The Bioscan 14(2): 121-124, 2019
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.com

VARIETAL RESPONSE OF OKRA (*Abelmoschus esulentus* L. MOENCH) TO GA_3 APPLICATION UNDER WALK IN TUNNEL GREENHOUSE IN COLD DESERTS

M. S. KANWAR[1]* AND P. ISHFAQ AKBAR
Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir
High Mountain Arid Agriculture Research Institute, Leh -194101, Ladakh (J&K) - INDIA
[1]SKUAST-K Krishi Vigyan Kendra, Nyoma, Leh -194404(J&K) - INDIA
e-mail: *mskanwar2004@rediffmail.com

KEYWORDS
Cold deserts
Gibberellic acid
Okra
Seed soaking

Received on :
10.10.2018

Accepted on :
20.40.2019

***Corresponding author**

ABSTRACT
Response of different varieties of okra to the application of gibberellic acid as seed treatment was studied in Factorial RBD in three replications. Results revealed that varieties have significant effect on all the plant characters except fruit length, fruit diameter and harvest duration. Gibberellic acid treatment was found to be non-significant for most of the characters except days to germination, number of ridges and days to harvest. Interactions of variety and gibberellic acid were non-significant for yield, fruit diameter and harvest duration only. Gibberellic acid (40 ppm) was best for early seed germination of okra. Pusa Sawni recorded highest number of fruits per plant (6.84), yield per plant (60.27 gm) and yield per ha.(402 Q). It may be concluded that Pusa Sawni is a good choice for early and total yield. Seed treatment with gibberellic acid in the concentrations of 40 ppm and 70 ppm is beneficial for seed germination and yield, respectively.

INTRODUCTION

Vegetable diversification in non-traditional areas under unfavourable agro-climatic conditions with improved and adaptive techniques like protected cultivation paves the way for nutritional security and to combat hidden hunger in inaccessible areas. Ladakh region of India is distinct in terms of agro-eco features from the rest of the country wherein some warm season vegetables do not perform well in open thereby providing meager opportunities for vegetable advancement. Protected cultivation is a possible answer to manage some economically viable vegetables to grow under the adverse climatic situations. Specific agro techniques need to be evaluated and defined for a particular crop to explore its maximum potential. Moreover, gibberellic acid (GA_3) application has been found to excel the overall performance of many vegetables crops (Khan *et al*., 2006 and Gupta, 2009).

Okra (*Abelmoschus esculentus* L. Moench) a member of family Malvaceae originated in Asia and Africa is an important vegetable crop of the tropics and sub-tropical regions of the world possessing excellent nutritional properties. Every parts of okra plant have equal importance and used as food, feed and fiber (Thapa *et al*., 2012).The green fruits are rich sources of vitamins, calcium, potassium and other minerals (Dilruba *et al*., 2009). Since okra cultivation in open field is not feasible in the most part of the region even in summer season, therefore it is confined to greenhouses in the region. However, yield per unit area as well as early yield is not up to the expectations. This necessitates proper varietal evaluation along with study of effect of gibberellic acids in enhancing the yield potential. Plant growth regulators affect the physiology of plant growth and influence the natural rhythm of a plant. GA_3 stimulated seed germination, stem elongation and flower development and enhanced total yield of okra. Ilias *et al*. (2007) reported that stem length was significantly enhanced by the application of exogenous GA_3. Therefore, an investigation can provide desirable results with the objective of making okra cultivation profitable for local farmers after evaluating the performance of different varieties of okra under protected conditions with varying doses of gibberellic acid application.

MATERIALS AND METHODS

The present investigations were conducted under walk in tunnel greenhouse at Experimental Farm of High Mountain Arid Agriculture Research Institute (SKUAST-K), Stakna, Leh which is situated at 3319 m above mean sea level with latitude 33°58.551′ NS and longitude 77°41.995′ EW. Climate of the area is typically dry temperate. Four okra varieties viz. A-4, P-8. Pusa Sawni and Pusa Makhmali were taken for study. Seeds of each variety were soaked for 48 hours in different concentrations of gibberellic acid (40 ppm, 70 ppm and 100 ppm) and control. Thereafter, seeds were sown at a line distance of 30 cm in May, 2010 under walk in tunnel greenhouse. After germination, plant to plant distance was maintained at 7.5 cm. Standard package of practices followed to raise healthy

crop. No spray of any pesticide was given to the crop. Design of the experiment was Factorial RBD and material was replicated 3 times. Data were recorded on 5 plants/fruits per replication for various plant, fruit and yield attributes and subjected to statistical analysis as per Snedcor and Cochran (1967). Response of four okra varieties to different doses of gibberellic on plant and fruit characters was studied.

RESULTS AND DISCUSSION

Analysis of variance indicated that varieties have significant effect on all the plant characters except fruit length, fruit diameter and harvest duration. Gibberellic acid treatment could show significant effect on days to germination, number of ridges of fruits and days to harvest. Plant growth regulators are organic compounds which, in small amounts, somehow modify a given physiological plant process and rarely act alone, as the action of two or more of these compound is necessary to produce a physiological effect (Unamba *et al*., 2009). Interactions of variety and gibberellic acid were non-significant for yield, fruit diameter and harvest duration only. Results are discussed under following sub-heads:

Plant characters

Okra takes more than 20 days for germination in cold arid region during May under open field conditions. Under greenhouse condition, it takes 4-5 days less as compared to open field conditions depending on the vigour of seed. Okra var. Pusa Makhmali was found statistically earliest in germination followed by var. P-8. Gibberellic acid (40 ppm) proved best in enhancing seed germination of okra. Gibberellic acid (100 ppm) could not produce desirable results and found late in seed germination statistically. Omran *et al*. (1980) also recorded enhanced seed germination by soaking okra seed in 400 ppm GA. Seed of okra var. Pusa Makhmali germinated statistically earliest (14 days) with the treatment of gibberellic acid (40 ppm). Plant height and stem girth were statistically maximum in variety Pusa Makhmali. However, gibberellic acid alone did not show any significant effect on both of these characters. Okra var. Pusa Makhmali x gibberellic acid (70 ppm) produced statistically maximum plant height over the other interaction effects which might be due to more of the varietal effect of Pusa Makhmali.

Okra var. Pusa Sawni recorded highest number of fruits per plant, yield per plant and yield per ha which is statically superior over the other varieties. Gibberellic acid alone did not show any significant effect on both of these characters. The yield and number of fruits were significantly increased by soaking seeds in different concentrations of GA (200 ppm) solutions (Omran *et al*., 1980) in contrast to the present results. Reason might be attributed to low concentrations of GA used in present investigations. Okra var. Pusa Sawni x gibberellic acid (100 ppm) gave highest number of fruits per plant followed by treatment combination of var. Pusa Sawni x gibberellic acid (40 ppm). Interaction effects were non-significant for yield per plant and yield per ha. Abdel-Mouty *et al*. (2008) gained the better plant growth and pods yield with the application of 50 ppm GA as spraying foliar. In the present study, seed soaking with 70 ppm GA_3 produced statistically non-significant but maximum plant height and fruit yield.

Fruit characters

Fruit weight is considered to be an important yield contributing

Table 1: Effect of variety, GA and their interactions on plant characters in okra

Treatments	*Days to germination*	*Plant height (cm)*	*Stem girth (mm)*	*No. of fruits/plant*	*Yield per plant (g)*	*Yield per ha (Q)*
V1	*17.33*	*93.82*	*11.79*	*6.84*	*60.27*	*402*
V2	*16.83*	*72.42*	*13.17*	*5.85*	*51.08*	*340.7*
V3	*14.67*	*157.6*	*13.77*	*5.75*	*34.87*	*232.6*
V4	*15*	*92.3*	*11.01*	*4.25*	*51.59*	*344.1*
$CD_{0.05}$	*0.28*	*11.08*	*0.95*	*0.72*	*11.24*	*74.99*
G0	*15.92*	*96.83*	*11.39*	*5.54*	*48.52*	*323.6*
G1	*15.42*	*102.9*	*11.86*	*5.56*	*45.02*	*300.3*
G2	*15.75*	*110.7*	*13.31*	*5.73*	*54.16*	*361.2*
G3	*16.75*	*105.7*	*13.18*	*5.87*	*50.11*	*334.2*
$CD_{0.05}$	*0.28*	*NS*	*NS*	*NS*	*NS*	*NS*
V1 x G0	*18*	*64.5*	*9.15*	*5.62*	*36.99*	*246.7*
V1 x G1	*16*	*85.33*	*10.21*	*7.17*	*63.31*	*422.3*
V1 x G2	*17*	*106.4*	*13.77*	*6.62*	*66.39*	*442.8*
V1 x G3	*18.33*	*119.1*	*14.03*	*7.97*	*74.39*	*496.2*
V2 x G0	*17*	*67*	*12.57*	*6.43*	*59.76*	*398.6*
V2 x G1	*16*	*79.4*	*12.83*	*5.52*	*42.47*	*283.3*
V2 x G2	*17*	*74*	*13.73*	*5.58*	*60.42*	*403*
V2 x G3	*17.33*	*69.27*	*13.53*	*5.85*	*41.67*	*277.9*
V3 x G0	*14.33*	*160.2*	*13.83*	*5.2*	*42.02*	*280.3*
V3 x G1	*15*	*154.6*	*13.47*	*3.62*	*27.55*	*183.8*
V3 x G2	*14*	*166.8*	*14.03*	*4.13*	*36.14*	*241.1*
V3 x G3	*15.33*	*148.9*	*13.77*	*4.04*	*33.75*	*225.1*
V4 x G0	*14.33*	*95.6*	*10*	*4.91*	*55.29*	*368.8*
V4 x G1	*14.67*	*92.27*	*10.93*	*5.91*	*46.76*	*311.9*
V4 x G2	*15*	*95.67*	*11.7*	*6.57*	*53.66*	*357.9*
V4 x G3	*16*	*85.67*	*11.4*	*5.61*	*50.63*	*337.7*
$CD_{0.05}$	*0.56*	*22.16*	*1.9*	*1.45*	*NS*	*NS*

V1: Pusa Sawani;V2: A-4; V3: Pusa Makhmali; V4: P-8;G0: No GA (control); G1: 40 ppm GA; G2: 70 ppm GA; G3: 100 ppm GA

Table 2: Effect of variety, GA and their interactions on fruit characters in okra

Treatments	Fruit weight (g)	Fruit length (cm)	Fruit) dia (mm	No. of ridges/fruit	Days to harvest	Harvest duration(days)
V1	8.94	11.47	16.56	5.67	87.5	50.92
V2	7.806	12.3	16.49	5.08	89.58	54.25
V3	8.142	11.63	15.44	5	91.42	55.33
V4	8.149	11.8	16.45	5	88.83	55.67
$CD_{0.05}$	0.797	NS	NS	0.18	1.55	NS
G0	8.36	11.43	16.03	5.33	87.75	52.67
G1	8.035	12.12	15.93	5.17	89.75	55.33
G2	8.526	11.54	17.47	5.25	89.67	54
G3	8.117	12.11	15.52	5	90.17	54.17
$CD_{0.05}$	NS	NS	NS	0.18	1.55	NS
V1 x G0	7.493	10.73	15.99	6	86.67	47.67
V1 x G1	8.957	11.83	17.52	5.67	86	54.33
V1 x G2	10.09	11.23	18.47	6	88	48
V1 x G3	9.223	12.1	14.28	5	89.33	53.67
V2 x G0	9.27	13.4	16.73	5.33	87.67	54.33
V2 x G1	7.747	12.57	16.54	5	88.33	54.33
V2 x G2	7.077	10.07	16.61	5	91.33	54
V2 x G3	7.13	13.17	16.1	5	91	54.33
V3 x G0	8.097	10	14.08	5	88.33	54.33
V3 x G1	7.517	12.1	13.8	5	95.33	55.67
V3 x G2	8.75	13.03	17.59	5	91	57
V3 x G3	8.207	11.4	16.29	5	91	54.33
V4 x G0	8.58	11.6	17.31	5	88.33	54.33
V4 x G1	7.92	12	15.88	5	89.33	57
V4 x G2	8.19	11.83	17.2	5	88.33	57
V4 x G3	7.907	11.77	15.42	5	89.33	54.33
$CD_{0.05}$	1.59	1.64	NS	0.35	3.11	NS

V1: Pusa Sawani; V2: A-4; V3: Pusa Makhmali; V4: P-8;G0: No GA (control); G1: 40 ppm GA; G2: 70 ppm GA; G3: 100 ppm GA

character along-with the number of fruits per plant. Under walk in tunnel, fruit weight was maximum in variety Pusa Sawni which is statistically superior to other varieties. Gibberellic acid alone could not affect fruit weight significantly. Var. Pusa Sawni x gibberellic acid (70 ppm) produced statistically maximum fruit weight. Variety as well as gibberellic acid treatment did show significant effect on fruit length and fruit diameter. Pusa Sawni was observed to be statistically superior for number of ridges per fruit. Gibberellic acid concentration (40 and 70 ppm) and control were found to be at par for number of ridges per fruit. Okra var. Pusa Sawni x gibberellic acid (40 ppm), Pusa Sawni x gibberellic acid (70 ppm) and Pusa Sawni x control were at par with each other for number of ridges. Var. Pusa Sawni took minimum number of days to harvest but at par with var. P-8. Control *i.e.* treatment with distilled water produced statistically earliest harvest. Treatment combination of Pusa Sawni x gibberellic acid (40 ppm) produced statistically earliest crop.

It is also possible that application to the seed is ineffective and the application of the GA to other parts of the plant could have the expected results. Another possible explanation would be the GA could have degraded before it could be effective. The effect of GA on the plants can be highly variable depending on the plant and the type of application (Melendez *et al*., 2009)

It may be concluded that variety Pusa Sawni is best in term of early and total yield. Seed treatments with gibberellic acid in the concentrations of 40 ppm and 70 ppm is beneficial for yield and seed germination. Gibberellic acid (GA) is a very potent hormone whose natural occurrence in plants controls their development. Since GA regulates growth, applications of very low concentrations can have a profound effect. Timing is critical: too much GA may have an opposite effect from that desired; too little may require the plant to be repeatedly treated to sustain desired levels of GA (Riley, 1987). So, future studies may be directed towards combined application of GA as seed soaking and foliar sprays to have more pronounced effect.

REFERENCES

Abdel–Mouty, Mona, M. and El-Greadly, Nadia H. M. 2008. The productivity of two okra cultivars as affected by gibberellic acid, organic n, rock phosphate and feldspar application. *J. Applied Sci. Res*. **4(6):** 627-636.

Dilruba, S., Mirza, Hasanuzzaman, Karim, R. and Nahar, Kamrun. 2009. Yield response of okra to different sowing time and application of growth harmones. *J Hort. Sci. and Ornamental Plants*. **1(1):** 10-14.

Gupta, R. 2009. Effect of various growth regulators on growth and productivity of trigonella corniculata. *The Bioscan*. **4(3):** 425-428.

Ilias, G., Ouzounidou, A., Giannakoula and Papadopoulou, P. 2007. Effect of gibberellic acid and prohexadione-calcium on growth, chlorophyll fluorescence and quality of okra plants. *Indian J. Hort.* **51(3):** 575-578.

Meléndez, Jesyka, Lugo Yadhira and Santiago, Elaine. 2009. The effect of gibberellic acid paste on abelmoschus esculentus stem elongation. www.slideshare.net/jmelendez15/the-effect-of-gibberellic-acid-paste-

Omran, A. F., El-Bakry, A. M. and Gawish, R. A. 1980. Effect of soaking seeds in some growth regulator solutions on the growth, chemical constituents and yield of okra. *Seed Sci. Tech*. **8(2):**161-168.

Riley, John M. 1987. Gibberellic acid for fruit set and seed germination. *www.crfg.org/tidbits/gibberellic.html*

Snedecor G. W. and Cochran W. G. 1967. Statistical Methods. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi. P.593 .

Thapa, U., Rai, A.K. and Chakarborty, R. 2012. Growth and yield of okra (Abelmoschus esculentus) as influenced by seed weight. *The Bioscan*. **7(4):** 711-714.

Unamba, C.I.N., Ezeibekwe, I.O. and Mbagwu, F.N. 2009. Comparative effect of foliar spray and seed soaking application method of gibberellic acid on the growth of Abelmoschus esculentus (okra Dwarf). *J. American Sci*. **5(4):**133-140.

Khan, M. Masroor A., Gautam, Champa, Mohammad, Firoz, Siddiqui, Manzer H., Naeem, M., Khan, Nasir. 2006. Effect of gibberellic acid spray on performance of tomato. *Turk. J. Biol*. **30 :** 11-16.