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A Critical Review on Effect of Plant Growth Regulators on Root Vegetables

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A B S T R A C T

The production potential of root vegetables depends on many factors, amongst them; plant growth regulators appreciably influence the growth, yield and quality of produce. They play an important role in producing high value root vegetables and increasing the yield. They promote root growth, increase the number of flowers, fruit size and induce early and uniform fruit ripening. Foliar application of plant growth regulators is reported to improve tuber yield, dry matter and quality characters like starch, total sugars and beta carotene content. Therefore the available literatures relating to the response of plant growth regulators on vegetative, root tuber yield, flowering and quality of root vegetable crops carried out at various places in India and abroad have been briefly reviewed in order to throw light on our existing knowledge, for understanding present problems.

Introduction

Root vegetables especially cassava, sweet potato, elephant foot yam, taro, tannia, yams, yam bean, arrow root, onion, carrot, radish etc. still continue to be major crops contributing significantly to human and animal food apart from finding use in various industrial applications. Provide their vital roots and stems for cooking delicious foods. They are well-known for their starchy storage usually harvested from below the ground. They have golden history of their role they played in the diet of early human being, especially of our ancestors and saints who used to live in forests. Today also, they constitute a major component of indigenous food, especially for people living in tribal areas in India. These crops are adapted to broad agro-ecological conditions and yield reasonably well even under marginal environments. Root vegetable crops fit well into a variety of cropping systems and can be profitably intercropped in coconut based cropping system.

Besides, good agronomic practices like growing high yielding varieties, providing proper spacing, irrigation, use of fertilizers, optimum sowing time and some advanced crop improvement techniques like application of plant growth substances and appropriate plant protection measures ought to be essentially followed in order to increase the productivity of tuber crops. The role of plant growth substances in the physiology of plant is one of the most interesting chapters in the science.

The plant growth substances are organic compounds, other than nutrients which in small concentration influence the physiological processes of plants.

Growth regulators are also reported to improve yield of many horticultural crops those in which the underground part is economically important.

Effect of plant growth regulators on vegetative and root tuber yield characters

Abdul Vahab and Mohana Kumaran (1980) reported that highest increase of sweet potato yield obtained with Ethrel (Ethephon) at 450 ppm and 300 ppm whereas tuber girth was increased with CCC applied at higher concentrations of 500 and 1000 ppm

Baijal *et al.,* (1983) reported that foliar application of 100 ppm GA_3 at 20 days after transplanting significantly increased the plant height, inter nodal length, stolon number, tuber number per plant, tuber fresh weight and dry weight of potato per plant.

Higher leaf area index values during the active tuber bulking period (40 to 70 DAP) of potato by foliar application at lower concentration of CCC (500 ppm) and GA_3 (50 and 100 ppm), while GA_3 at higher concentration increased the tuber yield in sweet potato (Banerjee and Das, 1984); in carrot (Maurya and Lal, 1987)

Mahabir Singh *et al.,* (1989) observed that foliar spray of GA_3 (30, 35 and 45 ppm) recorded maximum plant height, number of leaves per plant, leaf length, width of leaf and fresh weight of leaf in radish.

Mohamed Yassin and Anbu (1996) reported that root length, root girth and root weight were increased by foliar application of CCC at 1000 ppm in radish.

Pravin prakash *et al.,* (2001) reported that higher values of growth parameters and tuber yield of potato were recorded with the application of CCC (1000 ppm).

Remison *et al.,* (2002) conducted an experiment on ten cassava varieties with three growth regulators (GA_3, ABA and IAA) at 5 levels (0, 25, 50, 75 and 100 ppm) to study growth and yield of cassava. They reported that growth regulators increased the tuber yield and dry matter production by foliar application of GA_3 at 25 ppm.

Obasi and Atanu (2005) conducted a field experiments to study the effect of foliar application of growth regulators on growth, flowering and rhizome yield of ginger. Results revealed that leaf area (LA), leaf development rate (LDR), stem elongation rate (SER), vigour index (VI) and rhizome yield were increased with CCC and decreased with GA_3 and ethrel. Application of CCC @ 250 ppm significantly improved rhizome yield by 36.4%.

Jirali *et al.,* (2008) reported that the fresh and dry rhizome yield, number of mother rhizomes and length and circumference of primary and secondary fingers were more by foliar application of CCC 500 ppm in ginger.

Seema Sarkar (2008) studied the effect of GA_3, CCC and their interactions on yield of sweet potato. He concluded that spraying of GA_3 and CCC influenced yield of sweet potato irrespective of concentrations.

Sengupta *et al.,* (2008) conducted an experiment to study growth and yield patterns of Ginger Cv. Gorubathan with different growth regulators. They revealed that spraying with GA_3 at 150 ppm and Ethrel at 150 ppm showed maximum plant height and maximum number of pseudostem whereas maximum number of leaves per plant (72.19), maximum leaf length (29.69 cm) and leaf breadth (2.80 cm) were recorded in plants treated with Ethrel at 100 ppm, GA_3 at 150 ppm and CCC at 200 ppm. Maximum yield was recorded in the treatment GA_3 at 150 ppm.

Shedge *et al.,* (2008) conducted a study on effect of foliar application of MH and CCC on growth and yield of sweet potato. They revealed

that CCC at 500 ppm resulted in highest yield (23.64 t/ha) followed by MH (1000 ppm) and CCC (250 ppm).

Usha *et al.,* (2009) found that foliar application of CCC at 300 ppm reduces shoot growth and leaf area index, while rhizome diameter, fresh weight were enhanced significantly in Rhubarb.

Patel *et al.,* (2010a) conducted an experiment on influence of plant growth regulators and their application methods on yield and quality of onion. Growth regulators GA_3 and NAA each @ 50, 100 and 150 mg/l were tried as root dipping, foliar spray as well as their combinations and compared with control. The application of GA_3 @ 50 mg/l as root dipping + foliar spray significantly increased volume of bulb, equatorial and polar diameter of bulb as well as bulb yield, whereas average weight of bulb was significantly increased with GA_3 @ 100 mg/l as root dipping + foliar spray.

Patel *et al.,* (2010b) reported that application of GA_3 @ 50 mg/l significantly increased plant height, leaf length and number of leaves per plant compared to control in onion.

Abbas (2011) reported that foliar application of GA_3 decreases root fresh weight and root dry weight in carrot.

Ashok *et al.,* (2012) conducted a study on effect of foliar application of plant growth regulators on potato variety Kufri pukhraj. They revealed that growth promoters like GA_3 and IAA @ 50 ppm significantly increases the tuber quality parameters like dry matter content, specific gravity, tuber shape index, peel flesh ratio and sugar content.

Thondaiman Velayutham and Parthiban (2013) conducted a study on role of growth regulators and chemicals on growth, yield and quality traits of Ginger variety Rio-de-janerio. They reported that foliar spraying of CCC at 500 ppm recorded highest yield per hectare.

El-Tohamy *et al.,* (2015) conducted a study on effects of yeast extract and GA_3 on water status, growth, productivity and quality of sweet potato grown in sandy soils. Results revealed that foliar application of GA_3 @ 200 ppm was significantly increases the vine length, number of branches per plant, plant fresh weight, root diameter, root length and yield per plant.

Effect of plant growth regulators on flower characters

Ricard *et al.,* (1990) reported that sweet potato cultivars (Jewel, Shore Gold and Vardaman) responded differently to different growth regulator application for number of flowers produced, percentage capsule set and number of seeds produced. They observed that GA_3 at 300 ppm and 2, 4-D at 15 ppm significantly increased the number of flowers in cultivars *viz.,* 'jewel' and 'shore gold'.

Shalaby *et al.,* (1994) studied the effects of growth regulator treatments on the promotion of flowering and seed setting in 3 sweet potato cultivars (VNGBUAY, I59 and CN10 38-18). Plants were sprayed 60 days after transplanting with 2, 4-D (3.75, 7.50 and 15 ppm) and GA_3 (150, 300, 600 and 1200 ppm). All growth regulator treatments resulted in earlier flowering and more flowers per plant than the control treatment in all cultivars. All growth regulator concentrations induced capsule and seed set in I59 and C10 38-18. Percentage capsule set was highest following treatment with 7.5 ppm 2, 4-D, while GA_3 @ 1200 ppm resulted in the highest number of seeds per plant. Plants treated with the lowest concentrations of 2, 4-D and GA_3 produced the heaviest seeds.

Obasi and Atanu (2005) conducted field experiments to study the effect of foliar application of growth regulators on growth, flowering and rhizome yield of ginger. Results showed that GA_3 inhibited flowering and shoot emergence while ethrel had no effect on flowering but enhanced shoot emergence.

El-Gizawy *et al.,* (2006) conducted a study on effect of GA_3 on enhancing flowering and fruit setting in selected potato cultivars (Cara,

Diamant and Spunta). They found that cara cultivar recorded the best response to GA_3 with good flowering and fruit setting, followed by Cv. Spunta with good flowering but without fruit setting and Cv. Diamant did not flower under any treatment.

Walter *et al.,* (2013) conducted an experiment with 2, 4-D on sweet potato landraces. they reported that spraying of 2,4-D @ 100 ppm at 30 days after transplanting, initiated buds and set flowers after planting whereas 2,4-D applied at higher levels (300 and 500 ppm) results in extensive morphological and physiological disorders on plants.

Effect of plant growth regulators on quality attributes of root tubers

El-Gizawy *et al.,* (2006) reported that foliar application of GA_3 at 50 and 100 ppm significantly increases the total carbohydrate percentage in potato.

Seema Sarkar (2008) studied the effect of GA_3, CCC and their interactions on reducing sugar and starch content of sweet potato. She concluded that GA_3 @ 500 ppm and CCC @ 1000 ppm were the optimal concentrations for increasing the reducing sugars and starch content of the tubers.

From the present review, it is concluded that application of plant growth regulators in tuber crops has been found beneficial in improving growth, flowering, yield, quality attributes of root vegetables. In view of future thrust, awareness and popularizing among the farmers should be done to increase the area of growing vegetables by the application of plant growth substances.

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