins. Endogenous hormones level of the plant plays a great role in flowering and fruit set. Alternation or disturbance of these substances reduces metabolic activities and affects the normal physiology of the plant. Application of plant growth regulators improves the internal physiology of developing fruits that induce fruit seating and also reduce fruit drop.

Effect of growth regulators on flower and fruit drop: Dropping of immature flower and fruit from the mature tree is a natural tendency of the ber crop. It is a major constraint in ber production. Normally in ber, the number of fruit set is very high, but the extent of fruit retention varies according to the cultivar type and on the level of production of endogenous plant hormones.There was a highly negative correlation between fruit drop and fruit set and in fruit drop and fruit retention in ber. The problem can be minimized to some extent by the use of plant growth regulators. Generally, fruit drop occurs due to imbalance of auxin in the plants. If auxin level reduces and the concentration of abscisic acid increases that results in the formation of the abscission layer and dropping of the fruits.

Effect of growth regulators on fruit yield: The yield is a major and foremost important parameter for any crop which determines its commercial value. In general potentiality of yield in ber, depends on cultivars / varieties and also on the crop management practices. But sometimes the plant physiological process also affects the yielding capacity of the crop. The use of growth regulator to balance the physiological process is practised for many years. The effect of plant growth regulators like GA3 and NAA on the determination of ber yield has been tested by various researches.

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