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Study of responses of penicillin-G on morphological characteristics, physiology and productivity of bitter gourd (*Momordica charantia* L.)

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Abstract: Penicillin the "Queen of Drugs" is a large group of natural or semi synthetic antibiotics derived from strains of fungi of the genus Penicillium (*P. notatum* and *P. chrysogenum*). These are the compounds of 6-aminopenicillanic acid. Penicillin-G (Benzylpenicillin) is natural penicillin. This Paper is concerned with the morphological, physiological and productivity responses of penicillin-G in Bitter gourd (*Momordica charantia* L). A field experiment was conducted to see the effect of various concentration of Penicillin-G, on different parameters in bitter gourd, as three season's crop. Penicillin-G was applied, as foliar spray at pre flowering, flowering and post flowering stage. The lower concentration (25, 50 &100 mg/l) showed an increasing trend in leaf growth yield and biochemical estimation. The numbers of seeds were reduced significantly in lower concentrations.

Keywords: Penicillin, Bitter gourd, physiology

INTRODUCTION

Vegetables comprise a complex group of edible plants with diverse forms of reproduction and propagation, for example, seeds, cuttings, roots and tubers. They are rich sources of certain essential vitamins, minerals, proteins and dietary fibers, which provide additional calories. So, increase in production of vegetable like selected ones, have great potential to enhance the nutrition of the rural and urban poor, as well as to increase their incomes and provide greater employment opportunities. Economic trends suggest that vegetables will increasingly contribute to improve diets in the developing countries.

India is the world's second largest producer of vegetables next to China in the range of vegetable crops and their production systems. The annual production is estimated around 50 million tonnes from a cropped area of about 4 million hectares, excluding potato and tubers, which is about 3 per cent of the total cropped area. The per-capita availability of vegetables is around 120-130/g per day, in contrast to the recommendation of 300 g per person per day by dieticians. Even this low level not fully reflects the consumption pattern in rural households and those below the poverty line. This low per-capita consumption is mainly due to low productivity level of bitter gourd. Keeping in view, the role of vegetables in providing food security to the people, the present research work has been selected. In view of these properties of penicillin, it points to the validity of assuming penicillin action being of hormonal nature. In the present work, parameters are chosen as criteria to observe the various morphological, physiological and biochemical effects of penicillin-G on, *Momordica charantia* belonging to the family Cucurbitaceae.

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In recent years, increasing attention has been paid to the effects of antibiotics on higher plants. The development of a number of growth regulating compounds, especially an antibiotic- Penicillin has further enhanced the potential of chemical regulation of growth in agricultural and horticultural plants (Anonymous, 1974)[1]. The biological activities of penicillin have been worked out by several workers. This promising antibiotic of fungal origin has exhibited growth regulating properties in many plants. (Pelczar *et. al.,* 1977; Rose, 1979; Power, 1986; Tauro *et. al.*, 1986; Purohit, 1988; Hapwood, 1989)[2-7].

The growth regulating properties of penicillin's on various plant physiological and biochemical processes have been investigated in India by Dr. S. Mukherji and his team at the Department of Botany, Calcutta University, Calcutta (W.B.) and Dr. S.S. Purohit at Dungar College, Bikaner (Rajasthan), Penicillin, the well known antibiotic has been shown to affect plant metabolism by promoting several hormone-regulated phenomenon.

The Penicillin is the first antibiotic to be discovered. Penicillin and semi-synthetic penicillin are now a day's known as "**beta-lactum**" antibiotics, as a group because of the presence of so called **"beta-lactum"** ring in the chemical structure. It is the most important of the antibiotics, was first extracted from the mould *Penicillium notatum.* Subsequently, a mutant of a related mould *P.chrysogenum,* was found to give the highest yield of penicillin and is now used for commercial production of this antibiotic. Molecular structure of penicillin reveals that it includes the four membered 'beta lactum' ring. The amide bond of beta-lactum ring is readily broken in both acidic and alkaline medium and can be hydrolysed by Penicillinase (beta-lactamase) and synthesized by many bacteria. The naturally occurring penicillin differ from each other in R-groups or side chain groups, depending on the bases of different R-groups, different types of penicillin's are formed.

Bitter gourd is said to have originated in the tropical regions of the old world. The alkaloid momordicasoides imports the bitter taste to the fruit. Fruits are rich in Iron (1.8 mg/100 g), Calcium (20 mg/100g), Phosphorus (55mg/100g), Vit. A (210 IU/100g) Vit. C (88mg/100g) and form an ideal diet to the diabetic patients. The crop originated in India (Indo-Burma centre of origin). In Ballia (Utter Pradesh, India) the crop is grown throughout the district by local growers and also in kitchen gardens.

MATERIALS & METHODS

- **Collection of samples for growth and productivity:**

The material selected for the studies is Bitter gourd *(Momordica charantia* L.). The seeds of bitter gourd were obtained from National Seed Corporation, IARI, New Delhi-110012, the plants raised in the field. (Research field, S.M.M. Town (P.G.) College, Ballia-277001) under normal environmental conditions (Soil-loam, pH. 6.8 under min. 14.68 and max. temperature 36.81^{0}C). The fields were irrigated before ploughing and left for 6 days. Twelve quadrates of 10×10 feet were prepared for bitter gourd.

Seeds were sown in three rows at a distance of 30 cm. apart from each other and the distances between two rows were 30 cm. In all 15 seeds per quadrates were sown, and six quadrates were maintained for bitter gourd. The experimental plots were irrigated from time to time, when required. The plants were sprayed with penicillin at 25, 50, 100,150 & 200 mg/l, thrice, before flowering (at vegetative phase) at interval of 10 days *i.e.* 25, 35 & 45 DAS (Days after sowing) & twice after flowering (at reproductive phase) at 10 days of interval *i.e.* 55 & 65 DAS.

For the spray, Penicillin-G (250 mg) tablets were crushed and dissolved in glass distilled water at room temperature. Stock solution of Penicillin-G was prepared and five concentrations were selected after trial experiments.

The observations were taken after five days of spray i.e. 30, 40, 50, 60 and 70 DAS. For growth the parameters recorded were shoot length, root length, internodes length (3rd, 5th and 7th internodes, at 30, 40 and 50 DAS), leaf growth (number of leaves and leaf area), number of branches and biomass in area. The leaf area was calculated by using Graph Paper Method at 30, 50 and 70 DAS.

For productivity, the parameters taken were flowering (days of first flower initiation, number of flowers per plant (male and female flowers at 50 and 70 DAS), and ratio of male to female flowers (50 and 70 DAS). The number, size and weight of fruits, total yield and harvest Index were recorded at final harvest (120 DAS).

RESULTS

YIELD PARAMETERS-

A. Flower initiation and Number of flowers: In control plants, flower initiation was observed at 50 DAS, while 25, 50 and 100 mg/l showed early flowering by 2 days. Higher concentrations (150 and 200 mg/l) showed non-significant changes in flower initiation. (Table-01).

Treatment of penicillin significantly enhanced the development of female flowers. In case of male flowers, there is no significant change at 50 and 70 DAS, except 150 mg/l, which showed 33.4% increase over control. The maximum increase in number of female flowers was noted with 100 mg/l i.e. 137.5% and 129.4% at 50 and 70 DAS, respectively, as compared to control. However, 200 mg/l showed non-significant change for female flower. (Table-01)

B. Ratio of male and female flowers: The ratio of male to female flowers decreased with the lower concentrations i.e. 25, 50 and 100 mg/l, thereafter the ratio is increased. The maximum ratio of male to female flowers was recorded with 100 mg/l i.e. 1: 3.35 at 50 DAS and 1:4.33 at 70 DAS, as compared to control (Table-02).

C. Productivity: All the concentrations significantly enhanced the number of fruits. The increase was maximum with 100 mg/l (i.e. 54.13%), as compared to control. The length of fruit was significantly increased with the lower concentrations (25, 50 and 100 mg/l). The maximum increase was with 100 mg/l (53.05% over control). The weight of fruits was also increased with increasing concentrations. The maximum increase was with 100 ml/l i.e. 50.19% (Table-03).

D. Total Yield (q/ha) and Harvest Index: Total yield increased significantly, with all the concentrations. The increase was maximum with 100 mg/l (82.4%), as compared to control. Similarly harvest Index showed an increasing pattern, with all the concentrations, as compared to control. 100 mg/l showed 80.04% increase over control in harvest Index, which is also more as compared to other concentrations (Fig-1)

DISCUSSION

Much work has been done on exogenous application of plant growth regulators to incraease growth, to induce early flowering, fruit and seed production in various plants (Luckwill, 1957; Crane, 1969; Addicott, 1970; Scott, 1978; Davies, 1987; Davies and Curry, 1991; Saimbhi, 1993; Nevines, 1995)[8-15] due to their interaction with the endogenously metabolized plant hormones. The recent development of a number of growth regulating substances, especially penicillin has further enhanced the potential of chemical regulation of growth and development. In recent years, this promising antibiotic of fungal origin has exhibited growth regulating properties in many plants.

The role of penicillin as a plant growth regulator, on morphophysiological aspects of higher plants has been worked out. But so far, little published materials are available on various aspects of the plant metabolism. The study was, therefore, undertaken following the encouraging results, reported by many workers (Brian, 1957; Anderson 1968; Biswas and Mukherji, 1978, 1979, 1982; Mukherji and Biswas 1985; Purohit and Mukherji 1984)[6] (Mukherji, 1988; Sen Gupta *et al.,* 1989; Mukhopadhyay *et al.,* 1990, 1992, 1995; Basu *et al.,* 1996; Das and Basu 1997, 1998 b)[16-30] from treating seeds and foliar spray of various crops.

In the present studies, selected concentrations (25, 50, 100, 150 and 200 mg/l) of Penicillin- G, on the basis of trial experiments, was applied on Bitter gourd. The studies showed that growth and development of all the cucurbits followed an almost common pattern. All the concentrations of Penicillin-G significantly increased shoot length, in all the cucurbits studied, except 25 mg/l, which showed non-significant enhancement. Maximum increase was recorded with 100 mg/l, in Bitter gourd.

As far as flower initiation and number of flowers are concerned, penicillin treatment significantly enhanced female flowers. The mechanism of control of sex expression in cucurbits, with the use of plant growth regulators, is to decrease endogenous level of gibberellin content by inhibiting its biosynthesis and promote auxin content of the plants. So, increase in auxin content tends to shift male-flowering towards femaleness and there by lowers the sex ratio. (Cherry, 1970; Krishnamoorthy and Talukdar, 1976; Christopher and Lory, 1982; Tanimoto and Harada, 1984; Atherton, 1987; Arora *et al.*, 1989)[31-36].

As compared to control, penicillin in all the concentrations showed remarkable enhancement (maximum with 100 mg/l) of the yield, in all the three cucurbits, at the final harvest. This increment in productivity was mainly due to increase in the number of flowers, which ultimately increased the number of fruits. In this case, weight of fruit was also increased with increasing concentrations, in Bitter gourd.

Application of penicillin, increased fruit yield significantly, with all the concentrations, which was maximum in 100 mg/l, as compared to control. The same trend was maintained in respect of harvest index i.e. the harvest index also increased significantly, with the application of penicillin-G, in Bitter gourd. The percentage increased over control, were in the order of 63.47, 80.04, and 91.65 by penicillin in bitter gourd with 100 mg/l.

Table : 01

Effect of Penicillin-G on the number of flowers/plant in bitter gourd. All the values are average of three replicates.

Conc.(mg/l) \ DAS	Flower initiation	50		70	
		♂	♀	♂	♀
Control	50	5.00 ±0.67	8.00 ±0.67	9.67 ±0.22	17.00 ±0.67
25	48	5.67* ±0.22	11.00 ±0.67	9.67* ±0.89	20.67 ±1.56
50	48	5.83* ±0.22	14.33 ±0.22	11.00* ±0.67	29.00 ±0.67
100	48	5.97* ±0.22	19.00 ±2.67	11.30* ±1.56	39.00 ±0.67
150	49*	6.67 ±0.22	14.33 ±1.56	9.67* ±0.89	32.00 ±0.67
200	49*	6.00* ±0.67	11.67 ±0.22	9.00* ±0.67	18.33* ±1.56
C.D. at 5% level	1.16	1.48	2.39	1.93	2.10

Table : 02

Effect of Penicillin-G on the ratio of male to female flowers/plant in bitter gourd. All the values are average of three replicates.

Conc.(mg/l) \ DAS	50	70
Control	1: 1.60	1: 1.76
25	1: 1.94	1: 2.14
50	1: 3.31	1: 2.64
100	1: 3.35	1: 4.33
150	1: 2.15	1: 3.31
200	1: 1.95	1: 1.62

DAS : Days after sowing
Conc. : Concentration
***** : Non- significant

Table : 03

Effect of Penicillin-G on the number of fruits/plant, length of fruit and weight of fruits/plant in bitter gourd. All the values are average of three replicates.

Conc.(mg/l)	Number of fruits per plant	Length of fruit per plant (cm.)	Weight of fruits per plant (gm.)
Control	88.67 ±1.56	10.67 ±0.19	54.73 ±1.84
25	107.67 ±1.56	12.33 ±0.05	63.30 ±1.39
50	123.67 ±1.56	13.50 ±0.06	78.07 ±1.04
100	136.67 ±1.59	16.33 ±0.02	82.20 ±2.06
150	110.67 ±1.60	11.67* ±0.04	78.47 ±0.60
200	101.67 ±1.59	11.00* ±0.17	69.20 ±0.45
C.D. at 5% level	2.23	1.06	2.59

DAS : Days after sowing
Conc. : Concentration
***** : Non- significant

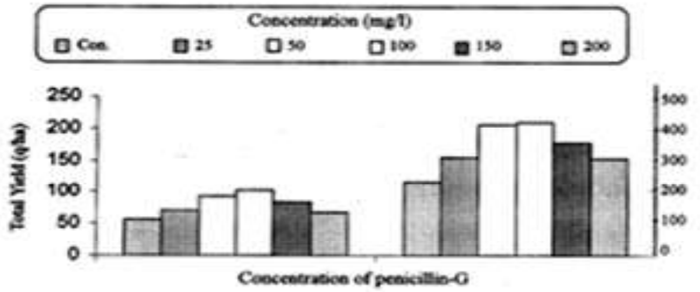

Fig. 1- Effect of Penicillin-G on the total yield(q/ha) and harvest index in bitter gourd. All the values are average of three season crops.

REFERENCES

1. **Anonymous, 1974**. *Antibiotics and farmers. Brit. Med. J.* **2:** 235.

2. **Pelczar, M.J. Jr., Ried, R. and Chan, E.C.S. 1977.** *Microbiology*, Tata McGrawHill Publ. Co. Ltd., New Delhi, India

3. **Rose, A.H. 1979,** *Economic Microbiology* : Secondary Products of Metabolism, Vol. **3**, New York, Academics, p. 595

4. **Power, C.B. and Dagniwala, H.F. 1986**. *General Microbiology,* Vol. I & II. Himalaya Publishing House, Mumbai, India.

5. **Tauro, P., Kapoor, K.K. and Yadav, K.S. 1986**. *An Introducton to Microbiology, Wiley Eastern, Ltd., N. Delhi.*

6. **Purohit, S.S. 1988**. *Microbiology.* Agro Botanical Publishers. (India). Bikaner.

7. **Hapwood, D.A., 1989**. Antibiotics: Opportunities for genetic manipulation *Phill. Trans. R. Soc. Land. B,* **324:** 549-562.

8. **Luckwill, L.C. 1957**. Hormonal aspects of fruit development in higher plants. In: *the Biological Activity of Growth Substance, Ed: porter, HK. Symposium of Society for experimental Biology no. 11, Cambridge University Press.* pp. 63-85.

9. **Crane, J.C. 1979**. The role of hormones in fruit set and developments. *Horticultural Science;* **4:** 108-111.

10. **Addicott, F.T. 1970**. Plant hormones in control of abscission. *Biol. Rev.,* **45:** 485-524.

11. **Scott, T.K. 1978**. *Plant Growth Regulation and World Agriculture.* Plenum Press. pp. 575.

12. **Davies, P.J. 1987**. Plant Hormones and their role in plant growth and development. (Ed.). Martinus - Nijhoff, Doodrecht, The Neetherlands.

13. **Davies, T.D. and Curry, E.A. 1991**. Chemical regulation of vegetative growth. *Critical Review of Plant Science* **10:** 151-188.

14. **Saimbhi, M.S. 1993**. Growth regulators in vegetable crops In *Advances in Horticulture:* vegetable crops, 6th eds. Chadha, K.L. and Kalloo., G. Malhotra publications, New Delhi. pp. 619-642

15. **Nevines, D.J. 1995.** Prospectives on the usage of plant bioregulators in vegetable crop production, *Acta, Horticultre,* **394:** 25-35.

16. **Brian, P.W. 1957**. Effects of antibiotics on plants *Ann. Rev. Plant physiol;* **8:** 413-426.

17. **Anderson, E.S. 1968**. The ecology of transferable drug resistance in the Entero bacteria, *Ann. Rev. Microbiol,* **22:** 131-180.

18. **Biswas, A.K. and Mukherji, S. 1978**. Penicillin induced regulation of chlorophyll formation and Hill activity of isolated chloroplasts in rice (*Oryza sativa* L.) seedlings. *Curr. Sci.* **47:** 555-556.

19. **Biswas, A.K., Mukherji, S. 1979**. Penicillin induction of gibberellin and a-amylase biosynthesis in rice endosperm. *J. Exp. Biol.* **30:** 43-51.

20. **Biswas, A.K. and Mukherji, S. 1982**. Comparison of penicillin and CAMP-induced a-amylase formation in rice (*Oryza sativa* L.) endosperm *Biochem. Physiol Pflangen,* **177:** 715-719.

21. **Mukherji, S. and Biswas, A.K. 1985**. Penicillin action stimulating growth and metabolism in seedling of rice (*Oryza sativa* L.) *Can. J. Bot.;* **63:** 1150.

22. **Purohit S.S. and Mukherji, S. 1984**. Growth Regulating Activity of Penicillin in higher plants. In. S.S. purohit edited in *Hormonal regulation of plant growth and development,* Vol.I Agro Botanical publishers, (India) , Bikaner. pp. 265-278

23. **Mukherji, S. 1988**. Growth Regulating Properties of penicillin in higher plants in S.P. Sen edited. *Plant Physiological Research in India,* p. 153-157.

24. **Sengupta, T., Bag, A., Biswas. A.K. and Mukherji, S. 1989**. Penicillin induced stimulation of protein efflux and membrane bound ATPase in Mungbean (*Vigna radiata* (L) Wilczek) Hypocotyl segments. *Indian J. Expt. Biol.,* **27:** 166-169.

25. **Mukhopadhyay, R., Ray, C. and Mukherji, S. 1990**. Study on growth, nodulation, sugar and amino acids contents in mungbean following application of penicillin as foliar spray. *Indian J. Plant Physiol.* **33 (3):** 197-203.

26. **Mukhopadhyay, B., Debashish. S. and Mukherji, S. 1992**. Influence of penicillin on nodulation and Nitrogen fixation in mungbean in relation to some nitrogen assimilating enzymes. *Indian J. Plant Physiol.,* **35(4):** 357-363.

27. **Mukhopadhyay, B., Bhattacharya, R., Biswas A.K. and Mukherji, S. 1995**. Penicillin regulation of leghemoglobin. Hill activity, net photosynthesis and ultra structure of nodule and chloroplast in mungbean *Plant Physiol. Biochem,* **22:** 195-199.

28. **Basu, P.S. Banerjee, S. and Das, S. 1996**. Effect of penicillin on flowering fruit setting and development in *Luffa acutangula* Roxb. *Indian J. Plant Physiol,* **1(NS):** 148-152.

29. **Das, S. and Basu, P.S. 1997**. Effect of cephalexin on flowering, fruit setting and development of *Luffa actangula,* Roxb. *Indian J. Plant. Physiol;* **2(NS):** 18-20.

30. **Das, S. and Basu, P.S. 1998. b.** Effect of cephalexin on flowering, fruit setting and fruit development of *Cucumis sativus* L. *Indian J. Plant Physiol;* **3(NS):** 201-204.

31. ***Cherry, J.H. 1970**. *Hort. Science* **5:** 205-207.

32. **Krishnamoorthy, H.N. and Talukdar, A.R. 1976**. Chemical control of sex expression in *Zea mays* L.Z. *Pflanzen physiol.* Bd., **79.(S):** 91-94.

33. **Christopher, D.A. and Lory, J.B. 1982**. Influence of foliarly applied growth regulators on sex expressions in water melon. *Journal of American Society of Horticultural Science,* **107:** 401-404

34. **Tanimoto, S. and Harada, H. 1984**. Hormonal regulation of flowering. In: *Hormonal Regulation of* Plant *Growth and Development.* 1. ed. : Purohit, S.S., Agro Botanical Publishers, India. pp. 41-93.

35. **Atherton, J.G. 1987**. *Manupulation of flowering.* Butterworth, London

36. **Arora, S.K., Kumar, J., Mangal, J.L. and Kalloo 1989**. Crop yield improvement through chemical sex modification in cucurbits-a review. *Haryana J. Hort. Sci.* **18:** 77-93.

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