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Effect of paclobutrazol and ethephon on growth and productivity of cape gooseberry (*Physalis peruviana* L.)

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Abstract

The influence of ethephon (100, 200, 400 and 800 ppm) and paclobutrazol (12.5, 25, 50 and 100 ppm) on growth and yield of cape gooseberry were examined. Compared to control, foliar spray of 400 ppm ethephon significantly reduced plant height (29.5%), leaf area (57.4%) and increased number of branches, number of leaves, fruit set, fruit weight, fruit diameter, diameter and length ratio, number of fruits and fruit yield (131%). At par values for all these characters were recorded with 50 ppm paclobutrazol.

Key words: Cape gooseberry, *Physalis peruviana* L., paclobutrazol, ethephon, growth retardant, branches, leaf area, fruit size, yield.

Introduction

The cape gooseberry (*Physalis peruviana* L.), member of Solanaceae, is important as quick growing fruit crop in India as well as other parts of the world and well known for its flavour and tasty jams. There is a vast scope for making cape gooseberry cultivation more profitable by improving the quality and productivity. The use of growth regulators, particularly paclobutrazol and ethephon have proved very effective in modifying growth, development, fruit setting and yield in several tropical and sub tropical fruit crops. Principle mode of action of paclobutrazol is the inhibition of gibberellin's biosynthesis (Anon., 1983), while ethephon has polyfunctional action, affecting the nucleic acid and protein metabolism of plants (Gruzdyev, 1982). These chemicals effectively modified growth of plant, branching pattern, leaf characters and ultimately the fruit yield.

The information regarding the effect of these retardants on growth and yield behaviour of cape gooseberry is scanty. Therefore, present investigation was conducted to find out the optimum dose of growth retardants for improving growth and yield of cape gooseberry.

Materials and methods

The experiment was conducted in sandy loam soil at Allahabad Agricultural Institute, Allahabad. One-month-old, nursery-raised seedlings of cape gooseberry were transplanted in the field in randomised block design with four replications. Growth retardants *i.e.,* paclobutrazol (12.5, 25, 50 and 100 ppm) and ethephon (100, 200, 400 and 800 ppm) were applied as foliar spray on the seedlings after 21 days of transplanting.

Fresh stock solutions of 100 ppm paclobutrazol and 800 ppm ethephon were prepared by dissolving the 0.4 ml of paclobutrazol (*a.i.,* 250 g/l) in one litre of water and 1.67 ml of ethephon (*a.i*., 480g/l) in one litre of water, respectively. A few drops of 'Teepol' were added to all the solutions as a sticking agent.

Four representative plants from each net plot were randomly selected and tagged for observations on height, number of branches, number of leaves, leaf area, fruit size, number of fruits per plant and yield per ha.

Results and discussion

Observations indicated that paclobutrazol and ethephon at 50 and 400 ppm, respectively had marked effect on plant height, number of branches, number of leaves, leaf area, fruit size, number of fruits per plant and yield per ha (Fig. 1-6). For all these parameters, 2nd degree polynomials were found suitable and indicates curvilinear relationship between the parameters and growth retardant concentration.

The dwarfing as well as stunted growth was recorded with the highest rate of paclobutrazol (100 ppm) and ethephon (800 ppm) but at the same time these plants produced lower yield than paclobutrazol 50 ppm and ethephon 400 ppm. Thus, paclobutrazol at 50 ppm and ethephon at 400 ppm influenced the vegetative growth of cape gooseberry positively, whereas, at highest concentration the supra optimal effects were recorded.

Paclobutrazol and ethephon are essentially retardants and exhibit significant influence on plant height. It seems that the reduced plant height is due to poor cell elongation causing reduction or blocking of the gibberellin's biosynthesis or movement or both. Reduction in plant height by these chemicals is well known and very well documented by Jones *et al*. (1989) and Singh (2000). The retardant help in weakening the apical dominance and make food available for growth and reproduction, thus encourages enhanced branching. More number of branches was recorded with paclobutrazol at 50 ppm and ethephon 400 ppm. This fact is strengthened by the findings of Singh (2000) and Faust *et al.* (2001) with paclobutrazol. Jana and Jahangir (1987) have reported similar findings with ethephon.

Similarly, paclobutrazol (50 ppm) and ethephon (400 ppm) significantly increased the number of leaves over control.

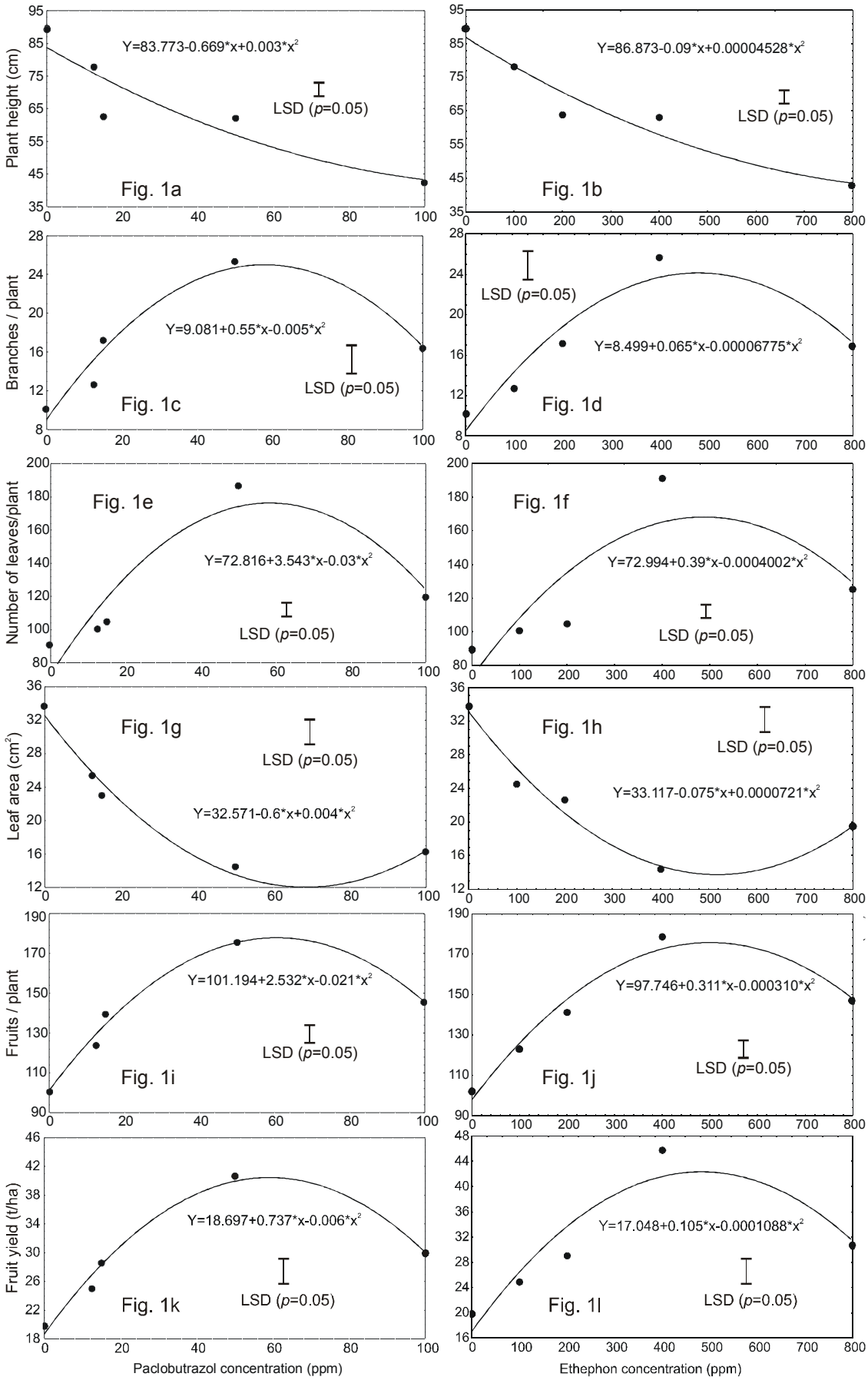

Fig. 1. Effect of growth retardants on plant height (**Fig. 1a,b**), number on branches/plant (**Fig. 1c,d**),number of leaves per plant (**Fig. 1e,f**), leaf area (**Fig. 1g,h**), fruits/ plant (**Fig. 1i,j**), fruit yield (**Fig. 1k,l**). Curve show second degree polynomial fit and filled circles are mean values. Vertical bars show LSD ($p \leq 0.05$)

Increase in number of leaves due to growth retardant application has been reported by several workers (Singh, 2000, Faust *et al.,* 2001, and Zayed *et al*., 1985).

A significant reduction in leaf area was observed with paclobutrazol at 50 ppm followed by ethephon at 400 ppm. The reduction in leaf area may be due to reduced intercellular spaces and spongy mesophyll cell near leaf margin in leaves due to paclobutrazol and ethephon (Singh, 2000, Rawash *et al.,* 2002 and Tewari *et al*., 1984).

Ethephon at 400 ppm as well as paclobutrazol 50 ppm exerted the higher percentage of fruit set. The higher percentage of fruit set may be linked with delicate balance between C: N along with auxins. The results are in close conformity with those reported by Lokonova and Kolonitseva (1987), Ahmad *et al*. (2000), Singh (2000) and Rawash *et al.* (2002).

Higher number of ripen fruits was recorded with ethephon 400 ppm and paclobutrazol 50 ppm. More number of fruits may be attributed to higher fruit set. The berry weight was higher with ethephon 400 ppm and paclobutrazol 50 ppm over control. The increased berry weight may be due to increase in size and diameter of fruit (Table 1). Increased fruit weight with paclobutrazol and ethephon was reported by Rawash *et al*. (2002) and Verma *et al*. (1984).

Table 1. Effect of growth retardants on fruit set, fruit weight, fruit diameter, diameter and length ratio, Number of fruits and fruit yield

Treatments	Fruit Set (%)	Fruit weight (g)	Fruit diameter (cm)	Diameter Length Ratio
Control	89.75	4.81	2.068	1.05
Paclobutrazol12.5ppm	91.50	5.01	2.118	1.15
Paclobutrazol 25ppm	93.25	5.08	2.129	1.17
Paclobutrazol 50ppm	98.00	5.77	2.352	1.32
Paclobutrazol 100ppm	93.88	5.12	2.145	1.19
Ethephon 100ppm	92.13	5.07	2.128	1.16
Ethephon 200ppm	93.75	5.14	2.135	1.18
Ethephon 400ppm	98.38	6.40	2.39	1.35
Ethephon 800ppm	93.38	5.20	2.149	1.20
CD (*p*=0.05)	2.80	0.48	0.153	0.09

It is noteworthy that ethephon 400 ppm and paclobutrazol at 50 ppm improved the fruit diameter and diameter/length ratio of the fruit. It may probably be due to increase in cell number of intercellular spaces in the flesh.

Both chemicals significantly produced a higher fruit yield over control. However, highest yield was recorded with ethephon 400 ppm followed by paclobutrazol 50 ppm. Yield depends upon reserve food maintained by plants. It seems that treated plants had less gibberellins and higher photosynthates; while less energy was utilised for vegetative growth saving more energy for flower bud initiation, fruit set and fruit growth with ethephon at 400 ppm and paclobutrazol at 50 ppm. Very high rates in the present study failed to give satisfactory yield due to phytotoxic effect on plant. It may be due to excessive amount of ethylene produced by higher dose of the chemicals, which had unfavourable effect on the cape gooseberry plants. In untreated control plants the lower yields may be attributed to the C: N where vegetative growth of the plant dominated over the reproductive growth resulting in poor accumulation of carbohydrates which caused reduction in fruit yield as well as poor fruit quality. Thus, it may be concluded that paclobutrazol at 50 ppm and ethephon at 400 ppm may be used for improving the growth and yield of cape gooseberry fruits.

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