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International Journal of Current Research
Vol. 10, Issue, 01, pp.63802-63805, January, 2018

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

DEVELOPMENT AND MAINTENANCE OF NOVEL SOURCE OF GYNOECY IN BITTERGOURD (*MOMORDICA CHARANTIA* L.)

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ARTICLE INFO

Article History:
Received 17th October, 2017
Received in revised form
20th November, 2017
Accepted 03rd December, 2017
Published online 19th January, 2018

Key words:
Gynoecy,
Bitter gourd,
Development and Maintenance.

ABSTRACT

Development of hybrids in bitter gourd is expensive because of hand-pollination but utilization of gynoecy is economical and easier for exploiting hybrid vigour. The study aim to develop gynoecious line of Bitter gourd (*Momordica charantia* L.) by isolating, selfing and evaluating selfed progenies from original population and to maintain the line by chemicals like Silver Nitrate ($AgNO_3$), Gibberellic Acid (GA) and Silver Thiosulphate ($Ag(S_2O_2)_2$) to induce male (Staminated) flower for selfing. Chemicals mainly silver nitrate ($AgNO_3$) performs well as compared to GA and Silver Thiosulphate ($Ag(S_2O_2)_2$) for induction of male flowers in gynoecious line. Open pollinated population only express gynoecious sex type. Gynoecious line development through progeny row method takes four consecutive selfing generations (S4) for obtaining complete gynoecious lines. The lines isolated from naturally occurring plants among that, Nirmal Gy-1 and Gy-14 are with medium long fruit type and Nirmal Gy-15 and Gy-34 are with long fruit type. The highest sex ratio M/F = 0.05/100 observed from chemical Silver Nitrate with 300 ppm applied twice at two leaf stage and 7 days later from first spray, which confirms highest possibility of flower synchronization. These lines were maintained by using Silver Nitrate ($AgNO_3$) and Gibbrelic acid (GA).

Citation: Jadhav, B. P., Patil M. B., Patil S. Y., Halakude, I. S. and Rajput, J. C. 2018. "Development and maintenance of novel source of gynoecy in bittergourd (*Momordica charantia* L.)", *International Journal of Current Research*, 10, (01), 63802-63805.

INTRODUCTION

Fruits of bitter gourd are widely consumed as a vegetable and are well known for its antidiabetic and other medicinal properties. Bitter gourd is an important cucurbitaceous vegetable. It is among the most popular cucurbits and has very wide commercial distribution in India. Sex determination is as process that leads to the physical separation of male and female gamete producing structures to different individuals of a species. A wide range of variation in sex forms ranging from monoecious, gynoecious, andro-monoecious, androgynoecious, gynomonoecious observed. Gynoecious flowering habit is characterized by the presence of only pistilate flowers on a plant. Sex inheritance plays an important role in bitter gourd breeding. Several researches have worked on sex expression of cucumbers and reported that it was genetically determinate but could be modified by growth substance application and also environmental factors (Krishnamorrthy, 1975: Kallo, 1988). The predominant sex form in bitter gourd *(Monordica charantia* L) is monoecious (Behera, 2004), however, gynoecious sex from has been reported by Ram *et al.* (2002), Behera *et al.* (2006). The development of hybrid in any crop is expensive. However the utilization of gynoecy is economical and easier (Behera, 2004) for exploiting hybrid vigour in many cucurbitaceous crops including bitter gourd that have high male : female ratio and require hand pollination. At present interest in stabilizing the gynoecious character and development of stable gynoecious inbred parent have been intensified and become a common goal of numerous hybrids breeding programme. Therefore this study was conducted with following objectives

1) To isolate the promising gynoecious lines from the existing gynoecious population.
2) To find out the appropriate chemical and concentration for staminate flower induction on gynoecious lines for the purpose of maintenance.

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MATERIALS AND METHODS

The experiment was conducted at the Nirmal Agriculture Research and Development Foundation, Pachora in Seasons Kharif-2015, Summer-2016, Kharif-2016 and Summer-2017. The material comprised of four Gynoecious lines *viz* Nirmal Gy-1 and Gy-14 are with medium long fruits and Nirmal Gy-15 and Gy-34 are with long fruit type. The gynoecious population were treated with different concentration of growth chemicals *i.e.* Gibbrelic acid (GA) (500, 1000, 1500 ppm), silver nitrate (200, 250, 300 ppm) and silver thiosulphate (6, 8, 10 mM) at two and four leaf stage of crop for induction of staminate flowers. All chemical solutions were prepared with deionized water and applied about 50 ml per plant with hand spray. The number of induced staminate and pistilate flowers per plant were recorded and the most appropriate growth chemical were standardized for maintenance of gynoecious source.

RESULTS AND DISCUSSION

1.Isolation of lines from naturally occurring population

Among the bitter gourd cultivars, the cultivar NBGH-167 (Notified under AICRP(VC) for zone IV and VI), which express predominately gynoecious sex type. On handling of transgressive segregants of NBGH-167 by plant to plant selection in progeny row method. The predominantly gynoecious sex type plant was isolated from this progeny, which express about 100% gynoecious population in S4 generation. These obtained population were maintained by selfing with plant to row method. Among that, four gynoecious lines (Gy-1, Gy-14, Gy-15 and Gy-34) with 100% gynoecious nature were isolated and used for induction of staminate flower by using chemical and growth substances.

2.Chemical induction of staminate flower in gynoecious lines

In Gy-1 gynoecious line, significant differences among the treatment were observed. All the bitter gourd plants treated with silver nitrate induced more staminate flowers than treatment with gibberellic acid and silver thiosulphate. The treatment silver nitrate, 300ppm applied twice induced highest number of staminate flower per plant (14.50) and found significance difference between 200ppm and 250ppm applied twice and also superior over the rest of the treatment (Table 1). For the appearance of first staminate flowers, the treatment 6 mM silver thiosulphate induce the staminate flower at lowest node (2.70) of the main axis, and found no significant differences with treatment SN (200ppm) but superior over the rest of treatment (Table 1).

In case of gynoecious line Gy-14 results showed that the highest significant differences among the treatment for total staminate flower induction was observed. All the bitter gourd plant treatment with 300ppm silver nitrate induced more staminate flower (6.12) than the other treatment. The maximum sex ratio (0.02 : 1) was observed with 300ppm silver nitrate applied twice (Table 2). For the induction of first staminate flower the treatment silver thiosulphate 6mM induced the staminate flower at lowest node (3.05) and the treatment Gibbrelic acid 1500ppm induced the staminate flower at longest node (13.70). In gynoecious line Gy-15, the treatment silver nitrate 300ppm induced highest number of staminate flowers (8.60) per plant and found superior over all the treatments (Table 3). The treatment Gibbrelic acid 1500ppm (5.60) also induced more male flowers than the other treatment, the maximum sex ratio (M/F) was observed in treatment silver nitrate 300ppm (0.03:1) and found statistically significance over all other treatment. For the induction of staminate flower the silver thiosulphate (6mM) induced the

Table 1. Sex expression and sex ratio as expressed number of staminate and Pistillate flowers in gynoecious line Gy-1

Treatment	Staminate Flowers (No.)	Pistillate Flowers (No.)	Sex ratio	Node of appearance of first staminate flowering in main axis
Silver nitrate - 200 ppm	4.62	388	0.01 : 1	2.85
Silver nitrate - 250 ppm	8.60	394	0.02 : 1	5.20
Silver nitrate - 300 ppm	14.50	322	0.05 : 1	6.20
Gibbrelic acid - 500 ppm	5.37	365	0.01 : 1	7.85
Gibbrelic acid - 1000 ppm	6.77	308	0.02 : 1	8.50
Gibbrelic acid - 1500 ppm	7.33	316	0.02 : 1	10.20
Silver thiosulphate - 6 mM	3.50	353	0.01 : 1	2.70
Silver thiosulphate - 8 mM	4.30	396	0.01 : 1	3.55
Silver thiosulphate - 10 mM	5.20	336	0.02 : 1	4.20
Control (water spray)	0.00	318	0.00 : 1	0.00
CV	13.23	18.50	8.6	15.30

Table 2. Sex expression and sex ratio as expressed number of staminate and Pistillate flowers in gynoecious line Gy-14

Treatment	Staminate Flowers (No.)	Pistillate Flowers (No.)	Sex ratio	Node of appearance of first staminate flowering in main axis
Silver nitrate - 200 ppm	1.50	308	0.00 : 1	3.20
Silver nitrate - 250 ppm	4.60	317	0.01 : 1	6.15
Silver nitrate - 300 ppm	6.12	324	0.02 : 1	5.80
Gibbrelic acid - 500 ppm	2.50	329	0.01 : 1	9.20
Gibbrelic acid - 1000 ppm	3.60	356	0.01 : 1	12.60
Gibbrelic acid - 1500 ppm	4.20	323	0.01 : 1	13.70
Silver thiosulphate - 6 mM	1.30	332	0.00 : 1	3.05
Silver thiosulphate - 8 mM	2.60	318	0.01 : 1	3.70
Silver thiosulphate - 10 mM	3.80	353	0.01 : 1	4.15
Control (water spray)	0.00	329	0.00 : 1	0.00
CV	11.43	7.30	12.5	13.70

Table 3. Sex expression and sex ratio as expressed number of staminate and Pistillate flowers in gynoecious line Gy-15

Treatment	Staminate Flowers (No.)	Pistillate Flowers (No.)	Sex ratio	Node of appearance of first staminate flowering in main axis
Silver nitrate - 200 ppm	3.13	284	0.00 : 1	3.80
Silver nitrate - 250 ppm	5.37	299	0.02 : 1	4.20
Silver nitrate - 300 ppm	8.60	287	0.03 : 1	5.60
Gibbrelic acid - 500 ppm	2.30	283	0.01 : 1	8.90
Gibbrelic acid - 1000 ppm	4.15	288	0.01 : 1	12.65
Gibbrelic acid - 1500 ppm	5.60	295	0.02 : 1	14.70
Silver thiosulphate - 6 mM	2.20	277	0.01 : 1	3.20
Silver thiosulphate - 8 mM	3.15	286	0.01 : 1	5.60
Silver thiosulphate - 10 mM	4.50	290	0.02 : 1	5.65
Control (water spray)	0.00	298	0.00 : 1	0.00
CV	12.40	14.73	8.6	17.83

Table 4. Sex expression and sex ratio as expressed number of staminate and Pistillate flowers in gynoecious line Gy-34

Treatment	Staminate Flowers (No.)	Pistillate Flowers (No.)	Sex ratio	Node of appearance of first staminate flowering in main axis
Silver nitrate - 200 ppm	4.00	268	0.01 : 1	2.75
Silver nitrate - 250 ppm	8.50	280	0.03 : 1	6.20
Silver nitrate - 300 ppm	10.20	269	0.04 : 1	8.60
Gibbrelic acid - 500 ppm	3.10	265	0.01 : 1	14.87
Gibbrelic acid - 1000 ppm	3.20	274	0.01 : 1	16.20
Gibbrelic acid - 1500 ppm	8.60	282	0.03 : 1	17.50
Silver thiosulphate - 6 mM	3.50	257	0.01 : 1	2.20
Silver thiosulphate - 8 mM	5.70	275	0.02 : 1	5.37
Silver thiosulphate - 10 mM	6.20	262	0.02 : 1	6.20
Control (water spray)	0.00	279	0.00 : 1	0.00
CV	11.70	17.35	7.4	19.40

Promising gynoecious line Gy-1

Promising gynoecious line Gy-1

male flower at lowest node and found superior over all other treatments (Table 3). Also in case of gynoecious line Gy-34 the significant difference among the treatments was observed. The treatment silver nitrate 300ppm induced more staminate flowers (10:20) than the other treatments followed by treatment Gibbrelic acid 1500ppm (8.60) and silver nitrate 250 ppm (8.5) respectively. For the sex ratio (M/F) the maximum sex ratio was observed in treatment silver nitrate (300ppm) (0.04:1) and found superior over the treatment silver thiosulphate 6mM, 8mM and 10mM. For the induction of male flower the treatment Gibbrelic acid induced the male flower at longest node in main axis and the treatment silver thiosulphate 6mM induced male flower at lowest on main axis (2.20)

DISCUSSION

Stable gynoecious line from the predominately gynoecious hybrid or line, can be developed from the selfed progenies of predominantly gynoecious plants. The percentage of gynoecious nature increased up to fourth generation by selection with plant to row method. It is obvious that by inbreeding and plant-to-row selection the traits become fixed by the progeny or line approach uniformity (Agrawal, 1998). For the maintenance of gynoecious line the induction of male flower is very essential. For the effective staminate flower induction in gynoecious line treated with silver nitrate found most effective than the line treated with silver thiosulphate and Gibbrelic acid. It is because may be due to that the silver nitrate is a potent anti-ethylene agent in cucumber and tomato (Elmo, 1976). It inhibits synthesis of ethylene and thus induce staminate flower (Krishnamoorthy, 1975). Though Gibbrelic acid also inhibit the ethylene level through auxin the induction may be more in silver ion because silver nitrate is a chemical and Gibbrelic acid is a kind of growth regulator (Tolla and Peterson, 1979).

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