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A REVIEW

Plant growth regulators in fruit and vegetable crops

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Abstract : The use of plant growth regulators in modern horticulture is well established. Indeed certain fields of horticulture such as asexual propagation are heavily dependent on the use of synthetic growth regulators. During recent years, the interest in fruit and vegetable production has increased rapidly because of good price value and place of vegetables in national food requirement. Yield increase in fruit and vegetable crops has been obtained through improved fruit and vegetable varieties, efficient use of chemicals fertilizers and various agronomic practices. Besides, growth regulating chemicals are also becoming important in the field of horticulture for the modification of vegetative growth, flowering, fruiting and quality.This review deals with the use of plant growth regulators in relation to vegetative growth, control of flowering, effects on fruit set and development and quality of fruit in the perceived future.

Key Words : Growth regulators, Vegetative growth, Yield, Quality

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INTRODUCTION

Plant growth regulators have remained an important component in horticulture from time immemorial because they were effective means of quantitative as well as qualititative improvement in growth and development of crops. Plant growth and development as well as the responses to environmental factors, are highly regulated by complex and coordinated action of the endogenous hormones. In addition to this other plant growth regulators are also reported to be very helpful in this direction by altering the growth and development of plant. The fruiting is regulated at different times of flower emergence (Sharma and Singh, 2000) and at different intensities to maintain the productivity of the plants. The different timings of crop regulation with different chemicals have produced different effects on fruit yield and quality. They have the potential of increasing plant productivity and quality through influence on various metabolic process. Plant growth regulators are known to improve fruit size, appearance and aril quality by direct effect on fruit growth and development or indirectly by regulating crops load, tree vigour and canopy architecture. The exogenous application of growth regulators has been found very effective in improving fruit size and quality of many fruit crops. Among the growth regulators, a synthetic cytokinin *i.e.* CPPU and promaline have been found very effective in stimulating fruit growth in grapes, apple and cranberry. Besides fruit size, CPPU also modifies the characters such as shape, dry matter and ripening process. In areas, where chilling requirement is not fulfilled during winters, use of hydrogen cynamide has been found to improve the flowering in horticultural crops. Now a day commercial formulations of these hormones are available in the market and their use is relatively cheap and economical to the farmers. The effect of plant growth regulators in horticultural crop production is briefly reviewed under appropriate sub headings :

Vegetative growth :

Devnath and Kundu (2001) reported that NAA at 200 to 400 ppm resulted in maximum production of new shoots in

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mango cv. Himsagar when applied twice in the middle of August and October. Gautam and Negi (2001) observed that foliar application of GA_3 at 200 or 600 ppm increased vegetative growth in pear nursery plants. Sharma (2001) investigated that GA_3 when applied at 10, 20 and 40 ppm at silver tip to green stage increased the leaf area of apple cv. Starking Delicious. Trees of apple cultivars Melrose and Granny Smith when treated with paclobutrazol at different concentration and in split dozes (3 X 200 or 3 X 400 ppm), 2-6 weeks after full bloom produced leaves with significantly increased chlorophyll content (Milatovic, 2001). Rana (2001) observed increase in plant height, number of leaves and number of runners per plant with application of 100 ppm GA_3 in strawberry cv. Chandler. Pre bloom or full bloom application of GA_3 at 20 or 30 ppm resulted in significantly increased average leaf area in pear cv. Flemish Beauty (Dev, 2002). Application of 7.5 ppm of tricontanol significantly increased shoot growth, tree volume and leaf area in plum cv. Santa Rosa when applied 10 days after full bloom (Brar, 2004). Paroussi *et al.* (2002) obtained the maximum petiole length and leaf area with the application of 50 ppm GA_3 in Seascape cultivar of strawberry. El Sabagh and Mostafa (2003) reported that GA_3 when applied at concentration of 300 ppm significantly increased the vegetative in apple cv. Anna. Leaves with larger area were produced when these were treated with 300 ppm GA_3 in early May and late July. Joshi and Singh (2003) studied the effect of NAA on chilli cv.Pant-1 at 20,40 and 60 ppm. They found that highest leaf area per plant and number of seeds per fruit increased with the application of NAA at 40 and 60 ppm. Kim *et al.* (2004) reported that application of ethephon at 200 mg/l decreased leaf chlorophyll, but had no effect on leaf area and thickness in persimons (*Diospyrus Kaki* L.). Pant and Kumar (2004) observed that application of CCC at 250, 500, 1000 and 1500 ppm after petal fall stage and again at 30 days after fruit setting decreased the extension growth of Red Delicious apple trees linearly with the increasing concentration. Rahemi and Atahosseini (2004) studied the effect of NAA and NAD on vegetative growth and recorded significant increase in leaf area index of pomegranate cv. Shisheh Cup with the application of NAA at 50mg/l and NAD at 100 mg/l. Sharma and Ananda (2004) reported that application of GA_3 either alone at 10-40 ppm or at 10 ppm in combination with BA at 5 ppm resulted in significantly higher vegetative growth over the control. Jadhav *et al.* (2006) observed that tree height, diameter and number of leaves were improved with the use of GA_3 at 50 and 100 ppm concentration in Rangpur lime. Singh (2008) reported that application of 400 ppm GA_3 significantly increased shoot growth, tree height and spread in pomegranate cv. G-137.

Flowering :

Naurka and Paliwal (2000) reported that increase in GA and NAA levels resulted in corresponding increase in plant height, number of leaves per plant, main stem girth, days taken to 50 per cent flowering, number of fruits per plant, mean fruit weight and yield in okra. Singh and Mukherjee (2000) studied the effect of NAA at 25, 50 and 75 ppm on chilli (*Capsicum annum*) var. Longum. Increasing concentration of NAA led to increase of 50 per cent flowering in okra. Application of paclobutrazol at 100 ppm, when applied 40 days before flowering, delayed flowering by 2 to 3 days in some cherry cultivars (Engin *et al.*, 2004). Soil application of paclobutrazol at 0.5, 1.0, 1.5 and 2 g/m^2, promoted flowering in mango (Mouco and Albuquerque, 2005). Singh *et al.* (2005) reported that soil application of paclobutrazol at 5 or 10 g a.i. per tree, prior to flower bud differentiation increased the percentage of panicles and hermaphrodite flowers in mango cv. DASHEHARI.

Fruit set and yield :

Application of cultar as soil drench at 20-40 g per tree, prior to flower bud differentiation during the first week of October increased fruit set in mango (Singh, 2000). Balraj *et al.* (2002) observed the effect of NAA on chilli (*Capsicum annum*) cv. Byadagi. They found that yield was highest when NAA at 20 ppm was applied. Hoang (2003) observed that application of 100 and 200 ppm of NAA significantly increased number of fruit and yield per tree in pomegranate cv. G-137. Khurana *et al.* (2004) observed the effect of NAA @ 20, 40, 60, 80 and 100 ppm on two varities of chilli namely Punjab Lal and Hybrid CH-1.They found that application of 20 and 40 ppm NAA increased fruit set, fruit yield and fruit number. Thakur and Chandel (2004) reported that application of 50 and 100 ppm NAA increased the fruit size, yield and number of fruit per vine in kiwifruit cv. Allison. Application of 500 ppm paclobutrazol in mid September significantly reduced fruit set in sweet cherry (Beppu *et al.*, 2005). Chand (2005) observed that pre bloom application of Paras at 0.6 ml/l concentration increased the fruit set and yield in apple. In another study, application of paclobutrazol during the dormant season did not significantly influence flower bud drop and fruit set in apricot (Ruiz *et al.*, 2005). Devi (2006) revealed that dipping of kiwifruit cv. Allison in 2.5, 5 and 10 ppm CPPU and 10, 20 and 40 ppm Promalin solution fourteen days after full bloom resulted in increased yield. Gomes *et al.* (2006) stated that the application of 0.1 mg/l brassinosteroids analogue BB-16 increased the number of fruits and yield per plant in passion fruit. Singh and Ranganath (2006) reported that application of paclobutrazol at 5.0 ml/l per tree, when applied during first week of April increased fruit set and retention in mango cv. Banganapalli. Kachave and Bhosale (2007) observed that application of GA_3 at 50 ppm concentration increased fruit set and yield in Kagzi lime. Rattan and Bal (2008) found that application of 20 ppm NAA increased fruit yield in ber cv. Umran. Singh (2008) reported that application of 30 ppm NAA significantly increased fruit set and yield in pomegranate cv. G-137. Saini and Sharma (2009) reported that application of GA_3 at 100 and 200 ppm

concentration increased fruit set, fruit retention and yield in plum cv. RED BEAUT.

Fruit quality :

Abou *et al.* (2000) observed that 10 ppm GA_3 when applied in combination with paclobutrazol on Le Conte pear increased average fruit weight, fruit volume, fruit length and diameter but decreased fruit firmness compared to control. Bassal *et al.* (2000) reported that GA_3 when applied at the concentration of 100 ppm, at petal fall stage, significantly increased fruit yield in "Le Conte" pear. In an experiment on 8 year old trees of Younai plum, different treatments of paclobutrazol when applied through foliage or soil, one month before flowering and again at the end of physiological fruit drop and one month after harvest, increased the fruit yield (Huang and Zhang 2000). Gibberellic acid when applied at 100 mg/l, 64 and 85 days after flowering significantly increased flesh firmness in peach (Jakubowski *et al*., 2000). Ozguven *et al*. (2000) reported that application of 200 ppm GA_3 in strawberry cv. Camarosa resulted in higher fruit weight, TSS and acidity. Rana (2001) found that promalin (GA_4 + GA_7 + BA) at 100 ppm recorded maximum berry length, BA at 100 ppm recorded maximum berry diameter, TSS and total sugars while GA_3 at 100 ppm recorded maximum fruit weight and increased anthocyanin content in strawberry cv. Chandler. Sharma *et al*. (2001) observed that post bloom application of etheral at 200-300 ppm enhanced fruit maturity, increased fruit size, fruit weight, TSS and sugar contents, decreased acidity and improved fruit skin colour in Red Heaven peaches. Muralidharan *et al*. (2002) studied the effect of planofix @ 50 ppm on chilli (*Capsicum annum*). Al Hmedawi (2003) reported that GA_3 at 100 and 150 mg/l increased the juice percentage in pomegranate cv. Salimi. Hoang (2003) noticed that application of NAA at 200 ppm 40 days after full bloom increased fruit weight, fruit volume, fruit size, aril percentage, aril rag ratio, total and reducing sugars in pomegranate cv. G-137. Thapa *et al.* (2003) observed the effect of NAA at 25, 50 and 100 ppm on chilli cv. Suryamukhi and found that NAA at 50 ppm produced highest seed yield per plant. They recorded that planofix @50 ppm gave higher dry fruit yield and quality compared to control. Basak (2004) reported that application of 100 ppm benzyl adenine significantly increased fruit weight, fruit firmness and total soluble solids in apple cv. Gala. Han and Lee (2004) reported that application of 25 mg/l GA_3 increased cluster length, bunch and berry weight in grape cv. Kyoho. Kaur *et al*. (2004) found that application of 20 ppm 2,4,5-T and NAA and 50 ppm GA_3 recorded higher TSS: acid ratio than control in plum cv. Satluj Purple. Pant and Kumar (2004) observed that application of cycocel at 250,500,1000 and 1500 ppm after petal fall stage and again at 30 days after setting increased fruit weight, fruit firmness in Red Delicious apple. Saran *et al.(*2004) observed that chlormequat at 500 ppm when applied 15 days before harvest improved fruit firmness and TSS, reducing sugar, total sugar, titratable acid and ascorbic acid contents in ber cv. Gola. Sharma (2004) obsereved that combined application of 10 ppm GA_3 + 5ppm BA + 5 ppm NAA significantly increased fruit weight, volume, firmness and TSS in apple cv. Starking Delicious. Natesh *et al.* (2005) studied the effect of planofix at 10 and 20 ppm in chilli cv. Byadagi Kaddi and found better seed yield with NAA at 20 ppm along with better quality of seeds. Kachave and Bhosale (2007) reported that application of NAA at 100 and 200 ppm concentration significantly increased fruit juice and reduced rind, rag and seed percentage in Kagzi lime. Rattan and Bal (2008) found that application of 20 ppm NAA increased TSS and reduced acidity in ber cv. Umran. Singh (2008) reported that application of 30 ppm NAA increased fruit and weight of pomegranate cv. G-137.

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