

SYNOPSIS

Title: Effect of GA₃ on Flowering and Yield Component of Bitter gourd (*Momordica charantia* L.)

MASTER OF SCIENCE
IN
(HORTICULTURE)
BY
Manpreet Kaur

Registration Number: **11716935**

Under the supervision of
Dr. Dipika Mal



L OVELY
P ROFESSIONAL
U NIVERSITY

**DEPARTMENT OF HORTICULTURE, SCHOOL OF AGRICULTURE,
LOVELY PROFESSIONAL UNIVERSITY, PHAGWARA, INDIA.**

CERTIFICATE

Certified that this synopsis of Manpreet Kaur, registration no. 11716935, entitled “Effect of gibberellic acid (GA3) on flowering and yield components of Bittergourd

(*Momordica charantia*)” has been formulated and finalized by the student himself on the subject.

<p>(Signature of Student) Manpreet Kaur Reg. no.: 11716935 School of Agriculture, Lovely Professional University, Phagwara, Punjab</p>	<p>(Signature of Supervisor) Dr. Dipika Mal UID-21885 School of Agriculture, Lovely Professional University, Phagwara, Punjab</p>
<p>(Signature of Co-advisor)</p>	<p>(Signature of Co-advisor)</p>
<p>(Signature of Head) School of Agriculture, Lovely Professional University, Phagwara, Punjab</p>	<p>(Signature of HOS) School of Agriculture, Lovely Professional University, Phagwara, Punjab</p>

INTRODUCTION

Bittergourd (*Momordica charantia* L.) is one of the most important and round the year cultivated popular vegetable crops. It belongs to the family cucurbitaceae. Bittergourd also known as balsam pear, karela, or bitter melon is a fast growing tropical vegetable crop. In India, it is cultivated in an area of 26,004 ha with a production of 1,62,196 tons and the productivity level is 6.23 t/ha. In Karnataka, it is cultivated in an area of 1,872 ha with a production of 13,676 tons and the productivity is 7.0 t/ha (Anon. 2008).

Fruits are highly nutritive and are relatively high in proteins, minerals and vitamins. The fruits contain, 83.2 per cent water, 2.9 per cent protein, 1.0 per cent fat, 1.4 per cent mineral matter, 1.7 per cent fiber, 9.8 per cent carbohydrates, 0.05 per cent calcium, 0.14 per cent phosphorus, 9.4 per cent iron and traces of Mg (Aykroyd . 1963).

It has immense medicinal properties due to the presence of beneficial phytochemicals which are known to have antibiotic, antimutagenic, antioxidant, antiviral, antidiabetic and immune enhancing properties (Grover and Yadav, 2004.) A compound known as charantin, present in the bittergourd is used in the treatment of diabetes in reducing blood sugar level (Lotlikar *et al.* 1966).

The plant growth regulators (PGR's) are considered as a new generation agrochemicals after fertilizers, pesticides and herbicides are known to enhance the source- sink relationship and stimulate the translocation of photo-assimilates thereby helping better fruit set. Similarly, even in bittergourd, it is possible to increase the yield level by increasing the fruit set per cent by use of some growth regulators. Use of plant growth regulators (PGR's) might be a useful alternative to increase crop production. Recently, there has been global realization of the important role of PGR's in increasing crop yield. Gibberellic acid is an important growth regulator that may have many uses to modify the growth, yield and yield contributing characters of plant (Rafeekher *et al.* 2002).

The principle in sex modification in cucurbits lies in altering the sequence of flowering and sex ratio. Besides the environmental factors, endogenous levels of auxins, gibberellin, ethylene and ascorbic acid, at the time and the seat of ontogeny determine the sex ratio and sequence of flowering. Exogenous application of plant growth regulators can alter the

sex ratio and sequence, if applied at 2 or 4 leaf stage which is the critical stage for suppression or promotion of either sexes. Hence, modification of sex to desired direction has to be manipulated by exogenous application of plant growth regulators. Gibberellins play a key role in promoting male sex expression and are antagonistic to that of ethylene and abscisic acid (Rudich, 1983).

Plant growth regulators are the chemical substances, when applied in small amounts modify the growth of plant usually by stimulating part of the natural growth regulatory system. About sixty plant growth regulators are now commercially being used and several of them have reached considerable importance in crop production. The growth regulators include both growth promoters and retardants which have been shown to modify the canopy structure and other yield attributes.

Though the PGR's have great potentialities to influence plant growth morphogenesis, its application and accrual assessments have to be judiciously planned in terms of optimal concentrations, stage of application, species specificity, seasons, etc. Which constitute the major impediments in PGR's applicability. In view of their wide spectrum effectiveness on every aspect of plant growth, even a modest increase of 10-15 per cent could bring about an increment in the gross annual productivity by 10-15 million tons.

Objectives

Since very little information is available on the effect of growth regulators on growth and yield in bittergourd, the present investigation was aimed to find out suitable growth regulators for increasing the yield potential and also quality in bittergourd with the following objectives:

1. To study the effect of GA3 on flowering and growth of bittergourd.
2. To find out the influence of plant growth regulators on yield of bittergourd.

REVIEW OF LITERATURE

Vine length

Application of GA3 increased the stem growth and effect was more at higher concentration (Krishnamoorthy and Sandooja, 1981). According to Mangal *et al.*, (1981), the application of CCC at 250 ppm showed significant increase in plant height compared to CCC at 500 ppm in bittergourd.

The application of GA3 at 25 ppm and NAA at 50 ppm stimulated the elongation of main vine length in summer squash. Similarly, the application of GA3 (25 ppm) at 2-4 true leaf stage resulted in the more vine length as compared to control in bottlegourd (Arora *et al.* 1982 & 1985).

Mishra *et al.* (1972) reported that the application of GA3 at 5 ppm was found to increase the length of creeper in bottlegourd. Application of GA3 at 5, 10 and 15 ppm and NAA at 25, 50 and 75 ppm at 4 to 6 true leaf stage increased the main vine length within increasing concentration in muskmelon (Randhawa and Kirtisingh 1973).

It was noticed that the application of NAA at 2 and 4 true leaf stages increased the main vine length in watermelon cv. Sugar Baby (Shinde *et al.*, 1994).

The experiment conducted by Sidhu *et al.*, (1982) revealed that the application of CCC at 100 ppm and ethrel (250 ppm) spray proved equally effective in the elongation of main axis in muskmelon.

Arun *et al.* (1982) reported that the application of GA3 @ 200 ppm resulted in maximum plant height followed by seed soaking with GA3 @ 15 ppm in brinjal cv Pusa Purple long. According to Ram Asrey *et al.* (2001), the application of GA3 at 500 ppm increased the length of the vine in muskmelon.

NUMBER OF LEAVES

Das and Swain (1977) reported that nitrogen and growth regulators increased leaf number as well as leaf area in pumpkin when the crop was sprayed with planofix (100 ppm), ethrel (200 ppm) and alar (200 ppm) at 10 and 20 days after planting.

Effect of growth 55.- Das, R. C. and Swain, S. C., 1977, substances and nitrogen on growth, yield and quality of pumpkin. *Indian J. Hort.*, 34(1): 51.

Whereas, Singh *et al.* (1991) reported that the foliar application of mix talol (30 ml / 10 l) increased the number of leaves per plant significantly in bottlegourd.

Seed soaking with 550 ppm GA3 for 12 hrs increased the number of leaves per plant in muskmelon (Ram Ashrey *et al.* 2001).

Fruit set (%)

Wittwer and Buckovac (1965) reported that the application of GA3 succeeded in promoting fruit set, without pollination in watermelon.

According to Gopalkrishnanand and Choudhary (1978), foliar application of GA3 at 25 and 50 ppm increased per cent fruit set.

The lowest (63.41) was obtained with GA3 (20 ppm) in bittergourd (Dostogir *et al.*, 2006).

PHENOLOGICAL CHARACTERS

Days to flower initiation

Sidhu *et al.* (1981 & 1982) concluded that ethrel @ 100, 250 and 500 ppm induced the hermaphrodite flowers earlier at basal nodes than male flowers in muskmelon. Further they revealed that during both the seasons (summer & rainy), maximum number of days and nodes to first male and female flowers were recorded with the application of ethrel. Whereas, MH induced the female flowers much early at basal nodes than the number of male flowers in squash melon.

Application of CCC at 250 ppm and 500 ppm recorded minimum number of days for the appearance of first female flower (48.4 to 49.5 days), which was about 13 days earlier to untreated control (Mangal *et al.*, 1981).

Arora *et al.* (1982) reported that the application of ethrel at 100 and 250 ppm was most effective in inducing early as well as increased number of female flowers than the male flowers in summer squash.

Application of plant growth regulator MH at 150 mg/l showed earliest appearance of first staminate and pistil late flowers; whereas, NAA at 50 mg/l delayed the appearance of first staminate and pistil late flowers in cucurbitaceous crops (Arora *et al.* 1985).

The application of NAA (50 ppm) produced the first male flower earlier (43 days) and was significantly superior to all other treatments in bittergourd (Gedam *et al.*, 1998).

Pankaj *et al.* (2005) studied the effect of plant growth regulators in bottlegourd and recorded substantial variation in the number of days for first male and female flowers over control and the application of CCC at 200 ppm exhibited significantly lower values (50.94days) for male flowers and 58.8 days for female flowers as against the control.

Application of NAA at 50 ppm delayed the appearance of first male flower (48 days) than female flower(45.04 days) as compared to control in bittergourd (Marbhalet *et al.*, 2005).

Similarly, The application of GA3 at 85 ppm showed significant influence on days to first male flower (34.7)in bittergourd. The earliest (30.63 days) was obtained in control (Dostogir *et al.*, 2006).

Days to Fruit Set

Dostogiret *al.* (2006) studied the effect of GA3 on flowering and fruit development in bittergourd and reported that the application of GA3 at 25 and 40 ppm reduced the number of days for fruit set.

Days to fruit maturity

Mishra *et al.* (1972) revealed that the application of GA3 (10 ppm) at 21 days after sowing and again a week later resulted in earliness of fruit maturity in bottlegourd.

Similarly foliar application of GA₃ (25 ppm) at two and four true leaf stages of plant growth resulted in earliness of fruit maturity in watermelon cv. Fuken (Arora *et al.*, 1988).

Similarly, the application of NAA at 50 ppm showed the earliest fruit maturity (19.3 days) in bittergourd (Gedam *et al.*, 1998).

In muskmelon, the seed soaking with 400 ppm GA solution for 24 hours showed the earliest fruit maturity followed by GA at 450 ppm (Ram Asrey *et al.*, 2001).

Marbhal *et al.*, (2005) studied the effect of growth regulators and picking sequence on seed yield in bittergourd and reported that the number of days required to pick the mature fruits from flowering significantly influenced by growth regulator treatments. It was also noticed that number of days was reduced by ethephon treatment (33.8 days) as compared to control (39.2 days) and also there was a slight reduction with NAA treatment (37.3 days).

Fruit characteristics

Yasuyoshi and Yoshiyuki (1995) opined that the application of NAA (150 ppm) at 2 and 4 true leaf stages increased the average fruit weight and also the combined effect of both hand pollination and cytokinin increased the fruit weight in watermelon.

The foliar application of NAA (50 ppm) and boron (4 ppm) recorded an increase in fruit diameter and fruit weight in bittergourd (Gedam *et al.*, 1998).

The maximum average length (6.0 cm) and average diameter (5.7 cm) was observed in squash melon with the application of 20 ppm & 10 ppm triacontanol (Mahajan and Sharma, 2000).

Ram Asrey *et al.*, (2001) studied seed soaking with 400 ppm GA solution for 12 hours and showed increase in fruit weight in muskmelon.

The foliar application of GA3 (5, 10, 20 ppm) and MH (50, 100, 200 ppm) at 2, 4 and 6 leaf stages resulted in increase in fruit diameter of summer cucumber; whereas, GA3 was inferior to MH (Rafeekar *et al.*, 2002).

The foliar application of NAA at 50 ppm showed increase in fruit weight by 34 per cent, as compared to 100 ppm MH (19%) and 13% with 50ppm ethaphon (Marbhal *et al.*, 2005).

The application of GA3 at 40 ppm showed the maximum fruit diameter and fruit weight and it was lowest with GA3 (85 ppm) in bittergourd (Dostogir *et al.*, 2006).

BIOCHEMICAL CHARACTERS

Apart from morphological and physiological alterations, growth regulators maximum influence various biochemical parameters, thereby bringing alterations in the quality characters in various crops. It was found that ablong fruited cultiveres were rich in large amounts of total phenols, glycoalkaloid and crude protein (Bajaj *et al.*, 1979)

Ahmed *et al.*, (1985) found that spraying of cycocel (500 ppm) at 21 days after planting in potato produced the higher amount of chlorophyll 'a' and 'b'.

Similarly, increase in chlorophyll content was found with the application of CCC and mepiquat chloride in seed tuber potato over control (Ganiger, 1992 and Gasti 1994).

Application of ethrel at 400 ppm showed increase in reducing sugars (3.13 g/ 100 g fresh wt.) and total sugars (3.43g/100g fresh wt.) as compared to GA in cucumber cv Beigaum (Vadigeri *et al.*, 2001).

Whereas, foliar application of GA3 to tomato increased the sugar content in fruits (Adhlakha and Verma 1984).

While, Siddareddy (1988) noted that the foliar application of mixtalol (1-2 ppm) increased the contents of reducing, non reducing, total sugars and protein content in potato tubers.

YIELD AND YIELD COMPONENTS

Yield is the ultimate economic product of the crop, which is determined mainly by fruit weight and number of fruits per plant. Most of the yield components show a direct influence on fruit yield. Under good crop management conditions, the highest yield levels could be obtained through improved package of practices, which includes the use of plant growth regulators.

Fruit yield

Choudhury and Elkholy (1972) reported that the foliar application of GA3 (10 ppm) at two and four true leaf stages in watermelon recorded 10 maximum fruit yield over control.

Das, R. C. and Swain, S. C., 1977, Effect of growth substances. The total fruit yield per ha increased with the application of GA3 (5 ppm) at 21 and 28 days after sowing in bottlegourd (Mishra *et al.*, 1972).

The application of GA3 (10 ppm) at 2, 4 and 6 leaf stages increased the fruit yield per hectare in muskmelon (Randhawa and Kirtisingh, 1973).

Gopalkrishnan and Choudhary (1978) studied the effect of plant growth regulators on fruit set and development in water melon and found that the application of GA3 (25 ppm) increased the fruit weight, fruit number and yield per ha.

The foliar application of CCC (250 and 500 ppm) at 4 leaf stage and second after 15 days of first spray in bittergourd recorded highest yield followed by spraying of ascorbic acid (25 ppm), ethrel (250 ppm), and boron @ 1ppm (Manga *et al.*, 1981).

The highest fruit yield per ha was recorded with the application of ethrel (500 ppm) in comparison to other treatments in muskmelon (Sidhu *et al.*, 1982).

The application of MH (150 ppm) in summer squash significantly enhanced fruit yield followed by 25 ppm GA (Arora *et al.*, 1982).

Foliar spray of MH (150ppm) at 2 and 4 true leaf stages at 7 days interval recorded highest total yield (376.3 q/ha) by number and weight in bottlegourd (Arora *et al.*, 1985).

Similar results have been reported by Pandey and Singh (1973) in bottlegourd but are contrary to the earlier findings of Randhawa and Kirtisingh (1973) who noticed the maximum yield of muskmelon with the application of NAA (25 ppm).

Gedam *et al.* (1998) reported that a significant increase in fruit yield per plant and perha was due to the application of NAA (50 ppm) as compared to other treatments in bitter gourd.

The application of ethrel (400 ppm) in cucumber cv. Poinesttee was found to besuperior with respect to yield with maximum number of fruits per plant (12.65) and yield(25.83 t/ha) than Beigam Local (Vadigeri *et al.*, 2001).

Seed soaking with GA (400 ppm) for 24 hours increased the number of fruits and yield in maskmelon (Ram Asrey *et al.*, 2001).

Maximum number of fruits and yield per ha were observed in the order of ethrel> MH > NAA > GA3 and optimum concentration was 100ppm ethrel in summer cucumber (Rafeekar *et al.*, 2002).

Marbhal *et al.* (2005) reported that the maximum fruit yield was observed by spraying of NAA (50 ppm) which was higher than control.

Dostogir Hossain *et al.* (2006) reported that the application of GA3 at 25 ppm recorded maximum number fruits per plants (15.8

MATERIALS AND METHODS

Experimental material: The experimental materials for this study comprises 6 treatments were presented as follows.

Treatments:

Factor A: Varieties

V1 – Prachi Local Punjab Variety

V2 –Kuber

Factor B: Different level of Gibberellic acid

T0 – 0ppm (control)

T1–Gibberellic acid (25 ppm) at pre flowering

T2–Gibberellic acid (40 ppm)at pre flowering

T3- Gibberellic acid (55 ppm)at pre flowering

T4–Gibberellic acid (75ppm)at pre flowering

T5- Gibberellic acid (85 ppm)at pre flowering

T6-Gibberellic acid (100 ppm)at pre flowering

Design of experiment: The experiment was laid out in Randomized Block Design (RBD) with four replications. Each replication consist of 7 treatments. The plan of layout is given as below:-

Design	Factorial RBD
Replication	3
Treatment	6+control
Crop	Bittergourd (<i>Momordica charantia</i>)
Season	Kharif (2017-2018)
Sowing Time	Feb-March
Date of Sowing	28 th Feb 2018
Date of Transplanting	3 rd April2018
Name of Variety1	Prachi
Source of Variety	East-West Seed International
Name of the Variety2	Kuber
Source of the Variety	Greenland International

Layout of the experiments:

Replication-1	Replication-2	Replication-3
----------------------	----------------------	----------------------

V1T0	V1T5	V1T3
V1T1	V1T2	V1T6
V1T2	V1T0	V1T4
V1T3	V1T6	V1T0
V1T4	V1T1	V1T3
V1T5	V1T3	V1T2
V1T6	V1T4	V1T1
V2T0	V2T3	V2T6
V2T1	V2T6	V2T3
V2T2	V2T0	V2T5
V2T3	V2T5	V2T0
V2T4	V2T1	V2T2
V2T5	V2T2	V2T4
V2T6	V2T4	V2T1

Observation to be recorded:

1. Length of vine(at 30 days, 45 days, flowering to fruiting and last picking)
2. Number of branches per plant(last picking)
3. Diameter of main vine
4. Total no of leaves per plant(at 30 days, 45 days, flowering to fruiting and last picking)

5. Days to first male flowering
6. Days to first female flower
7. Total no of male flower per plant
8. Total no of female flower per plant
9. Fruit set percent(Total no of fruit set/Total no of female flower)
10. No of fruit per plant
11. Fresh weight of fruit
12. Length of the fruit
13. Diameter of the fruit
14. Dry weight of fruit
15. Total yield per plant

Varietal characters:

	Variety-1(Prachi)	Variety-2(Kuber)
Plant height	24cm till 18 April 2018	19cm till 18 April 2018
Twining tendency	Vigorous growth, suitable for long duration harvest	Not Observed Yet
Fruit surface	Rough	No fruits yet
Fruit shape	Oval	No fruits yet
Sex type	Dioecious	Dioecious
Fruit skin colour	Light green to dark green	Light Green
Length of the fruit	12-15cm	
Diameter of the fruit	3-4 cm	
Days to first harvest	Not reached yet	Not reached yet

REFERENCES

- Arora, S. K., Pandita, M. L. and Sidhu, A. S., 1982, Effect of various plant growth regulators on vegetable growth, sex expression and fruit yield in summer squash (*Cucurbita pepo*L.). *Haryana Agric. Univ. J.*, 12 (4): 598-604.
- Arora, S. K., Pandita, M. L., Partap, P. S. and Sidhu, A. S., 1985, Effect of ethephon, GA3 and MH on vegetative growth, flowering and fruiting of Cucurbitaceous crops .*J. American Soc. Hort. Sci.*, 110 (3): 442-445.
- Adlakha, P.A. and Verma, S.K., 1984, Effect of Gibberellic acid on the quality of tomato fruit *Punjab Hort. Journal*, (4) :148-151.
- Ahmed, S. Ismail, S. and Zohra, S.B.,1985, Effect of Brown rust on sugar content of potato. *Pakistan J. Sci, Indust. Res.*, (28):116-118.
- Arora, S. K., Partap, P. S. and Pandita, M. L., 1988, Influence of foliar application of plant growth regulators on growth, sex expression and yield of watermelon. *Haryana Agric.Univ. J. Res.*, 18(2): 114-118.
- Arun, K. G., Hariwallabh and Jandial ,K. C., 1982, Effect of GA3 on growth and yield of Brinjal .*Haryana J. of Hort Sci*, (26): 143-145.
- Arora, S. K., Pandita, M. L. and Baswana, K. S., 1985, Effect of growth regulators on flowering and fruiting of bottlegourd. *Haryana Agric. Univ. J.*, 15(1): 36-41.
- Arora, S. K., Pandita, M. L. and Sidhu, A. S., 1982, Effect of various plant growth regulators on vegetable growth, sex expression and fruit yield in summer squash (*Cucurbita pepo*L.). *Haryana Agric. Univ. J.*, 12 (4): 598-604.
- Bajaj, K.L., Kour, G and Chadha, M.L., 1979, Poly phenol oxidase and other chemical constituents in fruits of Egg plant (*Solanum longena*L.) varieties *Veg. Sci.*,(8):37-44.
- Choudhury, B. and Elkholy, E., 1972, Effect of some new chemicals on the sex modification and fruiting in watermelon. *Proceedings of Third International Symposiu on Subtropical and Tropical Horticulture*,(3): 163-171.
- Das, R. C. and Swain, S. C., 1977, Effect of growth substances and nitrogen on growth, yield and quality of pumpkin. *Indian J. Hort.*, 34(1): 51-55.
- Dostogir, H, Abdul Karim, M., Habibur Rahman Pramanik, M., Syedur Rahman, A. A. M.,2006, Effect of gibberellic acid (GA3) on flowering and fruit development of bittergourd (*Momordic acharantia L.*). *Intl. J. Bot.*, 2 (3) : 329-332.

- Gedam, V. M., Patil, R. B., Suryawanshi, V. B. and Mate, S. N., 1998, Effect of plant growth regulators and boron on flowering, fruiting and seed yield in bittergourd. *SeedRes.*,26(1): 97-100.
- Gopalkrishnan, P. K. and Choudhury, B., 1978, Effect of plant regulator sprays on modification of sex, fruit set and development in watermelon. *Indian J. Hort.*, 35(1):235-241.
- Ganiger, V.M., 1992, Use of growth retardants in potato (*Solanum tuberosum* L.) production M.Sc. (Agri) thesis, *University of Agricultural Sciences, Dharwad*.
- Gasti, V.D., 1994, Response of commercial vegetables to growth retardants. M.Sc. (Agri) thesis, *University of Agricultural Sciences, Dharwad*.
- Krishnamoorthy, H. N. and Sandooja, J. K., 1981, Effect of ethrel and gibberellic acid on growth, flowering and sex expression of (*Curcubita pepo* L.) *Haryana J. Hort. Sci.*,10(3-4): 249-252.
- Marbhal, S. K., Musmade, A. M., Kashi, N. V., Kamble, M. S. and Kamthe, P. V., 2005, Effect of growth regulators and picking sequence on seed yield of bittergourd. *Haryana J. Hort. Sci.*, 34 (3-4): 323-326.
- Mishra, G.M., Prasad, B. and Sinha, S. C., 1972, Effect of plant growth substances on growth, sex expression and yield of bottlegourd. *Proceedings of Third International Symposium on Subtropical and Tropical Horticulture*, pp. 199-207.
- Mangal, J. L., Pandita, M. L. and Singh, G. R., 1981, Effect of various chemicals on growth, flowering and yield of bittergourd. *Indian J. Agric. Res.*, 15 (3): 185-188.
- Mahajan, B. V. C. and Sharma, R. C., 2000, Effect of pre harvest applications of growth regulators and calcium chloride on physico-chemical characteristics and storage life of peach (*Prunus persica* Batsch) cv. Shane-e-punjab. *Haryana J. Hort. Sci.*, 29(1&2):4143.
- Marbhal, S. K., Musmade, A. M., Kashi, N. V., Kamble, M. S. and Kamthe, P. V., 2005, Effect of growth regulators and picking sequence on seed yield of bittergourd. *Haryana J. Hort. Sci.*, 34 (34): 323-326.
- Pandey. R.P and Singh, K.1973. Note on the effect of nitrogen and maieic hydrazide on sex expression , sex ratio and yield of bottle gourd (*Lagenaria siceraria (mol)Standl.*).*Indian .sci.*(43):883-85.
- Pankaj ,G. Dhaka, R. S. and Fageria, M. S., 2005, Effect of plant growth regulators and water regimes on growth, yield and quality of bottlegourd. *Haryana J. Hort. Sci.*, 34(1 2):181-183.

- Rafeekher, M., Nair, S. A., Sorte, P. N. Hatwar, G. P. and Chandan, P. M., 2002, Effect of growth regulators on growth and yield of summer cucumber. *J. Soils and Crops*,12(1): 108-110.
- Ram Asrey, Singh, G. N., Shukla, H. S. and Rajbir Singh, 2001, Effect of seed soaking with Gibberellic acid on growth and fruiting of muskmelon (*Cucumis melo*L.). *Haryana J. Hort. Sci.*, 30(3&4): 277-278.
- Rajpalsingh, Godara, N.R., Rajbir Singh and Dahiya, S.S., 2001, Responses of foliar application of growth regulators and nutrients in ber (*Zizyphus mauritiana* Lamk.) cv. Umran. *Haryana J. Hort. Sci.*, 30(3&4): 161-164.
- Randhawa, K. S. and Kirtisingh, 1973, Effect of maleic hydrazide, naphthalene acetic acid and gibberellic acid applications on vegetative growth and yield of muskmelon (*Cucumis melo*L.). *Indian J. Hort.*, (27): 195-200.
- Sidhu, A. S., Pandita, M. L. and Arora, S. K., 1981, Effect of growth regulators on growth, sex expression and yield in squash melon. *Haryana Agric. Univ. J. Res.*, 11(4): 489.
- Siddareddy , N., 1988, Effect of mixtallol (Triacntanol) on growth, yield and tuber quality of two cultivars of potato (*solanum tuberosum* L.) *Mysore J. Agricultural Sci.*, (22): (suppl): 216.
- Singh , T., Jaiswal, R.C. and Singh ,A.K., 1991, Effect of Mixtalol on seed yield and quality of bottle gourd. *Veg. Sci.*,18 (2): 217-221.
- Sidhu, A. S., Pandita, M.L. and Hooda, R. S., 1982, Effect of growth regulators on growth ,flowering, yield and quality of muskmelon. *Haryana Agric. Univ. J. Res.*, 12(2): 231-235.
- Shinde, H. J., Desai, U. T., Masalkar, S. D. and Choudhari, S. M., 1994, Effect of plant growth regulators to control vine length in watermelon. *J. Maharashtra Agric. Univ.*, 19(1):150-151.
- Vadigeri, B. G., Madalgeri, B. B. and Sheelavantar, M. N., 2001, Effect of ethrel and gibberilic acid on yield and quality of two cucumber varieties. *Karnataka J. Agric. Sci.*, 14(3) :727-730.
- Wittwer and Buckovac, 1965, Effect of plant regulator sprays on modification of sex, fruit set and development in watermelon. *Indian J. Hort.*, pp. 235-241.
- Yasuyoshi, H. and Yoshiyuki, N. 1995, Synthetic cytokinin – 1 – (2-chloro-4-pyridyl) – 3 phenylurea (CPPU) promotes fruit set and induces parthenocarpy in watermelon. *J.American Soc. Hort. Sci.*, 120(6): 997-1000.